SIEMENS

Ingenuity for life

Building Technologies

Safety • Security • Comfort • Solutions

(English translation of Swiss catalogue)

buildingtechnologies.siemens.com

Contents

Introduction 

Advisory & Performance Services 

Incident Management 

Extinguishing 

Video surveillance 

Automation of primary plants 

Vertical Markets 

Desigo CC 

Gas detection 

Evacuation 

Intrusion 

Room automation 

BPS – Building Performance and Sustainability 

Power Management 

Fire detection 

Access control 

Tracking systems 

Protocols in building technology 

Dear reader,

Carsten Liesener

The world has never been more connected. Billions of smart devices and machines generate massive amounts of data, merging the real world with the virtual one. For instance, digitalization allows us to hear what buildings are saying. We can, if necessary, react in a timely way and make any changes needed to improve the overall performance of a building. This allows you to make the best of your time, focusing on your activities, not on the building around you.

We offer a highly effective range of products and solutions across many disciplines and subsystems. Our Desigo CC integrated management platform enables simple, seamless, smart networking of disciplines. All data in the building is digitized and operation of your infrastructure is made more efficient, more secure and simpler. For example, the intelligent use of the electrical power in a building or on a campus allows reducing CO_2 emissions without interfering with the core activity of the facility.

Our mission is to continue to develop these products and solutions, informed by constant interaction with you. This updated Solution & Service Portfolio handbook will give you a deeper insight into our latest developments and our application and integration know-how. As well as technical background information on the various areas, you will also find an overview of the relevant products.

This is how we are using intelligent building technologies to create perfect places.

I hope you will find it an interesting and enjoyable read.

Best regards

Carsten Liesener
CEO Siemens Building Technologies Europe

R&D employees and software developers (rounded) in FY 2014

3,500
Patenterstanmeldungen

39
inventions per work day[1]

20
patent first filings per work day[1]

7,600
invention disclosures

33,000
employees in Research and Development (R&D)

17,500
software developers

including around

4,200
software developers in Corporate Technology

[1] calculation based on 220 work days

A coherent strategy

Our positioning is guided by the global situation, the long-term trends that define our markets, the competitive environment and the needs of customers, partners and societies. Focused on the long term, it is the common denominator underpinning all our business activities.

Electrification

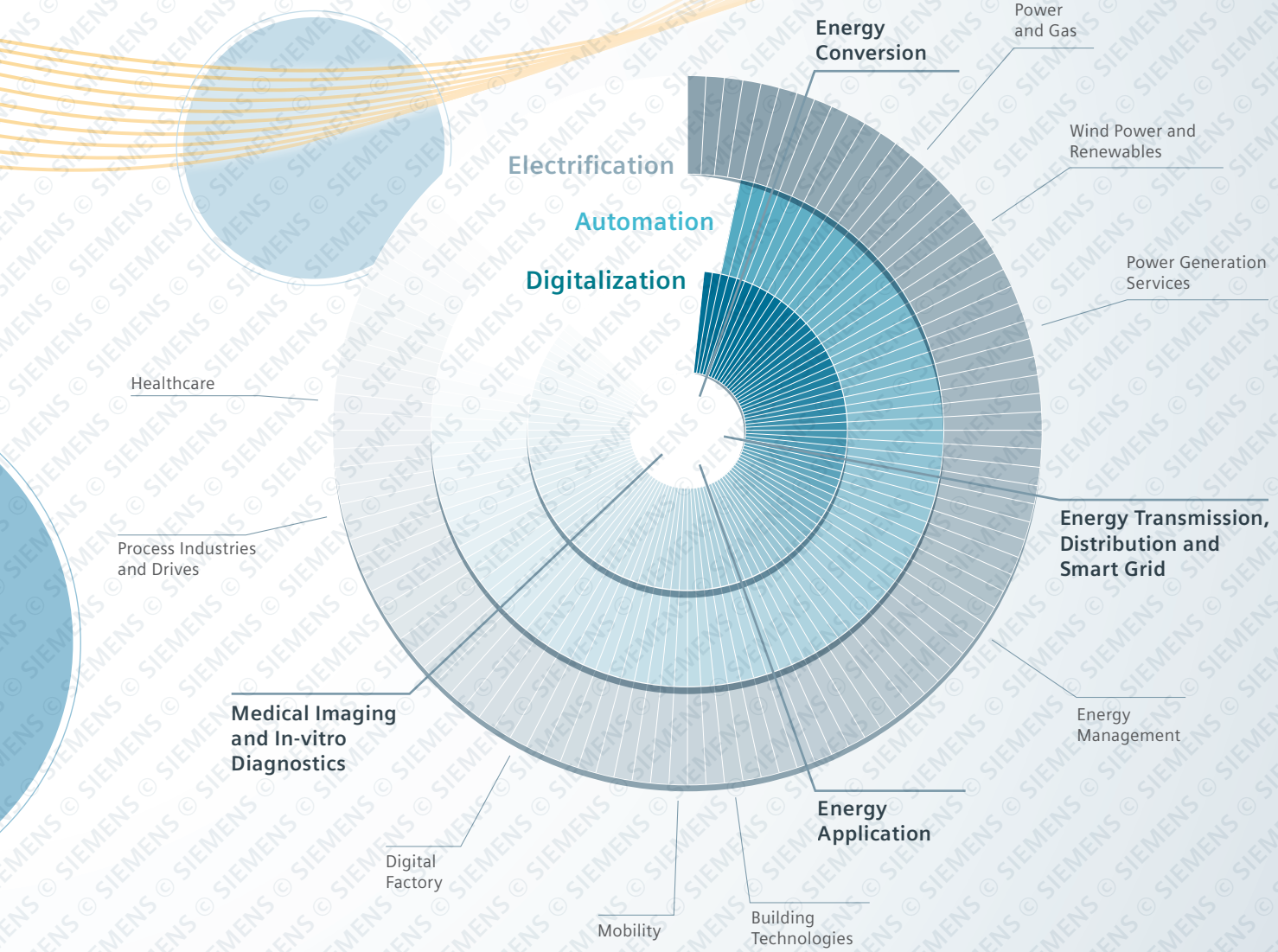
Siemens is positioned all along the value chain of electrification. Our products generate, transmit, distribute and utilize electrical energy extremely efficiently. Our roots are in electrification. We have led the way thus far and this is where our future lies.

Automation

We have been successfully automating customer processes for years. In automation too, we occupy leading market positions worldwide. We intend to maintain and extend these positions.

Digitalization

We also want to exploit the opportunities offered by digitalization even more effectively. This is because value add for the customer lies increasingly in software solutions and intelligent data analytics.



Siemens worldwide

351,000 employees worldwide

289 major production plants in more than 200 countries / regions

Building Technologies across Switzerland – never far from you

Headquarters Siemens Schweiz AG and BT

1 Volketswil
2 Steinhausen

BT branch offices

4 Geneva
5 Lausanne / Renens
6 Bern / Ostermundigen
7 Basel / Reinach
8 Lucerne / Root
9 Bellinzona / Camorino
10 St. Gallen / Gossau
11 Altenrhein

BT sales office

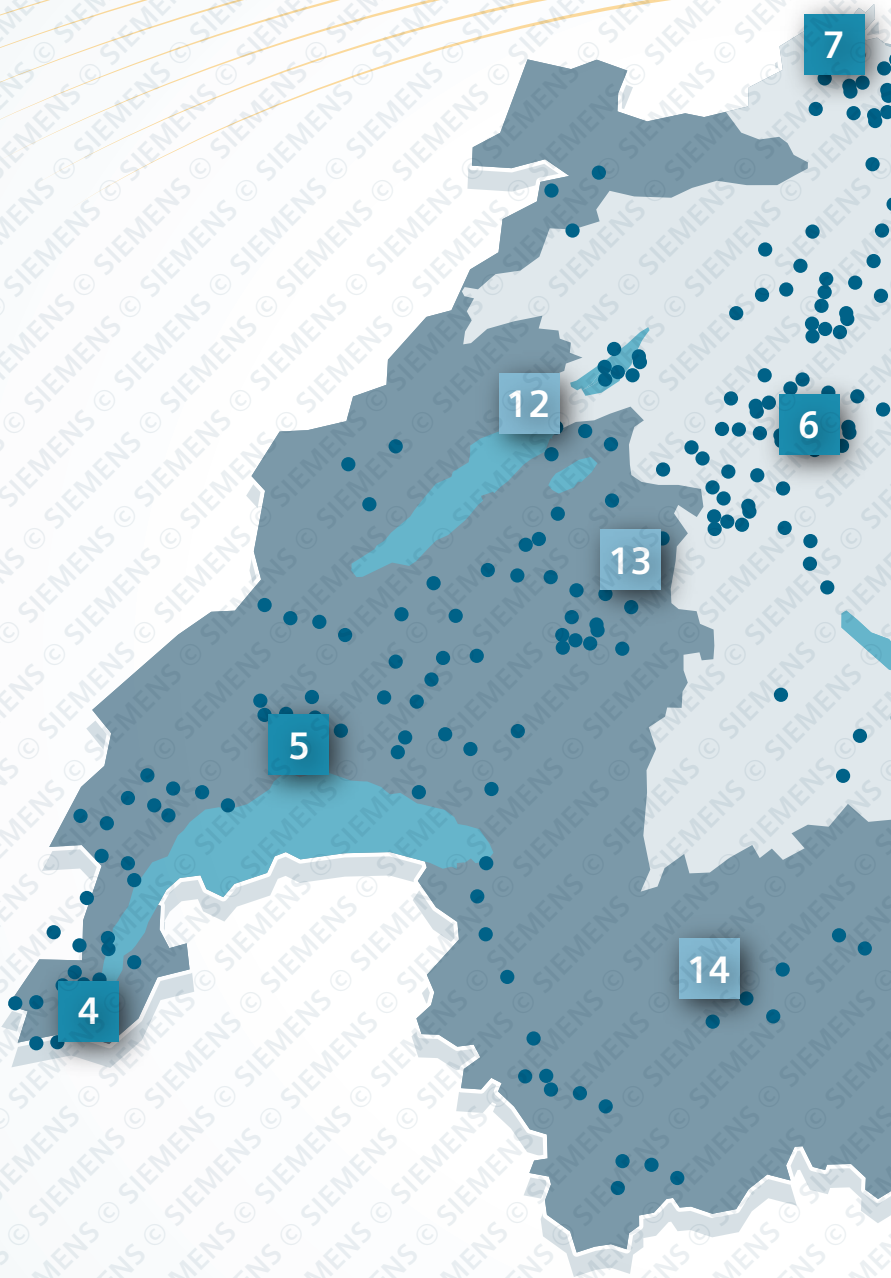
12 Neuchâtel / St. Blaise
13 Fribourg / Granges-Paccot
14 Sion
15 Dättwil
16 Chur

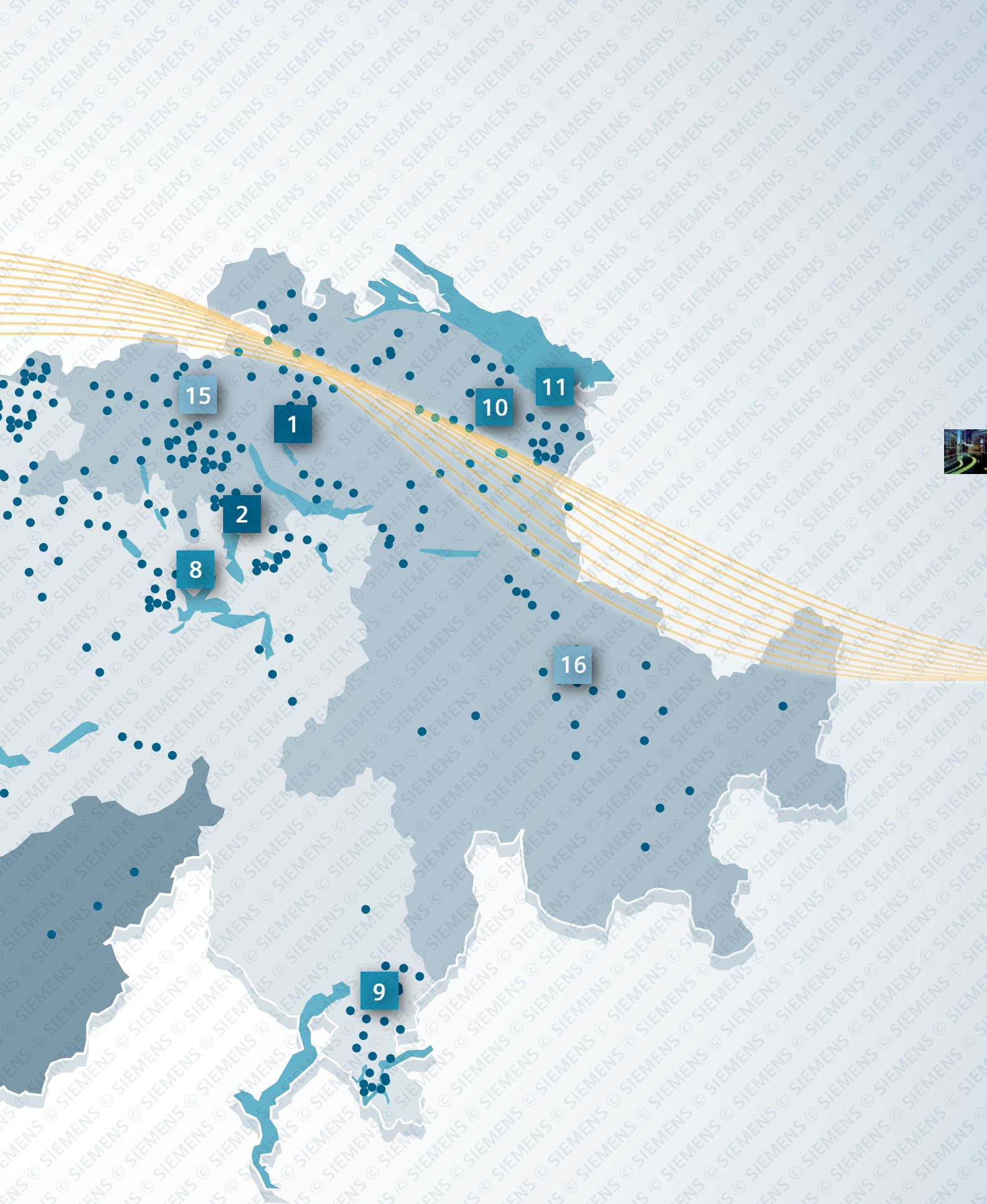
Area Zurich

Area Bern

Area Lausanne

1500 employees




15
1
10
11
2
8
16
9

«We make our money managing 170 shops and leasing 100,000 m²»

Up to
18 %
higher occupancy rate, if the building is seen as energy-efficient[1]

Up to
35 %
higher rents thanks to energy efficiency strategies[1]

Up to
1.3 %
increase in sales figures achieved by improving indoor climate[2]

[1] Source: Morgan Stanley Building Energy Efficiency, May 2017
[2] Source: Health, Wellbeing & Productivity in Retail: The Impact of Green Building on People and Profit, Feb 2016

Digitalization

The world has never been more connected. Billions of intelligent devices and machines generate massive amounts of data, merging the real world and the virtual world. Turning these vast amounts of data into value is a key success factor.

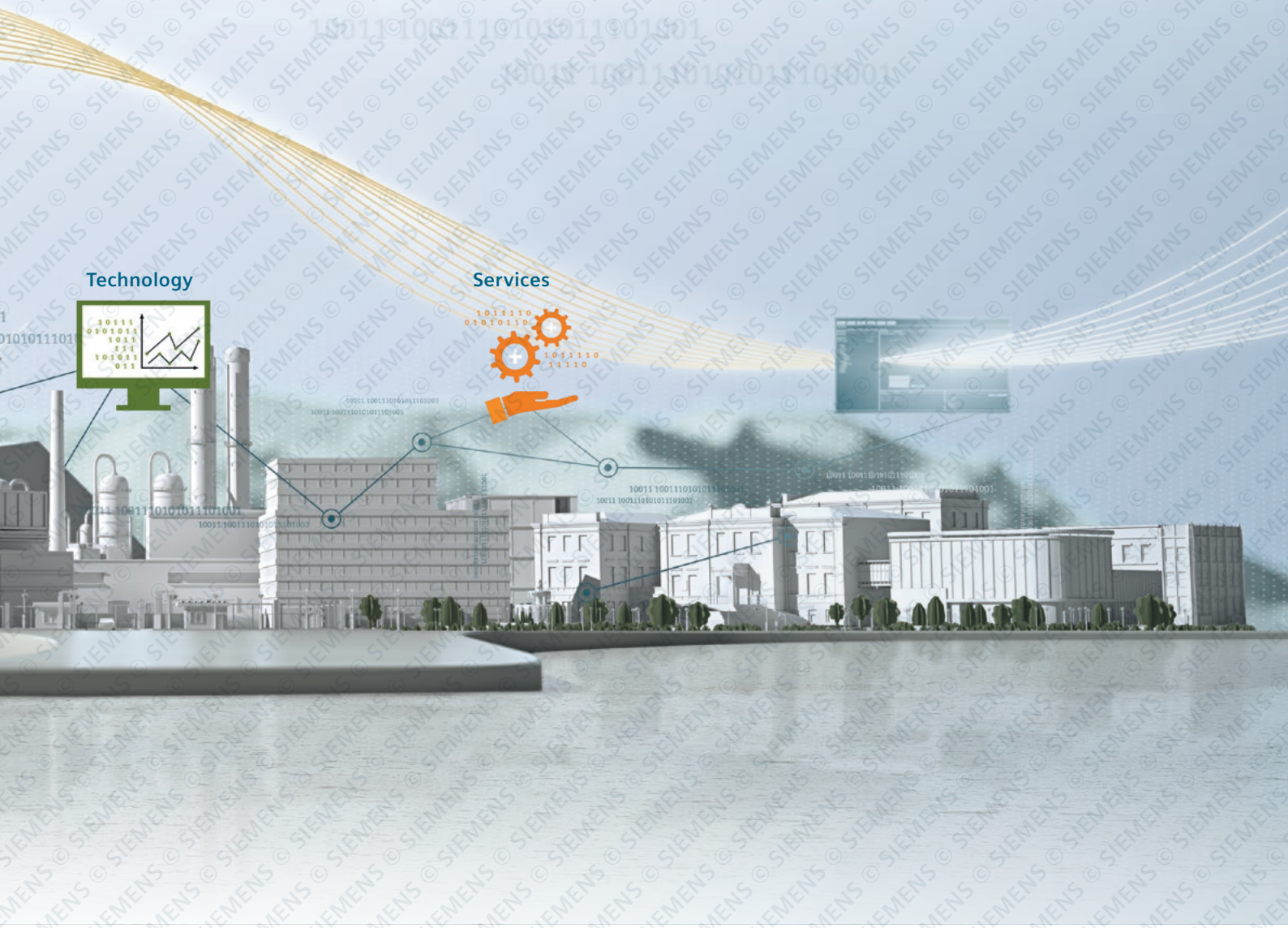
Companies that want to be successful in the future are seizing the opportunities provided by digitalization right now. Digitalization promises lower costs, enhanced product quality, flexibility and efficiency, shorter response time to customer requirements and market demands. And it also opens up new and innovative business areas. Irrespective of the industry sector or size of a company, it is important then for all decision makers to invest right now in the future as a digital enterprise. The good news is that solutions for the Digital Enterprise already exist here and now.

Data power delivers better building performance

The digital transformation of buildings brings new opportunities to grow your business. Today's buildings talk to us, continuously generating new data with each interaction. Most of this data is unstructured, however, and our customers are looking for more transparency and added value from their building data.

Thanks to an optimum mix of expertise, technology and services, we apply the right data to offer data-driven insights and actions – thus enabling our customers to make better decisions based on more accurate information, to improve the performance of their buildings and make their business even more competitive.

When the right data is correctly applied, we are able to create perfect places.



MindSphere

Master your digital transformation

The Internet of Things is speaking

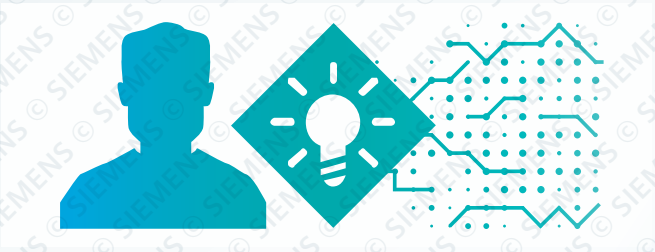
Every machine and system in your business holds a wealth of data. MindSphere is the operating system that lets you understand it. It enables you to connect your machines and physical infrastructure to the digital world and provides powerful industrial apps and digital services that can unleash more productivity and efficiency across your entire business. MindSphere lets you reduce downtime, increase output and use assets more effectively. And it's a completely open platform that lets you develop and run apps like never before.

Open IoT operating system

MindSphere from Siemens offers a cost-effective, scalable cloud Platform as a Service (PaaS) that's perfect for developing applications. Designed as an open OS for the Internet of Things, it lets you seamlessly connect with your machines like never before so you can improve the efficiency of plants by harnessing the huge volumes of data that your assets generate. MindSphere offers seamless connectivity between data-based services from Siemens and third-party providers. And it lets you seamlessly integrate your own apps and services.

Start speaking with the IoT

With MindSphere, you can harness data from the machines and physical infrastructure you already own to find game-changing insights across your entire business. And you can immediately develop, deploy and run digital services, create your own applications, or indeed new business models.



When machine builders speak with the IoT,

- they can increase service efficiency and lower warranty expenses
- offer additional services (e.g. availability)
- enable new business models
- enhance products via feedback loop to R&D

When plant operators speak with the IoT,

- they can increase uptime and asset availability
- optimize assets
- boost maintenance efficiency
- achieve data transparency and access centralized KPIs

When app developers speak with the IoT,

- they can rapidly develop apps thanks to an open API
- utilize a scalable development environment
- achieve scalability through access to major industries

We make it easy

Get started with MindSphere and benefit from the IoT

Open Standard (OPC UA)
Seamless connectivity between products from Siemens and third parties.

Plug & Play
Connect your assets to MindSphere – directly, easily and at any scale

Cloud Infrastructure
Public cloud, private cloud or on-site solution as a closed system.

Open Interfaces
Open application interfaces for individual customer applications

Transparent Pricing Model
Transparent pay-per-use pricing model.

MindSphere – Transforms data into knowledge. And knowledge into business success.

MindApps open up many new possibilities, allowing you to use your machine data to add value.

MindSphere, the open cloud platform from Siemens, is a powerful IoT operating system with data analytics and connectivity capabilities, tools for developers, applications, and services. It helps to evaluate and utilize your data and to gain breakthrough insights. Drive the performance and optimization of your assets.

Siemens treats all data stored in MindSphere as confidential in compliance with the DIN ISO/IEC 27001 standard.

Connect your asset to MindSphere – right now, easily, and at scale – with MindConnect, our connectivity suite from Siemens.

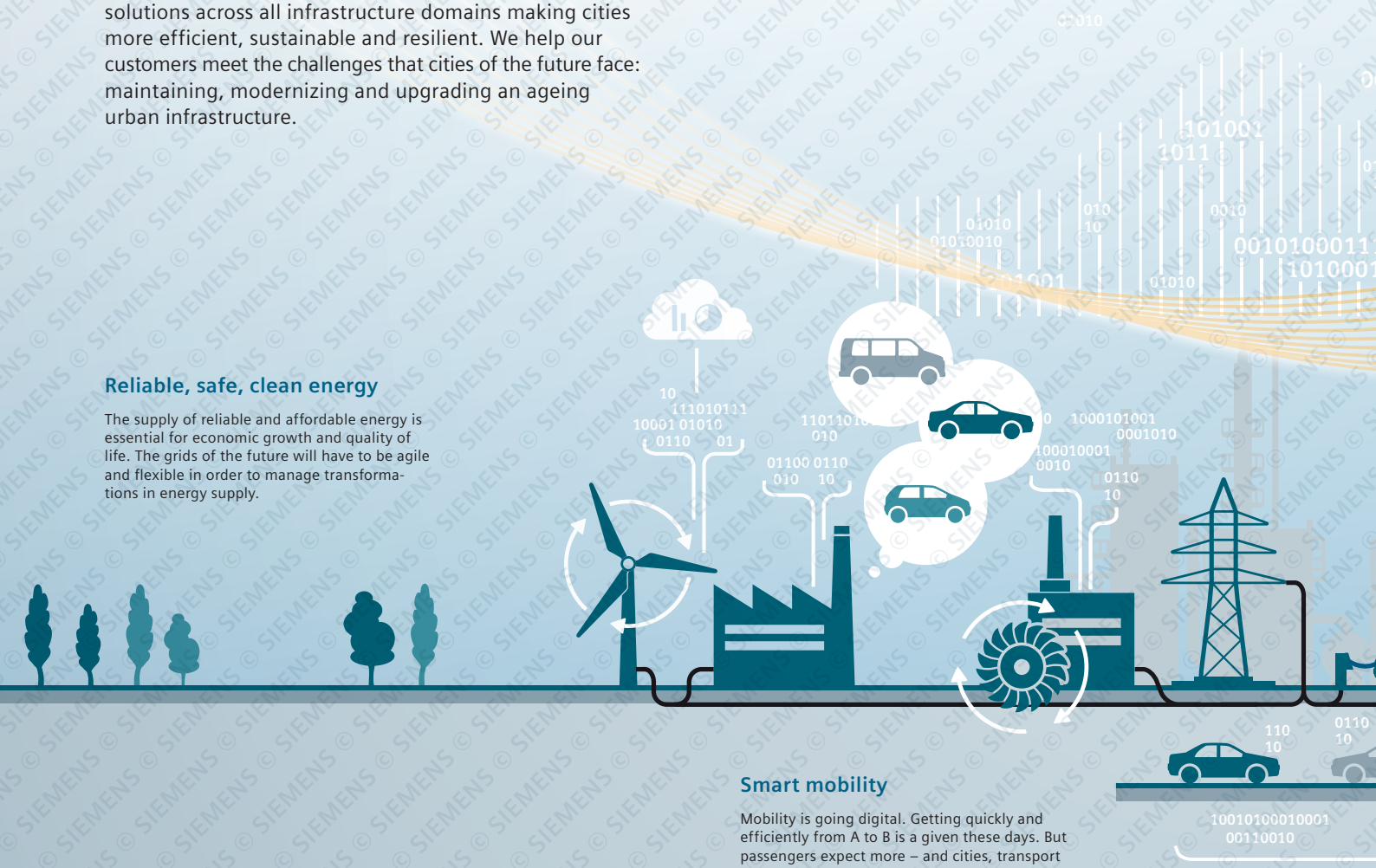
Open application interfaces for individual customer applications.

www.siemens.com/global/de/home/produkte/software/mindsphere.html

Infrastructure and urbanization

Infrastructure has a profound effect on quality of life, but one that we only really appreciate when things do not work as they should. Anybody who has experienced a power blackout or been stuck in a traffic jam knows that. Urbanization complicates matters further. Each week, cities are growing by 1.5 million inhabitants, and by 2050 more than two thirds of the world's population will be city dwellers, up from just one third in 1950. As cities grow, the way we build and manage urban infrastructure has never been more critical to global economic and social development.

However, much infrastructure has yet to be transformed by the information age. Instead, in many places, trains, power systems, buildings, buses, and roads are mostly old technology. Some digital systems have been incorporated but we have only just begun to unlock the potential of fully digitized, electrified, information-enabled, intelligent infrastructure. Doing so will be key to meeting the world's present and future sustainable development challenges. Siemens provides solutions across all infrastructure domains making cities more efficient, sustainable and resilient. We help our customers meet the challenges that cities of the future face: maintaining, modernizing and upgrading an ageing urban infrastructure.



Reliable, safe, clean energy

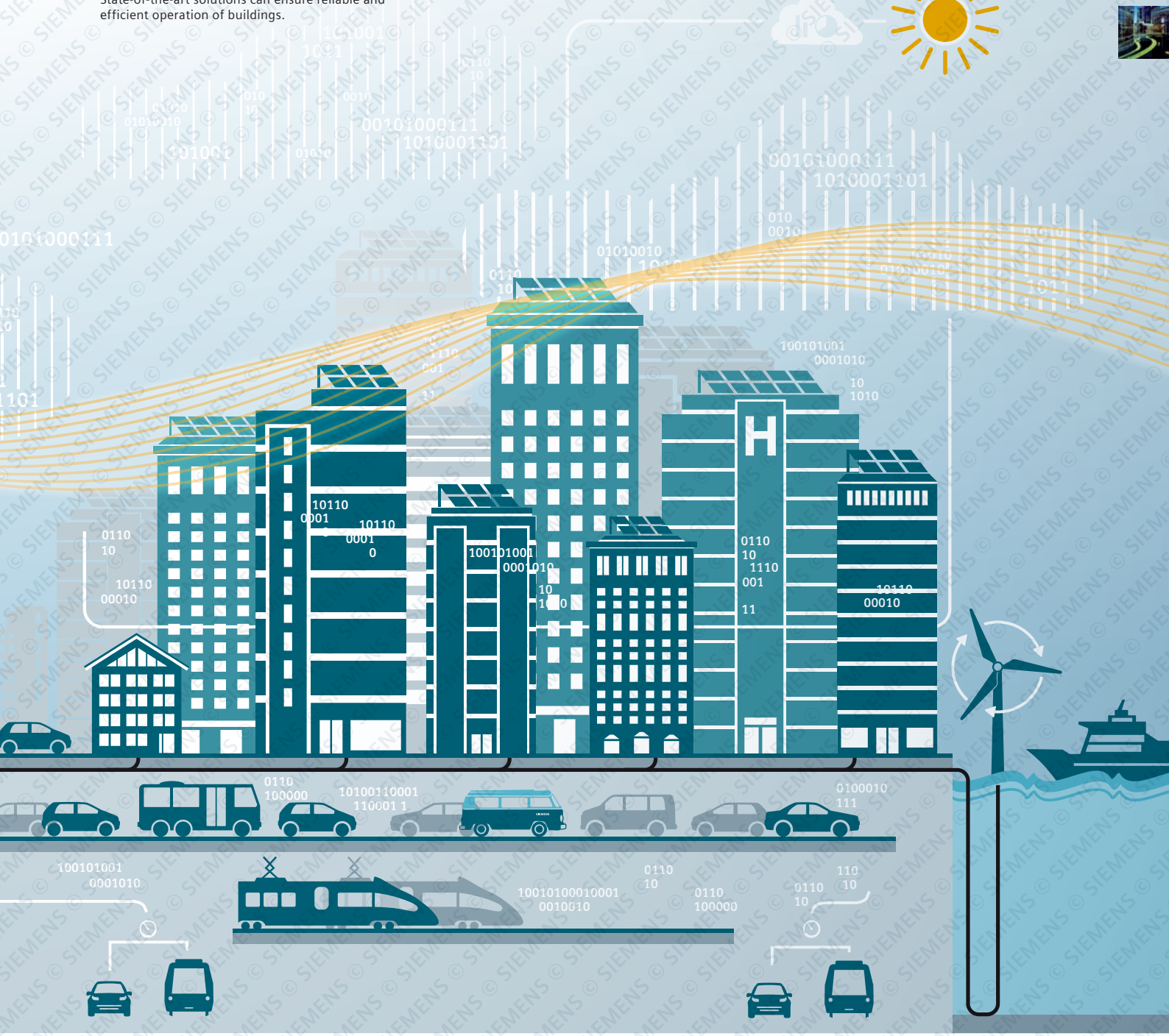
The supply of reliable and affordable energy is essential for economic growth and quality of life. The grids of the future will have to be agile and flexible in order to manage transformations in energy supply.

Smart mobility

Mobility is going digital. Getting quickly and efficiently from A to B is a given these days. But passengers expect more – and cities, transport operators and industry have to meet these needs. Intelligent mobility solutions increase the availability of infrastructure, optimize route utilization and create a new quality of travel experience.

Efficient building management

Intelligent control of building complexes not only improves working and living conditions, it also reduces the energy consumption of a building. State-of-the-art solutions can ensure reliable and efficient operation of buildings.



Digital leap

Master your digital transformation

The digital leap – realizing greater efficiencies by merging the real and virtual worlds

Our world is becoming ever more connected, from personal devices to complex systems in industry.
Sensors and actuators in buildings, gas turbines, trains or manufacturing systems collect data, monitor conditions, automate functions and optimize processes by utilizing the potential of the digital twin as well as consistent data models. Advanced algorithms, high-powered computing, better connectivity and cloud storage all facilitate the emergence of smart systems. Knowing how to exploit all this potential, however, requires a unique set of skills. Siemens has the engineering, domain and digital know-how to generate performance improvements across the entire value chain, from design to production and operations to maintenance.

Design & Engineering – higher productivity and faster time-to-market

Digital simulation technology radically accelerates design, installation and commissioning as well as the entire product development and production planning process.

Production & Operations – digital technologies deliver new levels of efficiency and resilience

Multiple components in systems and plants can be intelligently networked to communicate directly with one other and exchange real-time data. Analysis of this data optimizes systems for improved flexibility, efficiency and resilience in response to unforeseen disruptions.
Machine learning makes complex systems ever more efficient without human intervention – thanks to data analytics, high performance computing and advanced intelligent algorithms. Wind turbines, for example, can increase their output by comparing operating data with weather data and making necessary adjustments.

Maintenance & Service – intelligent analysis for minimum downtimes

Digital services quickly detect and resolve issues. Intelligent analysis of operational data helps identify patterns and predict potential downtimes. Minimizing downtime boosts reliability thanks to lifecycle services.

The digital leap – greater efficiency by merging the real and virtual worlds.

The world has never been more connected. From gas turbines to trains, to manufacturing and medical imaging equipment, our physical world is taking on a digital dimension.

The increasing convergence of the physical and virtual worlds offers hitherto unimagined potential – in almost every sphere.

Only companies with a deep understanding of software, equipment and users can generate performance improvements across the entire value chain, for themselves and their customers.

Design & engineering: higher productivity and faster time-to-market

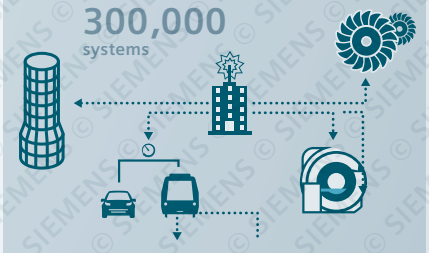
Digital twins and simulation
New products and production planning processes are designed, simulated and optimized virtually, before being built.

Production & operations: new levels of efficiency and resilience

Networked systems:
At Siemens' Digital Factory in Amberg, machines communicate directly with one another. The result: an impressively low defect rate of 0.0012 percent.

Self-learning software:
Complex systems like wind turbines can learn to become more efficient through data analytics, high-performance computing and advanced intelligent algorithms.

Maintenance & service: reduced downtime through predictive and prescriptive analysis



Innovative service concepts
From skyscrapers to gas turbines and traffic control centres, Siemens monitors and checks around 300,000 systems worldwide, via a secure connection.

BIM – Building Information Modelling

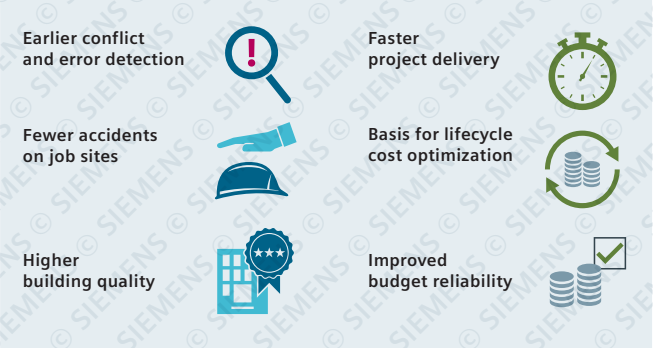
Understanding the language of buildings

Digitalization lets buildings talk and lets you hear what they say.

Data and technology are transforming every aspect of our lives, disrupting the status quo and creating exciting new ways of doing things. We are part of a constantly evolving, innovative environment that offers smarter and more flexible solutions to the construction industry.

With a comprehensive portfolio, state-of-the-art technologies and in-depth expertise, we are successfully driving forward the digitalization of buildings. Buildings are talking – and we help you to understand what they are telling you. With our expertise in dynamic data, we are taking data analytics and data-driven services to the next level with BIM. With Siemens as your trusted partner, you benefit from all the information you need to create a perfect place – from the initial planning phase right through the entire lifecycle.

Create more value from your building with BIM



Up to 40 % weniger Änderungsaufträge

Operating costs cut by up to 9 %

Up to 10 % savings in budget thanks to collision management

Project timeline cut by up to 7 %

BIM helps you to plan, build and operate buildings with greater insight. BIM data combined with real-time building data will enhance predictive data analytics over the building lifecycle. This allows you to achieve significant gains around productivity, reliability and quality.

Create more value from your building with BIM

The future of the construction industry is digital – and built on a holistic approach that effectively connects everyone involved. We combine the BIM process with consulting and system expertise to create and implement strategies that reduce costs, increase productivity, minimize risk and help you to achieve your business goals.

Enjoy increased efficiency and flexibility

How we understand the language of buildings

Siemens owes its success in delivering digital services to its strengths and competencies in building management and predictive data analytics, supported by reliable and secure infrastructure. With our trusted domain and IT expertise, we have built credibility over many years in all disciplines of building technologies. In our pursuit of excellence to deliver the perfect place, you benefit from our years of experience in building technologies.

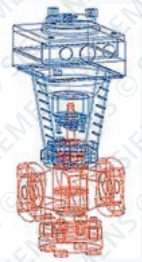
Siemens BIM-compliant product data: the basis for all digital buildings

Siemens BIM-compliant product data allows easy integration of the data into CAD systems.

With more than 1,300 products already available, Siemens is setting the benchmark for BIM-compliant product data.

- Fast download of all data
- Straightforward plug-in installation
- Filter function for easy product selection
- Integrated IFC export function
- Regular plug-in update to keep data current
- Continuous expansion of BIM data

BIM-compliant data according to:
- VDI 3805/ISO 16757
- IFC/ISO 16739
- COBie standard



Download: **www.siemens.com/bim**

Benefit from our BIM experience

New Building Technologies Division Headquarters in Zug, Switzerland

Collaboration between the Building Technologies Division and Siemens Real Estate creates a solution with cutting-edge new methods.

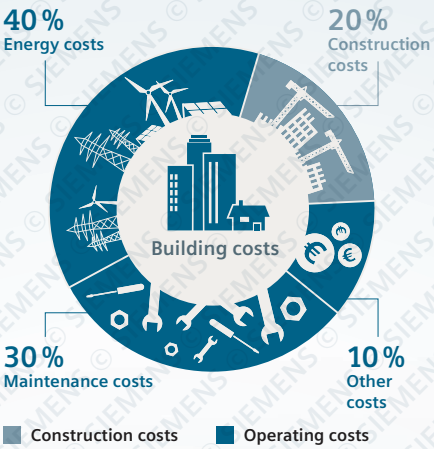
New Siemens Campus in Erlangen, Germany

Long-term, large-scale project with high repetition factor of similar buildings and components uses a modular approach based on BIM.

Intelligent buildings

Actual construction accounts for only around 20 % of a building's total lifecycle costs. There is a strong case then for addressing the issue of a building's real «lifetime costs» early on at the planning stage. It pays to invest in professional cutting-edge building technology if you are to do better than simply recouping the money invested over the lifecycle. This means that 80 % of costs are incurred after construction is completed. When one realizes that energy consumption accounts for 40 % of a building's lifecycle costs, with maintenance and servicing accounting for a further 30 %, it very quickly becomes clear that the use of intelligent networked building systems has a positive impact not only on the needs of the various stakeholder groups but also on key cost drivers.

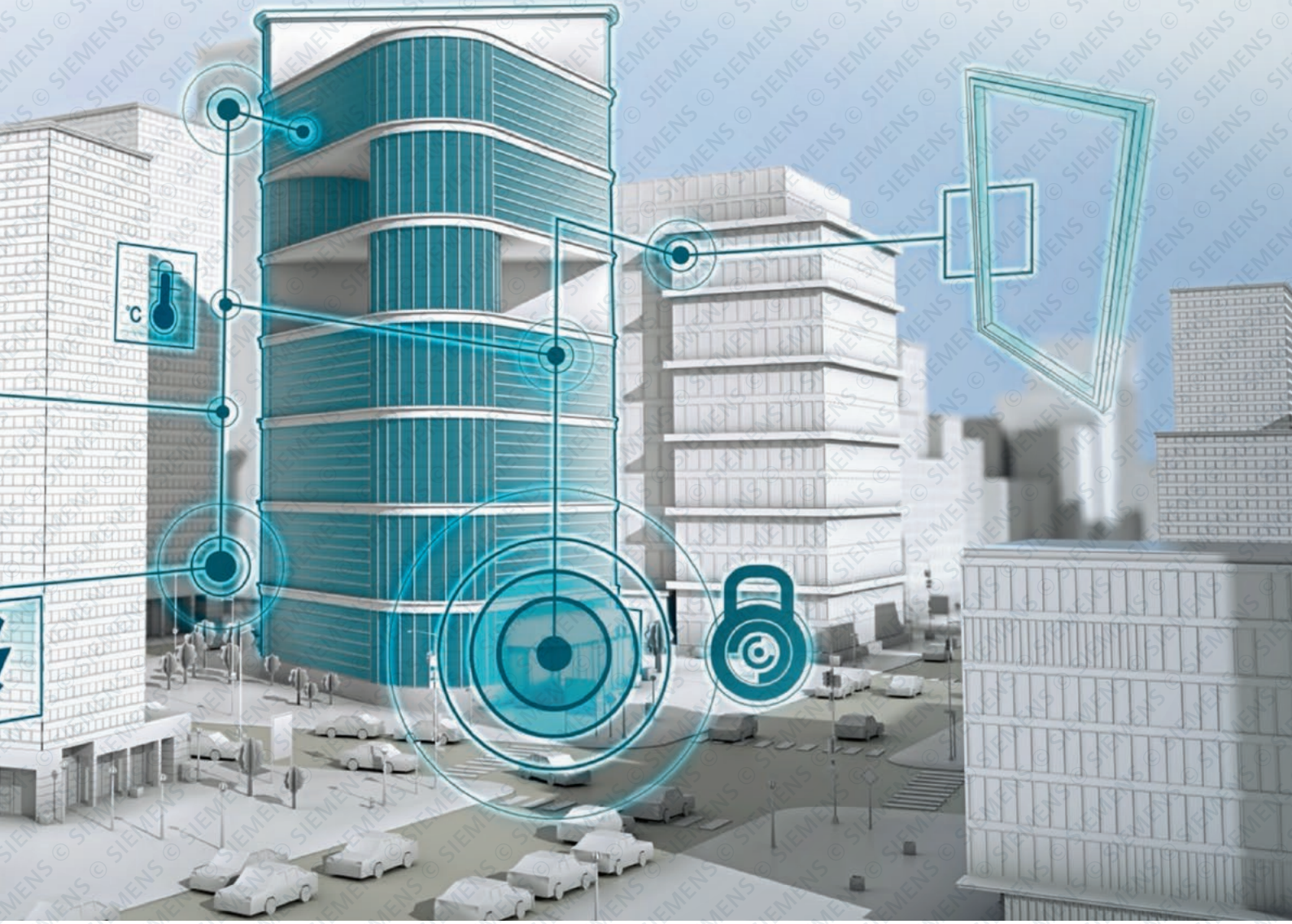
Thanks to the latest technology and intelligent systems, there is still huge savings potential yet to be tapped in building technologies. Applied effectively, building automation can achieve a great deal. Most of the disciplines installed in a building today go beyond simple automation: smart algorithms analyse trends, identify patterns of use and behaviour, enable predictive control strategies and the optimization of security measures and help reduce energy consumption. The impact of digitalization is already being felt in every discipline in a building. The resulting benefits are many – particularly in energy consumption and the reduction of CO_2 emissions. It is also possible to integrate digital security solutions – a real plus for the building's occupants.



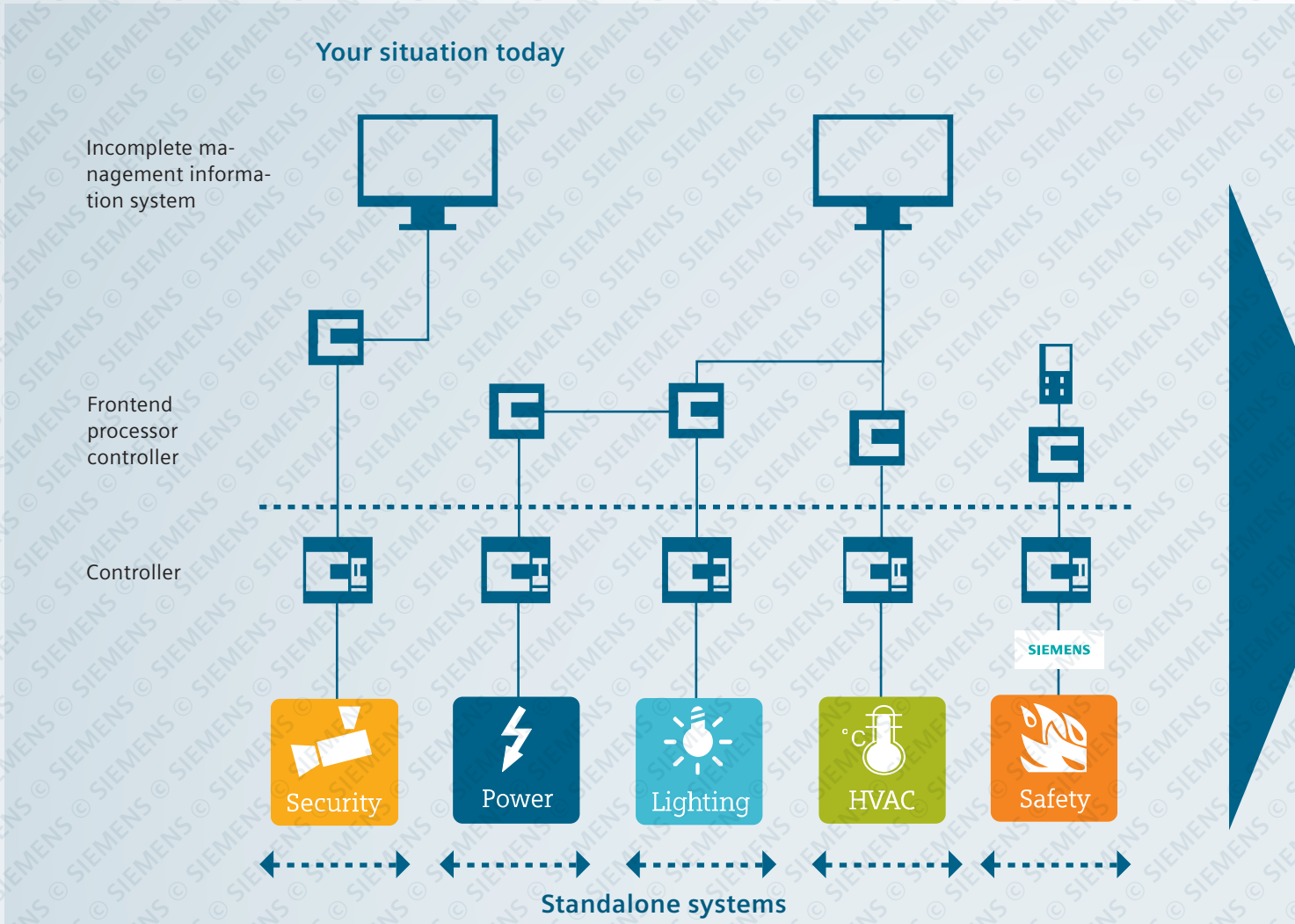
Creating perfect places

With people spending about 90 percent of their lives indoors, there is no place where we spend more time. So buildings are far more than just four walls. They are the places where we learn the most important lessons in life, where we encounter the personalities that inspire us, where the best of our ideas are born. Buildings are the places where we spend time with the people we love. They are our homes – and there is no place in the world that means more to us.

Ingenuity for life creates these perfect places – places where people can achieve their most ambitious goals, where they can always feel safe and secure, places where they can live the life they want.



Fully integrated building



Refurbishment & renovation work in existing buildings

Most construction projects in Europe involve existing buildings. Common examples are modernization projects, conversions or change of use.

Such work usually brings a whole set of challenges:

- Time invested in renovation work must be minimized so that the building's normal operations are not unduly disrupted.
- Areas of the building not directly affected by the renovation work should continue to operate normally for as long as possible.

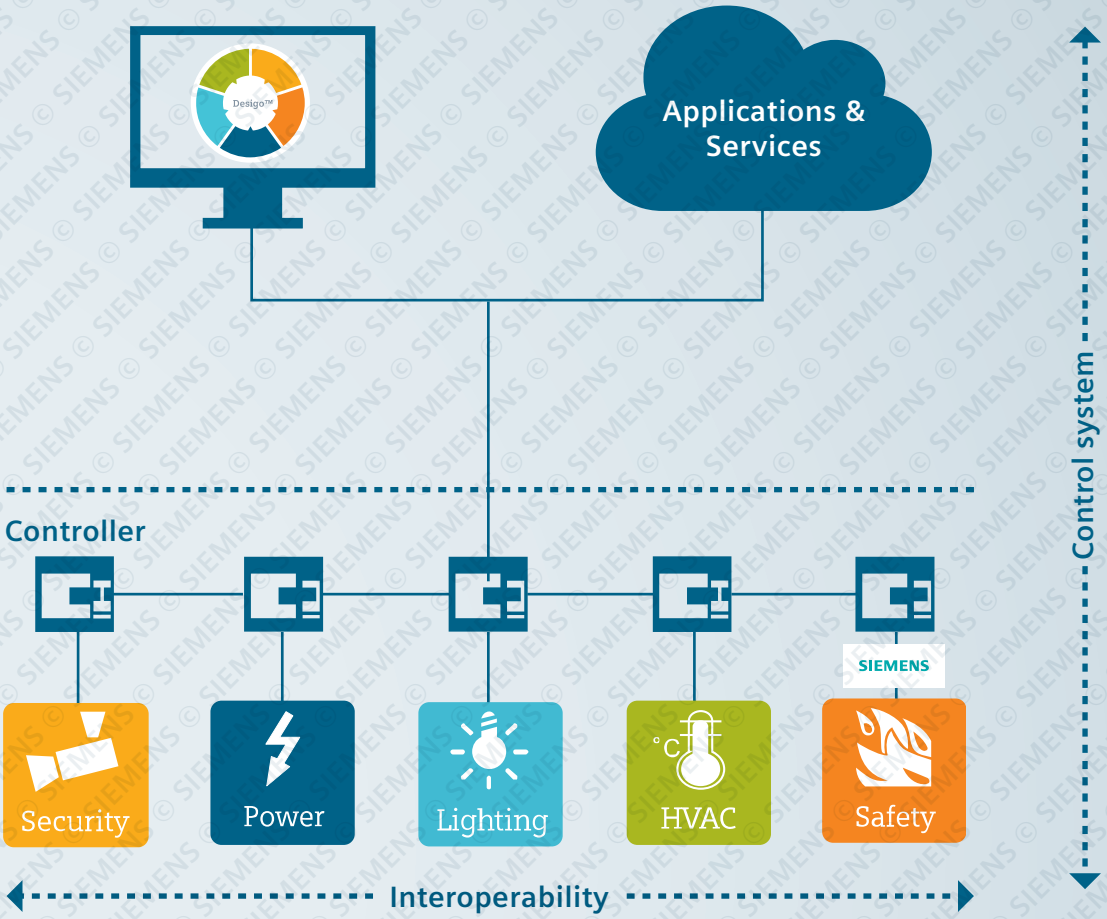
In hotels, for instance, renovation work is usually done «floor by floor», i.e. one floor at a time is refurbished to minimize the impact on operation of the hotel as a whole. Our solutions can accommodate such considerations. It is possible, for example, to deactivate certain zones of a fire detection system at the management station. And the scalability of our solutions means that the system grows with you.

Integration of existing solutions

When we collaborate with a customer, our aim at all times is to improve the overall efficiency of that customer's assets and create a competitive advantage in their core business. That means we don't replace anything that is working. At the same, we don't want to restrict ourselves to using exclusively Siemens systems for operation and data capture. For this reason, our W CC management station and our services are able to integrate other brands and other vendor systems.

This enables you to reduce the number of management tools needed in your building (e.g. separate tools for fire protection and HVAC) and to boost overall efficiency. This is achieved by a simplified workflow in which different interfaces are used for the individual disciplines. This allows gradual incremental development of the system when new technologies are added, without the operator having to acquire new skills in order to integrate these.

Your situation in future



At the same time, by linking multiple systems, we are taking the first step on the road to digitalization of buildings. The various data sources can be linked in order to initiate actions from different disciplines (see Figure for examples).

All this allows you to concentrate on your business while your assets and buildings support your core activities and help give you a competitive advantage.

1

Simply by reducing the management tools needed in your building, we can cut capital expenditure by as much as 20%.

2

By using available data from all systems for efficient management of the building, we can optimize our workflows and boost efficiency by up to 30%.

Examples of functional benefits:

- If a fire detector triggers an alarm, the image from the nearest camera appears automatically on your screen so that you can identify and assess the risk.
- Optimize your energy consumption (heating, ventilation and lighting) using data from your access control system.

Want to be more competitive? We can help you achieve this with «Perfect Places».

- **Value of assets increased**
- **Lower operating costs**
- **Reduced risk**
- **Increased productivity**

As Voltaire rightly said, back in the 18th century, «The perfect is the enemy of the good». A sentiment that is more relevant than ever today. In the business world especially we are constantly being urged to question everything and exploit improvement potential. Building infrastructure frequently has hidden potential, waiting to be discovered.

Years ago, at the planning stage of most buildings many assumptions were made as to future use and needs when it came to the technical installations. Often, budget constraints meant that compromises had to be made at the time, and in the intervening period business needs and requirements have kept evolving. Now, the building occupants concentrate on their core business and make do with the technical installations. The building and its infrastructure are thus often seen purely as a cost factor.

As a result, building infrastructure often holds great potential not just to optimize a specific cost item but to improve operational value add as a whole.

How can you increase the value of your assets?

Building infrastructure has a major influence on the value of real estate and installations. If the installations are state-of-the-art, if future-facing issues such as renewable energies are addressed and if the installations are perfectly matched to one another, not only will there be a direct benefit in the form of improved performance, but the value of the assets themselves will also be increased.

Flexibility and efficiency

- Flexible building technology
- Maximum efficiency
- OPEX reduced thanks to intelligent building technology
- Cost-efficient, smooth operation
- Costs per m^2 minimized
- Revenue per m^2 maximized
- Maximize workspace utilization
- Employee productivity
- Employee satisfaction

Time to market

- Trend to digitalization and mobility
- Customers expect personalized medication

New operating models

- Consolidation of organizations to increase economies of scale
- Changing regulations and compliance require greater transparency on quality of support, outcomes and prices
- Industrialization of operation through more standardized diagnostics and interventions

Technical innovations

- Internet of Things; enables technologies such as Real Time Locations Services (RTLS), in order to optimize workflows and boost productivity
- Data analytics and artificial intelligence to automate diagnostics & interventions and patient/visitor interactions and to provide better support to staff

Sustainability

- Customers increasingly think «green» and practice «green» accounting

Compliance

- New laws and regulations
- More stringent data privacy and security requirements
- New environmental guidelines

Laws and regulations

- CO_2 tracking

Safety and Security

- Absolute reliability
- Uncompromising availability 24/7
- Operational safety – essential to safety and security
- Increased security risks
- High awareness of security in view of terrorism, pandemics and natural disasters

Guest satisfaction

- Increasing expectations of modern technology
- Expectations of innovations

Customer satisfaction

- Changes in customer experience
- Increased brand awareness
- Digitalization and mobility
- Customers expect stress-free travel without unnecessary delays

Financing

Increasing urbanization, exploding population growth and climate change all add up to the pressing need for infrastructure that is smarter, more sustainable and more reliable.

Financing plays a vital role in facilitating infrastructure development around the world, especially in times of limited public funding or commercial budgets. However, when it comes to upgrading infrastructure or implementing new technologies, many policymakers and business owners are not fully aware of the financing options that can help manage risks, reduce initial costs, or make complicated projects bankable.

At Siemens, we understand the complex investment decisions behind the infrastructure technologies that matter – by combining our deep technological knowledge and innovative financing expertise.

Transforming buildings by financing new technologies

Buildings account for 40 % of the energy we use, so we must focus on improving their energy efficiency. Europe alone wastes €270 billion a year in unnecessary energy for buildings. However, many are deterred by the initial cost of installing intelligent building technologies.

When engineering and financing solutions come together, buildings can unlock huge energy saving potential – in energy consumption and in costs. A good example of this is Siemens' energy performance contracting for building technology in more than 10 countries – a combination of consulting, modernization services and customized financing. With this approach, customers do not need to make any initial investment – they simply use the energy cost savings to pay for the instalments.

Applying this principle, Siemens has modernized more than 5,200 buildings worldwide with Siemens› building technologies, achieving more than €1 billion in savings and more than 10 million tons of CO_2 reductions.

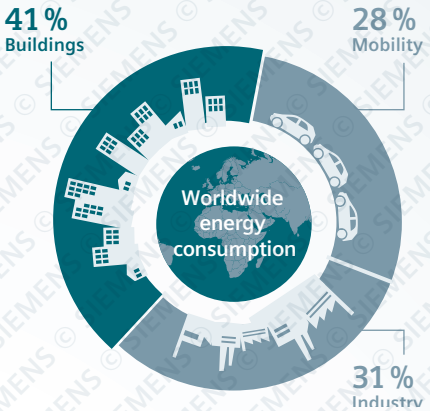
Enabling the global energy transition

The future of energy management will need to solve complex challenges of resilience, accessibility, smart connectivity and, in many cases, financial barriers.

Financing energy management

Around the world, energy consumption is rising and power networks are growing in both size and reach. In times of increased threat, resilience is crucial and an emerging landscape for distributed energy systems will influence the future of energy accessibility. At the same time, digitalization will hold the key to mastering new challenges in energy management, such as a changing generation mix, the addition of generation capacity and the need for upgrades.

However, many of these innovative technologies require sizeable investments with potentially long payback periods, making the energy transitions unattractive for many. Financing solutions that understand the world of utility companies inside out will play a pivotal role in realizing the future of smart energy management.



Financing sustainable buildings

Buildings account for **40 % of the world's energy consumption** and **a third of carbon emissions**. Yet, many hesitate to adopt **energy-efficient technologies** on cost grounds. Siemens financing solutions, such as **Energy Performance Contracting**, can help customers use guaranteed energy savings to finance the initial investment.

Cyber security

Comprehensive protection

Combining «Defence in Depth» with lifecycle activities
Minimizing risk around cyber security requires not just comprehensive security mechanisms but security activities that are integrated into the whole lifecycle. This means that security considerations must be part of the development and engineering process and must also feature in service and operations activities. Siemens is compliant with ISO/IEC 2700x. With the concept «defence in depth,» Siemens provides comprehensive security mechanisms combining physical security, network security, and system and software integrity.

- Physical security
- Network security
- System & software integrity
- Integration of security activities over the entire lifecycle

Aspects of the security circle

Access Management & Policies
Our solutions for secure authentication and authorization comply with regulatory requirements for rolebased access control. Authorized users will have the access rights they need and your system will be protected from misuse. You will keep control, increasing reliability and minimizing risk while retaining full operational availability.

Stay in control
Incidents are caused in many cases by misuse of access rights. Applying the principle of least privilege, system access is limited to the minimum necessary for your users.

Incident Handling & Security Patch Management
If a system incident occurs, your systems must be protected – quickly. Our incident handling and security patch management services provide anytime support and regular updates to keep your systems up and running securely.

Close security gaps
If a system security incident occurs, you must be prepared to take action. Our solutions for incident handling are closely coupled with our security patch management service, where we use our Siemens wide CERT to identify new threats globally to ensure timely provision of updates for our products and systems.

Monitoring, Detection & Reporting
Continuous analysis of network events allows you to identify risks and respond rapidly. If a security incident occurs, problems can be identified and isolated more quickly. Potential damage to your network can be reduced or indeed avoided.

Trust Anchor
Security relies on trust. In Siemens you have an experienced partner who has cost-effective and certified cyber security solutions for reliable operation.

Security built on trust
Cyber security is a highly sensitive area that demands a trustworthy partner. A technology partner like Siemens who understands how products, systems, and solutions interact with the processes and people behind them. Our expertise and the ability to integrate complex solutions into existing structures gives you products, systems and solutions with unique lifecycle support.

Proactive avoidance of security gaps
Siemens has opened its Cyber Security Operation Centre (CSOC) for the protection of industrial facilities. Siemens specialists based there monitor systems around the world for potential cyber threats, warn companies in the event of security incidents and coordinate proactive countermeasures.

Manage Security

SIEMENS

Ingenuity for life

Vertical Markets

buildingtechnologies.siemens.com

Specific solutions for dedicated markets

Desigo CC – building management platform 

Gas detection 

Fire detection 

Fire extinguishing 

Evacuation 

Video surveillance 

Access control 

Intrusion 

Tracking systems 

Siseco CC – security management system 

Automation of primary plants 

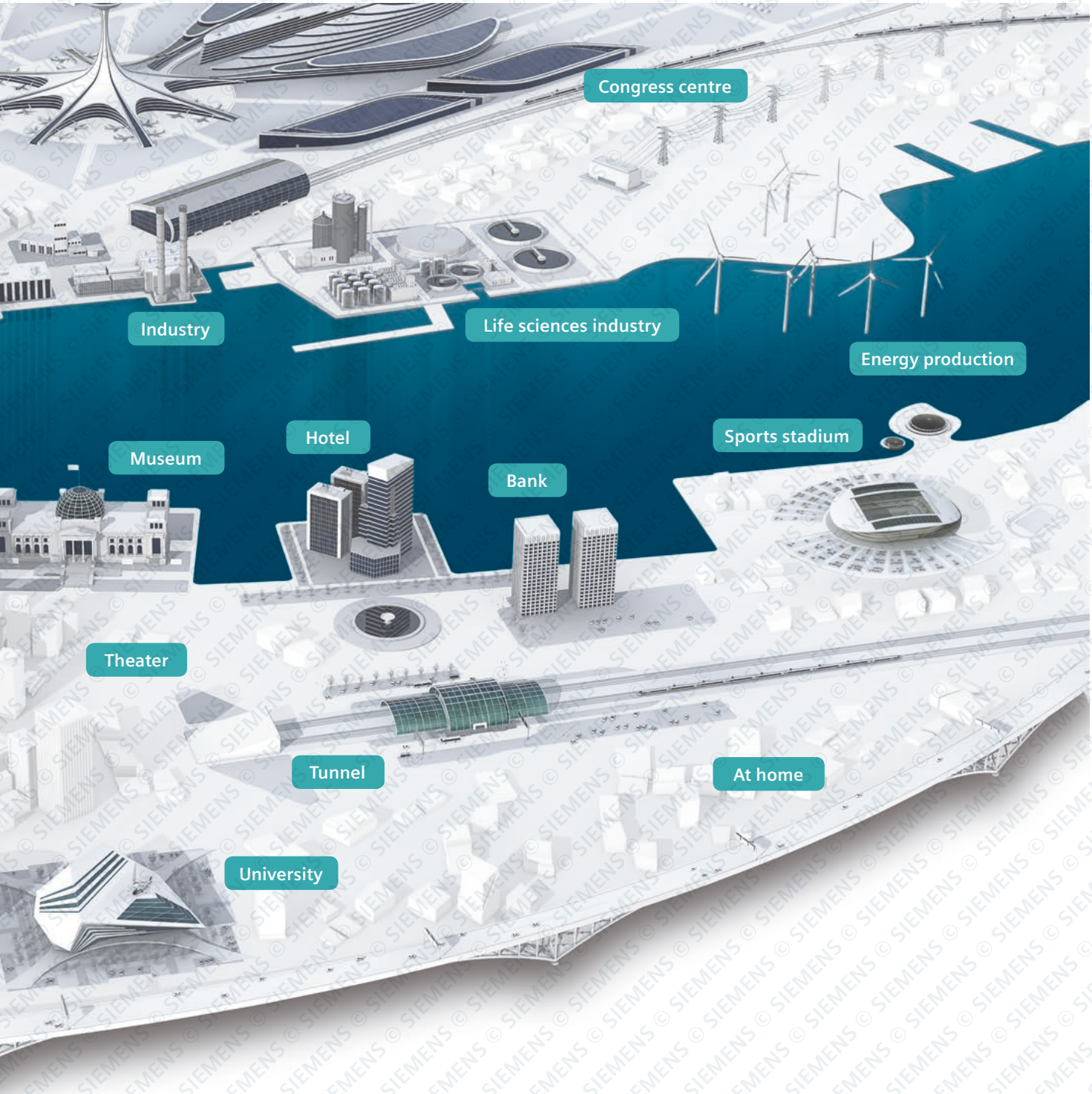
Room automation 

Energy management 

Desigo Insight – management station 

Advantage services 

Life sciences, airports, hotels, hospitals, tunnels, data centres, premium offices and energy supply are becoming increasingly important parts of our lives. We have created tailored solutions for them, based on our standard portfolio. They meet the technical and regulatory requirements, and they can support you in the planning and implementation of specific projects.



Life sciences

Reliable protection for critical environments

Our offerings for the pharma sector provide reliable protection for people, assets and equipment in critical environments such as laboratories, clean rooms, production facilities and warehouses. Our dedicated pharma solutions for critical environments meet all the relevant legal requirements. We can help you improve the performance of your building while simultaneously lowering costs. From planning to maintenance, validation, data administration and archiving, we are your partner for a successful environment throughout the lifecycle.

We have developed a solution portfolio specifically for the entire value chain of the life sciences industry and your operational requirements. Our solutions are based on a holistic approach to everyday challenges. From the initial analysis to ongoing support, we provide the solutions, services and resources needed in order to guarantee that your facilities are safe and efficient and meet all legal requirements.

- Uniform system integration of different subsystems
- Integration platform for third-party systems
- Integration and interaction of specific requirements
- Safeguarding regulatory requirements and data integrity
- Specific life sciences solutions for the entire value chain

The value chain of the life sciences industry

Success in the life sciences industry depends on safe, protected and compliant environmental conditions:

- **Safe:** to protect public health, people and the environment
- **Protected:** to protect knowledge, equipment and financial assets
- **Compliant:** to meet global regulatory expectations

Flexibility and efficiency

- A growing population requires more development
- New patterns of disease call for new medications

Safety and security

- Increasing security threats
- Guaranteed availability 24/7

Time to market

- Trend towards digitalisation and mobilisation
- Customers expect personalised medications

Laws and regulations

- CO_2 tracking

Our specific life sciences solutions are an integral part of our Desigo CC system platform. The various disciplines are monitored and visualised centrally. The modularity of the system platform means that the building automation system, the security and fire protection solutions can be combined into intelligent customer specific solutions. The legal regulations (FDA 21 CFR par 11, EU-GMP Annex 11) and their data management requirements are met in full.

Project management in the pharma industry with PM@SBT

Project management can only succeed if certain basic rules are followed. It is crucial to have a clearly defined project flow («phase model» and «milestones»), explicitly assigned responsibilities for each project phase and task («roles»), and goals which are easily understood by everyone. The purpose of these PM guidelines is to specify and implement consistent project management and high-value qualifications in all parts of national and regional companies. This process is supported by the Electronic Validation Tool (EVT).

Service

The dedicated Knowledge Services of Siemens offer a comprehensive range of services tailored specifically for the field of life sciences. This includes a unique set of methodical applications for impact analysis, risk assessments for entire building infrastructures, business continuity services such as data backup and archiving, and testing and baselining. Talk to our experts to find the most effective and efficient approach for a new solution or to modify or extend existing systems while they are running/being maintained.

Safety


Gas detection


Fire detection


Fire extinguishing


Evacuation

HVAC

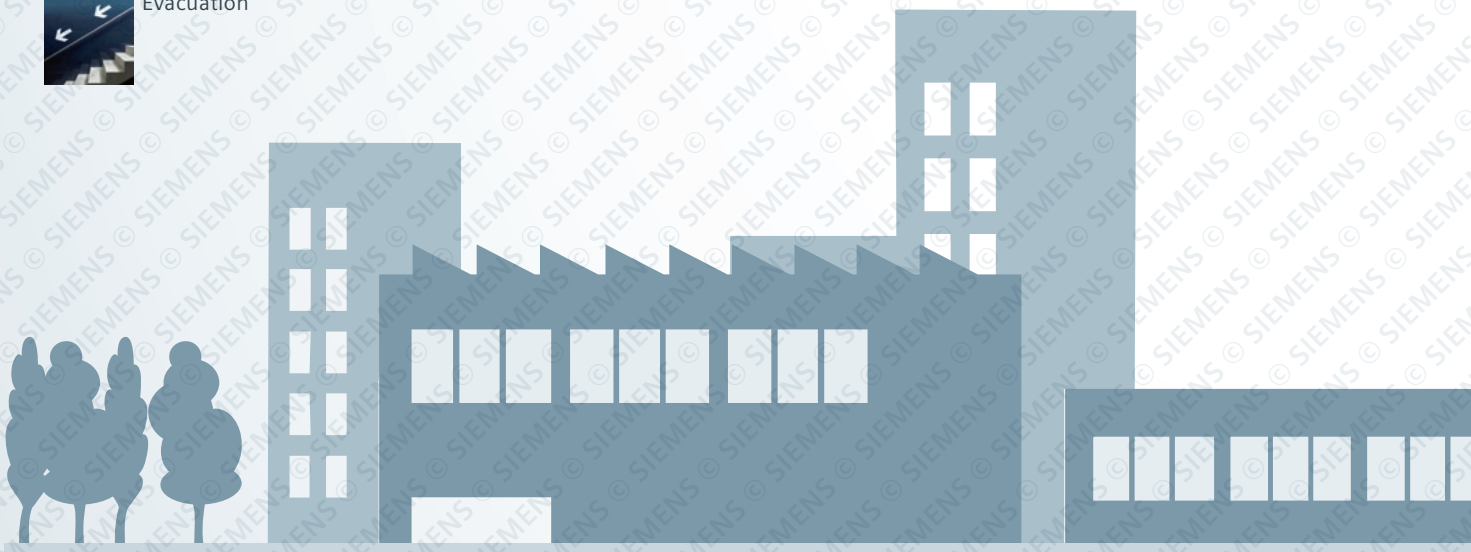

Energy management


Automation of primary plants

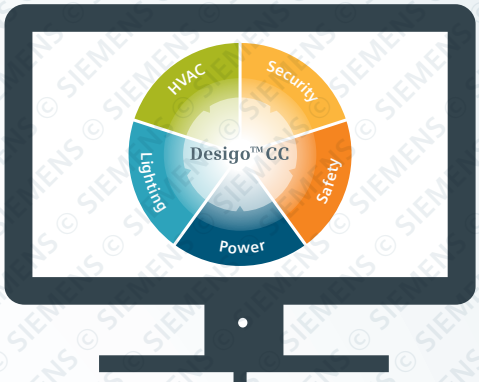

Room automation

Power

Power metering
Power management
Power monitoring
Power reporting



Safe, protected and compliant life sciences solutions for the entire value chain.



Interfaces with systems specific to life sciences

- Historian server
- Batch reporting
- DMS
- MES system
- Etc.

3rd Integration

- Environmental monitoring system (EMS)
- Laboratory control
- Critical environment control (CET)
- Validation and qualification
- Training
- Services specific to life sciences

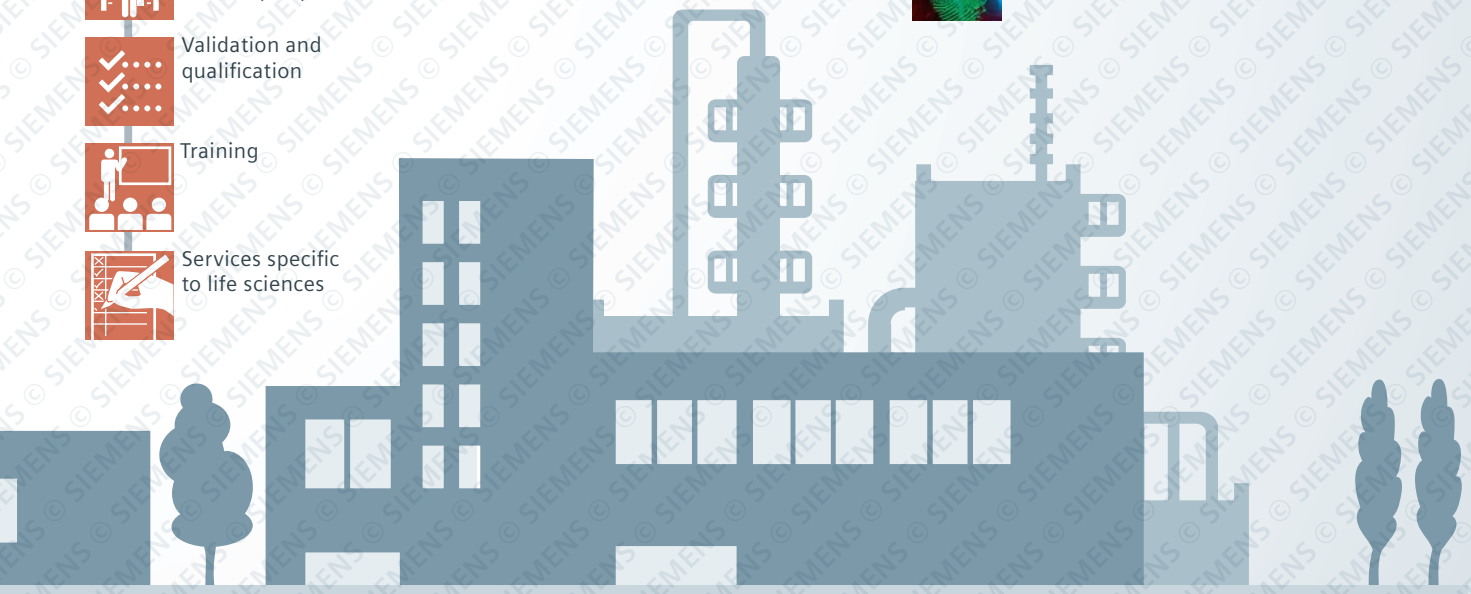
Security


Intruder alarm system


Video surveillance


Access control

Lighting



A global concept for safe, cost-effective and comfortable labs

A lab is a challenging workplace with strict rules and requirements designed to protect the people working there and the wider environment. The lab solution from Siemens is a global concept for building automation in the lab, helping you apply these strict workplace standards in a safe, comfortable and energy-saving way. The lab solution is a universal concept, allowing the various subsystems to interact – including the fume cupboard, room monitoring, primary plants and building and energy management. Control components from Siemens can be used to create VAV units which meet the highest standards of lab air handling: rapid volume flow control for the fume cupboard exhaust, and accurate and stable volume flow control for a constant room pressure. The Siemens lab solution can also be combined with other security systems from Siemens such as access control and video surveillance, early fire detection and gas detection and fire extinguishing. Total building solutions from Siemens provide you with a comprehensive product range from a single source. This optimises the interaction between building automation and danger management, improving investment security and increasing the value of the building.

Energy savings from maximum efficiency resulting from harmonisation of disparate disciplines across the building.

Shorter product introduction time thanks to comprehensive validation support and fewer interfaces.

Optimised energy consumption and lower (energy) costs with VAV and optimised air balancing.

Guaranteed efficiency, security and compliance using integrated and interactive lab solutions (measuring, controlling and monitoring air volume flows and room pressures in the building).

Protection of people, assets and the environment through gas detection.

Improved performance of the building and processes due to better energy efficiency and lower energy costs throughout the lifecycle.

Protection of people, assets and the environment using access control, intruder alarms and intelligent video surveillance.

Lab solution: A global concept for safe, cost-effective and comfortable labs

A lab is a challenging workplace with strict rules and requirements designed to protect the people working there and the wider environment. The lab solution from Siemens is a global concept for the building technology in the lab, helping you apply these strict workplace standards in a safe, comfortable and energy-saving way. The lab solution is a universal concept, allowing automation of the various subsystems – including the fume cupboard, room control with light and blind control, primary plant automation, building and energy management, and security and access technology.

Optimised room climate

With building technology, a modern lab building provides its users with state-of-the-art lab and office accommodation. The stringent requirements applicable to technical facilities in a lab cannot simply be reduced to safety aspects. The primary task is to protect the lab personnel from danger, but it is also important to create a comfortable indoor climate taking financial and ecological factors into account.

Energy-efficient facilities technology

The energy-saving potential of lab buildings is enormous if they are equipped with technically advanced systems. Building automation occupies a key position, making the facilities available dynamically according to demand. The more information the system has, the easier it is to optimise the facilities while also improving safety and comfort. Using building automation to link the building facilities together in an intelligent way significantly improves the energy efficiency of the building and boosts property values over the long term.

Many different integration options

The thing that makes the Siemens lab solution special is the way it fully integrates the control and monitoring of fume cupboards and lab areas with the system. This means you can easily create as many comprehensive functions as you need. There is also no need for additional interfaces with other subsystems.

A reliable solution from a single source

Whether you are working on a new build or a renovation, with Siemens everything comes from a single source, from project management to implementation and maintenance. That means less time spent on implementation, no additional interfaces and a clear division of responsibilities. You also enjoy a great deal of flexibility because extra equipment and software tools can be seamlessly added, giving you greater reliability in planning and execution.

Critical Environment Technology

Measuring, controlling and monitoring air volume flows and room pressures in the building. Critical Environment Technology (CET) is a range of reliable volume flow controllers and additional components to measure, control and monitor volume flows and room pressures in the building safely, precisely and quickly. All components come with open-standard interfaces. CET can easily be added to building automation systems. The overall system delivers maximum efficiency, cost-effectiveness and safety.

CET was primarily developed for:

- Room pressure control and room air balancing
- Room air conditioning
- Lab fume cupboard control
- Control of extraction units

Air volume flow control and room pressure control have a wide range of uses:

- Lab rooms
- Clean rooms
- Production rooms
- Storage rooms
- Operating theatres
- Isolation wards

CET – benefits for you

Maximum efficiency and safety with an integrated approach. From the high-quality individual components to the large overall system, from simplified planning to time-efficient start-up – CET works with our Desigo building automation system to get the very best out of your building in terms of efficiency and safety. To guarantee demand-based operation of the facility as a whole and to provide a safe work environment for users, predefined energy saving functions and emergency scenarios at room level can be combined with the corresponding primary plant control functions. A clear and simple operating and display concept is applied to individual devices and the control station, so there is always a detailed, transparent overview of the status of the facility. Modular concept for flexible configuration. CET has a modular and scalable structure. This means that individual components can be used by CET and also that CET itself can be used as a system solution. CET is therefore suitable not just for new builds but also for extensions, retrofits or refurbishments of existing facilities. The aim was to create a system that has no limits in terms of the design of the building, rooms, ventilation and equipment, and in terms of functional requirements. CET now includes a very wide range of ventilation control components and implemented applications offering great flexibility and many customising options.

High availability and reliability with tried-and-tested components.

Maximum efficiency and safety are founded on high-quality components and software modules that can be combined to form a system without additional expense. This makes it possible to provide functionality, stability, communication and reliable long-term operation right from the planning phase. It also minimises disruption and outages in the facility and planned maintenance periods throughout the lifecycle. A further benefit is the local presence of our competent service engineers anywhere in the world.

Monitor GxP parameters and reduce validation costs with the environmental monitoring solution (EMS)

The environmental monitoring solution (EMS) from Siemens can be configured for each customer, and monitors, records, stores and analyses all GMP-relevant data concerning your environment-critical conditions. This reliable solution also meets all international GMP requirements and supports validated operation in a simple and safe way. The EMS works independently or can easily be integrated into your existing IT infrastructure for convenient operation. It is not necessary to install local software. This compliant solution grows along with your needs. In pharma production, the products are protected from contamination, or in a hospital, sterile environments can be provided. The EMS monitors GxP-relevant parameters such as temperature, air humidity, room particles and room pressure, and also monitors access to quarantine areas and highly sensitive medical equipment. The EMS records and archives all relevant data and makes it easy to create useful trends and reports. We can provide expert support during validation of the system as a whole.

Ensuring conformity with precise HVAC control based on field devices meeting the requirements of the pharmaceutical industry (GAMP compliant).

Fulfilling GxP requirements and improving productivity with a monitoring solution based on certified sensors and particle counters for precise measuring of temperature, air humidity, room pressure and particle concentration in the clean room.

Preventing cross-contamination by monitoring the flow of personnel with validated access control solutions, and by using pressure systems and building automation systems in airlocks.

Guaranteed clean room classes and quality with 21CFR Part 11 for GMS and a monitoring solution.

Protection of people, assets and the environment using access control, intruder alarms and intelligent video surveillance.

Energy savings from maximum efficiency resulting from harmonisation of disparate subsystems across the building.

Improved performance of the building and processes due to better energy efficiency and lower energy costs throughout the lifecycle.

Improved safety for people and assets with reliable solutions for fire detection, fire extinguishing, alarm signalling and evacuation.

A global concept for critical stores protects your products around the clock

Critical warehouses contain various kinds of raw materials, packaging material and high-precision end products. The stored items must be protected again theft. Integrated security systems such as fire detectors, gas detectors, extinguishing systems, access control and video monitoring protect your valuable stores. Integrated solutions provide enhanced fire protection and security 24 hours a day. To prevent the loss of raw materials and finished products, and to guarantee uninterrupted production, the high-quality products must be protected from cross-contamination. The storage conditions are therefore measured, for example stable temperatures, constant air humidity and particle concentrations. The environment-critical conditions are monitored and safeguarded by a monitoring solution from Siemens.

In industry, toxic or flammable gases can occur during storage. Explosion-proof gas detectors can be used to detect dangerous concentrations well before an explosive mixture occurs.
Detectors to measure toxic gases are now able to detect tiny concentrations (ppm) and raise the alarm.

Total building solutions from Siemens provide you with a comprehensive product range of integrated solutions from a single source. Intelligently networking safety systems and building automation maximises the protection given to your investments and facilities, while also optimising running/energy costs throughout the lifecycle.

Guaranteed quality of raw materials and finished products with environmental monitoring including calculation of the mean kinetic temperature (MKT).

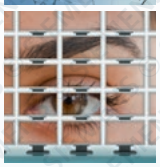
Compliance is guaranteed by storing all GMP-relevant information in an independent, tried-and-tested solution.

Temperature mapping and cold/hot point calculations improve the operating processes and guarantee the quality of materials.

Your assets are protected with RFID tracking solutions to monitor the movement of goods.

Energy savings from maximum efficiency resulting from harmonisation of disparate subsystems across the building.

Improved performance of the building and processes due to better energy efficiency and lower energy costs throughout the lifecycle.



Protection of people, assets and the environment using access control, intruder alarms and intelligent video surveillance.

Improved safety for people and assets with reliable solutions for fire detection, fire extinguishing, alarm signalling and evacuation.

Qualification – validation services

Our validation service provides comprehensive services and validation support throughout the building lifecycle, helping customers as they protect their critical environments and key processes. This allows customers to maintain high product quality and to meet all regulatory requirements in GMP. We offer comprehensive validation support for the quotation, execution and service phases. We have developed a validation strategy based on GAMP 5 which is fully integrated in our Electronic Validation Tool (EVT). A complete portfolio consisting of:

- Project management in BT Life Science
- Software tools
- Validation library, templates
- Standard operating procedures (SOPs)

Training and certification

Siemens BT takes employee training very seriously. We make sure we maintain the highest level of domain-specific expertise necessary in order to operate productively and profitably in the regulated industries. We nurture our highly motivated employees with free career development opportunities:

- **Training:** is focused on providing the necessary basic and detailed technical and process knowledge.
- **Competency Excellence:** is a performance-oriented career development system which certifies individuals on the basis of experience gained in the specific area, integrated in the personnel management system for staff pay.

Services

Our service concept designed to maintain a validated status is split into three main groups:

- Advice on conformity
- Business continuity
- Validation review

Advice on conformity

Special life sciences processes require a versatile building infrastructure which is tailored to the exact needs of the customer.

Your success is based on the optimised combination of organisational activities, the right environmental structure and the capacity to adapt to your current and future needs. Together, we can analyse site-specific business processes and produce a solution concept tailored to your needs.

Tailored solution based on:

- Customer-specific business processes
- Impact analysis and risk assessment
- Regulations and industry standards
- Financial resources

The right combination guarantees long-term success

- Whether you are planning a new location or extending an existing facility, we work with you to make the most of your options.
- The result is an environmental concept that covers regulatory aspects, industrial and in-house standards, and the available resources.
- Working with your specialists we investigate the potential impact of the building structure on product quality, and we assess GxP risk, business risk and security risk.
- Your individual solution is built from technical systems developed for the life sciences industry, and from operational interventions which integrate your building structures and IT structures.

Dedicated operating and maintenance systems

- The conceptual principles established in the planning phase help us to assess and plan your requirements for the future of your facility.
- Changes, extensions and migrations, with their potential consequences, are integrated in the solution with future objectives.
- During the design, engineering and installation phases you can be certain that our processes meet industry requirements and efficiently support the validation activities.
- System integration tests, calibration, system baselining, SOP maintenance and training for your workforce.

Business continuity

The regulatory authorities insist that there is no risk to the safety of products or the security of critical data in the event of outage or disruption. Our business continuity service protects the critical data you need to continue serving your customers and meeting the regulatory requirements.

Daily backup and frequent archiving are tasks typically carried out by the local IT department. With our detailed knowledge of system architectures, database structures and key performance indicators, we offer comprehensive reporting on current performance, and we can also suggest remedial action.

Every link in the life sciences value chain is important in establishing a structure that supports current and future investment in your life sciences building infrastructure. Our flexible and scalable systems can be easily modified, allowing your company to adapt and grow as needs change while protecting your investment. Flexibility allows for rapid migration and extension without losing sight of the functional design.

Documentary evidence throughout the lifecycle guarantees that all regulatory requirements are adhered to efficiently at all times. With our solutions for life sciences, you can concentrate fully on your core competences.

Validation review

The validation review services encompass two service modules:

- 21 CFR Part 11 review
- Calibration

21 CFR Part 11 review

The regulations place a high priority on the security of systems and data, e.g. 21 CFR Part 11 and the EU GMP Directive Annex 1. Our review analyses the following in detail:

- System access
- Data security
- Audit trail

Healthcare

Technology partnership with Siemens as operator model

Because of the greater challenges they face, a growing number of hospital operators are opting for new builds. Stable partnerships have long-term benefits, minimising the operator risk and guaranteeing budget certainty. They reduce the number of suppliers and consequently the number of interfaces in the company, and this reduces spending on replacement investments and modernisations. There is also an emphasis on optimising the cost structure. The cost situation is improved by turning CapEx into OpEx.

A new build is associated with high one-off costs which are also reflected in lower future costs. A lifecycle approach must therefore be used in order to consider these costs as a whole. Siemens offers a comprehensive Managed Equipment Service (MES), which is an operator model that helps hospitals control their costs over the long term. The MES model could include the construction, maintenance, management, modernisation and financing of all structural and medical facilities over an agreed period. This is based primarily on the know-how gained from previous successful MES projects in other countries.

Sustainable healthcare – technology combined with efficiency and quality

Economy and ecology in unison

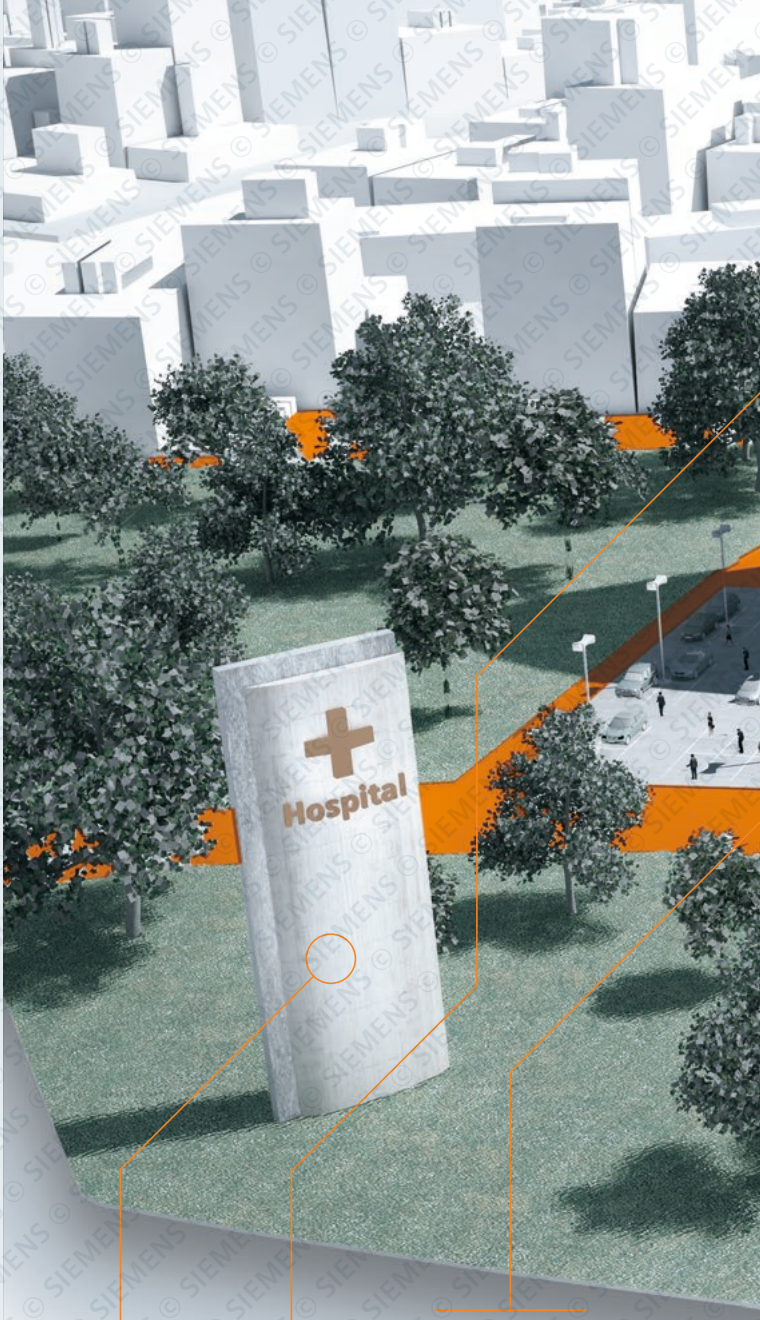
Siemens helps hospitals meet ecological as well as economic requirements as they plan their infrastructure. This benefits everyone: the hospital operator with energy cost savings, greater efficiency and an improved image; patients with faster and better treatment; and the environment with fewer emissions.

Safety and efficiency in the building

Integrated solutions in the fields of building automation, energy distribution, safety and fire protection systems and patient tracking all optimise the way the various subsystems interact and improve a building's performance and energy efficiency.

Information and communication

Standardised means of communication, IT infrastructures and applications enable the seamless integration of processes and information, deliver data security and protect your investment.

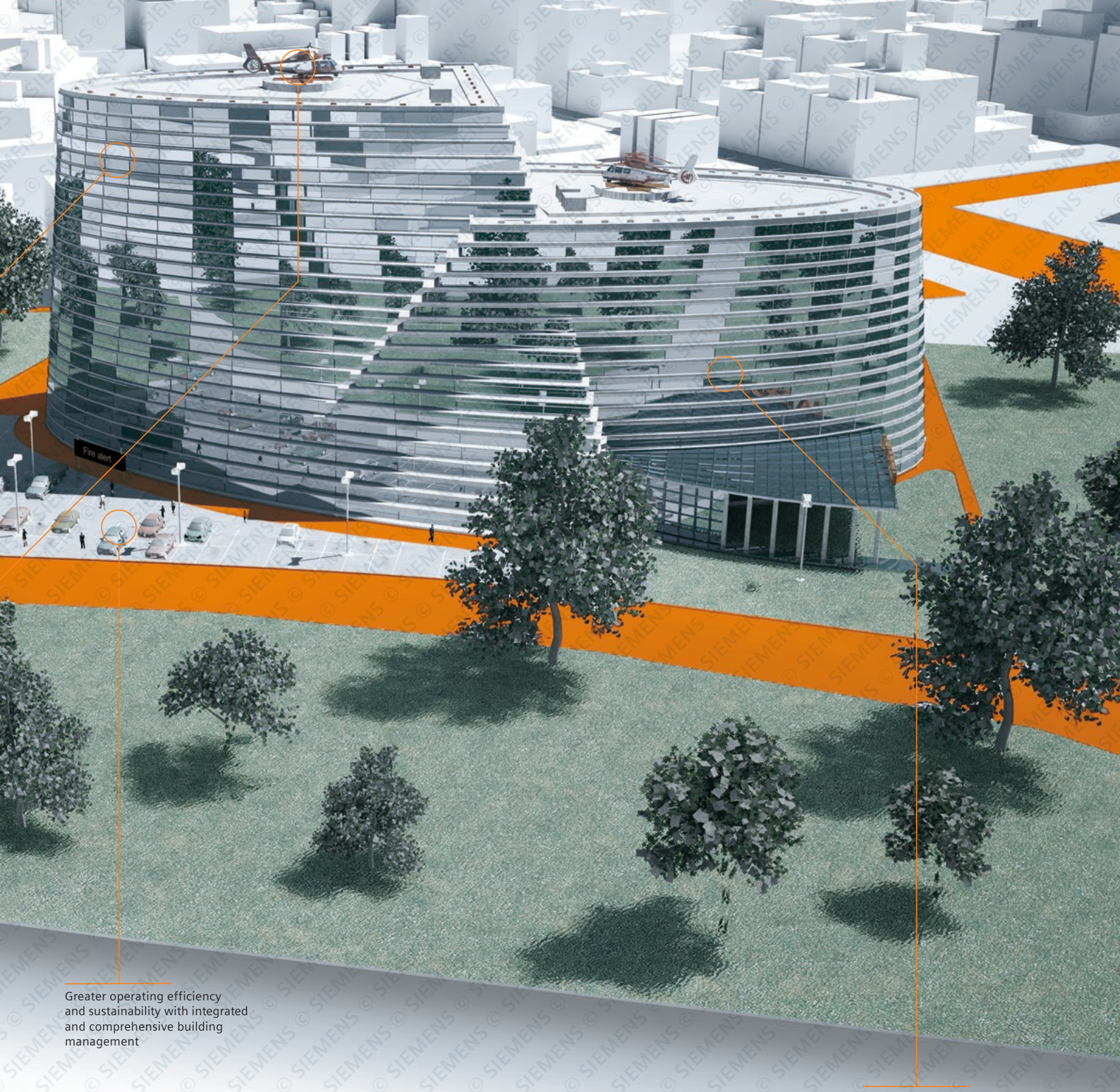


Technology partnership
- Budget certainty thanks to risk outsourcing
- Price and cost certainty with periodic repayment
- Easier operation with MES supporters on site

Improved building performance with maximum energy efficiency and energy services throughout the lifecycle of the building
- Recording of energy data
- Supportive access and assistance
- Professional display of current data

Greater staff comfort, safety and productivity from integrated building management and first-class service solutions.

First-class building technology providers are characterised by first-class service. 365 days a year, 24 hours a day, anytime, anywhere...



Greater operating efficiency and sustainability with integrated and comprehensive building management

Lower risk and maximum reliability with tried-and-tested, sustainable solutions and Siemens› many years of experience

Increasing demand

- **An ageing population** increases demand
- Sharp increase in **chronic diseases**
- Better-informed and more demanding **patients/consumers** expecting convenience, comfort and service

New operating models

- **Consolidation of organisations** for increased returns to scale
- Changing **regulations and compliance** require greater transparency regarding the quality of care, the outcomes and the prices
- **Industrialisation** of operating processes with standardised diagnoses and treatments

Technical innovations

- **Internet of things**; enables technologies such as **real-time location services (RTLS)** aimed at optimising the workflow and improving productivity
- **Data analytics** and **artificial intelligence** aimed at automat-ing diagnoses and treatments and interaction with patients and visitors, and improving the support provided to staff

Finance & compliance

- Greater pressure to drive down **health-care costs**
- A sharper focus on protecting a **good reputation** and **high patient satisfaction** based on a more consumerist mentality and cost reimbursement models
- **Risk minimisation** with a greater focus on compliance and transparent processes

Patient rooms

Indoor positioning systems

A range of factors is placing hospitals under greater financial pressure. Existing infrastructures are obsolete or no longer meet modern standards relating to short patient journeys and efficient procedures. This means that many hospitals are deciding whether to rebuild. In future, the aim is to continuously monitor and track patients, doctors and nursing staff. This is partly to improve safety, avoid waiting times or improve surgery planning by showing current locations. But it is also about visualising the costs incurred with treatment. Recording movement data for people and objects means that process improvements can be made through detailed analysis, thereby improving the efficiency and finances of the units throughout the lifecycle. Tracking medical inventory makes it easier to locate equipment while significantly reducing the amount of equipment which is necessary.

Lighting for hospital rooms

Natural light varies constantly over the day and through the seasons. The colour, direction and intensity of the light all change. Daylight is the main factor controlling the timing of the sleep-wake cycle.

Immobile patients and people with dementia frequently suffer from insufficient exposure to daylight. This has real consequences in terms of sleep disorders and disorientation. Intelligent lighting and control solutions with variable colour temperatures and intensities can help to speed up recovery, improve well-being and create an atmosphere that is noticeably better.

HiMed and Total Room Automation (TRA)

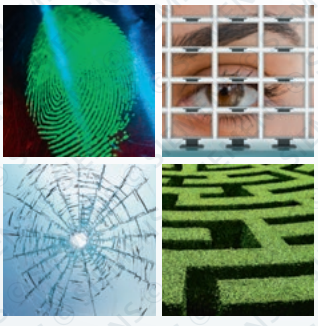
The multimedia terminal offers patients comfort in a new dimension. Apart from the entertainment and infotainment options, it allows patients to create their own ideal climate in the hospital room. For example, the multimedia terminal can operate lights and blinds and can adjust the room temperature and ventilation. The energy-efficient system monitors and controls our dedicated room control unit. This includes turning down the air conditioning if the window is opened, and switching to energy saving mode when the patient is not in the room. As a result, patient well-being is guaranteed alongside energy-efficient operation.

«Human-centric lighting» adjusts the lighting in terms of intensity as well as colour temperature – just as over the natural course of the day.

A perfect room climate can be created thanks to the interaction between continuously variable primary plants that can be controlled on a demand basis and the room automation.

HiMed and Total Room Automation

Greater comfort for patients and personnel through integrated solutions in the patient room, and room functions operated and controlled from the patient's bed.



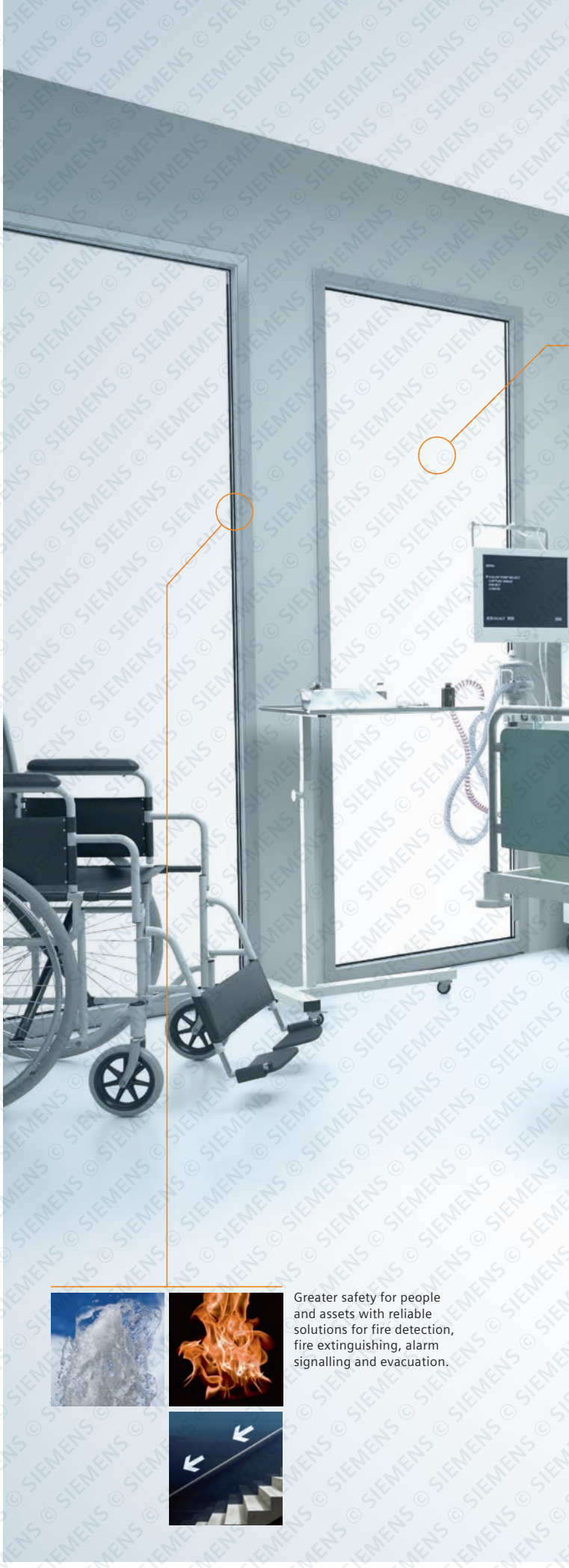
Protection of people and assets using access control, intruder alarms, patient tracking and intelligent video surveillance.

Greater safety for people and assets with reliable solutions for fire detection, fire extinguishing, alarm signalling and evacuation.

Isolation rooms

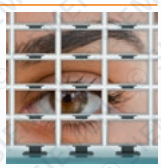
Isolation rooms are a critical environment

In isolation rooms it is crucially important that contaminated air is not allowed to escape in an uncontrolled way. This is done with efficient and rapid room pressure control combined with air locks. Our dedicated portfolio for this application consists of room air dampers, fast damper drives, sensors and controllers, and is able to guarantee the necessary room balancing. Access control systems can be added to ensure that only authorised personnel can enter the critical area. This improves safety for your patients as well as your staff. The necessary planning, configuration and realisation are included as part of the package, in addition to the solution, all from a single source.



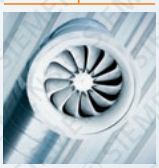
Greater safety for people and assets with reliable solutions for fire detection, fire extinguishing, alarm signalling and evacuation.

«Human-centric lighting» adjusts the lighting in terms of intensity as well as colour temperature – just as over the natural course of the day.



Protection of people and assets using access control, intruder alarms, patient tracking and intelligent video surveillance.

Preventing cross-contamination by monitoring the flow of personnel with validated access control solutions, and by using pressure and building automation systems in airlocks.



A perfect room climate can be created thanks to the interaction between continuously variable primary plants that can be controlled on a demand basis by the room automation.

Labs

A global concept for safe, cost-effective and comfortable labs

A lab is a challenging workplace with strict rules and requirements designed to protect the people working there and the wider environment. The lab solution from Siemens is a global concept for the building technology in the lab, helping you apply these strict workplace standards in a safe, comfortable and energy-saving way. The lab solution is a universal concept, allowing the various subsystems to interact – including the fume cupboard, room monitoring, primary plants and building and energy management. Control components from Siemens can be used to create VAV units which meet the highest standards of lab air handling: rapid volume flow control for the fume cupboard exhaust, and accurate and stable volume flow control for a constant room pressure. The Siemens lab solution can also be combined with other security systems from Siemens such as access control and video surveillance, early fire detection and gas detection and fire extinguishing. Total building solutions from Siemens provide you with a comprehensive product range from a single source. This optimises the interaction between building automation and danger management, improving investment security and increasing the value of the building.

Energy savings from maximum efficiency resulting from harmonisation of disparate disciplines across the building.

Protection of people, assets and the environment through gas detection.

Improved performance of the building and processes due to better energy efficiency and lower energy costs throughout the lifecycle.

Protection of people, assets and the environment using access control, intruder alarms and intelligent video surveillance.

Operating theatres

Safety and comfort in the operating theatre

In the operating theatre, the well-being of the patient is entirely in the hands of the doctor and the surgical team. Day-to-day activities are affected by heavy responsibility and extreme pressure. Our room automation plays an important part in ensuring that operations run smoothly and safely. Our solution helps doctors concentrate fully on their patients as they operate. Integrating the subsystems has the following advantages:

- Protection from unauthorized access
- Sterile zones protected from contamination thanks to automated monitoring of ambient conditions
- Maximum comfort and protection for patients and medical staff based on predefined scenarios
- Adherence to international hygiene and quality standards
- The consumption of medical gases is measured for maximum transparency and safe use
- Laminar air control for the inner and outer zone in the operating theatre
- Measurement and monitoring of microbiological air particles

Protection of people, assets and the environment using access control, intruder alarms and intelligent video surveillance.

Greater staff comfort, safety and productivity from integrated building management and first-class service solutions.

Reliable laminar flow of ventilation system.

Fulfilling GxP requirements and improving productivity with a monitoring solution based on certified sensors and particle counters for precise measuring of temperature, air humidity, room pressure and particle concentration in the clean room.

Hotel

The hotel business is in a state of turmoil, with digitalisation having an impact here, too. For example there are more and more online platforms and comparison web sites. On the other hand, this greater transparency and comparability come with certain opportunities. At present, most people search and select on the basis of free wifi or an attractive spa area, but in future people will increasingly be looking for the latest technology. For example, are there charging stations for electric vehicles or self check-in facilities? How safe is the hotel and how energy efficient is it? With greater environmental awareness and the advent of digitalisation, all these challenges can be met without difficulty. Building technology becomes an integral part of the booking process. «Room keys» are allocated online as a Bluetooth solution. Charging stations for electric vehicles are supplied by the hotel›s photovoltaic system during the day, and can be reserved at the time of booking. The hotel is made more energy efficient in a sustainable way thanks to the latest room control. The fire detection system is connected to the voice alarm system and the mass notification solution. Outages and disruptions are displayed centrally on a building management platform and can be dealt with as quickly as possible by the facility management team.

Hotel performance

- Increased competition from more hotels and private vendors
- Price pressure from online comparison tools

Safety and security

- 24/7 on site service required
- Stricter security because of the terrorist threat

Guest satisfaction

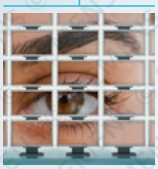
- Increasing expectations of modern technology
- Leading hotels are expected to innovate

Sustainability

- Customers are increasingly thinking green and booking green

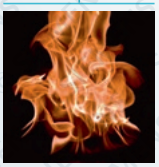
Lobby

"You never get a second chance to make a first impression." Harlan Hogan›s quote could have been written for the hotel lobby, where first impressions really do count. A green building monitor indicates real-time energy production and consumption. If these screens are combined with information about local attractions, public transport links or hotel information, they can also be used for mass notifications if an incident occurs. Pleasant lighting and an optimised room climate complete the first impression. Security has top priority, so the latest security systems make guests feel safe and sound 24 hours a day.



Video surveillance

Video surveillance with extensive analysis functions.



Fire detection

Reliable fire detection protects people and assets.

Fire extinguishing

Wet or dry extinguishing systems offer reliable protection from major damage.

Desigo CC building management platform

The Desigo CC building management platform provides a clear overview of all the disciplines.

Access control

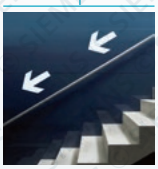
Modern entry systems can send access rights for the hotel and the room to the mobile phone even before the guests arrive (booking solution).

Room automation

Room automation for a perfect room climate.

Energy management

The green building monitor displays the current energy consumption and generation values and works well with digital signage.

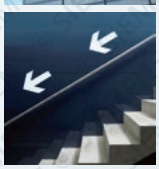


Evacuation

Voice alarms for an orderly and safe evacuation.

Room automation

Sun and shade dependent sun blind control to optimise the daylight.



Evacuation

Mass notification messages can also be displayed.

Hotel rooms

Does the guest feel comfortable and safe, and how easy is it to settle in? If the check-in process is tiresome, the room key is old and unwieldy or the climate in the room feels uncomfortable, any positive first impression can be quickly erased. This must not be allowed to happen. Modern solutions can help. The room door is opened with a modern Bluetooth solution on the mobile phone. The lighting and the room climate can be easily controlled on a user-friendly touch screen. The fire detection system is designed to rule out false alarms caused by deceptive phenomena such as steam from the shower. If there is a fire, the entertainment system automatically displays information about orderly evacuation. Guests with a visual or hearing impairment are alerted by a flashing or sounding interbase in the fire detector.

Fire detection

Fire detection meeting the highest standards. There must be no false alarms caused by steam from the shower. Sinteso detectors can be equipped with a flashing or sounding interbase, perfect for people with a visual or hearing impairment.

Access control

Access control with modern Bluetooth solutions.

Room automation

Room automation for a perfect room climate.

Room automation

Sun and shade dependent sun blind control to optimise the daylight.

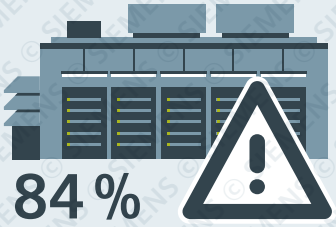
Evacuation

Mass notification messages can be displayed on the TV screen.

Data centre

Protecting critical data with maximum reliability and availability

Data centres are critical facilities for most sectors, whether they are outsourced or kept in house. Yet data centres face many different challenges – managing complex facilities, optimising energy efficiency, or complying with security and operating requirements. Protecting critical data is every bit as important as reliability and availability: our integrated, tailored solutions and services help you identify and deal with a wide range of events that might jeopardise the process continuity and profitability of a data centre, and they always follow the legal rules to the letter. Siemens is one of the world›s largest suppliers of green technologies, so it leads the field in terms of reducing CO2 emissions. Our environmental portfolio helps our customers reduce their carbon emissions by more than 300 million tonnes a year. The integrated building automation and control systems and the energy and monitoring solutions from Siemens help you save energy in your data centre.



84 %

of data centres report problems with:

- Power supply
- Space
- Cooling

57 %

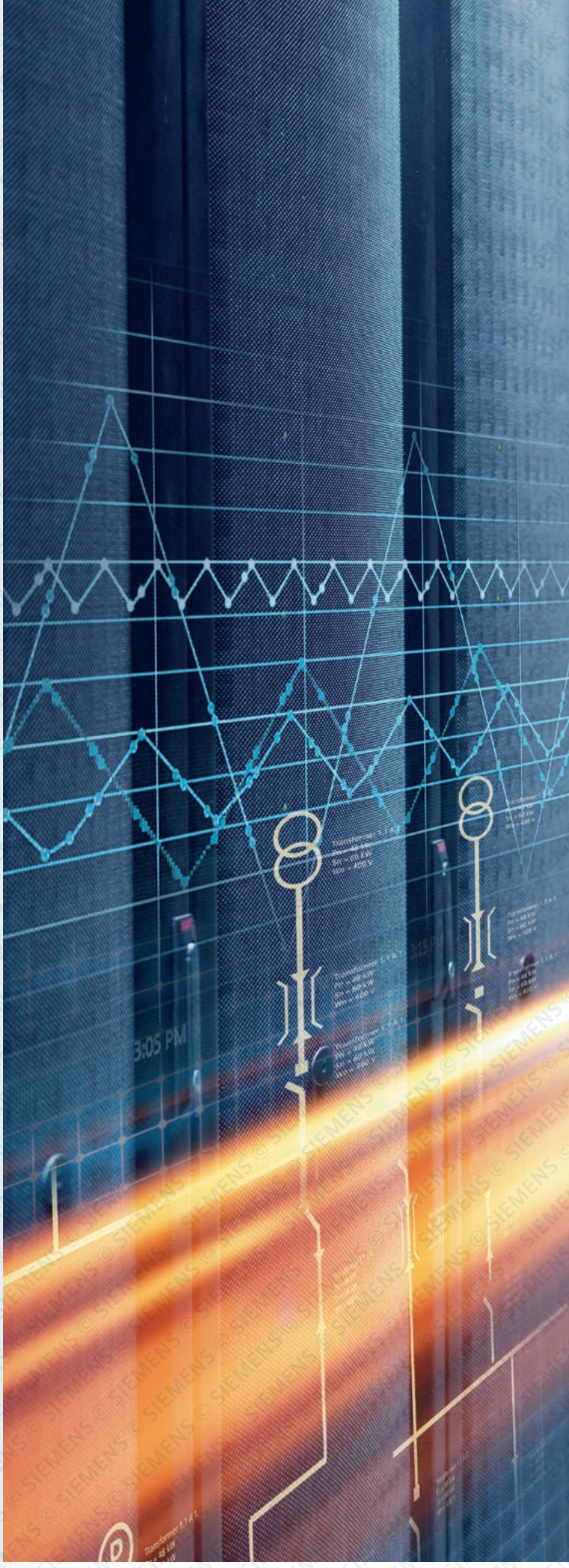
of data centre managers

think their data centre is **inefficient**

Data centres are **subject to laws and regulations**

Average cost of a one-minute outage

USD 7900




The challenges
77 % of data centres
have experienced outages
in the last 24 months
6 % of infra-
structure outages
relate to fire incidents
in the data centre
A power cut lasting
10 Millisekunden
can disrupt the entire IT operation of a data centre
Continuous protection
of data, people and assets safeguards
ongoing business processes

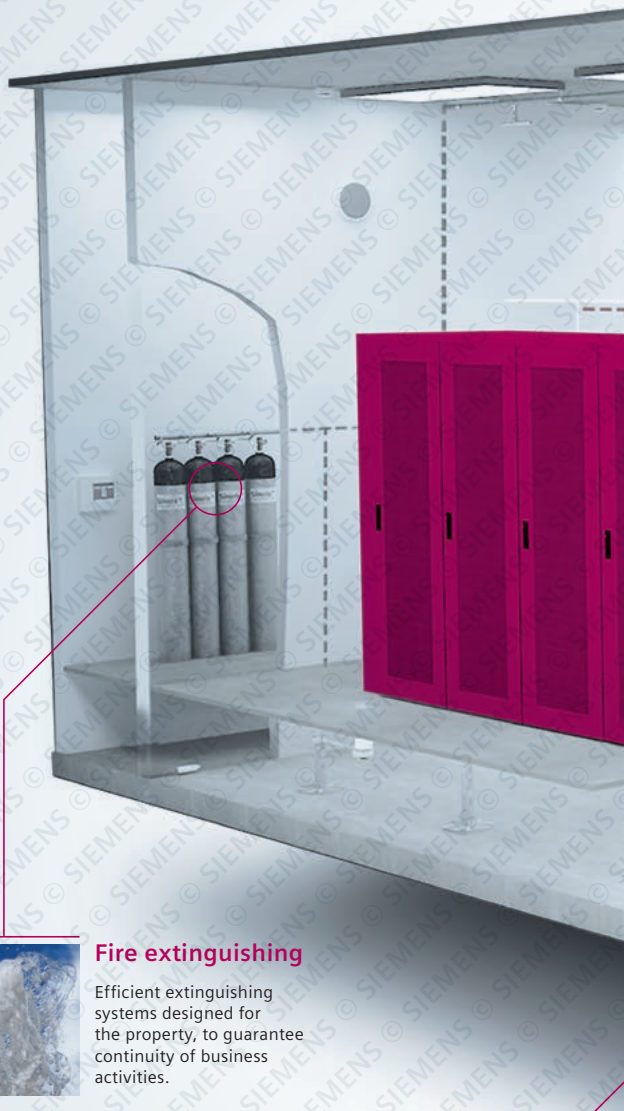
The integrated data centre – factories of the 21st century

Protecting sensitive data efficiently and securely
In today›s networked world, data centres play a key role. They house IT and building technologies of critical infrastructures which must guarantee high availability in order to protect sensitive data and to allow buildings to be run efficiently and safely.

The safe and efficient running of IT infrastructures has many similarities with traditional industrial infrastructures. So it makes sense to call data centres the "factories of the 21st century". In both environments, it is a matter of understanding typical processes and workflows, supporting them with end-to-end integrated solutions, and automating them. Here, «integrated» means that all individual subsystems are seamlessly intertwined in a technically transparent way. Siemens offers a solution-oriented approach specifically for data centres which does not focus on individual components but instead puts together a package from different components. «Integrated» can also mean that many different areas of competence must complement one another when such solutions are implemented. That is why Siemens is broadening its core competencies in building technology and energy efficiency through cooperation with selected partners from infrastructure and the field of IT, if necessary integrating their third-party products in its own portfolio of solutions. The systems and equipment used in a data centre must meet the highest availability standards, comparable to the high priority given to reliability in industrial production.

Fire detection

It is important to discover the fire as soon as possible and to start fighting it straight away.

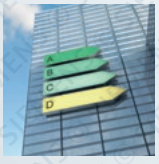


Fire extinguishing

Efficient extinguishing systems designed for the property, to guarantee continuity of business activities.

Energy supply

End-to-end solutions for secure and reliable energy supply.



Energy management

Optimised lifecycle costs with intelligent load management.

Desigo CC building management platform

Desigo CC is an integrated building management platform. The individual systems can be combined intelligently with each other through interactions spanning multiple disciplines.

Datacenter Clarity LC

Evacuation

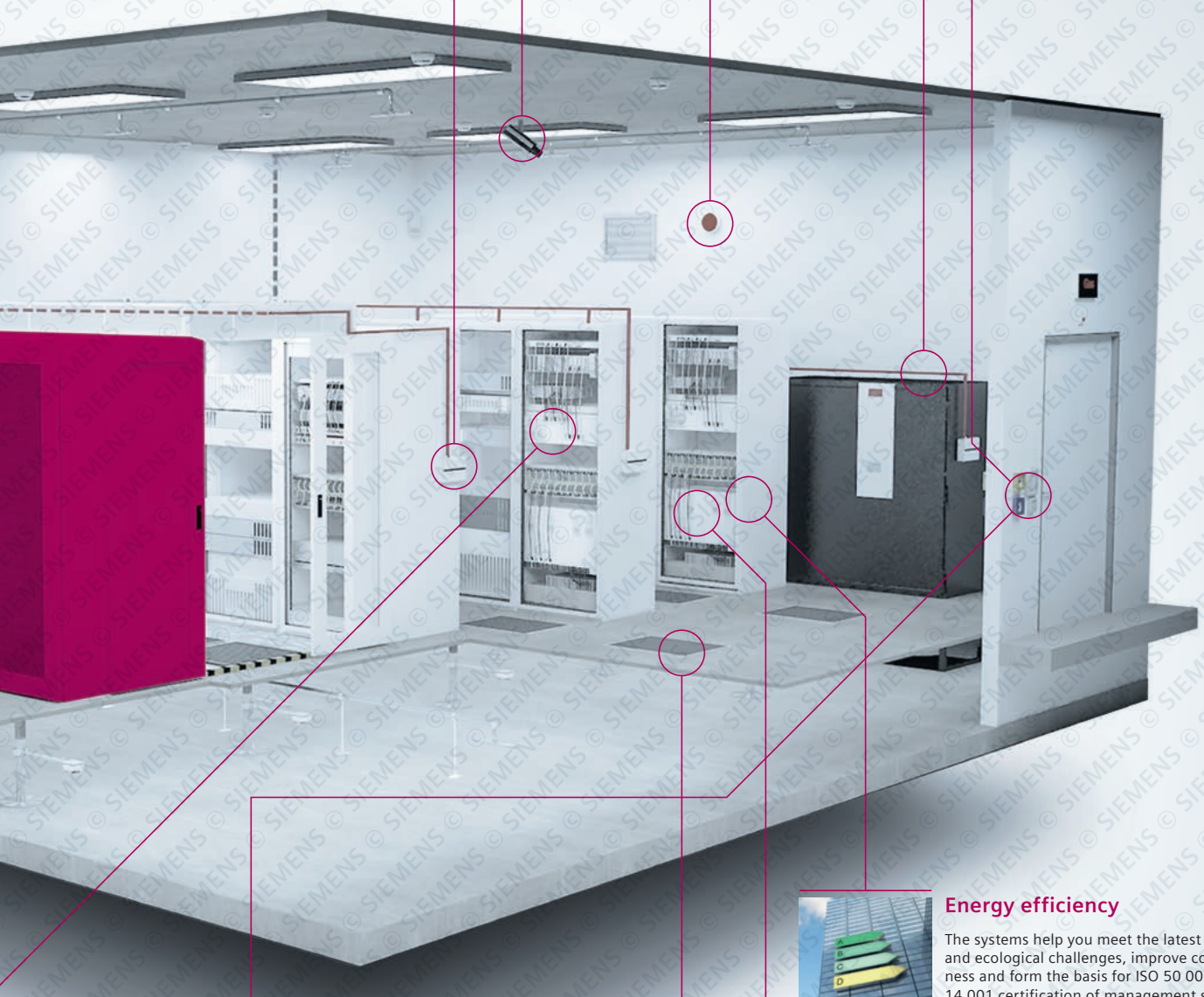
Voice alarm systems are used to directly address people in emergency situations, encouraging them to get to safety well before the rescue services arrive.

Video surveillance

Video management systems are able to analyse images in the same way as the human brain but they never get tired and keep working all day, every day.

Access control

Access control protects people, buildings and equipment, and prevents the theft of intellectual property.



Energy efficiency

The systems help you meet the latest economic and ecological challenges, improve competitiveness and form the basis for ISO 50 001 and ISO 14 001 certification of management systems.

Protection against intrusion

Comprehensive automatic discovery systems are used to protect against forced or fraudulent entry into perimeter or peripheral areas or parts of a building.

Demand flow

Optimisation strategy for water-cooled refrigeration facilities, which, by improving efficiency, can reduce annual energy consumption by 20 to 50% and increase the nominal cooling capacity.

Advantage™ services

Regular and expert maintenance, servicing and modernisation will optimise the security and availability of your facilities throughout the lifecycle, with maximum efficiency.

Building automation

The scalable, programmable automation stations are used to optimise the way all the technical facilities in the building are controlled, adjusted and monitored, and to integrate virtually all equipment.

Seamless integration – from field level to management level

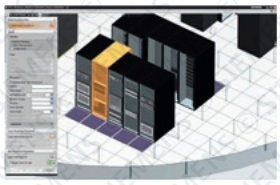
Data centre infrastructure management solutions improve efficiency and reduce costs

Data centres are frequently criticised for their insatiable thirst for energy. There are constant internal calls to improve efficiency in order to benefit from potential cost savings and also to live up to the company›s social responsibility. Efforts to reduce the ecological footprint are becoming an increasingly important factor when business decisions are being made. Software solutions help data centres improve their efficiency and reduce costs.

Datacenter Clarity LC

Datacenter Clarity LC is a DCIM (Data Centre Infrastructure Management) solution and a new addition to the Siemens portfolio for data centres. The software combines facility management and IT management. It merges information from subsystems which often used to be run separately. Examples include energy management, building management, fire protection, building monitoring, management of server racks, zones and shelves, data storage and switches and routers. On the basis of data from these subsystems, the DCIM solution optimises energy consumption and helps run data centres in a cost-conscious way.

Infrastructure lifecycle management:



- Equipment change process management
- Inventory management functions and reports
- Up-to-date, predefined IT and facility library templates
- Linking and management of IT and building assets
- Complete coverage of the energy and cooling process
- "What if" scenarios as a way of optimising the infrastructure
- Asset search
- Provides the information needed to decide the best location for physical infrastructure and IT components
- Provides a DCP (Dynamic Capacity Planning) simulation to establish the actual facility loads for different configurations of the infrastructure, and to determine the growth rate

Collaboration and process management:

- Monitors potential problems in the data centre and supports troubleshooting
- Analyses the impact of future relocations, extensions and alterations
- Allows adapted workflows to be created
- Manages project schedules, planning and resources
- Includes maintenance management
- Change requirement

Dashboard for the main key performance indicators (KPIs):

Provides quick, clear reports including:

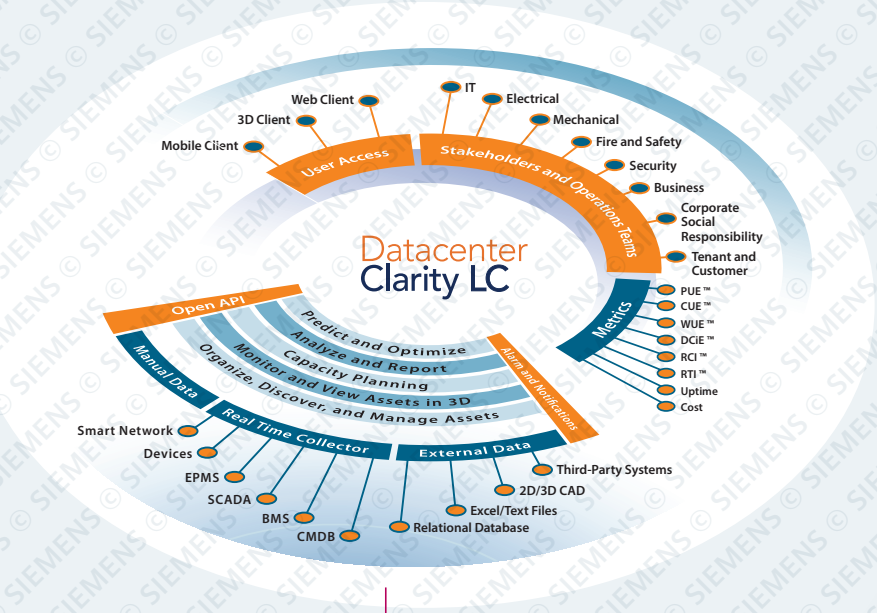
- CxO level dashboards for the company
- Detailed views for individual locations
- Metrics and KPIs
- Power Usage Effectiveness™ (PUE)
- Water Usage Effectiveness™ (WUE)
- Carbon Usage Effectiveness™ (CUE)
- Rack Cooling Index™ (RCI)
- Data Centre Infrastructure Efficiency™ (DCIE)

Cable management:

- Monitors and manages the electricity connections
- Identifies upstream and downstream connectivity
- Manages capacities and forecasts bottlenecks

Web client:

- Central access to all Datacenter Clarity LC protocols
- HTML5-based web client for multiple devices and suitable for all browsers
- Intuitive user interface for 2D and 3D navigation
- Installation as a zero-footprint client
- Asset and usage information directly in the 3D model
- Real-time temperature monitoring and display in the temperature model
- Network connections and cable management
- Management of the asset and equipment database
- User access administration
- Management of Datacenter Clarity LC configuration



Data centre infrastructure

Real-time visualisation of data centre systems creates transparency and allows building management and IT management to be combined in order to make efficient use of existing synergies.

Network management:

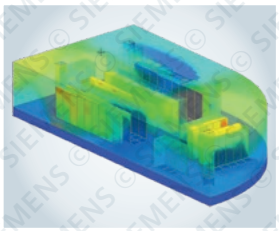
- Monitors and manages the network connections
- Identifies upstream and downstream connectivity
- Manages VLANs
- Quickly identifies the available copper and optical fibre connections
- Manages capacities and forecasts bottlenecks

Asset visualisation in HD:

Generates the main views, including:

- Overview of floor plans
- Rack units
- Dashboards for running in high-definition 4D
- Intelligent tags

CFD (Computational Fluid Dynamics):

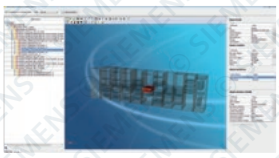


- Provides a virtual display of all air flow and heat transfer information
- Determines the most energy-efficient configuration before implementation or upgrades
- Forecasts temperature and air flow
- Identifies inefficient equipment and hotspots

Supports open interfaces and protocols:

- Supports more than 450 communication protocols
- Provides modern interfaces for IT monitoring
- Open API for enterprise software integration and adaptation
- Includes a mobile application

Real-time monitoring, alarms and notifications:

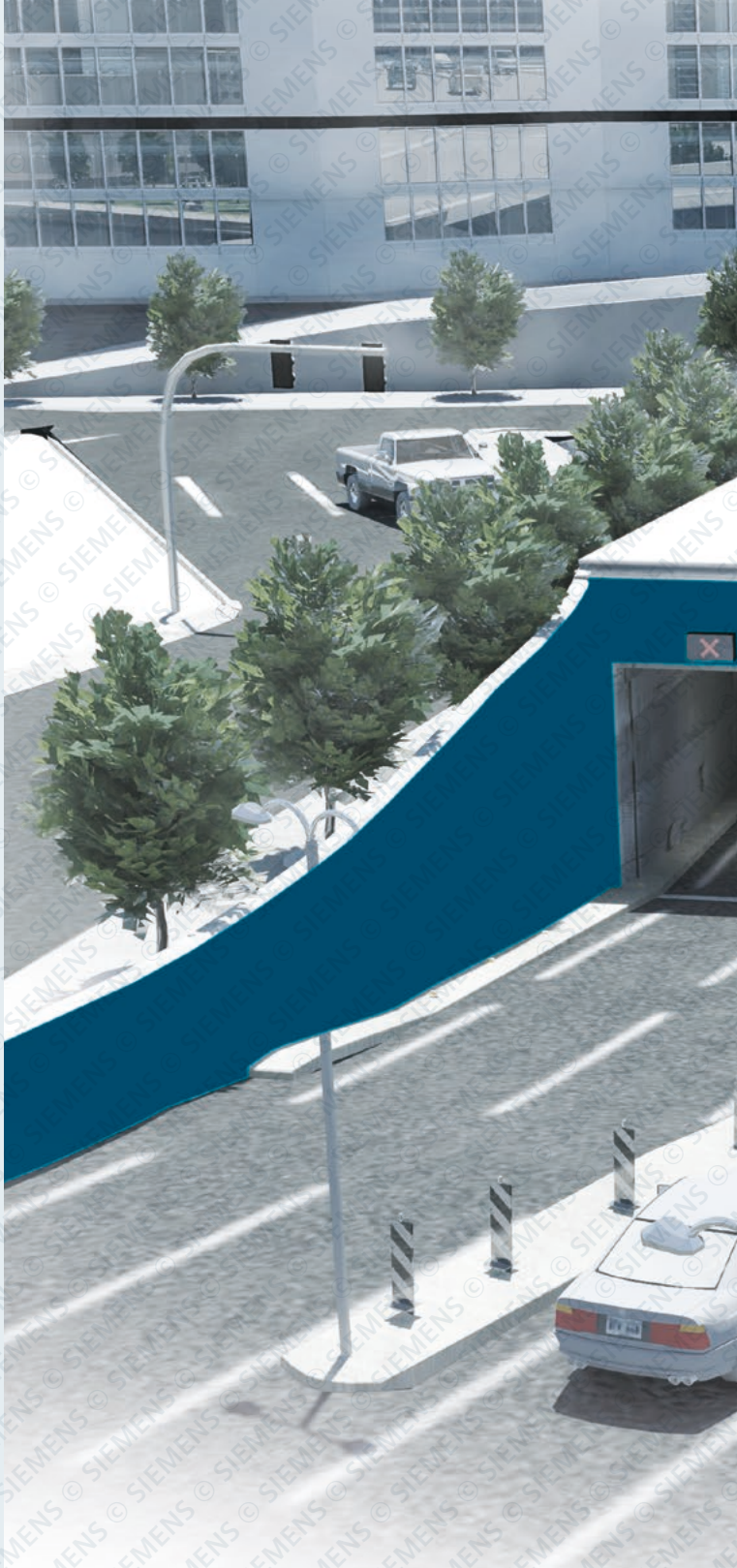


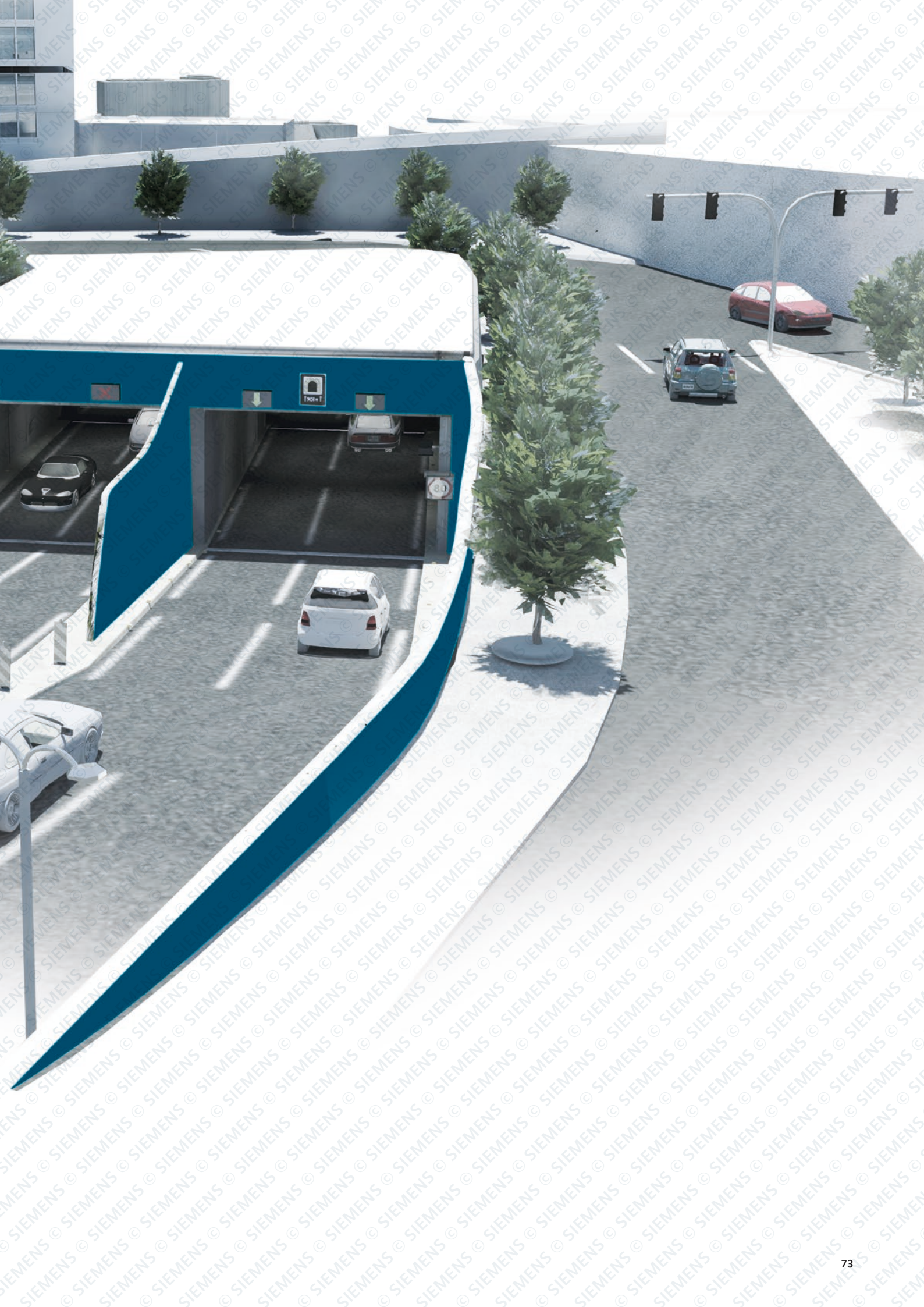
- Configurable alarms for all monitored data points of an asset
- E-mail and SMS notifications
- Automatically triggers workflows and task assignments
- Logs and documents events
- Visualises alarm events in 3D or in table form
- Monitors and records infrastructure data at the lowest level in real time, supporting intelligent analysis by expert staff
- Monitors physical security

Tunnel

Unique technologies and company-wide experience in the special structural and operational aspects of tunnels

Safety in road and rail tunnels is taking on more and more importance in Europe, mainly because of a number of dramatic accidents and fires. Apart from the loss of life, these caused serious structural damage and lengthy traffic disruption, with a significant impact on the regional economy. The priority is to effectively reduce the fire risk and the consequential damage. Studies show that the main factors are the ageing tunnel structures, changing traffic patterns and volumes, and the trend towards longer and longer tunnels in increasingly challenging urban and geological conditions. That is why a global approach is needed: safety must become a natural part of danger management processes in day-to-day operations. The Siemens solutions are based on years of experience in fire and hazard protection, evacuation and alarm systems. We make use of unique technologies and our company-wide experience in the special structural and operational aspects of tunnels. Our solutions meet or exceed the required safety standards, guarantee high availability of tunnels, and optimise the return on investment throughout the lifecycle. Tunnel safety is complex and wide-ranging: complex because structural and operational aspects inside and outside the tunnel must be taken into account; and wide-ranging because the availability of the tunnel can be increased in this way. Although the fire protection technologies used in tunnels are similar to those used in buildings, they must meet the very highest standards in terms of self-rescue and evacuation, danger management and the limitation of structural damage. These days, planning a fire protection system is much more than evaluating the technical utility of individual products and systems, because traffic patterns change constantly and volumes are increasing. Potential changes throughout the service life of the tunnel must be taken into account, as well as their impact on comprehensive control, maintenance and modernisation of the fire protection system.





The safe tunnel – comprehensive tunnel safety

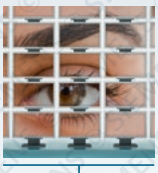
Comprehensive safety concepts support high performance and energy efficiency in tunnel operations

Efficient tunnel safety requires systems that monitor all areas with safety relevance, keep the traffic flowing smoothly, and protect people and assets. In the event of fire, overall solutions from Siemens protect all critical areas in the tunnel. Video/radar incident detection also improves user safety and optimises traffic flow. It is no surprise that they are used in so many tunnel projects – they meet or exceed European tunnel safety standards and industrial standards, and are easy to integrate into comprehensive safety concepts. The portfolio of tunnel solutions also encompasses building automation and energy distribution. These disciplines are just as important in developing an overall solution. They support high performance and energy efficiency in tunnel operations, with the right building automation, control and energy systems.

Safer inside the tunnel with reliable fire detection

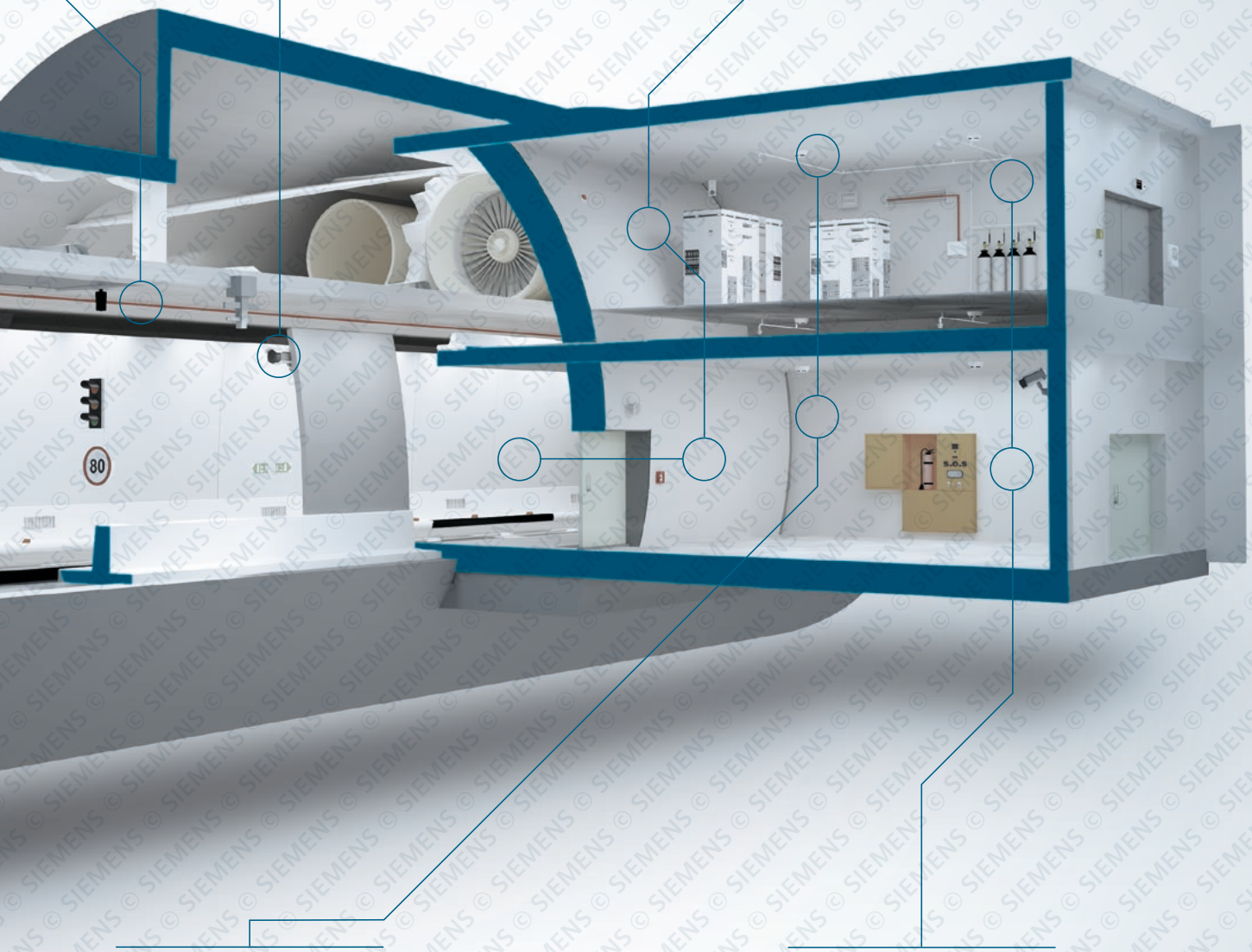
Improved safety in the tunnel portal area with radar and video

Safe, directed evacuation of tunnel users with audible alarms

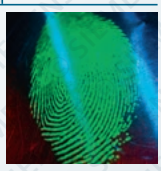


Greater traffic safety with video/radar incident detection and verification

Better ventilation and safety with integrated and energy-efficient building management and first-class service solutions



Improved safety for people and assets with reliable solutions for fire detection, fire extinguishing, alarm signalling and evacuation



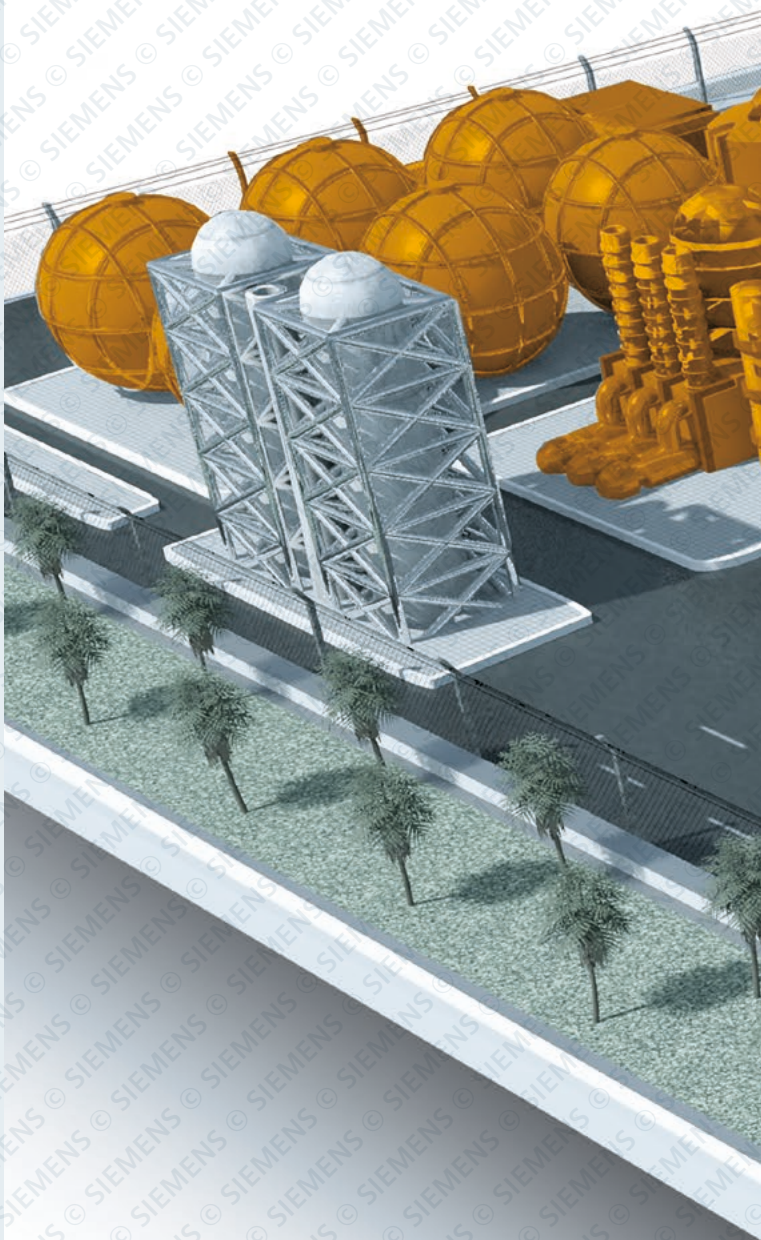
Protection of people, assets and the environment using access control, intruder alarms and intelligent video surveillance

Power utilities

Protecting critical infrastructures

Important infrastructures must be safeguarded against outages and destruction or the consequences could be serious. Siemens helps the operators of critical infrastructures define and achieve their goals in terms of protection.

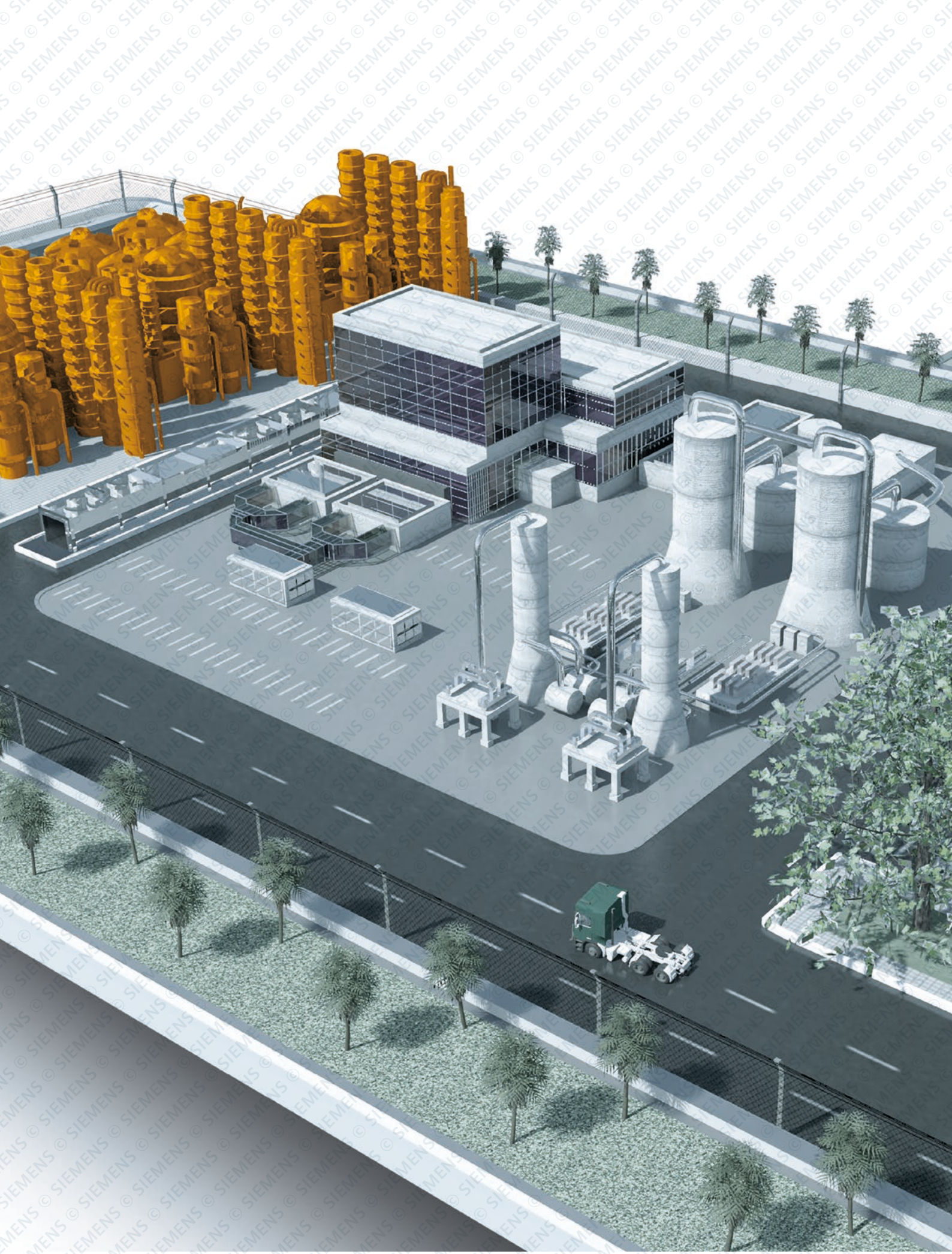
Disruptions or full outages of critical infrastructures generally have serious consequences for society, the economy and the state, and in an increasingly networked world they can quickly spread to other areas, causing shortages or significant public safety issues. Modern civilisation simply cannot do without energy or water supplies, road and rail transport, information technologies, telecommunications or banking. Yet these essentials are exposed to certain threats. Outages can be caused not only by technical failures or human error such as incorrect operation. Their importance makes them potential targets for criminals too, with major consequences because everything is so interlinked. For example, traffic flow depends entirely on the power supply and on information/communication technologies.



Safety and security

- Absolute reliability
- Guaranteed availability 24/7
- Increasing security threats

Disruptions to the energy supply can quickly spread to other areas in an increasingly networked world



Control – from one central location

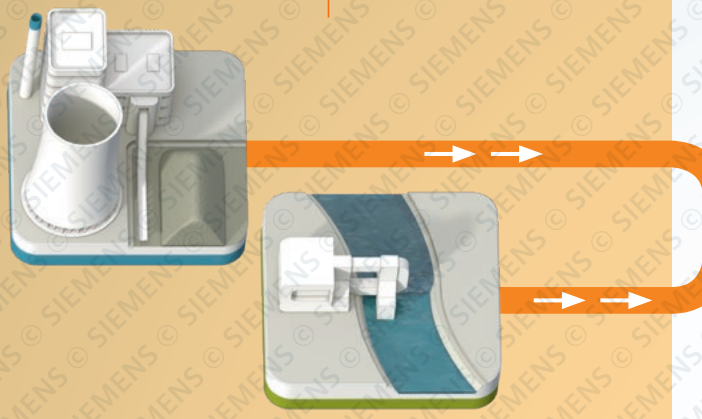
Tailored security solutions for an energy supply that is reliable and uninterrupted

These days, the industrial power and economic performance of a country are entirely dependent on a reliable supply of electricity. This is especially true for industrialised countries. Short power cuts or even just fluctuations in quality can cause serious economic harm in highly industrialised nations because modern electronic equipment and production processes such as those found in the steel, aluminium or pharma industries are extremely sensitive to any disruption. In the energy supply business, success depends on how operating risks are handled and how the uninterrupted production and supply of energy can be safeguarded in all sectors – hydroelectric, wind, solar or nuclear. With tailored security solutions, Siemens can help look after sensitive infrastructure in order to guarantee an energy supply that is reliable and uninterrupted. Systems are required which monitor all system-relevant areas reliably and thoroughly.

Reducing the risk of outage and limiting the damage if an incident occurs

For reliable electricity production it is important to have the right security solutions that meet the high standards in power plants. Comfort and energy efficiency in buildings are now also major considerations. Siemens has the necessary know-how within its portfolio, offering reliable and intelligent solutions in building automation. The Siemens solutions help to reduce the risk of outage, limit damage if an incident occurs, and restore the supply as quickly as possible. Our experienced and qualified project teams specify, design, install and maintain new systems and modernise existing systems with regard to security, fire protection, energy efficiency and low-voltage energy distribution.

Customer benefits	
Risk mitigation	Potential risks are minimised and the continuity of energy supply is safeguarded.
Greater situational awareness	Irregularities and anomalies are detected at an early stage using reliable local real-time data.
Targeted response and resource allocation	If an incident occurs, resources are deployed efficiently and outage times are minimised.

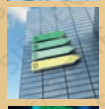


Generation


Building management

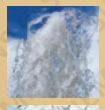

Security management system


Building automation


Energy efficiency

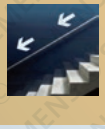

Access control, visitor management

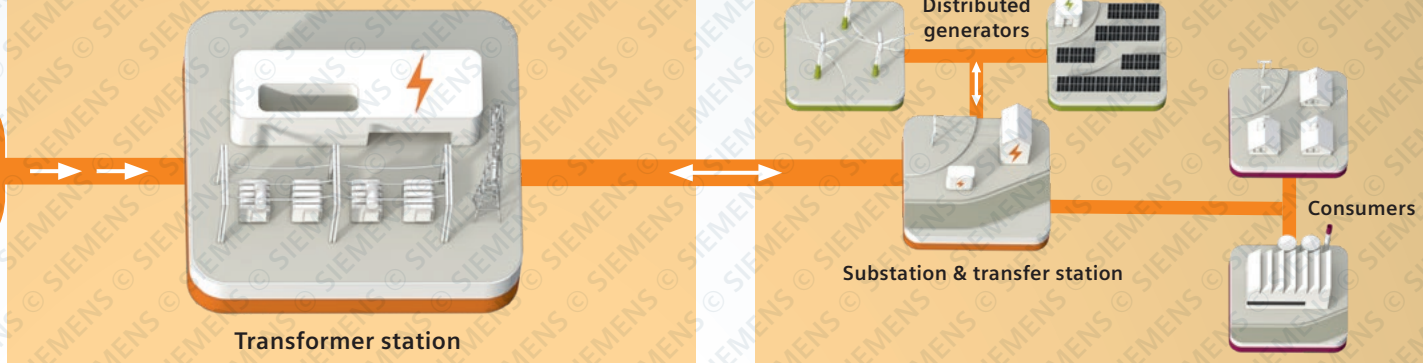

Fire protection


Fire extinguishing


Intrusion & perimeter protection


Video surveillance


Evacuation



Transmission

- Building automation
- Energy efficiency
- Access control
- Fire protection
- Fire extinguishing
- Intrusion & perimeter protection
- Video surveillance
- Tracking systems

Distribution

- Intrusion
- Video surveillance
- Fire protection

Advantage™ services

Regular and expert maintenance, servicing and modernisation will optimise the security and availability of your facilities throughout the lifecycle, with maximum efficiency.

Building automation

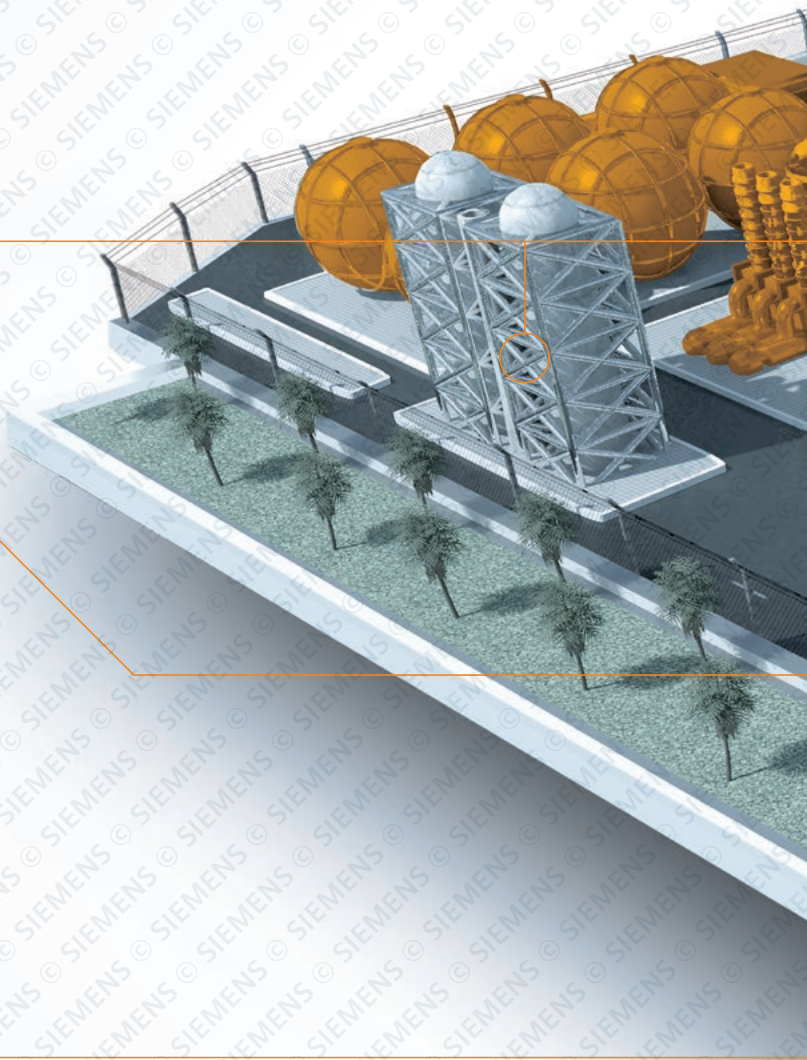
The scalable, programmable automation stations are used to optimise the way all the technical facilities in the building are controlled, adjusted and monitored, and to integrate virtually all equipment.

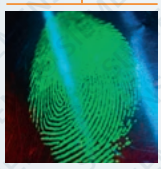
Protection against intrusion

Comprehensive automatic discovery systems are used to protect against forced or fraudulent entry into perimeter or peripheral areas or parts of a building.

Video surveillance

Video management systems are able to analyse images in the same way as the human brain but they never get tired and keep working all day, every day.





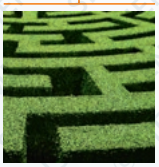
Perimeter protection

Sensor information intelligently combined

In the end, one thing counts above all: perfect networking. A global concept protects areas outside and inside the perimeter fence and consists of individual protections such as fence, infrared, microwave, laser or radar sensors all working in synergy to achieve the defined protection goals.

TIP

End-to-end solutions for secure and reliable energy supply.



Tracking systems

Tracking systems to protect people and assets.

Desigo CC building management platform

Desigo CC is an integrated building management platform. The individual systems can be combined with each other through interactions spanning multiple disciplines.

Fire extinguishing

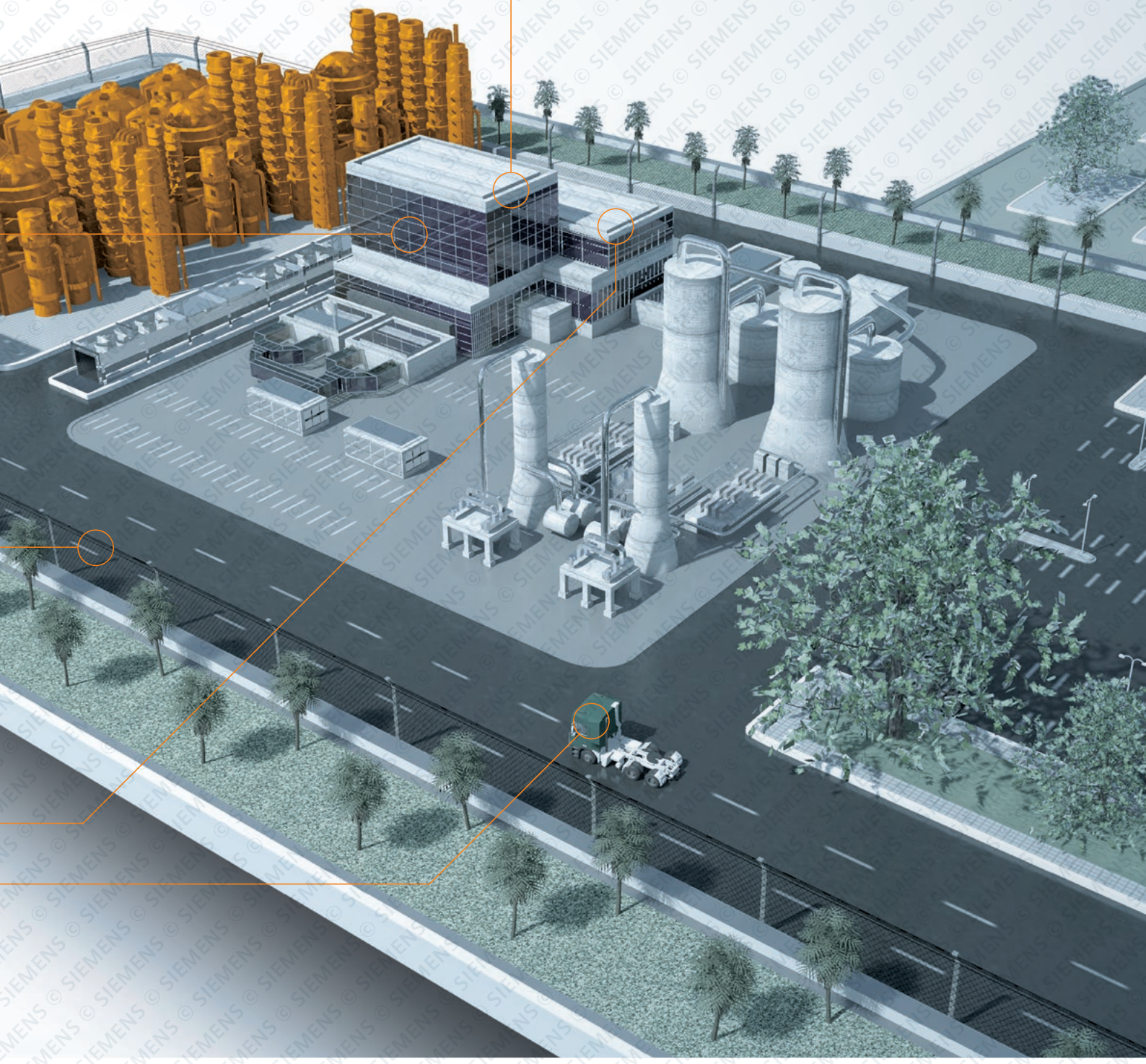
Efficient extinguishing systems designed for the property, to guarantee continuity of business activities.

Fire detection

It is important to discover the fire as soon as possible and to start fighting it straight away.

Access control

Access control protects people, buildings and equipment, and prevents the theft of intellectual property.



Premium offices

The office building of the future – intelligent, networked and adaptable

The digital transformation has now reached virtually all parts of the economy, and is driving new trends and technologies in building technology too. This is already affecting the way the buildings of the future are planned, constructed, used and managed. Networking the various subsystems creates added value at the highest level. This means that an intelligent building gives users the impression that facilities are responding physically to their particular needs.

CO_2 tracking

Energy consumption is a good example of the potential of digitalisation: Buildings account for over 40% of global energy consumption. Multinationals already ask for CO_2 tracking certificates in order to comply with their published guidelines. Data is constantly available to the building operator, helping to create full transparency and to keep track of energy consumption and CO_2 emissions. If necessary, optimisation or modernisation measures can be implemented immediately.

Forward-looking solutions for your business success

Room management and indoor positioning are no longer just buzzwords – they are now a reality. Building users can use their mobile devices to search for vacant meeting rooms, book them and even find them easily with indoor positioning. The mobile phone can take the user straight to the booked room like GPS. This saves time as well as money, and boosts user satisfaction.

Safety and security around the clock

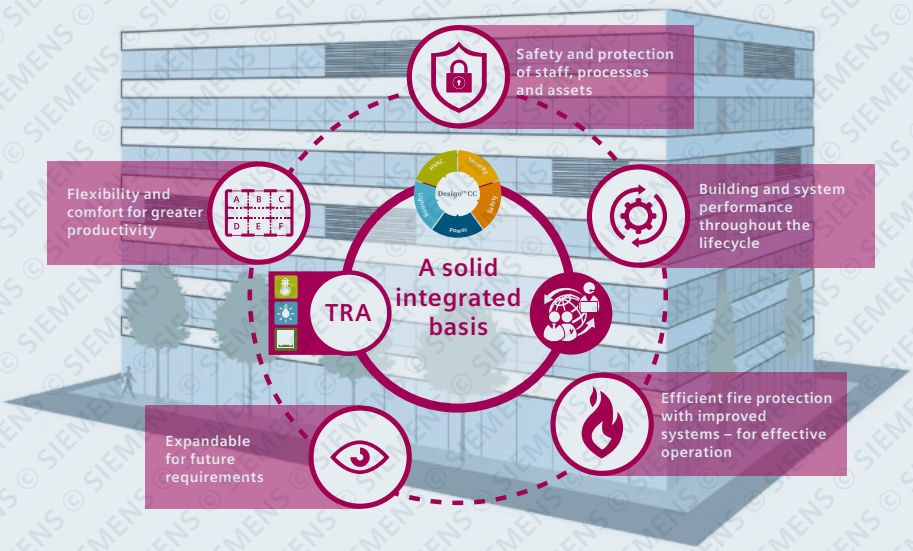
Security is becoming increasingly important. Premium offices stand out because they have prestigious and secure entrance and reception areas. Authorised personnel must have guaranteed access 24 hours a day. Malfunctions can quickly have serious financial consequences. Conventional badge-based entry solutions are combined with facial recognition in order to meet higher security standards. People counters can help ensure that everyone has managed to exit the building in an evacuation. It is therefore particularly important for all these systems to work together reliably

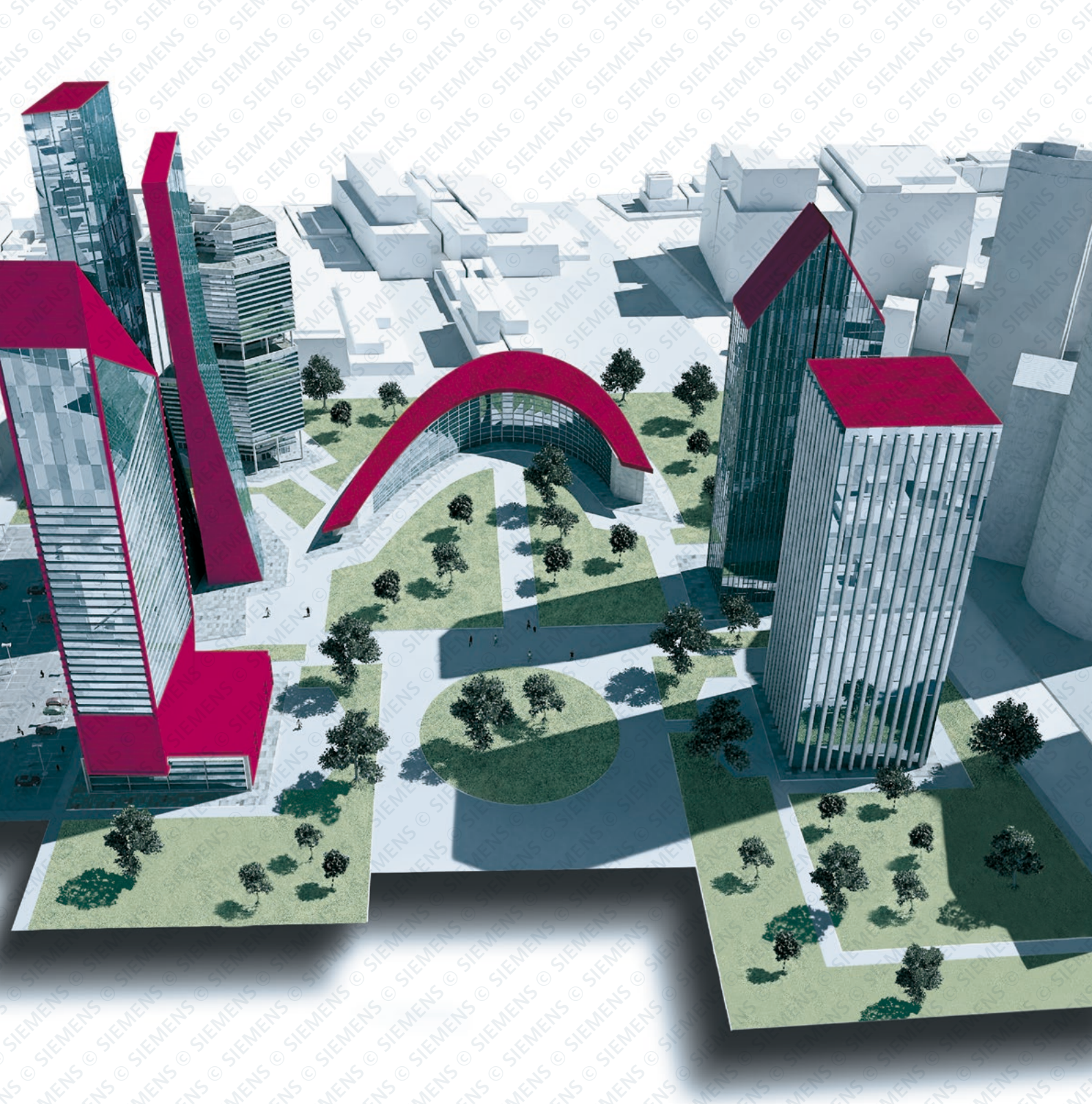
Perfect room automation makes employees more productive

Studies have shown that perfect conditions in the room can boost the well-being and productivity of employees. The interplay of daylight and artificial lighting is just as important as temperature and air humidity. The most important thing is that all these systems must be perfectly coordinated with each other. Artificial lighting is only needed if there is not enough daylight. An annual shading solution can help, calculating the shadows cast by surrounding buildings and including them in the blind and lighting controls. The blinds are only closed when the sun becomes a problem for users inside the building.

The control of heating, ventilation, air conditioning, energy and security systems across all subsystems is an important part of future-proofing your building. A range of factors is taken into account, including high occupancy rates or a steady increase in value thanks to cost-effective and problem-free operation and a productive, pleasant and safe work environment for users.

Our expertise across all subsystems and years of experience in building technology mean we can help you run your building safely, intelligently and efficiently.





Flexibility and efficiency

- Flexible rental spaces with adaptable building technology
- Maximum efficiency
- OPEX reduction with intelligent building technology
- Cost-effective and problem-free operation

Safety and security

- Absolute reliability
- Guaranteed availability 24/7

Laws and regulations

- CO_2 tracking

Entrance and reception area

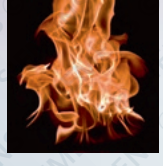
For many companies, the entrance and reception area is part of their calling card. As such, the entrance should give a professional impression. The visual appearance helps determine the first impression. The climate also plays an important part. Visitors are left with a bad impression if it is too cold in winter or too warm in summer.

That is why room automation is so important. A green building monitor is great way of displaying energy consumption. It can help to boost the company›s image, underlining and consolidating the values of the first impression.

Most companies take security extremely seriously. Reliable protection must be provided for people as well as assets such as cash, research results, etc. Guaranteed security must be provided 24 hours a day. Protection from break-in, unauthorised access, fire or panic during a disaster must be given top priority.

Badge readers, palm vein scanners and facial recognition ensure that at all times, only authorized individuals are given access.

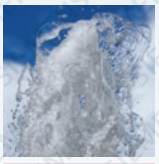
Room automation creates a perfect room climate.



Alarm call points can be used to trigger a manual fire alarm.

People counters with barriers that admit only one person at a time mean you know exactly how many people are in the building at any one time.

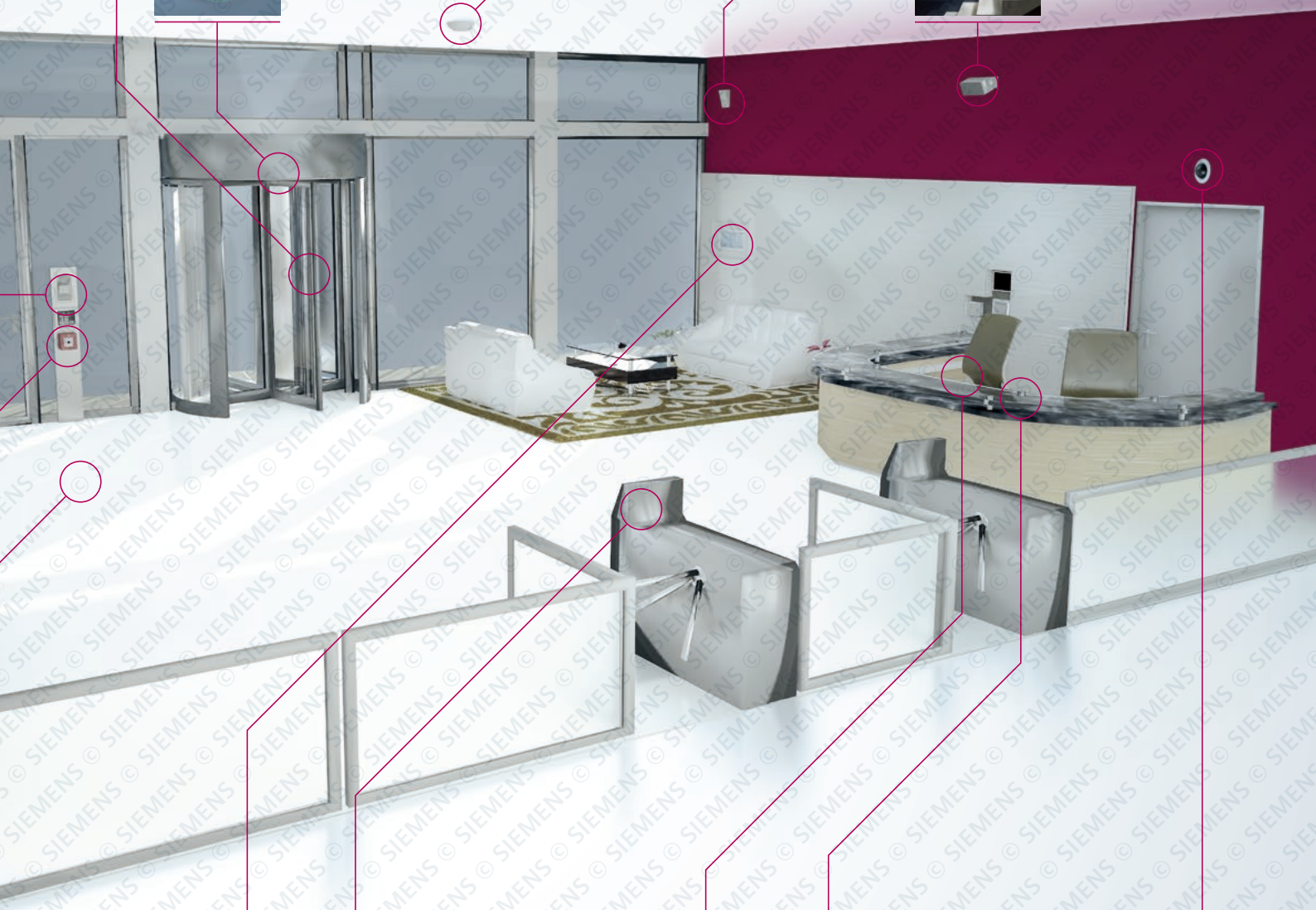
Reliable fire detection protects people and assets.



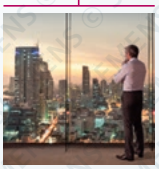
Wet or dry extinguishing systems offer reliable protection from major damage.

Escape route lighting helps people evacuate safely.

Voice alarms ensure there is an orderly and safe evacuation.



Access control is based on badges and vein scanners.



The Desigo CC building management platform provides a clear overview of all the disciplines.

If an evacuation is necessary, mass notification can efficiently guide people to a safe area or outside.

The video surveillance system is equipped with comprehensive analysis functions.

Office and meeting rooms

We spend almost 10% of our life at work. So we obviously want to make the climate at work as pleasant as possible. Heating, cooling and humidity must be just right, and the lighting should reduce work-related fatigue and use as much natural daylight as possible. Current room automation solutions take full account of all these aspects. The heating, cooling, daylight and artificial lighting all interact automatically in a way that feels natural.

Annual shading solutions take account of the shadows thrown by surrounding buildings and only adjust those blinds which are exposed to direct sunlight. The artificial lighting matches its colour temperature to the sun›s natural position. Less light tends to be required in the morning and evening, but the light is warmer. During the day, however, a large amount of «cool» lighting is required. This mimics the natural progress of the sun.

Features such as room management and indoor positioning can also positively influence a company›s image. A company is perceived as modern if it moves with the times and wants to plug into the modern digital world. Indoor positioning is used to guide staff and visitors straight to the right place. There is no need to waste time looking for meeting rooms, think tanks, printers, etc. If meeting rooms are vacated early, they become available again instantly. Mobile devices are used to search and book.

Safety, one of the most fundamental human needs, must not be forgotten amongst all this comfort and convenience. Fire detection, voice alarms and mass notification are important in this connection. The larger the building and the bigger the workforce, the more confusing the situation can become in an emergency. Those affected need to be evacuated straight to a safe area without losing grip of security in general. Access control, protection against intrusion and video surveillance are crucial. You can keep everyone safe with an intelligent building management system like Desigo CC.

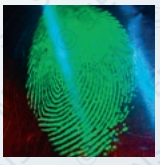
«Human-centric lighting» adjusts the lighting in terms of intensity as well as colour temperature – just as over the natural course of the day.

Sun and shade dependent blind control to optimise the daylight.

A perfect room climate can be created thanks to the interaction between continuously variable primary plants that can be controlled on a demand basis and the room automation.

Reliable fire detection protects people and assets.

Room management systems make it easy to book meeting rooms. Access is via a Bluetooth solution or a badge.



If an evacuation is necessary, mass notification can efficiently guide people to a safe area or outside.

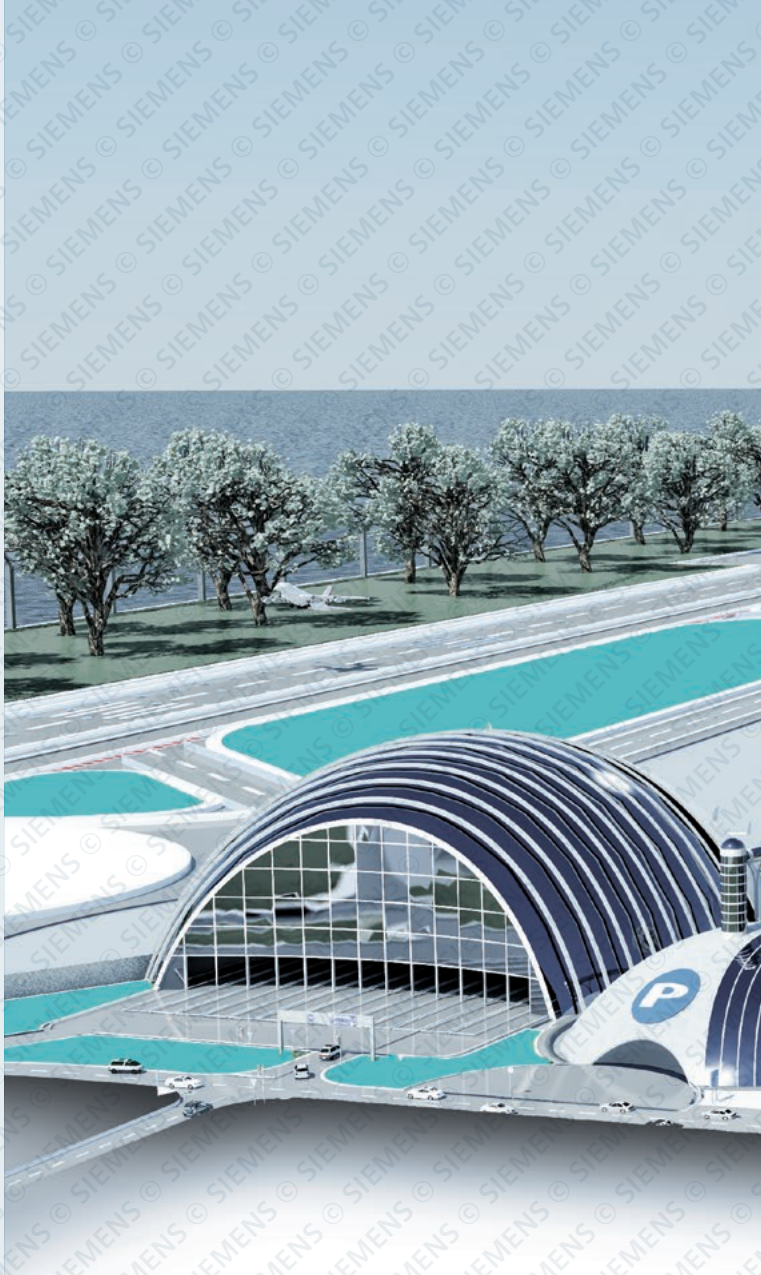
Indoor positioning helps users locate printers, copiers or coffee machines.

Airport

Airports face many different challenges in order to succeed in the market. Airlines pass on price pressure to the operators while asking for more and more. The authorities enforce compliance with international security standards. Other challenges include reducing CO_2 emissions and other environmental imperatives.

The many passenger types have different needs in terms of airport infrastructure. Business travellers, commuters, holiday makers and different ethnicities from various cultures must all feel at ease in order to generate maximum revenue from shopping, catering and other activities. The well-being of passengers is directly influenced by the security and safety activities, which must be seamless and work perfectly in order to give everyone confidence that their journey will be a safe one.

The portfolio of Siemens Building Technologies encompasses the main areas of passenger handling, security, building automation and energy optimisation for a successful airport. The diverse products and systems can be integrated with core airport processes such as passenger or security processes, enabling flexible and efficient digitalisation for the airports of tomorrow.



Airport performance

- Increased competition
- New business models
- Higher passenger volumes
- Increasing air freight volumes
- Raw materials and energy prices

Safety and security

- Operational reliability, a security essential
- Greater security risks
- High security awareness resulting from terrorism, pandemics and natural disasters

Customer satisfaction

- Changes to the customer experience
- Greater brand awareness
- Digitalisation and mobilisation
- Customers expect stress-free travel without unnecessary waiting times

Compliance

- New laws and regulations
- Higher standards of protection and security
- New environmental rules

Check-in

With the airside completely sealed off, the potential hazard has been largely displaced to the landside. Video systems are only able to record or detect certain objects with standard analytics. As active protection, they only have limited usefulness in preventing attacks.

In these areas it is therefore necessary to enhance security without extra checkpoints and queues, which in themselves can become potential targets.

Additional measures can provide important clues enabling early detection of threat scenarios while complying with data protection law. Such measures include automated wanted list checks, number plate recognition when cars arrive, or walk-through scanners at the entrances.

These measures must not impair the passenger›s travel experience and must blend into the surroundings as attractively as possible.

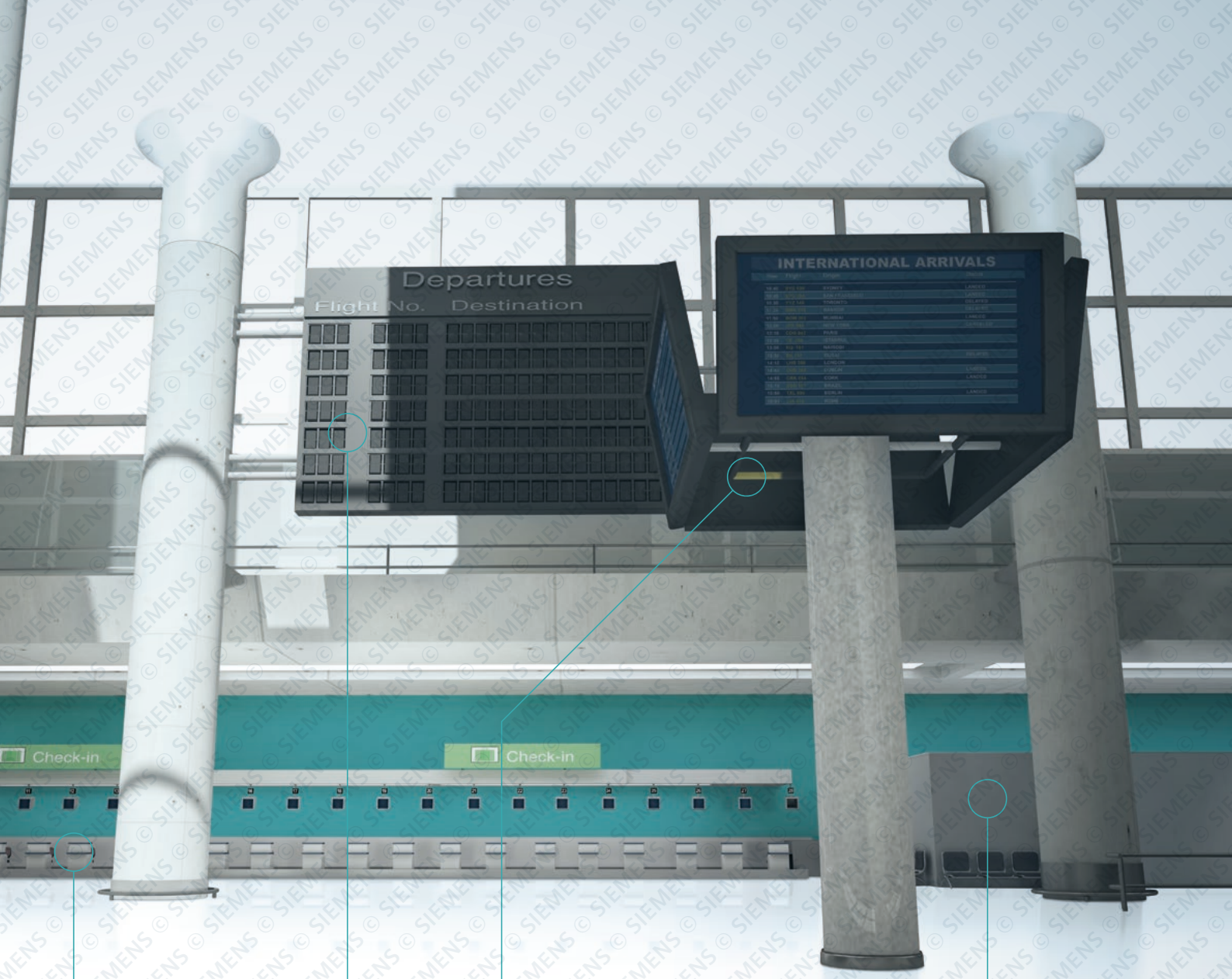
The trend towards replacing the boarding pass with biometric alternatives offered by appropriate technology should also be exploited to make the passenger experience more pleasant and more secure.

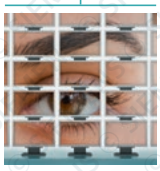
Desigo CC

Maximum protection combined with energy-efficient and comfortable control of the building infrastructure.

Biometric boarding pass

Siemens has been using palm vein scan technology in the airport environment for years, the only technology that incorporates the necessary accuracy, user-friendliness, protection from misuse, and data protection.





Automatic wanted list check

Inconspicuous, comprehensive, automatic surveillance of the airport area for early detection and discreet isolation of people who may be a threat to public safety.

Announcement and evacuation systems

Information for passengers must be comprehensible and relevant whatever the circumstances. EN 154 certified systems also ensure that evacuation takes place safely and in accordance with the regulations.

Walk-through detection

Automated searches for weapons or explosives at entrances, integrated with the other airport security systems, allow early detection of potential hazards.

Screening and scanning

The length of queues and the attractiveness of the surroundings at security checkpoints form part of an airport›s calling card and they directly influence passenger satisfaction.

With tighter regulations and more equipment, the complexity and the space required for the screening process are challenges for airport operators. Costs and logistics are day-to-day issues for the operator. The ever-higher standards imposed by the authorities require continuous adaptation and staff training. For example, the EU authorities plan to end the requirement to unpack hand luggage and to lift the ban on liquids in the foreseeable future.

Other checks include complex hold baggage checks in the baggage handling system, and staff checkpoints.

Scanning and screening carry-on bags

Efficient checking of hand luggage by CT-based systems and remote screening solutions allow for high throughputs and greater security, even against insiders. Automatic alarms and TIP (Threat Image Protection) support the operating personnel. Solutions meet existing or announced regulations (EDS CB1 -3, LED, etc.).

Room climate and ambience

Integrated control means that the lighting and climate in the waiting area can be optimised to help create a relaxed atmosphere.

Scanning and screening hold bags

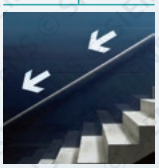
Checked-in luggage or transfer luggage from unsafe third countries undergo intensive checking as part of the automated luggage sorting process.
The new EU regulations (EDS 3) require changes to be made to most luggage sorting equipment.
The new EDS 3 based systems reach working speeds of up to 1800 bags/h and support remote screening and various different processing levels. CT technology means they are futureproof and easy to adapt to new requirements with the relevant diagnostic software updates.

LED (Liquid Explosion Detection)

Used to check liquids.

Announcement and evacuation systems

Relevant information or pleasant announcements can make the waiting times seem shorter and boost passenger well-being. EN 154 certified systems also ensure that evacuations take place safely and in accordance with the regulations. Combined with voice synthesisers, targeted information can be directed to specific passenger groups.



Security gates

Mm-wave security gates are able to detect explosives or prohibited items concealed on the body. The privacy of the person being checked is of course respected.

Check-in and shopping

Comfort and safety solutions from Siemens can create a pleasant climate and maximum security

In modern airports, the check-in area is now the start of the shopping experience. Voice announcements are increasingly being automated as a way of providing information or drawing passengers› attention to important points. In holiday periods especially, the large volume of passengers needs to be processed safely and efficiently. Siemens comfort and security solutions can do this. We offer a range of security disciplines for maximum security. The passengers must be given a feeling of comfort and safety at all times. Comfort solutions provide attractive lighting and control the climate so it always feels pleasant. Energy optimisation is always kept in mind.

Fire detection and automatic fire extinguishing systems provide constant protection for people and assets.

Coordinated sun protection systems and artificial lighting are controlled intelligently, keeping lighting levels constant at all times. Intelligent systems also block the heat on warm days and store it when it is cold.

Video surveillance is a versatile discipline because of the software used for video management systems: People flow measurement, detection of unattended bags or people behaving suspiciously, searching for particular individuals or items with «forensic search».

Heating and ventilation help create a pleasant and suitable room climate, and the ventilation system protects people and animals from smoke inhalation.

Voice alarm systems are not just used to issue valuable instructions in an emergency, they can also be used to make announcements for passengers or play background music and advertising messages.

Walk-through detection

Access control solutions do not inhibit the flow of people. They can control the actual "throughput" and divert people if necessary. The latest readers – biometric recognition or conventional badge or code readers – allow authorised personnel to access certain areas.

Boarding infrastructure

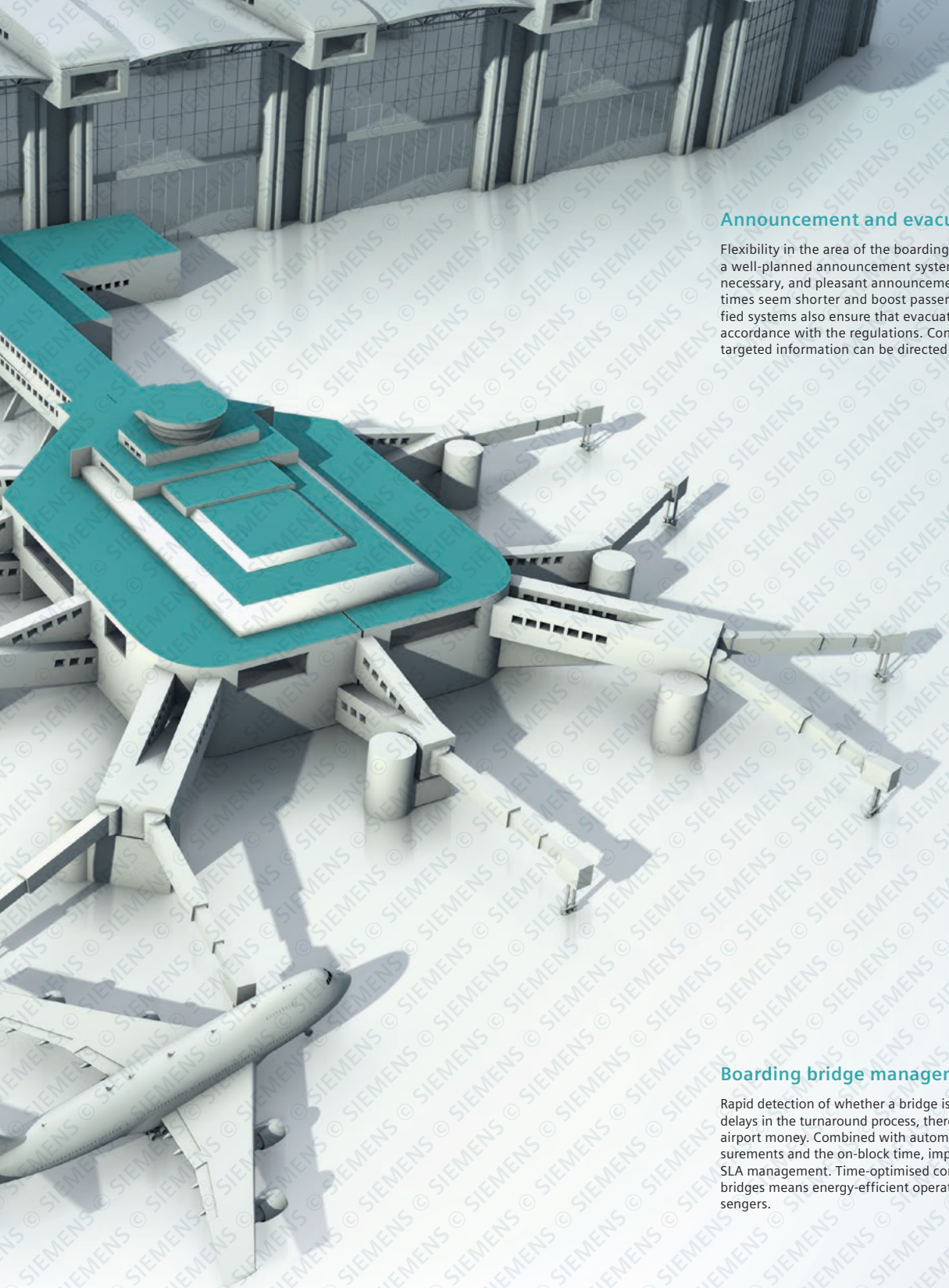
The building infrastructure has become much more complex in order to allow rapid boarding/deboarding and transfers in spite of all the security rules.

Intelligent solutions are needed in order to manage up to 30 different passenger types, and handling processes must be integrated. Meanwhile, data about achievement of SLAs between airlines, ground handling and the airport must be made available to the relevant business administration automatically.

Gate agents should be focused on the needs of passengers rather that managing the technology, the passengers must feel relaxed, and they must be guided smoothly in and out of the plane.

Boarding passenger guidance

In order to optimise costs and improve passenger comfort, the infrastructure must be controlled in a way that assists the handling process, for example through the automation of doors, escalators, lifts, lighting, etc. This kind of control also means the boarding area can be used flexibly while adhering to strict security standards.



Announcement and evacuation systems

Flexibility in the area of the boarding gates is only possible with a well-planned announcement system. No more information than necessary, and pleasant announcements, can make the waiting times seem shorter and boost passenger well-being. EN 154 certified systems also ensure that evacuations take place safely and in accordance with the regulations. Combined with voice synthesisers, targeted information can be directed to specific passenger groups.

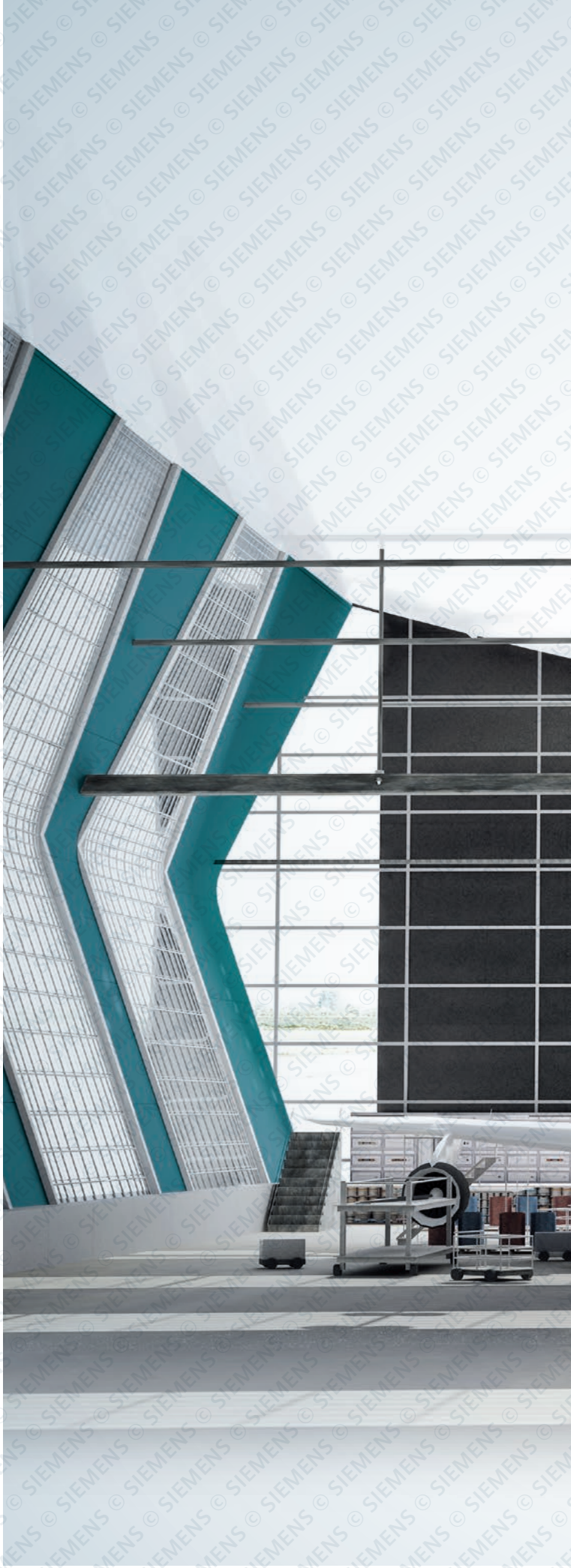
Boarding bridge management

Rapid detection of whether a bridge is ready for docking can prevent delays in the turnaround process, thereby saving the airline and the airport money. Combined with automated energy consumption measurements and the on-block time, important data can be provided for SLA management. Time-optimised control of climate, lighting and the bridges means energy-efficient operation which is pleasant for passengers.

Freight and maintenance hangar

Tailored solutions for challenging areas

Siemens also provides tailored solutions for areas which do not normally contain passengers. For example, the requirements of a fire detection system or an automatic extinguishing system are completely different in a maintenance hangar and in a freight area. The stringent requirements are defined by the single-span hall construction and the large amounts of kerosene. Access to these areas is also subject to special security requirements. After all, the security rules in the freight area and in maintenance hangars are extremely strict. Absolute security must be given top priority.



The giant wing spans of passenger aircraft require single-span hangers, which in turn present unique fire protection challenges.

Aspirating and laser systems guarantee reliable detection, and foam extinguishing systems are ready to deal with an emergency.

Authorised personnel are free to enter, but access and video surveillance systems block access for everyone else except fire and rescue services, which have guaranteed access at all times.

Tank farm

Airports run major infrastructure whose function and security are crucially important to operations.

Tank farms require particular attention. Sabotage or technical issues can quickly turn into runaway disasters, making it impossible for the airport to operate as normal. That is why early detection and automated fire fighting are so important.

It is equally important, however, to check who enters and exits the area, without fences or classic access controls.

Desigo CC correlates warning and alarm indications, works with the fire detection system to control the extinguishing equipment, and provides the emergency service with an excellent overview of the situation

Ground radar scans the security zone for intruders, correlating the data with an accurate 3D personal tracking system that locates authorised individuals or vehicles within the zone. The security devices also track the emergency services as they work, sending current locations back to the command and control centre.

If an incident occurs, fully or semi-automatic extinguishing systems immediately put out the fire with extinguishing foam or cool the area with water.

Specialised Ex-proof detectors sense critical situations at an early stage. Video and thermal cameras or linear detectors are able to locate critical areas and provide an overview of the situation.

Electrical cabinets and pump rooms can also be protected with Sinorix or other gaseous fire suppression systems.

SIEMENS

Ingenuity for life

BPS – Building Performance and Sustainability

buildingtechnologies.siemens.com

3.1. Introduction	106
3.1.1. Background and definitions	106
3.1.2. How do energy efficiency measures work?	107
3.1.2.1. Efficiency measures in existing buildings	107
3.1.2.2. Increased efficiency in new builds	108
3.1.3. Establishing energy and sustainability management	109
3.2. Transparency	110
3.2.1. Collecting data	110
3.3. Optimisation	111
3.3.1. Cutting costs and reducing emissions by increasing efficiency	111
3.4. Modernisierung	112
3.4.1. Installation of occupancy sensors and constant lighting control	112
3.5. Finance	113
3.5.1. What is energy-saving contracting?	113
3.5.2. General procedure	113
3.5.3. Financial assistance	113
3.5.3.1. CO_2 levy on fossil fuels	113
3.5.3.2. Cost-covering feed-in tariff	114
3.5.3.3. ProKilowatt: Promoting electricity efficiency	114

Use Case	116
Building Performance & Sustainability	118
How can buildings become perfect places?	120
Our ongoing holistic approach	126
Data collection and transparency	128
Smart modernisation	132
Extensive advisory services	134
Attractive financing models	135

3.1. Introduction

3.1.1. Background and definitions

These days all kinds of organisations and companies are confronted with the challenge of lowering their operating costs and deploying resources more efficiently in order to remain competitive. Moreover, reducing harmful emissions is vital both to protect the environment and slow the progression of climate change. Buildings and their associated infrastructure offer considerable potential for reducing emissions. In Switzerland, buildings alone are responsible for 46 % of total final energy consumption. Energy usage typically accounts for around 32 % of the lifecycle costs of a building.

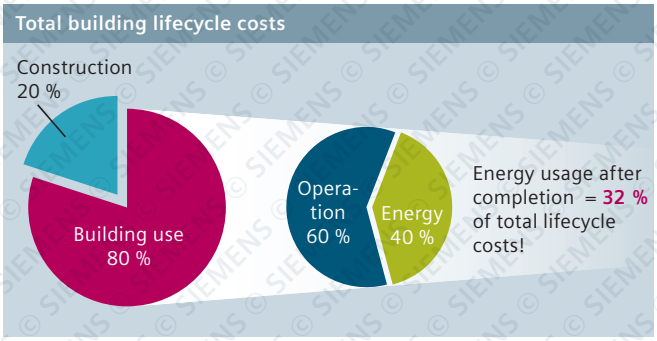


Fig. 3.1: Lifecycle costs of a building

Buildings also generate significant CO_2 emissions. The industry and services sectors are responsible for 29 % of Switzerland's emissions, primarily due to energy consumption in the manufacture of goods and for heating industrial premises and offices. Private households contribute around 20 % to emissions for space heating and domestic hot water. Buildings also generate large amounts of waste and sewage.

As journeys nearly always begin and end at buildings, they are also closely related to mobility. Mobility is currently responsible for a further third of Switzerland's final energy demand and for 32 % of CO_2 emissions, 99 % of which are attributable to road transport. For a significant proportion of the electromobility market, more and more buildings are becoming «filling stations». Electric vehicles and plug-in hybrids are currently experiencing high two-digit growth rates.

For the future we require sustainable solutions that not only provide data on consumption and efficiencies achieved, but also enable secure energy provision. A holistic approach begins with creating transparency about current energy demand as well as the associated costs and emissions. This must be followed by in-depth analysis and advice on how best to implement the measures identified through optimisation and modernisation. Ideally, support should be available during all the phases of a building or infrastructure's lifecycle, including financing options and documentation of efficiencies achieved. This is where energy and sustainability management come into play. But what do we mean by these terms?

Energy management is the overall combination of measures taken to maximise energy efficiency and optimise energy supply without impacting on the comfort and needs of building users in any way. To achieve these objectives, a whole range of measures are taken to reduce final consumption, increase efficiency, eliminate energy waste, identify alternative sources of energy and minimise procurement costs. Energy management also encompasses the management of energy availability and its long-term financial implications. This often includes the strategic selection of alternative energy technologies and plant locations.

If no energy management strategies are defined, consumption will continue to remain high while energy prices are subject to the usual fluctuations and uncertainties of the market. For companies this means avoidable higher operating costs and risks.

Sustainability is a term that is often used by scientists, but also by business people and policymakers. It tends to be used normatively rather than descriptively. The terms «sustainability» and «sustainable development» are often used interchangeably. Sustainability is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainability always encompasses environmental, economic and social aspects. Sustainable development consists of attaching equal weight to environmental considerations as to social and economic ones. In meeting the economic challenges of the future, we are therefore required to leave our children and grandchildren with intact environmental, social, and economic structures. We cannot have the one without the other.

Companies and organisations are being increasingly confronted with matters that demand an understanding of complex interrelationships.

Society and legislation:

- Greater environmental responsibility
- More energy / environmental regulation (legislation, regulations, standards, guidelines, directives) and increased complexity as a result of the Paris climate accord and the Confederation's energy strategy «2050»
- Government targets to lower emissions and zero net energy buildings
- Demand for building certification
- Public image

Economy:

- Increasing influence of energy costs on the cost of producing core products and services
- High energy costs impact negatively on profits
- Energy efficiency programmes pay for themselves through lower energy consumption and the availability of financial incentives, e.g. through the tax system or investment subsidies

Fig. 3.2: Questions organisations need to ask themselves

To get to grips with this complexity, more and more organisations are using management systems for areas such as environmental protection (ISO 14001) and energy (ISO 50001) for example. These systems require reliable data to form the basis of the Plan–Do–Check–Act management cycle.

3.1.2. How do energy efficiency measures work?

3.1.2.1. Efficiency measures in existing buildings

The following diagrams illustrate how valuable an efficiency and sustainability programme can be. The lifecycle of existing buildings and infrastructures using a variety of solutions for energy efficiency, energy supply and sustainability is shown.

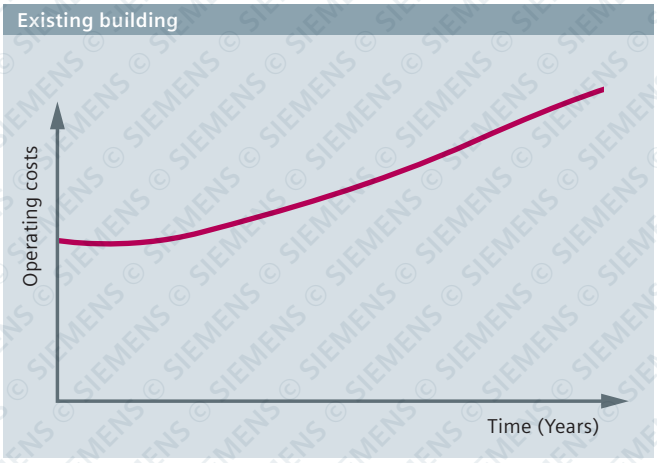


Fig. 3.3: Trend of operating costs over several years

This diagram shows the trend of real operating costs (baseline) caused by efficiency losses through plant technology, e.g. as a result of ageing, operational changes and other changes within a building.

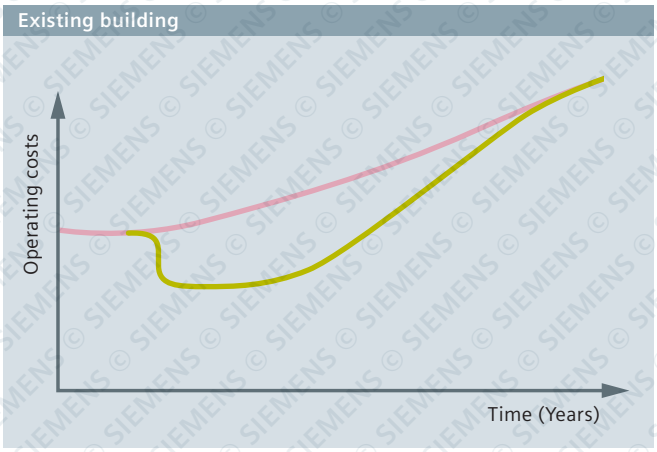


Fig. 3.4: Trend of operating costs when optimisation measures are implemented

By identifying and implementing optimisation measures, consumption is immediately improved compared with the baseline. Without continuous optimisation and data-based monitoring, however, operating costs can quickly rise to their previous level again.

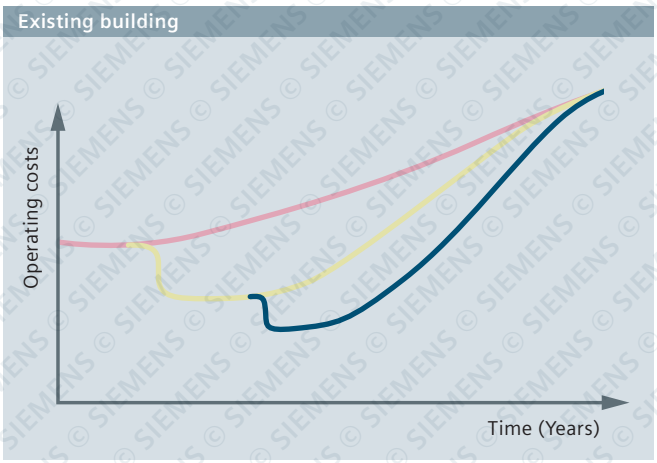


Fig. 3.5: Trend of operating costs with supply programmes

Energy procurement and supply programmes further reduce costs compared with the baseline. Without additional continuous monitoring, however, the operating costs of the building can quickly rise to their previous level again.

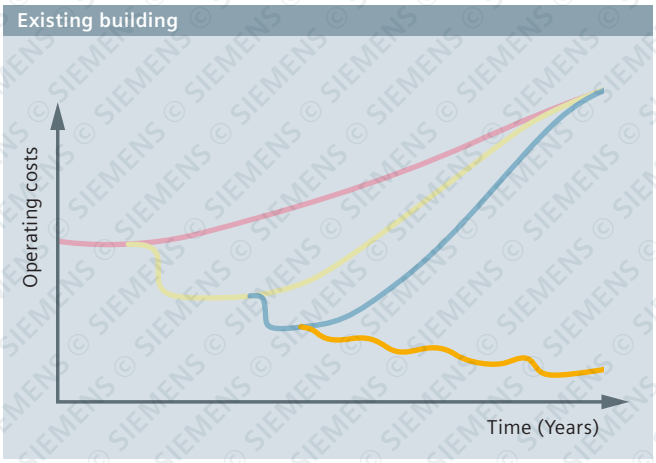


Fig. 3.6: Trend of operating costs with energy services

With continuous energy services, costs are maintained at the reduced level over the long term, and may be lowered still further by identifying and implementing additional optimisation measures.

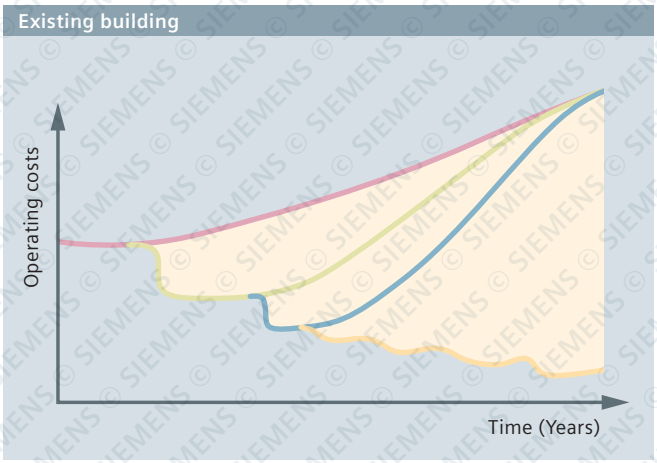


Fig. 3.7: Added value of sustainability solutions for existing buildings

The outcome of comprehensive efficiency and sustainability solutions is shown by the yellow-shaded added value across the entire lifecycle of the building.

3.1.2.2. Increased efficiency in new builds

The following diagram illustrates how valuable an efficiency and sustainability programme can be over the lifecycle of new buildings and infrastructures using holistic solutions for energy efficiency, energy supply and sustainability.

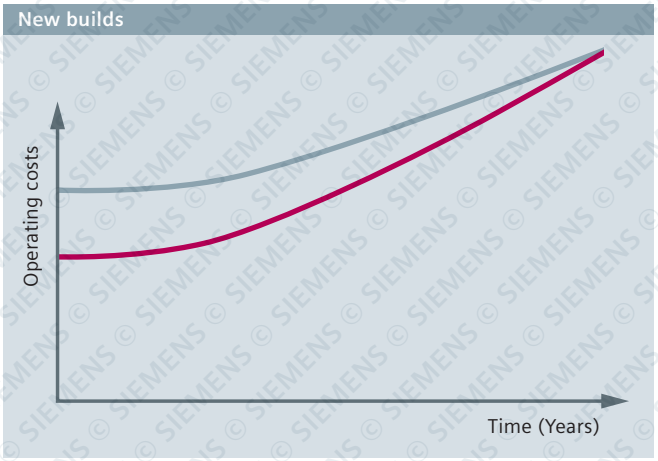


Fig. 3.8: Trend of operating costs with (lower line) and without (upper line) energy efficiency planning

Targeted energy efficiency planning during planning and construction can reduce operating costs by up to 30 %. However, without appropriate optimisation and data-based monitoring, costs can soon rise to their original level again, or even – due to the normal ageing processes of a building and other typical operational factors – beyond that.

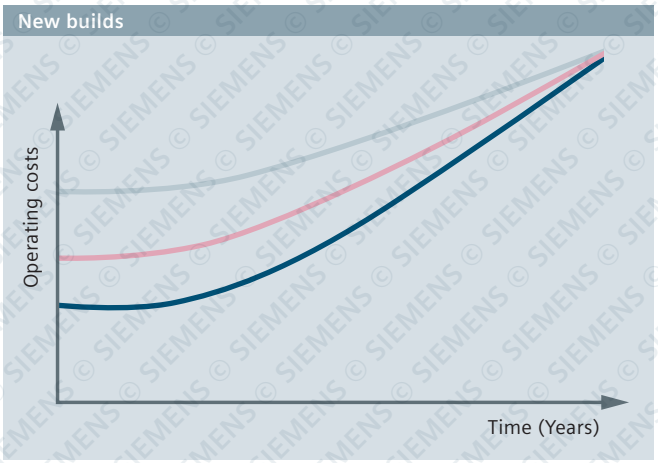


Fig. 3.9: Trend of operating costs when energy procurement and supply strategies are implemented

Energy procurement and supply strategies lower energy costs and slow down the rate at which forecast operating costs rise. However, these cost savings will again dissipate over time if no appropriate optimisation measures and data-based monitoring are performed.

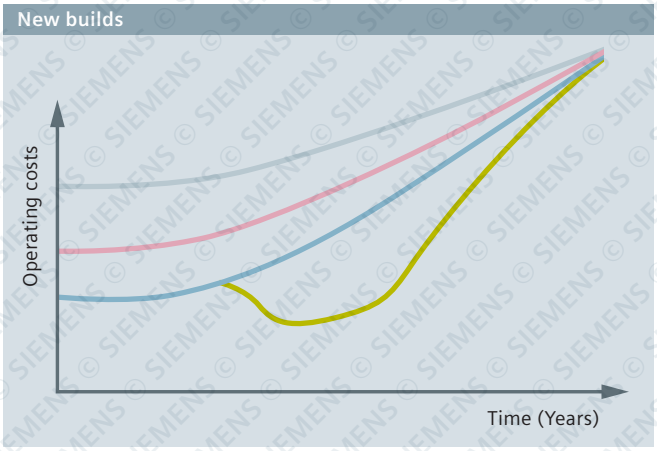


Fig. 3.10: Trend of operating costs with energy efficiency programmes

Demand-side energy efficiency programmes reduce operating inefficiencies and lower operating costs still further.

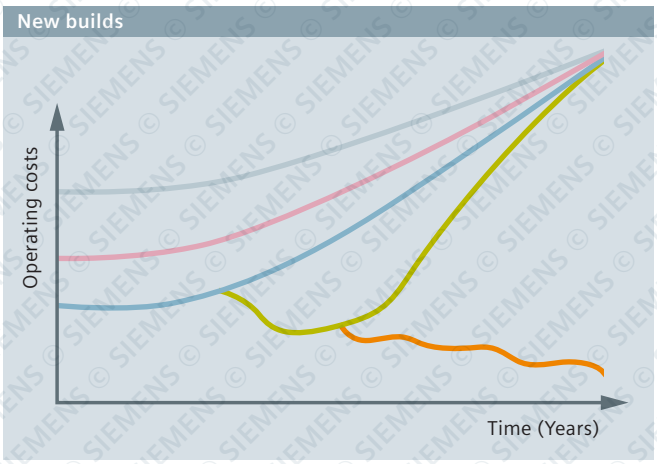


Fig. 3.11: Entwicklung Operating costs im Rahmen fortlaufender Leistungen bei New builds

With continuous services, operating costs can be maintained at the reduced level over the long term, and may be lowered still further by identifying and implementing additional optimisation measures.

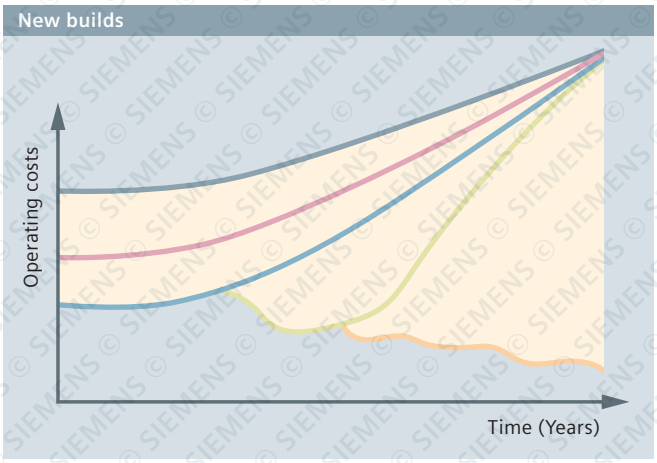


Fig. 3.12: Result of holistic efficiency and sustainability solutions for new builds

The yellow shading shows the result of holistic efficiency and sustainability solutions. Operating costs are consequently lowered over the entire lifecycle of the new building.

3.1.3. Establishing energy and sustainability management

Customised energy and sustainability management is divided into a number of different phases. The service partner is often a long-term partner for global enterprises, national customers and local authorities. The service provider identifies the underlying potential in buildings and infrastructures by offering specific energy services for transparency, optimisation, modernisation and financing.

3.2. Transparency

Various actors in a growing number of organisations are asking questions about energy and resource consumption:

- Energy managers are asking: What are we using our energy supplies for? Which buildings or infrastructures are delivering good energy performance, and which ones are poor in this regard?
- Sustainability officers want to know: What is our CO_2 balance?
- Those in charge of budgets want to know: How much of my budget will I need to earmark for energy and resources in future?
- Building services engineers want the information: Are the cooling units running at maximum efficiency?
- Facility managers would like to know: How should I interpret the data and identify what measures could be implemented?
- Individual users are asking: Why is it so hot in here?

The list could go on virtually indefinitely, especially if the organisation in question uses a management system to ISO 14001 (environmental management) or ISO 50001 (energy management), or needs to produce a sustainability report.

Conventional accounting systems do not provide answers to the above questions about energy, resources, etc. as such systems are generally used only to manage financial data. And, as they are usually issued quarterly and three out of four invoices are simply payments on account, bills from energy utilities are also only of limited use.

By contrast, many buildings are already equipped with smart meters so a lot of building automation data is already available. But what data is relevant? And how can it be gathered from multiple sites in such a way that sufficient information is available for benchmarking and for assessing the optimisation and modernisation measures implemented?

Without an organisation-wide «accounting system» for energy and resources, there can only be patchy answers to these questions. So what would an «accounting system» for energy and resources look like, and what internal and external sources would it be able to utilise?

Depending on the particular information sought, fewer or more data points will be required. These questions can also change over time – so the system must also be flexible.

Purpose	Who	Benefits	Number of users	Recommended frequency
Measure total consumption	CFO, environmental protection officer	Shows total costs / total CO_2 emissions	3 – 5	Annual, manual
Analyse system, optimise energy management	Energy manager, operator	Analysis of historical energy trends enables long-term optimisation and energy savings thanks to real-time energy monitoring and rapid adjustment	10 – 500	Automatic readout every 1/4 hour Daily automatic comparison against budget
Allocate costs	CFO, operator	Enables costs to be allocated to departments and tenants	50 – 200	Annual, manual Automatic readout every 1/4 hour better

Tab. 3.1: Measuring points for different purposes

3.2.1. Collecting data

The first question to ask is how the data is collected. All manner of methods are available for collecting data, starting from manual readouts from a water meter, for instance, or recording usage when delivering oil.

More and more utility companies are now using «smart meters» for electricity, heat, gas and water. These measure consumption and performance every quarter of an hour then upload the data to the utility. Often these smart meters support direct readouts as well. These readings can also be included in the data collected as they provide valuable information about overall consumption and performance. It is also possible to incorporate data from other sources, such as historical data from Excel spreadsheets, for example.

In larger commercial properties, this information is usually not sufficient to ascertain the status of individual systems. If no other measuring points are available, new meters can be linked via the MeterBox and data relating to consumption, generation, performance, internal room conditions etc. can then be automatically transmitted, e.g. every 15 minutes.

If a building automation system is already installed and able to output simple CSV files, this data can also be incorporated. Whatever manufacturer the system is from, the installation of some additional software makes it a simple matter to transmit the data on consumption and internal room conditions.

Data collection is thus flexible and can be readily adapted to the particular local circumstances and any changes that are made – for instance if a manual meter is automated and consequently provides 96 readings a day instead of twelve a year.

3.3. Optimisation

Energy and resource costs account for a significant proportion of the operating costs of a building. As a rule, structural inadequacies in system and energy management result in additional expenditure for maintenance and energy costs.

A prerequisite for successful optimisation is a certain minimum technical level of the existing systems. Ideally the property or site will have an energy demand of more than 200 MWh and the annual costs for energy and water will be over 30,000 Swiss francs. The age of the property is immaterial.

3.3.1. Cutting costs and reducing emissions by increasing efficiency

Clear gains can be rapidly achieved even with modest outlays on energy optimisation for existing systems in order to reduce energy consumption for everyday operations. Typically, a reduction in energy usage of 10 to 25 % is achieved following optimisation.

Energy optimisation typically also has a very fast payback time, usually less than two years. There is therefore a clear difference between operational energy optimisation and the modernisation of building services systems (with typical payback times between five and ten years) or the renovation of a building's envelope, where payback times of over 20 years can be expected.

Operational energy optimisation is not only cost-effective, because it does not require investment, as a rule it can also be implemented without a complex planning process. It does however require a structured, step-by-step approach (analysis and implementation). The result is the sum of the successful and long-term operational measures implemented plus visualisation of the before / after states.

Operational energy optimisation encompasses all the steps and measures taken during the life of a building services system that are aimed at operating these systems with the minimum of resources, taking their economic efficiency into account in each case. These could include for instance:

- Adjusting the operating times of systems to the periods when they are actually used
- Reducing air volumes to the minimum required
- Optimising humidity levels
- Lowering electricity consumption for transporting water and air
- Monitoring filters

The aim of long-term operational energy optimisation is to systematically lower and maintain the setpoints of existing systems at the minimum level required to meet users' needs, as well as to increase understanding among system operators of how they function and interact. Moreover, optimisation reduces «unnecessary operation without benefit». Comfort problems stemming from inappropriate system settings can also be typically addressed. The long-term impact of optimisation is underpinned by involving operating personnel in the implementation of the measures. They will then be in a position to respond to future changes and make adjustments and settings themselves. This also includes access to the latest operational, usage and generation data at any time in order to provide the transparency necessary to assess the status of the system.

The services of an experienced engineer are usually required to achieve these objectives. Along with specific specialist know-how and many years of experience, the consulting engineer must also possess a high level of social skills, as good communication with plant specialists and system owners on site is just as important as their technical skills. Customers may implement the measures proposed by the engineer, but they are also free to postpone or reject them altogether. Local experts play a key role here: it is vital that their expertise and understanding of the operational processes involved flow into operational optimisation. As operational requirements can change very rapidly, operational energy optimisation should be understood as an ongoing process rather than a one-off project. See also SIA Technical Specification 2048 on optimizing energy performance («Energetische Betriebsoptimierung»).

Cantonal legislators are increasingly stipulating that large-scale energy consumers should gradually improve their energy efficiency by 1 to 2 % annually. Premises with an annual consumption of over 500 MWh for electricity or more than 5000 MWh for heat are deemed to be large-scale consumers. The model cantonal provisions for energy consumption in buildings («MuKEn 2014») also mention operational optimisation for smaller-scale energy consumers. Module eight contains the following note: «This applies to facilities with an electricity consumption of at least 200,000 kWh.» The first cantons already implemented this in 2016. Operational optimisation is a highly cost-effective first step toward complying with regulatory requirements.

3.4. Modernisierung

As a result of advances in technology, the demands on infrastructure are constantly changing and leading to the need for modernisation. However, the modernisation of properties goes far beyond simple renovation. Renovation typically involves restoring a previous state, and possibly removing unwanted or hazardous materials. It also includes replacing or reinforcing parts of the building's envelope, primarily in order to save energy.

With modernisation, by contrast, some of the technical systems installed are replaced to provide greater functionality and better performance, and consequently improved efficiency that avoids «unnecessary operation without benefit». An illustrative example of this is set out in the following section.

3.4.1. Installation of occupancy sensors and constant lighting control

Even well-equipped buildings often only have a simple on/off switch for room lights. This equates to energy efficiency class D according to the SIA 386.110 or SN EN 15232 standards. In most cases a building will have modern T5 lamps with an electronic ballast. We can assume that the first office worker will turn up for work around 7.30 a.m. and will switch on the light. The light will then be left on the whole day and, with a bit of luck, the last employee to leave will switch it off again in the evening around 7.30 p.m. The blue shading below represents the energy demand for this scenario.

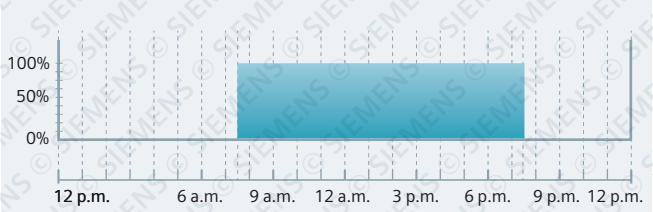


Fig. 3.14: Artificial lighting with energy efficiency class D

However, as the sun provides its contribution – for free and without extra CO_2 – it tends to get brighter by the hour. The increase in brightness caused by the sun can be represented by the following graphic.

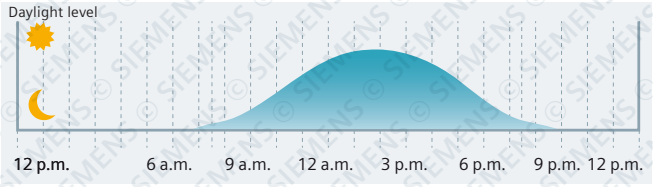


Fig. 3.15: Daylight levels throughout the day

If the building had a constant lighting control system, it would dim the artificial lighting in the morning then increase it again during the course of the afternoon so that the required level of illumination for the respective workplace is provided in each case (e.g. 500 lux).

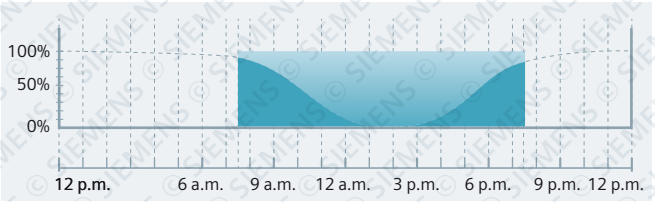


Fig. 3.16: Artificial lighting with constant lighting control

This new state is indicated by the dark-blue shading, and it can be seen that the shaded area is now much smaller than for the original scenario.

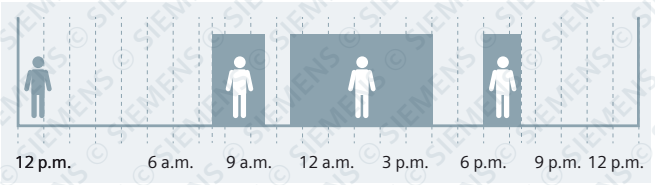


Fig. 3.17: Times at which rooms are actually occupied

From time to time, staff leave the rooms, for breaks, meetings, client visits, etc. What happens when the last one to leave does not switch off the light, as we have been taught to do for generations? This is where an occupancy sensor can step in as an auxiliary system to switch off the artificial lighting.

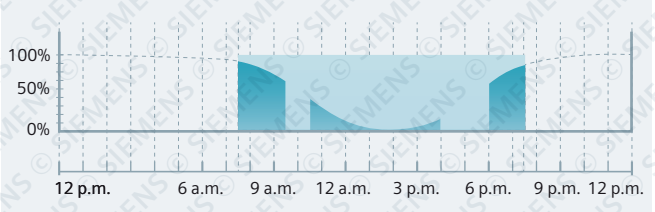


Fig. 3.18: Energy demand for lighting when occupancy sensors are used

This gives the scenario as depicted in the above graphic: the four dark-blue shaded areas indicate the new energy demand for lighting, drastically reduced by over three-quarters. Unnecessary operation without any benefit has now been eliminated without sacrificing comfort levels. And according to SIA 386.110 and SN EN 15232, the energy efficiency class has now been improved from D to A.

Many more examples can be readily found for heating, cooling, ventilation and shading controls as well as for hot water. For space reasons, however, we will not describe these in detail, but here is a summary:

- Installation of air quality sensors which turn on ventilation only when the air is actually poor
- Installation of frequency converters so that ventilation systems only run at the minimum level required
- Retrofitting of heat recovery systems to put waste energy to good use
- Improved shading controls to prevent overheating in summer

- Installation of energy efficiency class-A room automation systems to systematically prevent unnecessary operation without benefit

Modernisation of systems and controllers typically has a payback time of five to ten years, in some cases also longer. This equates to a return on capital employed of 10–20 %! The energy savings gained range between 20 and 50 %. Similar savings can also be achieved in relation to the reduction of greenhouse gas emissions from fossil fuels. Cantonal legislators are increasingly stipulating that large-scale energy consumers should gradually improve their energy efficiency by 1 to 2 % annually. Premises with an annual consumption of over 500 MWh for electricity or more than 5000 MWh for heat are deemed to be large-scale consumers. Module five of the model cantonal provisions for energy consumption in buildings («MuKEn 2014») also now mentions the obligation to incorporate building automation in new builds. The first cantons have already been implementing this since autumn 2016.

3.5. Finance

3.5.1. What is energy-saving contracting?

Energy-saving contracting is also known as energy performance contracting (EPC) or energy savings performance contracting (ESPC). It differs from the energy contracting model in the way it is financed. With energy contracting, a project is financed on the basis of the number of megawatt hours sold, whereas with energy-saving contracting a project is financed on the basis of the megawatt hours saved – the term negawatt hours has been coined to describe this.

3.5.2. General procedure

After carrying out an audit, the energy savings contractor (ESCO) submits a tender listing a range of measures together with the projected energy savings guaranteed by the ESCO. If the client accepts the tender and a contract is signed, the ESCO plans, builds, finances and operates (optional) all the measures required to achieve the energy savings. In return the ESCO receives a percentage of the energy costs saved until all its outlays for planning, financing and controlling – and also its profit – have been covered by the end of the contract. This may either be financed by the ESCO or the client can make a contribution to the construction costs which will then be offset by an appropriate shortening of the term of the contract.

This model is especially suitable for evaluating the energy modernisation of a large number of buildings. This form of contracting is particularly effective when an energy management system already exists or is being put in place. Due to the amount of work involved, however, it is less suited to smaller projects where building systems are to be upgraded (e.g. smaller individual buildings).

In principle, any measures relating to technical building services are conceivable. In order to enable the system to be monitored, it is often necessary to replace some controls – or at least some of the valves and pumps – and connect them to a central building services management system. Among other things, the boiler could be replaced or the heating distribution system upgraded. It may also be possible to realise savings on maintenance costs as a result of these replacements.

The benefit for the client lies in the systematic optimisation of building services and the aggregation of building automation in one central building services management system. This is usually performed at a high technical level across all resources. Financial outlays for energy supplies are reduced.

The scope of the potential savings covers the elimination of the existing, inefficient building services, contractual arrangements or other key economic decisions or factors that the contractor changes. At the end of the contract, the client then gets to enjoy the full cost savings. Depending on the particular contract, ownership of the systems installed is transferred to the building owner at the outset or at the end of the contract.

One possible disadvantage of energy-saving contracting may arise if the client chooses a very short term during which only the most economically beneficial measures are identified, while other more long-term measures are either not implemented or could actually be rendered more difficult. This «cherry-picking» approach can subsequently be an impediment to more general refurbishment or long-term solutions. In practice, it is necessary to formulate the contract precisely with respect to the scope involved and consideration of future or internal measures.

3.5.3. Financial assistance

3.5.3.1. CO_2 levy on fossil fuels

The CO_2 levy on fossil fuels (natural gas, petroleum, etc.) is a special form of tax. It is a market-based steering instrument which uses price to incentivise reductions in the consumption of fossil fuels. It does not flow into the government's coffers, but serves to internalise external costs, that is to say it factors the environmental and climate costs into the selling price of the particular energy vector. In order not to impair the competitiveness of a country overall, the proceeds from the CO_2 levy are therefore paid back to organisations or private individuals so that those who use fossil fuels sparingly benefit. The purchasing power is retained.

The portion that industry pays towards the CO_2 levy is paid back to employers on the basis of their employee payroll via the respective AHV compensation funds. In 2016, 81.40 Swiss francs were returned for each 100,000 francs of payroll costs. Organisations that use fossil fuels efficiently, invest in renewable energy, and employ a large workforce benefit in particular. The aim is to reduce the burden of labour cost for employers. Private individuals receive a credit to their respective health insurance fund. In 2016, together with other incentive payments, this amounted to around 67.80 Swiss francs.

A portion of the CO_2 levy is retained and used to finance the building programme. The focus here is on strengthening the building envelope and heating system measures aimed at reducing CO_2 emissions. Overall, some 642 million Swiss francs were available for redistribution of the CO_2 levy in 2016, with a maximum of 300 million francs earmarked for the

building programme, which is also further topped up by funds from the individual cantons.

Further information: www.dasgebaeudeprogramm.ch

3.5.3.2. Cost-covering feed-in tariff

The cost-covering feed-in tariff («KEV») is a policy instrument used to subsidise electricity generation from renewable sources. Since January 1, 2009, producers that generate electricity from wind and small-scale hydropower, biomass, photovoltaic or geothermal power plants are paid a guaranteed amount for electricity fed into the national grid, provided they are not on a waiting list as a result of «capping».

The maximum tariff paid for a particular technology (or subsidy for the associated plant) is also informally referred to as a cap. This limit has led to a waiting list of well over 38,000 plants registered with Swissgrid (as at Q1 2017). Over 90 % of the plants on this waiting list are ones with a capacity of less than 10 kWp. They receive a one-off payment. Plants between 10 kWp and 30 kWp may choose between the one-off payment or remuneration based on KEV. Plants that output over 30 kWp receive KEV.

Further information can be obtained from the KEV Foundation: www.stiftung-kev.ch
and the Swiss Federal Office of Energy: www.bfe.admin.ch/kev

3.5.3.3. ProKilowatt: Promoting electricity efficiency

Grants for ProKilowatt projects and programmes are also available from the funds of the KEV Foundation. These are awarded for «competitive tenders». The Swiss Federal Office of Energy (SFOE) is responsible for the strategic management of ProKilowatt. Operational management is handled by the offices of the firm CimArk in Sion. An advisory panel led by the SFOE with representatives from the State Secretariat for Economic Affairs (SECO), the cantons, the electricity supply industry, Swissgrid, economiesuisse, consumer and environmental protection organisations as well as the Federal Institutes of Technology and universities of applied science also contribute their know-how.

There are basically two ways in which organisations, companies or private individuals can benefit from ProKilowatt incentives: either by being part of the target group for a current programme or by submitting their own projects.

ProKilowatt differentiates between the following types of «competitive tenders»:

- **Tenders for projects**
  This category is aimed in particular at industrial, trading and services companies (who implement measures in their own operations).
- **Tenders for programmes**
  This category covers funding bodies that generally bundle numerous similar individual measures within a programme for external third parties.

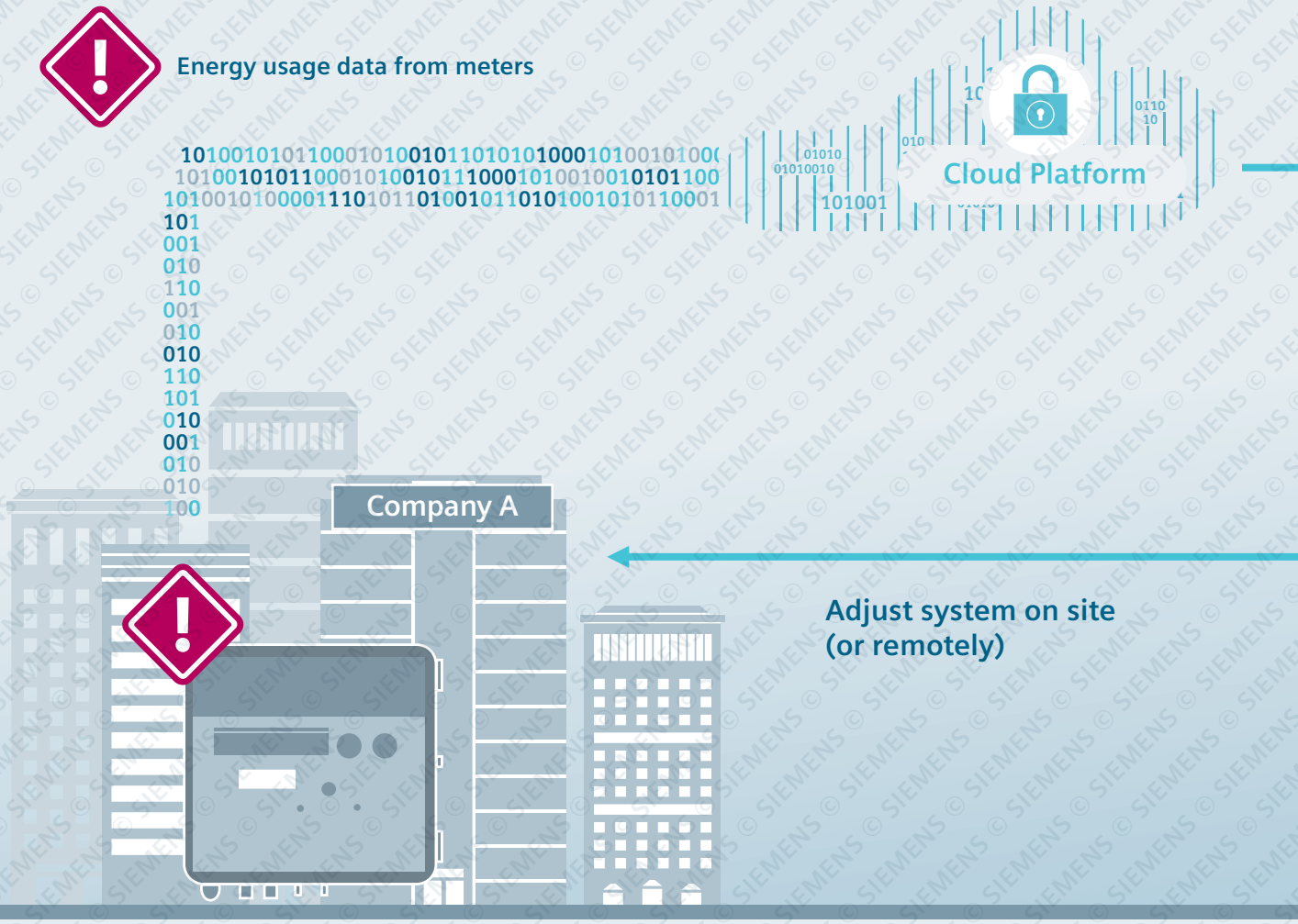
Further information: www.prokilowatt.ch

Use Case
BPS – Building Performance and Sustainability

Energy usage is continually metered and the data is transmitted to the cloud platform. At predefined intervals, the data is then analysed by the Digital Service Center (DSC) and compared with the expected usage (budgets). If there are significant differences, the current operating modes of the systems are checked and analysed.

Based on this analysis, either the performance engineer in the DSC or the service engineer contacts the customer to suggest ways of optimising the systems to reduce energy costs, cut CO_2 emissions, or increase comfort levels for the building's occupants.

Depending on which ones are agreed, measures can either be implemented remotely by the DSC or carried out on site by the service engineer.



Data-driven improved building performance

Digital Service Center

- Data analysis
- Energy reports
- Identification of abnormal energy usage
- Information is sent to the local service organisation.

Local service organisation

- Remote analysis
- Options are discussed with the customer.
- **Building Performance & Sustainability**

Perfect places for all aspects of our lives

Perfect places

We all begin our lives in a perfect place: our mother's womb. A place where it is never too warm or too cold, too loud or too quiet. A place where we feel completely safe and secure. So why should we not live our entire lives in perfect places?

A perfect place helps us to perform our best, relax undisturbed, feel safe and have a minimal impact on our environment. A perfect place is also one that can adapt to our constantly changing needs.

Building Performance & Sustainability

With Building Performance & Sustainability, we promise to maximise the performance of our customers' infrastructure, optimise efficiency and minimise environmental impact.

Together with our customers we determine what the individual requirements for their «perfect place» are then compare these with the status quo.
Next, our experts draw up an individually tailored solution concept covering all the customer's needs and their entire building technology infrastructure. Finally, we implement the concept together with the customer so that – step by step and day by day – we help to make their buildings more perfect places.

Digital transformation

While buildings themselves are always made of static elements such as concrete, stone and glass, their infrastructure and the ways they are used are highly dynamic. They communicate constantly with us, we only have to understand what they are saying.

Siemens has the technologies, the knowledge and the resources to collect the data from buildings, to understand it, and consequently optimise the building services. With our know-how, the expertise of our staff and our innovative portfolio, we are propelling the digital transformation market forward to create real value for people.

Impressive results

We are already involved in continuously optimising more than 7,500 buildings all over the world, saving our customers over €2 billion in energy costs every year, and we constantly monitor upwards of 34,000 buildings.

We believe that the places where we spend our time have a very big influence on our lives. They determine how we grow and develop, what we achieve and the people that we become. We believe we can create «perfect places». With our ingenuity for life. Our technology. Our products. Our solutions. Our services. Our innovation. Our people. Our commitment.

Creating «perfect places» is what motivates us every day to develop building technologies and help improve people's lives.

Can efficient building infrastructure boost competitiveness?

Competitiveness

As Voltaire so aptly put it back in the 18th century: «The better is the enemy of the good». In the modern world, this is more apposite than ever. Particularly in the business world, we are forever being called upon to constantly question everything and exploit any scope for improvement. Building infrastructure is an area where potential is frequently just waiting to be discovered.

Often when building services were planned in the past, many assumptions were made about future use and needs. Budgets were often limited so compromises had to be made, but since that time the needs and requirements of the business have continually changed. Today, organisations tend to focus on their core business and simply accept whatever building technology is already installed. Buildings and their infrastructure are consequently often seen solely as a cost factor.

But frequently the building infrastructure offers interesting potential, not only to optimise costs, but also to add operational value.

How can you add value for your company?

Your building infrastructure has a big influence on the value of your property and plant. With optimally coordinated state-of-the-art systems that already incorporate leading edge concepts such as renewable energy, you profit not only directly thanks to improved performance, you also increase the value of the systems.

How can you exploit the opportunities offered by digitalisation?

Digital transformation offers innumerable ways of continually improving your building infrastructure. A secure Internet connection to the cloud makes data centrally available. This can then be readily transformed into meaningful information. In addition, the data can be analysed by experts and consequently provide the building operator with valuable information about what is really going on in it. This not only enables problems to be identified and rectified, it also allows forecasts to be produced and preventive action to be taken where appropriate. We help you stay ahead of the pack in this exciting race.

Business is a perpetual contest to keep up with the competition.

Keeping up with the competition

Perfect places improve your competitiveness:

- More valuable corporate assets
- Lower operating costs
- Less risk
- Improved productivity

Understand your building infrastructure to gain competitive advantage

We can help you understand what is holding you back.

80 % of the lifecycle costs of a building are incurred during its operational phase. A holistic analysis will uncover untapped potential.

Continually adapting the building infrastructure to meet the needs and requirements of its occupants.

Common management practice

In many companies, the concept of bringing in external expertise is a familiar tried and trusted process. Companies often bring in consultants who, thanks to their different perspective, can more easily identify potential for optimisation and contribute ideas that have proved successful in other industries or regions. This method can also be extended to technical infrastructure. Experienced Siemens experts have a wealth of knowledge and experience from many projects in different industries, countries and regions all over the world.

Analyse what is holding you back

Just as the activities and processes for creating value are continually changing, so too are the needs that perfect places must satisfy. Although the building itself can be relatively static, a much more dynamic technical infrastructure can better support activities.

To take one specific example: in summer, refrigeration generation and distribution systems might become overloaded, which could cause operations to be disrupted or curtailed, or even lead to stoppages. This limited flexibility could therefore directly impact the core business. So how can we gain operational benefits while at the same time optimising building performance to meet current and future needs?

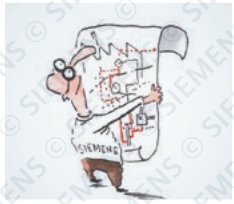
Holistic analysis of building infrastructure

First of all we seek to understand the customer's core business and their needs then we analyse the building's location and its infrastructure. This enables us to determine where the technology is already adequate and what steps could be taken to better meet the customer's needs and requirements. It is vital to take all building services into account, and to consider innovative technical solutions such as renewable energy, efficient waste heat utilisation, or optimised controlling of the various processes where appropriate.

Create transparency, optimise existing systems, modernise where necessary.

Creating transparency

We come and look at your existing systems and how they are being used. Our cloud-based Navigator software analyses all the data to create a reliable information baseline.



Optimising existing systems

We optimise and adapt existing systems as far as technically possible to meet the customer's individual needs; this step alone can achieve savings of up to 25 % on operating costs.

Modernising the infrastructure

Where systems have reached the end of their life, we modernise the infrastructure. The aim is to create the optimal efficient overall system. We therefore look at all the technical services together in order to identify optimal solutions that represent more than the sum of their individual parts.

Cooperative partnership

We work closely with our customers. From analysis and implementation through to operation, i.e. for the entire life of the building. The needs of our customers are always paramount.

How can I find a partner who will really help me?

We work out an individual solution concept based on our customer's core business. Rather than optimising individual building services, we adopt a holistic approach to identify current and future needs. We create transparency, optimise the system as a whole and modernise it where necessary. We collaborate with the customer on an ongoing basis to implement a coordinated solution. One particular advantage of this approach is that the projects pay for themselves and, thanks to our finance solutions, no upfront investment is required.

All our solutions are tailored to the specific circumstances and needs of the customer.

Impressive results.

Implementing projects that bring long-term benefits

When upgrading systems while a building is in use, companies often have to focus on urgent individual projects. Often it is not possible to implement other desirable, but lower-priority, projects – either because they require too much coordination effort or it is feared that they will have a negative impact on operations, or because the financial resources are not available.

Our holistic approach does not stop at the solution concept, it also extends to turnkey implementation while operations in the building continue uninterrupted. Thanks to the financial benefits produced by lower outage and maintenance costs, increased productivity or lower energy costs, this all-round upgrading approach represents a business model where modernisation pays for itself. What is more, this investment does not need to come out of capital funds, but can be paid from the operating costs budget without driving up running costs.

Sustained long-term benefits

Once the various services have been optimally coordinated, they can be continuously adjusted to meet the needs of our customers, just like Swiss clockwork.

To sustain the operational benefits gained, Siemens experts constantly monitor the systems in the Remote Service Center and can react immediately if any variances are detected.

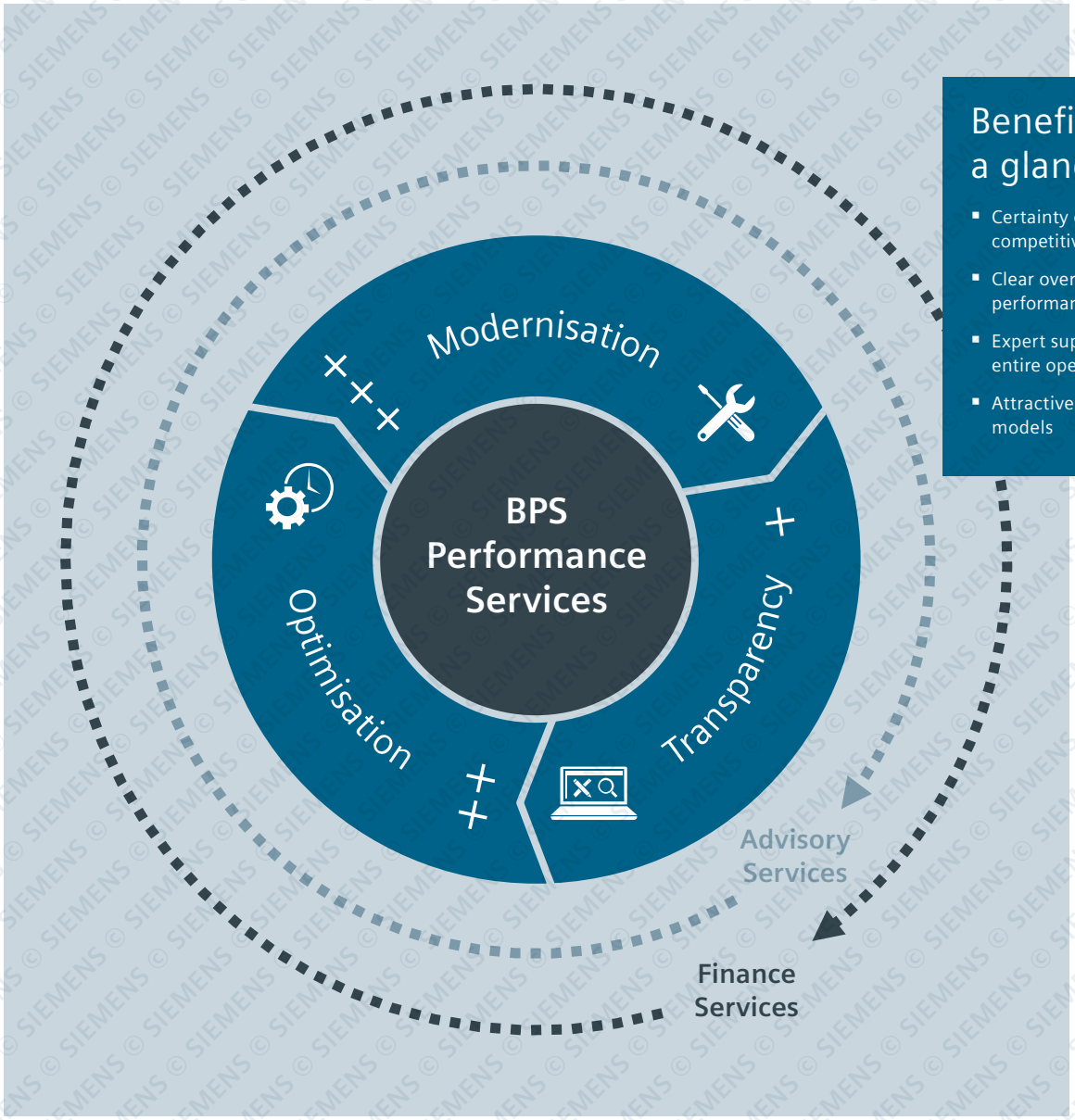
The results are measurable: greater flexibility, more reliable operation, fewer complaints, increased savings and lower emissions. As a result, our customers have one less thing to worry about in future, leaving them free to focus more closely on their core business.

Benefits at a glance

- Solution concept precisely tailored to the customer's needs
- Guaranteed performance
- Reliable implementation without interrupting operations
- One contact for all services
- Continuous monitoring
- Modernisation without affecting investment budgets
- More time and resources freed up for core business
- Improved competitiveness

Everything works together perfectly like Swiss clockwork.

A holistic process for maximising building infrastructure performance



Benefits at a glance

- Certainty of retaining a competitive advantage
- Clear overview of performance parameters
- Expert support during entire operational phase
- Attractive financing models

The necessary data is collected and transformed into information in one continuous process. Existing systems are then optimised on the basis of this information. To boost building performance further, systems are modernised and effectiveness is monitored through the transparency measures. All process phases are supported by performance services – we offer comprehensive advisory services and interesting financing models for the entire process.

Since processes and applications in a building are constantly changing, the building infrastructure also needs to be continually adapted in order to retain a competitive edge in future.

Full lifecycle

While construction accounts for only approximately 20 % of the lifecycle costs of a building, 80 % of the costs are incurred during operation. It is therefore well worth organising this operational phase professionally in order to maintain the performance of the building infrastructure over the long term. This requires a continuous improvement process which Siemens realises with the aid of the services set out below.

Transparency

Reliable facts and figures that are continuously collected, analysed and evaluated are essential in order to continually monitor the performance of a building. The data required can vary depending on how a building is used and the individual requirements, which is why we draw up a tailored measuring and metering concept. As part of our performance services, we can evaluate the data, transform it into meaningful information and help you interpret it correctly.

Optimisation

The aim of optimisation is to spot variances, identify potential, propose concrete improvements and then implement them on site. We collate the building data from various sources and interpret it on the basis of our extensive expertise. Our experts can draw on a wide range of competencies, including specialist knowledge in the various technical disciplines of the systems installed, experience of individual applications, as well as detailed know-how for analysing the actual data. These analyses are carried out by Siemens experts in the Advanced Service Center as part of remote diagnostics. This enables many improvements to be achieved simply by optimising existing systems.

Modernisation

A more extensive modernisation concept could be triggered if more innovative and efficient technologies are available, if systems are coming to the end of their life, or if there are significant deficits with respect to current needs or regulatory requirements. Only a holistic approach covering all the services concerned can effectively generate additional benefit.

However, increased complexity often brings with it additional, hidden, risks: will everything work together? As the general contractor, Siemens bears all these risks – we not only take care of planning and developing the concepts, we also ensure turnkey implementation without any interruption to your operations. We also offer the option of guaranteeing the promised performance of the overall system.

Following modernisation it is necessary to verify whether the promised performance is actually being delivered. This is done by means of our special «Performance Assurance» services, thereby closing the circle again.

Advisory services – building infrastructure consulting

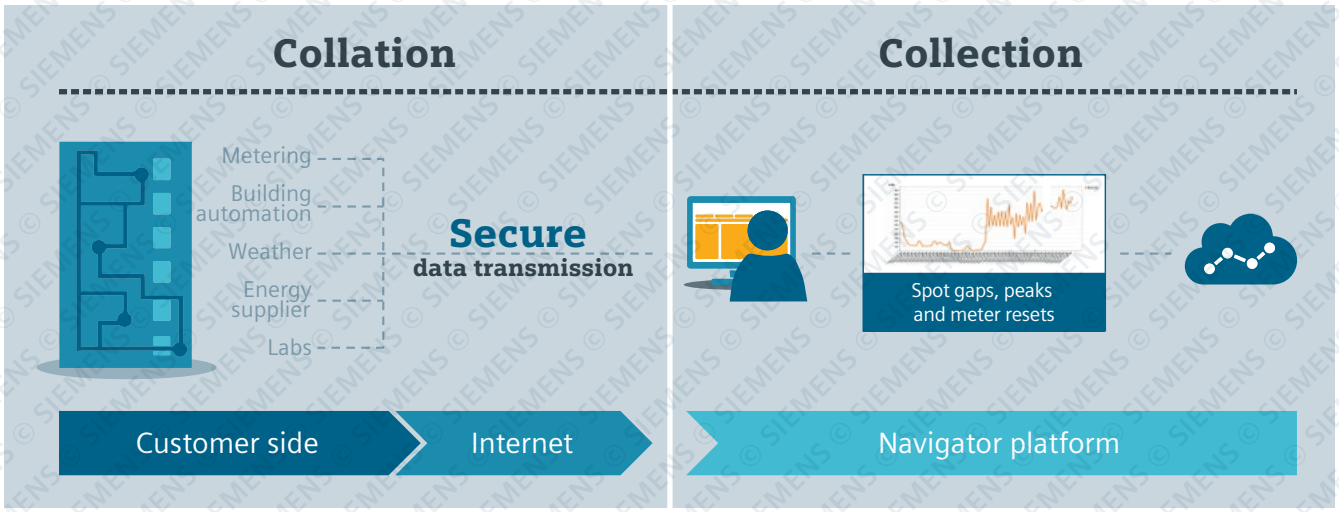
We offer an extensive range of advisory services, from developing and implementing an energy strategy through to efficient energy procurement.

Financing services – innovative models to boost capital efficiency

As well as technical proposals, our tailored solution concept always takes economic and investment considerations into account.

The forecast savings as well as possible incentives are also included. Various models are available for financing the required investment, including for extensive modernisation projects.

Thanks to continuous data collection, the Internet of Things provides reliable facts.



The building sends encrypted data to the Navigator cloud, where it is transformed into meaningful information.

Benefits at a glance

- Simple collection and transmission of building data
- No separate IT infrastructure required
- Secure access to the data – from anywhere
- Plausibility checks and transformation of the data into meaningful information
- Clear presentation and analysis of the information

Building data is prepared for the various users and is then available to them from anywhere.

Continuous data collection

The systems in the building provide a lot of data that requires further processing before it can be of any real use. Since the needs of the target users vary widely, a tailored measuring and metering concept is required. The bill from the energy supplier might be adequate for statistical analysis of the energy costs, but if the costs are to be divided among different cost centres on the basis of their usage, continuous metering of actual consumption is essential. To assess the reliability of a system, other parameters such as the frequency of fault signals, alarms or limit breaches are required.

This data is collected from various sources based on the individual requirements and is then stored on a shared server via an encrypted Internet connection. A number of different ways of collecting the data are conceivable: via a link with the building automation system, a direct link to smart meters, importing the data from the energy supplier, manual input, or a mix of these methods.

Transforming data into reliable information

The next step is to augment the data collected with the additional information required to interpret it correctly. For instance, the weather data from a particular location could be taken into account in order to assess the usage of heating systems. The metered data is adjusted by degree days, allowing usage to be compared across different years with varying weather conditions.

The data is checked and validated in our Advanced Service Center. Our experts are trained to quickly spot anomalies in the metered data, which avoids potential misinterpretation.

Customised dashboards provide a speedy overview.

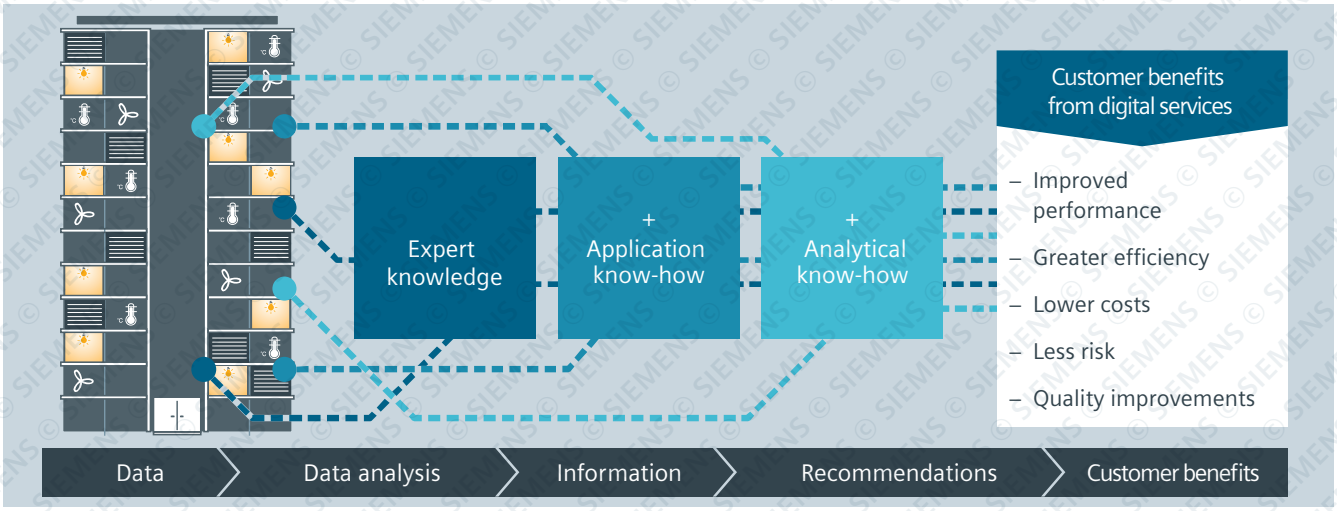
Tailored information for individual users

The preprocessed information is made available to the user via an individual web interface as customised reports and dashboards. As part of our transparency services, we create an individual cockpit in line with the customer's requirements.

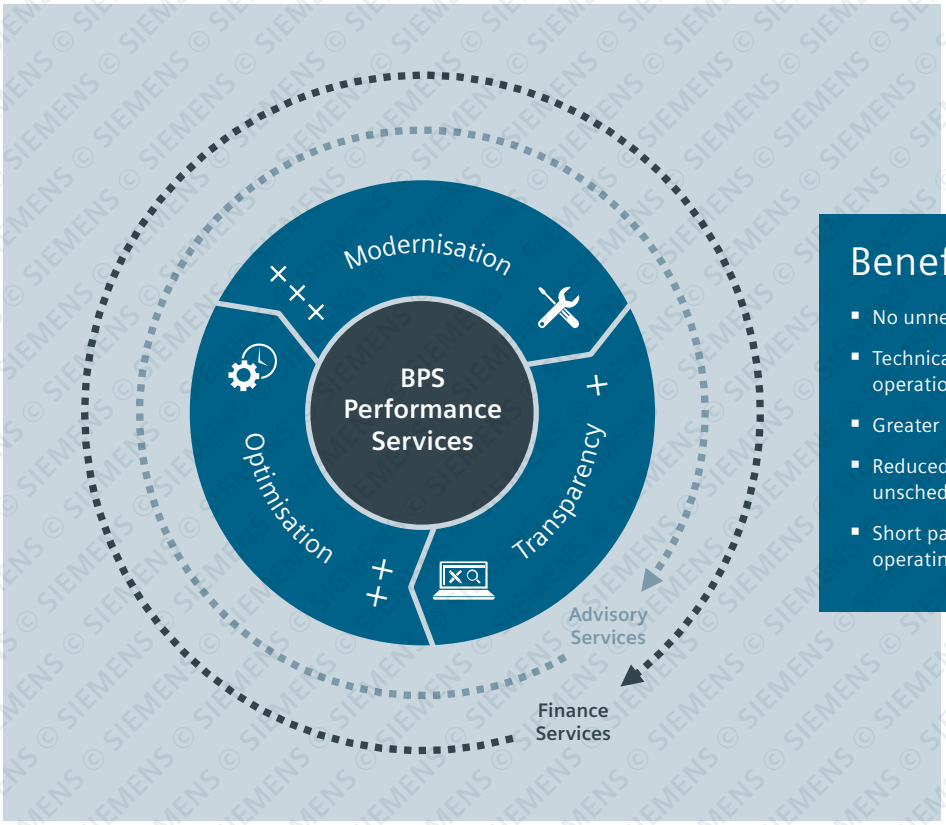
Benefits of the IoT architecture

One great benefit of the Internet of Things (IoT) architecture is that it only requires an Internet browser to enter data manually and call up the first reports. Since the continuous data collection is performed on our servers, no significant investment in IT infrastructure is necessary. The data on our servers is also safe and protected from manipulation and the user does not have to think about data archiving or backup at all. This solution provides an overview of all properties at a glance and also allows you to compare data from anywhere.

Understanding what is going on in a building.



Various competencies are required to translate the collected building data into real benefits for the customer.



Benefits at a glance

- No unnecessary operation without benefit
- Technical systems perfectly coordinated with operational processes
- Greater user satisfaction
- Reduced maintenance outlay and less unscheduled downtime
- Short payback time thanks to optimised operating costs

Operational optimisation is performed as a recurring process on the basis of expert data analysis.

How data can deliver real benefits

Systematically collecting building data enables continuous optimisation of the installed systems and processes. Successfully spotting potential, identifying possible measures and monitoring their effectiveness requires extensive specialist knowledge in a variety of disciplines. First a sound knowledge of various technical fields is necessary to determine the criteria for evaluating the performance of a particular system and its present state. In addition, the expert must also possess the necessary application know-how in order to correctly evaluate the dynamic components and their behaviour in this specific project. For instance, heat generation for an office building is different from that in a hospital or industrial plant.

Given the large amount of data and the interdependencies involved, a special knowledge of data analysis is required. This combined expertise can identify entirely new ways of optimising a building's infrastructure.

By analysing the collected historical data, it is possible to evaluate its effect on the present. For instance, it would be possible to find out why a particular energy bill was higher. Next we identify causal dependencies and correlations. Our experts then take a look at the future to provide approximate forecasts. We also formulate recommendations as to how certain incidents could be avoided, or how best to respond to future events.

Operational optimisation with short payback times

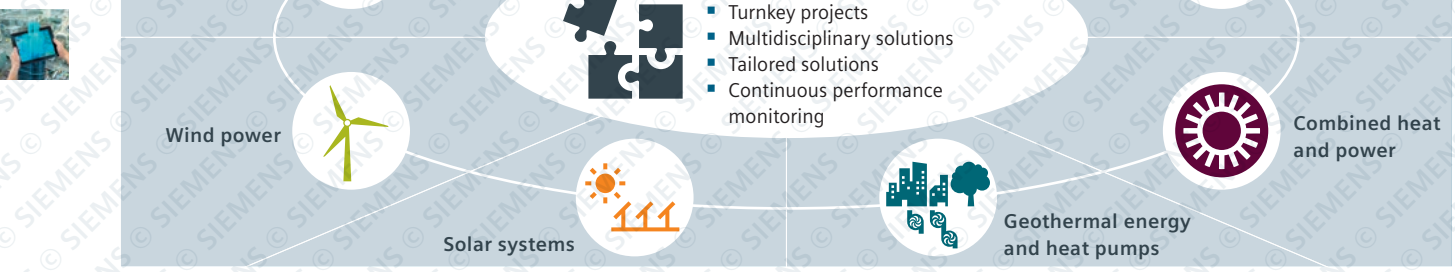
Operational optimisation requires the remote analysis and evaluation of the data, an assessment of the situation on site, the planning of optimisation measures followed by their efficient implementation. SIA Technical Specification 2048 on optimizing energy performance («Energetische Betriebsoptimierung») focuses on measures which will not sacrifice comfort levels, have short payback times (usually less than two years), are cost-effective, and can usually be implemented without any extensive planning process.

Aspects of operational optimisation

One crucial element of optimisation is to run systems based on their effective use or effective demand. For instance, it is not necessary to actively heat an office building at night. Another important aspect is determining the optimal mode of operation of the various systems from the point of view of energy. The information initially provided by building users must be checked in order to identify any unnecessary operation without benefit. Systems can also malfunction. Such malfunctions can be spotted and rectified during optimisation. The success of the optimisation measures implemented is also continuously monitored and documented.

Thanks to their many years of experience, Siemens experts can quickly identify and efficiently exploit any potential for optimisation. As well as the considerable savings to be made on running costs, the comfort levels in buildings are also generally improved so occupants are happier.

All-round modernisation equips buildings for the future.



Siemens looks at all the systems as a whole to create an individual solution concept tailored to the customer.

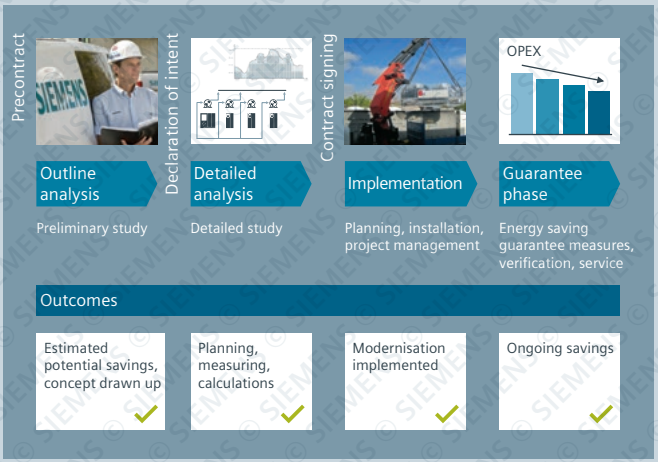
Benefits at a glance

- Optimisation of overall systems instead of replacing individual units
- Speedy project development in multistage process
- One contact for all building services
- Involvement of local partners, for example for installation and maintenance
- One single partner for concept creation, planning, realisation and operation

The holistic assessment of all building services together with project development in a multistage process offers many advantages.

Difference between renovation and modernisation

In the case of renovation, equipment or systems that have come to the end of their service life are replaced on a like-for-like basis. For instance, a boiler is replaced by a newer model, but the same method of heat generation is largely retained. With modernisation on the other hand, the whole heat generation and distribution system is analysed and current and future needs are assessed. Alternative technologies, such as waste heat utilisation or renewable energy for example, are also evaluated. Although a new system may be more complex, the benefit will certainly be greater.



Modernisation projects follow a multistage audit process.

There are many reasons why modernisation might become necessary:

- Significant limitations or divergence from current and future user requirements (e.g. lack of redundancy, lack of flexibility).
- Systems are at the end of their life: the technology is obsolete or inefficient, spare parts or knowledge about older systems is no longer available, frequent breakdowns, high maintenance requirements.
- Statutory requirements that impact further operation (e.g. refrigerant R22 is no longer permitted).
- Individual systems in silos that cannot be coordinated with each other.
- Lower environmental impact (emissions, noise).

Modernisation in a multistage process

Modernisation is always carried out without interrupting operations in a number of stages. An outline analysis is performed to establish the local circumstances and users' wishes. The existing data is evaluated and some new data is collected where needed.

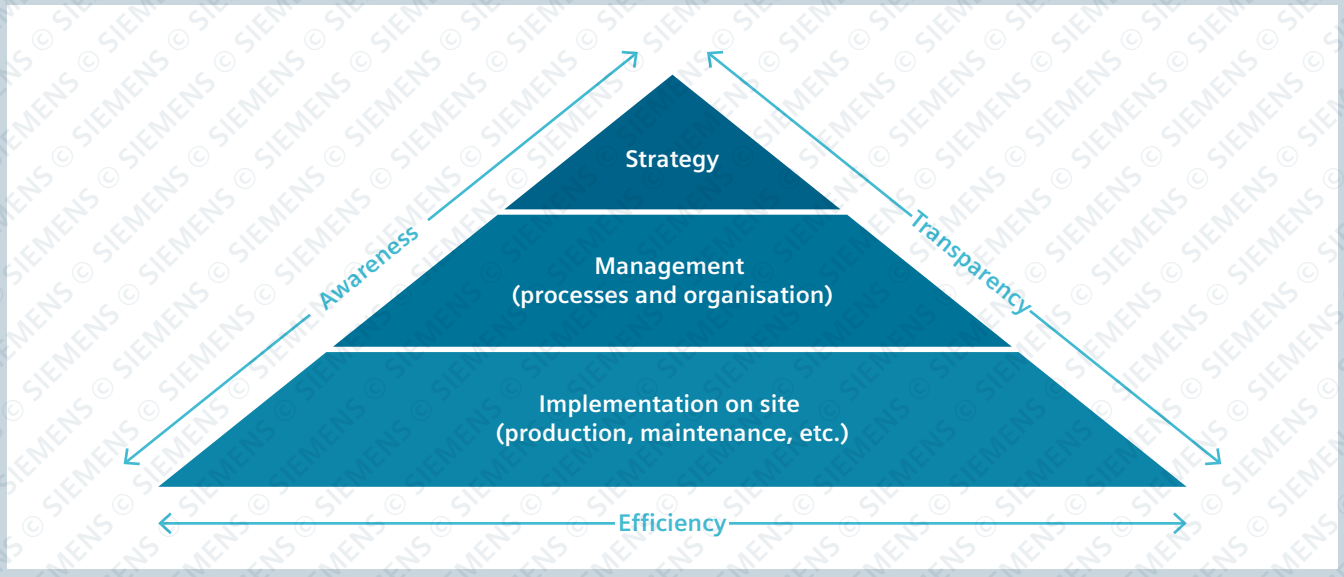
Our energy engineers then draw up a provisional solution concept setting out the proposed measures along with the estimated costs and forecast savings. The findings are discussed with the customer, and the scope of the project to be analysed in detail in the next step is determined.

During detailed analysis, measurements are taken to support the assumptions made, the various systems are correctly dimensioned, implementation on site is planned and the estimated potential savings are calculated to arrive at a binding figure. In addition, the current baseline is recorded and a detailed measuring and documentation method is established. The result is a binding fixed price quotation.

The project is implemented without any interruption to operations, in accordance with operational cycles and scheduled maintenance windows. Where necessary, we will work with standby systems and temporary installations to ensure trouble-free operation of the systems before commissioning the new systems step by step. We coordinate all the building services involved on site.

The modernisation project is followed by the guarantee phase during which we continuously monitor the performance of all systems, maintain the systems and constantly further optimise operations.

Advisory services – building infrastructure consulting



Strategic management consulting on the basis of various modules.

Strategic advice based on a wealth of experience

As well as a specific need to improve the performance of a particular building, companies often need to raise awareness about energy among their workforce in order to anchor it firmly in their corporate strategy. We can assist customers with this process of creating a strategic plan and implementing it in the company, as well as with continuous evaluation.

Roadmap development

Based on

- external considerations (regulatory requirements, price trends, market models),
- internal considerations (energy demand and forecasts, process requirements, environmental goals, site targets), and
- technological considerations (on-site generation, digital transformation, storage, demand response),

together with the customer we draw up an individual roadmap for creating and implementing a strategic plan. To do this our experts utilise the experience they have acquired from a wide variety of projects and industries worldwide.

Analysis of complete building portfolios

Both property managers from a single company and asset managers from property investment funds would like the assurance that buildings will remain attractive for both tenants and investors. Our experts assist in analysing the portfolio and in drafting a successful portfolio development strategy.

Together with the customer, we will work out a strategy for decarbonising the portfolio, for improving the reliability of the building systems, and for substantially cutting energy usage. We can also offer support in relation to strategic purchasing and selling decisions for individual buildings.

Energy procurement

Based on their objectives and requirements, we work with our customers to draw up an individual energy procurement strategy. Security of supply and the management of other risks are always of paramount importance.

Energy management system to ISO 50001

A functioning energy management system provides a systematic way of enabling companies to continuously improve their energy performance (efficiency, energy usage, energy consumption), fulfil their statutory obligations, and also achieve cost and tax savings. The ISO 50001 standard describes the requirements for an energy management system, including the definition of internal processes and procedures and the necessary resources. We possess a wealth of expertise in defining and implementing such systems.

Regulatory compliance

Regulations such as the European Energy Efficiency Directive (EED), national energy legislation or other energy regulations are aimed at continually lowering energy usage, primarily by getting people to use energy more efficiently. For companies in energy-intensive industries in particular, complying with these regulations is a challenge. We help our customers to develop appropriate strategies, carry out compliant audits, and implement measures.

Financing services – innovative models for boosting capital efficiency

Why finance solutions can be expedient

Along with technical proposals, our tailored solution also always covers economic and investment considerations. The forecast savings as well as possible incentives are also included. Various models are available for financing the required investment: if the project is to be financed from the company's own funds, the invested capital is no longer available for other investments. Companies therefore very often limit themselves to measures with the most attractive payback times, realise a project in a number of phases over many years, or simply do not bother with other measures that have even longer payback times.

If the entire modernisation project is carried out at the same time, the customer will benefit immediately after implementation, both from the system functions and from the savings achieved. The hybrid approach also allows measures to be taken that individually would offer a poorer payback time.

Incentives

We are aware of all the important incentive schemes for improving energy efficiency and reducing emissions and successfully assist our customers with applications.

Energy performance contracting

With this type of contract, the investment costs are amortised from the savings on energy and operating costs that can be expected during the agreed term of the contract. Siemens bears the technical risk for this modernisation. The savings achieved from the time the guarantee begins (completion of modernisation) until the end of the contract finance all the measures taken to generate these savings. Any savings achieved over and above this are split between the partners, while Siemens will bear the costs of any savings not achieved. At the end of the contract, the customer will have profited 100 % from the lower costs.

Managed Service Agreements (MSA)

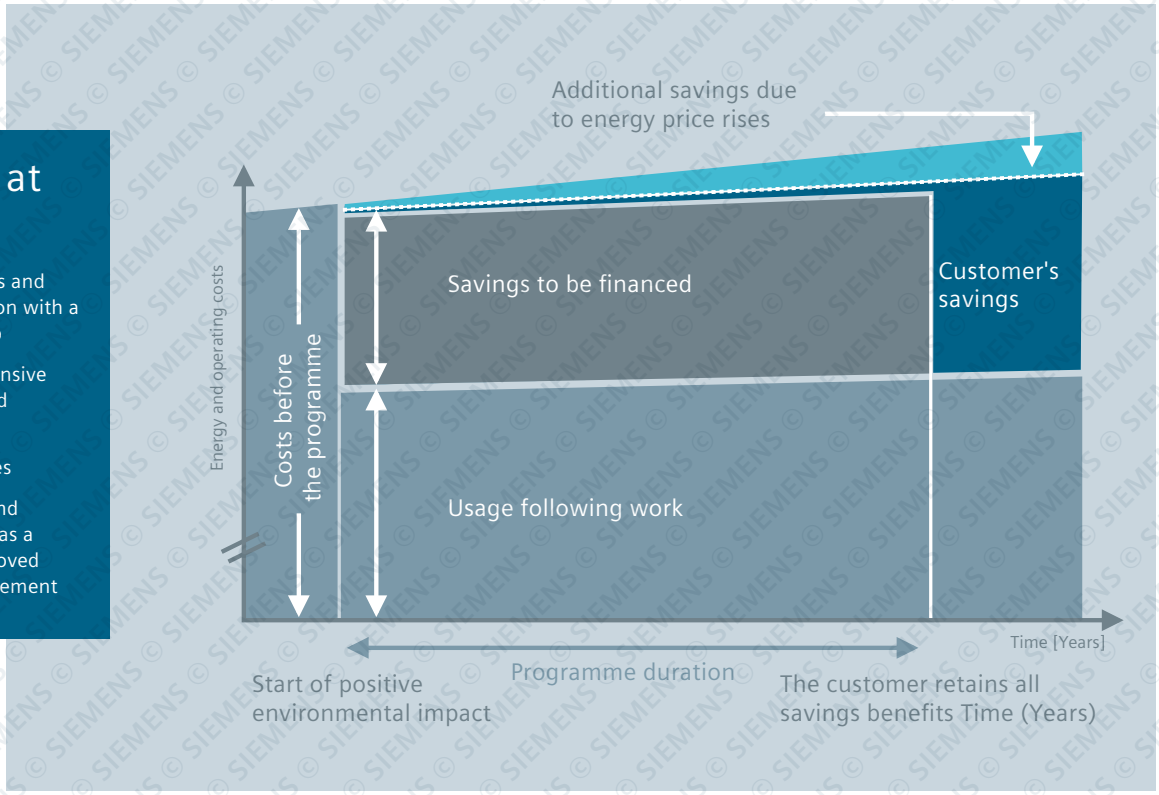
MSAs are a special form of energy performance contracting in which efficiency improvements are delivered in the form of a service. What is interesting about this method is that, for the duration of the contract, the value of the modernised systems is stated in the financing entity's books and therefore does not affect the customer's credit line at all.

Operating or finance leasing

This type of financing requires fixed payments without minimum costs or initial payments. At the end of the contract, the customer has the option of purchasing or returning the systems, or taking out a new lease.

Benefits at a glance

- Strategic focus and implementation with a clear roadmap
- Access to extensive know-how and expertise
- Tax advantages
- Lower costs and reduced risks as a result of improved energy procurement



Energy performance contracting: investment pays off thanks to savings achieved.

Advisory & Performance Services

buildingtechnologies.siemens.com

4.1. Introduction	140
4.2. Aims, categories and impact	140
4.3. Types of maintenance	143
4.3.1. Periodic maintenance	143
4.3.2. On-call service and repair	144
4.4. Extension and modernization	145
4.5. Selecting the appropriate services	146
4.6. Performance criteria	147
4.7. Alarm management	148
4.7.1. Alarm transmission	148
4.7.2. Alarm monitoring centre	148
4.8. Siemens Remote Services	148
4.8.1. Services over remote connection	148
4.8.2. Security of remote connections	149
4.9. Integrated maintenance	149

Use Case	150
Advisory & performance services	152
Advisory services	154
Performance services	156
Siemens Remote Services	158
Overview of service models	160
Service portal	162

4.1. Introduction

No-one would question the need for servicing and maintenance in mechanical systems where parts may be susceptible to corrosion or require lubrication. Electronic systems and components too require regular maintenance, even if signs of ageing here are usually not visible. The latest hazard detectors, valves and sensors may have extremely low failure rates, but depending on their operating conditions, they are constantly exposed to often very harsh environments and their performance may be altered as a result:

- Building management systems (security and building comfort solutions) comprise not one but many devices, located in different places and connected together in a network. Depending on the size and extent, this can greatly increase the complexity and mean that the different devices will age differently. In the case of building systems, a detector in a cold store for instance, will be exposed to different stresses than one in an underground car park.
- Network problems range from simple earthing problems (potential difference) to serious protocol handling problems in networks, e.g. caused by EMC issues (electromagnetic compatibility).
- A life expectancy of between four and eight years is perfectly adequate for consumer electronics. By contrast, building security systems for instance have to last much longer and, more importantly, they have to be reliable. While a television set, for example, may be on between three and twelve hours a day, a security system has to operate 24 hours a day.
- Installation and commissioning of building management systems represent a large part of the initial investment. A longer life expectancy therefore has huge implications for return on investment and will mean lower overall system costs.
- Building management systems are regarded as part of the building, which is why life expectancy of these systems is equated with building renovation cycles.
- Security systems in particular must have a very high level of reliability. This is not only because of the risk to life and assets, it is also about minimizing the problems and faults that facility managers have to deal with day-to-day.

Building management systems normally work in the background, without human intervention. Normal operation is simply taken for granted. This is why these systems have extensive self-test capabilities. Nevertheless, monitoring and control is still necessary even if it is limited to fault detection, so that appropriate measures can then be initiated on the basis of this.

For all these reasons, maintenance of building management systems is vital. In the case of security systems, maintenance is also a requirement under the Technical Connection Conditions issued by the Fire Service. Proper, regular maintenance carefully carried out reduces system failures and false alarms. The result is significantly higher availability of building management systems.

Correct maintenance ensures the reliability of building management systems.

4.2. Aims, categories and impact

Advisory & Performance Services covers all the services provided by the installer or manufacturer following installation. Initially this will be to maintain functional capability, later it will involve modifications to adapt to changing conditions of use or work done to ensure that preset targets continue to be achieved. DIN standard DIN 31051 defines the following categories of maintenance:

Abb. 4.1: Categories of maintenance

- **Maintenance**
  of building systems is intended to ensure that functional condition is maintained throughout the entire lifecycle or is restored in the event of failure.
- **Inspection**
  includes measures to establish and assess the actual condition of all building management systems. Inspection enables the causes of wear to be identified and the necessary conclusions drawn for future use.
- **Servicing**
  covers measures taken to delay depletion of the available wear margin for all building management systems. Servicing is undertaken while the building is occupied and in use.

Repair
is the process of restoring defective objects in building management systems to their original functional condition. Exceptions are improvements.

- **Optimization**
  or correction is a retrospective modification to an object in the building management systems that affects only a comparatively small part and is in the form of an improvement measure. Functioning of the object remains unchanged.

The quality of building management systems is largely influenced by the following parameters:

- **Reliability**
  The systems, plant and IT are in a serviceable condition at all times.
- **Performance**
  High performance of HVAC and management systems thanks to regular software updates, plant checks and tests.
- **Availability**
  The capacity, where required and without interruptions, to alert, to clear and to control building management systems in accordance with customer parameters.

Ease of maintenance is determined primarily by system design in which maintenance methods and means are defined. The other parameters affecting system quality – reliability, performance and availability – also depend largely on system maintenance as it is only through maintenance that they can be achieved. Consequently, system design influences ease of maintenance, while maintenance determines system performance. This correlation between design, maintenance and the quality of a system must not be underestimated. Options for services and maintenance are often not considered until after the system has been installed, an approach which ignores the importance of maintenance and other services. This is why it is worth analysing the ease of maintenance of the various systems at an early stage, when selecting a system. An essential requirement is that the supplier should have an extensive service network.

While maintenance refers to all activities aimed at ensuring smooth operation of the system, services relate to all types of modifications and improvements. Services cover virtually every aspect from change of use of a building, changes to the structural layout of the building through to system upgrades and modernization.

Periodic maintenance is often offered on a fixed-price basis with defined services. By contrast, demand for services is usually not predictable and depends instead on circumstances. Maintenance is often perceived as costly, but a more integrated view shows that the cost of maintenance is more than offset by the significant increase in reliability and longer life expectancy.

There are many reasons for maintenance:

- Smooth operation of building management systems is absolutely essential if they are to perform their task, namely, to protect life and assets and to operate reliably.
- Certain security installations are a legal requirement. Owners and operators of buildings are required by law to ensure that the systems function as intended. By entering into a maintenance contract, responsibility can be delegated to a service company. This means that liability for functioning of the security systems in the event of an incident is normally no longer an issue. This significantly improves the legal position of owners and operators of buildings.
- Maintenance protects the value of building management systems, as devices that are maintained have a significantly longer service life than ones that aren't.
- A regular inspection by a service technician maintains the original system functionality. Experts from outside the company are able to detect the need for changes easily and reliably. One such example is a change of use for the building (e.g. conversion of rooms) which requires the building management systems to be modified.

Services and maintenance are part of the normal lifecycle of a system as can be seen from the Figure below:

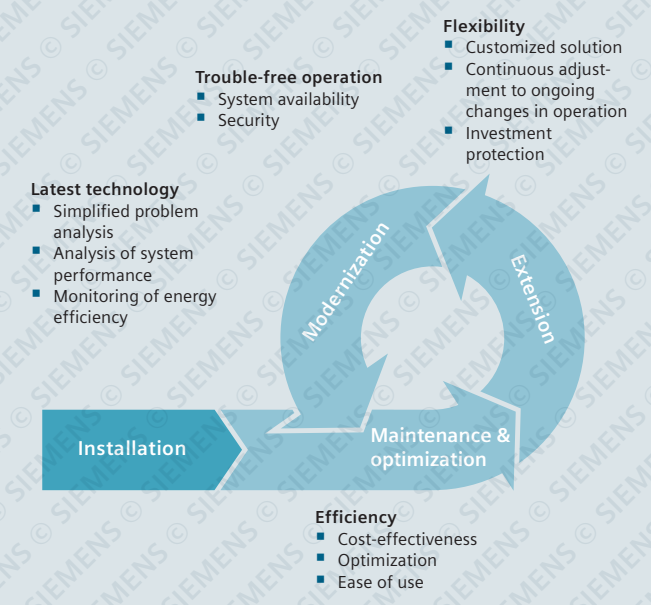


Abb. 4.2: Lifecycle of a system

This graphic shows the lifecycle process. This extends from system installation, followed by a lengthy period of normal system operation when the various building management systems are sometimes simply forgotten, to modernization. A periodic maintenance regime is essential to keep the system operating smoothly in all phases. While maintenance work is being carried out on security systems, building security must still be ensured. If a system is switched off, for instance, guards must be posted or other measures taken to protect the building. Such precautions will ensure timely detection and effective response in the event of a fire, for example.

Maintenance is subdivided into preventive maintenance and repair. Maintenance activities fall into one of three different types:

- **Support**
  A system requires attention. This involves various activities including management, monitoring, training, support, etc.
- **Diagnosis/inspection**
  If there is a problem, various tests must first be done to pinpoint the cause or to establish the exact system status when undertaking preventive maintenance.
- **Intervention/corrective action**
  Once the exact status of the various system components has been established, then repair, replacement, calibration or a system upgrade can be undertaken.

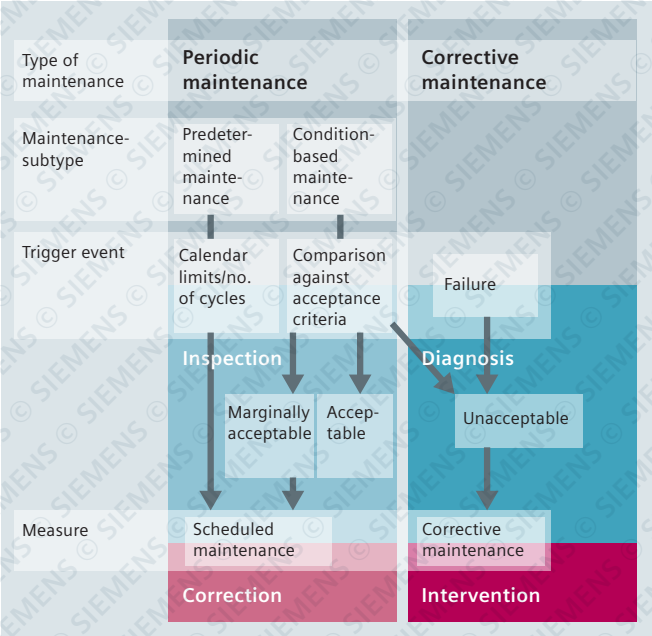


Abb. 4.3: Structure of the maintenance process

Periodic maintenance and repair actions ensure that a high level of system reliability is maintained. Most systems require one annual periodic maintenance action but more frequent inspection is necessary for certain types of security system. Repair is a one-off intervention to restore to a serviceable condition in the event of a system failure or to restore to design conditions in the event of non-compliance with defined criteria.

In the above diagram, periodic maintenance is divided into two categories:

- **Predictive maintenance**
  Maintenance is performed once a year or once every x cycles.
- **Condition-based maintenance**
  Comparison of system performance against acceptance criteria produces either an acceptable result without the need for subsequent maintenance work or marginally acceptable results that will trigger scheduled maintenance action. If the results are not acceptable, repair work must be initiated without delay.

The benefits of maintenance are higher levels of system performance, reliability and stability. Furthermore, a maintained system has a longer service life than one that is not maintained. This not only protects investment in building management systems, it optimizes such investment.

Fig. 1.4 compares two maintenance strategies: System 1 is maintained regularly, e.g. with annual maintenance, while System 2a is not maintained. As a result, this system will have to be replaced earlier by a similarly non-maintained System 2b.

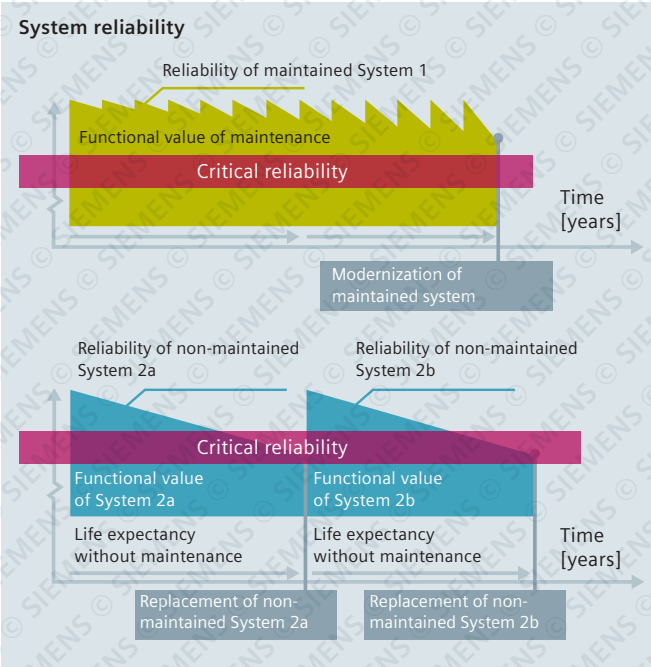


Abb. 4.4: Impact of system maintenance

There is a decline in the performance of system components over time, as a result of the length of time they have been in use. The system starts to age from the time it is commissioned and enters service. This aging process is delayed by periodic maintenance, which ensures reliability. Maintenance also extends the useful economic life of investment in the system. We must therefore make a distinction between the financial value of maintenance and the functional value of maintenance.

The added value achieved by maintenance is thus made up of two components – financial value and functional value:

- **Financial value**
  A longer system life - 12 years, for example, instead of only eight – means a longer depreciation period. The annual costs of System 1 in this case are one third lower. But a well-maintained system will only have such a long life expectancy if the supplier is also in a position to supply the necessary spare parts.
- **Functional value**
  Improved system reliability yields significant cost savings, including the cost of production downtimes, evacuation times and expenditure on repair, system downtime when protection is reduced (risk) and the associated time spent by staff managing the various measures. The aim of preventive maintenance is to prevent system failures as far as possible, so as to achieve a high level of system performance for the customer, thus increasing productivity and efficiency.

The basic approach of the manufacturer is crucial in determining the end-of-life options available for the system – either a completely new system will be required or the system will support a smooth upgrade. In this case the better maintained system components will have a longer service life, thus increasing the value of the original investment in the system.

4.3. Types of maintenance

When people talk about "maintenance" their interpretations of what this means vary widely. The problem is that maintenance is a general term that covers many different areas. It is important therefore to use terms precisely. The table below illustrates the various types of maintenance.

Type	Maintenance modules				
Operational services	Alarm/fault handling	System monitoring	System operation	Operational system support	Analysis of system performance
Specific services	Detector overhaul	Maintenance of fire extinguishing systems	Gas detection		
Maintenance services	Inspection	Functionality check	Preventive maintenance	Corrective maintenance	Emergency intervention
	On-call service (24/7)	Guaranteed response time	Spare parts	Consumable supplies	
Software services	Software backup	Software updates	Software upgrade		
Management services	Technology consulting	Technology assurance	Documentation management	Customer services	Training
Financial services	Pre-financing plan	Leasing	Rental		

Tab. 4.1: Great variety of maintenance tasks

On-site maintenance tasks are largely standardized. Hence, a small number of standard contracts will suffice to meet the many different customer requests for specific optional services to be available.

4.3.1. Periodic maintenance

Periodic maintenance covers all services and spare parts provided for in a maintenance contract concluded by the system owner and the service company. Such a contract specifies technical and administrative conditions and covers management aspects.

Systematic planning and implementation enables permanent analysis of performance thanks to a well-designed information flow. This is crucial to ensuring effective processes in periodic maintenance. The aim of scheduled inspections is to keep the system in perfect working order and to prevent downtimes. Scheduled inspection normally involves a visual inspection and periodic assessments, annual tests and maintenance work on the central controller, testing of detectors and sensors, testing the alarm equipment and the installation as well as updating the system documentation. Compliance with local and national codes, standards and regulations is essential. A maintenance report provides information on tests done on the central controller and peripheral devices and contains suggestions to improve system availability or to modernize ageing devices.

Preventive maintenance can largely be tailored to customer requirements. The main components of this type of maintenance can be classified as follows:

- **Diagnosis (system inspection and various system tests):** Deals with establishing the condition of the various system components. Depending on system tooling options and service company policy, this may involve various tests, including testing of detectors, gauges, sensors, manual call-points, smoke exhaust systems, valves, room tightness, alarm transmission systems, visual and audible warning devices (microphones, loudspeakers, etc.) and many other parts.

- **Correction (setting/repair/replacement):** Problems can be fixed, settings adjusted, components calibrated (e.g. gas detectors) or parts replaced in order to prevent future malfunctions or degradation of system performance.

- **Overhaul:** In order to maintain detection capability, some vendors offer periodic overhaul of certain components. Including overhaul in the maintenance contract enables the additional overhaul costs of the overhaul years to be spread over the lifetime of the system.

- **Remote monitoring:** Today's systems enable continuous monitoring. Depending on the system options, parameters including system status, performance, contamination and many others can be monitored remotely (remote connection). This is the ideal solution for systems in unattended locations, such as small or medium sized telecommunication stations. Remote monitoring of all sorts of systems is becoming increasingly common.

- **Software services:** Modern systems rely on information technology and this automatically involves software. A major advantage with information technology is that software can be upgraded to an improved version. In the past, it was not possible to alter system behaviour but state-of-the-art systems now support changes at various levels. The main levels are the changing of parameters (in the past this functionality was provided partly by small hardware switches) and replacement of software. This allows flexible systems to be adapted in the light of new developments. If there is a software updating option in the contract it makes sense for it to include the associated training and documentation. A backup service offers reliable protection against the unfortunate situation of software loss.

- **Customer training:** While initial training of customer staff is normally part of system handover, periodic refresher training ensures that employee skills do not diminish over time. Successors are as well trained as their predecessors and expertise that is needed less frequently is still retained.

- **Consumable supplies:** Depending on the terms of the contract, spare parts and other materials required may either be billed separately or are included in the contract. In the latter case, a list of the parts and materials covered by the contract, such as replacement batteries or printer paper for instance, will be agreed and included in the contract.

4.3.2. On-call service and repair

The primary aim of on-call service is to maintain system availability and to clear any problems in the shortest possible time, in line with the service level the customer has opted for. The on-call service responds with an unscheduled intervention which may be requested by the customer with or without a service contract. Interventions on the customer site are frequently necessitated by equipment or system failures. Another scenario is a planned maintenance visit during which an unscheduled, corrective intervention is found to be necessary. The aim of an on-call intervention is to restore component or system functionality to a specified level of performance.

The scope for tailoring repair to specific customer requirements is somewhat more limited than is the case with preventive maintenance. As well as restoring system functionality, unscheduled maintenance can also include support for customer infrastructure. The following modules are normally used:

- **On-call service:** Restoration of system functionality as quickly as possible. On-call intervention involves diagnosis to establish the precise system status and then the actual intervention to restore the system's full functional capability.

- **Intervention standby (On-call standby 24/7):** Unfortunately, system faults do not keep regular business hours. In cases where an immediate response is required, regardless of the time of day or the day of the week, the service company must ensure that it has staff available.

- **Alarm monitoring centre:** Alarm monitoring centres are designed to receive all types of alarm and fault messages from security installations and to handle all alarms according to an agreed response and escalation plan. As such, they can eliminate the need for the customer to have an in-house organization to do this. Obviously experts in handling alarm situations will perform better than the customer's own less well trained employees. Economies of scale mean that a central alarm monitoring service costs less than it would for the customer to organize this service in-house. Being connected to an alarm monitoring centre saves the customer having to set up its own security organization.

- **Hotline/remote support:** Advice from an expert is often crucial in enabling system managers to react effectively. This is why hotlines were set up to provide assistance and advice. Modern systems allow remote access via a remote connection. This means the manufacturer or the service company can log in remotely to analyse the system status. Intervention can also take place remotely or by the customer's own staff acting on the instructions of the service company. The findings may of course give rise to an on-site intervention. Hotline support and remote support are becoming increasingly popular as a means of accessing specialist expertise not available in-house. It enables a system problem to be resolved by a simple phone call (Hotline Support) or by online analysis (remote support). This makes hotline and remote support very cost-effective maintenance options.

- **Guaranteed response time:** It is unacceptable for critical infrastructure not to be in a working state, which is why a rapid response is required in the event of a fault. Appropriate agreements must be reached with the service company. The company has to guarantee that the intervention will start within a defined response time and with qualified technicians. Obviously, companies that have a dense network of branches will have a huge advantage over their competitors.

- **Consumable supplies:** If these are included in the maintenance contract, the system will be maintained for the agreed fee – whatever happens.

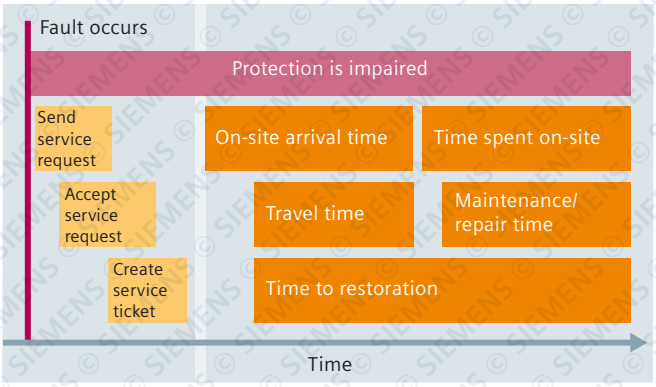


Abb. 4.5: Events and measures involved in a service call-out

An on-site intervention always starts with certain administrative steps, i.e. call qualification which is vital if the intervention is to be effective. Travel time does not start until the technician is properly prepared. On arrival on-site, the technician must first report to the customer representative to get a full picture of the situation. Only then can the technician start work.

Installers and manufacturers are the experts when it comes to maintenance of building management systems. Some of these companies looked at ways of increasing the overall value of their services to the customer. The result of these deliberations is system lifecycle management – an interesting service offered by only a few suppliers. The aim of this process is to identify which system components have to be replaced when, in order to minimize maintenance costs while at the same time considering the risk situation and maintaining the necessary protection level.

4.4. Extension and modernization

If major changes have to be made to an existing system, this requires a service project. The two main reasons for a service project are to perform a system upgrade (extension) or a system update (modernization). Separate service contracts are signed in order to undertake these service projects. System upgrades may be necessary to adapt the system to meet new requirements or to extend protection to or include new parts of the building. There are almost as many reasons for service projects as there are buildings.

By replacing system parts, weaknesses in an older system can be eliminated using state-of-the art products. This allows an older system, for instance, to support new features such as remote maintenance via a remote connection, with payback in a short space of time.

All systems reach the end of their lifecycle at some point. This is when a system update needs to be performed as a service project. Updates (modernization) normally involve partial replacement of obsolete components by new ones, with the wiring being retained. This does of course rely on the new components being compatible with the old ones. A flexible modernization concept (including a partial modernization) will add value, as the weakest components are the first to be replaced. This means that the other system components, which are in better condition, can remain in use for longer and this equates to a longer service life. Also, this approach causes fewer problems and less disruption to normal building operations than a full system replacement and means that no conversions are required.

An important aim of such services is value retention over the entire lifecycle. Modernization is part of the lifecycle of a building. This involves updating (modernizing) ageing systems in a timely manner to provide a bridge to the next system generation. This removes the need for an expensive total replacement while reaping the benefits of the latest technologies. This migration philosophy guarantees predictive maintenance, minimizes downtime and increases the value of your building.

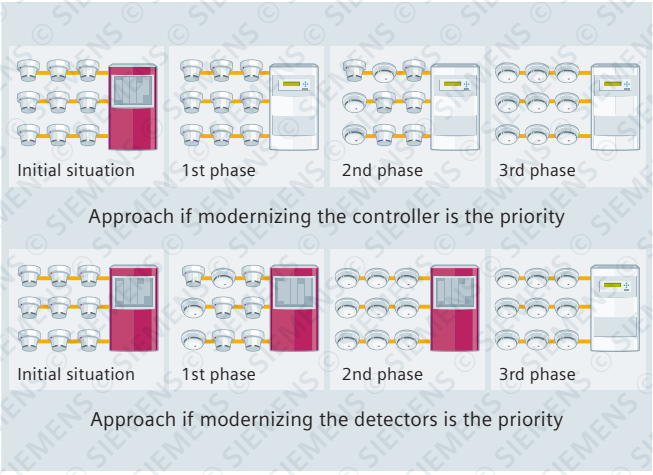


Abb. 4.6: Example showing modernization of a fire detection system tailored to the customer's specific needs.

The Figure shows how flexible modernization concepts increase the value of an existing system by extending the life of the better preserved system components. This relies on an individual assessment of the actual situation but this is not a problem for a competent service company.

Service packages also address the issue of optimizing building performance. The first step toward an efficient future starts with migration of existing systems. Analysis of the installed plant, development of integrated modernization measures and professional implementation of these will deliver the desired success and will combine the positive economic effect with a sustainable contribution to the environment. Thanks to upgrade programs tailored to specific needs and business processes, buildings and infrastructure are kept on the cutting edge of technology, thus increasing the energy efficiency, sustainability and availability of the infrastructure. If energy efficiency targets are to be achieved in the long term, after migration, this will require continuous monitoring of the relevant performance indicators. Energy management is a tool that supports facility operators, helping them to identify and systematically achieve potential energy savings (for more information, see section on "Building performance & sustainability").

4.5. Selecting the appropriate services

Scheduled on-site maintenance helps to limit the number of unscheduled on-site interventions that are needed. Remote maintenance via a remote connection gives the system operator added flexibility and support. But which maintenance contract should you choose? Which services are most appropriate for a particular company? Clearly there is not always one simple answer to these questions. It may prove useful however to consider the following points:

- In many countries system operators are required to take out a maintenance contract for security and safety systems, primarily fire detector systems. The aim is to ensure that the system is fully functional. Such regulations are often the result of bad experience. Regardless of whether or not maintenance is a stated requirement, a basic contract is a logical conclusion based on safety awareness and common sense. A system must be maintained if it is to fulfil the function for which it was installed.
- Furthermore, a well-maintained system lasts longer and thus protects the investment it represents. Another point to remember is that investment comprises not just external costs, but also the resources committed by the company's own employees to planning and managing replacement of the system (internal costs).
- Is the company consciously committed to high standards in its products and services? In this case nothing less than a comprehensive maintenance contract should be contemplated. High standards create high expectations which have to be met.
- Does our company have a high value add per employee? In this case, outsourcing necessary services to the manufacturer or system vendor will further increase value add as this will cost less in the end than using in-house staff.
- High-risk organizations must of course be able to guarantee absolute availability of their security and safety systems in particular. If a fire detection system fails, a fire watch will have to be put in place – a costly measure.
- High-risk companies benefit from software updating: future software updates and functional upgrades increase the value of the system.
- Are our own resources an adequate basis for handling the various aspects of the building management systems? Are our own people equipped to deal with any eventuality, in terms of their skills and availability? If, for instance, there is no full-time corporate security manager, then a contract with an alarm monitoring centre can be very useful.
- It is possible for in-house staff to assist service technicians with routine detector tests and basic maintenance work on the various systems.

Well-organized service companies offer a variety of standard contracts so the available maintenance services can be matched to individual requirements. A system and its maintenance are closely interlinked. The choice of system largely dictates the companies capable of maintaining that system. This is why it is important to consider maintenance requirements early on, at the system evaluation and selection stage. The following questions will help you to assess the services offered:

- Is the company able to maintain my system with the designated service team?
- How far away is the company's local branch?
- Which Standards does the company meet?
- Which certifications does it have?
- What performance level is guaranteed?
- How is the equipment lifecycle managed?

4.6. Performance criteria

Selecting the right company to provide services and maintenance for a system is often seen as a complex task. Which aspects need to be assessed? What differences are there between the individual providers? The following questions will help form a better assessment of the service company:

- Does the company have a good reputation?
- What credentials, references and certificates guarantee the professionalism of the company and its work?
- Which qualifications and certificates do the service company's employees have?
- Is the company capable of resolving major problems in a short time? Even if the situation is not expected to arise, it is reassuring to know that problems can be fixed quickly.
- Where is the nearest branch?
- How far must the service technician travel to maintain the system? A dense branch network reduces travel time.
- Does the company have multiple branches (branch network), so that bottlenecks in the local branch can be cleared quickly or good support can be provided for the customer's entire network of branch offices?
- What is the company's average repair time? It is annoying if the service technician has to attend three or even more times to carry out a repair.
- Is the company able to provide remote maintenance in some cases? Efficiency has many facets.
- Will the company still exist and be able to honour the contract in a few years' time? If services for security systems, for instance, are not part of the service company's core business, might it change its strategy one day and cease its maintenance activities?
- Is the company able to maximize system life and thus optimize your return on investment? Maintenance work only pays off if it has the effect of extending system life.
- Is the company able to migrate the system smoothly at the end of its lifecycle? An incremental system replacement is more beneficial for the customer than a cost reduction during contract negotiations.
- Is the company able to expand its scope of services significantly at short notice? This may be necessary, for instance, if the customer needs to overcome an internal resource bottleneck.
- Does the company have sufficient stocks of spare parts for the customer's system? A rapid response is not possible if the defective parts first have to be ordered and finally shipped to the service company.
- Does the company use the manufacturer's original tooling and software tools for analysis and support? This is essential if it is to work efficiently.
- Is the service company able to do all the work itself or does it require the assistance of other companies for more complex tasks? This has a detrimental effect on efficiency, average repair time and the quality of the work.

The choice of system largely dictates the choice of service company. Also, not every system is suitable for incremental updating. Finally, some systems are more conducive to maintenance than others, based on modularity, replacement options and component interaction, for instance.

For these reasons, the factors listed above should be considered when selecting a system. Sometimes more detailed research is needed to identify any stumbling blocks. And if there are none, the exercise will still have been worthwhile as you can then be sure of having found the right partner.

Selecting the right service company and maintenance modules will pay off.

4.7. Alarm management

A building management system serves its purpose only if there is fast, professional intervention in response to a fault or emergency or if continuous monitoring proactively allows steps to be initiated. This requires reliable transmission of alarms, faults and system messages. Alarm transmission requirements are set out in the building and contents insurance. These requirements cover internal and external alarms routed to a public alarm monitoring centre (police, fire service) or a private alarm monitoring centre. Together, the alarm transmission system and alarm monitoring centre form an unbroken alarm chain and as such are the basis for successful alarm management. The transmission equipment also provides the technical infrastructure needed to support remote maintenance and operation of building management systems.

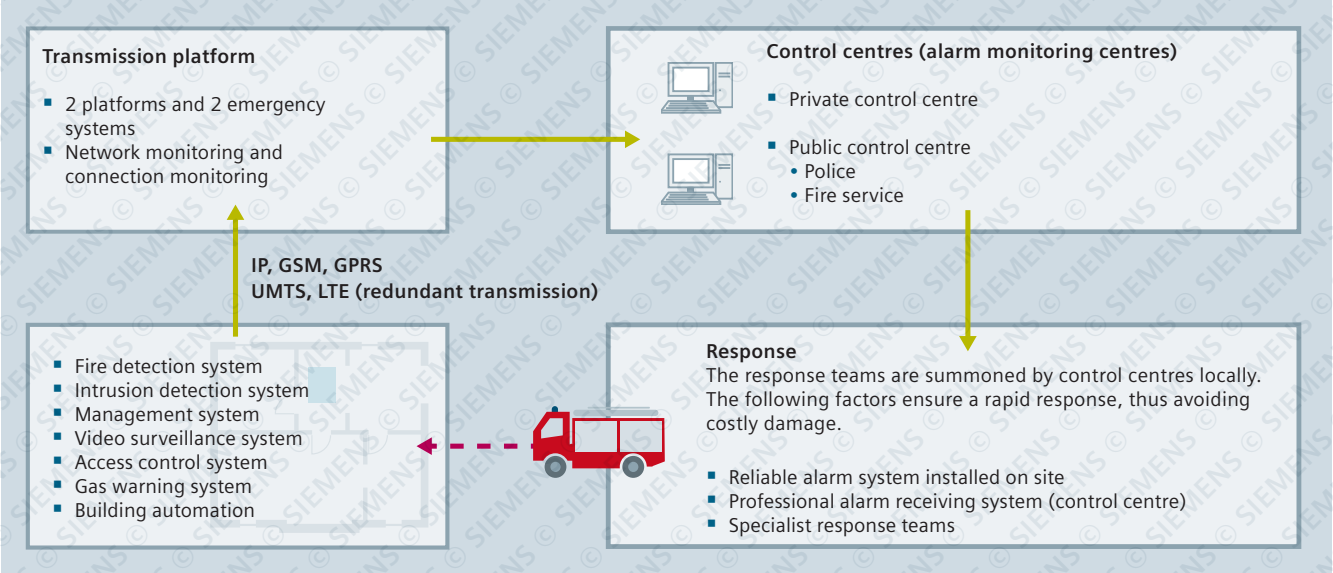


Abb. 4.7: Alarm transmission to alarm monitoring centres

4.7.1. Alarm transmission

Alarm transmission devices that are installed predominantly in security systems transmit alarms and fault messages over a public network to a recipient (company's internal control centre, public or private alarm monitoring centre). Secure alarm transmission devices use two different technologies (wired and wireless network), so that a single fault location or a single act of sabotage cannot cause all transmission channels to fail simultaneously. Depending on the risk level, end-to-end monitoring of the alarm transmission channel is done either permanently or periodically. Secure connection of the alarm transmission devices to the alarm receiving centre is ensured by specialist providers of alarm transmission platforms.

4.7.2. Alarm monitoring centre

The alarm monitoring centre is at the heart of all security concepts. This is where alarm messages are received, processed and forwarded. The necessary emergency response measures (intervention) are initiated without delay. Alarm monitoring centres ensure that a contact person or response professionals (e.g. security guarding company, police, fire service) are directed to the right place and serious damage can be avoided by their fast response.

4.8. Siemens Remote Services

4.8.1. Services over remote connection

Remote access allows the service company to provide support and services to the customer online over a secure remote connection. This includes:

- Full functional access via remote desktop applications for remote support, diagnosis and fault clearance
- Engineering and parameter changes, including configuration backup and upload
- Log file access and analysis
- System status monitoring or event monitoring, including reporting
- Proactive monitoring 24/7, so that abnormalities can be identified and immediate action taken to avoid imminent system interruptions
- Identifying the optimum time for maintenance
- Availability of specialists and experts

The key advantage of remote diagnosis is that the customer is assured of optimized, all-round system support. In the event of a malfunction or a defect, the fault can first be located by analysing the log files and then plans made to clear it by the relevant specialists and using the right materials. Rapid, accurate fault clearance achieved in a single intervention reduces system downtime and means the customer has to spend less time on coordination. An intelligent mix of remote main-

tenance and on-site services aims to deliver high system availability and minimize any disruption to the customer's operations.

If the customer's supervisory personnel have problems with system operation, remote access and the virtual user interface mean that timely, targeted assistance is at hand – 24 hours a day. It is also possible, by agreement with the customer, to change system configurations, parameter values or customer settings to meet current needs or to comply with new guidelines, e.g. changes to authorizations or temperature adjustments. The updated configuration can be backed up and uploaded directly over the remote connection or, if necessary, via the service company's secure servers.

The remote connection can also be used to search and analyse system/plant data which is used to generate periodic reports on plant stability and system performance. These reports are the basis for system analysis and the resulting system optimization measures, around energy efficiency or cost savings, for instance.

Permanent monitoring of building management systems is vital where critical business processes are involved. Proactive monitoring enables irregularities in the system to be identified either periodically or in real-time and then corrected. This prevents system interruptions and the associated potential disruption to customer processes and the resulting costs. The impact of functionality and availability of building management systems can be demonstrated to the customer using key performance indicators. What counts here is not the individual service performed to meet a requirement, but the quality of the outcome, i.e. the impact on the customer's business processes.

The service company prepares analyses and reports for the customer and makes these available via a customer portal. The customer can access a list of installed plant and relevant information via a secure gateway, where the associated service contracts can be accessed, work reports and invoices can be viewed and service tickets can be created and tracked.

und damit verbunden auch mögliche Störungen der Kundenprozesse oder daraus resultierende Kosten. Die Auswirkung von Funktionalität und Verfügbarkeit der gebäudetechnischen Anlagen können dem Kunden mithilfe der Kennzahlen aufgezeigt werden. Somit spielt nicht die einzelne Dienstleistung zur Erfüllung der Anforderungen eine Rolle, sondern die Qualität des Ergebnisses, d. h. die Auswirkung auf den Geschäftsprozess des Kunden

Auswertungen und Berichte bereiten die Servicefirmen für den Kunden auf und machen diese per Kundenportal verfügbar. Über einen gesicherten Zugang kann der Kunde auf die Liste seiner installierten Anlagen und entsprechenden Information zugreifen aber auch die dazugehörigen Serviceverträge aufrufen, Arbeitsrapporte oder Rechnung einsehen oder Servicetickets anlegen und verfolgen.

4.8.2. Security of remote connections

Data protection and data security are extremely important, as is access protection and monitoring. Remote maintenance can only be done with the customer's approval and these aspects are covered in a service contract. Remote connections are based on a secure Virtual Private Network (VPN) which uses complex encryption technologies to prevent unintentional interception of data between private sites. Remote service platforms also implement an authentication process for system access, i.e. each time a service technician logs on in the platform, his user identity and access rights are verified.

4.9. Integrated maintenance

Often, a customer has not just one building management system, but several interdependent systems (e.g. fire detection system, comfort system, control system). The maintenance of our systems is carried out in a coordinated fashion in order to preserve network connectivity. This means that the customer is not affected by system interruptions during maintenance.

By putting maintenance of all its building management systems in the hands of a single service company, the customer no longer has to perform a coordinating role. This is not the only benefit however. Integrated support also means that the service partner is able to identify and assess deficiencies in integration/interaction between the individual subsystems. The service partner can then advise the customer on potential optimization measures and implement these effectively. This efficiency has an impact on the customer not just in terms of the reduced coordination effort for maintenance and the operating costs of the individual systems, it also ensures an optimum system lifecycle and this in turn is reflected in reduced capital investment costs for the customer.

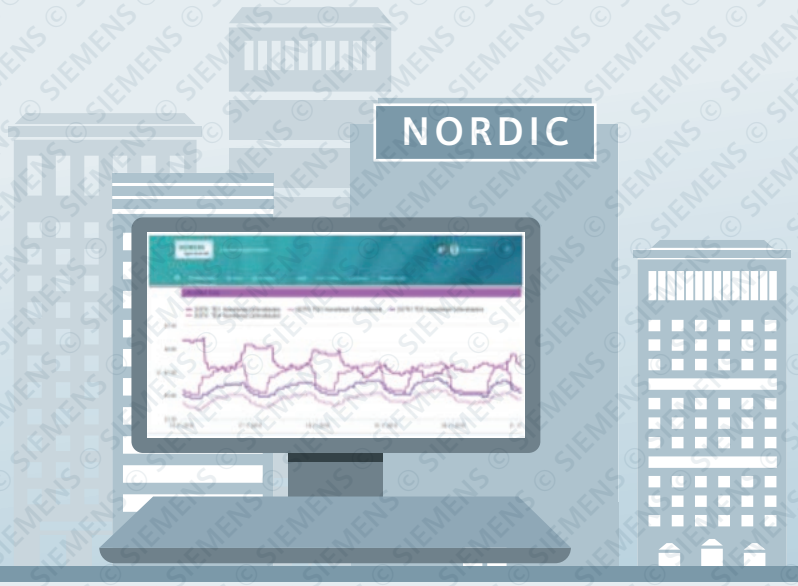
A practical example of a perfect place – one of the Nordic shopping centres

Most pressing concerns

- Leaseholder satisfaction and retention
- Public perception and visitor satisfaction
- Modernization and efficiency (€/sq.m.)

Siemens solution

- Ability to keep rents fair and consistent
- Safe and convenient workplaces
- A modern and sustainable building that is easy to advertise
- Safe and convenient places for relaxing
- Continuous data-based analytics for identifying potential
- Regular implementation of projects in order to reduce OPEX



"We make our money by managing 170 shops and leasing 100,000 m²"

People
- Dedicated energy and operations managers on site

Technology
- Service platform with remote analytics and reporting
- Cloud-hosted Desigo automation system

Services
- Fault detection and diagnostics

OUR **GUARANTEE**

50%
reduction in district heating

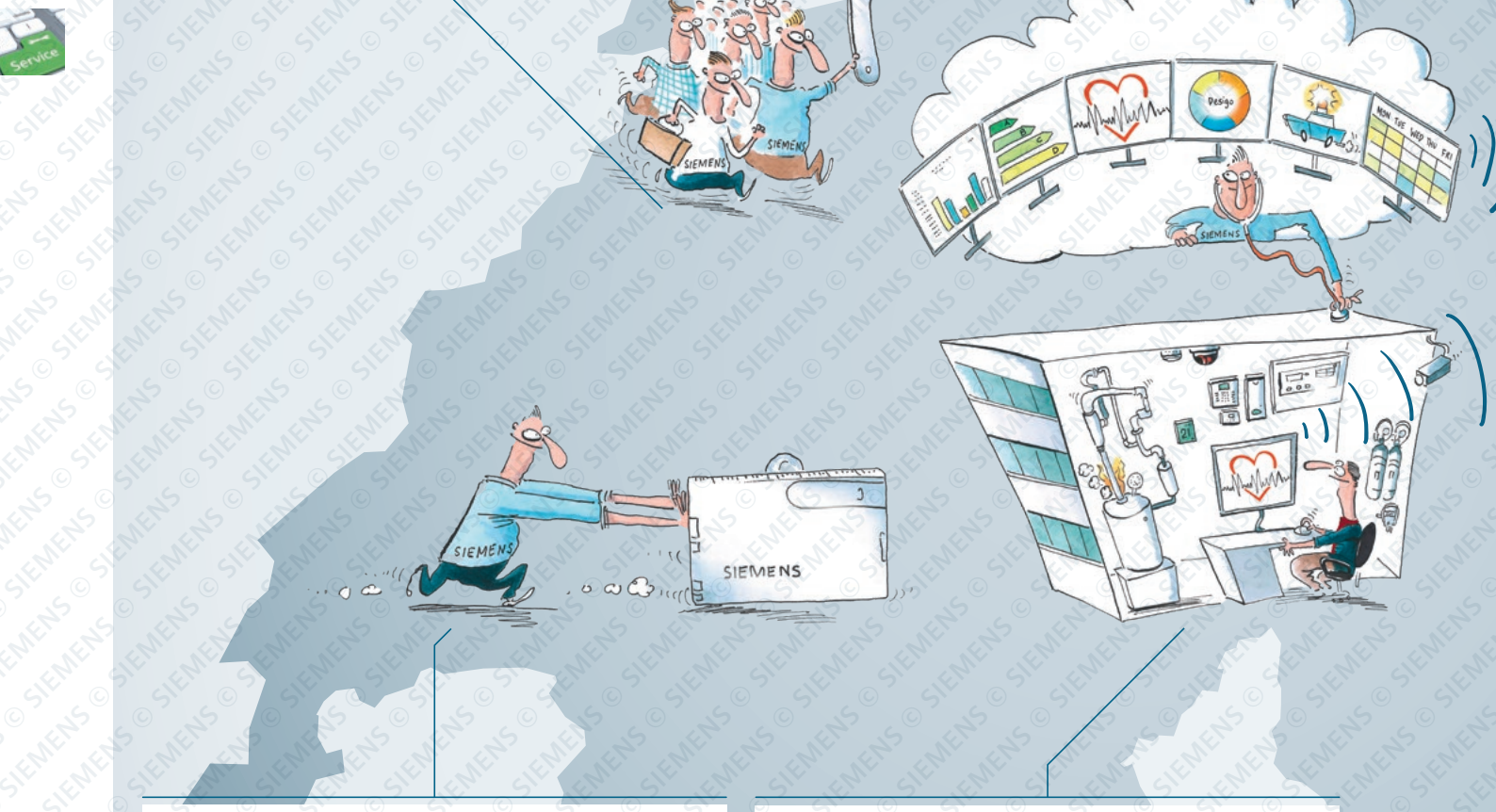
€110k a year
immediate savings

Advisory & performance services

Over 800 field technicians covering the whole of Switzerland

Wherever your buildings are located, we are close at hand. With over 800 field technicians, we offer a comprehensive range of services:

- You benefit from the pooled expertise of experienced senior technicians
- Our friendly technicians can be on site quickly to help – even late at night, around the clock
- Continuous training means that our technicians are always abreast of the latest developments



Your local technician

It is important to us that you should have a well-established contact:

- Our technician will carry out preventive maintenance and inspect wear parts before they fail
- He/she will advise you on technological issues and identify trends
- He/she is knowledgeable about topics such as lifecycle management

You are the focal point

We understand your need for safety and convenience for you and your employees. We therefore keep a finger on the pulse of your plant:

- You want an optimum and pleasant interior climate
- It is important to you to have safety systems that are easy to manage
- You aim to improve performance and building efficiency
- It is vital to ensure continuous operation
- You want to benefit from predictive analyses of plant conditions and data

Regular expert servicing, maintenance and modernization ensure the utmost possible safety and maximum convenience of your plant – in terms of the overall lifecycle and maximum efficiency. Technology and requirements change. Our services adapt to suit. Highly competent, well equipped and ready to help you at any time – anywhere in Switzerland!

Secure, totally secure

You can trust us – your data is safe with us. Information security is our top priority:

- We are experts in managing data security
- We follow the latest information security guidelines
- Your data is stored in the Siemens Data Centre and protected by firewalls
- Encryption complies with current data protection guidelines
- The connection is secured via VPN

Everything under control

The Siemens Service Portal keeps you constantly informed about exactly what is running and when, so you have your finger on the pulse of your plant:

- You can retrieve data from anywhere at any time, giving you complete transparency
- This allows you to plan your finances and costs clearly
- We offer trend analyses of plant conditions and data
- Information security and data protection are guaranteed at all times

Overview of evaluations and analyses

We are used to managing a wealth of data and information:

- We transform your data into smart data and draw up reports for you
- We identify trends and derive measures from these, enabling us to identify optimization/modernization potential immediately
- Data and information security is guaranteed at all times

We keep a finger on the pulse of your plant

Our integrated management system enables us to see more than just the individual components

- We analyse your data in real time and record the interaction between the various components
- This makes preventive diagnostics possible

Alarm management

We provide you with all the technical tools you need to enable you to respond quickly in an emergency:

- We make sure the alarm is connected to the emergency response services
- In the event of an incident, we provide assistance to the investigating authorities
- We secure and evaluate all important data

Energy services

Energy optimization and efficiency planning are two of our core competencies:

- We evaluate your data, thereby creating transparency
- At the same time, we identify the potential for savings in your buildings
- We take appropriate action to reduce your operating costs

Servicing – 24/7

We are here for you round the clock, providing support with:

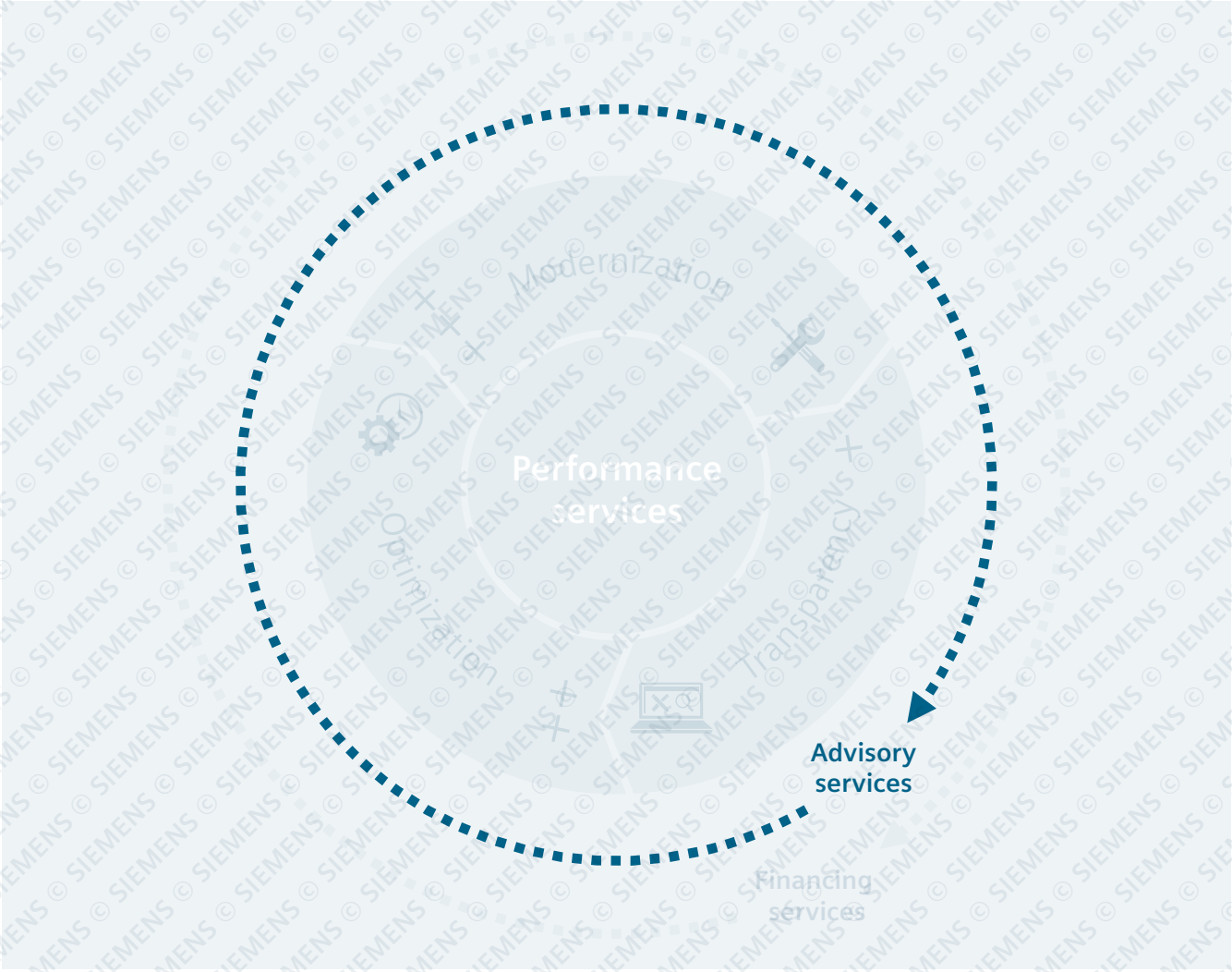
- Software and firmware updates
- Via remote access, we are able to respond immediately in different plants and to take remedial action (management systems, BMA, EMA, access control, video security, HVAC and room automation)
- If necessary, we rectify faults directly at the plant

Hotline/Helpline

Whenever you have questions about your plant, give us a call. We will be pleased to assist you further:

- Competent and professional advice from specially trained Siemens employees
- Support in your own language
- Optimal operations and maintenance planning for your requirements

Advisory services – advice to companies on their building infrastructure



Strategic consulting based on our extensive experience

Besides specific needs relating to improving the efficiency of a particular building, there is often a need to change employees' aware-ness of energy issues and to embed these in the corporate strategy. Here, we support our customers in this process of drawing up a strategic plan, implementing it in the company and continuously evaluating it.

Development of a roadmap

On the basis of

- external considerations (regulatory requirements, price trends, market models)
- internal considerations (energy requirements and forecasts, process requirements, environmental objectives, site objectives) and
- technological considerations (on-site generation, digitalization, storage, demand response)

we work out, together with our customers, a customized schedule for drawing up and implementing a strategy. Our experts draw here on the experience they have accumulated in a variety of projects and industries worldwide.

Analysis of overall building portfolios

A company's property managers, as well as the asset managers of a property investment, want to ensure that the buildings are and remain attractive to both lessees and investors. Our experts provide assistance with the analysis of the portfolio and with the drafting of a successful portfolio development strategy.

Together with our customers, we work out a strategy for decarbonizing the portfolio, increasing the reliability of building systems and reducing energy consumption substantially. We also help with strategic decisions on the purchase and sale of individual buildings.

Energy procurement

Together with our customers, we draw up a customized energy procurement strategy, based on their goals and requirements. Security of supply and the management of other risks are always paramount here.

ISO 50 001-compliant energy management system

A functioning energy management system enables companies continuously to improve their energy-related performance (energy efficiency, energy use, energy consumption) by means of a systematic approach, to meet regulatory requirements and to implement cost and tax savings. The ISO 50 001 standard describes the requirements for an energy management system and contains definitions of in-house procedures and processes, as well as the necessary resources. We have extensive expertise in defining and implementing such systems.

Fulfilling regulatory requirements

Statutory provisions such as the European Energy Efficiency Directive (EED) and domestic energy laws and regulations pursue the goal of continuously reducing energy consumption, mainly through more efficient energy use. For companies in energy-intensive industries, in particular, the implementation of these regulations presents a challenge. We help our customers to develop appropriate strategies, to conduct compliant audits and to implement measures.

Performance services – intelligent maintenance looks ahead

Merely carrying out servicing and maintenance when a problem arises is an outdated approach. Digitalization is now opening up totally new perspectives – through the continuous recording and intelligent analysis of data. The knowledge gained as a result does not just make it possible to predict the optimal time for servicing the plant. The possibilities are far wider-ranging and play a critical role in ensuring that companies benefit from significant increases in productivity.

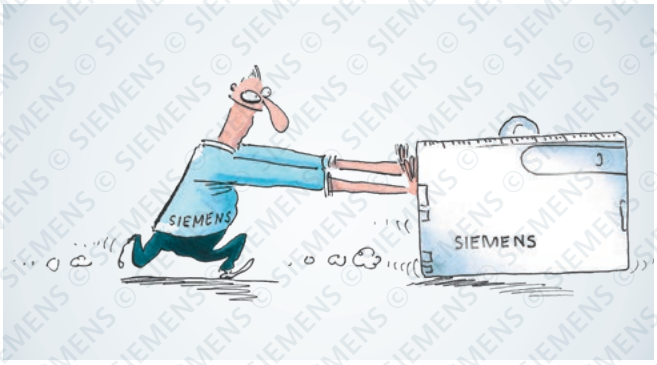
Performance services – the basis of your success

Our performance services will help you to secure a vital competitive edge by protecting your investments, increasing your efficiency and managing your risks. In addition, our performance services provide you with all the services necessary for preserving the value of your building throughout its lifecycle.

These services create and maintain the optimum preconditions for efficiency, reliability and value creation. Moreover, they relieve you of tasks, processes, assets and responsibilities. In this way you can increase your competitiveness – partly because you have more time to concentrate on your core business.

We safeguard technical progress, service growth and innovation through migration or modernization concepts. Supplementing the services provided locally, our remote services ensure that know-how, information and technology are available to you anytime, anywhere.

For example, through product-oriented, preventive and reactive services. These prevent unplanned outages and secure the functionality, quality and availability of your technical infrastructure. They are tailored to your technical and normative service requirements and provide optimal support for your business processes.



Increasing efficiency

- Modernizing and continuously improving plant
- Improving system performance and employee productivity

Pioneering innovations and solutions and customized migration and modernization concepts enable continuous optimization of your service processes, e.g. faster response times. With the aid of preventive services, we increase the efficiency and quality of your technical infrastructure, relieving you of tasks, processes and responsibilities.

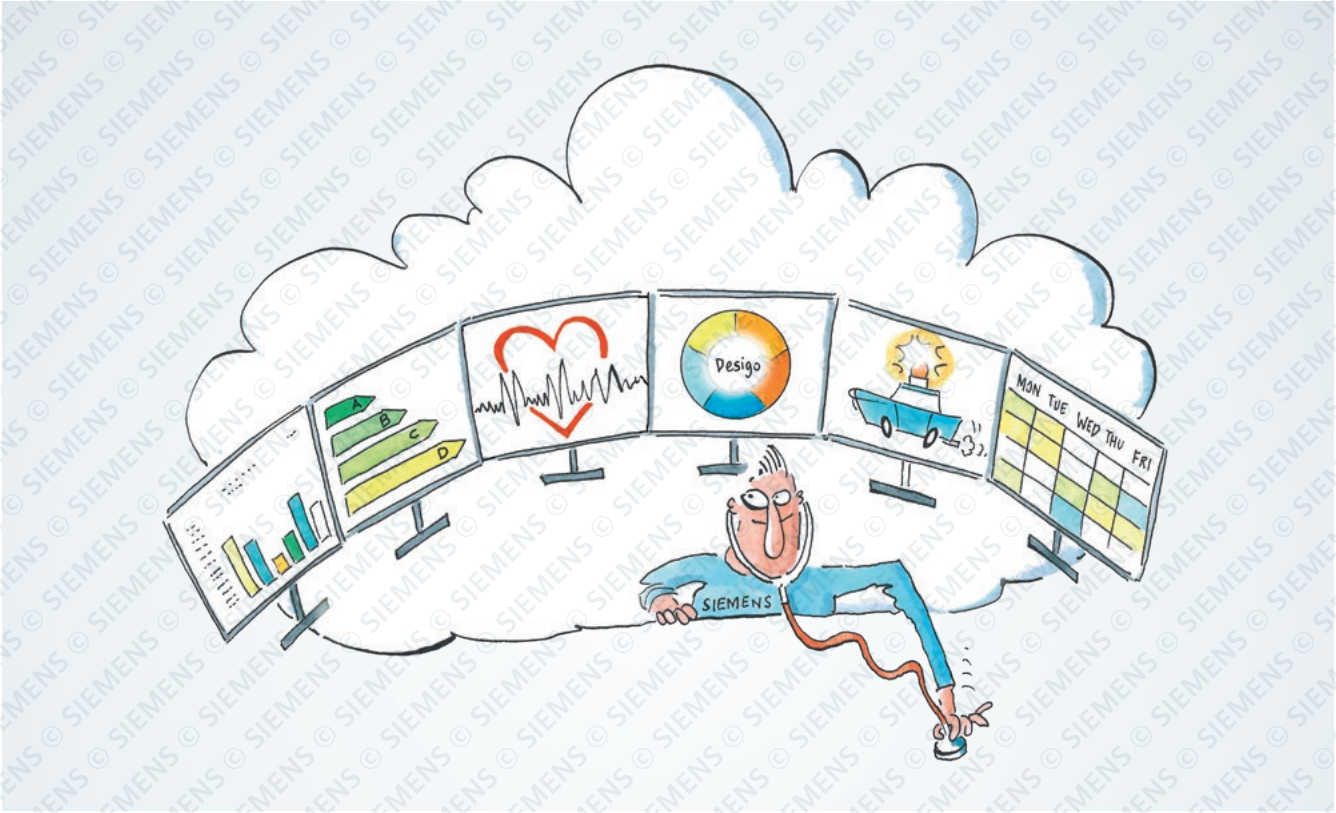
Protecting investments through long-term partnership

Ensuring functionality, quality and compliance

Our ongoing maintenance and software support measures form the basis for the long-term usability of your plant and protection of your investments. Through the transfer of knowledge and skills and through our support, both remote and on site, we create the basis for a reliable partnership over the entire lifecycle of your technical infrastructure.

Keeping your finger on the pulse and managing risk

In order to ensure optimal performance, proactive monitoring of the components used in your system is a key aspect of our service. Faults are detected or even prevented at an early stage, guaranteeing the availability of your plant and thus also the continuity of your business operations. The associated automation facilitates greater transparency regarding your processes and costs.



Profitable impact of digitalization

With the aid of innovative technologies, digital business models make use of the data from products and processes in order to create additional customer benefit: they maximize the availability of the systems, ensure cost-efficient operation and offer the customer further advantages such as greater security or energy savings. A thorough understanding of your needs and processes is vital when it comes to creating customer benefit. Rather than focussing solely on big data, Siemens draws on smart data: in this way, Siemens engineers can intelligently combine product know-how and process expertise, and the data analysis helps the customer to avoid unplanned downtimes and improve operational efficiency. Data creates transparency and enables better decision-making. By integrating huge quantities of data generated in buildings or from other sources such as weather forecasts or service reports, as well as using modern analytical methods, our experts are able to predict and prevent faults. Moreover, they can also identify ways to improve performance and save energy and costs.

1 Enhanced services and services through digitalization

2 Data-based services 24/7

3 24/7 service transparency thanks to our service portal

Siemens Remote Services

The benefits at a glance

- Operator support by Siemens system specialists
- Rapid initial diagnosis enables targeted fault clearance
- High standard of security, end-to-end encryption
- Remote dial-in for in-house staff and on-call service personnel

Saving time with remote services

We offer you comprehensive services based on a remote connection. Your systems can be accessed via a secure connection, and the key parameters can be recorded and/or adapted. This makes it possible to provide a proactive service – before anything happens – thus increasing the availability of your systems.

Service over the entire lifecycle

The remote connection of your fire-alarm, security and building automation systems means that you will benefit not only in the event of a fault, but also during operation and maintenance.

Practical for new and existing systems

The remote connection ensures prompt processing of your requirements, both in newly installed systems and in existing systems.

Equipped for the digital world

Continuous data recording via the remote connection is the basis for further services, such as performance optimization or data monitoring.

Your systems under constant scrutiny

For cost-effective, uninterrupted and efficient operation, you must be able to rely on the fact that your systems are all functioning properly. We provide support in the form of precise information and regular performance reports.

On call around the clock

Our service organization is available for you 24 hours a day. In addition, during the agreed service period you will have access to support and advice from trained specialists via the remote connection. Where necessary, they will initiate appropriate action immediately.

Faster initial diagnosis and repair

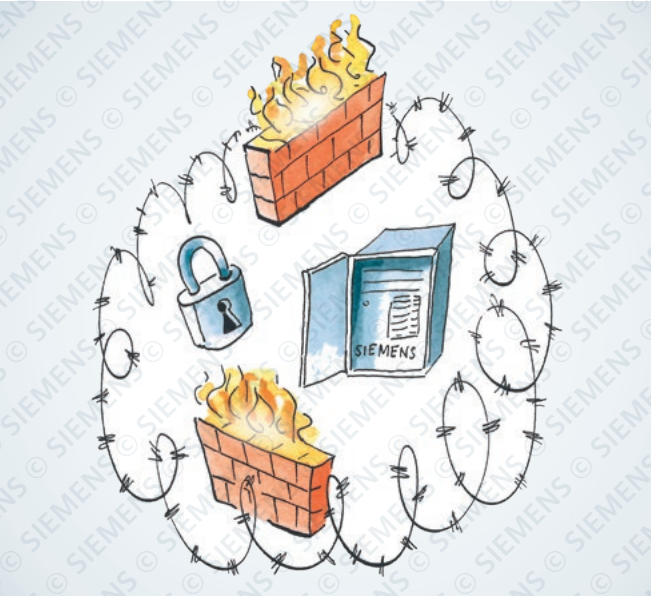
In the event of a fault, our customer service technicians can use remote diagnosis to ensure that they are fully au fait with the situation before they arrive on site. This intelligent combination of remote and on-site services reduces waiting times and minimizes night-time call-outs.

Customer-controlled access
In order to provide you with access even from outside the Siemens network, a secure facility for external operation has been created. In this way, you always retain control over remote access to your plant. If necessary, you can explicitly block access to individual targets or approve it only when required.

Guaranteed platform availability
Two fully redundant computer centres in Germany and in the USA ensure the highest possible level of availability of our remote services.

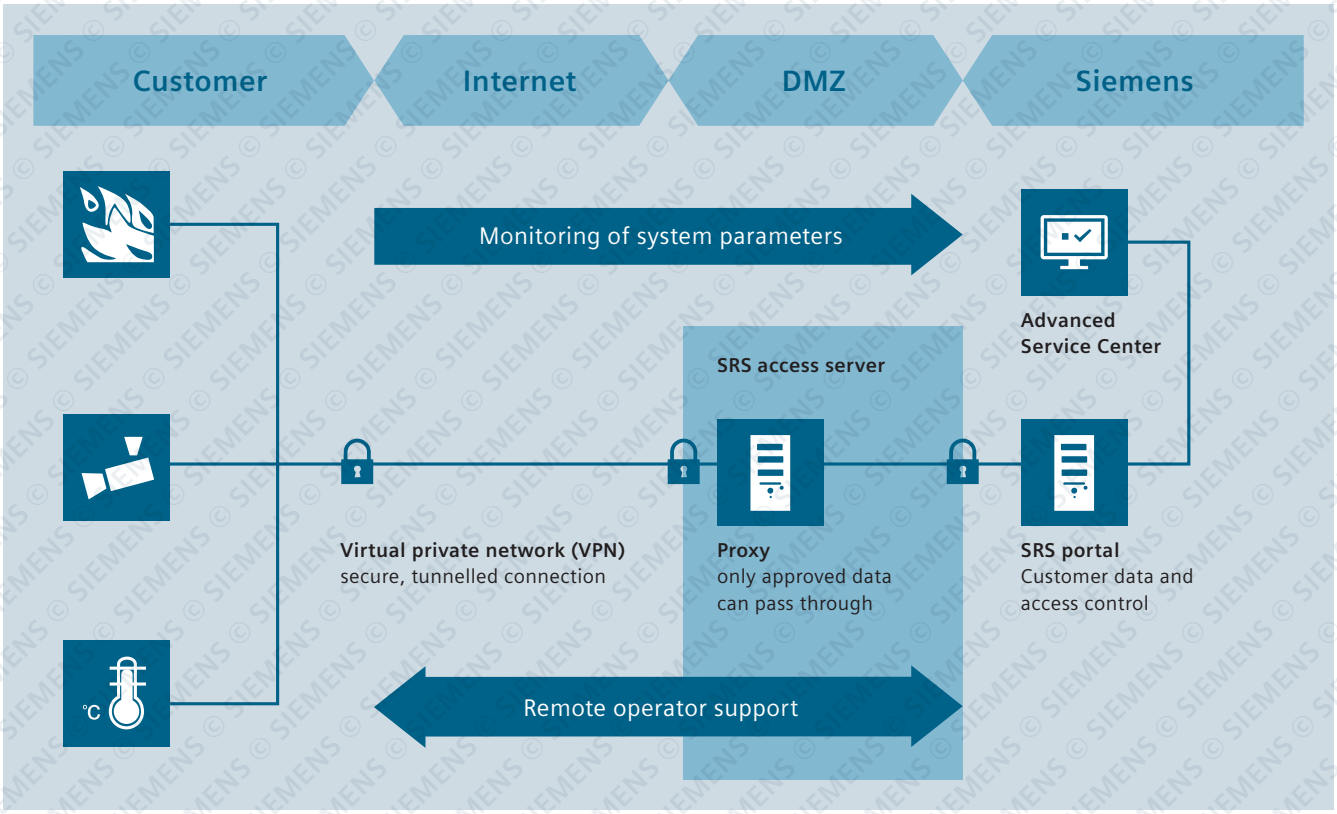
Regular audit trail
The Siemens Cyber Emergency Readiness Team (CERT) is an internal, independent and trustworthy partner which develops preventive security measures and regularly audits the information security of our IT infrastructure.

ISO 27001
Our company-wide Siemens Remote Service platform offers a reliable global IT infrastructure and at the same time the highest level of data protection. We are one of the first organizations worldwide to have implemented an internationally recognised information security management system (ISMS) that is certified in accordance with the ISO/IEC 27001 standard. Our SRS platform is listed in the international register of ISMS certificates: http://www.iso27001certificates.com



Our company-wide ISMS has been certified by TÜV Süd as complying with ISO/ IEC 27001 and has been audited on a regular basis ever since.

More efficient support during operation
If you have any questions regarding the operation or handling of your systems, we will provide you with active support. Based on the remote connection, your questions can be answered faster, more easily and in a more targeted way. If you ever have any questions concerning remote services, we will be pleased to assist you further.



Siemens services – security, convenience and cost-effectiveness

Digitally always there for you

Whatever your expectations, you can rely on a prompt, reliable response. Wherever you and your company are located, we are close at hand, whether through our strong local presence or via a remote connection. Not only do we know your systems and their individual applications, we are also familiar with your operating processes. All of which will be to your advantage and contribute to the success of your company.

Migration-ready – because the world does not stand still

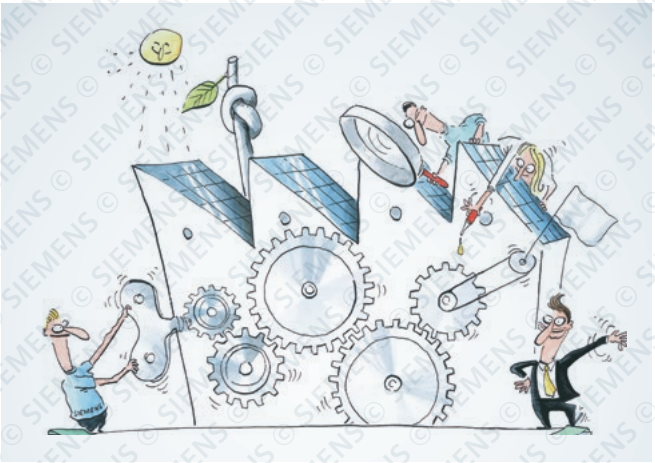
We provide future-ready system solutions. The latest state-of-the-art, financially attractive migration and modernization solutions extend the lifecycle and improve the performance of your systems and solutions. This commitment to the long term protects your investment and allows efficient financial planning.

First class service – that's what you can expect from us

Our ability to deliver first class service depends on our field technicians and their experience built up over years. Continuous training and the latest tools mean they have expertise across all product generations. As a result, you can enjoy guaranteed service level agreements and total transparency.

À la carte – the choice is yours

However diverse your requirements, we will find the right solution for you. Our services focus on your needs and your wishes. The anticipated risks, the level of operational reliability required and cost-efficiency – we take all these factors into account. Our service solutions are individually scalable – for you!



Sustainable and forward-looking

State-of-the-art service solutions are energy-efficient too. By monitoring and controlling relevant parameters we can guarantee building systems that deliver comfort and convenience while minimizing energy costs. The very latest tools, an extensive service network and innovative remote services all help us to avoid unnecessary emissions. We see environmentally responsible recycling as our duty – to our environment and to you.

Advisory & performance services

Our service packages can be combined with other services and tailored to your company's specific needs.

Service modules

		Service packages			
		Pre	Pro	Plus	Modular
A1	Basis	■	■	■	■
A1.1	Software backup	□	■	■	□
B1.1	Periodic hardware/software maintenance		■	■	□
03.1	Software update		■	■	□
B3	(Rechargeable) battery replacement		■	■	□
C1.1	Maintenance during work hours		■	■	□
B2	Replacement of fire detectors (only fire)			■	□
O2	Spare and replacement parts			■	□
O4	Maintenance outside work hours (+C1.1)		■	■	□
B5	Refresher instruction (+B1.1)		□	■	□

Other service modules

O1	Remote access connection	□	□	□	□
O3.2	Software upgrade		□	□	□
O4.1	On-call service				□
O1.1	Customer secure remote access (+O1)	□	□	□	□
O1.2	Support/Hotline support via remote access (+O1)		□	□	□
B1.2	Inspection				□
B2.3	Replacement of detection modules in aspirating smoke detectors (ASDs)		□	□	□
B2.5	Replacement of gas sensors				□
B2.7	Integral test				□
B4.1	K3/K4 inspection				□
B4.2	Sprinkler test				□
B4.3	Room tightness test (door fan test)				□
B4.3.1	Antifreeze flushing				□
B4.3.2	Sprinkler network flushing				□
B4.4	Pressure vessel test				□
B4.5	Sprinkler system inspection				□
B6	System analysis		□	□	□
C1.2	Data restoration (+A1.1)		□	□	□
C1.3	Replenishment/Replacement of extinguishant				□
D1	Plant operation (+O1)		□	□	□

Other service modules

		Service packages			
		Pre	Pro	Plus	Modular
O5	Fixtime		□	□	□
O6	Reporting		□	□	□
O8	Alarm management		□	□	□
O9	Web hosting plant data (+O3.2)		□	□	□
O12	Intervention time		□	□	□
O13	Financing		□	□	□
O14	Training		□	□	□

IT modules

B1.3	Network (+B1.1)		□	□	□
B1.4	PC/ Server		□	□	□
B1.5	IT security (+B1.1)		□	□	□
B1.6	Redundancy (+B1.5 and/or +B1.3)		□	□	□
B1.7	Network maintenance		□	□	□

Energy services

E1	Transparency with resource monitoring		□	□	□
E2	Hotline resource monitoring		□	□	□
E3	Report analysis		□	□	□
E4	Green Building Monitor editing		□	□	□
E5	Optimization		□	□	□
E6	Energy-model-based energy management				□

Pharma modules

P1	Backup integrity		□	□	□
P2	System integrity		□	□	□
P3	Archive test		□	□	□
P4	Calibration		□	□	□

(+XX) indicates whether another module is required for this module.

Service portal – secure information on demand

When the service portal is used, data is protected by means of data isolation, and user accounts and privileges are administered centrally. Role-based access control is used to ensure that only authorized persons are given access to all relevant information. During its lifecycle, the security of the service portal is checked regularly in vulnerability tests. These security measures guarantee secure and protected access to the stored service information.

Information security has a vital part to play in our networked world, and its importance is growing enormously by the day. Siemens Building Technologies' service portal features an integrated security architecture and system management, two-factor authentication, encryption and a multi-layered security approach. This meets the requirements of the most stringent security standards

Secure design for your protection

Siemens combines traditional local services and digital services in an integrated concept that provides our customers with optimum support. The service portal complements the personal services of your local Siemens branch with the speed and convenience of modern media and opens up another means of communication.

Security protocols and white-hat vulnerability tests, which are carried out for all major software releases, are part and parcel of IT development. Change controls and mandatory risk assessments are also built into the design of new releases.

Data security

Customer data is stored securely in Siemens' computer centre and logically isolated. The service portal, to which data is up loaded only where necessary (i.e. for selecting or searching), is hosted in the Amazon cloud. Connectivity is restricted here to essential services: stored transaction data and backups are stored in encrypted form and all the servers have malware protection.

Secure, controlled access to applications

The role-based approach to access control uses the principle of least privilege. User accounts and privileges are administered centrally by trained experts. For customers with high security requirements, two-factor authentication with a one-time password (OTP) which is sent by SMS can also be used.

Secure system access

For administrative access to the systems we use the jump server concept – with no connections at the network level.

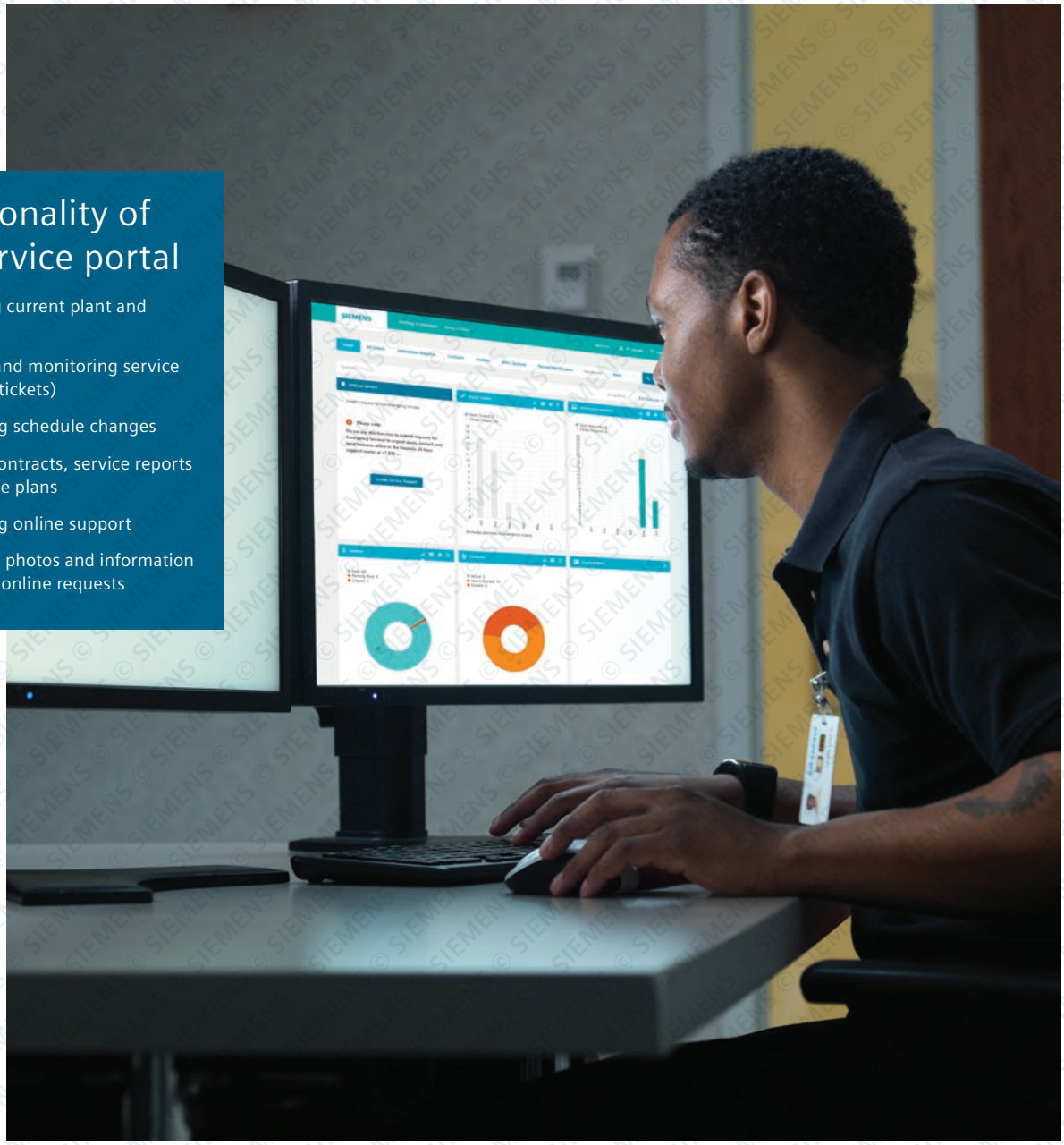
Trustworthy, certified partners

Connections to the portal via the cloud are protected through Transport Layer Security (TLS), using the latest cipher suites. We are collaborating with Amazon AWS in Dublin (Ireland) on system hosting and the intermediate storage of data for cloud access. All the services from AWS are subject to ISO/IEC 27001 certification and to AICPA SOC2 type II reporting. Our application management partners are also ISO/IEC 27001-certified.

Transparency in the service makes your life easier

Functionality of the service portal

- Displaying current plant and systems
- Opening and monitoring service requests (tickets)
- Requesting schedule changes
- Viewing contracts, service reports and service plans
- Requesting online support
- Uploading photos and information regarding online requests



Never has it been easier to achieve service transparency of the highest standard. Siemens Building Technologies' service portal gives you access to our industry-leading service infrastructure – wherever you are, whenever you need it. This online tool is packed with information which makes it possible for you to be proactive, get answers and work more productively.

The service portal relieves you of the burden of having to manage your plant, so that you have more time to concentrate on your real priorities. Using our intuitive user interface, you can call up important information on all your buildings and installed plant quickly and efficiently. The service portal makes it easy for you to achieve more – around the clock.

Efficiency, trust and convenience at the touch of a button

Siemens combines traditional, local and innovative digital services in a single integrated concept, which provides you with the ultimate in support and optimizes your buildings so that you are prepared for the challenges of today and tomorrow. The personal services you normally receive from your local Siemens branch will continue to be available to you, and will be complemented by the speed and convenience of the new media accessible through the service portal.

You can connect to the service portal anywhere you have access to the Internet. This gives you round-the-clock access to the latest information on all the systems at your sites, together with helpful tools for increasing your productivity and the value of your service programme.

Security

Establish a secure basis for maximum system performance, business continuity and competitiveness. The service portal gives you a better overview of your equipment and services. In this way, you can be sure that the right services are being carried out at the right time, that your investments are protected and that your processes are being optimized. Data security and access protection are the top priorities.

Achieving more

Avoid waiting times, using the latest technologies. The service portal gives you a complete overview: you can call up maintenance schedules, change deadlines or open and track tickets. You can also view service reports, invoices and contracts. This simultaneously helps you improve efficiency throughout the company.

Transparency in a matter of seconds

Using the service portal, you can access all your service information, anywhere and at any time. You receive information on urgent matters immediately, so that you can complete the task and devote yourself to other activities. Using the service portal, you are always up to date, and plant and service data for one building or for your entire company can be called up at the touch of a button.

Information sharing

Improve transparency in your company. It is really easy to add new users to the service portal. You can also control information via administrator privileges. In this way, you can ensure that your team has all the information it needs to do a perfect job of completing the task at hand.

SIEMENS

Ingenuity for life

Desigo CC

buildingtechnologies.siemens.com

5.1. Introduction	170
5.2. Background and structure	171
5.2.1. Technical building management platform	171
5.2.2. Integration versus integral	172
5.2.3. System topology	173
5.2.4. Complete building integration	173
5.3. Main functionality	174
5.3.1. Event handling and security	174
5.3.2. Energy efficiency and comfort	175
5.3.3. Integration and operation of subsystems	176
5.3.4. Reporting functions	176
5.4. Operation and scenarios	177
5.5. Cost-effectiveness and advantages	179

Desigo CC – Use Case	180
Desigo CC – The building management platform	182
Highlights	184
System Manager	186
Alarm management	188
Desigo CC – an integral platform for building security and building automation	190
Support for validated environments	192
Full integration of all disciplines	193
System architecture	194
Server – Client types	196
Web client	197
Open integration platform	198

5.1. Introduction

In larger buildings today there are more and more technical systems that control and monitor all areas of building management technology. This technology is constantly evolving and becoming increasingly automated and complex. Also, trained personnel for all these areas have always been in short supply. To enable staff to maintain an overview nonetheless and respond correctly in critical situations, a whole array of different building management platforms exist to support and simplify day-to-day operation of technical building management systems.

Technical building management encompasses two different areas – building automation and building security – which are represented either in separate systems or in one shared system. All subsystems in a building are integrated into the building management platform, i.e. on the automation side, HVAC systems, lighting and shade control systems and room automation and, on the security side, fire and intrusion detection systems, access control systems, video surveillance and technical contacts.

All the information required for these subsystems is combined, standardized and consolidated on a clear user interface. Users are thus supported when making important decisions on the next step to take in critical situations and in their routine work. Integration on a common platform enables direct intervention in the systems from a central point and documents what happened when and what action was taken in response.

If a building management platform is to be able to meet various demands, it has to have a system structure that is flexible, scalable and readily extendable. This is essential if the requirements of different sectors, different sizes of organization and growth stages are to be easily integrated into the system.

If subsystems are combined into a totally integrated platform, this enables customer-specific scenarios to be implemented and platform responses automated to support complex operator responses.

Event handling and operation of the subsystems represent the core functionality of a building management platform. Here, the main priority is to provide a quick, complete overview of the hazard situation or system status which is then followed by assisted problem handling. To provide a verifiable record of events, the management system includes extremely diverse and extensive reporting and trending features.

Ease of use is by far the most important attribute of a management system. The user interface must be intuitive, informative and situational if it is to enable fast problem handling, minimize stress and support efficient operation.

Flexibility and an open system architecture are needed to allow integration of very disparate subsystems with minimal effort. The issue of IT security must also be addressed where network topologies and internet access are concerned. Depending on customer requirements, fail safety and redundancy may also be important aspects of system architecture.

Use of a management system is appropriate even for smaller systems. The benefit lies in greatly enhanced building security and also a significant reduction in the time that has to be spent on building services.

5.2. Background and structure

Building management encompasses a variety of tasks and technical systems that support efficient day-to-day operations. These tasks normally fall into three different categories:

- Commercial management is handled by specialized systems that support an organization's business operations and covers many different individual areas from procurement and logistics through to sales and maintenance. These systems are integrated to varying degrees, depending on the particular solution and can be referred to collectively as ERP systems (Enterprise Resource Planning). The best known companies in this field include SAP and Oracle, for example.

- Building infrastructure management includes systems for building maintenance, such as facility management systems (FMS) for maintenance of the technical infrastructure, for example.

- Technical building management comprises building automation and security management. While building automation is concerned with HVAC system and lighting and energy optimization, for example, security management involves fire detection, intrusion detection, access control, video surveillance and other security issues.

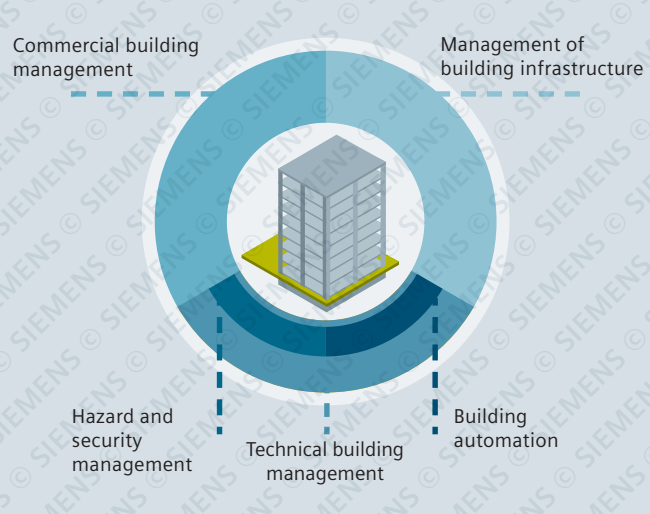


Fig. 2.1: Various building management tasks

The sections which follow give a more detailed insight into technical building management and the building management platform (also known as building management system) used in this area.

5.2.1. Technical building management platform

Technical building management covers two areas – building automation and security and hazard management. The management systems used in these two areas, namely the building automation management system and the security management system can be referred to collectively today by the term building management platform. This is a platform that combines the former two management systems and in addition provides cross-discipline functionalities.

When it comes to security, the main aim of a building management platform is first to alert the individual responsible when a problem occurs and then to guide that individual through the appropriate response to this critical situation with the aid of checklists or action texts. This usually requires an initial analysis of the situation based on video images or an assessment on the ground, followed by intervention in the subsystem involved – for example acknowledging active alarms or notifying the fire service or police, if necessary. In addition, fire and intrusion detection systems can be armed/disarmed (home/away) centrally depending on building operation.
Security and hazard management are important issues in cases where the risk of loss and the probability of occurrence are high in a particular building.

In a building automation management system, the main focus is on process visualization, optimization and control and on the energy efficiency of the installed systems. This means that all HVAC systems have to be clearly represented centrally and, if necessary, setpoint values and control settings have to be adjusted, systems switched on and off and analysis activities supported by trend logging. Other important aspects of building automation include fast detection and correct handling of alarms in order to prevent damage to systems in the event of faults or external influences. If room automation systems such as climate control, lighting, shading and blind control are technically able to be networked, these too can be integrated into the management station, enabling central overview and operation here too. Building automation and energy optimization are becoming increasingly important areas for buildings with larger installed systems and higher energy demand.

With state-of-the-art technology it is also possible to provide cross-cutting technical support for building systems over and above building automation and security, by networking the various systems and programming specific scenarios. As a result, an alarm in one particular subsystem can affect how other systems in the building operate – for example, entry to the building can be prevented while a fire alarm is active.

Building management platforms are frequently used in the following infrastructures to address their specific requirements:

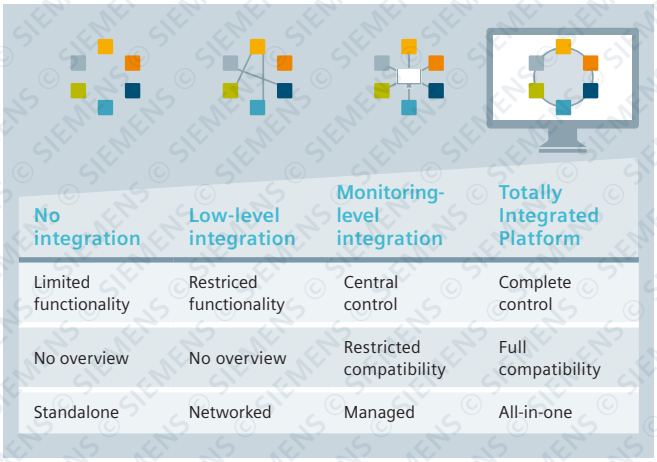
- Offices and business premises
- Banks and insurance companies
- Industrial premises and storage facilities
- Prisons
- Hospitals
- Pharmaceutical industry
- Public sector and universities
- Airports
- Power plants
- Museums

5.2.2. Integration versus integral

The technological advances apparent in everyday life producing smaller, faster, more intelligent and less costly solutions have also opened up new opportunities in security and building technology. The functions in the individual subsystems are becoming increasingly extensive, and so too is the scope for networking. In the past, these systems were seen in isolation and installed as standalone systems.

If individual systems are connected together, this achieves additional functionality. Simply connecting systems, however, produces limited integration and there is still no shared overview. This requires a higher-level management system to provide the necessary overview and the benefits of single, unified and shared operation.

Today it is possible to go one step further and achieve total integration of the systems – the systems exchange information and interact with one another. In this «all in one» or «totally integrated platform» approach, the building and the associated subsystems are regarded as a single overall system and managed as such. All systems can mesh with one another and thus support smooth day-to-day operations and the ability to respond effectively in a hazard situation.



No integration	Low-level integration	Monitoring-level integration	Totally Integrated Platform
Limited functionality	Restricted functionality	Central control	Complete control
No overview	No overview	Restricted compatibility	Full compatibility
Standalone	Networked	Managed	All-in-one

Fig. 2.2: Different degrees of integration

The resulting benefit for the user is seen not just in lower initial purchase and operating costs but also in the following aspects:

- Increased reliability and improved self-monitoring
- Fast, foolproof hazard detection
- Initiation of immediate, automatic, cross-discipline interaction to combat the hazard
- Clear, graphics-based hazard notification to relevant security personnel
- Rapid intervention regardless of location is supported by web browsers and mobile devices
- Simple, clear operation of all disciplines
- Provision of powerful, detailed reports and analyses to enable optimization of energy consumption and operation
- Compliance with statutory regulations in production and research environments in accordance with standards including, for example the 21 CFR Part 11 regulations or EUDRALEX, Volume 4, Annex 11
- Ability to have geographically distributed systems that can be monitored and controlled from one or multiple display workstations
- Reduced training effort

The management system is always the central part of the overall system which is made up of peripherals (known as subsystems) and the network. To structure this overall system, levels were introduced with the result that building management can be represented as a hierarchical pyramid.

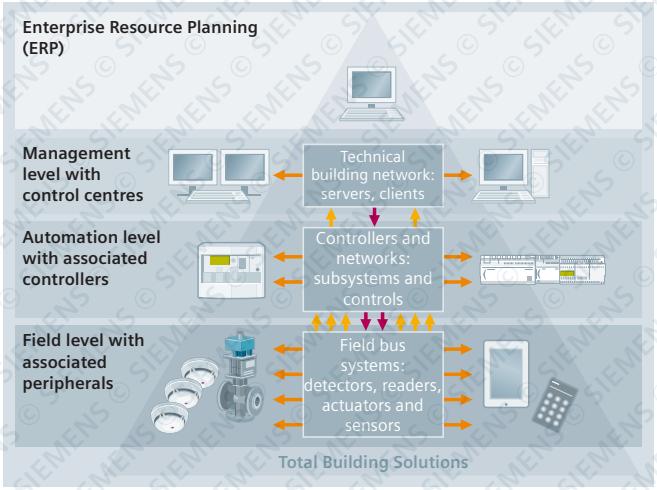


Fig. 2.3: Hierarchy of building control systems

The information from the individual sensors and actuators down at the bottom of the pyramid is propagated upwards, and is increasingly concentrated and interpreted in the process. The individual levels function autonomously and are interconnected in powerful communication networks. There are three different levels:

- **Management level:** Management system with functionalities for management of subsystems, which specifically involves central monitoring and operation of subsystems, as well as visualization, archiving, logging and analysis capabilities

- **Automation level:** Automation controllers with functionalities for decision-making, distribution as well as management and control of processes

- **Field level:** Sensors and actuators with functionalities including detection, activation and transmission of hazard alarms/relevant countermeasures or measurement of temperatures, damper positions and valves

  The field level captures a great deal of information, but only a small part of this is passed on. A case in point are intelligent fire detectors that continuously capture e.g. smoke density and temperature but only periodically report a hazard level to the controller or only report the event to the controller immediately in case of an alarm. Even mid-size systems comprise thousands of data points at the field level.

Each of these three levels has a powerful network to interconnect the local components in its own level or to integrate the networks of the level below it. Information flowing from a lower to a higher level is condensed and filtered according to predefined criteria. Information from top to bottom can be multiplied according to predefined criteria, in order for example to open multiple smoke dampers with a single command. The centrally managed subsystems transmit data and statuses to the building automation system, where these are visualized, interpreted and, if necessary, logged as well.

5.2.3. System topology

Today's network technologies support quite different and diverse system topologies. Simpler concepts and a single-station system can be used in smaller systems. Server/client concepts are always used in larger or distributed systems.

Depending on load and geographic distribution of the subsystems, for instance, several servers can be used for data collection and networking. These are all interconnected over the customer's internal LAN networks or alternatively over the internet in a cross-location network. This allows central monitoring of a customer system that spans multiple locations.

In addition, redundant systems can be implemented where the requirement is for higher system availability. There is a wide range of concepts in terms of cost and functionality which is why in these cases it is important to define the specific project needs precisely during the concept phase if an optimum cost/benefit ratio is to be achieved.

From an operator point of view, the following options are available for operating and monitoring systems:

- Single-station systems for smaller installations: client and server are combined on one physical hardware device.
- Installed clients with one or more screens for operator lodges
- «Click Once» clients: the operating application is downloaded with a single click and is then immediately available for operation.
- Web clients: the web application is accessed via a URL in the existing web browser. Operator data is transmitted to the server using encrypted https communication.
- Apps on mobile devices: apps on mobile devices such as smartphones and tablets can be used to communicate with the building management platform.
- The requirements to be met by a building management platform may well change during a system's lifecycle; new systems or buildings may be added over the course of time. This is why an important consideration when choosing a building management platform is that it offers extensive, flexible support for future building extensions and conversions and has a scalable system structure. A system's ability to allow incremental expansion along with equally simple, efficient system upgrading is a key quality feature of a management system.

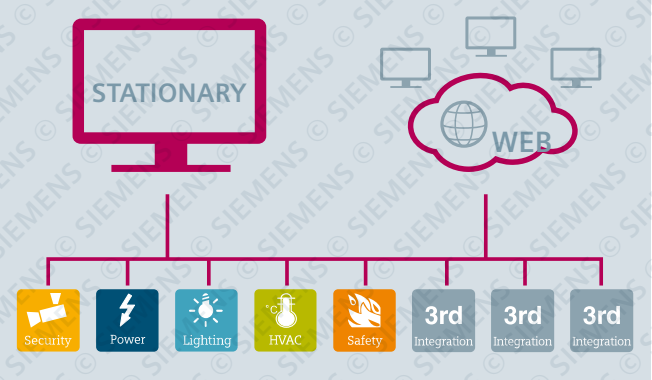


Fig. 2.4: A building management platform should be flexible and scalable

Client/server networking and networking of subsystems is done virtually exclusively using Ethernet today, which means that IT security is a key issue for building systems too. If building management platforms are connected to the internet or if unauthorized persons also have access to the network, they may become a deliberate or random target for hackers or used for industrial espionage or sabotage. For this reason it is very important that the networks of the building management platform and of the subsystems are correctly configured, maintained and as far as possible secured and firewalled. Here too, it is very useful to identify needs during the design and build phase, as well as periodcally during actual operation.

5.2.4. Complete building integration

A large part of the projects running today are based on existing buildings, that are already equipped with functioning systems. This is the reason why Desigo CC was designed as an open platform, being able to understand and command a large variety of sub-systems. These do not necessarily need to be from Siemens.

Desigo CC is able to control open protocols, like BACNet or Modbus for example (for a detailed list of protocols, please refer to the end of this chapter). Also, our experience worldwide has allowed us to develop a large amount of drivers to integrate proprietary protocols one can find in existing installations. These drivers are developed by Siemens or by external partners, allowing to have a strong integration capability with Desigo CC.

Since these drivers are developed not only for one site but for multiple locations, we can rely on a higher quality, since each installation allows to increase the quality of these integrations using a continuous improvement method.

This logic is interesting for existing solutions co-existing for example on campuses, where different technologies may have been utilized over time.

Having the capacity to integrate several technologies allows also to ensure a smooth transition in case of modernization projects. The operator of the facility may know his systems are getting modernized and exchanged, a complete integ-

ration of these in Desigo CC allows his daily tasks to remain exactly similar. This reduces heavily the risk of this type of projects.

In order to check if your systems can be easily integrated in Desigo CC to open the door to the management station and to digitalization, get in touch with your local Siemens BT representative.

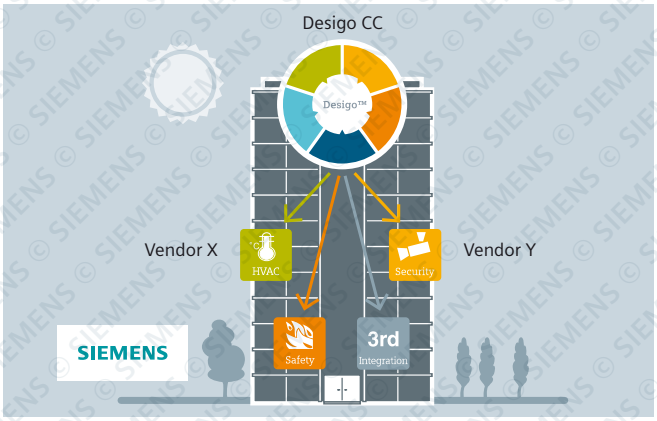


Abb. 5.5: Complete building integration

5.3. Main functionality

Key elements in a building management platform include event handling, alarm routing, operation of subsystems and reporting.

To make these main functions possible, a whole range of add-on functions is required that constitute the «infrastructure» of the management system. Here are just some of the most important add-on functions: access rights concept, user management and user-specific views, password management, object management in tree and graph structures, graphics level management, data management and storage.

The next three subsections describe the most important functionalities of a building management platform.

5.3.1. Event handling and security

Handling of current events, sometimes referred to simply as «alarm handling», is the core function of a building management platform. Its main elements include:

- Hazard/event detection
- Hazard/event notification
- Appropriate intervention

If, for example, a detector identifies a hazard source, the operator at his workstation must be made aware of this by audible and visual alerts. Appropriate means employed by the management system to attract the attention of the operator include loudspeaker sounds, flashing elements on the screen or mobile tools such as SMS or pager if the operator is away from the workstation. The operator then usually has the following questions to which answers are needed as quickly as possible:

- What is the problem?
- Where is the problem?
- What needs to be done next?

Event handling therefore includes:

- Displaying all active events in plain text and as dynamic icons on the floor plan of the building or on the plant schematic
- Confirmation of receipt of event notification (acknowledgment) thus stopping potential escalation
- Resetting the event
- Operator guidance with predefined individual operating steps depending on the nature and severity of the event and based on the general conditions and requirements in the particular system
- If necessary, intermediate steps are also indicated, including video image review or additional information such as flowcharts and emergency telephone numbers (action texts)
- Alarm routing if an event has occurred and escalation protocols, if necessary

A typical sequence in response to an event is as follows:

- The building management platform notifies the operator in charge than an event has occurred (e.g. alarm or fault) and at the same time starts a countdown.
- The operator identifies the location of the alarm and informs either the building management platform or the actual subsystem involved that he is aware of the alarm (acknowledgement). The countdown is cancelled.
- If the subsystem detects that there has been no response (acknowledgement) within the countdown period, it automatically alerts an external agency (e.g. fire service).
- After acknowledging the alarm, the operator establishes which resources are currently available to help verify the event and then ensures that the alarm is investigated. In small systems, it is usually the operator who is responsible for investigating the alarm using video images if video cameras are available or with the assistance of another person.
- Depending on the result of the investigations, the relevant intervention agencies are alerted (police, fire service or other emergency services) or the alarm proves to be unfounded and is cancelled (reset).

There are two different types of event acknowledgement, namely local acknowledgement which takes place only on the building management platform (e.g. technical contacts), and event acknowledgement directly on the subsystem which, in turn, reports this acknowledgement to the building management platform.

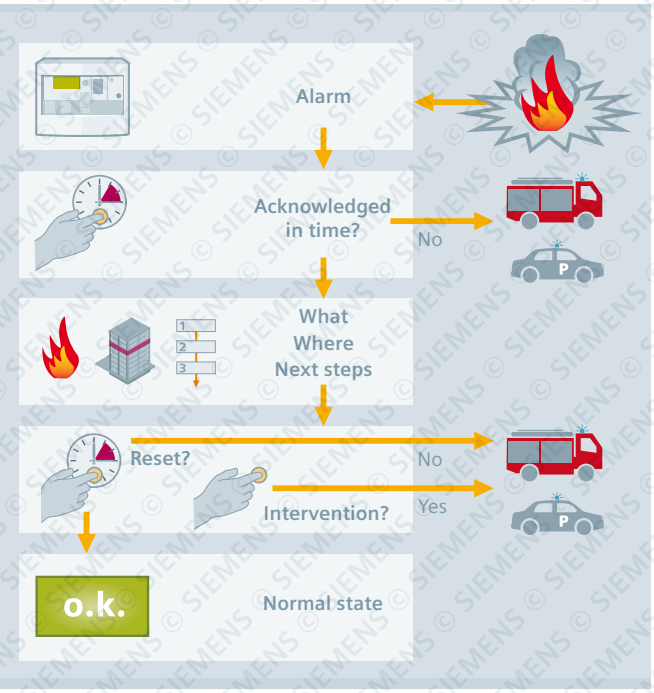


Fig. 2.6: Event handling with building management platform

5.3.2. Energy efficiency and comfort

Buildings are not just an environment in which to live and work, they also represent a capital investment. They need to be operated efficiently if they are to retain their value. In a climate of growing cost sensitivity, energy-efficient solutions are a must. A state-of-the-art building management platform can minimize this cost factor.

What is energy efficiency?

DIn a quality management context, ISO 9000 defines efficiency as the «relationship between the result achieved and the resources used». Energy efficiency of buildings refers to the relationship between the resources used, i.e. the amount of energy used and the benefit produced, i.e. achievement of desired features such as room air conditions and air quality.

According to the EU Directive on the Energy Performance of Buildings (EPBD), the following thermal and electrical forms of energy are considered when determining the energy efficiency of buildings:

- Heating
- Domestic hot water
- Cooling
- Ventilation
- Lighting
- Auxiliary energy

Equipment used by building occupants such as PCs, printers, machines (excluding lifts in the building), etc. are not included in the electrical energy demand for building operation. The waste heat from such equipment does however affect the thermal energy demand of the building.

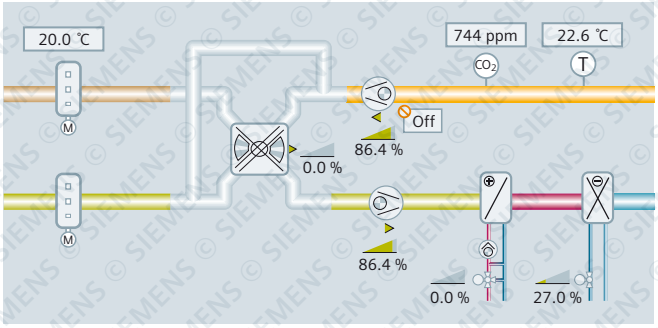


Fig. 2.7: Schematic circuit diagram of a typical simple ventilation system with exhaust air energy recovery and two heat exchangers

Energy efficiency in practice

A state-of-the-art building management platform fully leverages a building's energy saving potential by efficiently linking, controlling, managing and monitoring extremely disparate functions and building disciplines. This results in a healthy room climate and greater user satisfaction and also reduces ever increasing energy-related operating costs through efficient energy saving features.

Savings and optimization can only be achieved however if the relevant performance indicators are available for analysis. This involves, for example, comparing actual values from energy consumption meters with target values. This data is read automatically from the process devices which in turn record values from field devices including heat and electricity meters. In a state-of-the-art building management platform this is achieved by processing historical and real-time data that is based on one or more relational databases.

Fig. 2.8: Graph showing variation in temperature and ventilation over time

The data collected is processed, analyzed and used to compile information-rich reports on a regular or ad-hoc basis. Operators can use these as the basis for fast, targeted plant optimization.

Fig. 2.9: Comparison of electrical and thermal energy

5.3.3. Integration and operation of subsystems

State-of-the art building management platforms support all the major types of subsystem including fire detection, gas detection, intrusion detection, access control, video surveillance, HVAC systems, room automation, lighting and shading control systems and stored programmable controllers that can be used in quite different areas.

Fig. 2.10: All subsystems are united on the building management platform

Bringing together all information relating to building systems on a single building management platform produces the following benefits:

- Improved overview and with it increased security
- Lower costs compared to multiple independent control centres in terms of initial purchase, configuration and maintenance
- Unified operating concept which means reduced training effort and no risk of confusion in a real situation
- Interaction between the subsystems is simplified

The building management platform should provide the following functionality as uniformly as possible for all connected subsystems:

- Display events and enable event handling
- Enable subsystem-specific functions to be initiated
- Enable pre-programmed control sequences (macros) to be initiated

Unified operation of different types of subsystem with their different operating concepts is only possible if the conceptual design of the building management platform accommodates the specific features of the various subsystems and is able to integrate individual, subsystem-specific functions in a flexible manner.

Depending on customer requirements, systems are integrated at a very detailed level or only selected information is represented. This can be addressed at the start of each project and will depend on the specific needs of the customer.

State-of-the-art building management platforms can integrate subsystems either using vendor-specific protocols or via standard protocols. OPC and BACnet are often used as standard protocols in building management applications. Other examples include LON, KNX, PROFIBUS, Modbus, Web-service Interfaces and other protocols that are also used at the automation or the field level.

5.3.4. Reporting functions

Today's building management platforms work with integrated database applications. This enables past events and records of how these were handled to be stored. These plant-specific records and the relevant query options enable the following questions for example to be answered:

- What happened in the past 24 hours?
- How many faults occurred last year?
- Who did what and when following yesterdays alarm?
- What did last weeks temperature graph look like?
- How does it compare with this week?
- How much energy did we use this month?
- Where and what level of energy savings were made?

Such reporting features support optimization of building operation and of the installed plant.

Fig. 2.11: Visualized analyses of energy consumption, costs and savings

5.4. Operation and scenarios

Building management platforms are normally operated via a user interface that is based on graphics files. In the event of an alarm, this enables the floor plan of the room involved or the relevant plant schematic to be displayed on the user interface. We take for granted today the simplicity offered by such graphics-based navigation and operation using photos, floor plans and other images. Floor plans can be very large, so vector graphics have great advantages. Useful features such as automatic scaling, zooming and small overview windows (bird's eye view) are only really viable with vector graphics. Floor plans can either be uploaded directly to the system in the form of CAD files from the architect or exported to a supported format and inserted. For dynamic schematics, various templates are normally available to greatly simplify the engineering process.

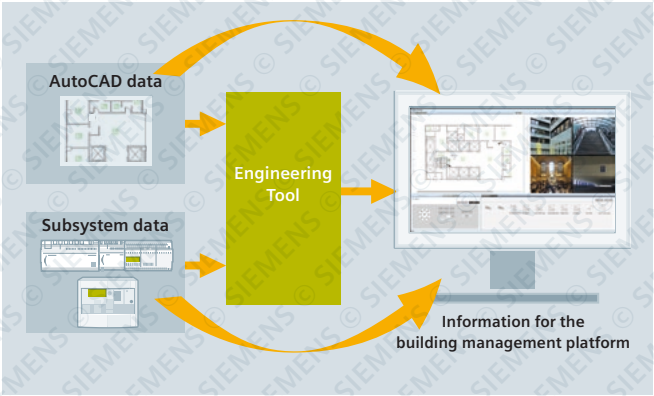


Fig. 2.12: Excellent efficiency thanks to tool-based data import

User friendliness of a building management platform is probably one of the most important criteria when choosing a system. It is important that not just experienced security systems staff and HVAC technicians find the management system quick and easy to use for their work. Even inexperienced staff with little PC knowledge must be able to react quickly and confidently in an emergency, with the aid of the management system. An added complication where security systems are concerned is that these systems rarely need to be operated as no hazards are reported under normal circumstances. If however an emergency suddenly arises, most users will find themselves in a situation of stress.

A user will only be able to get an accurate picture of what is happening and then will only be able to react correctly if the system provides information as simply as possible. At the same time, it will only be possible to take the right actions and in the correct sequence if the user is given adequate support and guidance by the system.

Successful hazard mitigation therefore relies on workflows that are clearly structured, logical and easy to control.

It is very important, therefore, that the user is able to rely absolutely on a few simple and intuitively clear rules. These rules must remain the same, irrespective of what the systems current status is, when an event occurs or who is operating the system at the time.

Today, in addition to supporting event handling, it is also possible to model entire scenarios. A scenario is where the overall situation in the building is considered, not simply a single event in a subsystem. The user is presented with additional information on the event from all available subsystems. At the same time, necessary and appropriate processes between the individual disciplines and systems are automated.

The example below of an office with doors, fire detector, lighting and shading controls, video camera and room climate control will serve to illustrate such a scenario.

Everyday scenario: an employee uses his badge to authorize access to the office in the morning. The camera detects a person's presence and the power comes on when the room is entered. A personalized lighting scenario is selected and the room is heated, or in summer, cooled. A continuous fire check is performed in this room by the fire detector.

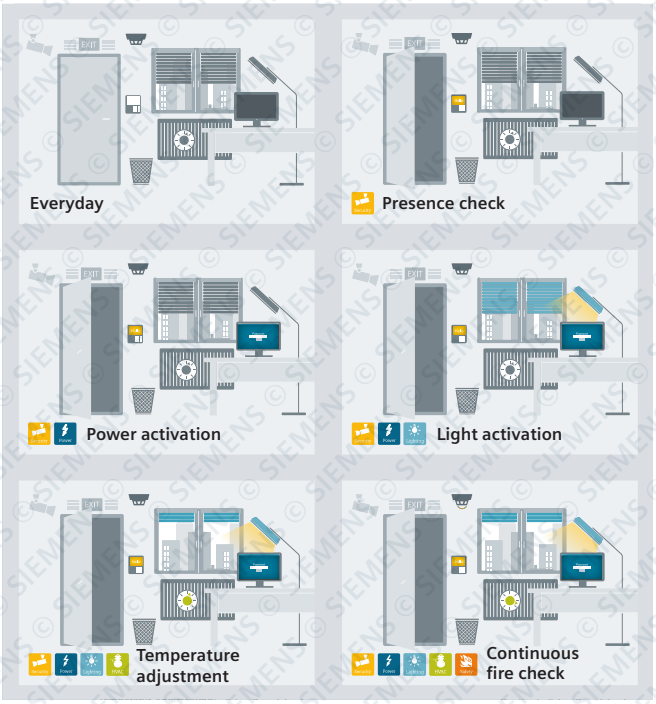


Fig. 2.13: Everyday scenario

This interaction of subsystems and cross-discipline control by the building management platform allows the room to be adapted to the needs of the occupants while at the same time saving energy and providing security.

If an unexpected event occurs in this room – a smouldering fire in a waste bin for example and smoke is generated – this leads to another scenario:

The installed smoke detector detects the smoke and triggers an alarm. The fire detection system's investigation time starts at this point, so a fast response is now crucial. Cameras in the immediate vicinity come on automatically on the user interface and provide images of the event. This helps assess the situation better from a distance. The fresh air supply is shut off, any smoke dampers operated and systems are powered down for a possible intervention by the fire service. The evacuation lighting comes on immediately and an automated voice alarm system is activated or live announcements are made. Blinds are raised automatically and employees are informed via existing information systems.

In a conventional integrated solution it is up to the operator to initiate and implement appropriate action in response to these individual isolated events. In a building management platform that supports such scenarios, all the necessary subsystems interact automatically, intelligently and across the various disciplines in a predefined scenario. The operator is still alerted and kept informed as the scenario progresses but intervenes only if necessary.

To deliver maximum customer benefit, the intelligence combined into scenarios is defined for each specific project and is matched precisely to the customer's particular needs and processes.

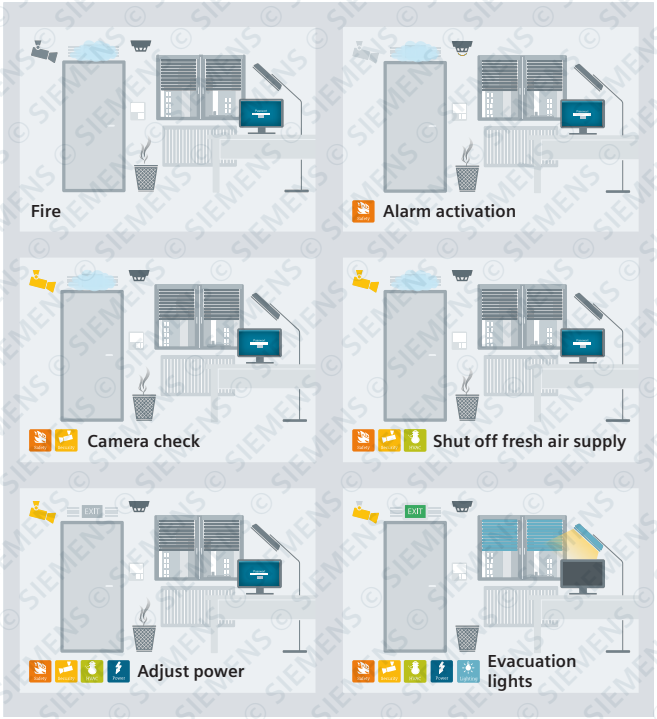


Fig. 2.14: Scenario in the event of fire

5.5. Cost-effectiveness and advantages

Building management platforms are worthwhile even for smaller systems as they offer the following advantages:

- **Fast response:** Unlike the subsystem control panels positioned near exits, the management system is located on the workstation of the relevant security or building automation professional. This means that in the event of an alarm there is no need to leave the office and go to the panel – the result is a faster response time and less stress for those whose job it is to respond.

- **Increased productivity:** Having to operate subsystems does not just mean wasted time going to and from the individual panels, it also means having to remember how to operate all the different systems, as the operating procedures for an intrusion detection system, for instance, are not the same as those for a fire detection system. A building management platform puts an end to the time-consuming toing and froing and having to mentally switch from one subsystem to another. Operating reliability is also improved as event handling procedures are the same for the various detection systems.

- **Cost reduction:** One advantage of a central building management platform is that security monitoring can be centralized and as a result security staff numbers locally can be kept to a minimum. In addition only one hardware infrastructure is required and one training program covers all systems. Another advantage is that the building management platform enables the operator to monitor the building's system performance, energy demand and energy supply more cost-effectively and more efficiently. A state-of-the-art integral building management platform allows effective combinations of HVAC and security subsystems resulting in energy savings and lower costs. It supports economically and environmentally efficient operation by, for example, not turning up the heating in an office from a preheated level or activating the ventilation until someone is present in the room. The building management platform is automatically alerted by the access control system that an employee has entered and operates the heating and ventilation systems.

- **Multi-system overview:** Seeing the building as a system, a cohesive whole, is only possible with a management system. This is particularly important as combined threats will become increasingly prevalent in future – for instance, an intruder taking advantage of the confusion caused by a fire alarm.

- **Better basis for decision making:** The wealth of information contained in combined systems allows situations to be assessed accurately. Video surveillance, for instance, enables precise assessment of an incipient fire in real time. The access control system provides information on the number of people present in the fire section or makes it possible to identify the location of an intruder more accurately. Networked delivery of such information is only possible with the aid of a management system. If a fire is detected, for example, the blinds are raised to give the fire service easier access to the building and the HVAC systems are operated at predefined levels.

- **Targeted reaction:** If an operator takes decisions based on graphic 3D representations, such decisions are undoubtedly better than if the person only had access to a simple subsystem display. Is the riser right next to the seat of the fire or does the gas cylinder store pose a greater risk at present? Questions such as these can be answered quickly and reliably even in an alarm situation, thanks to precise spatial information and video images.

Use Case – Desigo CC

A Desigo CC Health Check will find out if an installation is up to date and secure.

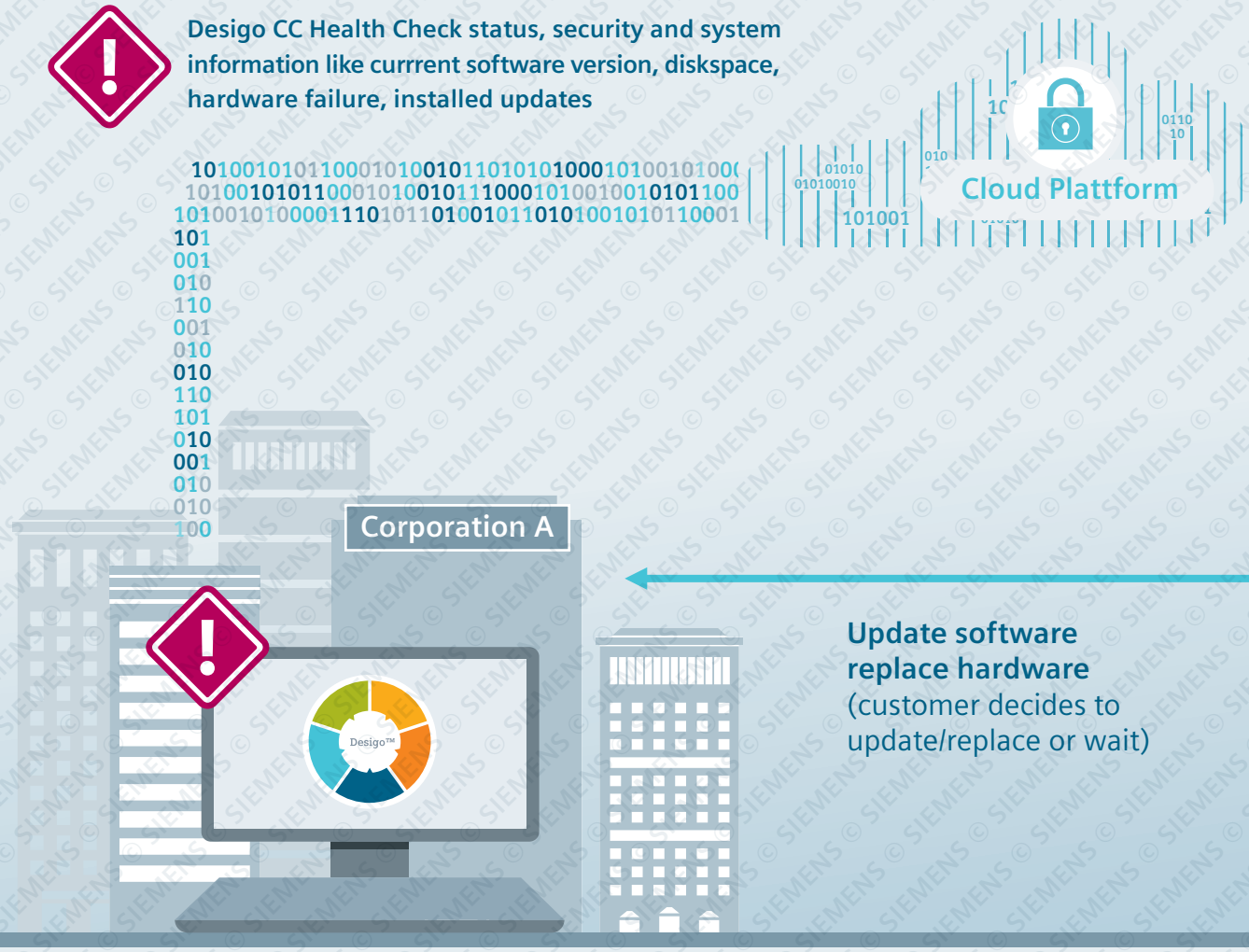
It is performed remotely by the Digital Service Center (DSC). The Health Check will check parameters such as whether the software version is up to date, if there is still enough disk space available, or if any hardware problems have been logged. It will also include information regarding actual updates and security alerts such as known risks due to malware threats.

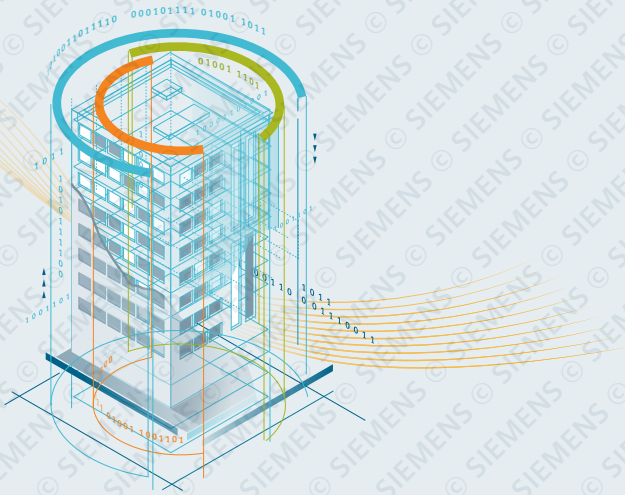
The DSC will review the system status and, if issues have been registered, a proposal for relevant actions will be shared with the field Service Engineer. The proposal focuses on what can be done at the customer site.

The field Service Engineer then informs the customer about the issues, such as a potential security risk, hardware failure, or missing updates, and proposes options and recommended actions.

The customer decides on which actions he wants to have implemented and agrees on an implementation plan with the field Service Engineer.

Customer benefits are increased system security, higher system utilization, and increased functionality.

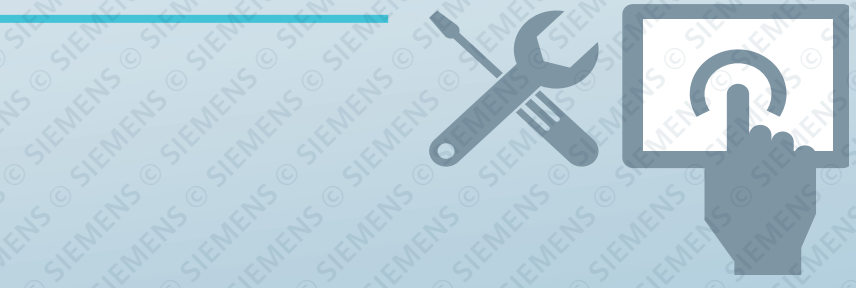




Data power delivers better building performance

Digital Service Center

- Record event
- Information is sent to local service organization



Local Service Organization

- Customer is informed about potential security risk, hardware failure,missing updates
- Customer decides: Update and relace now or wait

Desigo CC– the building management platform

Highlights

- Integral control and management of building infrastructure
- Enhanced comfort for building occupants
- Increased building efficiency
- Highest levels of security and safety for people and assets
- Constant overview of all disciplines in the building

Desigo CC is an integrated building management platform. This means that building comfort systems (HVAC, room automation, energy efficiency), building security (fire, intrusion, access control, video, evacuation, extinguising, gas) and energy distribution are managed from a single integral and entirely open platform. Interaction across the various disciplines allows the individual systems to be combined intelligently. The result is functional value add that the separate standalone systems could not deliver on their own. The management platform is open for third-party systems and can be used both for individual disciplines and as a complete overall solution.

Security

Integrated security systems minimize response times.

Power

The average costs of downtime for a mid-size company is around

70 000 $

per hour.

Lighting

Efficient lighting management can achieve

80 %

cost savings.

Advantage™ Services

We protect your investment, increase your efficiency and manage your costs and risks.

Fire safety

70 %

of companies that suffered a major fire were unable to recover. We offer unique detection reliability and protection against false alarms.

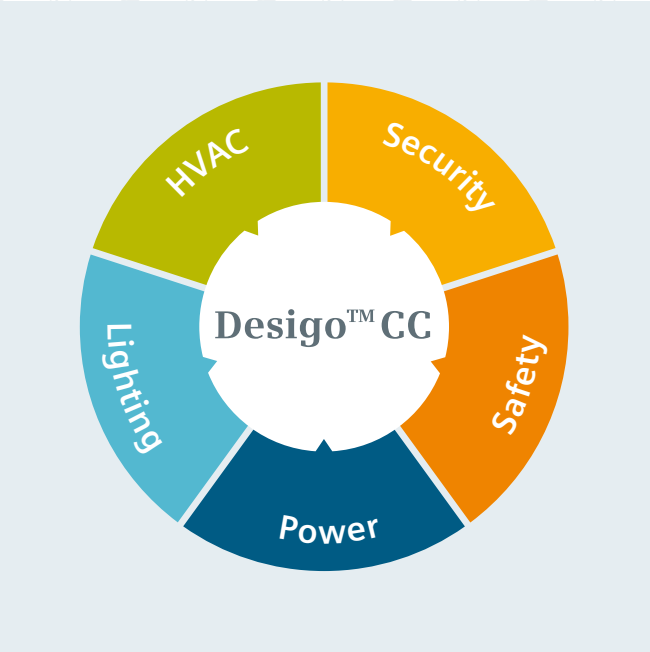
HVAC

Energy monitoring combined with lighting, shading and power on demand can achieve energy cost savings of up to

20 %

Advanced building management systems can achieve energy savings of up to **20 %**

Highlights



Desigo CC brings together on a single easy-to-use graphical user interface, all functions and statuses of the integrated subsystems including HVAC, safety/security and power distribution – irrespective of their individual interfaces. This reduces the training effort required and dramatically reduces the likelihood of operator error. Desigo CC is scalable and can be deployed anywhere from single-station solutions or entire buildings to multi-building campuses or geographically dispersed locations. Operating profiles can be tailored to individual needs – whether this is the security professional in a command centre, the HVAC system operator, right up to the person in overall charge with an overview across all building disciplines.

Intelligent applications for faster, better decisions

- Integration of all data and information from disparate building systems in one integral database
- Support with data management, analysis and processing
- Fast, reliable response to critical events, assisted event handling
- Display of trend data with time breakdown and comparison of trend curves and data
- Integrated alarm handling, e.g. fire alarm handling via an integral platform and across all disciplines (including power distribution, lighting and ventilation systems)
- Vectorized multi-layer graphics with animated icons and direct import of schematics from AutoCAD drawings
- Alarm routing via e-mail, ESPA 4.4.4, SMS or pager

Easy to understand, simple to operate

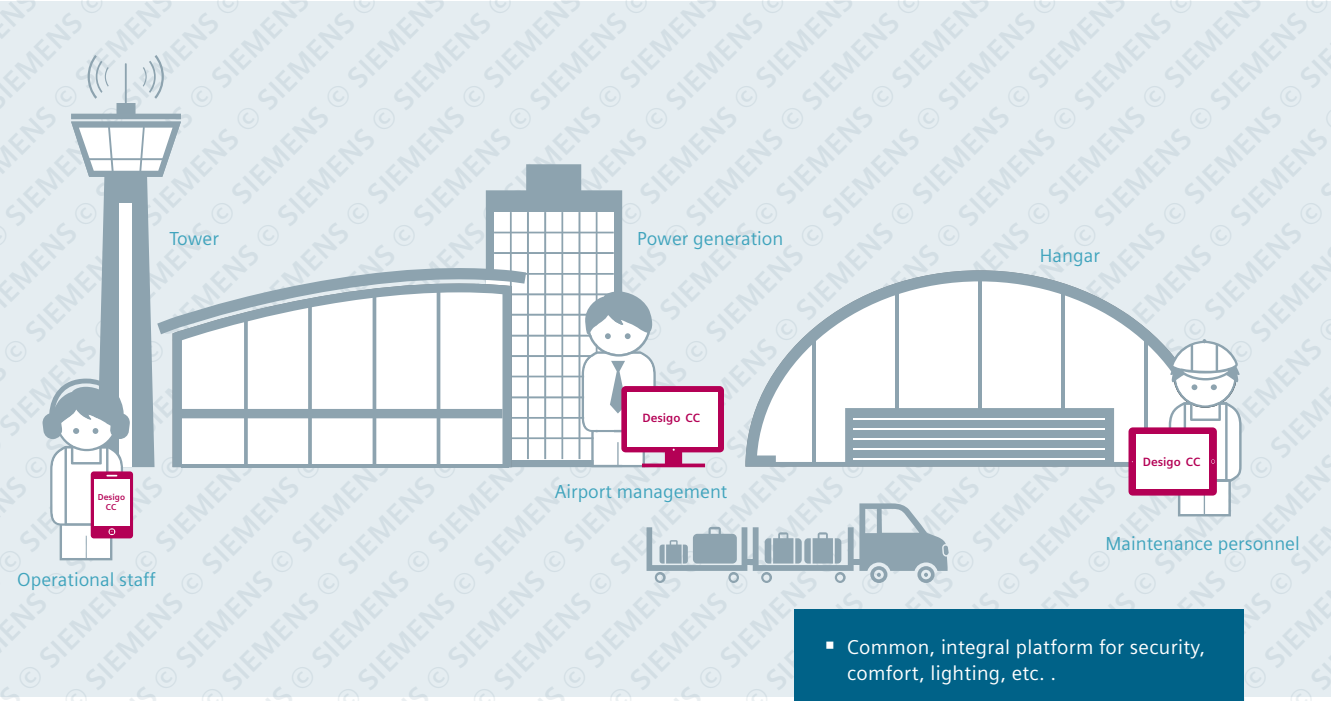
- User-specific views and profiles
- Simple navigation and display using tree structures and graphics
- Drag and drop feature for generating graphics
- Remote service to support rapid system fault clearance
- Single unified intuitive graphical user interface (GUI) for very disparate systems

Meets the requirement of systems whatever their structure or size

- Multi-client solutions with own workstations, remote clients and web clients
- Creation of user groups and profiles for more accurate navigation and fast, selective display
- Predefined user profiles for HVAC and/or security systems
- Distributed server structures and front-end processors for power sharing in large systems
- Online engineering for changes and upgrades without having to restart or interrupt operation

Open platform

- Supports standard protocols for building automation: HVAC, power supply, security, fire safety, etc.
- Supports standard interfaces including BACnet, OPC, SNMP, etc.
- Management of all data and statuses in one integral database
- Native system-level integration of disparate disciplines for increased functionality



- Common, integral platform for security, comfort, lighting, etc. .
- Simple, intuitive operation with profiles for different user groups
- Fast, reliable event handling in situations of stress, across all building services
- Based on state-of-the-art IT technologies and operating systems
- Permanently installed clients and/or web clients with full functionality
- Extensive reporting and trending for analyses and efficiency optimization measures
- Overview and visualization of all systems and statuses in the building, in graphic or table format
- Integral alarm scenarios for all disciplines, including lighting, power distribution, etc.
- Archiving and logging of all actions and data
- Ability to evolve and expand, adding other disciplines such as access control, video surveillance, energy efficiency analyses, etc.
- Scalable architecture ranging from single-station system with one discipline all the way to cross-site multi-server networks comprising all building systems and disciplines
- Certified for pharma applications (Desigo CC V3.0 and above) in compliance with US FDA 21 CFR Part 11,GMP Annex 11
- Supports IEC 61850 for integration of power distribution and monitoring elements

System Manager

With the System Manager, the user is able to navigate through the system and can access the following functions: Display and updating of current conditions, analysis of functional data, system configuration and image and event activation.

Navigation

The System Manager offers standard workflows for all subsystems, whether they are Siemens building disciplines or 3rd party systems. This ensures reliable, error-free operation, even in situations of stress, and also reduces the amount of training needed.

The pane-based navigation system presents users with important information without overlapping areas. Using graphics, floor plans and video images, users can configure the system so that they have all relevant information available at a glance.

Similarly, values can be changed, operating modes selected and trend analyses and reports generated and displayed directly from within the schematics. The alarm and event bar provides a complete overview of anomalies and all active alarms and warnings, at all times. Assisted or manual alarm handling is possible.

Graphics

The graphics engine in Desigo CC uses intelligent objects that adapt automatically to the page according to predefined parameters (e.g. scale). This means that the user can generate graphic representations of the system by simply dragging and dropping objects to the desired position on the page. Manual binding of the symbol to the object is not necessary. Desigo CC also features a powerful tool for importing AutoCAD files where individual layers can be selected and manipulated during and after import.

Display of documents

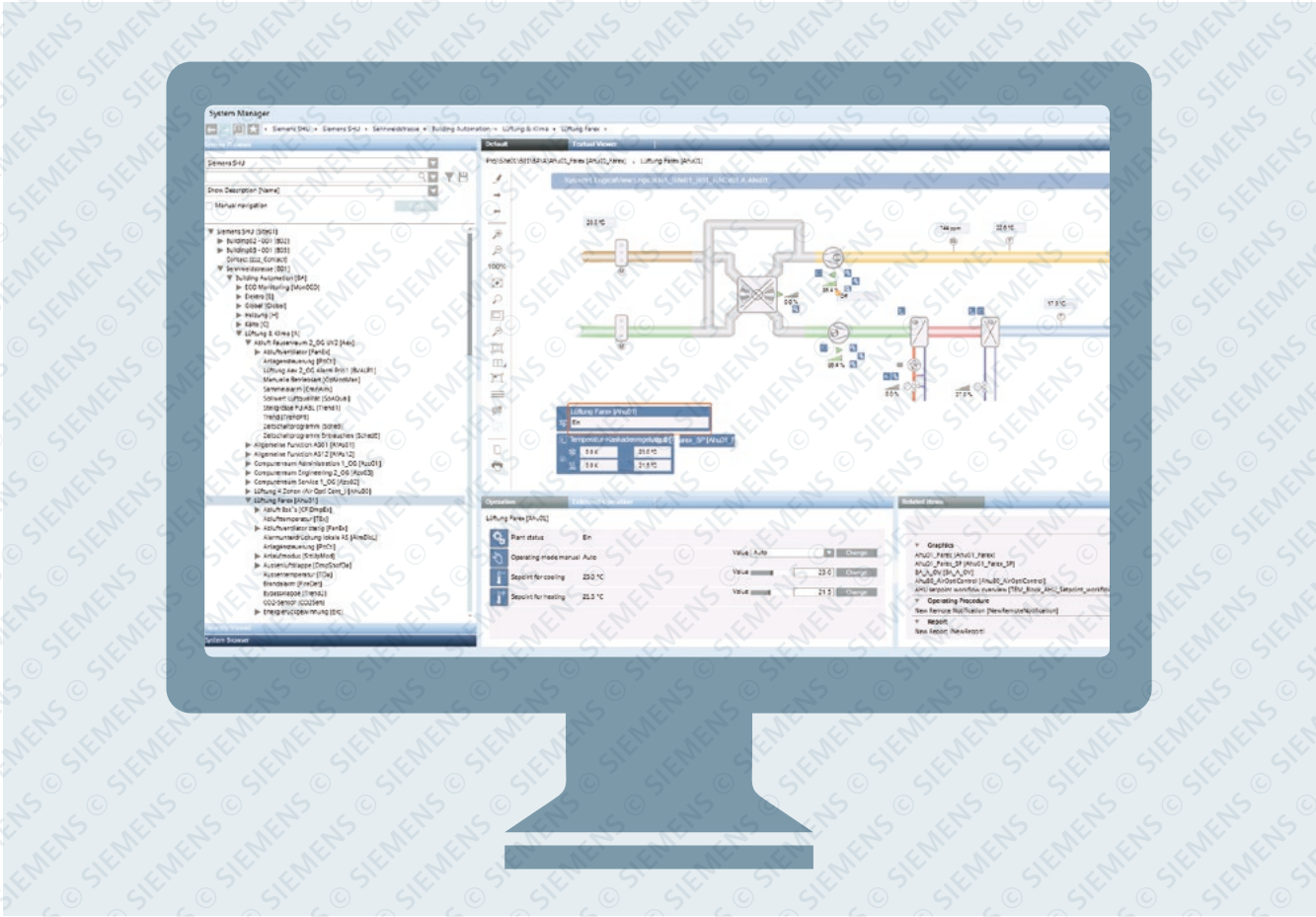
The Text Viewer provides a quick overview of current values and status information for all selected objects or object groups, without prior system configuration. This gives users a fast, accurate overview of all system statuses.

Trend log and activity reports and data on trends and system activities are stored in a Microsoft SQL server database. SQL Server Express is the version included with Desigo CC and can be upgraded if required.

The trend display tool can be used to represent the trend in a measured value or multiple parameters over time. The display interval can be adjusted and the trend comparison feature makes it easy for the user to compare data for different time periods and analyze time-dependent changes in conditions.

Schedules

This function allows complete configuration and monitoring of all standard BACnet objects of the type schedule, calendar and command. Management-based schedules can also be used to support systems without built-in scheduling capa-bilities. The schedules are automatically assigned to the relevant control systems, enabling users to navigate quickly to the schedule for the object selected at the time.



Timeline Viewer and time axis

This application allows the user to display details of schedules that apply within a certain period for multiple management system and subsystem schedules.

Macros and scripts

Macros are predefined lists for executing a series of specific commands with a single user action. Some macros can be started manually, while others are executed as part of defined schedules for time-based functions or as automatic reactions. The system too uses macros to perform multiple command steps. These predefined system macros are used for specific control functions, including for instance blocking commands for fire control panels and system backup functions.

Reaction Processor

The Reaction Processor allows the technician to program Desigo CC so that a series of actions will be executed automatically when certain conditions occur. These conditions may be time-dependent (e.g. every Monday at 7.00 a.m.), event-dependent (e.g. if an air handling unit fails), value-related (e.g. if the temperature in a room exceeds a preset value) or dependent on any combination of the above parameters. If the conditions are met, the Reaction Processor executes a predefined series of commands (e.g. switch on the lights).

Report

The Desigo CC report generating tool includes a set of standard templates. The user can also, however, create completely customizable reports with logo, header, footer and layout elements including tables for instance, and incorporating screenshots. Reports can be exported and saved in CSV or PDF format for future reference.

Operating Mode and Configuration Mode

The Desigo CC System Manager has two different function modes: operating mode and configuration mode. In operating mode, users can navigate through the system, access and override current statuses, change system function parameters and analyze the chronological history.

Users who have system configuration rights can select configuration mode. In this mode, it is possible to manage system configuration parameters and user profiles. Navigation within the system is identical in both these modes.

Alarm management

Desigo CC offers a variety of features for fast, simple and reliable handling of alarms and events.

User profiles

To ensure that users are always best equipped to handle events, an individual user and/or a user group can be assigned predefined profiles with relevant rights and views for events and alarms.

Alarm summary bar and event bar

The alarm summary bar is a key element in Desigo CC alarm management. It shows current alarm conditions and clearly indicates their priority. The alarm list can be opened directly from the alarm summary bar. Depending on the active user profile, the alarm summary bar can either be docked on the desktop or it can be freely opened and closed as required.

Alarm list

The alarm list is a complete, easy to filter list of all alarms, warnings and messages known to the management system. If the alarm list is expanded, it indicates the source and category of each alarm, its current status as well as custom messages and suggested actions. Alarms can be acknowledged, silenced or reset directly in the alarm list.

Alarm bar

When using profiles to manage critical alarms, the alarm list can be collapsed into a list of buttons docked on the desktop. This patented display format keeps the current situation where the operator can see it at all times.

Fast treatment

From the alarm list or alarm bar, operators can quickly select an alarm and execute commands directly (e.g. acknowledge, reset, close or suspend). The operator does not need to start any other actions such as activating video images or showing the floor plan of an alarm area. The expanded alarm list shows a brief description of the next action to be performed (or command to be selected). During alarm treatment, the available commands can be sent to the object which triggered the alarm or treatment can be suspended.

Free alarm treatment

The System Manager can be opened directly from the alarm list or alarm bar, with the focus on the object that originated the alarm. All relevant information (video, historical data, schedules, etc.) can be displayed.

... in the event of intrusion

Security
Alarm activation

Lighting
Light activation

HVAC
Shut off fresh air supply

Safety
Fire check

... everyday scenario

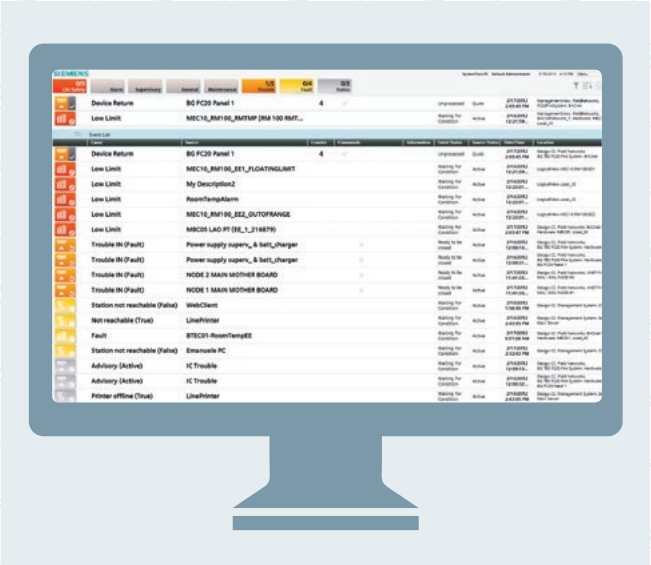
Security
Presence check

Power
Power activation

Lighting
Light activation

Assisted alarm treatment and action catalogues

Assisted alarm treatment can be opened directly from the alarm list or alarm bar in order for the operator to be guided through preconfigured action catalogues. Each action catalogue consists of individual, sometimes mandatory actions that must be performed by the user (e.g. display video images, select graphic for an object in an alarm condition, complete an event report or automatically print a copy of the alarm log). Action catalogues consist of a sequence of measures or actions which the operator must perform in assisted alarm treatment. For each type of action, the system provides processing and configuration tools. Users with the appropriate rights are able to create, display, edit and delete their own action catalogues. Assisted alarm treatment significantly reduces the number of errors or wrong decisions in situations of stress and guides even inexperienced users safely through the alarm handling procedure.



Alarm routing

With alarm notification enabled, Desigo CC can be configured so that e-mail, SMS or paging messages are sent automatically or manually to (primary) recipients. In addition to simple notification, messages can if necessary be escalated and sent to other (secondary) recipients such as emergency services.

... in the event of fire

Desigo CC – an integral platform for building security and building automation

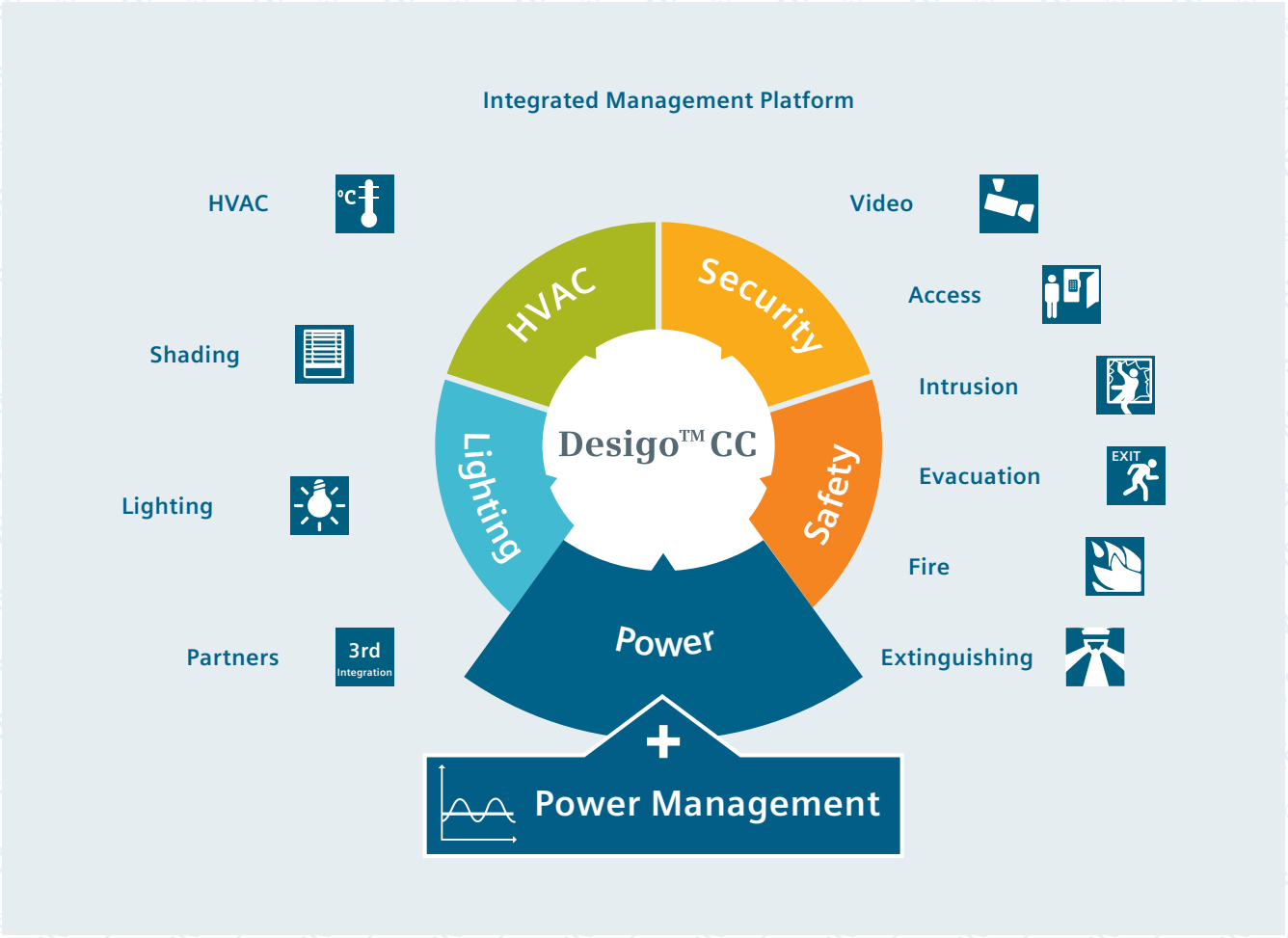
Desigo CC is an integrated management platform for all installed building disciplines including security, building automation, energy distribution, lighting and shading, energy efficiency and room automation.

Management level for building automation

As a building automation management system, Desigo CC provides a comprehensive package of applications to support comfort and productivity of building systems while ensuring optimum energy consumption and optimized equipment performance. With all current communication standards supported in compliance with international standards, open system architecture for integration of subsystems and its flexible client/server topology for full operation and configuration from anywhere, Desigo CC is the perfect tool to ensure continuity of operation of your building systems.

Desigo CC is designed as the ideal hazard management solution in security/safety systems:

- Display and management of alarms: acknowledge, reset, etc.
- Representation of floor plans and initiating elements as well as the status of detectors and contacts
- Graphic control and management of security/safety disciplines
- Display of alarms by category and priority
- Single-click navigation directly to alarm-initiating object
- Fast navigation and graphic representation of alarm-initiating object and display of action texts
- Activation/deactivation of fire detectors and sections, for renovation work for example
- Assisted alarm handling to avoid operator error in situations of stress
- Automatic alarm notification via e-mail, SMS, pager, etc.
- Arming/disarming of systems and areas (day/night mode)
- Activating video images, indicating door status (open, closed, alarm)
- Logging all statuses and actions
- Power Energy Management System (PEMS)



Management level for power distribution

- Desigo CC Power Management offers an insight into electric power and energy distribution and optimization of operation.
- Standard Modbus libraries for Siemens and generic third-party devices
- IEC 61850 electric protocol connectivity
- Cost reduction by identifying improvement potential
- Ability to identify, locate and prevent potential anomalies in power distribution
- Desigo CC generates Energy & Power reports using an embedded reports engine

Support for validated environments

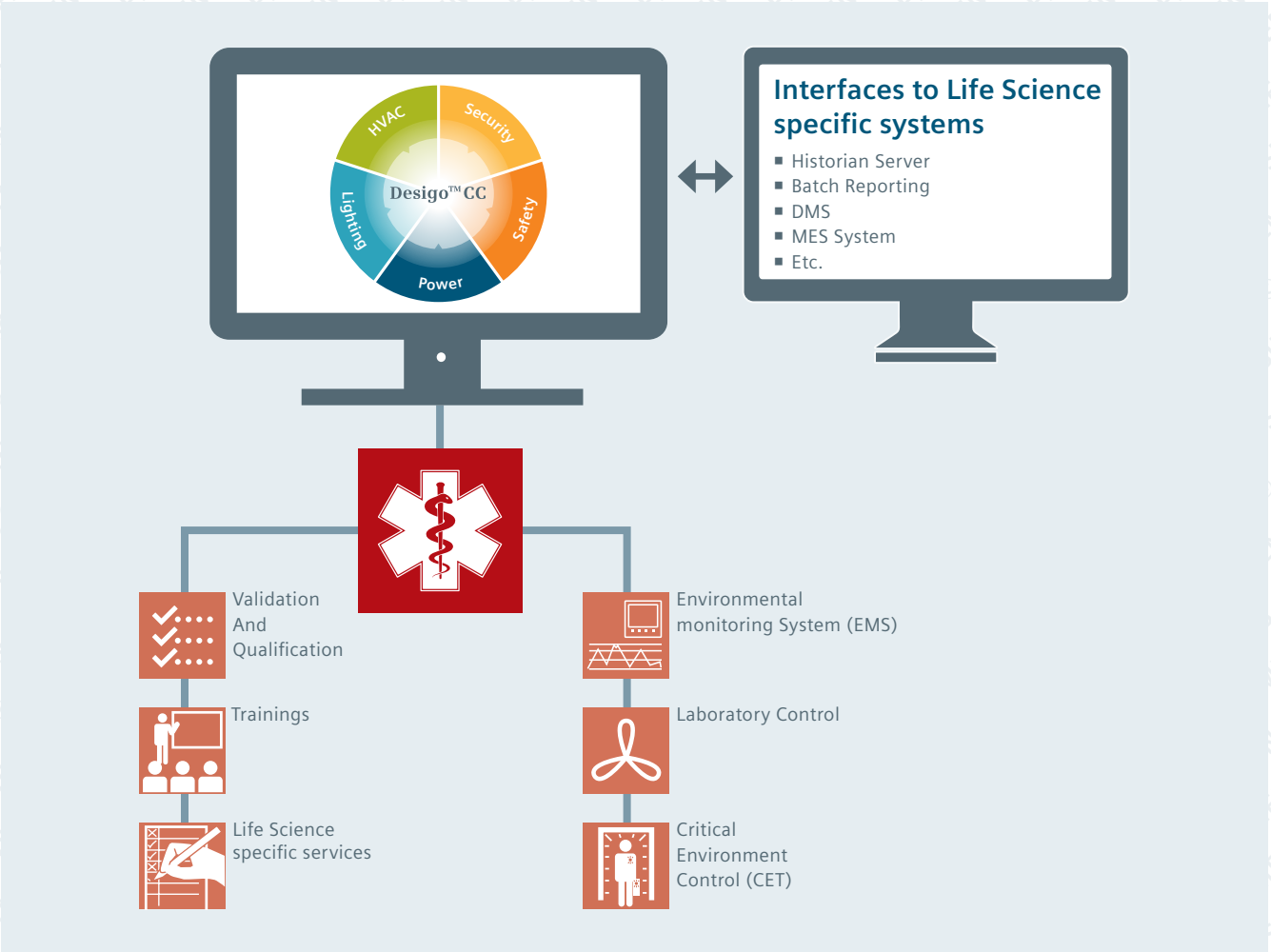
Desigo CC V3.0 can offer Pharma and Life Sciences customers the option of making parts of their building automation system compliant with regional certifications, such as US FDA 21CFR Part 11, GMP Annex 11 or similar.

Elements

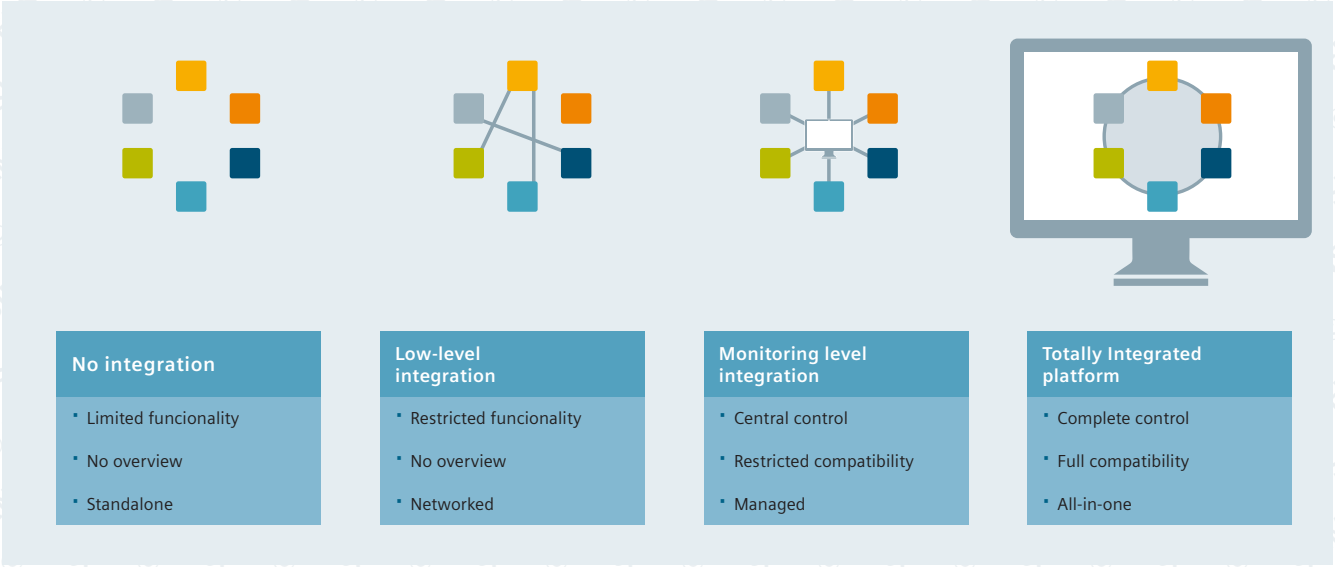
- Validated objects – engineering/configuration, operation and monitoring of certain critical objects in a specific manner compatible with the regulatory requirements for the pharmaceutical industry. Validation takes place at object level, with the result that Desigo CC does not have to be validated as a whole.
- Audit Trail – tracking of system and user activity for critical objects in an operation and engineering audit trail that is held in a tamper-proof, protected environment.
- Access security – restricting the ability of a
- set of users to change critical objects without ID confirmation or additional privileges.
- Reporting – ability to retrieve stored data in a variety of graphic or tabular report formats.
- Long-term archiving of data – provision of tools to export captured trend and audit trail data while preserving data integrity and long-term accessibility.

Process

- Capturing changes in conditions – monitoring and recording variability of temperature and humidity
- Tracking changes in the system – monitoring and recording changes to validated objects, such as setpoints, trends and schedules.
- Preventing unauthorized changes – requirement for correct authorization to make changes to settings for validated objects.
- Report on captured data – output as industry standard graphics and tables, as required by internal and external audits
- Storing and protecting data – data captured over years is retained securely, protected from changes and accessible to users.



Full integration of all disciplines

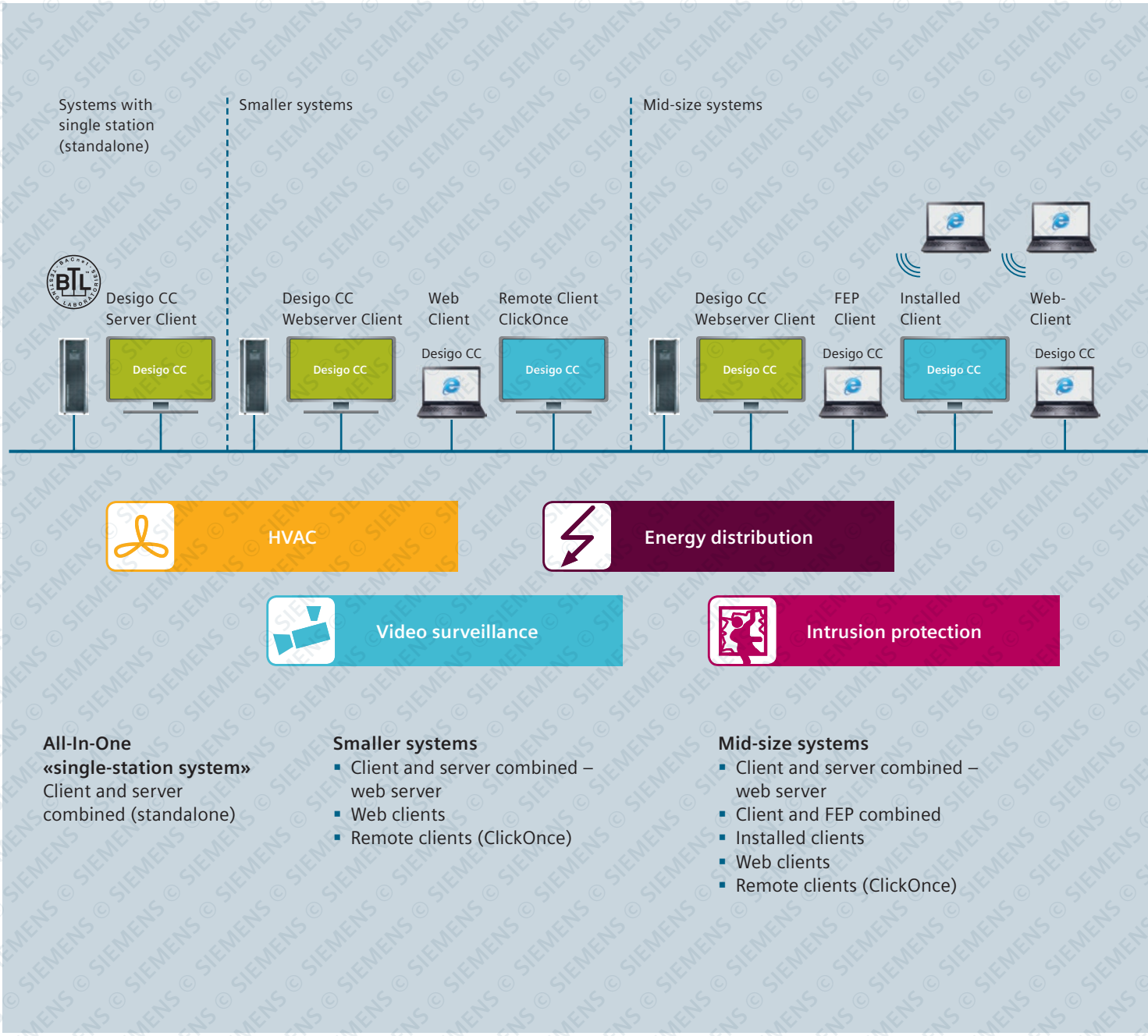


Desigo CC delivers end-to-end integration of all disciplines in a building. Specific user profiles accommodate the needs of a security management system or a management level for building automation, for the operator on the user interface. One innovation is that each data point – whether on the building automation side or at the security level – can be fully integrated into the building control system and utilized effectively in an alarm situation. The result is that, in the event of a fire for instance, power can be switched off in the area affected, lights turned on and ventilation systems switched to emergency mode. In addition to conventional measures for handling fire alarms, escape routes can also be released and blinds opened. Fully integrating all disciplines on one integral platform avoids the drawback of having to detour via interfaces and dramatically increases functionality.

Advantages of the integral approache

- One single platform rather than many different ones
- Cost optimization: only one platform need be bought, managed and later migrated
- Reduced complexity in building management
- User-appropriate range of functions
- Scenarios: disciplines work effectively together, not in isolation or indeed at cross purposes
- Flexibility thanks to openness and modularity
- Reduced training effort

System architecture



All-In-One
«single-station system»
Client and server combined (standalone)

Smaller systems
- Client and server combined – web server
- Web clients
- Remote clients (ClickOnce)

Mid-size systems
- Client and server combined – web server
- Client and FEP combined
- Installed clients
- Web clients
- Remote clients (ClickOnce)

Building automation system

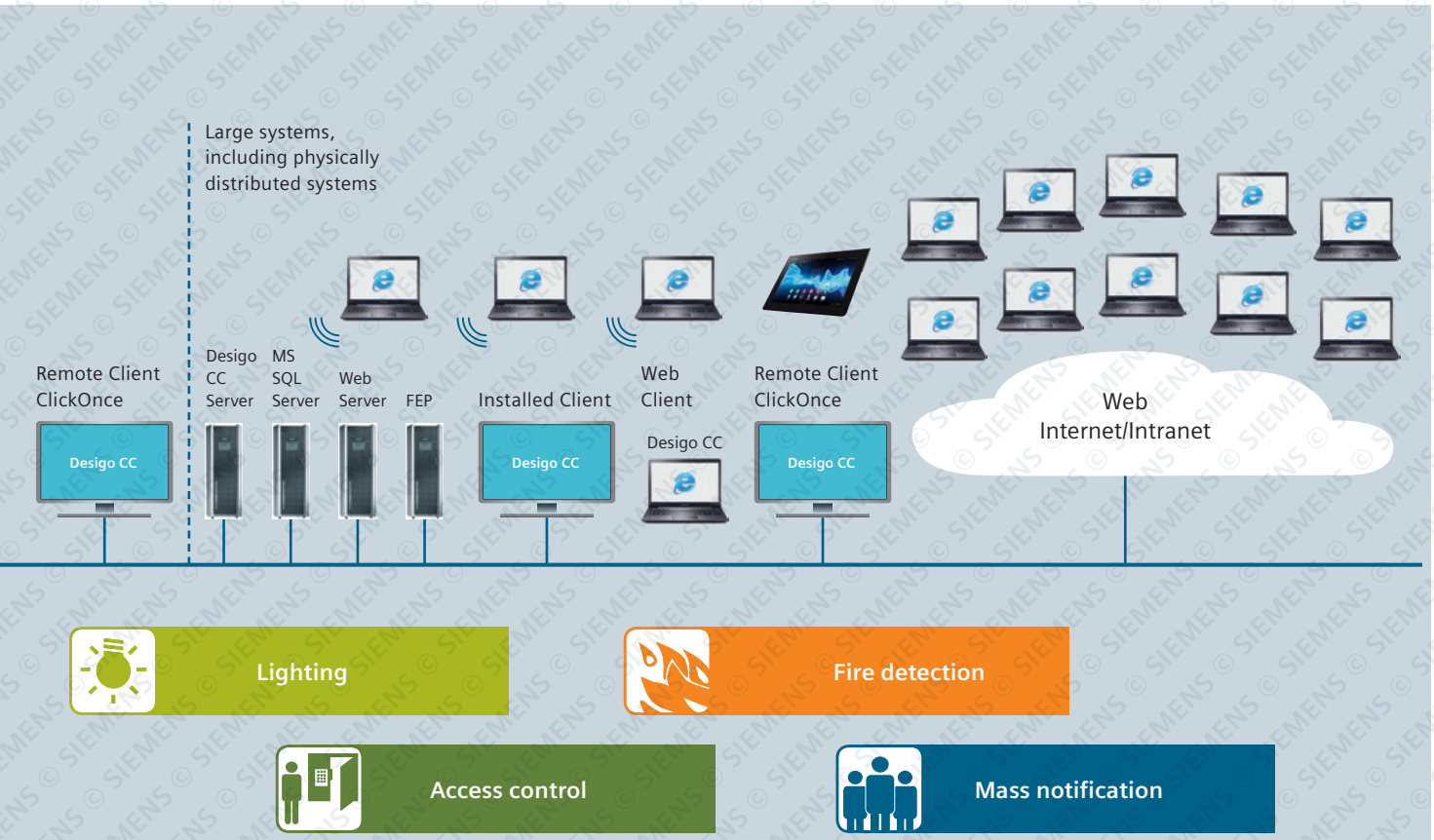
The Desigo CC building automation system is based on an extremely flexible client/server architecture which supports configurations both for smaller structures with a single station and for complex structures with large numbers of distributed client stations.

Desigo CC can be installed completely on one computer with server and client functionality. Other installations can then be added as web and remote client (ClickOnce).

For large, distributed systems, Front End Processors (FEP) can be deployed as data collectors for load sharing.

All system data is managed on the server, with the clients being used solely for visualization and user interaction. The clients provide a high-resolution user interface (full HD) for all system data required for monitoring and control of the system.

Distributed server architectures are also possible and enable very large installations or, alternatively, segmentation by discipline or geographic aspects, for example



Larger systems

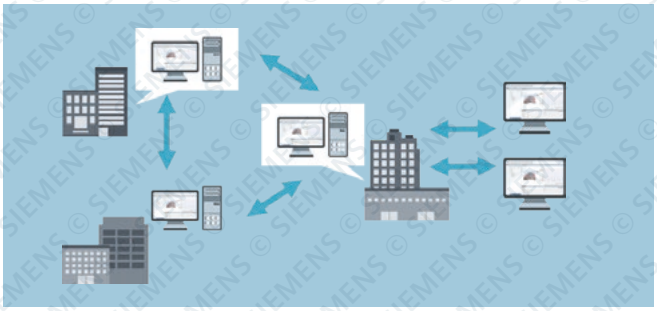
- Desigo CC server (not used as client)
- Special SQL server
- Special web server
- FEP (not used as client)
- Installed clients
- Web clients
- Remote clients (ClickOnce)
- Distributed server architectures

Desigo CC V3.0 supports distribution over multiple servers. Servers are connected to each other so that a user can seamlessly navigate the system independently of the server he is connected to.

Three types of distributed deployment are supported:
Fully meshed: each server is logically connected to all others. Clients can see all objects in all servers. Servers can be geographically distributed.

Hierarchical: front servers are logically connected to one head server. Clients connected to the head server can see all objects, and clients connected to front servers can only see local objects – for campuses or inherently hierarchical applications.

Segmented: fully meshed configuration where all systems run on the same server. Allows to build larger systems on a single server.



Server

Desigo CC server

The server hosts the project database and the software that monitors and controls the system network. Clients access this server in order to monitor and control the system. If Microsoft Internet Information Services (IIS) is enabled on the same computer and web support is installed, the system provides web clients with access to the server. There is always one client installed on the Desigo CC server. In a small application, a single computer generally acts as server and client, while in mid-size to large installations the server PC is provided exclusively for management of the project database and communication with peripherals. The server has interfaces to the subsystems (either directly or via FEPs) and provides the central database and other services for the connected clients. The server can support a number of clients connected over a network (LAN/WAN) or an intranet.

Web server

In order to use the Desigo CC web clients and the Windows app clients (remote clients), the web server service must be installed. The web server is usually on the Desigo CC server. Alternatively, it may be installed on a separate computer if the IT Manager specifically requires this or if the resources of the main server do not fully satisfy IIS requirements and tasks. The web server gives users access to the system via a web browser and via the the customer's intranet. The web server allows web clients and remote clients to download all data required.

Front End Processor

The FEP is a computer that provides additional interfaces between the automation level and the Desigo CC system. With these interfaces to the subsystems and to the network, the FEP enables better processor load balancing between the various stations of the Desigo CC system as a whole.

Client types

Desigo CC supports several client types that are optimized for situations ranging from occasional use through to workstations for dedicated, task-specific applications. All client types are based on the same user interface allowing operators to switch between client types without having to learn the different user interfaces. Rights can be assigned to users and workstations, so that users at different locations (workstations) have the same or different access rights. It is also possible to assign a specific language to each user or each user group so that on one client, the user interface appears in German for instance, while on another it is in French or Italian.

Installed client – closed mode

The installed client is designed for users and to manage critical situations and includes security management and control of critical processes, where the user's whole focus is on managing these systems and processes. In such a configuration, the software components for event handling are fixed on the screen and cannot be moved or hidden by other applications. This ensures that critical events are always handled in a timely manner and with the highest level of priority. Installed clients can be configured so that they operate in «closed mode». In this mode, only Desigo CC software and its other specific applications can be run and displayed on the workstation screen. In closed mode, the workstation is available only for use of Desigo CC, while access to the Windows Start menu and other user software is available only to system administrators.

Web client

Web client in the browser

When used on the intranet (trusted net-work) the web client allows access to local resources via Internet Explorer. The system uses HTTPS as the communication protocol and is downloaded if the user launches the system as a web application. When the browser is used via a web client, the same functions and user rights are available as with an installed client, but access to functions can be restricted when connecting remotely. Web clients require low latency times and high network bandwidth and as such are only appropriate for use on the intranet. They are not suitable for use on the internet – for various reasons including security.

Web ClickOnce client (Windows app client)

The ClickOnce client is like the installed client but is a leaner application that can be downloaded from the Desigo CC server when connecting via the browser. Once the ClickOnce client (Windows app client) has been downloaded, it runs on the desktop like any other Windows program. It can be launched from the Start menu, from a desktop icon or from the toolbar. Administrator privileges are not needed to run the client, and this can be done without the support of Internet Explorer.

Each time Desigo CC is launched as the ClickOnce client, a search for system updates is performed on the web server. If a new version of the system is available on the web server, the user can decide whether to launch the update or continue to use the existing version.

Open integration platform

Desigo CC being an open system, here is a non-exaustive list of the protocols and IT communication standards the platform is able to work with.

Integration support

Below is a list of the protocols and IT communication standards supported by Desigo CC. Desigo CC is an open system, so this list is not exhaustive.

Standard protocols and open systems

- BACnet
- Certified by BACnet Testing Laboratory as BACnet Advanced Workstation Software (BTL B-AWS), including support for Life Safety Points and Life Safety Zones
- OLE for Process Control OPC DA V2.0
- OPC Server (read and write operations)
- OPC Client OLE for Process Control OPC DA V2.0/V3.00
- OPC Server OLE for Process Control OPC DA V2.05/V3.00
- ONVIF standard for IP video camera systems
- Modbus supports use of PXC controllers
- XNET, FireFinder, XLS and MXL fire safety systems
- Axis standard for Axis video cameras
- SNMP standard for IT devices and Internet standard protocol
- DALI for lighting controls (supported via TRA PX controller)
- M-Bus standard for heating/cooling metering (supported via PX controller)
- S7 standard for Simatic controllers 300/400/1200
- SSL/TLS protocol for sending and receiving e-mails
- IEC 61850 electrical devices communication protocol
- Web Services Interface

IT communication standards:

- SNMP (V1 and V2), IP monitoring
- WMI, computer hardware monitoring
- SMTP, POP3, IMAP for e-mail transmission
- Microsoft SQL Server, trend data and historical data storage
- HTTP(S) client/server communication
- DWG, DXF, import of AutoCAD files
- Protocol for pager communication (TAP)
- Windows Communication Foundation (WCF)
- Serial data interface ESPA 4.4.4

SIEMENS

Ingenuity for life

Power Management

buildingtechnologies.siemens.com

Introduction on power management	204
Power management implementation	208
Our solutions	214

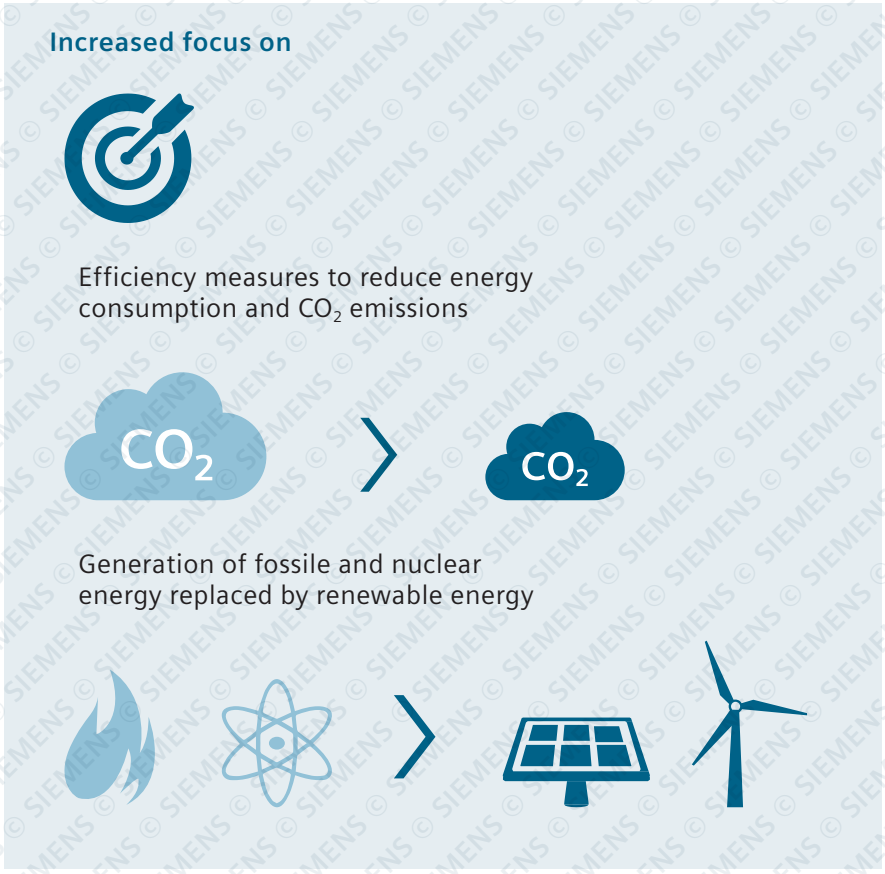
Introduction on power management

Market introduction

Over the past century, the global energy usage has been growing steadily, due population growth and economic development. Both these elements will keep being applicable in the future, while the efficiency increase in production and consumption will not compensate the future demand. In this sense, the International Energy Agency forecasts a raise of about 30 % over the next 25 years in global energy consumption.

The legal environment was heavily impacted by the Paris UN Climate Change Conference in 2015. The pressure on CO_2 emissions is coming from global and local legislations. They are promoting the use of renewable energy sources, and are causing a shift from centralized production to distributed generation. Additionally, the population is getting more concerned about the climate change, and is thus requiring additional information when consuming goods or services.

Consequences of energy transition

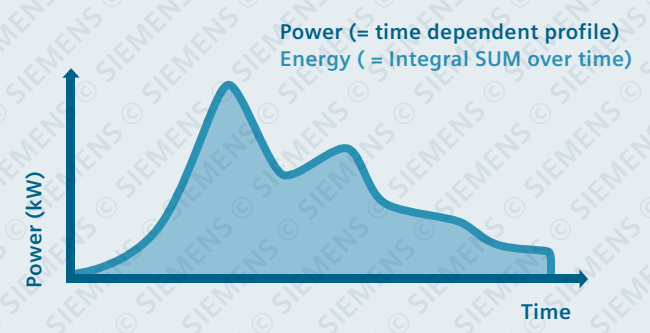


As urbanization and global population rise, the importance of buildings in the energy landscape increases: in Switzerland it is estimated that buildings are consuming approximately 46% of the overall energy. While some legislations are also adapting in this sense, by requiring buildings to be energy rated before being sold or rented, changes in the consumption models need to be addressed as well. As the urban populations increases, new heavy electricity loads appear, such as air conditioning, which can put the grid under pressure in case of important heat waves. Electric cars, adoption of heat pumps for heating solutions, the high sensibility to power quality of many modern devices and other trends impact the electrical landscape as well.

These pressure factors are usually transferred as additional costs to the final electricity users. This can be done by increasing prices, or by limiting the power peak availability for heavy users. In the meantime, some risks related to power availability still remain. These challenges also bring big opportunities to facility owners willing to adapt and to differentiate. Before we analyze these opportunities, we must clarify some basic concepts related to power management.

Definitions

Power management is based on different metrics and processes that are defined below.



Energy represents the accumulated amount of thermal and electrical power integrated over a defined time period. It is measured as kilowatt-hours.
Power relates to the instantaneous part of electricity. It is measured as kilowatt.
Energy Efficiency aims at reducing the amount of energy required to provide a defined set of products and services.
Energy Management is the proactive, organized and systematic coordination of supply, conversion, distribution, consumptions and use of multimodal energy sources, taking into account environmental and economic objectives.
Power Management is a systematic approach to ensure continuity and optimize the electricity used to perform a given services considering user needs, utilities needs, energy pricing as well as availability.

Power management & smart buildings

A smart building is valuable for its users and owners: this type of buildings increase productivity of the employees while ensuring safety and security, can reduce energy cost and support sustainability and decision making in the organization. What smart buildings allow is the integration of the different disciplines such as HVAC automation, Lighting, Fire detection systems, Energy management, etc.

Power management is a key element in a smart building, and might include:

- **Own energy production:** a smart building should be able to integrate some local energy production capacities. That can be based on solar energy or wind energy for instance. This approach allows to reduce the exposure of the building to the variations of costs and energy availability of the grid and to reduce the overall CO_2 footprint of the building.
- **Heat pumps + thermal storage:** not only electricity is used in a building. The production of heat is an important factor of the overall energy consumption. The utilization of heat pumps and the capacity to store locally the heat energy allows reducing heavily the impact of the building on its environment.
- **Batteries:** the possibility to store locally the electrical energy allows optimizing the overall performance of the building. The grid is facing important variations of its production /consumption during the day. The demand peaks (e.g. lunch time and evenings) are coming with an important increase of the energy price. The local storage of electricity, combined with a local energy production capacity, allows covering the cost intensive electricity by the stored energy.

Smart Buildings

- Power Monitoring and reporting
- Power quality analysis
- Own energy production
- Heat pumps + thermal storage
- Batteries
- Flexible energy tariffs
- Flexibility offerings
- Microgrid management

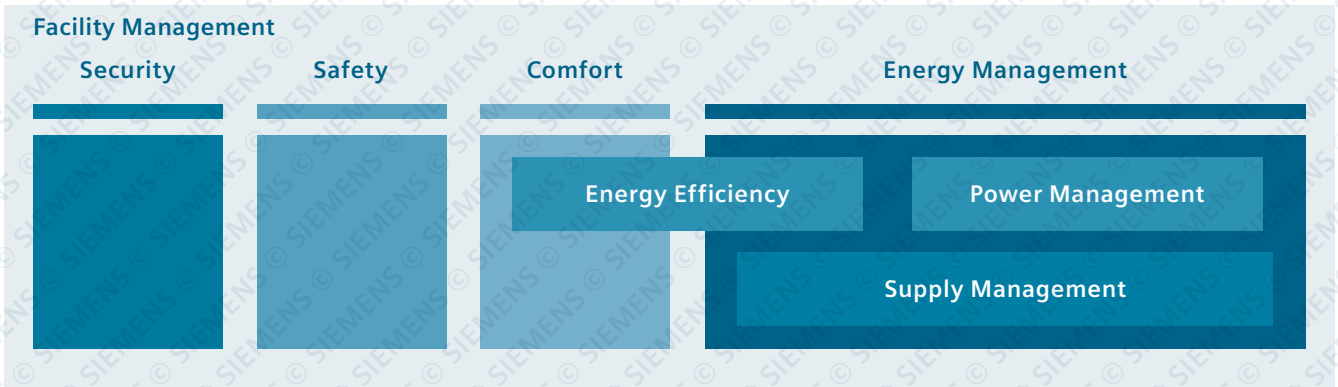
The overall transfer from a traditional energy user to a smart user takes time. Different changes have to happen in the market for the complete implementation to be effective. However, the buildings can already integrate technologies ahead of the grid itself, since the changes done locally can already be applicable with today's infrastructure.

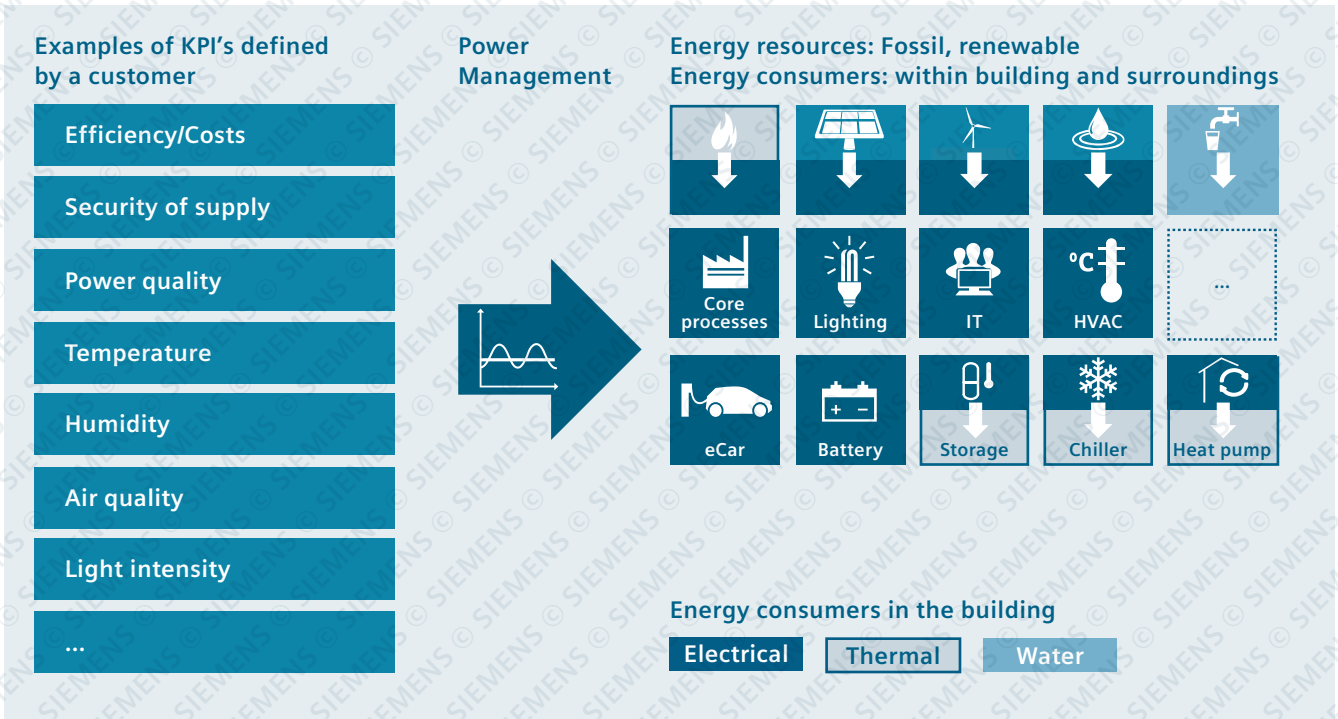
Integration in the Building Management System landscape

In order to ensure the best out of power management in a smart building, power should not be considered independently from the rest of building disciplines. Having on the same platform the energy supply, the local storage and the consumers, together with other disciplines gives a clearer view on the overall energy flows within a building or a campus, enhanced by common monitoring, command and reporting.

The image below shows that obtaining Energy efficiency can focus on the energy management but should consider other building disciplines such as HVAC automation, room automation, power distribution and lighting.

Furthermore, the energy efficiency should not be limited to just the electrical energy. An important part of the energy used in buildings comes from fossil sources, like fuel or gas. In addition, the different energy users should be considered separately in order to allow an effective influence on their consumption patterns.





Integrating different disciplines within the same platform allows having cross-discipline KPIs. For example, if the air quality is getting too low in an office building, the ventilation should be kept at a high level, depending on the cost impact. This will optimize the productivity of the employees which is more critical than a small energy over-spending. However, if the air quality is sufficient, the ventilation can be reduced since the influence on the employee's productivity will be neglectable. The key to correct cross-discipline functioning is the possibility to set rules and prioritizing of actions, based on criticality and customer's own expectations

Typical market needs

Depending on the field of activity, the focus concerning power management can significantly vary. Identifying the needs of the customer when it comes to power management is the first step towards efficiency. Different departments within the organization may have opposite interests (e.g. IT, production, business units, procurement...). In general, to allow a good process to be put into practice, the following questions should be answered:

- Which infrastructure elements are key for core operations, and which ones can be operated in a flexible manner?
- What are today's energy requirements, and how are they likely to evolve in the future?
- How can the utility costs and consumption be reduced?
- How can the risks attached to a power outage be reduced?

For industries like data centers, critical infrastructures, hospitals, manufacturing, power management ensures the continuity of their core operations. For example, a power outage in a data center implies an interruption of the complete premises. The costs attached to such events are tremendous and can endanger the complete business. These types of applications usually require a solution to cope with a grid failure, for example, with an Uninterrupted Power Supply. In this kind of infrastructure it is also necessary to monitor the power. Key Performance Indicators related to the efficiency of the used energy in the facility are often important to measure the overall impact of the building and for certifications.

Office buildings, hotels and multi-use buildings often are most concerned with the capacity to manage and monitor the energy flows within a building or a campus. The possibility to provide reports for the different section of a building, the possibility to allocate the energy costs to the different tenants of a building, the definition of a smart metering concept are examples of solutions for these customers. The awareness of the building users is also an important factor when it comes to reduce the footprint of a building. Individuals need to get awareness of the effect of their behavior in order to change the mentalities and to allow a long term energy strategy within a building or a campus.

Power management implementation levels

We differentiate between three levels of Power Management implementation.

Optimization based on grid incentives
... uses external incentives such as dynamic energy and demand response requests to bring cost optimization to a higher level.

Energy efficiency measures
... contains technical infrastructure, automation and services for optimizing energy costs by reducing the energy requirement, which is necessary for the defined comfort and productivity limits.

Optimization for self-consumption
... enables the coordination of supply systems, on-site load and storage systems to optimize costs, improve the availability and autonomy of energy and reduce emissions (consumption and generation).

Transparency & Awareness

... enables reliable network operation and cost optimization through measures. The offer includes systems and services for the acquisition, visualization and calculation of relevant information for electrical energy.

Autarchy & Monetization

Efficiency & Optimization

Transparency & Awareness

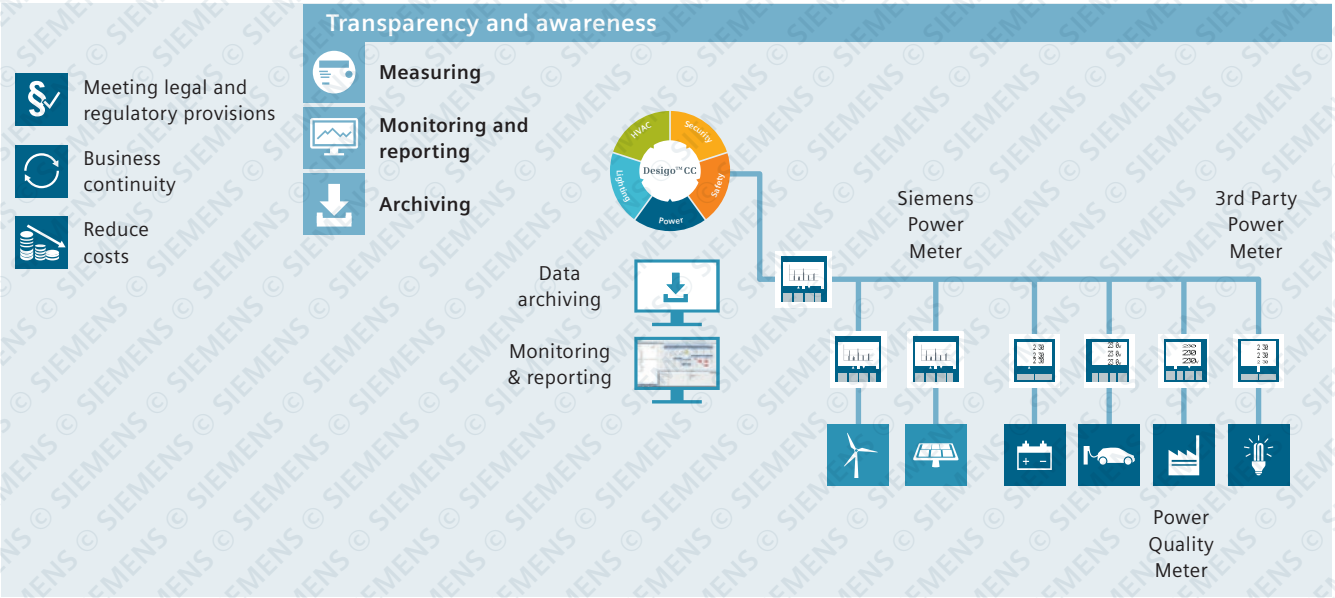
Different customers will have different requirements for this implementation.

Examples of applications for different customer profiles				
	Needs	**Transparency & awareness**	**Efficiency & optimization**	**Resiliency & monetization**
Critical infrastructures, hospitals, production plants	▪ Very high availability of power supply ▪ Power quality ▪ Reduction of power consumption and cost	▪ Possibility to track and document energy usage to perform internal and external audits ▪ Monitoring of the power quality from the network Example of KPIs: ▪ Average energy consumption per m^2 / room / production unit per year	▪ Monitoring of energy sourcing, cross-referencing of different sources to identify energy usage patterns ▪ Dynamic load management	▪ Enhance sustainability by switching between different energy sources based on the grid's pricing model ▪ Management of a Uninterrupted Power Supply and local energy storage for core business continuity
Data centers	▪ Very high availability of power supply ▪ Power quality ▪ Reduction of power consumption and cost	▪ Tracking and reporting of the energy consumption ▪ Monitoring of the power quality from the network Example of KPIs: ▪ Power Usage Effectiveness (PUE) ▪ Data Center Infrastructure Efficiency (DCIE)	▪ Monitoring of power quality from the network and automatic report creation ▪ Optimization of the mechanical and electrical infrastructures ▪ Reduction of utility costs by optimizing the non-critical consumers schedules	▪ Optimization of energy sourcing based on the pricing model of the grid
Office buildings, hotels	▪ Power & Energy monitoring ▪ Energy & Cost management (efficiency & allocation) ▪ Sustainability targets tracking	▪ Energy consumption tracking per user (tenant, building...) ▪ Documentation for external customers of the energy behavior of the building (dashboards) Example of KPIs: ▪ Energy consumption per year and m^2/ room... ▪ Cost allocation per zone / user ▪ CO_2 equivalent emissions per office space	▪ Optimization of the energy usage by influencing the consumption patterns for non-critical consumers	▪ Optimization of the energy usage pattern to reduce the overall utility costs ▪ Management of local production with photovoltaic panels ▪ Optimization of the energy use with local energy storage

Level one: Transparency & Awareness

Transparency on the buildings behavior is a prerequisite to any further improvement actions.

For this, the metering concept should fit the facility's needs: for example, a multitenant building will have to understand the electrical consumption on a building level, but also on floor, subtenant, cost centre, and/or individual consumers and producers. The metering concept should be developed already in the planning stage of a new facility, but can also be improved in existing buildings by adding new meters or building logic on the automation or management level (virtual meters). The Integrated Management Station Desigo CC allows to seamless integrate the power and quality meters, as well as circuit breakers and other relevant devices in your facility by supporting the relevant protocols on the building and electrical market (Modbus TCP, IEC 61850, etc.). The openness and scalability of the system allows us to make solutions tailored made to fit the facility's needs both in the case of new projects and for retrofits.



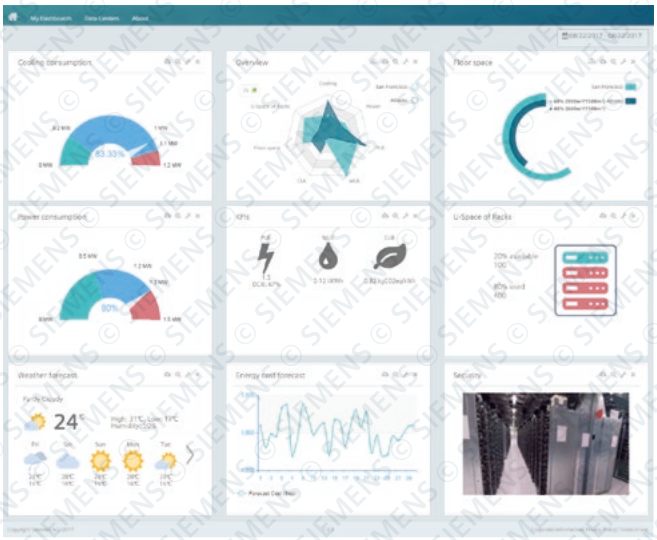
Real-time data allows monitoring electrical power generation, consumption and distribution. Alarms can be set to inform of faults, malfunctions and if power limits are exceeded. Advanced reporting allows visualization of historical data in a structured format, such as in power, consumption or cost center reports, which support further optimization measurements. These reports can be automated and customized for each customer. The functionality is completed by long term storage of trend information and data. Historical data can be used to create models for load and production forecasts based on different data sources: core processes, weekday, weather, building utilization, etc.

Desigo CC supports power quality fault notification and location with upload of corresponding reports.

Custom made KPI tracking facilitates both performance supervision and awareness creation in your organization.

The needs will often be defined depending on the industry requirements.

- **Data centers:** The main KPI for energy performance will be the PUE, Power Usage Effectiveness, which measures how efficient energy is used in the facility (meaning the ratio of total energy consumption in relation to the energy consumption of information and communication technology equipment). By calculating the PUE we can easily see not only the current performance, but get the average per day, month or year, identify shifts thanks to Desigo CC trending, and derive actions.
- **Shopping malls or multi-tenant office buildings:** Shopping malls are facing a high average utility cost. The average energy consumption per m^2 will might be a good indicator for the overall building efficiency, but allocating the costs to the concerned tenant (shops) will enable fair costs sharing as well as branding towards final customers.
- **Hospitals:** Besides the energy consumption, a hospital will focus on the power quality to ensure the efficiency and the protection of sensitive equipment's.



Our Dashboard solution allows you to share the right information to the right people, in the right format and at the right time. For example, the building user will be interested in understanding their impact on energy consumption, while an executive member of the company will be more interested in energy usage and financial effects. The graphical representation of the information helps everyone to become actors of the energy and power behavior of the overall building.

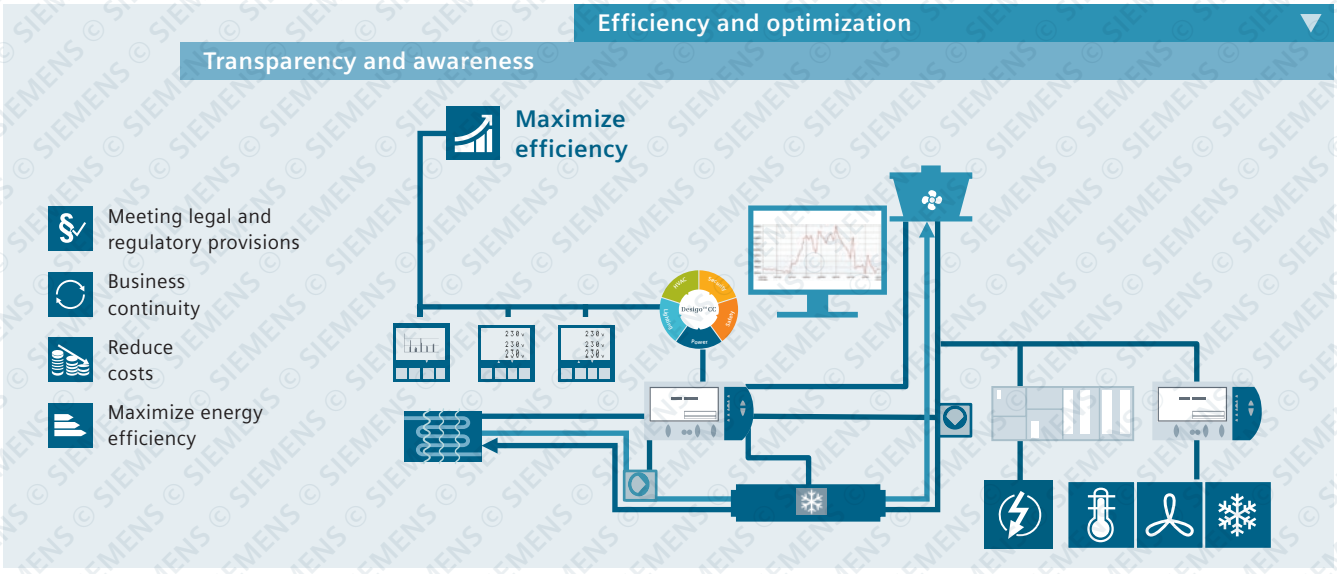
Level two: Efficiency & optimization

Having a clear overview of the building's situation concerning the energy and power flows allows making it possible to increase the overall efficiency of the facility.

The management station Desigo CC can be used together with the automation level in order to optimize the building's consumption of electricity and related costs. For example, by avoiding consumption peaks.

Thanks to the integration and reporting capabilities of Desigo CC, we can correlate unexpected changes in the building consumption with events from the electrical automation. We can also cross reference the electricity consumption with other events from the facility such as production schedule, weather situation... Our building know-how allows us to use this information to derive improvement measures.

The metering network allows the allocation of objectives of consumption per zone / floor / unit in order to track the results of energy efficiency initiatives.



In addition to automated real-time solutions with Desigo CC, Siemens is able to offer energy services to support through the entire lifecycle of the building and help to maximize its efficiency; optimize your energy procurement; and at the same time improve your sustainability impact. Siemens energy services can manage your greenhouse gas footprint, allow the benchmarking of your installation versus comparable ones, and support your energy budget management ... More details can be found in the building performance services chapter of this document.

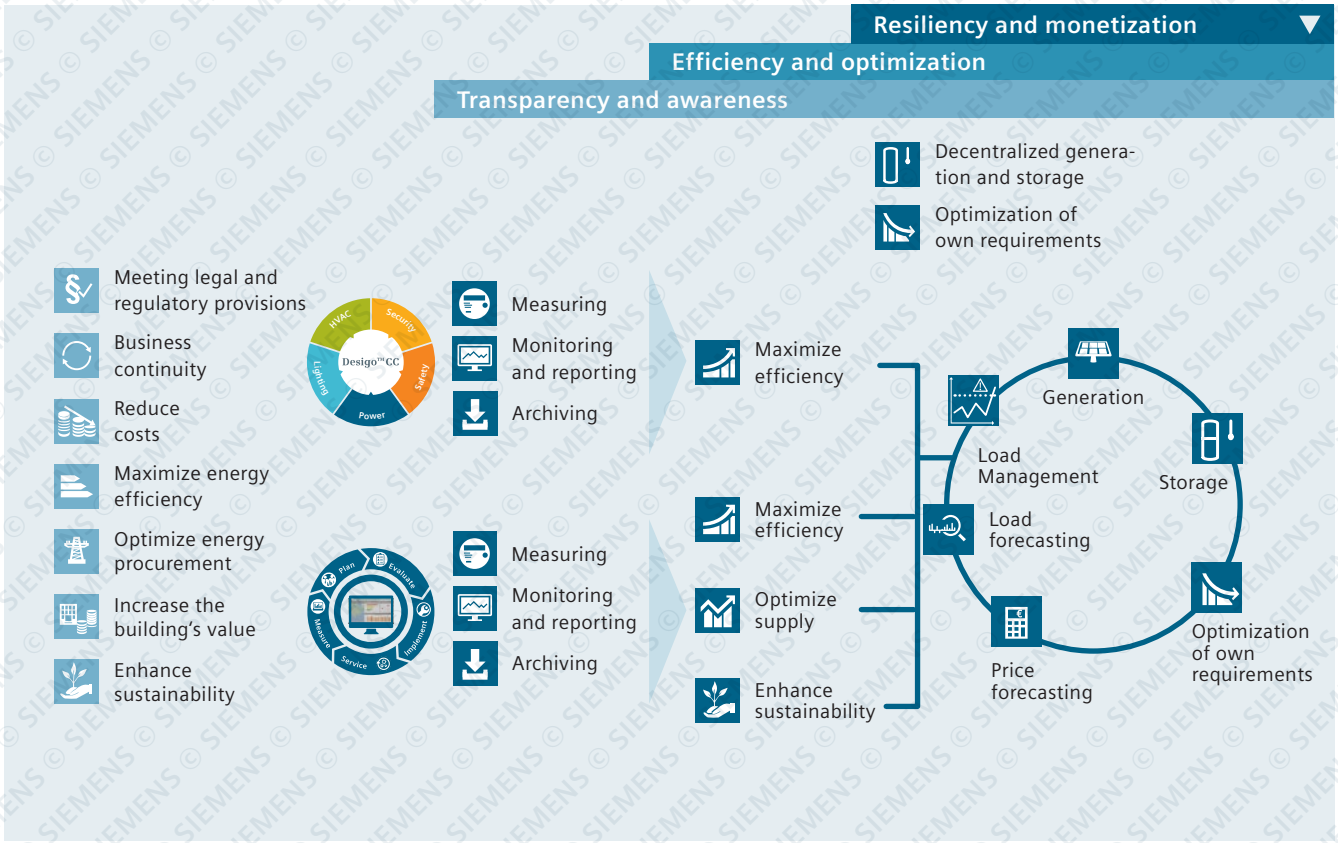
Level three: Resiliency & Monetization

The traditional energy grids, which were based on a small number of production facilities and a large number of strict energy consumers, are getting replaced by new grids where consumers incorporate own production. This means on-site production capacities are made available using technologies like photovoltaic or combined heat and power. Local storage of energy is also possible for smaller players, using on-site batteries or e-car loading stations. These solutions allow facility owners to ensure an optimization of their electricity procurement as well as autarchy in case of power outages, providing the continuity of their businesses.

In order to reach such a level of self-sufficiency, it is necessary to have a deep intelligence of the building's energetic behavior. Load-forecasting, based on previous building behavior; generation forecasting, based on weather forecasts for renewables; load management by shedding unnecessary loads in a smart way; storage of electricity when suitable, and demand response applications are needed to reach this level. All this shall be based on rules that allow the most efficient and cost effective behavior, while ensuring business continuity following the facility's requirements.

Once a facility has been optimized, additional extensions can be developed. Exchanges between the facility and the grid can be monetized: the spot energy price is heavily varying during the day. Sending power to the grid when the prices are high is a way to limit the overall energy costs. Also, more and more energy grid players have interests having large customers able to modulate their use of electricity from the network to ensure a higher quality of their supply.

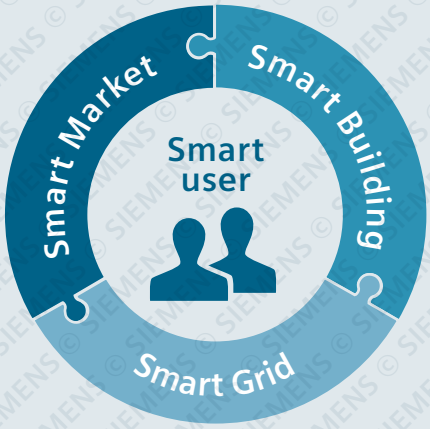
The currently available Siemens technology allows us to develop with our customers the applications they need to ensure business continuity, to optimize their energy costs and / or to limit their carbon footprint.



The combination of the smart buildings, the smart energy markets and the smart grids allows the user to get smarter concerning their energy utilization and production.

Smart Markets

- Production increasingly dependent on weather
- Demand for improved production and load forecasts
- Demand for short term energy pricing according to present production volume
- Platform for flexibility trading



Smart Buildings

- Power Monitoring and reporting
- Power quality analysis
- Own energy production
- Heat pumps + thermal storage
- Batteries
- Flexible energy tariffs
- Flexibility offerings
- Microgrid management

Smart Grid as facilitator for smart energy system (Vision)

- Provisioning of Power quality and grid availability under fast changing requirements
- Improved load and generation forecasts
- Flexibility management and grid protection
- Additional services for market partners

Our solutions

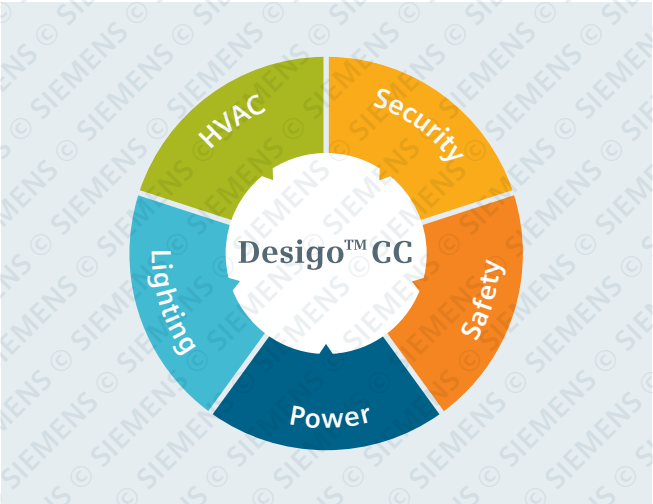
To implement such applications, three elements are essencial: the Desigo CC management station layer to keep the control on the installations, the metering network to monitor continuously the installations and the automation layer to act on the flows.

Desigo CC

Desigo CC includes the libraries, the algorithms and the data management capacities to handle power management solution. This platform has the capacity to integrate the data coming from various sources to optimize the building's power behavior in an effective manner.

The long-term data storing capacity allows creation of trends for the facility to determine efficiency initiatives to be undertaken.

More details on the Desigo CC capabilities can be found in the relevant chapter of this document.



Metering

Siemens offers you a broad portfolio on Power Distribution products for your building: a complete range of circuit breakers and measuring devices allowing precise, reproducible, and reliable measure the power values for in feed's, outgoing feeders or individual loads. They provide not only important data on your electrical installation and power distribution but also key measured values for assessing the system state and power quality. The easy and flexible integration of these metering devices on Desigo CC allows further processing of the measured data to maximize efficiency in your building.

Other Power meters available on the market are easily integrated into Desigo CC transparently w/o any limitation.

Automation layer

Simatic S7 Automation / Desigo PX allow integration of information from the electrical automation. A complete portfolio is available allowing a scalable solution to control your installations, which is seamless integrated into our Management Station Desigo CC. It can be typically used for automatically between different sources or generally to switch off/on, to automate load management and for interlocking mechanisms.

S7 is used when high level functions of Power Management requires interoperability with Medium Voltage (MV), allowing direct Integration of MV protection and MV Power Meter: in this case additional functions are made available to analyze and manage trouble shooting on MV with integration of Sicam PQ

Desigo PX is used when no critical functions are required.

SIEMENS

Ingenuity for life

Incident Management

buildingtechnologies.siemens.com

Basic principles	220
Siveillance Viewpoint	226
Siveillance Vantage	230

Basic principles

Introduction

What control systems are used in modern building services?

Incident management systems

Integrated control systems	Incident logging	CTI integration	Incident handling

Overarching building automation and control system, TBS

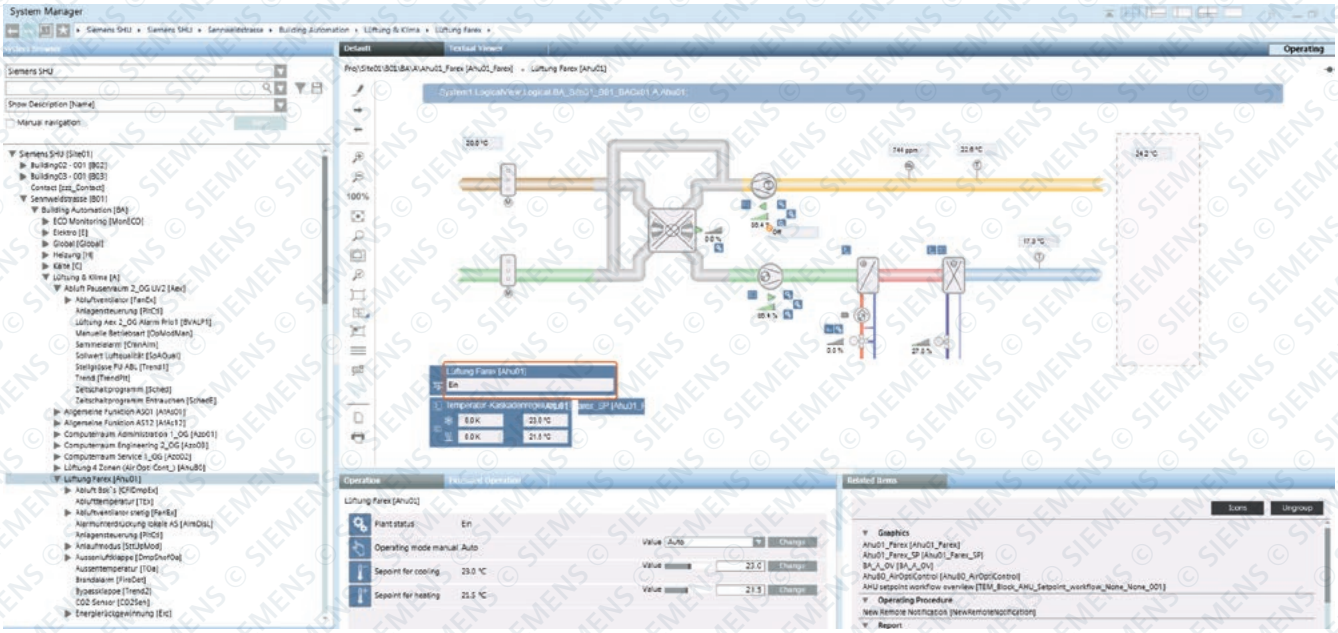
Building safety & security Protection of people and assets	**Building comfort** Well-being of people
▪ Physical security management system ▪ Video management systems ▪ Fire detection, intruder alarm, access / perimeter control systems ▪ Evacuation systems ▪ etc.	▪ Building automation ▪ Room automation, TRA ▪ Primary energy, HVAC ▪ Energy usage ▪ etc.

The management level displays the current status of technical control and monitoring systems in a building or on a site / campus and allows user-friendly operation. It also displays alerts, provides reports and forwards data to the relevant software for further analysis, e.g. for energy optimisation.

A distinction is usually drawn between building automation, physical security management and incident management systems.

Basic information about management levels can be found in the Desigo CC section

Building automation



Screenshot of building automation from Desigo CC

Building automation systems are designed to ensure the optimal comfort and well-being of a building's occupants while minimising energy consumption, or to control precisely defined room parameters in pharmaceutical or clean room environments for example. On the automation level below the management level are subsystems such as room automation or systems for controlling primary energy (heating, ventilation, air conditioning). The management level is used for visualising all the relevant parameters (e.g. temperatures, humidity, heating burners on / off, etc.) on the system schematic and for easy adjustment of these parameters (e.g. setpoints, control parameters, etc.). In addition, alarms and faults are displayed and it is possible to view reports and trends.

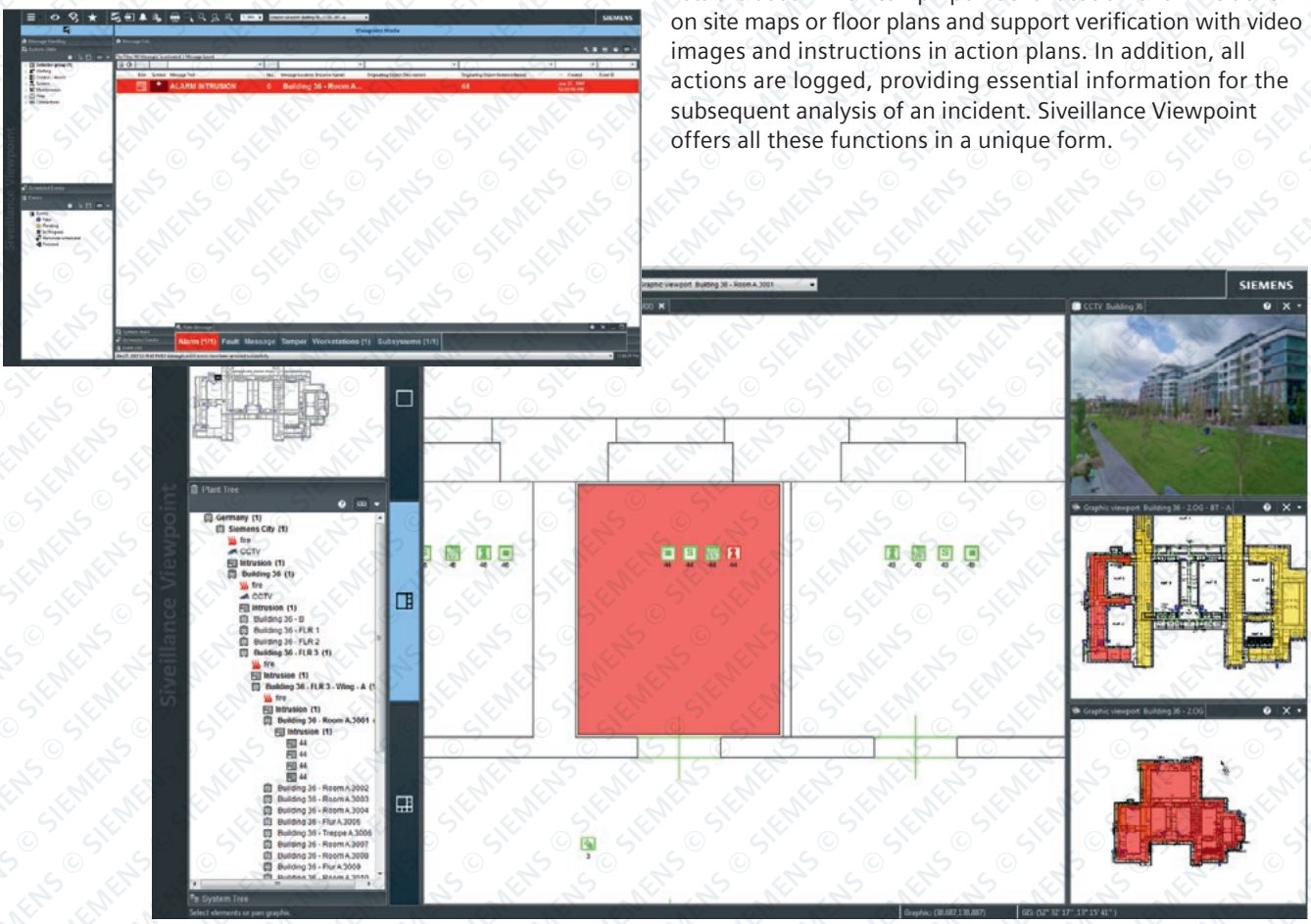
The building automation user interface is always active – temperatures are updated, setpoints are adjusted and trends are displayed. Building automation systems are usually operated by trained experts and access to the system is relatively open. Alarms can be processed according to their priority.

Physical security management system

A physical security management system is designed to protect people and assets in buildings or campus-type sites from incidents such as fires, gas leaks, break-ins or other attacks. On the automation level below the management level are subsystems such as fire detection, intruder alarm, access control and video surveillance systems. The management level is used for visualising the current alarms and faults on all the integrated subsystems, for displaying the status of doors, or for viewing video images. In addition, it is very easy to zoom in and out of intruder alarm zones, activate or deactivate fire detectors, and release or lock doors for example.

Ideally the user interface of a physical security management system should be completely passive. If there are no alarms or incidents reported, there is no need for action and nothing changes (except for messages about door movements, IR detectors etc. being updated in the background). The operators of these systems are usually building security personnel and therefore they have not been specifically trained in the technology of the subsystems. Access to the physical security management system is usually tightly controlled. If an alarm is reported (e.g. intruder or fire alarm), an immediate correct response is vital. People's lives, valuable assets and the continued existence of a plant, or even the company itself, could depend on this response. Moreover, this is an extremely tense moment which greatly adds to psychological stress, consequently increasing the likelihood of mistakes being made.

In these circumstances, it can be helpful to have a dedicated independent physical security management system with specific functionalities and mechanisms for monitoring and responding to incidents and events. This includes an easy-to-read user interface (GUI) that displays only the relevant information in a clear and simple way: what happened, where it happened, and what action needs to be taken. Alarm lists are used which can pinpoint the location of an incident on site maps or floor plans and support verification with video images and instructions in action plans. In addition, all actions are logged, providing essential information for the subsequent analysis of an incident. Siveillance Viewpoint offers all these functions in a unique form.



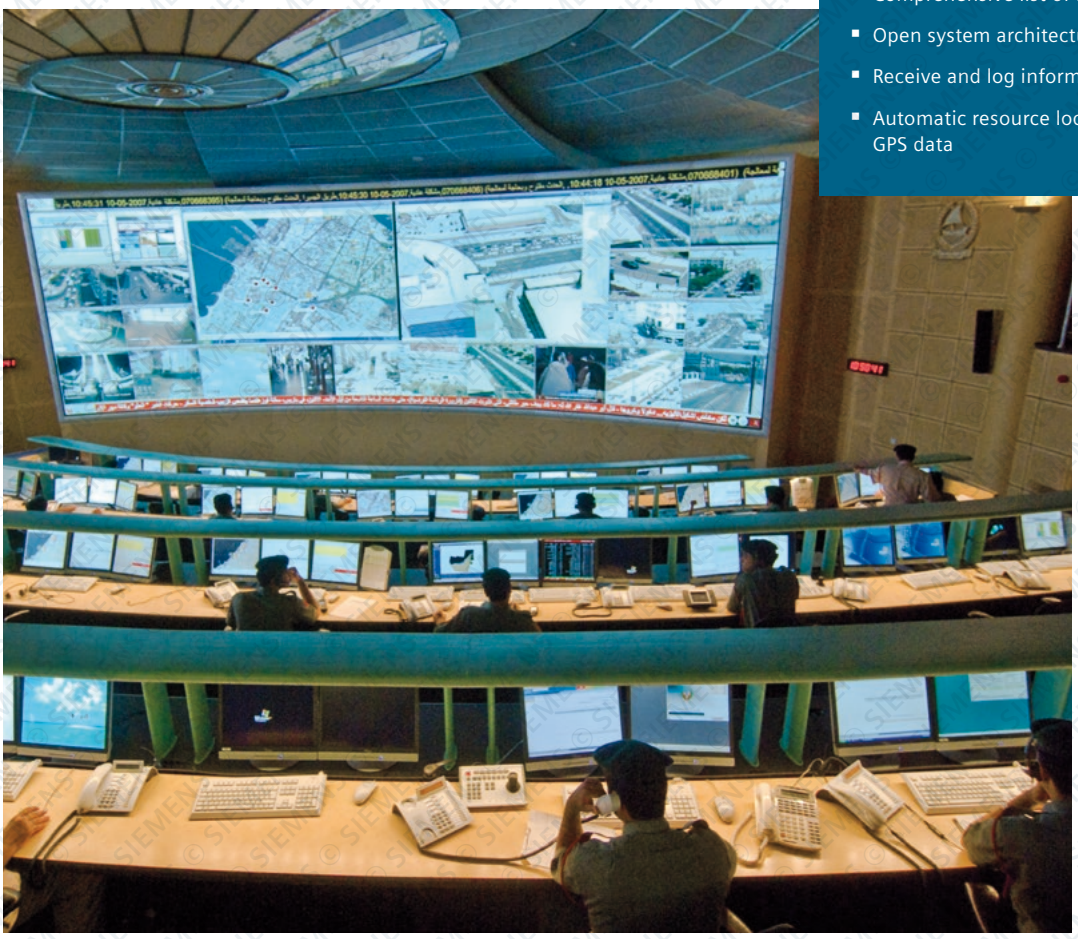
Viewpoint screenshot

Incident management level

Above the building automation and security control levels it is also possible to have an incident management level. This level handles the dispatch and coordination of emergency responders such as the police and fire service, as well as the management of major incidents (disaster management) from the time they occur until everything has returned to normal again. This involves intelligent correlation of all the information on the lower levels, on the basis of which intervention strategies and decision-making aids can be combined and offered. Intelligent algorithms such as crowd behaviour simulations can be helpful for quickly assessing a situation and identifying the appropriate action to take, and also for enabling the effective and efficient planning and deployment of emergency responders. Possible applications include public and industry emergency responders or major public-sector or private infrastructures, for example. Siveillance Vantage offers the flexibility to handle projects involving this level of complexity. Backed by a wealth of international experience, our Siemens specialists will help you find the best solution for you.

Highlights

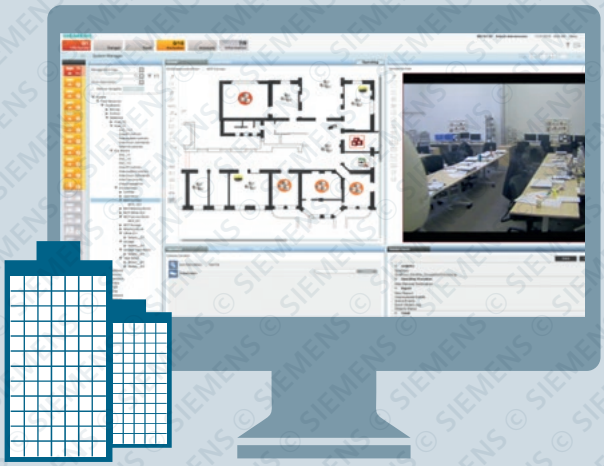
- Geographic information system (GIS)
- Georeferenced presentation of objects in the GIS
- Clear overview of resources deployed and sensors
- Communication via:
  - VoIP and analogue telephones
  - Digital and analogue radio
  - E-mail, SMS, SDS and fax
- Decision support from:
  - Automated actions
  - Context (geography, time, etc.)
- Resource management:
  - Coordination of emergency responders, vehicles and equipment
  - Outside buildings or internal
- Comprehensive list of integrated subsystems
- Open system architecture
- Receive and log information from resources
- Automatic resource location (ARL) using GPS data



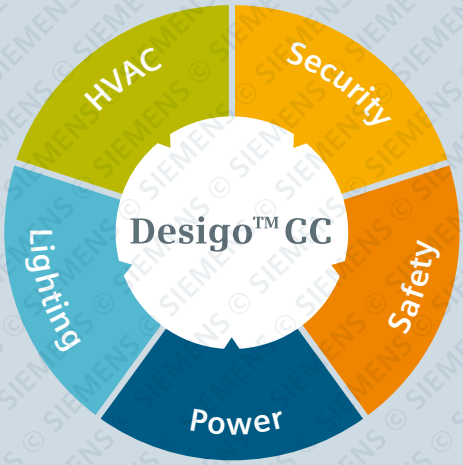
Everything comes together in the command and control centre.

All-round security across buildings and corporate customers – a combination of Desigo CC and Siveillance Suite

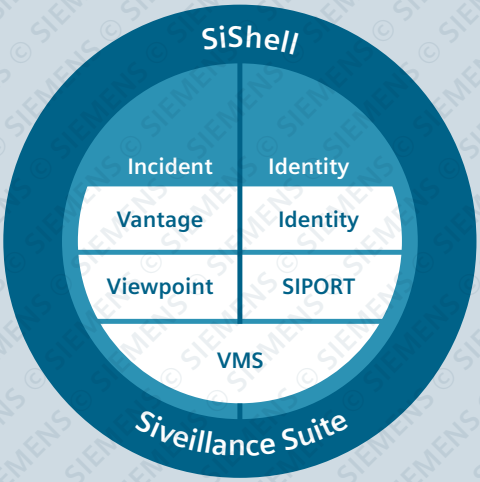
3rd Integration



SiPass Mass Notification Desigo Video



OIS (Open Interface Services)



Physical security information management (PSIM)

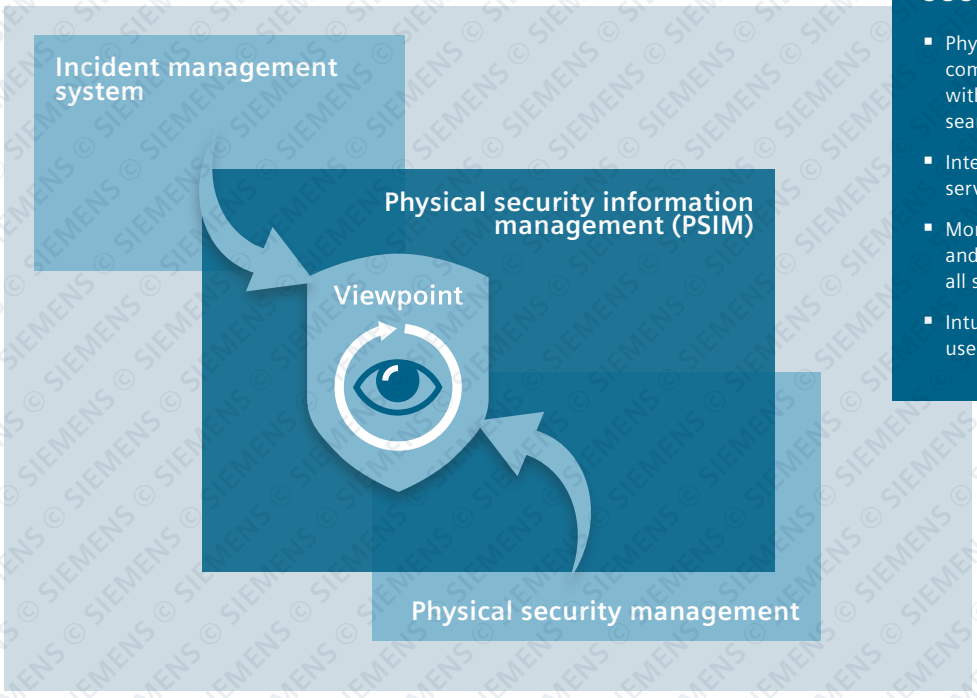
Siveillance Viewpoint – the benchmark for tomorrow

As reliability and risk minimisation are vital prerequisites for ensuring business continuity, security is of increasing strategic importance for successful companies. We can help with a completely new approach that seamlessly integrates physical security management and control centre functionality in one system.

A new approach

As a pioneer of physical security management in recent decades, we know that security and reliability are vital prerequisites for ensuring business continuity. Investments in various security infrastructures over many generations of hardware and software must work in harmony. Operators need to be able to focus on what is essential in order to follow clear security protocols in every situation.

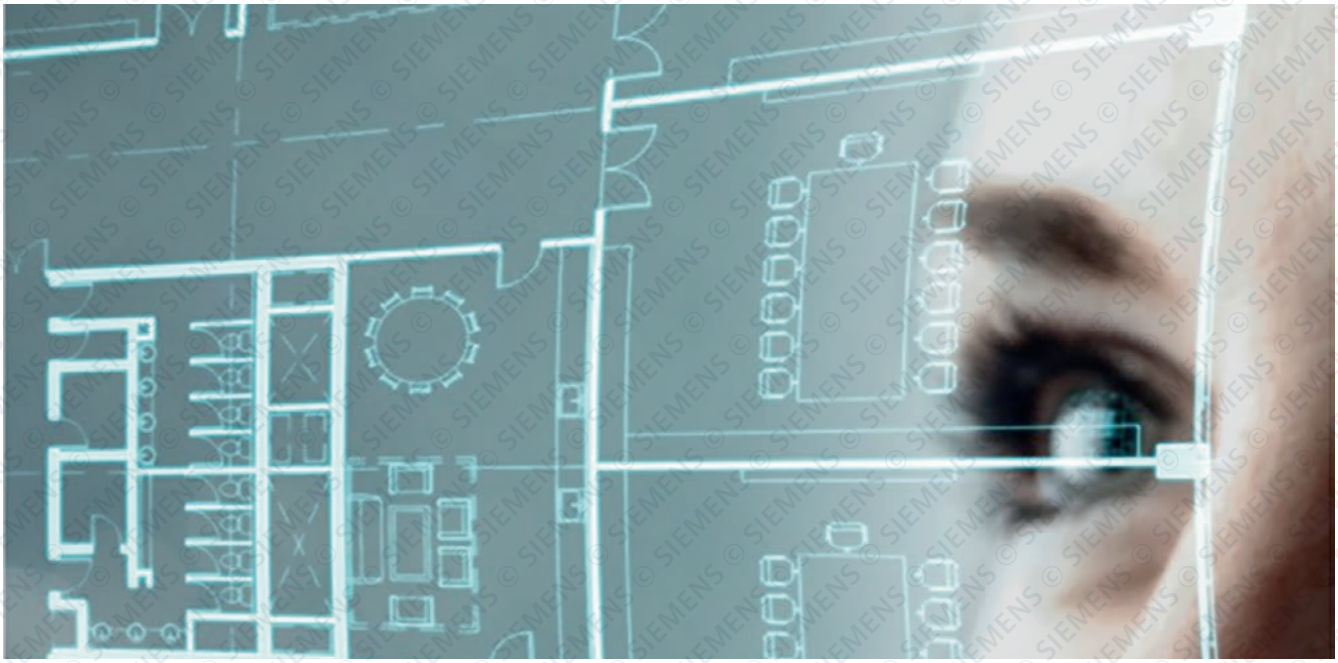
We are now taking this one step further to deliver significantly enhanced security. Operators are fully aware of all situations and system states at all times, allowing them to initiate the optimum response and minimise the consequences of any threat. For the first time it is possible to link physical security management with command and control-based operations without the need for system bridges. The georeferencing of all data leads to groundbreaking minimal-error system intelligence. The result of all this is a next-generation physical security management system.



Siveillance Viewpoint™ – an innovative approach for enhanced security

- Physical security management plus command and control functionality without security-critical system bridges, seamlessly combined in one system
- Interactive visualisation of all technical services
- More efficient incident handling and standardised user interface across all systems
- Intuitive process-based interface allows users to focus on what is important

Staying on top of every critical situation and keeping tabs on your security technology – simple, clear and in control at all times.



Complexity under control – less stress

This is exactly the idea behind Siveillance Viewpoint: taking the pressure off users in ever more complex situations and helping them to do their job, i.e. increase your security. Siveillance Viewpoint achieves this with a unique combination of innovative and tried and trusted technologies. In the event of an alarm, users can respond much more quickly and are guided to make better decisions via the shortest possible pathway. Thanks to preprocessed alarm messages, command and control functions and interactive visualisation, Siveillance Viewpoint provides a more complete overview while at the same time preserving a focus on the essential information.

Less stress – greater efficiency

Siveillance Viewpoint uses state-of-the-art technologies and controls them via a unique, intuitive user interface. This has several advantages: firstly, users are more speedily and better informed about the status of the integrated fire prevention and security systems so they have less to learn. Secondly, they also have little to learn because the information required to correctly assess a situation is clearly summarised and presented to operators on the basis of their security process workflows. Along with intelligent user guidance and the ability to view security-related incidents from all angles, graphical visualisations and surveillance camera feeds also help users take sound decisions quickly.

Greater efficiency – more options

The challenges you will face tomorrow are set to be just as varied as the ones already facing you today. When it comes to the flexibility to adapt to individual security needs and workflows, Siveillance Viewpoint sets new standards – for example in the design of customised workflows, such as specifying the use of the four-eyes principle for important control functions in order to prevent inadvertent mistakes. At the same time, Siveillance Viewpoint can grow as your requirements grow, integrating new data and expanded or reorganised infrastructure with ease. Georeferencing also allows the system to correlate all elements of the detector landscape. This 3D system intelligence provides an unprecedented level of situational awareness for your infrastructures and enables the optimum response to incidents. With its innovative tools, Siveillance Viewpoint therefore represents the perfect answer to the challenges of both today and tomorrow.

Highlights

In the innovative Siveillance Viewpoint physical security management system:
«real world» mapping of your security technology

Systematic data compaction and interactive visualisation:

- As a first, preprocessing of associated messages using logical structures in the event list
- Integrated incident handling functions for more efficient responses
- Viewpoint Multi-View also speeds up the visual assessment of incidents
- Seamless restoration of operational readiness supported
- Always the right tool for everything along the security spectrum – from responding and situational awareness through to restoration of resource availability

Georeferenced system intelligence and GIS-based data:

- Verified data model based on matching up detectors with infrastructures eliminates engineering errors
- Automatic graphics and data feed from CAD plans, plus efficient data maintenance for the entire system
- GIS positioning enables automated correlation of objects and incidents even across different buildings
- The system automatically establishes correlations and checks their plausibility in order to prevent human error throughout its entire lifecycle

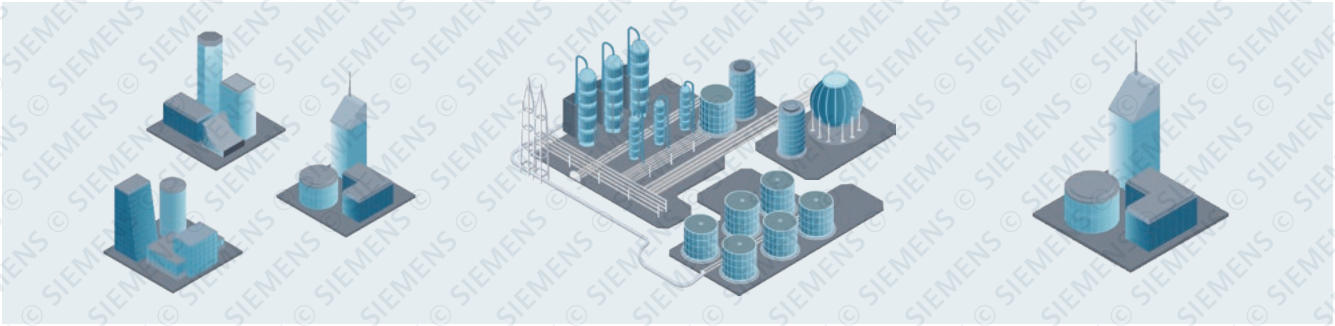
Adaptability

Maximum adaptability in day-to-day operations:

- Integrated security solution covering the entire value creation and production process
- Optimum flexibility for daily changes in the enterprise
- Full control, even in a highly heterogeneous building services environment
- Parallel coupling of multiple control centres for technical services for high performance and scalability

Central and decentralised scalability

- Variable criticality levels for different objects and zones
- Holistic overall concept with individual subsystems plus different incident-based responses
- Centralised or local control possible for multiple sites running different operations
- External security coupled with maximum productivity and freedom of movement for personnel at all times



Future-proof investment

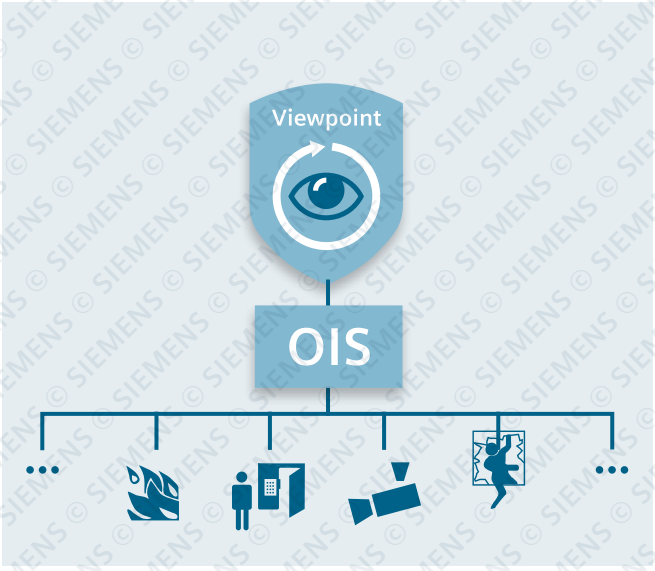
Cybersecurity by design:

- System hardening and penetration tests at every step in the development process ensure the system will function correctly in the customer's current IT environment
- Certificate-based, encrypted communication (HTTPS, SSH) from client to system
- ProductCERT from Siemens AG provides constant updates and cyberthreat analysis

Open Interface Services (OIS) for full connectivity:

Modular and high-performance integration of subsystems and all products in the Siveillance family

- Software Development Kit (SDK) for individual integrations
- Standard interfaces to the Siemens Building Technologies portfolio guarantee long-term connectivity
- No knock-on effects when changes are made in individual parts of the system



Siveillance Vantage safeguards your critical infrastructure

Guaranteeing security, safety and business continuity

From ensuring the safety of their workforce and local residents, protecting their reputation and avoiding financial losses due to production stoppages, today's enterprises face a multitude of security-related challenges. Any disruption to production, business processes or services – whether as a result of accidents, malfunctions, deliberate sabotage or theft – can cost millions of francs a year, not to mention the impact on human lives and the environment. Ensuring the safety of your workforce and the public, as well as maintaining business continuity, requires effective central planning, communication and coordination of safety and security.

The Siveillance™ Vantage control centre solution from Siemens is specifically designed to manage safety and security in critical infrastructure sites, industrial complexes and campus-type environments. It offers precisely the kind of real-time support functions required to respond efficiently to incidents at any time.

Highlights

- Integrated control centre solution for critical infrastructures, industrial complexes and campus-type sites
- Complete situational awareness
- Fully adaptable to all relevant security policies
- Workflow-based decision support boosts effectiveness and minimises mistakes
- Tried and trusted redundancy concepts for reliable availability
- Easy operation via a web-based graphical user interface
- Extensive range of services during entire lifecycle

Integrated safety and security management with reliable coordinated responses for routine operations as well as emergencies

Intelligent control centre solutions

Integrated safety and security management

Siveillance Vantage was specifically designed for critical infrastructures like ports, airports, mass transportation, energy utilities and industrial complexes such as oil and gas plants, chemical and pharmaceutical companies or heavy industry and campus-type sites. As an integral part of the Siveillance family, this solution offers reliable, scalable and efficient security management combining intelligent video functions with command and control functionality. This unique approach enables fast and efficient decision-making for everyday routine operations and time-critical processes, as well as during crisis and emergency situations.

Open and flexible integration

Thanks to open interfaces and powerful integration technologies, a wide variety of security systems such as access control, video surveillance, fire detection, emergency calls, telephone and radio systems can be integrated in Siveillance Vantage. Conventionally, these subsystems are operated separately, or as inter-linked systems. Consolidation on a single platform allows operators to assess situations faster, make rational decisions and coordinate any necessary action more quickly.

Intuitive graphical user interface

A geographic information system (GIS) automatically shows the location of the incident and the current location of security personnel on maps or site plans. It is also possible to locate security personnel or key equipment within a building on floor plans. A further user-friendly feature is that additional support information can be displayed as needed. Situational awareness can be further enhanced through integration with Siveillance SiteIQ Wide Area, our innovative solution for intelligent video analytics and wide area surveillance. Seamless integration of the two systems considerably strengthens the security of your sit.

Siemens – synonymous with quality

Siemens brings decades of experience and know-how to the development, design, production, implementation, maintenance and operation of security solutions. You too can benefit from this experience – combined with innovative technology – to make your overall security concept more effective. Ensure safety, security and business continuity with this modular, scalable solution for critical infrastructures.

Greater effectiveness, fewer errors

Well-defined security policies are essential for operating safely in critical environments. This requires detailed action and response plans to be defined for a wide variety of potential incidents and scenarios. Siveillance Vantage can be adapted as required to comply with specific corporate security policies. A role-based user concept allows appropriate measures to be defined for daily routines, time-critical processes, crisis and emergency situations. This greatly reduces the time it takes to respond to incidents and also minimises the risk of making poor decisions.

Equipped to meet every challenge

Thanks to the modularity, great flexibility and extraordinary reliability of our control centre solution, your critical systems are equipped to meet every challenge.

Alarm management

Siveillance Vantage offers a wide range of functions for managing detectors and various alarm systems. Signals from these systems can be displayed with defined priorities to ensure that the most critical incidents are dealt with first. You are free to implement your company's own particular system structures and hierarchies.

Open interfaces

Siveillance Vantage uses standardised open interfaces to enable the flexible connection of numerous customer-specific subsystems. OPC, one of the most popular process automation standards, offers numerous options for exchanging data and information with subsystems. A powerful Software Development Kit (SDK) is also available for developing custom interfaces using open, modern SOAP*-based communication. Moreover, it is possible to automatically load configuration data for the subsystems and map sensor locations on AutoCAD floor plans, provided the information is available in a structured format.

Integrated communication functions

Through integration with third-party suppliers, selected communication functions can be used directly from within Siveillance Vantage. This allows operators of critical infrastructures to coordinate all their resources efficiently.

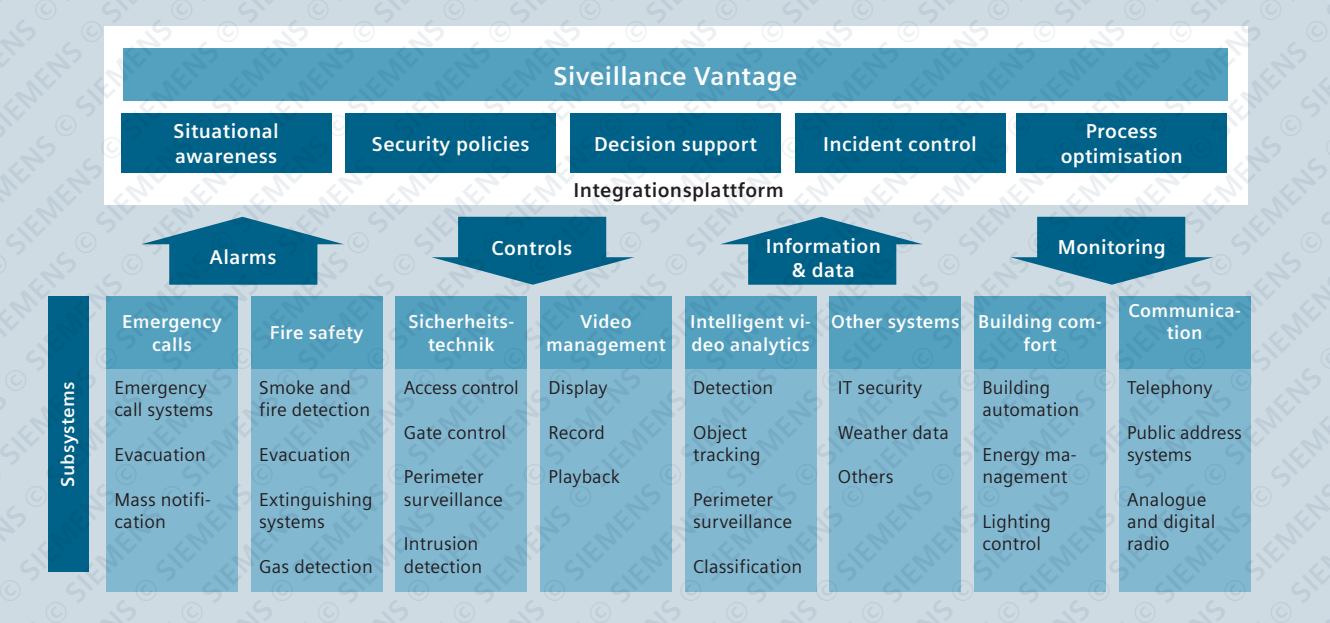
Provided it is configured to do so, the system recognises an incoming caller's number and forwards the call to the appropriate team for the service required. Caller data such as name and location is recognised, and the caller's location is displayed in the GIS.

Siveillance Vantage also supports integrated communication with on-site personnel via an analogue or TETRA digital radio link. Bidirectional communication between the control centre and field personnel via smartphones or tablet PCs is supported.

Highlights

- Seamless integration of various alarm and communication systems, scalable and future-proof
- Clear graphical visualisation on site plans and maps for maximum situational awareness
- Flexible and role-based operation via intranet or Internet
- Specific control of all incidents rather than alarm management alone
- Understanding of individual requirements thanks to industry know-how

*SOAP is a network protocol which enables data exchange between systems.



Improve your situational awareness and control over your site by consolidating all your subsystems, for example by integrating video technology. Intelligent video analytics as provided by Siveillance SiteIQ Wide Area can identify a large number of incidents and trigger the appropriate alarms. When incorporated in the control centre solution, alarms can greatly assist all-round situational awareness. To avoid information overload, Siveillance Vantage shows the operator only the information relevant to the current situation.

Flexible architecture

Built on a stable architecture, the graphical user interface provides an intuitive, hierarchical structure for status information, incidents, resources and actions. The zero administration client concept minimises the installation and maintenance effort required during setup and daily operation. Updates can be performed without shutting down or interrupting system functions. Role-based user privileges and a flexible web-based client concept support both central and decentralised forms of organisation.

Advanced incident management

In addition to simply displaying alarms and incidents, it is possible to assign predefined actions to each signal. Suitable actions are then proposed to the operator depending on the situation in question. These actions are in line with the security policies. The progress and completion of incidents are logged and the data can be used for improving security operations for example.

Coverage of large geographical areas

Siveillance Vantage supports incident management for large plants and multi-site facilities. As they form the basis for controlling responses, all incidents are displayed on maps and site plans. In the case of critical infrastructures, it is possible to include not just the site in question, but also the surrounding area along with structures such as roads and security-critical points.

Resource management

Siveillance Vantage also offers the option of managing security personnel in the field. Displaying the status and availability of these resources, including their current location, as well as proposing the most suitable responder for a task, are just two key functions. Automatic or semi-automatic alerts plus the communication of incident-relevant information and logging the progress of response operations are further features required by some critical infrastructures. Siveillance Vantage Mobile Web offers fully integrated communication between a control centre and field personnel in larger security organisations.

Designed to meet the toughest demands

Siveillance Vantage was designed specifically with professional security organisations in mind. To enable it to handle the thousands of incidents each day that are processed by multiple operators working in parallel on their own specific area of responsibility, the system is based around an Oracle® database. This also ensures the highest level of system availability and reliability.

SIEMENS

Ingenuity for life

Gas detection

buildingtechnologies.siemens.com

8.1. Introduction	238
8.2. Principles of gas detection	238
8.2.1. Characteristics	238
8.2.2. Toxic gases	238
8.2.3. ATEX explosion protection	239
8.2.4. Safety of gas warning devices	240
8.2.5. Safety integrity level (SIL)	242
8.2.6. System quality	242
8.2.7. Use of gas detection	242
8.3. Measuring principles	243
8.3.1. Semiconductor sensor	243
8.3.2. Catalytic combustion	243
8.3.3. Electrochemical detection	243
8.3.4. Infrared detection	244
8.3.5. Photoacoustic detection	244
8.3.6. Photo-ionization detection (PID)	244
8.3.7. Zirconium oxide detection	245
8.4. Control unit and system technology	245
8.4.1. Topology of analogue systems	245
8.4.2. Topology of digital bus systems	245
8.4.3. Monitoring	246
8.5. Planning	246

Schematic diagram	248
About gas detection	250
Gas detection	257
Gas detection control unit	261
Modernization	264

8.1. Introduction

An accident caused by gas explosions, escaping or corrosive liquids and dangerous gas leaks can have serious consequences for a company, including damage to the company's image. These factors directly influence the gas protection concept for buildings in the pharmaceutical industry, food processing plants, parking garages, sewage treatment works and airports. In many establishments, a gas warning system is able to guarantee adequate protection. The gas detection concept can be individually tailored according to the use of the building, the processes, the infrastructure, the safety concept and the SES technical guidelines.

Danger often lurks where it is least expected. Many industrial installations are unaware of this, giving them a false sense of security. This is where a gas warning system can help. Gas leaks are initially very difficult to pick up because many gases are odourless and invisible to humans. Smart electronic gas measuring principles, which even detect substances that are imperceptible to humans, never make mistakes. They keep measuring round the clock, reliably and continuously, guaranteeing safety in the company.

This is what makes sensors such a crucial component in a gas detection system. Fault-free and fast detection is the only way to guarantee high quality and dependable alerts. To achieve the best possible results, a wide range of detection technologies is used. They undergo constant development to meet the growing demands.

Gas detection aims to do one of the following:

- Detect poisonous substances (toxic gases)
- Detect flammable substances (explosive gases and gas mixtures)
- Detect oxygen depletion

To prevent damage or injury, a gas warning system picks up non-hazardous concentrations well before a dangerous situation can occur. Gas warning is therefore an important element in the protection concept because:

- Gas explosions are devastating, often starting fires
- Toxic concentrations can be poisonous and corrosive to humans and animals
- Oxygen depletion may be harmful to health
- Solvents and solvent vapours are harmful to people and the environment

8.2. Principles of gas detection

8.2.1. Characteristics

Matter consists of tiny particles called atoms. Atoms have a positively charge nucleus surrounded by a negatively charged shell composed of electrons. The electron shell determines which chemical bonds are possible with other atoms, and this is why chemical reactions usually take place in the electron shell. Atoms can bond to form metals, salts or molecules. The aim of gas detection is to detect molecules that are contained in the air and are therefore gaseous.

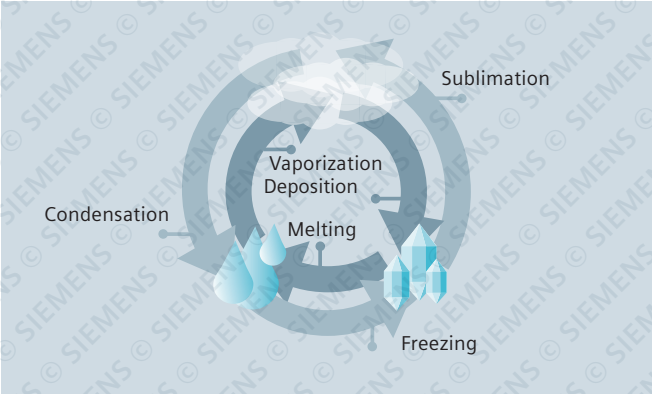


Fig. 8.1: States of matter

All pure substances can occur in the three states of matter (see figure 3.1.). The lighter a molecule, the sooner it becomes a gas. If the molecules are lighter than air, they very quickly diffuse (spread out) in still air to occupy the space, and if the process is undisturbed, they reach their highest concentration at the highest point of the space (density <1).

If, like most gases, they are heavier than air, the gas diffuses more slowly, reaching its highest concentration at the lowest point of the space (density >1).

In terms of the physics, gas and vapour are the same thing. However, it is customary to use the word gas if the substance is gaseous at room temperature and normal pressure. Vapour, on the other hand, means the vaporized part (= gas phase) of a substance that is mainly liquid under normal conditions.

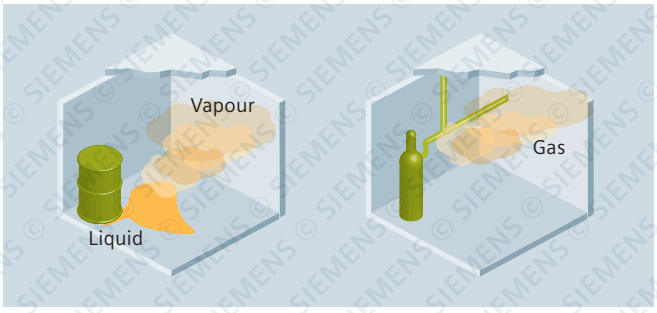


Fig. 8.2: Explosion hazard from escaping gases or liquids

8.2.2. Toxic gases

Toxic gases can be found in many places. In chemicals plants, food processing plants, cooling systems, sewage treatment works and underground car parks – concentrations of toxic gases can occur anywhere. In high concentrations, many of these gases and vapours are harmful or hazardous to human health and yet cannot be detected by our sense of smell. Other substances are corrosive or poisonous, making potential leaks into the environment undesirable. And it is not

just animals and people who suffer – the corrosive properties of many toxic gases can adversely affect machinery and equipment. Using the various measuring principles of gas detectors, these substances can be identified very quickly in tiny quantities of just a few ppm (parts per million – the ratio of one part gas to a million parts air), raising the alarm before a harmful concentration has the chance to build up. Some gases are toxic as well as flammable. This explains the fact that there are more deaths from toxic gases than from explosions caused by flammable gases.

Toxicity of combustion gases

Fires produce toxic carbon monoxide. At high concentrations, however, another product is hazardous – carbon dioxide. Varying amounts of other substances are also created during fires, with different degrees of toxicity.

The following table summarizes the physiological effect of the gases likely to be produced in fires. The literature concerning the actual danger posed by these substances is contradictory. The degree of toxicity is also heavily dependent on the human constitution, body weight and the person's location at the time. The concentrations in [ppm] should therefore be seen as approximate values.

Gas	Name	Odour detection threshold	Throat irritation threshold	Several hours unaffected	One hour unaffected	Hazardous in ½ – 1 hour	Fatal in ½ hour	Instantly fatal
CO	Carbon monoxide	Odourless	No irritation	100	100	400	1500	10000
CO_2	Carbon dioxide	Odourless	No irritation	1000	1000	3000	Not known	60000
CL_2	Chlorine	4	15	0,5	4	40	150	1000
HCl	Hydrochloric acid	15	35	10	50	1000	2000	1300
$COCl_2$	Phosgene	6	3	1	5	25	30	50
H_2F_2	Hydrogen fluoride	Not known	10	3	10	50	250	Not known
HCN	Hydrogen cyanide	Nighly individual	Not known	15	50	100	150	180
NH_3	Ammonia	20	140	100	200	500	2200	2500
H_2S	Hydrogen sulphide	1	100	20	100	300	600	1000
SO_2	Sulphur dioxide	0,5	0,4	10	60	150	400	500
NO_X	Nitrous gases	5	62	10	80	100	Not known	200

Tab. 8.1: Physiological effects of constituents of combustion gas (unit = [ppm].

Threshold limit value

The purpose of occupational hygiene in every company is to protect staff from environmental influences that are harmful to health, such as noise, dust, gases, radiation, etc. Gas concentrations, too, are subject to specified limit values to which staff must not be exposed at work. These threshold limit values (TLVs) describe the permitted exposure thresholds for staff in an eight-hour working day. TLVs for different gases are set out in the relevant list published by SUVA entitled «Workplace TLVs» (Grenzwerte am Arbeitsplatz).

8.2.3. ATEX explosion protection

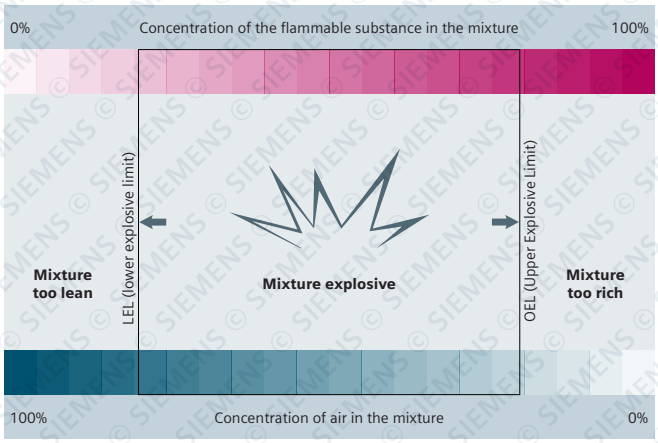
Flammable gases and vapours mixed with air are only explosive in a particular range of concentrations. This is called the explosive range and is defined by the lower (LEL) and upper (UEL) explosive limit. Below the LEL the substances are largely harmless, but above the UEL they can burn off and therefore remain dangerous (a toxic effect also occurs with most substances). The explosive range between the LEL and the UEL is different for every flammable gas. In order to detect flammable concentrations before an explosive mixture occurs, gas detectors measure and sound the alarm at values between 10 % and 15 % of the LEL, in other words well before a dangerous atmosphere is created.

Depending on the type, flammable gases must be detected either at ground level or ceiling level. Methane, for example, is much lighter than air so it rises to the ceiling, and that is where the gas detector must be fitted. Propane on the other hand is heavier than air so it falls to the floor when it leaks, which means the sensor must be placed close to the floor in order to detect it.

Gas warning systems can also be used effectively for early fire detection. A gas detector can determine the combustion gas concentration in smouldering fires, in particular, which may burn for a long time before any flames and smoke appear. The combustion gases in question are odourless carbon

monoxides, which result from incomplete combustion. Standard optical or thermal fire detectors are unable to detect them (in the absence of smoke or flames), even though they are present long before smoke or flames occur. In these situations, using a gas warning system to measure combustion gases and sound the alarm provides early fire detection and can prevent serious damage.

Fig. 8.3: Explosive limits



Flash point

Another important parameter in assessing the risk of explosion of flammable liquids is the flash point. The flash point is the temperature at which the vapour pressure of a liquid is so high that the gas concentration exceeds the lower explosive limit (LEL). Substances with a flash point about 20 °C above the maximum expected ambient temperature do not form explosive mixtures and so do not need to be detected for explosion protection. For example toluene cannot explode under normal conditions. Toluene is nevertheless flammable so liquid escaping from a leaking container can certainly cause a fire. To detect escapes like this and thereby prevent fires, highly sensitive gas sensors can be used to monitor leaks if the environment is sufficiently clean.

If the atmosphere is explosive, all it takes is a source of ignition (e.g. a spark from a light switch or a hot object) to trigger the explosion. The necessary ignition energy is extremely low – in the case of carbon disulphide (CS2) it is about one ten-thousandth of the transmission energy given off by a cell phone every second. For this reason, an explosive gas mixture must never be allowed to form under any circumstances.

Auto-ignition temperature

The auto-ignition temperature of a flammable gas or liquid is determined in a test device and is the lowest temperature of a heated wall at which the flammable substance mixed with air spontaneously ignites. The auto-ignition temperatures of flammable gases are divided into temperature classes T1 to T6, which correspond to the category code of explosion-proof equipment. The auto-ignition temperature of most gases is much higher than the flash point, which is often just a few °C (for example methanol 11 °C, toluene 4 °C etc.).

Substance name	Density liquid [g/cm³]	Flash point [°C]	LEL [% vol.]	UEL [% vol.]	Auto-ignition temp. [°C]
Acetone	0,79	-19	2,5	13,0	540
Acetylene	0,40	-18	2,3	78	305
Ammonia	0,61	-20	15,4	33,6	630
Ethane	0,44	-135	2,7	14,7	515
Ethanol	0,79	-12	3,5	15	425
Ethylene		-136	2,3	32	425
Ethylene oxide	0,88	-18	2,6	100	440
n-Butane	0,58	-60	1,4	9,3	365
Butanol	0,81	-29	1,4	11,3	340
Cyclohexane	0,78	-18	1,2	8,3	260
Cyclopentane	0,75	-51	1,5	8,7	380
Decane	0,73	46	0,7	5,4	205
n-Heptane	0,68	-4	1,1	6,7	215
Hexane	0,66	-21	1,0	8,1	240
Carbon monoxide			10,9	76	605
Methane		-188	4,4	16,5	595
Methanol	0,79	11	5,5	36	455
Nonane	0,72	30	0,7	5,6	205
Octane	0,70	12	0,8	6,5	210
n-Pentane	0,63	-20	1,4	7,8	285
Propane	0,50	-60	1,7	10,9	470
Carbon disulphide	0,13	-30	0,6	60	102
Hydrogen sulphide			4,3	45,5	270
Toluene	0,87	6	1,2	7,8	270
Hydrogen			4,0	77	560
Xylene	0,88	30	1,0	7,0	465

Tab. 8.2: Substance data for selected flammable gases and liquids

8.2.4. Safety of gas warning devices

Gas warning devices for industrial use in Ex zones are electrical equipment and as such they must at least fulfil the applicable requirements for operation in potentially explosive atmospheres as described in the ATEX Directive 94/9/EC..

ATEX

«ATmosphère EXplosible» – French for explosive atmosphere. The ATEX Directive 94/9/EC states that all gas detectors and equipment installed in potentially explosive atmospheres (Ex zones) must be tested and marked to verify electrical safety and suitability. The test ensures that such devices do not themselves become a source of ignition for an explosive gas concentration. In the case of untested gas detectors this cannot be guaranteed.

In companies, explosive zones are divided into categories according to the probability that an explosive atmosphere will occur. A different equipment category must be selected for detection depending on the particular zone. The category of the gas detector can be seen on the device housing. An explosive zone can only be determined and categorized by a safety officer or an expert. It is always the job of the installation owner/building operator to arrange for zone categorization to take place. The gas detectors necessary for the zones can then be determined with the support of the gas warning system supplier. Explosive zones are divided into the following categories:

- **Zone 0:** Areas in which dangerous concentrations of flammable gases/vapour are present permanently or for long periods. For example inside an enclosed fuel tank. Equipment category: 1G
- **Zone 1:** Areas in which dangerous concentrations of flammable gases/vapour are present occasionally. For example the area immediately surrounding an enclosed fuel tank (drip tray). Equipment category: 2G, 1G
- **Zone 2:** Areas in which dangerous concentrations of flammable gases/vapour are present rarely and for brief periods only. For example the area further away from an enclosed fuel tank. Equipment category: 3G, 2G, 1G

Movement of zone

Installing a gas warning system may cause an Ex zone to be moved or declassified. Taking this into account in the planning phase may produce considerable cost savings.

Explosion protection types

Gas detectors for use in potentially explosive atmospheres can be enclosed in sealed, strong housings (flame proof enclosure EEx d) or they can be intrinsically safe (EEx i). In other words that must be constructed to that no sparks can occur. There are many other types but they are not used widely in gas detection. Most of the tested gas detectors use the protection type «Flame proof enclosure ATEX Ex d».

Name	Marking	Principle
Flame proof enclosure	EEx d	An explosion inside is prevented from spreading outside by the housing.
Pressurized enclosure	EEx p	The inside of the equipment is protected by means of pressurized protective gases (air, inert gas, etc.)
Powder filled enclosure	EEx q	Powder filling (e.g. sand) prevents an arc inside the housing from igniting the surrounding atmosphere
Oil filled enclosure	EEx o	Full or partial immersion in oil or a non-flammable insulating liquid prevents gases and vapours outside the liquid being ignited by an arc inside the liquid
Increased safety	EEx e	Additional measures to prevent ignition even at excessive temperatures
Non-sparking equipment	EEx nA	Structural features that reliably prevent arcs, sparks, etc.
Encapsulation	EEx m	Full encapsulation of critical parts in a non-flammable, inert and thermally stable sealing compound to prevent ignition
Hermetically sealed	EEx nC	Ambient air is reliably prevented from penetrating into cavities in the structure
Enclosed equipment	EEx nC	Similar to encapsulation but with the possibility of cavities
Protected by housing	Ex tD	A sealed housing with a limited surface temperature prevents the penetration of flammable dust
Intrinsically safe	EEx i	All parts and circuits are designed so that no sparks or thermal effect are able to cause ignition

Tab. 8.3: Protection types

The explosion group indicates the application for which a device is intended.

- Group I: electrical equipment intended for use in mines
- Group II: electrical equipment intended for use in other locations with potentially explosive mixtures.

Group II is subdivided into subgroups IIA, IIB and IIC, of which IIC is the strictest and is only needed for a small number of gases such as carbon disulphide (CS_2), hydrogen (H_2) or acetylene (C_2H_2)

Explosion group	MESG [mm]	Minimum ignition current ratio
IIA	> 0,9	> 0,8
IIB	0,5 bis 0,9	0,45 bis 0,8
IIC	< 0,5	< 0,45

Tab. 8.4: Explosion groups of equipment group II

The gas warning system must be selected so its specification matches the gases to be detected. So if a gas like ethylene is present, the system must be specified to subgroup IIB at least, and in the case of hydrogen, acetylene or carbon disulphide, the system must be in subgroup IIC.

8.2.5. Safety integrity level (SIL)

The safety integrity level (SIL) is primarily concerned with the safety of a product in its intended environment. This additional safety assessment aims to minimize risk in all applications in which a failure jeopardizes the safety of people, the environment or material assets. Four values are defined as safety integrity levels (SIL). The greater the SIL, the more reliable the system. In terms of hardware and software, the products used in the safety system must be highly reliable in order to prevent discernible faults occurring at all, or to keep the probability of failure extremely low. The SIL assesses and defines the availability requirements of the safety function and, for process control, the probability of failure of the system in question. The entire chain is considered including the sensor, the signal evaluator, the alarm system and the actuator.

For structural reasons, gas warning systems can achieve levels SIL 1 to SIL 3, and the SIL is marked on the device. The device manual describes in detail how to use SIL tested devices correctly. In the case of gas warning systems which must meet additional safety criteria, the SIL product standard for gas detectors EN 50402 is also applicable.

8.2.6. System quality

To keep the quality of gas warning systems high, the SES (an association representing Swiss installers of safety systems) has published two guidelines entitled «Gas warning systems – flammable gases» (Gaswarnanlagen – brennbare Gase) and «Gas warning systems for toxic gases and oxygen» (Gaswarnanlagen für toxische Gase und Sauerstoff). Systems planned, constructed and maintained in accordance with these specifications are state of the art and guarantee a high standard of quality. SES members have pledged to follow these guidelines, thereby safeguarding the high quality and functionality of their systems. To verify compliance, members undergo annual quality certification and they are awarded a quality label called «Q-Label SES». Ask your gas warning system supplier for the «Q-Label SES».

8.2.7. Use of gas detection

Gas detection should be used where dangerous gas concentrations might build up unnoticed, for example if the contents of the gas cylinder are enough to reach the lower explosive limit in the room if the cylinder leaks. In this case, a gas warning is recommended for explosion protection. Even if there is not enough gas to trigger an explosion, it is still flammable and able to burn off (flare), potentially causing a fire.

The fire protection concept in a building therefore needs to consider these situations when assessing the overall risk.

Natural gas is normally used to heat industrial and commercial buildings. The rooms containing the heating plant are rarely entered so gas leaks stay undetected. Natural gas consists mostly of methane, a light gas which rises and collects at the ceiling. The minimum concentration (LEL) of methane is 4.4 % vol. Equipment (switches, lights, electric heaters, electric tools, etc.) is a potential source of ignition. As the gas concentration increases, the gas detectors sense the gas well below 2.2 % vol., and the gas warning control unit triggers the alarm in two stages before the flammable concentration is reached.

In chemical plants especially, substances are used which, although not flammable, are toxic and corrosive. Certain chemicals also have a very low vapour pressure, which minimizes gas formation. Nevertheless, even the tiniest gas concentrations can be dangerous. Highly sensitive specialist suction systems can use a sample of air to pick up a very low concentration of substances at the site of the leak. Devices are available for measuring a range of substances commonly used in the chemicals industry. Using a built-in measuring point switch, a single device is sufficient to take air samples at multiple locations and analyse the vapour concentration.

Ammonia is a poisonous and strong smelling chemical, widely used in refrigeration. It is a refrigerant with very good thermal properties, making it sought after for cooling systems in the chemical industry, food processing, heavy industry and ice sport centres. The tiniest concentrations of leaking ammonia are perceived by the human sense of smell. Values over 100 ppm are experienced as an acrid smell, causing people to leave the area. Extended exposure to ammonia can cause the human olfactory organ to lose its sensitivity to the substance, giving the impression that the concentration has declined. The electronic circuits inside gas detectors constantly and reliably measure the very smallest concentrations without losing any sensitivity.

Not every gas is equally dangerous. There are three gases which must be treated with particular care because they need an extremely low ignition energy to explode:

- Hydrogen
- Acetylene
- Carbon disulphide

With hydrogen in particular, a flame is practically invisible because it is translucent in bright light. Hydrogen is also lighter than air, colourless and odourless. This makes it easy to falsely assume that there are no leaks in the system and that monitoring of these group IIC gases is unnecessary. Yet oxygen displacement and freezing injuries are a danger to the people present. Gas detectors above potential sources of danger can detect a leak of these substances at an early stage so that action can be taken.

Many flammable gases and solvents are used as fuels in industry, as process gas in petrochemicals or as a raw material in chemical processes. Some gases are imperceptible to humans, whereas others very quickly become flammable when combined with oxygen. Correctly placed gas detectors can offer useful protection. It is critical that the detector does not itself trigger an ignition of the flammable mixture. It is therefore essential only to use gas detectors with Ex protection that have undergone the relevant ATEX testing. The same measuring principle cannot always be used to accurately detect the various substances. Depending on the substance, it is vitally important to choose the correct detection technology and sensor location.

8.3. Measuring principles

Gas warning technology has been continuously improved and perfected over the decades. As a result, tried-and-tested detection technologies are now available, delivering great reliability as long as the limits of use are respected. There are few other disciplines with as many different measuring principles as gas detection. The sections below focus on the most important safety procedures that are able to run fully automatically and detect flammable gases, toxic vapours or oxygen concentrations. The most suitable measuring principle must be selected according to the gas being measured. The selected gas detector is calibrated for the target gas when it is first commissioned, meaning it can only reliably detect one gas. It is not advisable to measure multiple gases with just one sensor or to measure gas displacement by means of another substance.

8.3.1. Semiconductor sensor

The measuring principle of the semiconductor sensor is based on the change of electrical conductivity that occurs when gases are absorbed on a semiconductor surface. A silicon chip with a thin film of metal oxide is heated to around 400 °C and connected to a downstream electronic circuit by two electrodes.

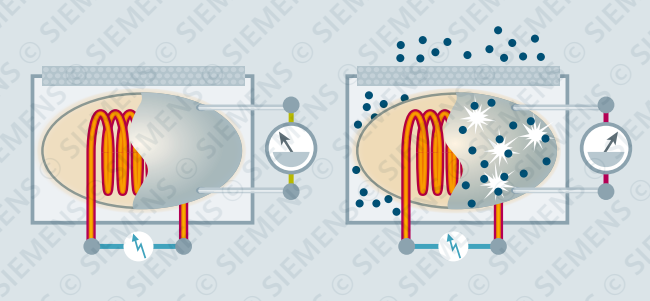


Fig.8.4: Semiconductor measuring principle

If a gas touches the surface, it is absorbed and catalytic oxidation occurs. The hot surface speeds up the reaction and minimizes environmental influences. This property alters the resistance of the oxide surface, and this can be measured with a current flow. The downstream electronic circuit amplifies the signal and supplies information in proportion to the gas concentration. Semiconductor sensors measure a wide range of gases in a mixture and can be fine-tuned to a particular gas.

8.3.2. Catalytic combustion

The measuring principle behind this technology is based on the catalytic combustion of the sample gas or gas vapours in the air. The standard measuring range is 0 to 100 % LEL. The sensor consists of a pair of balanced elements called pelements – one detector and one capacitor.

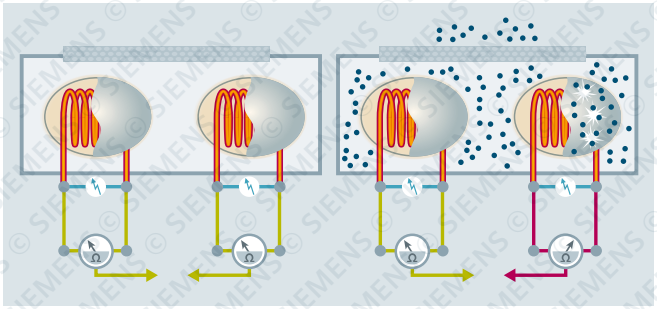


Fig. 8.5: Catalytic combustion

The detector has a coil-shaped platinum wire in a small bead of catalytic material. The capacitor has the same structure, but there is no catalyst so it does not respond to gas. The pelements are wired up to create a Wheatstone bridge, which is heated to around 500 °C by means of a current flow. The flammable gases oxidize on the hot detector element, with the catalyst unaffected so it can act as control. The heat of the oxidation increases the resistance of the detector, altering the current flow in the platinum wire in proportion to the concentration of flammable gas. The capacitor in turn corrects pressure, temperature and humidity fluctuations which affect the two elements equally. This measuring principle detects all explosive gases but it is fine-tuned to a specific gas-air mixture through comparison with the relevant calibration gas.

8.3.3. Electrochemical detection

Electrochemical sensors are used to monitor toxic gases in trace amounts or oxygen concentrations as a percentage. The most widely used quantity is ppm, but in oxygen monitoring, an increase or reduction in concentration is measured. The measuring cell contains two electrodes covered in a chemical electrolyte.

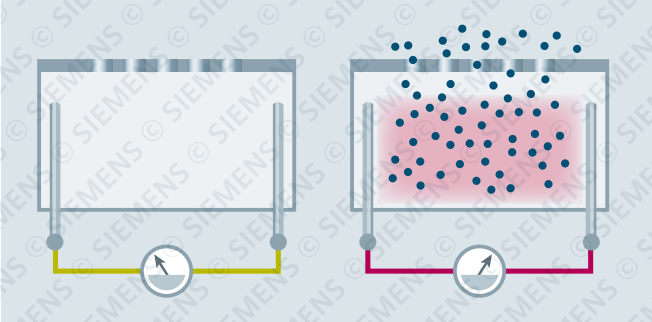


Fig. 8.6: Electrochemical detection

If gas molecules pass through the opening in the measuring cell and reach the electrolyte, a chemical reaction occurs which reduces the electrolyte over time. This reaction produces a flow of electrons that can be measured as current at the two electrodes. The current is proportional to the gas concentration diffusing in. This measuring principle is similar to a battery and keeps working until the electrolyte is used up and the measuring cell has to be replaced. A regular functional test using test gas ensures that the measuring cell is still is perfect working order.

8.3.4. Infrared detection

Gases absorb infrared light at certain wavelengths, each with a different absorption spectrum that is typical of the gas in question. A source of electronically modulated infrared radiation operates in a measuring channel and is measured with a photoreceiver. A second unmodulated infrared signal is also transmitted and measured with a second photoelement. This is used as a control and to compensate for various fluctuations.

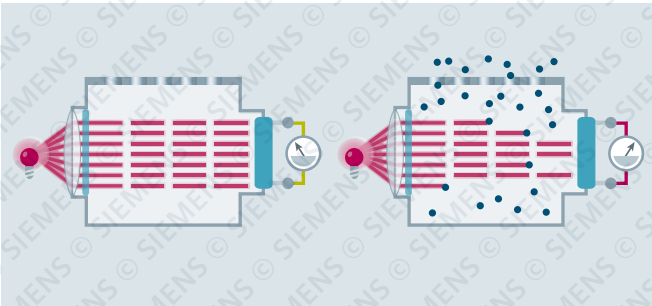


Fig. 8.7: Infrared detection

If a gas disturbs the beam of light in the measuring channel, the modulated signal is weakened by the gas molecule but the unmodulated signal is not. The weakening can be measured as current and amplified. The signal is processed by a downstream microprocessor circuit and is proportional to the gas concentration.

8.3.5. Photoacoustic detection

Photoacoustic sensor technology is used to detect poisonous and flammable gases in very low concentrations. A gas sample for measurement is often obtained with a suction system and pump. The gas sample is introduced into the measuring chamber and exposed to a specific wavelength of pulsed infrared light. The wavelength of the light is calibrated to the gas being measured in advance.

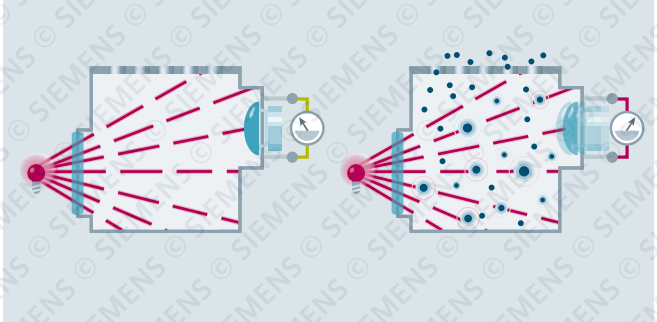


Fig. 8.8: Photoacoustic detection

If the sample contains the particular gas, the sample absorbs a large amount of the infrared light, whereas the remaining components do not affect the beam of light at all. The gas molecules which absorb the pulsed infrared light alternately heat up and cool down again. The resulting pressure fluctuations in the air can be measured as sound waves with a high-sensitivity microphone. The intensity of light absorption is proportional to the concentration of the gas being measured.

8.3.6. Photo-ionization detection (PID)

This measuring principle is based on the ionization of gaseous components by ultraviolet (UV) light. The main components of a PID are the UV lamp with lamp control (high-voltage or high-frequency process), two collector electrodes and a downstream electronic amplification circuit. The gas is irradiated from a UV source with an emission energy of 10.6 eV. The impinging molecules are photo-ionized by the light and the resulting ion flow is measured by the electrodes. Molecules with an ionization potential less than or equal to the excitation energy of the UV lamp are verified – all other substances cannot be verified. The high sensitivity of this measuring principle means that even the lowest concentrations of just a few ppm can be verified. However, this is only possible in the right kind of atmosphere. Another issue is the sensitivity of PID sensors to humidity and temperature fluctuations, causing inaccurate readings.

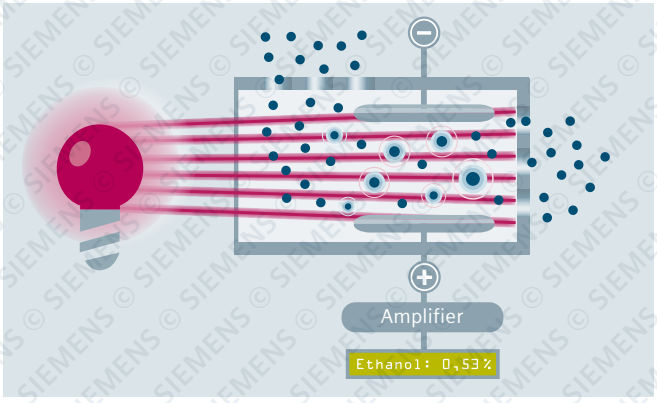


Fig. 8.9: Photo-ionization detection (PID)

The ionization potentials of various substances can be found in the literature, or a list can be obtained from the detector supplier. Examples of compounds which can normally be verified:

Organic molecules containing some carbon atoms and/or heteroatoms such as oxygen, sulphur or bromine

- Unsaturated and aromatic hydrocarbons
- Various inorganic flammable compounds such as ammonia, hydrogen sulphide and carbon
- Some non-flammable gases such as nitrogen dioxide, nitrogen monoxide and trichlorethylene

Molecules like hydrogen, carbon monoxide and methane cannot be verified using this measuring principle. The many benefits of a PID detector can only be preserved with more intensive maintenance and inspection regimes than conventional gas detectors.

8.3.7. Zirconium oxide detection

The zirconium oxide measuring principle is used primarily to detect oxygen. Apart from industrial gas detection, other applications include catalytic converters in vehicles. This detection method makes use of the oxygen ion conductivity. Two zirconium oxide plates (ceramic with a thin layer of porous platinum) are arranged to create a chamber between them. The material is heated to around 600 °C and voltage is supplied to the plates. This causes the movement of oxygen ions (pump effect) until the chamber is evacuated. The process is then reversed and oxygen is pumped back into the chamber. The resulting partial pressures generate a current that can be measured with two electrodes and is proportional to the oxygen content.

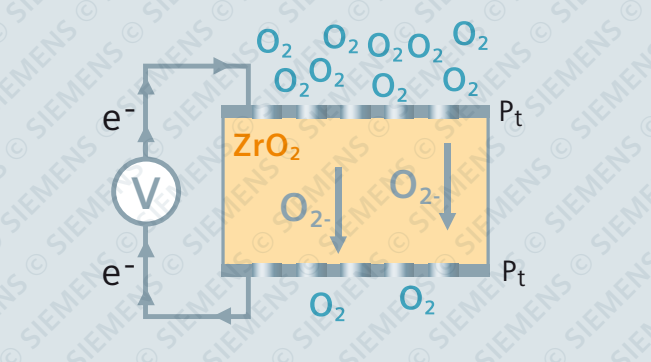


Fig. 8.10: Zirconium oxide detection

8.4. Control unit and system technology

Gas warning systems consist primarily of the control unit, the attached detectors and the alarm system. Most systems can be connected to gas detectors for Ex zones and for safe zones. Over the years, a detector signal standard of 4 to 20 mA has taken root. New systems, however, are increasingly using digital bus technologies, making them much more flexible and drastically reducing cabling costs.

A gas warning control unit generally monitors the readings of the connected gas detectors and continuously evaluates them. At least two alarm thresholds are usually defined for each measuring point – a pre-alarm and a main alarm – which trigger connected alarm devices when the gas concentration is exceeded. To ensure the gas warning system keeps running without interruption, the control unit continuously monitors itself and indicates any faults on the display. It is sometimes forgotten that gas leaks can occur during or even because of a power cut. That is why modern gas warning control units have an emergency power supply, switching automatically to the batteries as soon as there is a mains failure so that measurement and alarm functions can continue.

8.4.1. Topology of analogue systems

The classic cabling arrangement of gas warning systems is star topology using a standardized 4 to 20 mA current signal. This means that each gas detector has a dedicated cable carrying the output signal to the control unit. This is the right approach for small systems. As the system size increases, though, the cabling costs grow disproportionately.

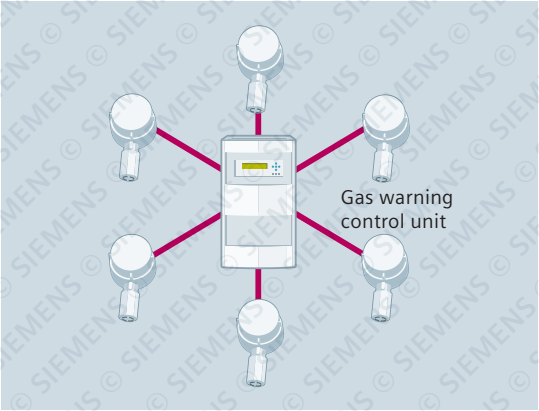


Fig. 8.11: Gas warning control unit with star topology

8.4.2. Topology of digital bus systems

Cabling costs fall significantly when the detectors can be connected using a digital bus. The bus is always address-based, with each detector given its own address as a way of verifying that it is still working. A single feeder, to which the necessary bus connectors are attached, is run from the control unit through the rooms being monitored. The data connection and the power supply to the detectors are both supplied by the bus line.

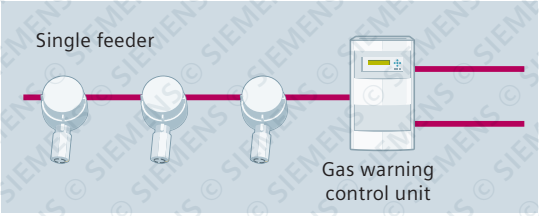


Fig. 8.12: Gas warning control unit with detector line

8.4.3. Monitoring

Hazards must be monitored. Even simple battery chargers have been known to cause explosions so they, too, must be watched. It is rare to be able to predict with certainty where a gas leak will occur, so the detectors should be evenly distributed over the area for safety reasons. For room monitoring, one gas detector can cover a maximum surface area of 60 m^2, and at least two gas detectors must be provided per room.

A gas warning system can be used for general detection across the whole room, but also for selective detection in a particular place. If the risk area is limited to a certain location in a larger room, object monitoring can replace room monitoring. In this case, though, it is essential to update the gas monitoring concept if changes are made to the system. Object monitoring is often designed with the detectors installed immediately above the machine and not on a high ceiling. In other words the detectors are fitted directly adjacent to a potential leak, for example screw fittings, gas meters, pressure reducers, containers, pumps, etc. This avoids delays in detection and gas dilution. To make absolutely sure the gas reaches the detector, gas collectors are installed directly above the gas pipe/machine.

Rooms with unsealed connections to service pipes carrying flammable gases or liquids must also be monitored. With high-sensitivity gas detection, leaks of flammable liquids can even be monitored using the vapour phase. This allows for fire protection with liquids that do not form explosive gas-air mixtures under normal environmental conditions (high flash point).

In practice, object detection is normally preferable for cost reasons and because the installation can be better targeted. The most suitable monitoring concept and detector types are always determined in the particular situation depending on the location and the circumstances. The precise detector position must be determined on the basis of the gas to be detected.

8.5. Planning

When planning a gas warning system it is essential to be familiar with the surroundings. A checklist is therefore used to establish the status of the immediate area. The relevant aspects include the following:

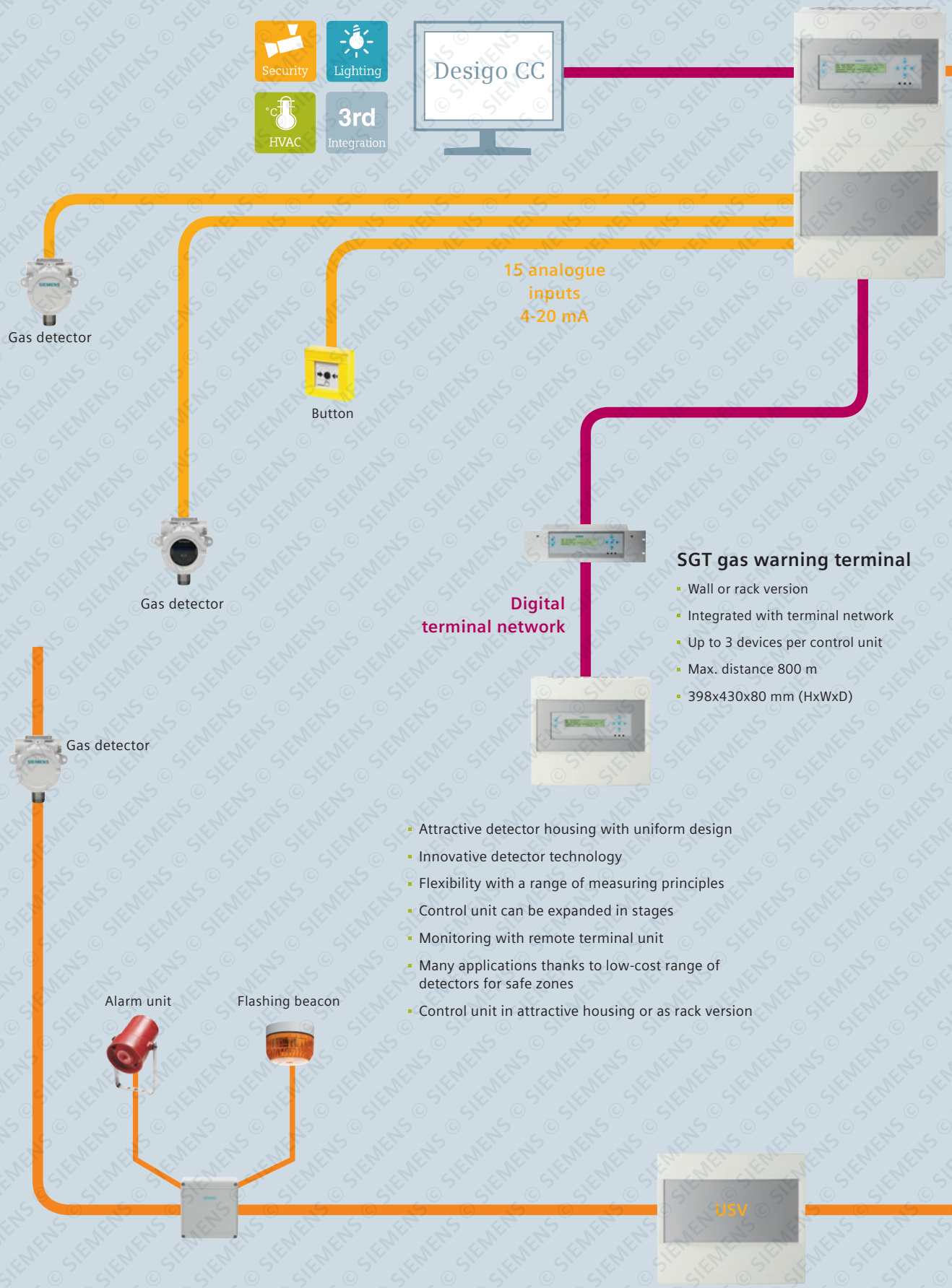
- Substances to be detected
- Other substances present/involved
- Handling of these substances
- Where do what substances come from?
- How are they transported, stored and processed?
- Temperatures
- Humidity situation
- Wind conditions/ventilation
- Cleanliness of atmosphere (sensor poisons and inhibitors)

Using this information, the type, number and positions of the detectors can be determined. The following factors must be considered first when deciding whether to install gas detectors at floor level or under the ceiling:

- Gases and vapours move around much more quickly in air flows than by diffusion.
- The room geometry, fixtures and fittings, machinery, temperature conditions and ventilation, etc. therefore determine the spread of gases and vapours following a leak. This means it is often more important when deciding detector positions to establish the room parameters and environmental conditions than it is to consider simple factors such as gas density.

The control unit, terminals and displays should be positioned so they meet the following conditions:

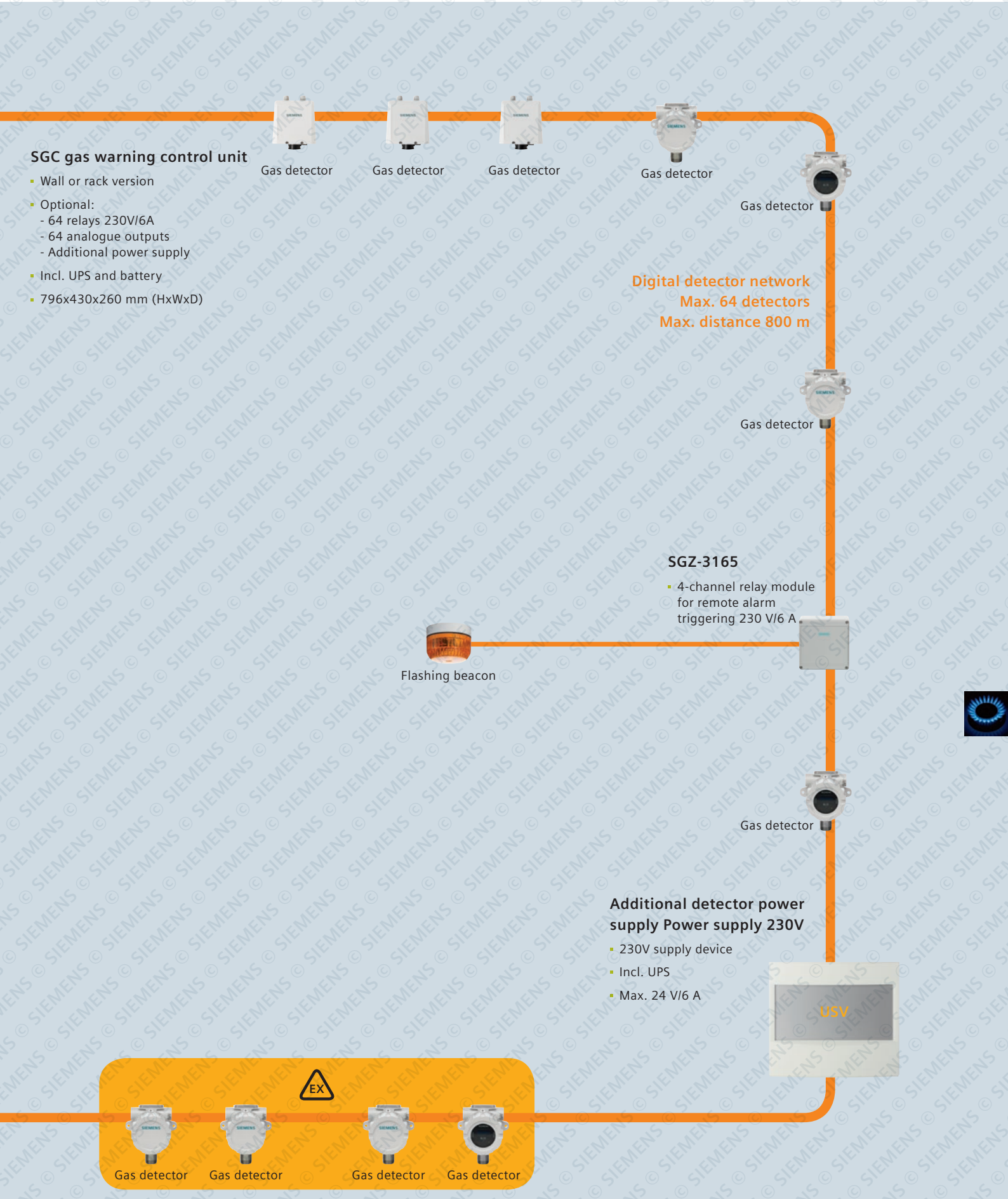
- Quickly and easily accessible
- Outside the Ex zone
- Normal conditions
- Good lighting
- Room temperature
- Normal humidity
- Dust free



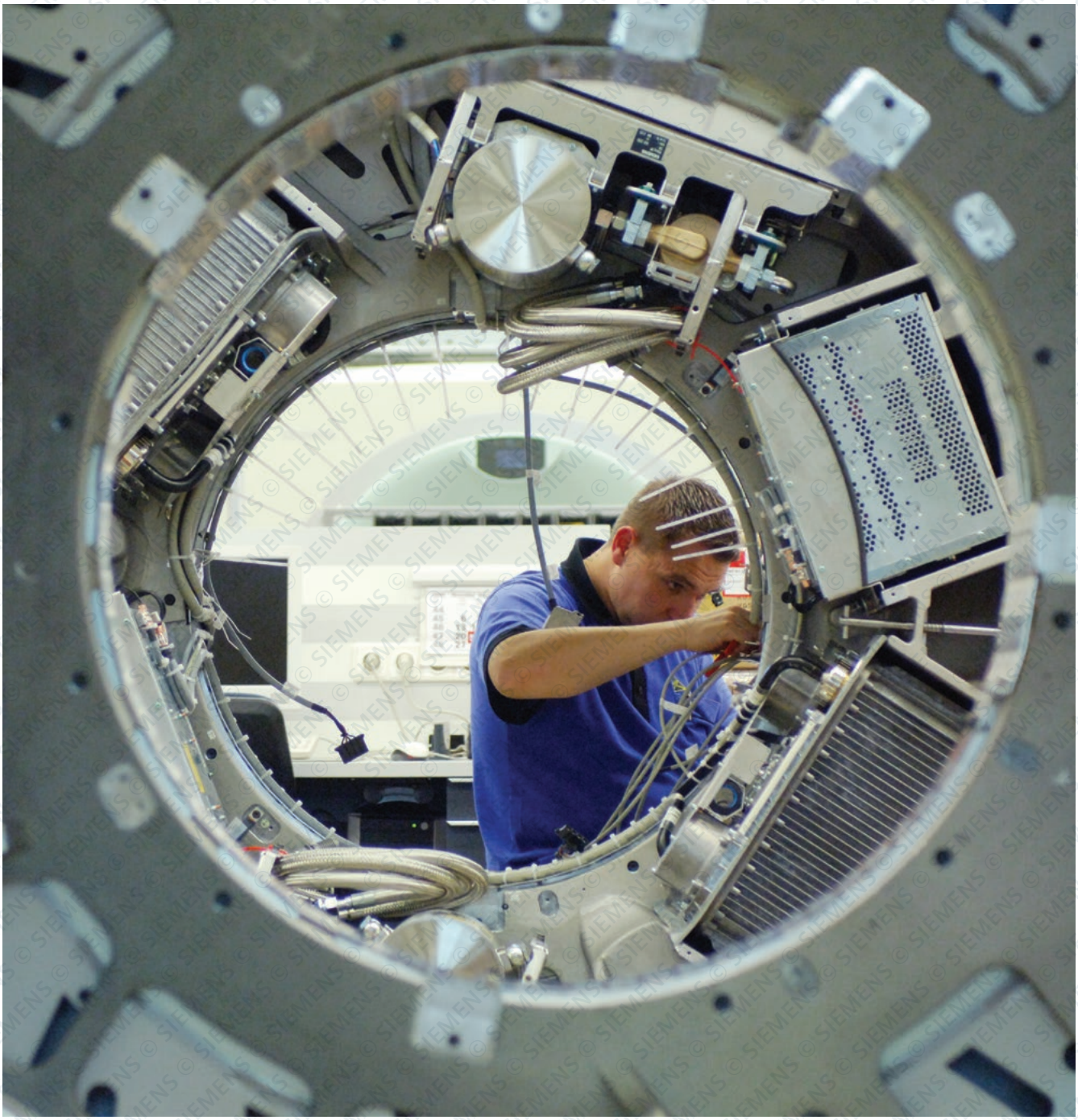
SGT gas warning terminal

- Wall or rack version
- Integrated with terminal network
- Up to 3 devices per control unit
- Max. distance 800 m
- 398x430x80 mm (HxWxD)

- Attractive detector housing with uniform design
- Innovative detector technology
- Flexibility with a range of measuring principles
- Control unit can be expanded in stages
- Monitoring with remote terminal unit
- Many applications thanks to low-cost range of detectors for safe zones
- Control unit in attractive housing or as rack version


SGC gas warning control unit
Wall or rack version
Optional:
- 64 relays 230V/6A
- 64 analogue outputs
- Additional power supply
Incl. UPS and battery
796x430x260 mm (HxWxD)
Gas detector
Gas detector
Gas detector
Gas detector
Gas detector
Digital detector network
Max. 64 detectors
Max. distance 800 m
Gas detector
SGZ-3165
4-channel relay module for remote alarm triggering 230 V/6 A
Flashing beacon
Gas detector
Additional detector power supply Power supply 230V
230V supply device
Incl. UPS
Max. 24 V/6 A
USV
EX
Gas detector
Gas detector
Gas detector
Gas detector

Individual needs – flexible solutions



An accident caused by gas explosions, escaping or corrosive liquids and dangerous gas leaks can have serious consequences for a company, including damage to the company's image. All these factors directly influence your gas protection concept for buildings in the pharmaceutical industry, food processing plants, parking garages, sewage treatment works and airports. In many establishments, a gas warning system is able to guarantee adequate protection. The Siemens gas detection concept can be individually tailored according to the use of the building, the processes, the infrastructure, the safety concept and the SES technical guidelines.

Protect yourself from the invisible danger

Safety begins with the sensor

Danger often lurks where it is least expected. Many industrial installations are unaware of this, giving them a false sense of security. This is where a gas warning system can help. Gas leaks are initially very difficult to pick up because many gases are odourless and invisible to humans. Smart electronic gas measuring principles, which even detect substances that are imperceptible to humans, never make mistakes. They keep measuring round the clock, reliably and continuously, guaranteeing safety in the company.
Sensors are a crucial component in all gas detection systems. Fault-free and fast detection is the only way to guarantee high quality and dependable alerts. To achieve the best possible results, a wide range of detection technologies is used. They undergo constant development to meet the growing demands.

Flammable and explosive gases

When chemicals are produced, processed, stored and transported in an industrial context, flammable gases and vapours are created and released into the environment. With oxygen, these substances form a potentially explosive atmosphere which explodes if ignited, causing serious injury and material damage.

Potentially explosive atmosphere

A potentially explosive atmosphere is a mixture of ambient air and flammable gases or vapours. Through evaporation or vaporization, parts of a liquid substance change into the gaseous state of matter. As the temperature increases, the liquid vaporizes in sufficient quantities to form a flammable mixture together with the air, which may be ignitable. An explosion can result from contact with a source of ignition (sparks, static discharge, electronics, etc.).

The risk of an explosion is reduced if explosion-proof equipment is used correctly in these zones. The category code of the explosion-proof equipment indicates how effective the explosion protection is and therefore which particular hazardous areas it can be used in. With flammable liquids and gases, the important parameters are the flash point, the auto-ignition temperature and the upper and lower explosion limit. Explosion-proof gas detectors can also be used to detect dangerous concentrations well before an explosive mixture occurs.

Our customers have been putting their trust in Siemens gas warning technology for more than 40 years. It offers the best protection not just during working hours but overnight too. Even in a power failure, detection continues uninterrupted with a built-in emergency power supply.

Parameters of flammable gases

Lower explosion limit LEL

It is the mixture concentration of air-gas/vapour that determines whether a potentially explosive atmosphere is formed. Starting with clean ambient air, a gas leak causes the gas concentration in the air to increase steadily. The lower explosion limit is reached once an explosive concentration has built up.

Upper explosive limit UEL

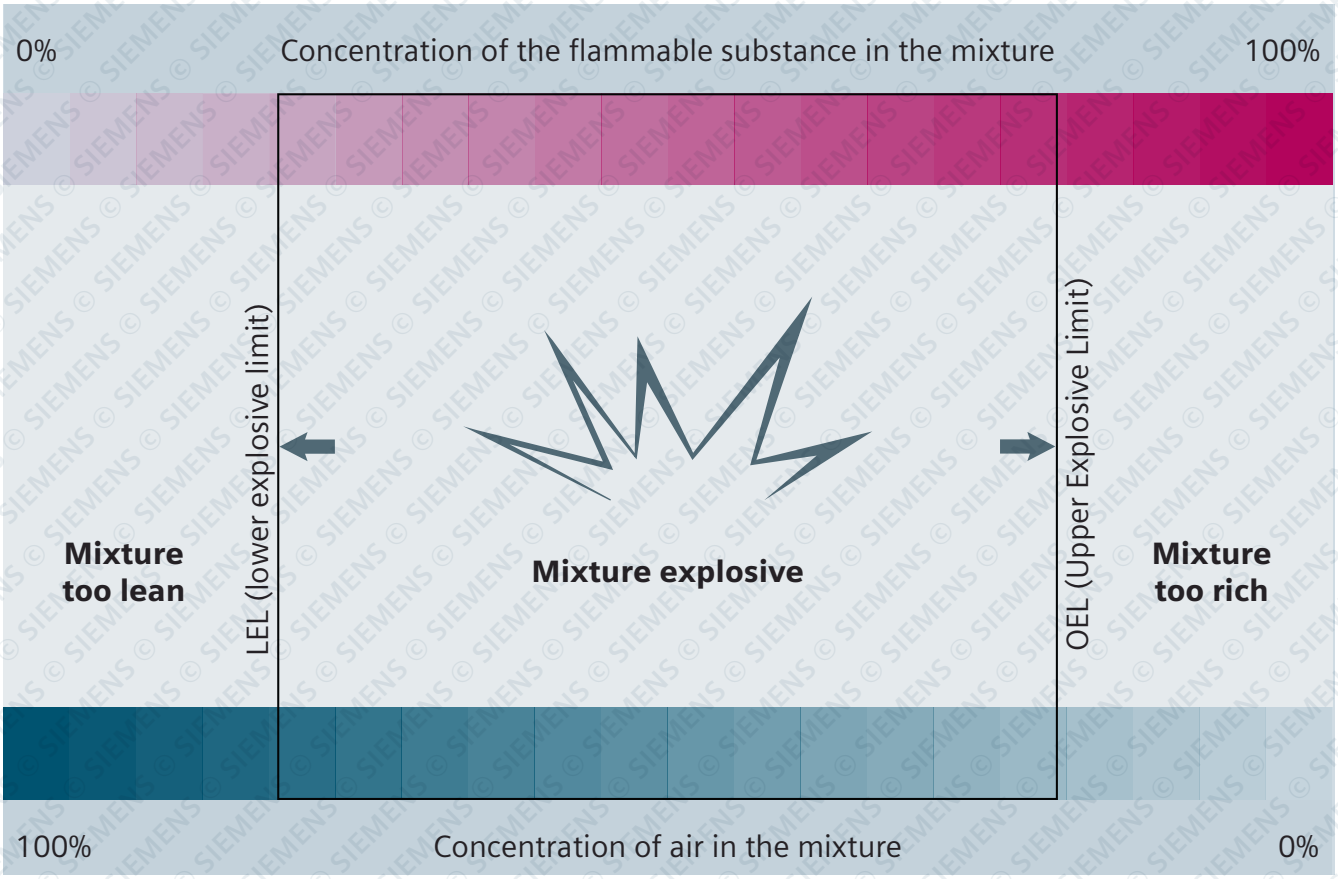
If the concentration continues to increase through the explosive range, a degree of concentration is eventually reached at which the higher proportion of gases and vapours means there is not enough oxygen to make the mixture explosive. This is the upper explosive limit. Above this limit the mixture is too rich, although it can still burn off in an oxidizer.
In enclosed spaces, a concentration may exceed the UEL but then fall back to the explosive concentration below the UEL if doors are opened and the air thins. The explosive range between the LEL and the UEL is different for every flammable gas.

Flash point

The flash point is the temperature at which a mixture or substance gives off so much vapour or gas that a flammable mixture occurs above the substance. With an external source of ignition (fire, sparks), the mixture suddenly ignites.

Auto-ignition temperature

The auto-ignition temperature of a flammable gas or liquid is determined in a test device and is the lowest temperature of a heated wall at which the flammable substance mixed with air spontaneously ignites. The auto-ignition temperatures of flammable gases are divided into different temperature classes, which correspond to the category code of explosion-proof equipment. The auto-ignition temperature of most gases is much higher than the flash point, which is often just a few °C (for example methanol 11 °C, toluene 4 °C etc.).



Alarm devices and toxic gases

Alarm devices

Identifying and detecting hazards is one half of a safety system. However, the hazard and the generated alarm must also be made clearly visible or audible to the people present so they can respond accordingly.
Siemens offers a wide range of penetrating alarm devices. We have the right solution for safe zones and Ex zones, consisting of flashing beacons, sirens or illuminated panels showing customized text or symbols.

Toxic gases

Toxic gases can be found in many places. In chemicals plants, food processing plants, cooling systems, sewage treatment works and underground car parks – concentrations of toxic gases can occur anywhere. In high concentrations, many of these gases and vapours are harmful or hazardous to human health and yet cannot be detected by our sense of smell. Other substances are corrosive or poisonous, making potential leaks into the environment undesirable. The various measuring principles of gas detectors allow these substances to be picked up even in small concentrations.

Many gas detectors can identify the tiniest concentrations of just a few ppm (parts per million – the ratio of one part gas to a million parts air), raising the alarm before a harmful concentration has the chance to build up.

Occupational hygiene

The purpose of occupational hygiene in every company is to protect staff from environmental influences that are harmful to health, such as noise, dust, gases, radiation, etc. Gas concentrations are subject to specified limit values to which staff must not be exposed at work. These threshold limit values (TLVs) describe the exposure thresholds for staff in an eight-hour working day and they are contained in lists. Some gases are toxic as well as flammable. This explains the fact that there are more deaths from toxic gases than from explosions caused by flammable gases.

Safety

ATEX – für explosionsgefährdete Bereiche

SIL – Sicherheits-Integritätsstufen

Gas warning devices for industrial use in Ex zones are electrical equipment and as such they must at least fulfill the applicable requirements for operation in potentially explosive atmospheres as described in the ATEX Directive 94/9/EC.

ATEX

«ATmosphère EXplosible» – French for explosive atmosphere. The ATEX Directive 94/9/EC states that all gas detectors and equipment installed in potentially explosive atmospheres (Ex zones) must be tested and marked to verify electrical safety and suitability. The test ensures that such devices do not themselves become a source of ignition for an explosive gas concentration. In the case of untested gas detectors this cannot be guaranteed. Most of our tested gas detectors use the protection type «Flame proof enclosure ATEX Ex d».

Failure safety

The SIL is primarily concerned with the safety of a product in its intended environment. This additional safety assessment aims to minimize risk in all applications in which a failure jeopardizes the safety of people, the environment or material assets. Four values are defined as safety integrity levels (SIL). The greater the SIL, the more reliable the system. However, gas warning systems can only achieve levels SIL 1 to SIL 3. In terms of hardware and software, the products used in the safety system must be highly reliable in order to prevent discernible faults occurring at all, or to keep the probability of failure extremely low. The SIL assesses and defines the availability requirements of the safety function and, for process control, the probability of failure of the system in question. The entire chain is considered including the sensor, the signal evaluator, the alarm system and the actuator. In the case of gas warning systems which must meet additional safety criteria, the product standard for gas detectors EN 50402 is also applicable.

Keep things running

The best safety system is useless unless it works when it needs to. Siemens plans, installs and operates gas warning systems in accordance with the applicable high quality standards of the SES (an association representing Swiss installers of safety systems), but then they must also be regularly inspected. Electrochemical measuring cells and catalytic sensors wear out over time, and the ambient air can cause them to lose sensitivity. To ensure that regular maintenance is never forgotten and to maintain building protection, Siemens offers a maintenance agreement option.

Gas leaks in heating systems

Natural gas is normally used to heat industrial and commercial buildings. The rooms containing the heating plant are rarely entered so gas leaks stay undetected. Natural gas consists mostly of methane, a light gas which rises and collects at the ceiling. The minimum concentration (LEL) of methane is 4.4 % vol. Equipment (switches, lights, electric heaters, electric tools, etc.) is a potential source of ignition.

As the gas concentration increases, the gas detectors sense the gas and the gas warning control unit triggers the alarm in two stages before the flammable concentration is reached.

Specialist substances – specialist measurement

In chemical plants especially, substances are used which, although not flammable, are toxic and corrosive. Certain chemicals also have a very low vapour pressure, which minimizes gas formation. Nevertheless, even the tiniest gas concentrations can be dangerous.
Our highly sensitive specialist suction systems can use a sample of air to pick up a very low concentration of substances at the site of the leak.
The Chemgard device is available for measuring a range of substances commonly used in the chemicals industry. Using a built-in measuring point switch, a single device is sufficient to take air samples at multiple locations and analyse the vapour concentration.

Ammonia for cooling systems

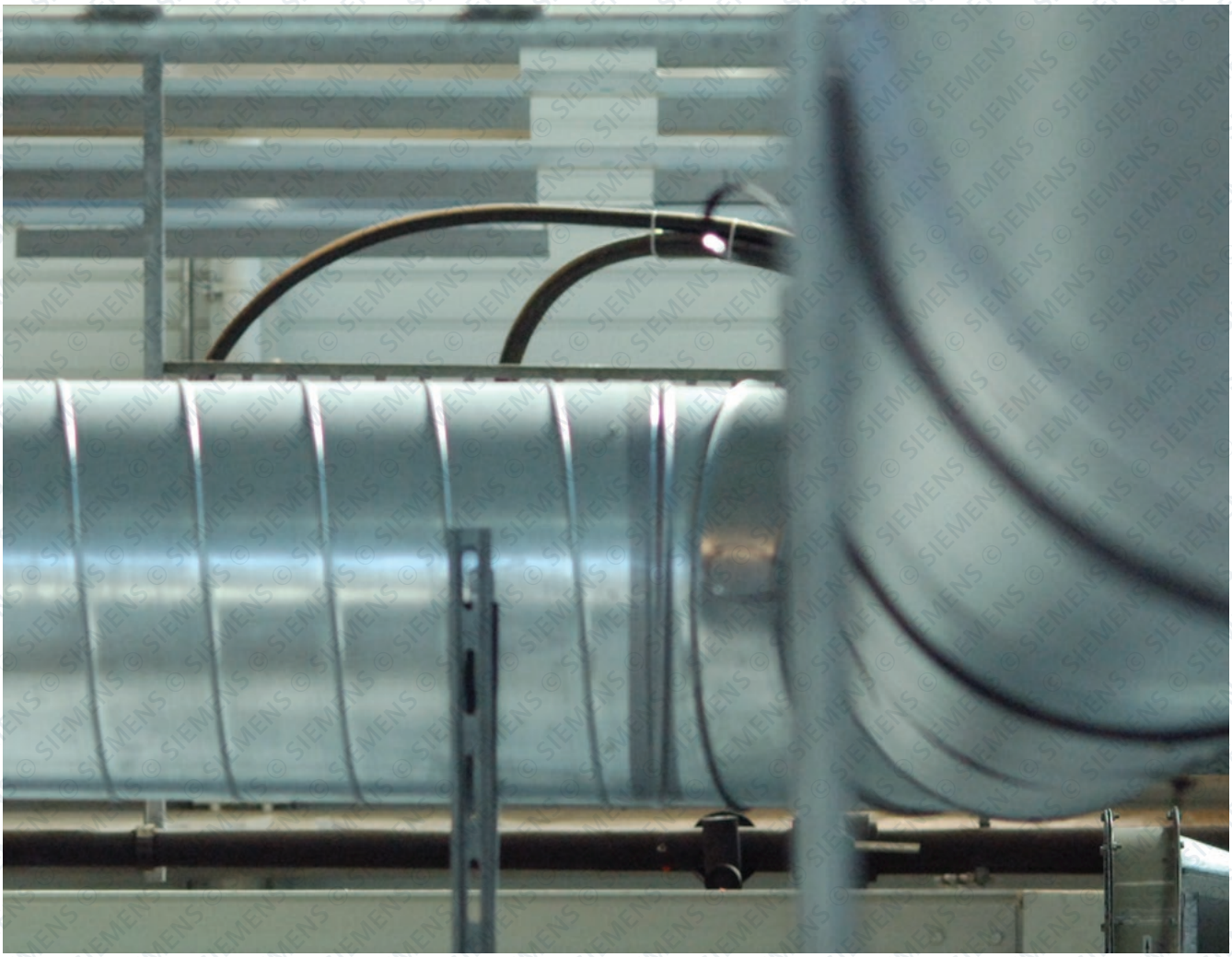
Ammonia is a poisonous and strong smelling chemical, widely used in refrigeration. It is a refrigerant with very good thermal properties, making it sought after for cooling systems in the chemical industry, food processing, heavy industry and ice sport centres.
The tiniest concentrations of leaking ammonia are perceived by the human sense of smell. Values over 100 ppm are experienced as an acrid smell, causing people to leave the area. Extended exposure to ammonia can cause the human olfactory organ to lose its sensitivity to the substance, giving the impression that the concentration has declined. The electronic circuits constantly and reliably measure the very smallest concentrations without losing any sensitivity.

Not every gas is equally dangerous

There are three gases which must be treated with particular care because they need an extremely low ignition energy to explode: hydrogen, acetylene and carbon disulphide. With hydrogen in particular, a flame is practically invisible because it is translucent in bright light. Hydrogen is also lighter than air, colourless and odourless. This makes it easy to falsely assume that there are no leaks in the system and that monitoring of these group IIC gases is unnecessary. Yet oxygen displacement and freezing injuries are a danger to the people present. Gas detectors above potential sources of danger can detect a leak of these substances at an early stage so that action can be taken.

Industry, chemicals and food processing

Many flammable gases and solvents are used as fuels in industry, as process gas in petrochemicals or as a raw material in chemical processes. Some gases are imperceptible to humans, whereas others very quickly become flammable when combined with oxygen. Correctly placed gas detectors can offer useful protection. It is critical that the detector does not itself trigger an ignition of the flammable mixture. It is therefore essential only to use gas detectors with Ex protection that have undergone the relevant ATEX testing. The same measuring principle cannot always be used to accurately detect the various substances. Depending on the substance, it is vitally important to choose the correct detection technology and sensor location.



Analogue detectors

47K catalytic sensors, PrimaX P series, PrimaX IR

47K Catalytic sensors

The 47K gas detectors use a passive catalytic sensor that can measure dangerous concentrations of flammable gases and vapours up to 100 % LEL. A Poison Resistant Pellistor (PRP) is used as the sensor, making these detectors much less sensitive than others to extraneous gases and disturbing influences. Optional accessories are available for many industrial applications. The 47K gas detectors are SIL 2 and they satisfy all ATEX requirements including the suitability test, so they can be used as part of a safety-oriented system.

ATEX II 2G Ex d IIC T3/T4/T6, II 2D Ex tD A21 IP6X T85°C/T135°C/T200°C including certification, SIL 2

PrimaX P series

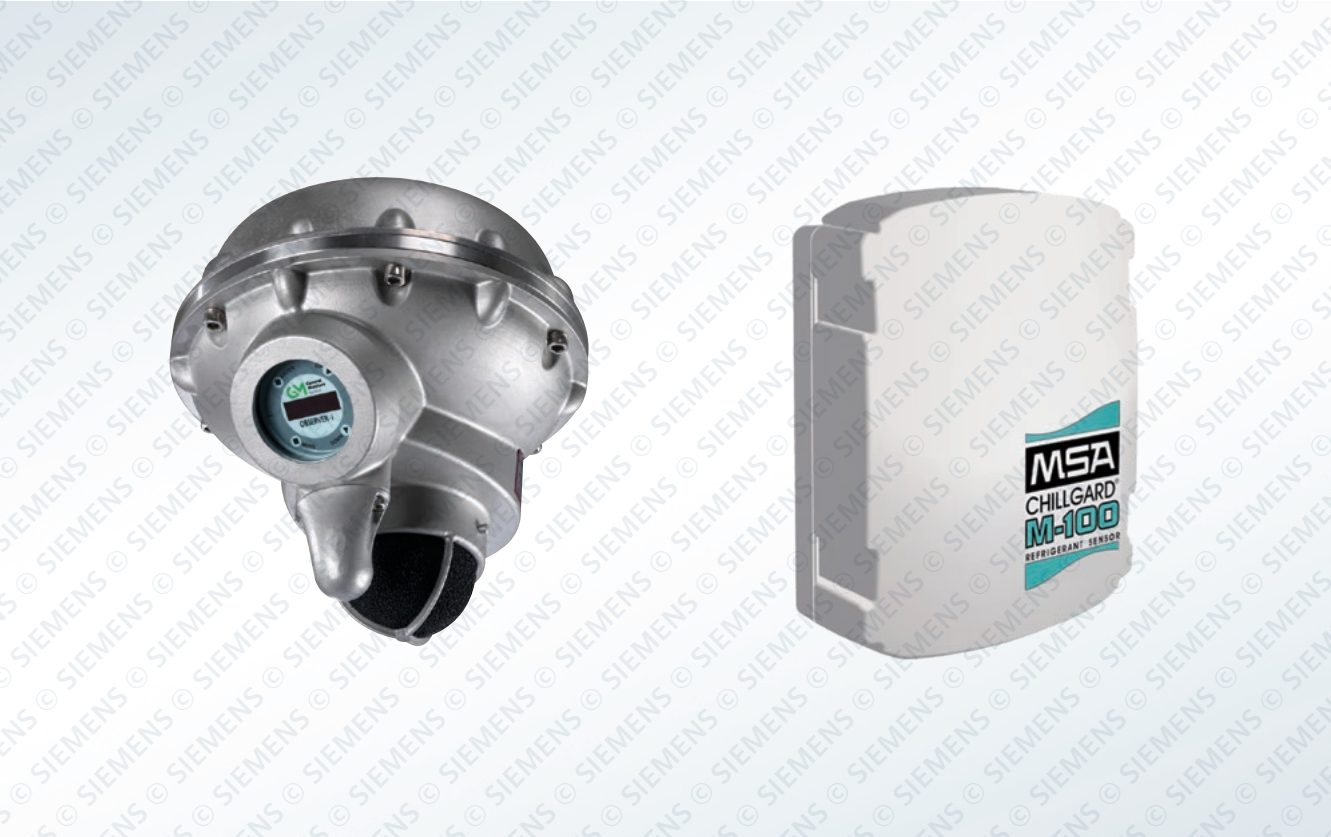
The PrimaX P gas detector is suitable in many indoor and outdoor applications for detecting flammable gases (catalytic sensor) and toxic gases or oxygen (electrochemical sensor). An innovative, user-friendly housing with integrated keypad makes it easy to use even in Ex zones. The LCD display shows normal text so information is available at a glance. The LEDs indicate the status. Calibration is easy using the integrated operating panel. Plug-in sensors and an integrated mounting plate mean that installation is quick and easy. The PrimaX P series has the protection type «Flame proof enclosure» in the powder-coated aluminium housing with 4-20 mA signal output and SIL 2 compliance.

ATEX II 2G Ex d ia [ia] IIC T4 Ga, II 2D Ex tb ia [ia] IIIC T130 °C Db IP67, SIL 2

PrimaX IR

The PrimaX IR gas detector has an innovative dual source design with redundant infrared light source, for LEL detection of flammable gases with maximum reliability and uninterrupted availability even if one of the radiation sources fails. The IP67 housing also protects the PrimaX IR from external influences. A mounting plate is supplied with the housing for easy installation. The PrimaX IR gas detectors have a 4-20 mA signal output, a wide temperature range and SIL 2 compliance.

ATEX II 2G Ex d IIC T4 Gb, II 2D Ex tb IIIC T130°C Db IP67, SIL 2



Observer-I, Chillgard M-100

Chillgard M-100

Observer-i

Instantly detect pressurised gas leaks with this high-precision, non-directional acoustic measuring instrument with Gassonic ultrasonic technology. Also works when conventional gas measuring technology is unsuitable or dependent on the air flows. Uses an Artificial Neural Network (ANN), which can distinguish between real gas leaks and false alarms without the need for a teaching phase on site. The Observer-i ultrasonic gas detector measures at distances not previously achieved in the sector (up to 28 m) which means that fewer detectors are needed. Ideal for use in complex pipeline systems in the open air.

- Uses Gassonic technology to detect pressurised gas leaks at the speed of sound.
- The neural network technology distinguishes between the sounds of real gas leaks and background sounds, suppressing false alarms
- No need for a teaching phase on site, fully functional on installation
- Detects gas leaks from a pressure of 2 bar (29 psi) and quickly detects small leaks
- The patented Senssonic™ self-test guarantees completely fail-safe operation
- Easy maintenance, inspection and calibration by a single person

Chillgard M-100

The Chillgard M-100 was specially developed to monitor halogenated refrigerants in cold stores, machine rooms and other applications. It is a compact gas detector that can be installed almost anywhere to pick up possible leaks. Easy to install, the Chillgard M-100 can be quickly and easily connected to existing monitoring systems.

Digital detectors

Gas detector series SGD-2311, Gasdetektor Serie SGD-5310/SGD-4310

Gas detector series SGD-2311

The compact gas detector series SGD-2311 is suitable for a wide range of indoor applications and detects toxic gases or oxygen (electrochemical, infrared or semiconductor sensor). Its lightweight and compact design makes it ideal for use in safe zones. The standard model has two interfaces providing full flexibility. With the analogue 4-20 mA signal, the detector can be directly connected to a range of signal evaluators. The innovative digital bus interface allows multiple detectors to be connected to the SGC-3000 signal evaluator via a single bus line, saving considerable amounts on cabling.

Gas detector series SGD-5310/4310

Gas detector series SGD-5310/4310 is mainly used in situations requiring a robust housing. The series 5310 also has a display clearly showing the reading. These devices continuously monitor flammable and toxic gases and oxygen using many different measuring principles and they can be used anywhere, even outside Ex zones. You can choose from the catalytic measuring principle to detect flammable gases, electrochemical sensors to monitor toxic concentrations, the infrared method and semiconductor sensors. The SGD-5310/4310 series has the protection type «Flame proof enclosure» with robust IP53 aluminium housing. The standard model has two interfaces providing full flexibility. With the analogue 4-20 mA signal, the detector can be directly connected to a range of signal evaluators. The innovative digital bus interface allows multiple detectors to be connected to the SGC-3000 signal evaluator via a single bus line, saving considerable amounts on cabling.

II 2GD EEx d IIC T6

Accessories

A wide range of accessories is available for the gas detectors of the SGD series depending on the environment and the measuring requirements:

- Gas collecting hood
- Splash guard
- Pipe adapter
- Suction pump
- Alarm display

The gas detectors of the SGD series can also be fitted with three relays as an option, to allow local alarm signalling. The sensor activates an alarm device directly for each alarm level, for maximum flexibility.

Gas detector SGD-2130-I4417, alarm indicator SGZ-3194-E0101, suction pump SGA-2010-X0000

Coolant sensor SGD-2130-I4417

New coolants offering major benefits are taking over the market. That means new detectors are needed to monitor cooling systems. The SGD-2130-I4417 sensor, which detects R1234yf, does this job perfectly. The infrared measuring principle detects concentrations up to 1000 ppm. The integrated suction pump means the measuring point can be up to 25 m away, in places where access is difficult. The compact design, the status display on the front and the universal signal output combine to give this sensor great flexibility in use. This sensor is also available for other coolants (R134, R22, R404, etc.)

Alarm indicator SGZ-3194-E0101

The SGZ-3194-E0101 is ideal for the local display and signalling of a very wide range of alarm events. The three large, illuminated display areas for three signal levels can be labelled individually. The status field can also be set to flash or remain constant, and to appear in red, green or yellow. The internal alarm buzzer can be cancelled and additional alarm devices can be activated with the provided switching contacts.

Suction pump SGA-2010-X0000

The SGA-2010-X0000 is used alongside a gas detector to detect gas concentrations in places that are difficult to access or at the ceiling. The strong suction pump is connected between the potential leakage site and the gas sensor, and the measuring point can be up to 50 m away. The status display on the front also signals the current state of the pump and the supply line.

Gas warning and control systems

SGC-3000, SGT-3000, SGC-100

SGC-3000

The latest innovative technology brought together within an attractive housing – that is the SGC-3000 flexible control system. It is compact enough for small and medium size systems but is also modular and flexible so it can be expanded to create a larger system as a rack version in a standard cabinet. A range of detectors can be used for explosive/flammable and toxic gases or vapours and oxygen. The system also has analogue sensor input and a digital bus input, to which up to 64 SGD-x310 gas detectors can be connected using a single cable. The outputs can be flexibly assigned, with up to 64 main switching contacts in the control unit housing or at remote sites on the bus line. To ensure that the system's detection and alarm functions continue to work in a power outage, an emergency power supply can be included within the housing as an option. It is useful to be able to take gas detector readings at different locations. With the SGC-3000 this is no problem – up to three remote display units can be connected over a digital bus line.

The SGC-3000 control system supports signal processing for up to 64 digital gas detectors plus 15 analogue gas detectors, three remote display terminals and up to 64 local or remote relay outputs.

SGT-3000

The SGT-3000 distributed remote control and display terminals are a convenient way to display the readings from the SGC-3000 digital control unit at any location. Up to three devices can be connected to each control unit. The link consists of a digital data bus which can be up to 800 m in length. It is available with a wall-mounted housing or as a rack version.

SGC-100

1 channel gas warning control unit with compact design to monitor potential danger in boiler rooms, sewage treatment works, etc. The measured value and the alarm values can be read directly from the device. Alarm signalling devices can be connected for each alarm level, for maximum flexibility despite the compact design.

9020 LCD, GasGard XL, Suprema Touch

9010/9020 LCD

The classic control system 9010/9020 delivers an excellent price/performance ratio with maximum flexibility, easy operation and high reliability. The system is compatible with all gas detectors so it can protect many different applications.

ATEX II (1)G (2)G, MED 96/98/EC

GasGard XL

The GasGard XL control system operates a maximum of eight gas detectors. The unit is intended to be wall-mounted. It is fully configurable and has a large, clear display and status indicators for each channel. The standard version has four sensor channels and five collective alarm relays. The GasGard XL can also be upgraded with eight further channels and 16 fully programmable relay outputs, enabling it to satisfy many industrial requirements with ease. And the integrated Mod-Bus interface can be used as an elegant way to integrate the unit with a higher-level management system. To ensure that the GasGard XL control system's detection and alarm functions continue to work in a power outage, an external emergency power supply is available as an option.

ATEX II (1)G (2)G, SIL 2, MED 96/98/EC

Suprema Touch

A touchscreen is much more straightforward and intuitive to use, and the Suprema Touch has a convenient user interface that is easy to understand. It is the preferred choice for comprehensive monitoring in heavy industry and for measuring and monitoring in SMEs.
A range of detectors can be used for explosive/flammable and toxic gases or vapours and oxygen. Suprema Touch has a large colour display with touchscreen functionality for user-friendly operation and outstanding information and diagnostics functions. The latest hardware and software technology is used, making planning, installation, configuration, integration and operation extremely straightforward and economical. Its compact and modular structure makes it easy to adapt and expand the Suprema Touch control system in a flexible and economical way to meet requirements.
The Suprema Touch control system has signal processing for up to 256 inputs and 512 outputs, which can be divided between up to eight remote racks.

ATEX II (1)G (2)G, SIL 3, MED 96/98/EC

High sensitivity suction systems

Chillgard RT, Chemgard

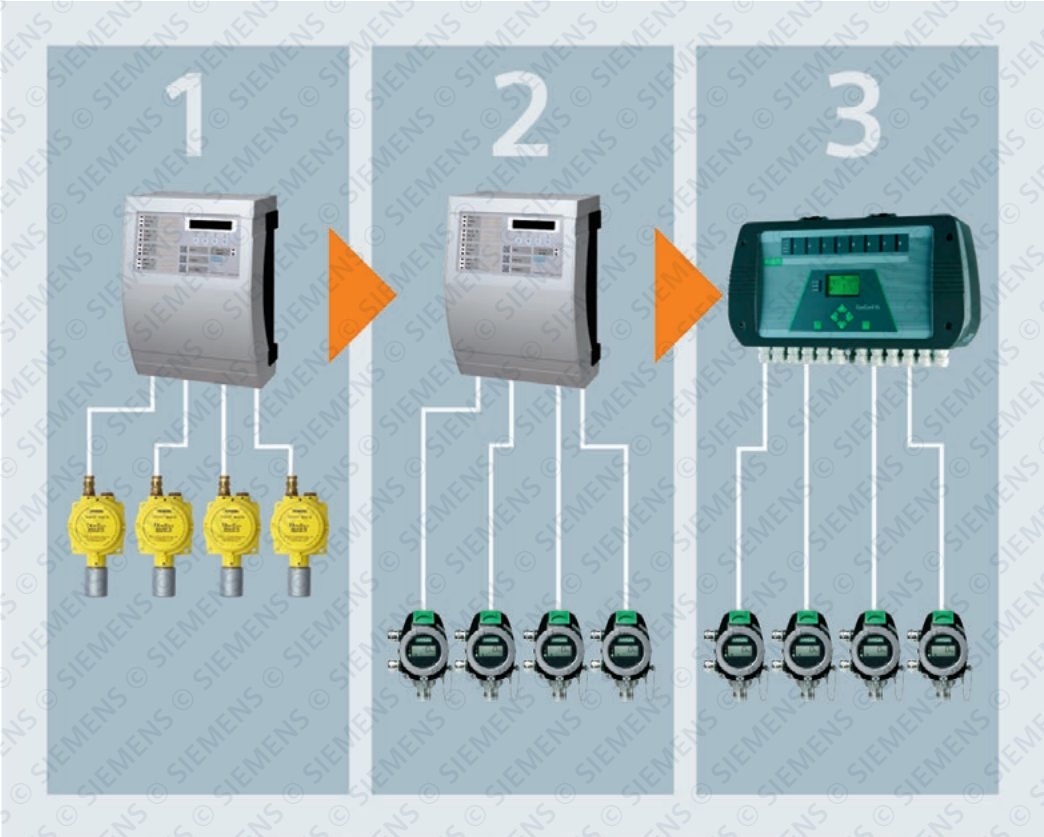
Chillgard RT

The Chillgard RT gas suction system is a single or multipoint gas warning system suitable for industries using refrigerants, for example laboratories, cold stores or food processing plants. It accurately monitors Freon concentrations in the ppm range and can detect leaks at an early stage. It has outstanding detector stability meaning it can work for months with very little zero point deviation. As outputs, the Chillgard RT has relay contacts and a 4-20 mA signal.

Chemgard

The Chemgard uses a precise suction system to monitor over 60 substances in widespread use in the chemical industry, including carbohydrates, solvents, alcohols, alkanes, etc. IR spectroscopy offers certain benefits, meaning the unit can run for months with very little deviation from the zero point. A switch operated test gas pump moves the sample from one of eight measuring points to the analysis unit. Available outputs are relays and a 4-20 mA signal.

Modernization – something that affects you too



Flexible – Detector modernization

Be prepared

When gas detector systems have been installed for a long time and are still in service, they often disguise the fact that they no longer up to the task. Modernization is important for the following reasons:

Safety requirements change

Many things in your organization develop and change over time: you products and services, your working methods and processes, your customers' needs, your responsibility towards your staff, your dependence on perfectly working infrastructure and a first class image. The consequences of gas explosions, escaping corrosive liquids, gas leaks and the resulting damage to the image are serious. Continuous modernization carefully follows the changes and developments taking place in your company, delivering competitive advantages in the medium term.

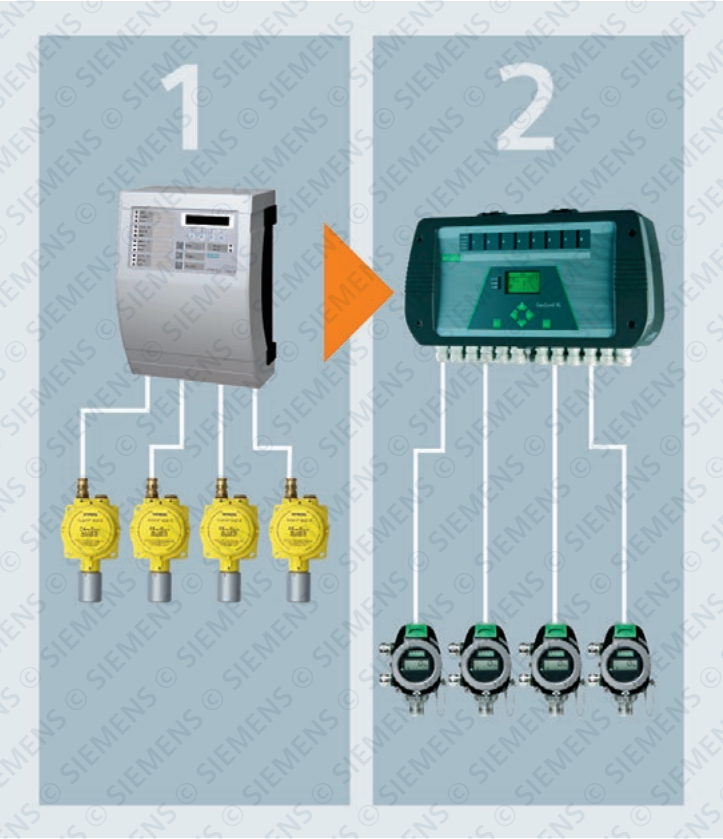
Old systems – more frequent maintenance

Maintenance becomes more and more tricky with gas detector system developed in the 80s and 90s. Spare parts are often unavailable or very expensive. The measuring heads wear out so they need regular inspection and replacement. That is why you are recommended to modernize these systems.

Solutions that protect your investment long-term

A modernization is based on the current gas protection concept in your company. That means our solutions are so individual that they perfectly match your preferred pace and available funds. The solutions are developed in partnership, with mature products and services safeguarding the success of your investments in the long term.

You set the pace



Classic – total modernization

Do you want to modernize your gas warning system in phases or all at once? There are two approaches so the choice is yours.

Flexible – detector modernization

This solution is flexible because the modernization starts at the periphery, in other words the individual gas detectors. You can design the phases however you like, to meet your particular requirements. For example you could start by replacing Ex detectors, followed by the remaining detectors and finally the control unit.

Advantages:

- The partial investments are small compared to replacing the entire system.
- You instantly benefit from the latest detection technology.
- Staff and operations are largely unaffected by modernization in phases.

Classic – total modernization

Say you are changing the purpose or use of a building. So you need to modernize you gas detection system all at once.

Advantages:

- Your system is updated and perfectly tuned to the environment very quickly.
- Cost savings are possible if the modernization can be combined with other building work.

SIEMENS

Ingenuity for life

Fire detection

buildingtechnologies.siemens.com

9.1. Introduction	270
9.2. Principles and objectives	270
9.2.1. Aims of Fire Detection	270
9.2.2. Outbreak of a Fire	271
9.2.3. Development of a Fire	271
9.2.4. Fire Phenomena	272
9.2.5. Types of fire	273
9.3. Fire Detectors	274
9.3.1. Detection Principles	274
9.3.1.1. Point-type Smoke Detectors	275
9.3.1.2. Linear Smoke Detectors	276
9.3.1.3. Aspirating Smoke Detectors	276
9.3.1.4. Point-type Heat Detectors	277
9.3.1.5. Linear Heat Detection Systems	277
9.3.1.5.1 Detection Principles	278
9.3.1.5.2. Selecting the Suitable System	279
9.3.1.6. Flame Detectors	279
9.3.1.7. Multisensor Fire Detectors	280
9.3.1.8. Video Systems in Fire Detection	281
9.3.2. Detection reliability	282
9.3.2.1. Detector Sensitivity	282
9.3.2.2. Detector Design	282
9.3.2.3. Signal Processing	283
9.4. Selecting the Appropriate Fire Detector	284
9.4.1. Sensitivity of Optical Smoke Detectors	284
9.4.2. Fire Detectors and EN 54 Test Fires	284

Use Case	286
Graphical overview	288
Sinteso S-Line	290
ASA Technology	290
Neural Fire Detectors	292
Radio Fire Detectors	293
Flame Detectors	294
Linear Smoke Detectors	295
Radio Fire Detectors	296
Ex-Portfolio	299
Sinteso C-Line	300
Detectors	300
Detectors	302
Manual Call Points	303
Indicators / Alarm Sounders	304
Sounder Bases	305
Input / Output Modules	306
Floor Repeater Terminal / Display	307
Aspirating Smoke Detectors	308
Principle of Operation	308
Siemens ASD	310
Aspirating Smoke Detectors	311
Titanus	313
RackSens	314
Special Detection Applications	315
Enhanced Fire Protection	317
Sinteso Fire Control Panels	318
System description	318
Modular Large and Modernization Fire Control Panel	321
Fire Terminal	322
Networking Options	325
Network Modules	326
View Software Control Panel	327
Sinteso Mobile	328
FibroLaser	330
Linear Heat Detection System	330
Extinguishing Control	332
XC10	332
Extinguishing panels	334
Sinorix Compact	336
Modernization	338

9.1. Introduction

The task of an automatic fire detection system is to detect fire as early as possible, to alarm and activate the preprogrammed control functions. State-of-the-art fire detection systems are capable of detecting fire extremely early and thus of minimizing the damage that may be caused by fire. By an optimal product selection and appropriate knowledge it is possible to set up systems that virtually rule out false alarms.

A fire detection system consists of the control unit, the peripherals such as fire detectors and contacts, as well as alarm and control devices activated by the control unit.

In selecting, setting and positioning fire detectors, it is crucial to consider – in addition to the actual prevailing risk – the type of fire to be expected, the room height, ambient conditions such as air changes and possible deceptive phenomena. In high-risk areas, multisensor fire detectors with state-of-the-art signal processing are used more and more frequently. For medium and lower risks, usually optical smoke detectors with conventional signal processing (algorithm technology) are applied.

State-of-the-art fire detectors allow an exact configuration of the detector behavior, which meets the environmental conditions and the prevailing deceptive phenomena. A fire detector in a hospital room must respond in a completely different way than a fire detector in a foundry.

When arranging the fire detectors, one must be sure that the fire phenomena (smoke, heat, radiation, gas) reach the fire detectors, giving special consideration to the ceiling's construction (e.g. the ceiling joists, special roof or ceiling shapes), and a possible room division by alcoves, furniture or fixtures and fittings.

In rooms where strong deceptive phenomena occur, the ideal arrangement of the fire detectors is of central significance. Even small changes of the detector position bring about massive improvements of the immunity to deception, without reducing the detection reliability.

In selecting the fire detection control unit, user-friendliness, a high degree of flexibility and a very high degree of fail-safe operation must be taken into consideration. The control unit is the point of interaction between people and the system and must thus make easy and intuitive alarm and fault processing possible.

High flexibility in networking and parameter setting facilitate extensions and the adaptation of the system behavior to a change of customer requirements.

The availability of a fire detection system is crucial, which is why emergency power supply and an integrated emergency operating function are mandatory, making fire alarms possible in spite of a failure to a module or a power failure.

For economic reasons, a fire detection system's technology is chosen according to the requirements and the specific risk situation. For an office building, a fire detection system with manual call points and optical smoke detectors with normal signal processing is usually sufficient, but if production facilities in the chemical industry shall be protected, for example, the use of advanced technology is a must.

A comprehensive product portfolio, highly reliable fire detectors with multisensor technology and the use of an exceptional logic, high flexibility of the fire detection control unit and its connection to the danger management system are topics to be considered in setting up a fire detection system.

9.2. Principles and objectives

Fires can have a devastating impact and can put assets and human lives at risk. That is why it is so important to detect fires as quickly and as reliably as possible. This requires efficient systems that are immune to deceptive phenomena – from the highly sensitive aspirating smoke detection system to the multisensor detector.

A fire can only start if there is oxygen, a fuel and a source of ignition. If all three elements are present, fire can occur. Every fire starts small. That makes it all the more important to discover it as soon as possible and to start fighting it straight away. If a fire progresses to what is called a flashover, fire fighting becomes much more difficult and the damage caused is normally very serious.

9.2.1. Aims of Fire Detection

Fire detection always has the following aims:

- Protecting people, animals and assets
- Preventing outages
- Identifying critical situations as early as possible
- Reliably alerting the emergency services
- Controlling automatic extinguishing and evacuation systems

The knowledge of the outbreak of a fire and its development is decisive for fire prevention and fire fighting. To ensure reliable, early detection in the case of fire, it is equally important to be familiar with the different fire phenomena and the possible types of fire. The following four topics will be handled in detail hereinafter:

- outbreak of a fire
- development of a fire
- fire phenomena
- types of fire

9.2.2. Outbreak of a Fire

For a fire to break out, combustible material (fuel) and an oxidation agent (usually oxygen) must be available. Our environment is to a large extent made up of combustible materials – and oxygen is virtually always sufficiently available. But another condition must be fulfilled for a fire to break out: The ignition energy must be the driving force to initiate oxidation. Ignition energy sources are manifold: Electrical discharge (e.g. lightning), short-circuits, flying sparks, hot surfaces (light bulbs, heating equipment, etc.), direct exposure to flames or bundled light, to name only the most important ones. If a fire occurs, it provides the necessary energy to maintain the combustion process.

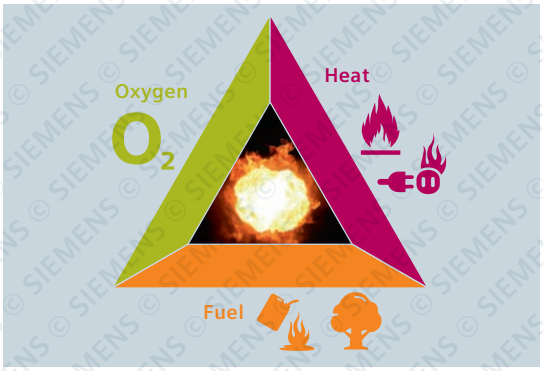


Fig. 4.1: The fire triangle

Fire thus occurs by the interaction of fuel, oxygen and heat (energy).

9.2.3. Development of a Fire

Apart from explosion-type processes, a fire normally develops more or less quickly, depending on the combustible material. As fuel and oxygen are sufficiently available at the beginning of the fire development, it is to a large extent determined by the available energy. Especially a flaming fire releases a lot of energy resulting in exponential fire growth at this stage.

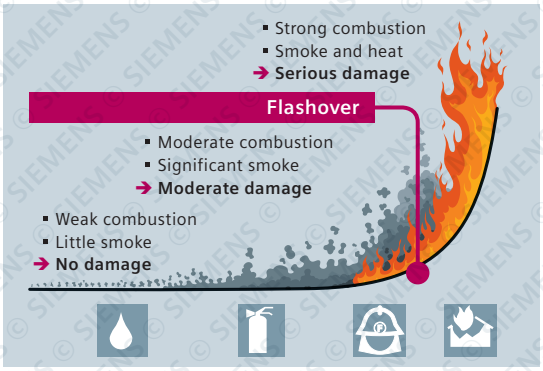


Fig. 9.2: Typical fire development

As shown in Figure 4.2, most fires pass through the following phases and events:

- **Early stage:** The incipient fire can be extinguished with a few deciliters of water; little visible smoke occurs, but especially invisible aerosols are generated.
- **Smoldering phase:** In this phase, the fire can be extinguished by means of a fire extinguisher or a similar extinguishing agent. Visible, partly dense smoke occurs. Usually, combustion is incomplete, which is why rather a lot of (toxic) CO is produced in this phase.
- **Flaming phase:** We are faced with an open fire to be fought by the fire brigade. As enough energy is available, the combustion process is rather complete, resulting in a high production of CO_2.
- **Flashover:** The transition between an open, flaming fire and a total fire is called flashover. This is the explosive fire spread, taking place exactly at the point when the gases and aerosols produced during the previous phases ignite and carry the fire into all rooms already penetrated by the smoke gases.
- **Total fire:** In this phase, the fire has reached larger building parts. In most cases, the building or fire sector can no longer be saved and the fire brigades concentrate their efforts on the protection of neighboring buildings and fire sectors.

Fire detection must occur as early as possible, so that intervention can start before the flashover. Incipient fires should thus be detected in the early stage or in the smoldering phase at the latest, so that there is enough intervention time left. The problem is that the early stage and the smoldering phase can be of completely different intensity and duration. Some smoldering fires may continue to smolder for hours or even days before an open fire occurs.

With liquid fires, there is no smoldering phase at all; they directly develop flames. With such fires, the intervention time is extremely short. Usually, damage can only be limited by an automatic extinguishing system. Of course, there are other possibilities, such as constructive measures, to slow down fire spread, thus prolonging the intervention time – but this is usually very expensive.

As the fire progresses, the amount of damage caused increases. The overall losses caused by a fire are determined not just by the size and intensity of the fire itself, but also by the precipitation of fire aerosols in the surroundings. Rooms contaminated by fumes are often rendered unusable even if the actual fire did not reach that far. And people tend not to be injured by flames but by inhaling toxic smoke – ranging from a cough and watery eyes, to more serious cases with signs of paralysis, potentially followed by immobility and suffocation.

Conclusion: The earlier a fire is detected, the more time there is for fire fighting, and the less damage occurs. Earliest possible detection is thus the key to minimizing damage and winning precious intervention time.

9.2.4. Fire Phenomena

Fire phenomena are physical values that are subject to measurable change in the development of a fire (e.g. temperature increase, light obscuration or flames).

The processes in material combustion can be principally viewed from the perspective of a conversion of energy and substances. The energetic conversion releases energy into the environment. The substantial conversion produces – depending on the substances present at the seat of fire – products in any physical state, ranging from non-toxic to highly toxic.

The figure below indicates the concomitant phenomena of a fire with the associated fire phenomena (in parentheses).

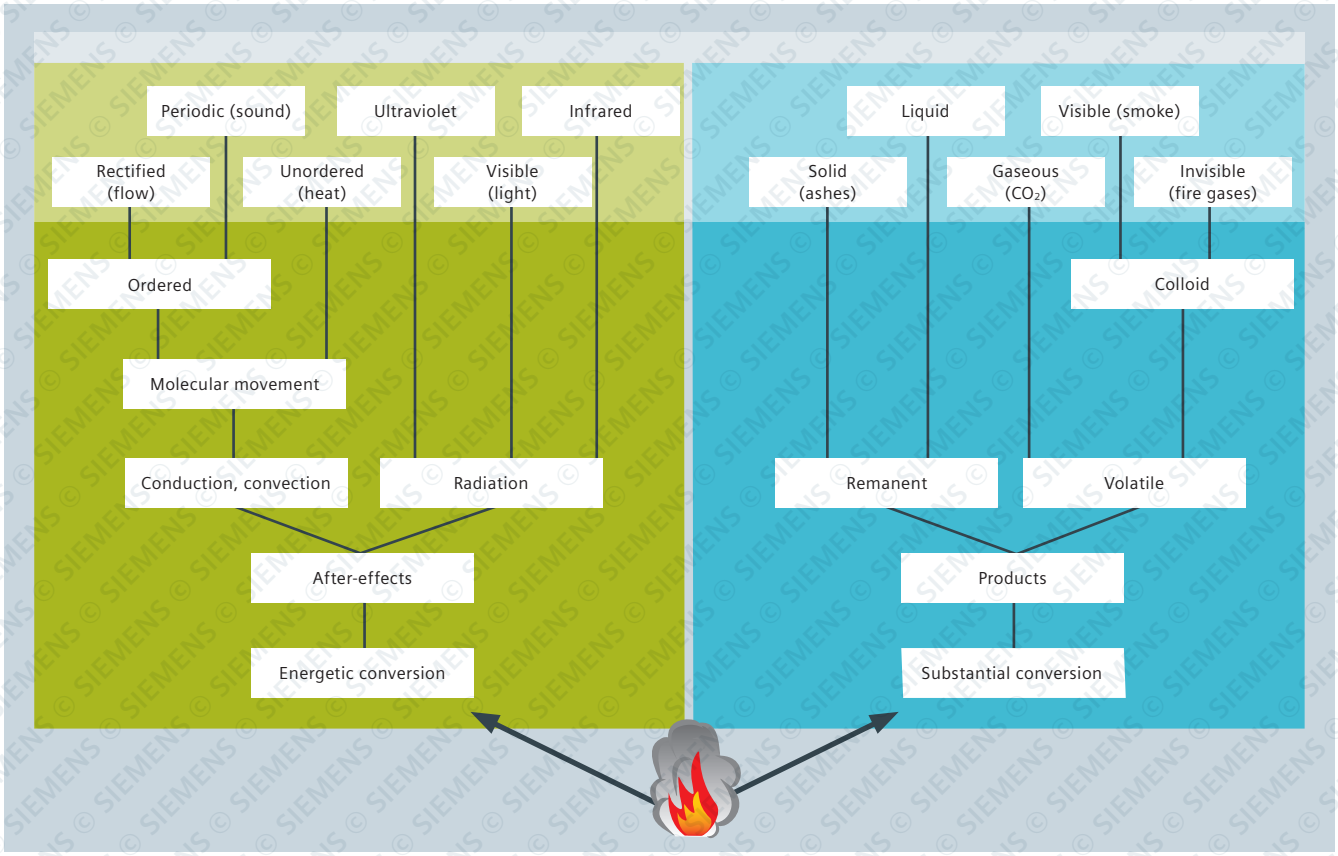


Fig. 4.3: Schematic representation of fire phenomena

The energetic conversion releases energy by radiation and convection. The range of radiation released during a fire can be divided, by wavelength, into ultraviolet (UV), visible light and infrared (IR). Energy release by convection essentially takes place through the ambient air. First, the kinetic energy of the air molecules is increased, resulting in a temperature increase. The associated expansion leads to an upward air flow. Due to this flow, cooler air and thus oxygen is guided to the fire seat. These processes can also lead to periodic pressure fluctuations that are perceived as sound in certain frequency ranges (e.g. the typical crackling of a fire).

The conversion of substances taking place in a fire is characterized by the various chemical reactions that can occur at the seat of fire, depending on the substances present.

The substantial conversion of a fire is determined by the different chemical reactions that may go on at the seat of fire. The solid or liquid conversion products either remain at the fire seat (e.g. ashes) or are distributed into the direct environment of the fire. In the latter case, they form a so-called aerosol, as finely distributed solid or liquid suspended matters mixing with the ambient air. Gaseous conversion products always spread through the air.

9.2.5. Types of fire

The fire phenomena occurring with a smoldering or open fire differ in terms of type and intensity.

Type of fire / Properties and fire phenomena	Smoldering fires (non-flaming fires)		Open fires (flaming fires)		
	Pyrolytic decomposition (carbonization process)	Glowing fires	Solid matters (mostly emberforming fire)	Liquid matters (flame combustion)	Gaseous matters (flame combustion)
Combustion process	Not independent, requires continuous energy supply	Independent after ignition	Independent after ignition	Independent after ignition	Independent after ignition
Type of smoke (aerosol)	Very light smoke	Light smoke	Dark smoke	Very dark smoke	Depending on the carbon share of the gas, its chemical properties and mmixing with oxygen
Optical properties of smoke	Quickly spreading	Quickly spreading	Strongly absorbing, spreading little	Strongly absorbing, spreading little	
Aerosol volume	High	High	High	High (except pure alcohol: none)	
UV / IR radiation	Low	Wenig bis mittel	High	High	Increases with C-share
Heat convection	Low	Wenig bis mittel	High	High	High
Combustion gases	Much CO, little CO_2	Much CO, little CO_2	Little to much CO, much CO_2	Little CO, much CO_2	Little CO, much CO_2
Sound	None	None	None to much	None to much	None to much
Pressure increase	None	None	Low to medium, depending on the fuel	Low to high, dep. on fire phenomenon	Low

Fig. 9.1: Fire types and fire phenomena

The main property of the pyrolysis fire is that it does not go on independently but requires the continuous supply of new energy. The fire can be extinguished by stopping the energy supply. The propagation of that fire type is thus restricted to the size of the heat source, which is why we can also speak of overheat-ing accompanied by chemical decomposition. As soon as the ignition tempera-ture is reached, the fire develops to a glowing or even an open fire.

The glowing fire is an independent process. The glowing temperatures are high and the particles produced are thus relatively small. The visible particles are only a small part of the particle spectrum generated. Typical for a glowing fire are incipient fires in hay or cotton bales.

If organic fuels are involved in the fire, the combustion process produces carbon oxides, which depend on the availability of oxygen in the environment of the fire. CO is produced by smoldering fires in particular. If the smoldering fire becomes an open fire, significant air movements replenish the air around the fire with oxygen. This creates a combustion gas (especially CO_2). CO is an unstable gas that constantly attempts to bond with other substances. This is what makes it so highly toxic. CO combines with hemoglobin and reduces the oxygen-carrying capacity of the blood. Just a few breaths is enough to cause permanent damage to the human organism. CO is odorless and tasteless. CO_2 is a very stable gas that is also present in the normal atmosphere. An excess of CO_2 can help to extinguish fires by displacing oxygen, but higher concentrations, characterized by a pungent smell, can be harmful for humans. One characteristic of open fires except for alcohol fires is that they produce soot, in other words black smoke. But even so, most of the particles created are invisible. Studies show that in virtually all cases, including the early stage and the smoldering phase, more invisible than visible particles are produced.

Summarizing, we can state that large volumes of volatile fire aerosols are pro-duced with almost all hostile fires. Smoke has thus become the most important fire phenomenon for an early detection of fire. Depending on the size and concentration of the fire aerosols, they may be visible or invisible. In general, fire aerosols are 10 to 10'000 times the size of gas molecules.

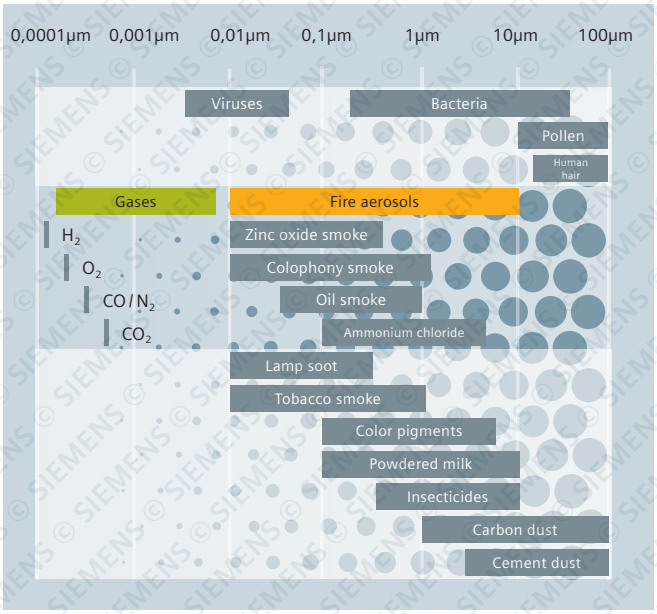


Fig. 9.4: Diameter of different molecules and suspended matters

9.2.6. Fire Detection System

The main task of an automatic fire detection system is to reliably identify a fire at the earliest stage possible, to alarm and to activate the preprogrammed control functions.

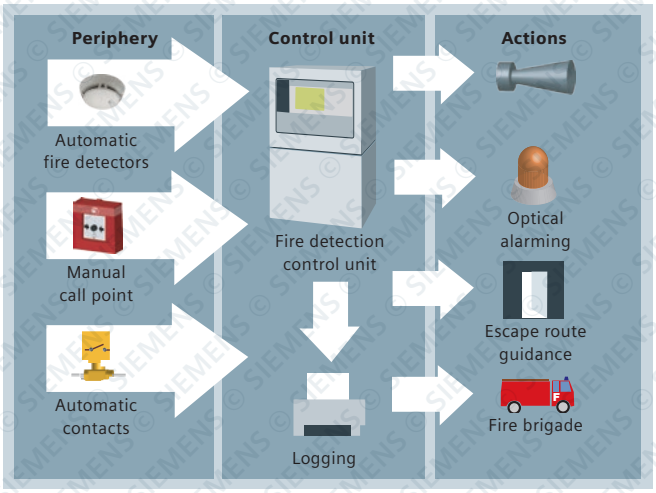


Fig. 9.5: Setup and function of a fire detection system

The periphery comprises all field elements acquiring the actual state on site, which is transmitted to the control unit in the form of hazard levels. The intelligent, automatic fire detectors detect and analyze the different fire phenomena on site and automatically report prevailing hazards to the control unit. Manual call points serve for the direct alarm activation by people present in the danger zone. Automatic contacts (e.g. from an activation of a sprinkler extinguishing system) report a fire alarm indirectly.

The fire detection system is monitored, controlled and operated by the control unit, which evaluates the hazard messages from the peripheral devices and activates alarm and fire control installations. Additionally, it serves for operating the fire detection system itself.

The measures initiated by the control unit serve for alarm and intervention. Optical and acoustic alarm devices inform the people in the building and those responsible for the building and call the fire brigade. Controls activate smoke extraction systems and stationary extinguishing systems. Optical escape route guidance and voice alarm safely evacuate people from the building.

9.3. Fire Detectors

Fire detectors are sensors with processing capability, connected to the fire control panel over a field bus. The following categories of fire detectors are basically distinguished:

- **Non-automatic fire detectors:** Manual call points are non-automatic fire detec-tors that have to be activated by a person in the case of fire.
- **Semi-automatic fire detectors:** We speak of semi-auto-matic fire detectors when a fire detector may recognize a fire but alarm is activated manually. These are usually camera systems equipped with appropriate software, which are ca-pable of detecting changes to the recorded images, for example the generation of smoke or open fires. As the reliability of these systems is presently not sufficient to activate actions such as the direct alarm of the fire brigade or extinguish-ing activation, these systems are usually semi-automatic. The system alerts people to a possible danger, while the actual alarm must still be verified.
- **Automatic fire detectors:** These most frequently used fire detectors capture fire phenomena such as smoke, heat, flames or gas and activate an alarm via the control unit in the case of fire.
- **Fire detectors for special applications:** For applications with an increased fire risk, where a normal fire detector cannot be used for different reasons, special detectors are required. In mining or heavy industry, very robust systems are re-quired that are capable of reliably detecting fires under extreme environmental conditions. For example, sparks in transport ducts used in the textile industry must be detected and appropriate measures must be initiated immediately, as otherwise devastating consequences can occur. Normal fire detectors react much too slow for such applications – systems reacting within a few milliseconds are required here.

No fire detector can work unless the triggering fire phenomena actually reaches the detector. Because fires are acted upon by heat / thermal draft, fire detectors are normally installed on the ceiling of a room (unlike certain specialist gas detectors, which are fitted close to ground level because the combustion gases they detect are significantly heavier than air). The ceiling structure must be taken into account, including joists, sloping roofs or ceilings, niches, fixtures or full-height furnishings. In rooms in which serious deceptive phenomena occur, it is vitally important to get the arrangement of fire detectors right. Even slight changes of detector position can vastly improve immunity to deceptive phenomena without impairing detection reliability.

The following chapters exclusively handle detection princi-ples, detection reliability and the available networking technologies of automatic fire detectors.

9.3.1. Detection Principles

A fire detector must be capable of detecting at minimum one fire phenomenon (smoke, heat, radiation, gas) reliably at an early stage. Increasingly, state-of-the-art fire detectors are used that can detect several phenomena at once. These fire detectors generally have a significantly better response behavior and are highly immune to deception.

Of course, a smoke detector's sensitivity does not only depend on the detection principle but also on the specific detector design, the type of smoke and other environmental factors, such as air humidity, etc. To be able to exactly determine the sensitivity of a detector, a standardized procedure is used (see also section 4.4.1.1).

9.3.1.1. Point-type Smoke Detectors

Most fires produce smoke, which can be detected by relatively simple detectors. This is also the reason why state-of-the-art fire detection systems consist to more than 80 % of smoke detectors. Based on the great significance of this fire detection principle, new and improved point detectors have been continually developed in the past. The most important principles are scattered light, extinction (light absorption) and ionization. Until about 1990, ionization was the most important principle. Today, however, most point detectors work according to the scattered light principle. People speaking of optical smoke detectors today usually refer to scattered light smoke detectors.

Scattered Light Smoke Detectors

As the name indicates, the scattered light smoke detector measures the light scattered by smoke. The construction type, especially the position of light source and receiver, has a strong influence on the detection behavior. In a scattered light smoke detector, the photoelectric cell is arranged in such a way that it cannot receive any direct light from the light source. When there is no smoke, the light hits a labyrinth and is completely absorbed. If there are any smoke particles in the area of the light beams, the light is scattered. Some light beams impinge the photoelec-tric cell, which in turn generates a signal. Decisive for the signal intensity are the smoke density and the optical properties of the smoke particles.

Fig. 4.6: Operating principle of a scattered light smoke detector

A scattered light smoke detector has two infrared light sources (1). The beams from the two IR sources are scattered by the smoke particles in the measuring chamber (2) and are picked up by the photoreceptor. The special arrangement of the two IR light sources (3) allows light and dark smoke particles to be detected by the forward scatter and backscatter of the light.

The scattering capability of large, light smoke particles is extremely high. Soot particles and black smoke scatter the light only faintly, which is why the scattered-light smoke detector rather captures visible, light smoke particles and is especially suited for the detection of such fire types whose smoke spectrum is marked by light smoke. With a forward scatter detector, light smoke particles produce a much stronger signal on the photoelectric cell than dark particles could. For this reason, forward scatter detectors are best suited for the detection of smoldering fires with light smoke particles. With the backscatter detector, the signal difference between light and dark smoke particles is less distinct. Backscatter smoke detectors are thus much more balanced in their detection behavior and are equally suited for the detection of fires producing dark smoke particles.

The patented labyrinth (4) absorbs the light emitted from the light sources, thereby preventing random reflections. Small fibers and dust particles can also settle there so they do not enter the measuring chamber. The temperature is measured using the two redundant temperature sensors (5). The CO concentration is measured using the monitored CO sensors (6).

Extinction Smoke Detectors

The word «extinction» originates from Latin, designating physical processes result-ing in attenuation or obliteration.

An extinction smoke detector measures the light attenuation caused by absorption and scattering. A light source is focused on by a photoelectric cell from a certain distance. When there is no smoke, the photoelectric cell measures a signal. When smoke penetrates the space between the light source and the photoelectric cell, the signal measured is slightly reduced. This signal reduction caused by absorption and light scattering is proportional to the smoke density.

If the distance between light source and receiver measures only a few centimeters, as it is the case with a point detector, this signal reduction in case of smoke is very low (0.05 % to 0.2 %). Although the evaluation of such a low signal change is meas-urable with state-of-the-art electronics, the required long-time stability still consti-tutes a great challenge.

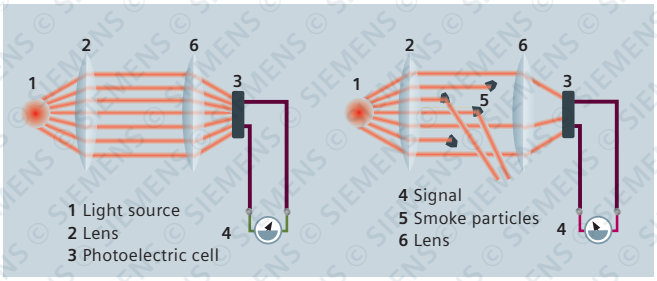


Fig. 4.7: Functional principle of the extinction smoke detector

The extinction smoke detector detects light and dark, large and small aerosols and is characterized by its uniform response behavior. This detector is suited for the early detection of all fires producing visible smoke.

9.3.1.2. Linear Smoke Detectors

Linear smoke detectors work according to the extinction principle, i.e. they meas-ure the light attenuation caused by smoke. Systems accommodating the emitter and receiver in the same housing use a remote reflector and have the advantage that they need to be connected to the detector line at one point only, and that maintenance is easier. In systems without a reflector, the emitter and receiver are separate. Both systems, however, work according to the same measuring principle.

The emitter sends out a focused light beam. When there is no smoke, this light beam reaches the receiver in its unattenuated intensity. However, if there is smoke between the emitter and the receiver, the light is partly absorbed when impinging the smoke particles and partly scattered by them, meaning that it changes direc-tion. Only a part of the emitted light can reach the receiver. The signal reduction indicates the average smoke density over the measuring section.

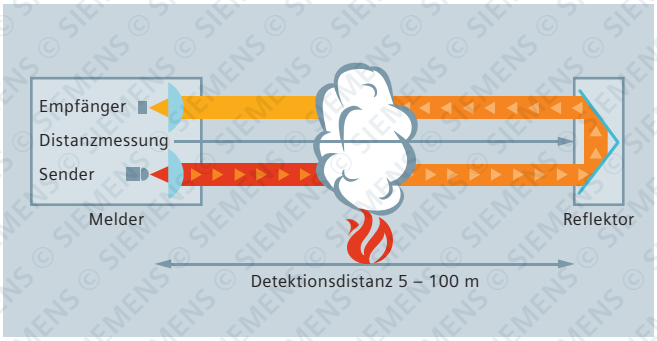


Fig. 9.8: Functional principle of the linear smoke detector

Linear smoke detectors are used for measuring sections between 5 m and 100 m. Even a low smoke concentration causes a signal attenuation of several percent. The stability problem, which must be considered with point-type extinction smoke detectors, virtually does not exist with linear smoke detectors.

As the linear smoke detector reacts on absorption and scattering, it is suited for light and dark, large and small aerosols. It is characterized by its uniform response behavior and is suited for the early detection of all fires generating visible smoke.

9.3.1.3. Aspirating Smoke Detectors

Aspirating smoke detectors are also known as air sampling smoke detection system or aspiration smoke detection (ASD). They are active detector systems which autonomously draw in the smoke from the surrounding atmosphere. In the air sampling smoke detection system, air samples from the monitored area are guided to the detection chamber via a pipe network by means of a powerful suction system.

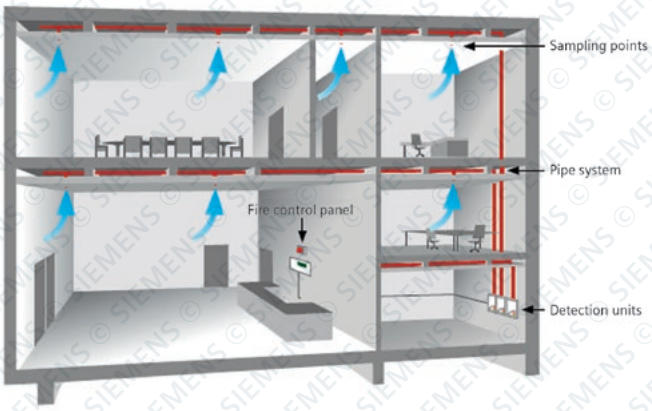


Fig. 9.9: Functional principle of an aspirating smoke detector (simplified)

The sampling points in the monitored area are staggered so that if possible, the same amount of air is taken from each opening. Each sampling point covers the same area as a point-type smoke detector.

Aspirating smoke detectors with different sensitivities are suitable for applications in challenging environments, where aesthetic considerations are important or where high detection sensitivity is required.

Class	Sensitivity	Possible applications
A	Very high sensitivity	Very early detection: mainly for heavily air conditioned areas with a significant partial vacuum. Used for incipient fire detection in computer centers, clean rooms or air conditioning ducts.
B	High sensitivity	Early detection: fire detection within or close to particularly valuable, vulnerable or critical items such as computers or electrical equipment cabinets, as well as high halls.
C	Normal sensitivity	Normal detection: general fire detection in normal rooms or areas. The sampling point of a class C system has the same sensitivity as a conventional point-type smoke detector.

Tab. 4.2: Classification of aspirating smoke detectors

Depending on the manufacturer and the necessary sensitivity, the detection chamber contains a smoke detector which uses one of the following detection principles. The number of sampling points per sensor system determines the necessary sensitivity of the smoke detector used. As the fire grows, smoke aerosols are only extracted from a small number of sampling points, with the other openings in the system being used to introduce clean air into the system, thereby thinning the smoky air.

Point-type Smoke Detector

When no high sensitivity levels are required, the ASD systems are equipped with point detectors. The smoke detectors used for ASD are usually of the same construction as normal point detectors, but they are set to the highest sensitivity level.

Optical Smoke Detector
The sensor consists of a high-energy light source emitting a focused light beam (e.g. laser) and of a receiver. Aerosols in the measuring section deflect the light, which in turn impinges on the receiver's sensor electronics. This signal is evaluated and serves for triggering an alarm.

Xenon
Permanently aspirated air is guided through a detection chamber and is illuminated by a xenon lamp over a distance of several centimeters. Smoke particles deflect the beams and produce a correspondingly strong signal due to the relative length of the detection chamber. This signal is evaluated and serves for triggering an alarm. These aspiration smoke detectors require periodic calibration, which is reflected in the expenditures for maintenance. Xenon detectors work according to the scattered light smoke detector principle.

Particle Counter
A focused light beam illuminates aspirated air. Smoke particles deflect the beam, which impinges on an optical mechanism and generates an electric pulse. The number of pulses per unit of time is proportional to the smoke density. When the number of particles exceeds a predefined value, an alarm is triggered. With this measuring principle, the air flow must be regulated, as an inconstant air flow would disturb the result.

Comparison of the Detection Principles
A comparison of the different detection principles shows that there are both ad-vantages and disadvantages to each principle. In general, the higher the sensitivi-ty, the more susceptible the detector is to deceptive phenomena. In selecting the system, the required maintenance expenditures must be taken into account.

Property / Detector type	Sensitivity	Immunity to deception	Easy servicing
Point-type smoke detectors	0	+++	++
Cloud chamber	+	0	0
Optical smoke detectors	++	++	++
Xenon	++	+	0
Particle counter	+++	+	+

+++ : Excellent
++ : Very good
+ : Good
0 : Moderate

Tab. 9.3: Comparison of ASD principles

9.3.1.4. Point-type Heat Detectors
Heat detectors are equipped with a temperature-sensitive element and are only suited for the detection of open fires.

Maximum Temperature Detector
With maximum temperature detectors, a maximum temperature is defined. The detector is based on one of the following physical principles:
- Thermistor (semiconductor element with temperature-sensitive resistor)
- Fusible element
- Bimetallic strip
- Expansion of a liquid

These detectors only react when a certain temperature is exceeded, independent of the smoke density and other characteristic values. For this reason, maximum temperature detectors are suited for simple applications with a relatively low risk only.

Rate-of-Rise Temperature Detector
With the rate-of-rise temperature detector, the temperature increase per unit of time required to trigger an alarm is defined (°C / min). If the measured temperature increase per unit of time exceeds this threshold, an alarm is triggered. Rate-of-rise temperature detectors are usually based on the functional principle of a thermistor. In practice, rate-of-rise temperature detectors are usually designed so that they also switch to alarm mode when a predefined maximum temperature is exceeded – similar to the maximum temperature detector.

As the reference value for alarm activation is the rate of rise, these detectors are clearly superior to the maximum temperature detectors. It is rarely appropriate to use the temperature as the only fire phenomenon for early detection of a fire, so heat detectors remain restricted to low-risk applications. Because of their immunity to disturbance, heat detectors can provide adequate protection in environments subject to massive deceptive phenomena.

9.3.1.5. Linear Heat Detection Systems
Linear heat detection systems consist of a line-type sensor and an evaluation unit. The sensor is either a cable with electrical or optical conductors, a cable with a number of sensors or a pipe. These evaluation units are usually connected to a superordinated system, enabling the visualization of measured values and the control of extinguishing systems, ventilation systems, etc.

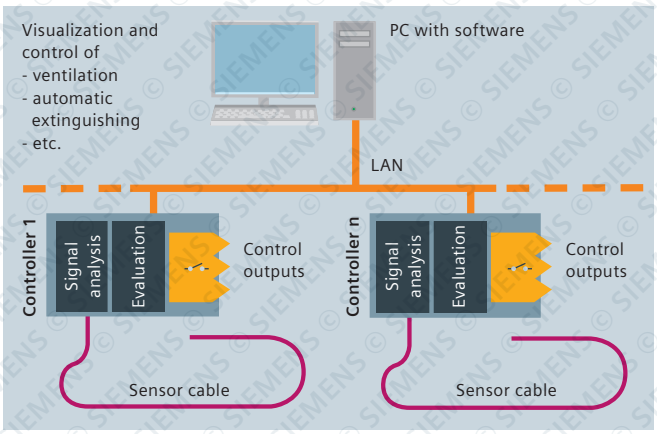


Fig. 9.10: Topology of a linear heat detection system

Linear heat detection systems are capable of triggering an alarm in case of a defined temperature increase or when a maximum temperature is exceeded. They are applied in areas in which temperatures need to be monitored over long dis-tances, but also where harsh environmental conditions prevail, for example in the case of corrosive gases, extreme temperatures, high humidity or soiling. Typical application areas for linear heat detection are:

- road and railroad tunnels
- cable trays and ducts
- conveyor system and transport ducts
- escalators
- gas and long distance energy / heating lines
- process monitoring in the chemical industry
- mines and oil platforms
- tank farms
- paint shops

9.3.1.5.1 Detection Principles

The market offers a number of linear heat detection systems based on the most different detection principles and system characteristics. The most frequently used detection principles are described below.

Sensor Cable with Heat-sensitive Polymer

The sensor cable consists of two electrically conductive wires embedded in a heat-sensitive polymer. As soon as the temperature threshold is reached, this isolation starts to melt. The wires touch and generate a short-circuit, which in turn generates an alarm. To monitor different temperatures, cables with different polymers are used.

This measuring principle produces an alarm as soon as a temperature threshold is exceeded. With some systems, the approximate location of the short-circuit, i.e. the location of the fire seat, can be determined by measuring the residual resistance.

Sensor Cable with Temperature-sensitive Isolation

The sensor consists of a cable with electrically conductive wires and insulation with a negative temperature coefficient. This means that the insulation reduces its electric resistance as the temperature rises. This signal is evaluated for alarm.

Cables with Integrated Temperature Sensors

With these systems, temperature sensors are mounted at equal intervals onto a screened flat cable serving as data and feed line. The values measured by the sensors are polled by an evaluation unit and serve for alarm activation.

Measuring Temperatures with Fiber-Optic Cables

This system is based on a laser beam being sent through a fiber-optic cable. As the fiber-optic cable reflects a small part of the laser radiation at any point, the backscatter can be measured by a receiver connected at the same end as the laser source.

The fiber-optic cable is a doted quartz glass, i.e. a form of silicon oxide (SiO_2). The infrared electromagnetic laser radiation emitted is reflected in different ways by the fiber-optic cable:

- Rayleigh scattering
- Stokes scattering
- Antistokes scattering

The Rayleigh scattering has the same wavelength as the laser beam, whereas the stokes scattering has a slightly higher and the anti-stokes scattering a slightly lower wavelength. The two stokes scattering types are also referred to as Raman scatter-ing. While Stokes scattering is temperature-independent, Antistokes scattering is affected by the thermal energy of the fiber-optic cable's local temperature. The intensity increases with the temperature. The temperature of the fiber-optic cable thus results from the intensity ratio between Stokes and Antistokes scattering.

By means of runtime measurements, it is possible to measure the associated Raman scattering for each cable spot. The local cable temperature is then deter-mined by the ratio between stokes and anti-stokes scattering.

The following illustration shows the spectral position of Raman scattering.

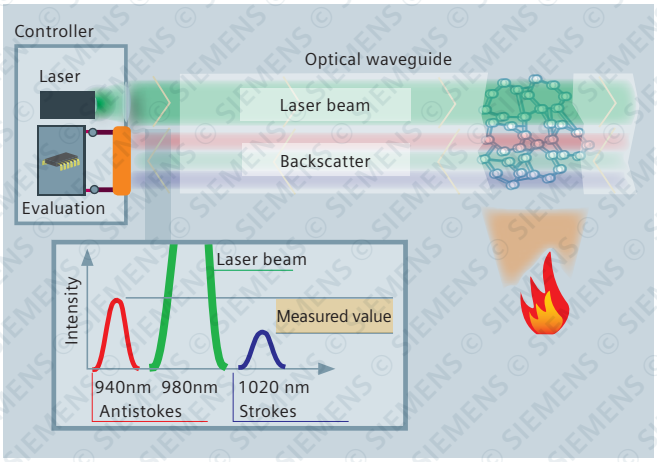


Fig. 9.11: Principle of Raman scattering

The sensor cable can be divided into sensor sections from 1 to x meters by using appropriate electronic and software components. These sections are then handled as individual sensors. This means that several sensors can be combined in groups, or multisensor logic can be created. This measuring principle allows temperature measuring and alarm triggering according to the differential and / or maximal characteristics. Based on the accuracy of the sensor sections, it is possible to localize the heat sources.

Depending on the fiber-optic cable type, systems available today make activation temperatures up to 400 °C possible. With a given sensor section length up to 4m, current systems allow sensor lengths up to 16 km.

9.3.1.5.2. Selecting the Suitable System

The table below shows the properties of the different principles of linear heat detection systems.

Properties \ System	Heat-sensitive polymer	Temperature-sensitive isolation	Sensor tube	Temperature sensors	Fiber-optic cable
Selectable temperature thresholds	No	Yes	Yes	Yes	Yes
Increase and fixed value evaluation	No	No	No	Yes	Yes
Possibility of creating zones	No	No	No	Yes	Yes
Pre-alarm possible	No	Yes	Yes	Yes	Yes
Temperature measurement	No	No	No	Yes	Yes
Ambient temperature compensation	No	No	No	Yes	Yes
Max. activation temperature	200 °C	250 °C	150 °C	150 °C	400 °C
Automatic resetting	No	Yes	Yes	Yes	Yes
Localizing the heat spot	No / partially	No	No	Yes	Yes
Maximum sensor length	2000 m	2000 m	200 m	2500 m	16000 m

Tab. 9.4: Properties of different linear heat detection systems

The most suitable system has to be chosen depending on the field of application, the risk and the price:

- If the operator wants to ensure with the simplest available means that a trans-former will be switched off from the mains in case of overheating, it suffices to use a cable triggering alarm when a predefined tempera-ture is exceeded. When such an event is expected rarely or not at all, no automatic resetting is required.
- To monitor the temperature of a reactor in the chemical industry, it is important that the system reliably produces a prealarm and an alarm message. The possi-bility of creating zones or localizing the heat spot is not normally necessary.
- To monitor a road tunnel with a linear heat detection system, it is mandatory to create zones, compensate the ambient temperature and localize the heat spot, i.e. the fire seat.

9.3.1.6. Flame Detectors

Flame detectors convert the electromagnetic radiation emit-ted by flames into an electric signal. To rule out faults and deception by sunlight, reflected light, lamps and other light sources as far as possible, the detection range of the detec-tors is shifted from the visible to the invisible range. Most flame detectors therefore operate in the ultravio-let or infrared range.

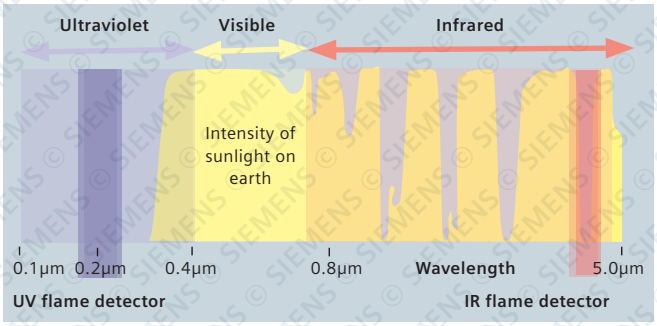


Fig. 9.12: Application of UV and IR flame detectors

UV Flame Detector

UV flame detectors react on the electromagnetic radiation emitted by an open flame in the short-wave range of UV radiation (at a wavelength of approximately 0.2µm).

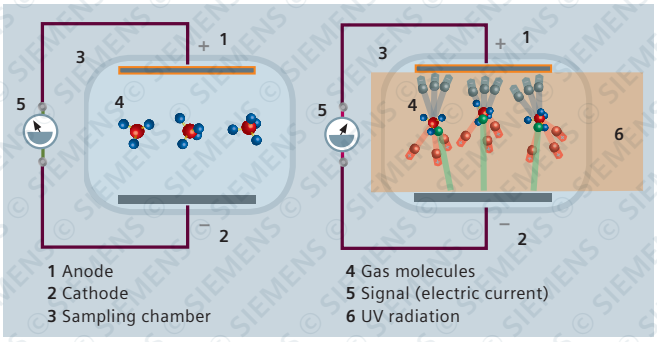


Fig. 9.13: Functional principle of the UV flame detector

High-voltage is applied between the cathode and the anode. As soon as UV rays impinge on the cathode, its surface emits electrons. These electrons hit the gas molecules in the tube, ionizing them and thus initiating a snowball-type electron flow from the anode to the cathode. The result of this process is a striking increase of the current flow that is proportional to the intensity of the UV radiation emitted by the fire.

UV flame detectors are capable of detecting all types of open fires. With appropri-ate sensitivity settings, they are also resistant to sunlight, special fluorescent lamps and spark discharge. However, strong UV sources, such as welding flames, spe-cial lamps, electric arc lamps and ionizing radiation (radioactivity or X-rays) may cause false alarms. Any soiling of the detectors must be avoided as their sensitivity will decrease. Especially an oil film on the sensor lid immediately renders a detec-tor completely inoperable.

IR Flame Detector

IR flame detectors make use of the maximum intensity of the infrared-active flame gases in a frequency range of 4.3µm, occurring during the combustion of carbona-ceous materials (emission spectrum of hot CO_2).

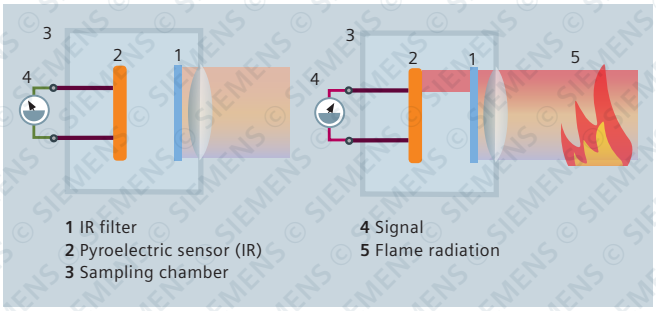


Fig. 9.14: Functional principle of the IR flame detector

The flame irradiation on the IR flame detector is filtered by the infrared filter in such a way that only radiation with a wavelength between 4 and 5µm impinges on the pyro-electric sensor. This sensor only responds on a change of the radiation intensi-ty (energy change) and generates an electric current proportional to that value.

High-quality IR flame detectors have additional sensors, and as well as the wavelength of the hot carbon dioxide, they simultaneously use other sensors to measure stray radiation in other wavelengths. The spectra of IR radiation from organic fires and deceptive phenomena (e.g. sunlight, halogen light, hot objects) are different. This is a way of distinguishing be-tween deceptive phenomena and actual fires.

Infrared flame detectors are suited for the detection of smokeless liquid and gas fires as well as smoke-generating, open fires of carbonaceous materials. All organic, com-bustible materials such as wood, plastics, gases and oil products contain carbon. Fires of purely inorganic materials such as hydrogen, phosphorus, sodium, magnesium or sulfur cannot be detected by infrared detectors. As soon as such materials are burned together with organic materials, like for example packaging material, detection can be ensured.

9.3.1.7. Multisensor Fire Detectors

Multisensor fire detectors are equipped with two or more sensors whose signals are interlinked in an appropriate way. Such detectors are often – and rather impre-cisely – referred to as «multi-criteria detectors». They often detect different fire phenomena and can thus detect fires earlier and more reliably. The market offers multisensor fire detectors in virtually all conceivable combinations of smoke, heat and gas sensors:

- smoke sensors (scattered light, extinction, laser, ionization)
- heat sensors (maximum, differential)
- gas sensors (CO, CO2)

Optical / thermal multisensor fire detectors

Today, the most frequently used multisensor detectors identify smoke by means of an optical sensor and heat with a heat sensor. Flame detectors also include multi-ple sensor products. By intelligently interlinking the different sensor signals, the response behavior and immunity to deception can be largely improved, resulting in a much higher detection capability that it would be the case with separate sensors. The crux of developing a multisensor fire detector is the selection of the best suited sensor principles and combination of the sensors with optimum characteristics, so that both the detection properties and the immunity to deception can be optimized.

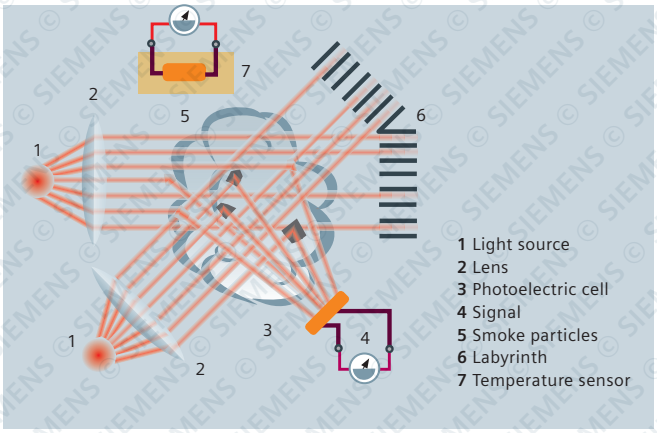


Fig. 9.15: Example of a multisensor fire detector

The multisensor fire detector shown here is equipped with two scattered light sensors (forward scatter and backscatter) and a heat sensor.

Optical / thermal multisensor fire detector with additional CO sensor to detect carbon monoxide

With smoldering and glowing fires, combustion is mostly incomplete due to the low temperatures. For this reason, the aerosol particles agglutinate to larger and thus more easily visible particles (strong smoke generation), and a large amount of toxic CO gas is produced. Colorless and odorless, carbon monoxide is very dangerous for the human organism. Even small amounts can cause nausea, vomiting, and ultimately unconsciousness leading to death.

Various sensor types are available on the market to detect carbon monoxide. In multisensor fire detectors, however, the most widely used is the electrochemical cell.

The detection principle of the elctrochemical cell
The electrochemical cell can simply be described as an incomplete battery, whose electrolyte is completed by the gas entering through a semi-permeable membrane. Electric current can only flow in the electrolyte between the two electrodes if a gas is present. The flow of current is proportional to the gas concentration.

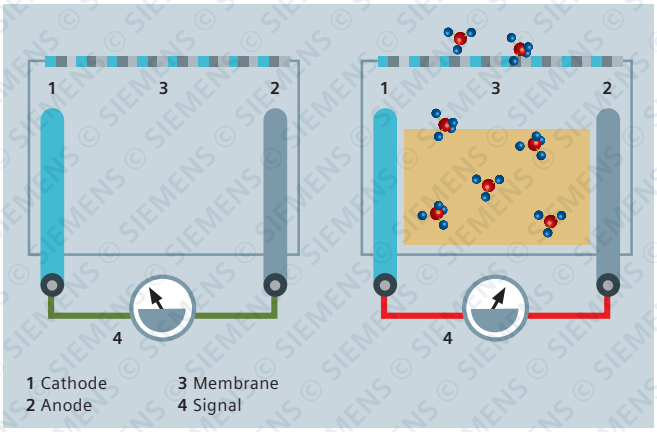


Fig. 9.16: Operating principle of an electrochemical cell

The electrochemical cell is very sensitive. This, however, may have a negative effect if the cell is too frequently exposed to high gas concentrations, possibly even reducing the cell's service life.

The service life of the sensor is basically determined by its ambient temperature and humidity. The multisensor fire detector with additional CO sensor is able to detect even the tiniest amounts of carbon dioxide. Because the CO gas has a slightly lower density than air, it spreads evenly around the room if the temperature is constant.

However, if CO occurs in a smoldering fire, it is warmer than the surrounding air so it rises to the ceiling with the smoke. The planning rules for the multisensor fire detector with CO sensor are the same as for a fire detector.

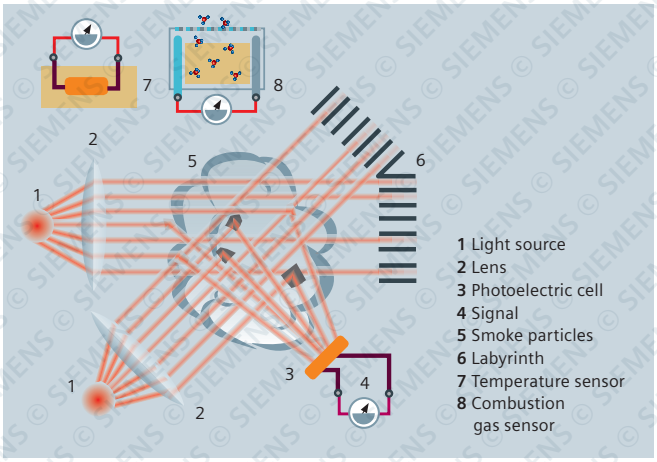


Fig. 9.17: Example of an optical / thermal multisensor fire detector with additional CO sensor

The multisensor fire detector shown here is equipped with two scattered light sensors (forward scatter and backscatter), a heat sensor and a combustion gas sensor to detect carbon monoxide. Modern systems are able to monitor the gas concentration alongside fire detection. If specified CO limits are exceeded, control functions of the fire detection system can be used to take action automatically (e.g. switching on the ventilation in the workshops).

The detection behavior of such a detector is characterized by the following properties:

- Excellent detection of smoldering fires with light smoke particles by the forward scatter sensor.
- Good detection of fires with black smoke particles by the backscatter sensor.
- Reliable detection of fires without visible smoke by the heat sensor.
- Sensitive detection of incipient smoldering fires with significant production of carbon monoxide
- High reliability and immunity to deceptive phenomena such as vapor, exhaust gases or heat sources due to the combination of the individual sensor signals.

The main advantage of multisensor fire detectors is that not only the strengths and weaknesses of the different sensors can be balanced due to the combination of the different measured quantities, but an interpretation of events becomes possible. The result is an essential improvement of the response speed (early detection of fires) and a considerably higher immunity to deceptive phenomena (no false alarms).

9.3.1.8. Video Systems in Fire Detection

In addition to classic point-type or linear fire detectors, a system technology that is normally seen in security applications is also used in fire detection.

Video smoke and flame detection
Video smoke and flame detection is based on a real-time analysis of video images captured by standard cameras (e.g. CCTV cameras). The camera is used as the sensor. The video image from an analog or digital camera is processed with detection algorithms. These algorithms determine whether smoke or flames can be identified from temporary pixel changes in the images.

A video smoke and flame detection system consists of an image capture component, a processing component and a detection component. The processing component can be housed in a separate processing unit which analyzes the images captured by the camera, or in the camera housing itself. The detection algorithms identify features in the video image matching one or more characteristics of flames and / or smoke.

Various techniques are used to identify the characteristics of flames and smoke. Features like light intensity, brightness, contrast, movement, dynamic frequencies, texture, pattern and color matching are analyzed. One advantage of this technology is that a large area can be protected with just a single sensor. This permits very early detection because smoke and flames can be detected across the whole field of view of the camera.

Detection is possible through a window, meaning that this non-intrusive method can also be used in restricted areas. In addition to locating the fire, the technology can also be used to verify an alarm because live images of the area can be relayed to a monitoring station. Typical applications include large-scale structures like stadiums, atriums, exhibition halls, production facilities, warehouses, aircraft hangars or tunnels.

9.3.2. Detection reliability

The most important quality characteristic of a detector is to quickly and reliably detect a fire while **simultaneously** remaining largely immune to deceptive phenomena. Two parallel criteria must therefore be met – detection reliability and immunity from false alarms. So it is not the answer simply to make the detectors as sensitive as possible. Although this would guarantee that the fire is detected very early, the likelihood of false alarms greatly increases.

Type of false alarm	Reason for triggering alarm
Deception alarm caused by fire-simulation event	Phenomena occurring are the same as, or similar to those of fire (deception)
Fault	Detectors are soiled, influence of electromagnetic fields, defective components
Erroneous operation	Improper manipulation of the system, or improper maintenance work
Willfully triggered false alarm	Willful triggering of a fire detector
Not identifiable	Reasons unknown

Tab. 9.5: False alarms

Most false alarms are triggered by deceptive phenomena such as cigarette smoke, water vapor from showers or aerosols produced during welding. Fire detectors without automatic drift compensation frequently cause false alarms when the detector is excessively soiled. Basically, false alarms can never be completely ruled out. However, they can be significantly reduced by taking appropriate measures:

- False alarms caused by fire-simulating events can be reduced by the correct selection and arrangement of the fire detectors (detectors with intelligent signal processing in locations with fewer deceptive phenomena).
- False alarms caused by faults can be reduced by paying attention to the quality of the products applied in selecting the system.
- False alarms caused by erroneous operation can be reduced by user-friendly control units and appropriate user training.
- Reducing willfully caused false alarms can usually be combated with additional expenditures (e.g. access control, video monitoring).

9.3.2.1. Detector Sensitivity

State-of-the-art technology makes possible the production of highly sensitive fire detectors. These detectors are capable of detecting incipient fires at an early stage. However, they are also more sensitive to deceptive phenomena. The probability of deception can thus be reduced by using fire detectors with a lower sensitivity level – which in turn reduces the possibility of detecting fires at an early stage. The figure below shows the general correlation between detection reliability and the probability of deception.

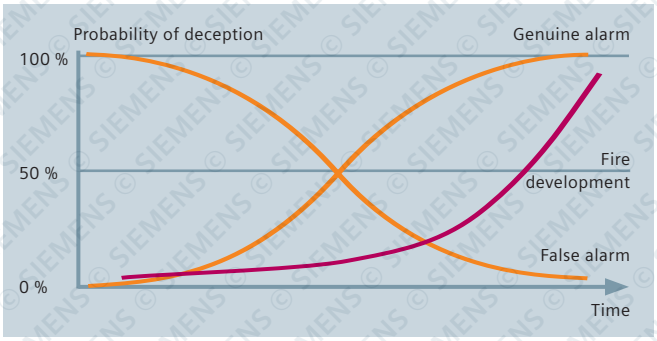


Fig. 9.18: Detection reliability and probability of deception

At the beginning of a fire, the intensity of the fire phenomena is still very low. Possible deceptive phenomena at this stage may produce a signal many times higher than the signal actually wanted. To reduce the risk of false alarms, it would thus seem logical to simply give enough time to fire detection – which, however, contradicts the desire of early fire detection and the associated damage mitigation.

Intelligent fire detectors with the latest algorithm technology, able to adapt dynamically to the environmental conditions, provide the best combination of detection reliabilit and immunity from false alarms.

9.3.2.2. Detector Design

Detectors are subject to all the rigors of normal environmental conditions. If smoke can enter the measuring chamber, so can dust, insects, other dirt particles and steam. Sooner or later, a soiled detector will malfunction. Sensitivity could either be increased or decreased. It is possible that a soiled detector might respond too late to a fire. The phenomenon is explained below using the example of a chamber in an optical smoke detector:

- The inlet openings must be designed in a way that the penetration of fibers, dust and insects is aggravated, at the same time ensuring the unhindered penetration of smoke.
- The distance between the detection volume and the labyrinth must be long enough, so that fibers and other particles that have nevertheless penetrated the detector cannot reach the detection area.
- The encapsulation of the optics must be designed in a way that particles can neither settle on the emitter nor on the receiver.

In addition to soiling, especially the penetration of external light can cause faults or malfunction. This can be avoided by the design and nature of the labyrinth. To reduce malfunction due to the impact of electromagnetic fields, corresponding measures must be taken regarding the detector electronics. A sophisticated layout of mechanics, sensor unit and detector electronics is the prerequisite for reliable signal processing.

9.3.2.3. Signal Processing

By far the most effective way to improve detection reliability is the use of highly intelligent fire detection systems capable of distinguishing between deceptive phenomena and genuine fires. Apart from the high quality of sensor electronics, especially the fire detection system's intelligence plays a key role, particularly the processing and interpretation of the sensor signals.

Threshold Value Technology

With this technique, the sensor signal is amplified and if an alarm threshold is exceeded, the alarm is transmitted to the control unit either directly or after a preprogrammed delay. Detectors are equipped with simple electronics and know the two states: Alarm and quiescent condition.

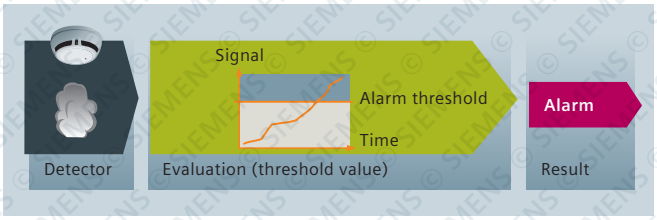


Fig. 9.19: Signal processing based on threshold value technology

ASIC Technology

Detectors employing ASIC technology are equipped with comprehensive electron-ics featuring an ASIC (Application Specific Integrated Circuit). These highly inte-grated modules enable fast and intelligent signal processing, making the detec-tor capable of detecting faults or soiling in addition to several hazard levels. In case of minor soiling, the sensitivity is corrected automatically (drift compensation).

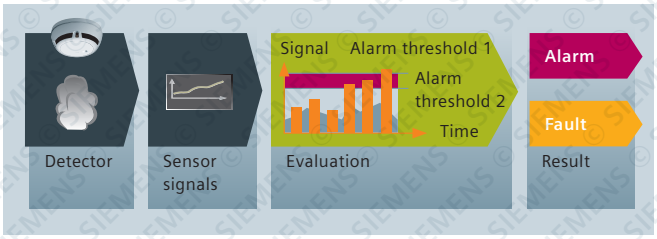


Fig. 9.20: Signal evaluation based on ASIC technology

Algorithm Technology

Fire detectors based on algorithm technology perform complex signal analyses at short intervals and process large data volumes. They are therefore equipped with a microprocessor. The sensor signals are broken down into mathematical components and are offset against the defined and pro-grammed algorithms (mathematical rules). The character of these algorithms is defined by their parameter setting. The comparison of the calculated values with the default values stored in the detector results in the corresponding hazard level.

Fire detectors with algorithm technology do not automatically guarantee an excel-lent detection behavior, which is affected by the way the sensor signals are broken down, the mathe-matical rules applied, the parameter sets available and the comparison with the default values stored in the detector. This is where knowledge comes into play. Detectors using a sophis-ticated algorithm technology have the following properties:

- Sensor signals: Dynamic detection behavior is only possible when the signal progression is observed and compared throughout the complete period of time the respective phenomenon is effective. Signal progression is the collectivity of the following determinants:
  - signal strength: sensor signal (amplitude)
  - rate of rise: change of sensor signal
  - fluctuation: sudden changes of the sensor signal
- Mathematical rules: The mathematical rules must be set up in such a way that, in combination with the available parameter sets, they allow for all types of fire developments.
- Parameter sets: A parameter set is a set of data having an impact on the mathematical rules and on the comparisons with the default values. By loading the respective param-eter set, the fixed mathematical rules are specifically set to the fire phenomena and ambient conditions to be expected, and the results are compared to the corresponding defaults. If a fire detector is installed in a production hall, a parameter set must be loaded that assesses sudden changes normally caused by deceptive phenomena as relatively insignificant. If the same fire detector is installed in a hospital room, however, a parameter set must be selected that responds to rapid changes to the sensor signals, guaran-teeing earliest possible fire alarm. As state-of-the-art fire detectors can be operated with a wide array of parameter sets, they are suited for all types of special applications.

- Comparison with the stored default values: The stored default values are based on a large number of real fires, thus reflecting the characteristics of many different types of fire. The comparison between the calculated values and the stored default values results in the danger level (e.g. 1 = possible hazard, 2 = hazard, 3 = alarm). Additional evaluations enable statements about the detector status (e.g. soiling or fault, diagnostic level).

Empirical values from a very large number of real fires, but also from constantly variable normal conditions, are essential when evaluating signals from the smoke sensors. The conditions around the smoke detector change all the time, and not in the same way in a meeting room as in a joinery workshop. Knowledge of these everyday environmental influences with no fire present is a crucial part of signal evaluation by intelligent smoke detectors. This knowledge was obtained from the operation of real-life detector systems and also from a number of special test series for many sensors (air pressure, humidity, temperature, air speed, brightness, transmission, etc.) in a large number of different buildings.

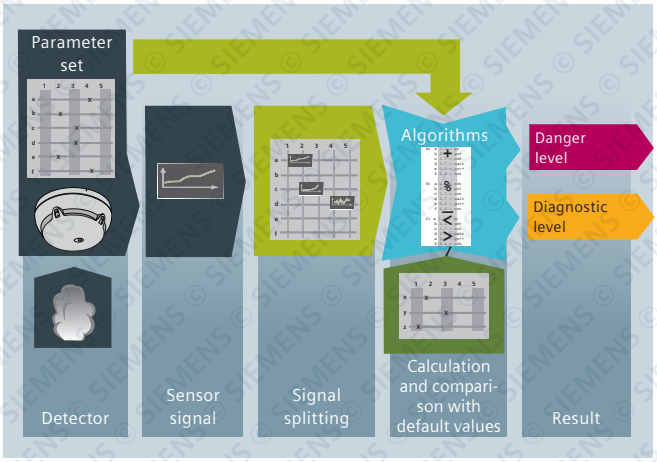


Fig. 9.21: Signal processing in a smoke detector based on algorithm technology

9.4. Selecting the Appropriate Fire Detector

Fires can develop explosively, fast (within a few seconds), normally (within a few minutes) or slowly (within hours). This chapter only deals with classic fire detectors used to detect fires developing from fast to slow.

9.4.1. Sensitivity of Optical Smoke Detectors

In practice, the sensitivity of optical smoke detectors is often given as a certain smoke density in %/m. This value corresponds to the detector's response value, measured in a defined smoke channel with predefined test aerosol, defined air speed and temperature (EN54-7). This smoke density is more precisely referred to as the «light obscuration module».

9.4.2. Fire Detectors and EN 54 Test Fires

The EN 54 test fires serve as proof that the detectors have sufficient sensitivity to certain fire phenomena. They are set up in such a way that each fire produces a different, typical aerosol spectrum. Such fires are mandatory to achieve approval of fire detectors. They are also quite often used for testing the response behavior of existing fire detection systems.

EN Test fire	TF1	TF2	TF3	TF4	TF5	TF6
Fire type	Open cellulose fire (wood)	Pyrolytic smoldering fire (wood)	Glowing / smoldering fire (cotton)	Open synthetic fire (polyurethane)	Liquid fire (n-heptane)	Liquid fire (ethyl alcohol)
Heat development	Strong	Negligible	Negligible	Strong	Strong	Strong
Upward air flow	Strong	Weak	Very weak	Strong	Strong	Strong
Smoke generation	Yes	Yes	Yes	Yes	Yes	No
Aerosol spectrum	Predominantly invisible	Predominantly visible	Predominantly invisible	Partly invisible	Predominantly invisible	None
Visible property	Dark	Light, strongly scattering	Light, strongly scattering	Very dark	Very dark	None

Tab. 9.6: Test fires according to EN 54 and their properties

EN 54 test fires are artificially induced, «ideal» fires that will rarely occur in practice, as real fires usually produce a mix of smoke types. The advantage of the EN test fires is that they produce reproducible fire phenomena and thus enable exact comparisons between the response behavior of different detectors or sensors.

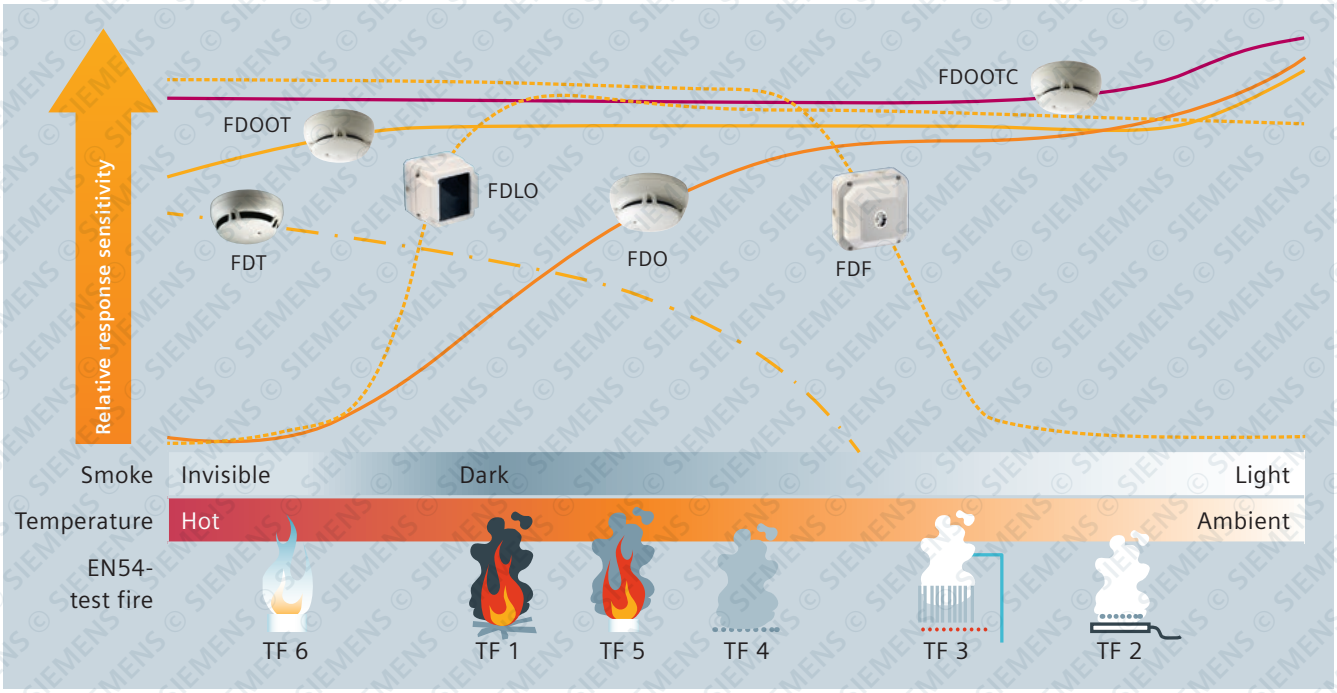


Fig. 9.22: Response behavior of different fire detectors on EN 54 test fires

The figure above shows the qualitative, basic capability of the detectors to respond to EN test fires. A heat detector cannot respond when a fire does not produce heat (TF 2 and TF 3). The sensor design has an additional impact on the quantitative response behavior of the sensors. The response of optical smoke detectors to TF 1, for example, depends on the scattering angle.

The selection of the optimum fire detector is based on the expected fire phenomena, generated by the incipient fire. For an office building, smoke detectors will preferably be selected, as in this case fires will produce clearly visible smoke both in the incipient phase and later. In a storage area where combustible liquids are stored, flame detectors and / or heat detectors would be the right choice.To be able to reliably detect all expected incipient fires, it may be necessary to combine different fire detector types. Apart from the mechanical design and the sensor electronics applied, it is the signal processing that determines the quality of fire detection. Early and absolutely foolproof fire detection is the goal. When fire detectors are placed in a clean environment, this is possible without any problems today. If, however, a detector shall be able to detect a fire as early and safely as possible, even in environments where different deceptive phenomena occur, we are still faced with a challenge. Very fast fire detection combined with 100 % detection reliability cannot be guaranteed. Fire detectors with intelligent signal processing and an appropriate detector design, however, already come very close to this goal.

Use Case – Fire detection

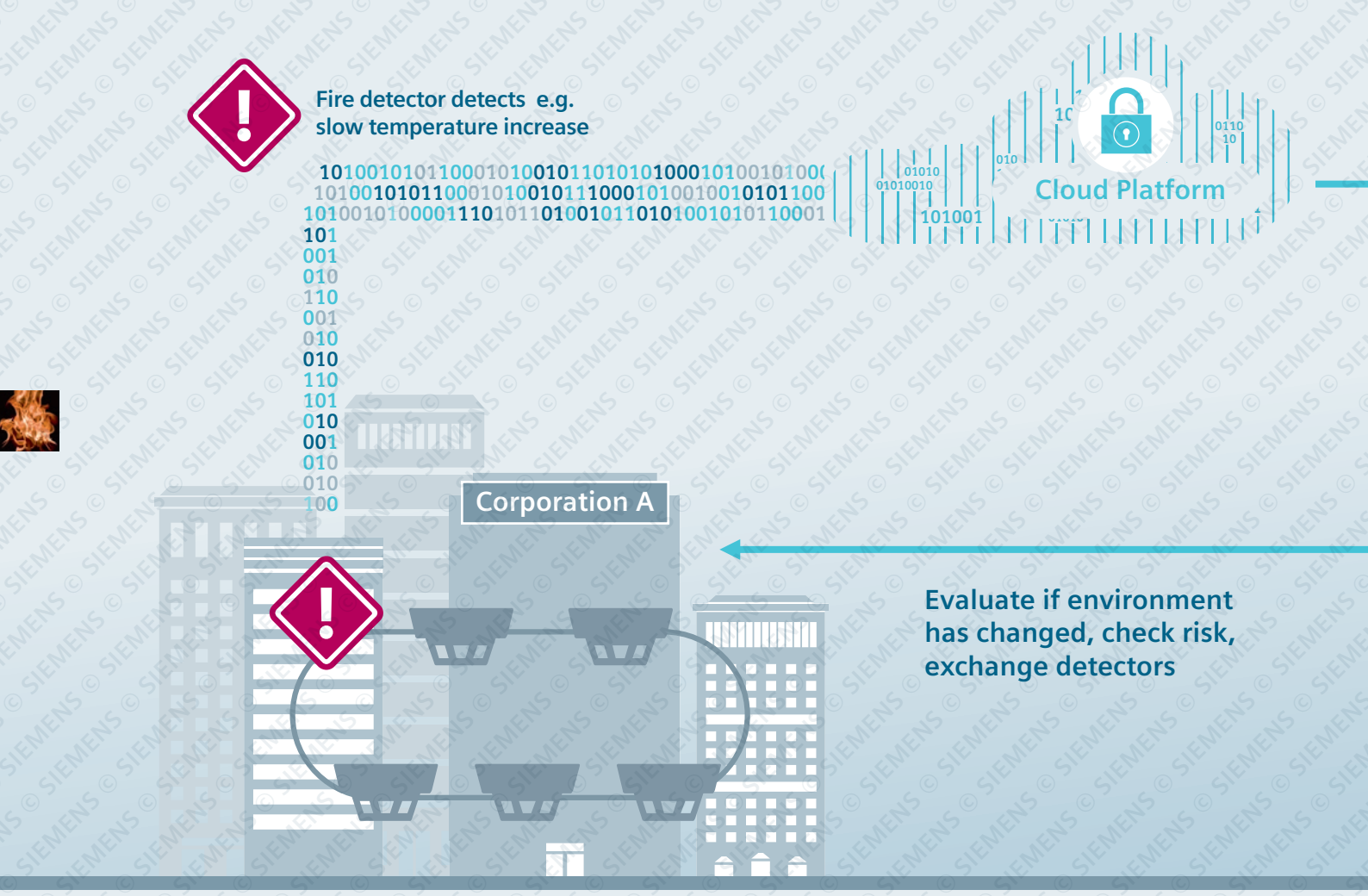
Our fire detectors can measure the temperature data in a room to detect if it is increasing more than the temperature in other rooms. While it doesn't mean that a fire has started, it is an indication that something could be wrong. It could be that mechanical or electrical components in a meeting room are not working correctly and are getting overheated. If this isn't resolved, it could in the end lead to a real fire.

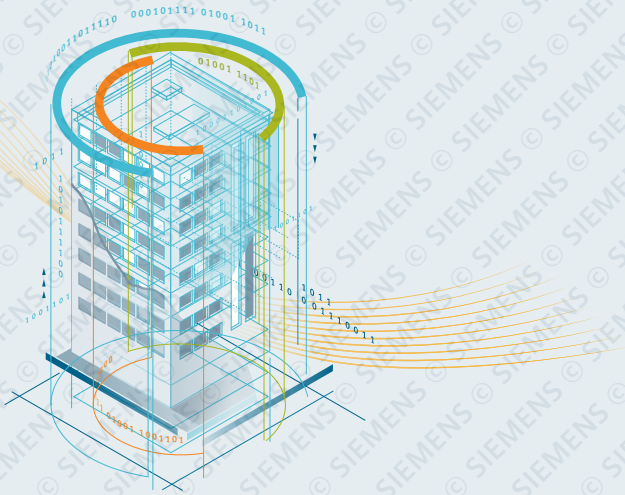
Thanks to remote monitoring performed in the Digital Service Center (DSC), the event will come up on the DSC's dashboard. The DSC will make direct contact with the customer to inform him about the data, potentially avoiding a fire breaking out. The customer will know or can check to see if there is a good reason for the temperature increase in the room. If there is a good reason, there will be no further action. Otherwise, intervention can be handled by the customer, his facility manager or similar personnel.

The DSC will also inform the field Service Engineer so he will know about this event for his next service visit. If it is a severe event, the field Service Engineer will talk with the customer immediately about evaluating it to determine any possible actions which should be taken in the short term.

Such actions could include replacing existing equipment or calling a service technician to repair the relevant device.

In this way the customer will eliminate the potential risk of a damaging fire.





Data power delivers better building performance

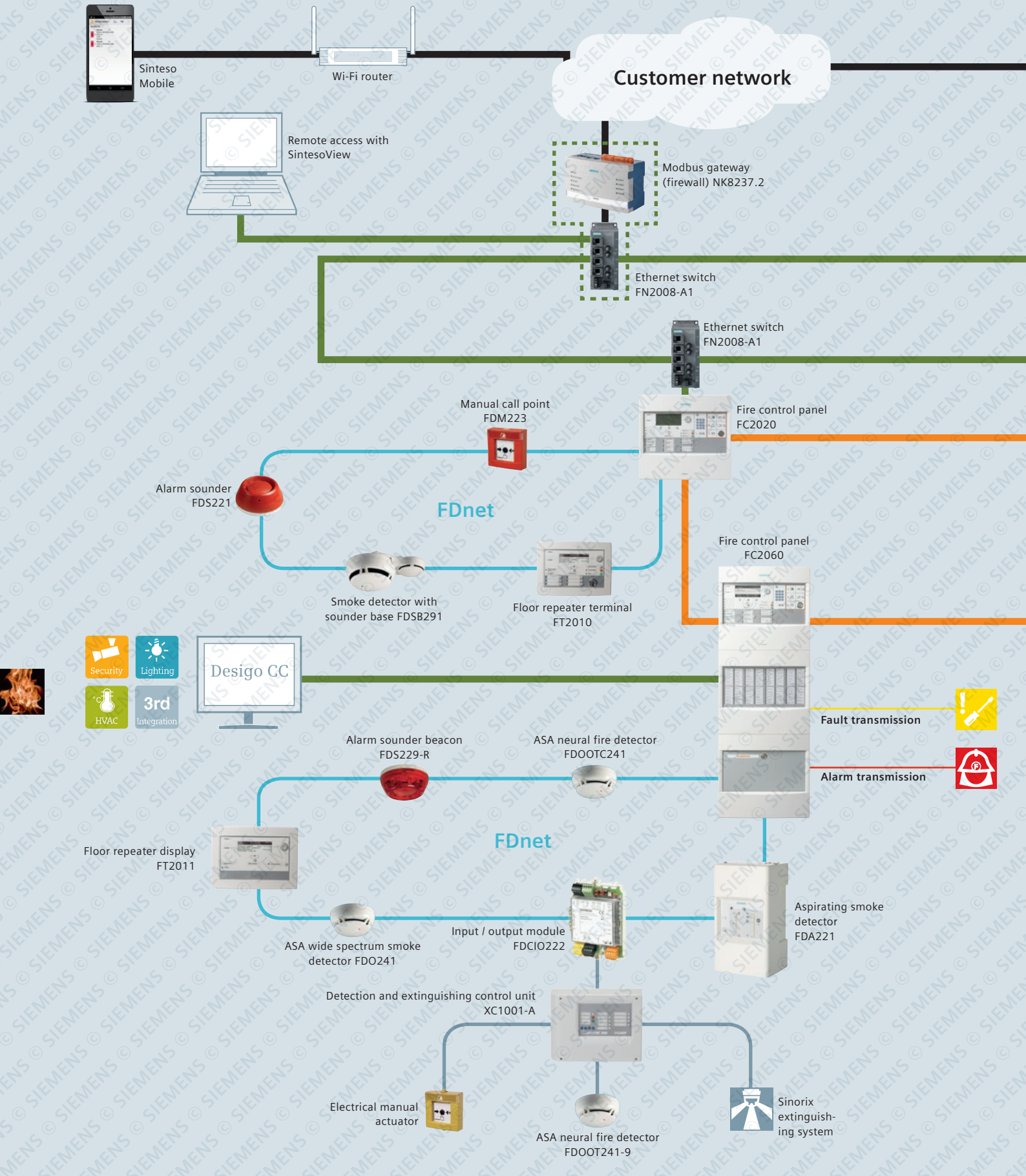
Digital Service Center

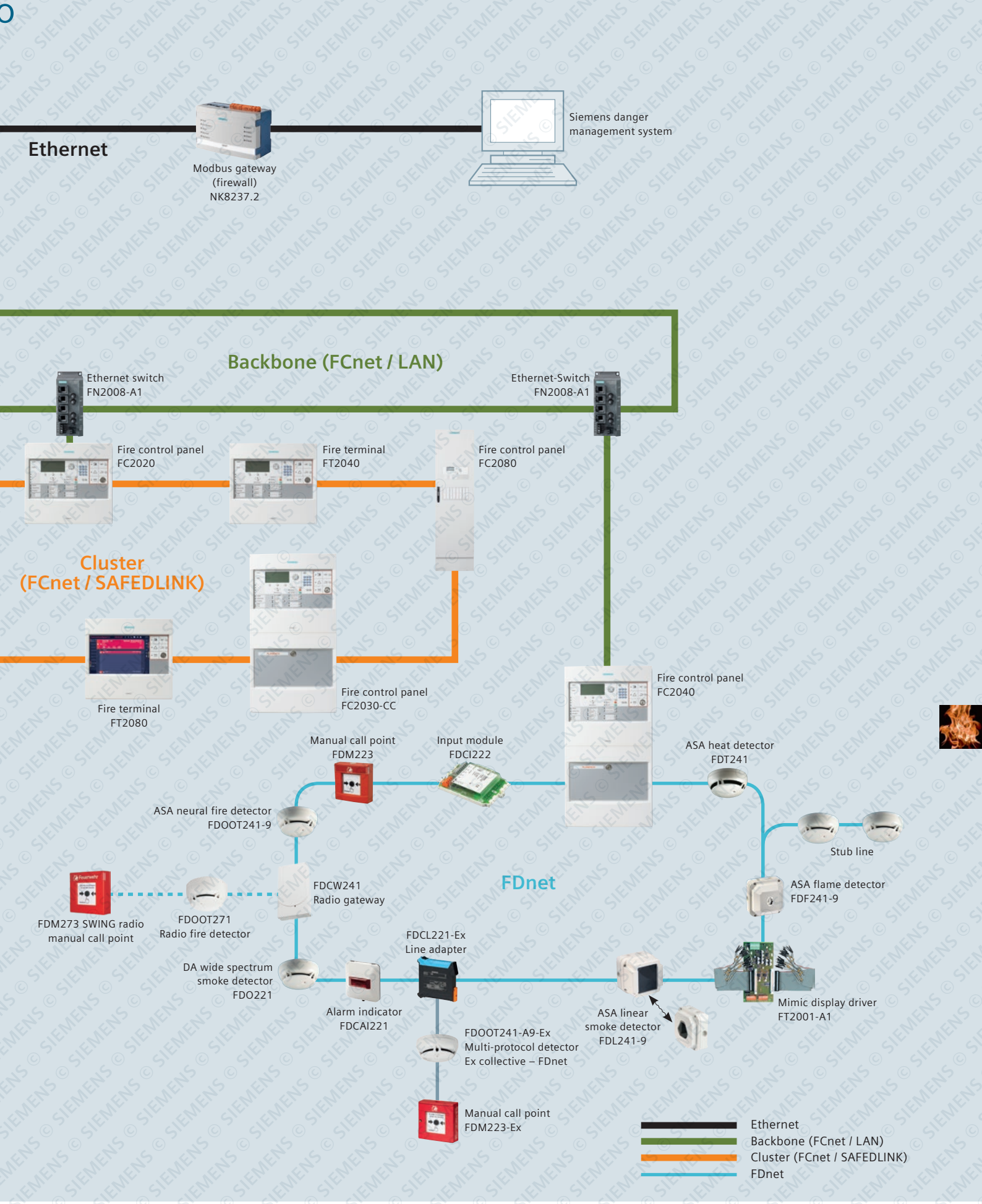
- Events are recorded in dashboard
- Information is sent to local service organization and / or customer

Local Service Organization

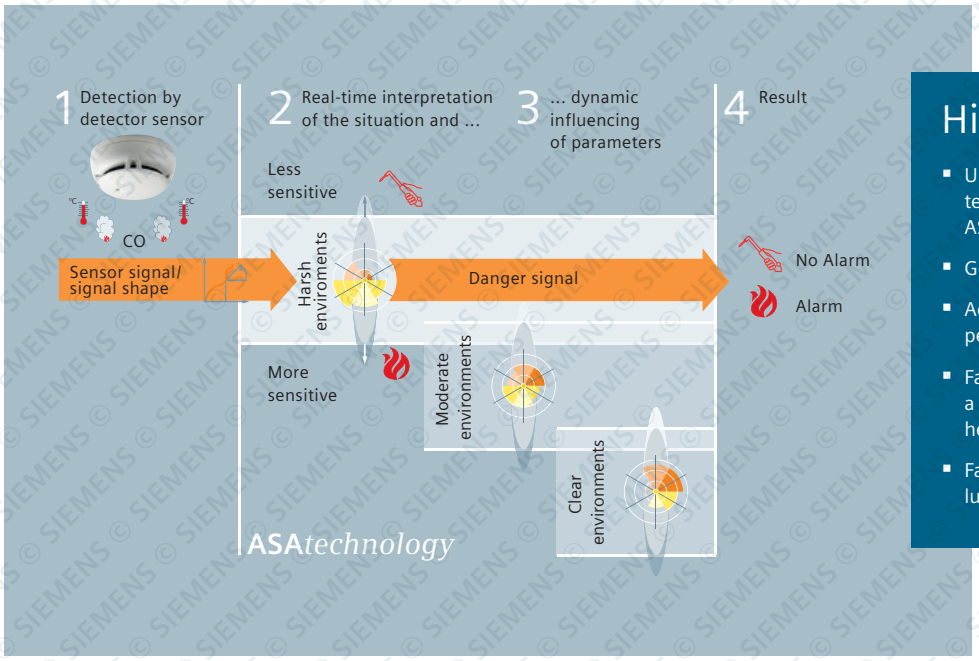
- Customer is informed about potential security risk and / or system analysis

Your system for fire detection, alarms and control: Sintes




Ethernet
Modbus gateway
(firewall)
NK8237.2
Siemens danger
management system
Backbone (FCnet / LAN)
Ethernet switch
FN2008-A1
Ethernet-Switch
FN2008-A1
Fire control panel
FC2020
Fire terminal
FT2040
Fire control panel
FC2080
Cluster
(FCnet / SAFEDLINK)
Fire terminal
FT2080
Fire control panel
FC2030-CC
Fire control panel
FC2040
Manual call point
FDM223
Input module
FDCI222
ASA heat detector
FDT241
ASA neural fire detector
FDOOT241-9
Stub line
FDnet
FDCW241
Radio gateway
ASA flame detector
FDF241-9
FDM273 SWING radio
manual call point
FDOOT271
Radio fire detector
FDCL221-Ex
Line adapter
DA wide spectrum
smoke detector
FDO221
Alarm indicator
FDCAI221
ASA linear
smoke detector
FDL241-9
Mimic display driver
FT2001-A1
FDOOT241-A9-Ex
Multi-protocol detector
Ex collective – FDnet
Manual call point
FDM223-Ex
Ethernet
Backbone (FCnet / LAN)
Cluster (FCnet / SAFEDLINK)
FDnet

ASA*technology* – an innovation that sets new standards



Highlights

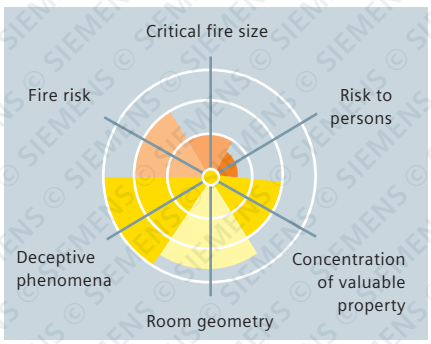
- Unique detection reliability and protection against false alarms thanks to ASAtechnology
- Genuine Alarm Guarantee possible
- Adaptation to process- and time-dependent ambient influences
- Fast and reliable detection thanks to a multisensor fire detector for smoke, heat, and carbon monoxide
- Fast and efficient modernization solutions possible

Sophisticated applications require exceptional technology – and that includes the field of fire detection. The special signal analysis process employed by S-LINE fire detectors is very reliable in preventing false alarms caused by deceptive on-site phenomena, such as machine exhaust gases, industrial dust or steam.

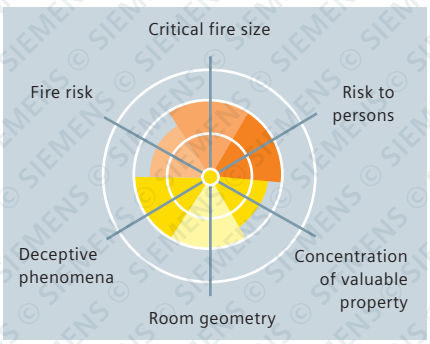
Extremely reliable fire detection, thanks to ASA*technology* and real-time interpretation

Sinteso S-LINE fire detectors feature **ASA***technology* (ASA = Advanced Signal Analysis). The signals (1) recorded by the sensor are converted into mathematical components using algorithms and compared with preprogrammed values. With the selection of an ASA parameter set, the algorithms can be influenced – and the fire detector can be set to the expected local environmental influences and individual risks. The optimal parameter set is selected taking the individual risks and the existing environment into account.

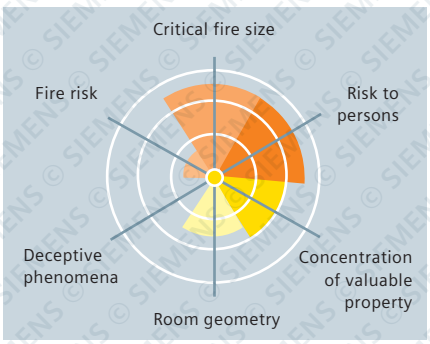
Interpretation of the situation (2) in real time results in the selected ASA parameter set being dynamically adapted (3). This automatically shifts the optimum application range of the detector. Consequently the detector reacts more sensitively in the event of a fire – and more forcefully in response to deceptive phenomena. The result is unique fire detection with unprecedented reliability against deception (4).



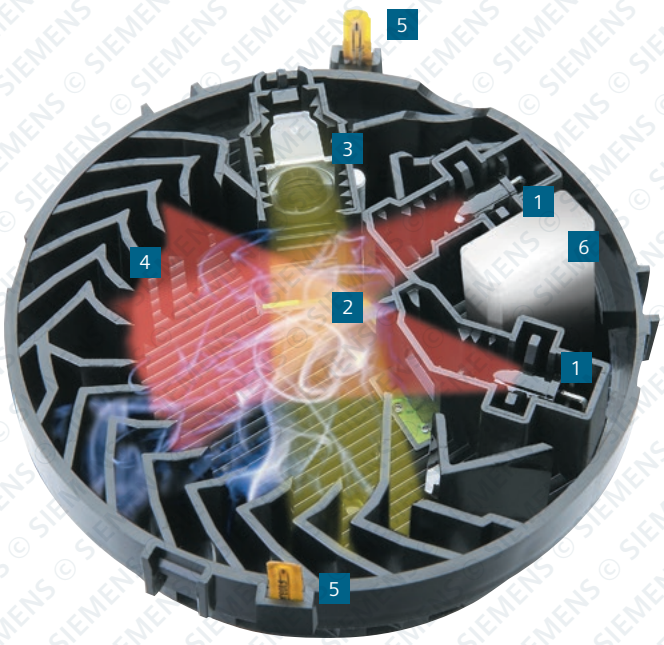
Harsh environments – for example in industry, with frequent deceptive environmental phenomena such as dust, steam or welding fumes ...



Moderate environments – such as office buildings and shopping centers, with average risk to people and occasional deceptive environmental phenomena ...



Clean environments – such as server rooms or patient rooms, where the top priority is protection of people and data ...



1 Two IR light sources

2 The rays of the two IR light sources are scattered by the smoke particles in the sampling chamber and hit the light receiver.

3 The special position of the two IR light sources helps to distinguish between light and dark smoke particles due to the forward and backward scattering of the light.

4 The patented labyrinth absorbs the light emitted by the light sources, thus preventing accidental reflections. It can also capture small fibers and dust particles so that they do not enter the sampling chamber.

5 Two redundant temperature sensors measure the temperature.

6 The monitored CO sensor measures the CO concentration.

Unsurpassed reliability – thanks to ASAtechnology

Preventing downtimes and costs caused by false alarms are a central consideration for any company. ASAtechnology offers unsurpassed detection reliability with high immunity to deception. Therefore, a Genuine Alarm Guarantee can be offered.

Safe, intelligent detection – the new ASA neural fire detector

The ASA neural fire detector has been developed to ensure a fast reaction to CO generating fires, such as mattress fires in nursing homes. It combines the unique ASAtechnology with CO detection for maximal safety: with two optical sensors, two heat sensors, and one additional electrochemical carbon monoxide sensor. Thanks to the intelligent analysis of the three most important fire criteria – smoke, heat, and carbon monoxide – it responds very quickly to all fires that generate carbon monoxide. Moreover, the FDOOTC provides very quick and reliable detection in harsh environments with deceptive phenomena.

Event-controlled detection – through parameter switching

Different ASA parameter sets can be used in the S-LINE fire detectors, and can be switched over as a function of time or to accommodate processes. This guarantees permanent, reliable and early fire detection even under frequently changing environmental conditions, such as «manned and unmanned times» in production plants or assembly rooms.

Modernization – fast, efficient and economic

The ASA neural fire detector FDOOT241-9 allows step-by-step modernization. It can communicate with a control panel via FDnet as well as via a limit value detection system. This provides a bridge to existing older fire detection installations – and older fire control panels can make full use of the **ASA***technology* of the FDOOT241-9 today. In a second step, installation of the new Sinteso control panel is all that is needed to bring the system up to the latest state of the art.

Thanks to ASAtechnology, the CO signal has direct, active influence on the analysis of the other sensors. The integrated CO sensor is constantly monitored.

Neural Fire Detectors

FDT241

FDT241
Neural thermal fire detector Sinteso FDnet

FDO241
Neural optical fire detector Sinteso FDnet

FDOOT241-A
Neural multisensor fire detector Sinteso FDnett

FDOOT241-A9
Multi-protocol collective – Sinteso FDnet

FDOOT241-A5
Multi-protocol AlgoRex interactive – Sinteso FDnet

FDOOTC241
Neural multisensor fire detector

Applications
Neural fire detectors with ASAtechnology, suitable for many different uses and for all applications in harsh environments with serious deceptive phenomena.

Characteristics
- Configurable detection behavior with application-specific ASA parameter sets
- Time and process dependent detection behavior, i.e. time or process controlled parameter set switching (presence / absence) is possible. This function permits use in places where major changes occur frequently (e.g. major event venues, production facilities)
- The special patented detector structure makes the detector resistant to environmental and deceptive influences such as dust, fibers, insects, humidity, extreme temperatures, electromagnetic interference, corrosive vapors, vibration, artificial aerosols and atypical fire phenomena

FDT241
- Heat detector with ASA*technology*, for detecting open fires or outbreaks with rapid temperature rise
- Signals are captured by two redundant heat sensors so if one of them fails, the detector remains in the highest response class
- The ambient temperature and the temperature in the detector housing are measured, to accurately determine the temperature rise
- The detector can be used as fixed or rate-of-rise heat detector

FDO241
- Optical wide spectrum smoke detector with ASA*technology*, used for early warning in smoke-forming flaming fires and smoldering fires
- The scattered-light principle is used with one sensor (forward scatter)

FDOOT241-A
- Neural fire detector with ASA*technology*, for many different applications. Detects all fire types, the entire smoke spectrum and all open fires
- The scattered-light principle is used with two optical sensors – forward scatter and backscatter – to optimize detection of light and dark smoke, and two redundant heat sensors to optimize detection of fires without smoke
- Configurable in the software as neural fire detector, smoke detector or heat detector

FDOOT241-A9
Multi-protocol support (FDnet and collective protocol) means the FDOOT241-A9 can be used in the phased modernization of older collective fire detectors. The detector automatically recognizes the configured protocol type. A single detector or an entire line can be modernized without the need to modernize the control panel too – this can be left until later. The fire detector recognizes when the new Sinteso control panel is installed, and automatically switches the protocol to the FDnet protocol based on unique addresses.

FDOOT241-A5

Supports multiple protocols (FDnet and AlgoRex interactive protocol) so the FDOOT241-A5 can be used with the FDB251 interactive base adapter to modernize AlgoRex fire detectors. The detector automatically recognizes the configured protocol type. With the FDB251 base adapter there is no need to replace the AlgoRex base. That means no electricians or painters, and no wiring errors.

Modernizing AlgoRex detectors: quick, easy and cost-effective

Sinteso – modernizing AlgoRex collective or interactive detectors with Sinteso detectors:
1. Remove AlgoRex detector, 2. Fit Sinteso detector to base adapter, 3. Insert Sinteso detector

FDOOTC241

Functions

The neural fire detector with integrated CO sensor and ASA*technology* has two functions:

- It is highly sensitive to fires which produce carbon monoxide (CO), e.g. smoldering fires, and is immune to deceptive phenomena in the environment. It also detects dangerous environmental CO concentrations when a predefined limit is reached, and triggers targeted interventions, e.g. switching on the ventilation. This reduces the risk of CO poisoning in places with large amounts of exhaust gases or where CO is produced during processing and production. The detector is intended for use in hospitals and homes where, for example, a smoldering mattress fire generating large amounts of CO could quickly turn into a life-threatening situation for patients, visitors and staff.
- The additional CO protection also makes the detector suitable for use in places like covered or underground car parks, vehicle workshops, engine test facilities, incineration and anaerobic digestion plants, heating rooms, chemical labs and production facilities.

Carbon monoxide (CO)

Carbon monoxide is a product of combustion. It is a deadly respiratory poison which forms a bond with the hemoglobin in red blood cells and prevents it from carrying oxygen. High concentrations of carbon monoxide can cause damage to health and can even be fatal.

Flame detector

FDF241-9

FDF241-9

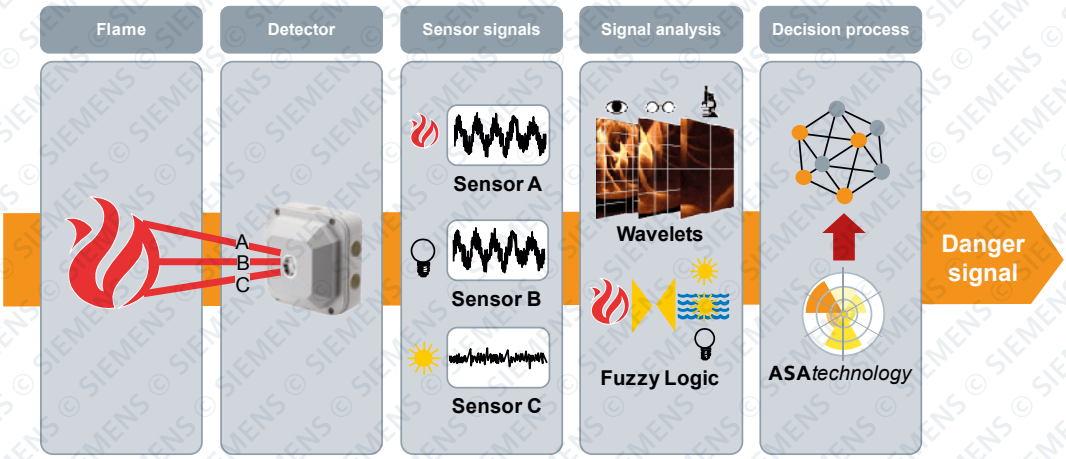
Applications

Flame detector with ASA*technology*, for detecting smokeless liquid and gas fires as well as smoke-forming open fires which occur when carbonaceous materials burn. It can be used in challenging indoor and outdoor applications.

Description

The three sensors pick up different specific infrared wavelengths so they can distinguish between fires and artificial light / sunlight.

The Sinteso S-LINE flame detector works with Sinteso FDnet network technology, or in a collective line.



Characteristics

- The detector measures the infrared radiation with three sensors, each working in different spectral ranges. One sensor measures the hot carbon dioxide in a specific wavelength of the flame, and the two others simultaneously measure the stray radiation in other wavelengths. The spectra of infrared radiation from organic fires and deceptive phenomena (e.g. sunlight, halogen light, hot objects) are different. This property, combined with the three sensors, allows the flame detector to use ASA*technology* to distinguish between deceptive phenomena and real fires. This is also what makes the FDF241-9 flame detector work so well in an environment containing deceptive phenomena such as direct sunlight or hot engines
- Time and process dependent detection behavior, i.e. time or process controlled parameter set switching (presence / absence) is possible
- Outstanding immunity from false alarms with fuzzy logic and wavelet analysis

ASA linear smoke detector

FDL241

FDL241-9

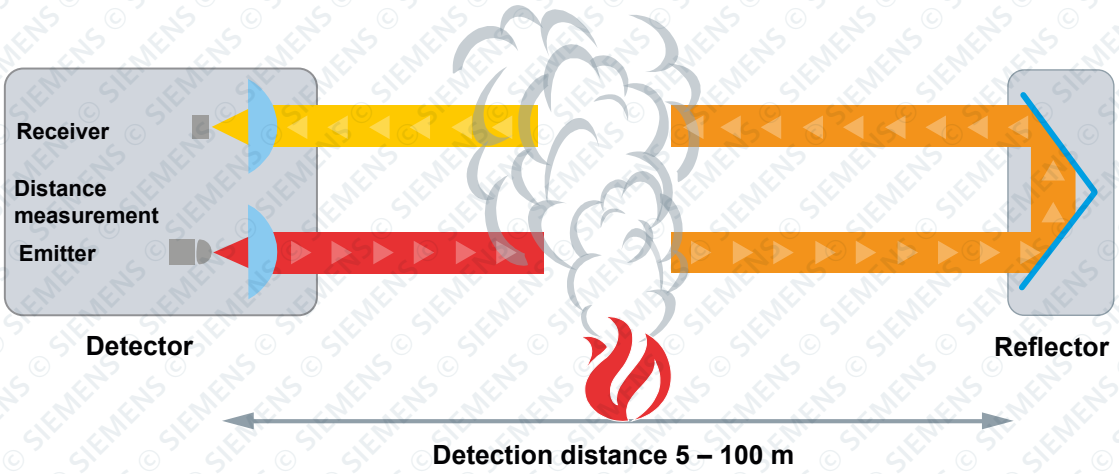
Applications

Linear smoke detector with **ASA***technology*, used for early warning in smoke-forming fires.
Preferably used to protect large warehouses and production halls, or rooms with complex ceiling structures. Other applications include decorative ceilings of historical value, atriums, reception areas, etc.

Description

The infrared signal is weakened through absorption and scattering if smoke builds up in the monitored area.

This Sinteso S-LINE smoke detector works with Sinteso FDnet network technology, or in a collective line.



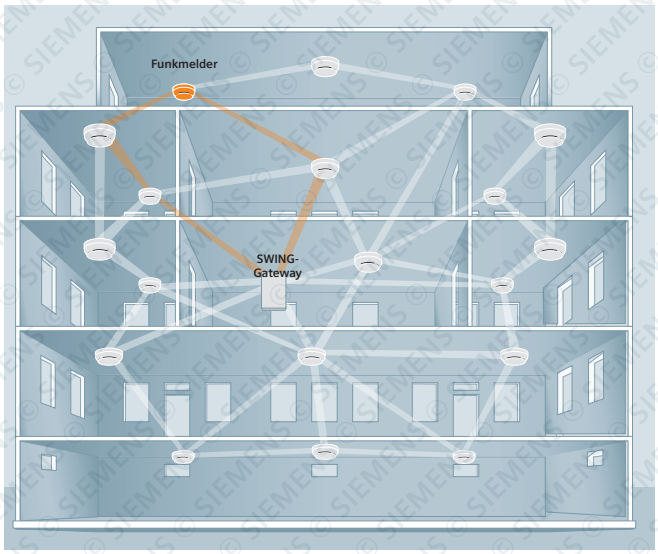
Characteristics

- The detector works on the principle of light attenuation by smoke. The detector contains a light emitter and a light receiver. The light emitter transmits a beam of infrared light, which is returned to the light receiver by the reflector. The receiver converts the infrared signal into an electrical signal, which is analyzed with **ASA***technology*
- Smoke entering the monitored space weakens the infrared signal. If the signal reaches certain values, the detector sends the relevant hazard level to the control panel
- Detection distance from 5 to 100 m, additional distance measurement (second light beam) to detect objects breaking the light beam
- Emitter and receiver in one housing
- The detector reports differential hazards in 4 hazard levels, allowing targeted early interventions at the control panel
- Configurable detection behavior with application-specific ASA parameter sets
- Time and process dependent detection behavior, i.e. time or process controlled parameter set switching (presence / absence) is possible
- Automatic self test and automatic compensation for dirt

Maximum protection with unique technology

Wireless devices can be freely positioned and repositioned, increasing flexibility should the room usage change in the future.

With SWING, Siemens sets new safety standards in radio fire detection – by combining the highly reliable mesh technology for safe wireless transmission with the unique ASAtechnology for high detection reliability.



With SWING, you can reliably protect up to five floors with one gateway – and without the need of cabling.

Advantages of wireless technology

Radio fire detection is the ideal solution for rooms or buildings of historical value, with aesthetic or architectural restrictions or for temporary installations. Thanks to wireless technology, devices can be quickly and freely positioned and repositioned. This facilitates planning, allows for cost-efficient installation and offers a high level of freedom and flexibility should room usage or building structure change in the future.

Application examples for SWING

- Museums, historical sites, libraries
- Hotel rooms, offices, convention halls
- Industrial rooms with changing usage
- Temporary installations like exhibitions

Efficient commissioning without interrupting business processes

Mesh technology facilitates planning, as no cables are needed. Smart tools and remote access allow for timely handover without interrupting your business processes because a wireless connection to a SWING device is sufficient. Integrated in the fire protection system, SWING can be accessed via the control panel or remotely via the Internet.

Mesh technology – outstanding connection reliability

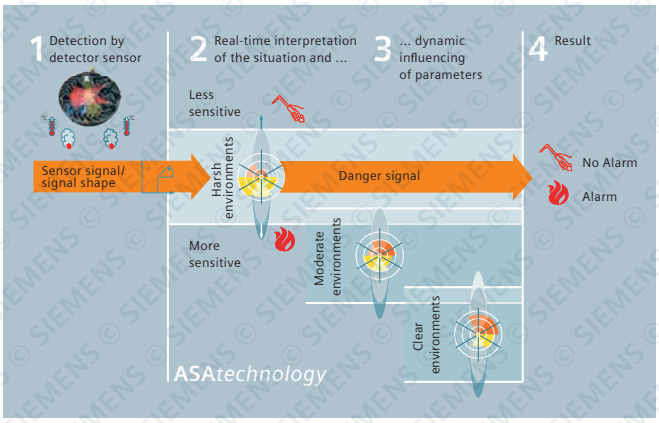
Mesh technology takes wireless network and communication reliability to the max. Because all wireless devices communicate with their neighbors, at least two redundant paths are always available to transmit information. To increase reliability even further, each wireless device has two frequency bands with several channels. In case of a disturbance, the network will mend itself by automatically changing the channel or frequency band or by rerouting the information via another neighboring device. That way, all information will always reach the gateway, making the wireless network as safe as a cabled one.

Moreover, mesh technology enables large and powerful wireless networks: An installation with one gateway can have a radius of up to 90 m. Taking into account local regulations, it can span up to five floors. As all wireless devices are interlinked, the gateway does not need a direct connection with each and every one.

Unique detection reliability with ASA*technology*

The SWING detector offers very fast and highly reliable detection response to smoldering and flaming fires caused by the combustion of liquid and solid matters – for highest life safety.

The redundant sensor system with two optical and two heat sensors enables highest detection reliability. The unique **ASA***technology*™ (ASA = advanced signal analysis) from Siemens allows you to optimally adapt the detector to the current environmental condition by simply choosing an application-specific ASA parameter set. **ASA***technology* interprets and evaluates the signals in real time and dynamically adapts the selected parameter set. As a result, the detector is immune to deceptive phenomena such as dust or steam – preventing false alarms and thus costly business interruptions. This makes the ASA detector the optimal solution for any application, from clean to harsh.



With SWING, you can reliably protect up to five floors with one gateway – and without the need of cabling.

Relying on long-term experience from Siemens

Products from Siemens are backed by 160 years of experience in fire safety and by the know-how gained from more than 60 million fire detectors installed worldwide. Actually, Siemens was the first manufacturer to offer automatic fire detectors and approved wireless detectors. By introducing mesh technology into fire safety and combining it with its unique **ASA***technology*, Siemens once again proves its innovation power and technology leadership.

Wireless devices can be freely positioned and repositioned, increasing flexibility should the room usage change in the future.

Highlights

- Safe wireless communication – at least two redundant communication paths
- Highest detection reliability and immunity to deceptive phenomena – with unique **ASA***technology* from Siemens
- Wide application range – due to selectable application-specific ASA parameter sets
- No costly business interruptions – thanks to self-mending mesh network and deception-free **ASA***technology*

Radio Fire Detectors

FDCW241
Radio gateway

FDOOT271
Radio fire detector including base and batteries

FDM273 SWING
Radio manual call point

FDCW241 Radio gateway
FDOOT271 Radio fire detector
FDM273 SWING radio manual call point

Applications

Important heritage sites such as museums, churches or libraries. Rooms that can only be out of service for a short time during fire detector installation, e.g. hotel rooms, executive offices or conference rooms.

Description

Wireless fire detection system with radio fire detector, radio manual call point and receiver (gateway), delivering outstanding reliability through the combined use of three state-of-the-art technologies. The multisensor fire detector has ASA*technology* for real time interpretation.
The multiband technology allows the fire detector to automatically select from two frequency bands with 16 channels each to optimize transmission and reception quality. With mesh technology, the fire detectors join together to form a wireless network. The fire detector does not need to have direct radio contact to the gateway – it can instead use another fire detector to establish the connection. In total, a gateway can handle up to 30 devices. This allows more than one connection path to be created so there is always a second, redundant path. If a connection fails, the fire detector automatically switches to the second connection and finds another way to access the gateway via other fire detectors. This is what makes the SWING wireless system the most reliable in its class.

Characteristics

- Neural fire detector with ASA*technology*, Suitable for a wide range of applications. Detects all fire types, the entire smoke spectrum and all open fires
- The scattered-light principle is used with two optical sensors – forward scatter and back-scatter – to optimize detection of light and dark smoke, and two redundant heat sensors to optimize detection of fires without smoke
- Mesh technology (wireless network) ensures that the fire detector and manual call point can establish a second, redundant connection to the gateway at all times in case the primary connection fails
- Because the connection can be established via other detectors, the permitted distances to the gateway are greater than in conventional systems
- Planning, design and commissioning are straightforward because the system creates the wireless network automatically
- In total, a gateway can handle up to 30 devices and there can be up to 16 gateways within range

Sinteso Ex

FDCL221-Ex
Line adapter including safety barrier for FDnet

FDOOT241-A9-Ex
(Ex multi-protocol collective FDnet)

FDM223-Ex

Installation housing

FDO221-EX
FDOOT241-A9-Ex
FDM223-Ex
FDCH222

Applications

In many industries, the production, processing, transport and storage of flammable substances create gases, vapors or mists which are released into the environment. Combined with the oxygen in the air, this can create a potentially explosive atmosphere which, if ignited, will explode. If these potentially explosive areas are monitored with fire detectors, the electrical equipment used must meet certain safety requirements.

Description

The FDCL221-Ex line adapter contains a safety barrier and galvanic separation, and does not require bonding in the Ex area. The line adapter ensures that no sparks can occur in the Ex area and that the Ex area is galvanically separated from the non-Ex area. A stub line runs from the Ex line separator into the potentially explosive area for individually addressed Sinteso Ex units. The chosen parameter set adjusts the algorithms and therefore the detectors to the expected fire types and environmental influences. S-LINE detectors offer high detection reliability combined with good immunity to deceptive phenomena.

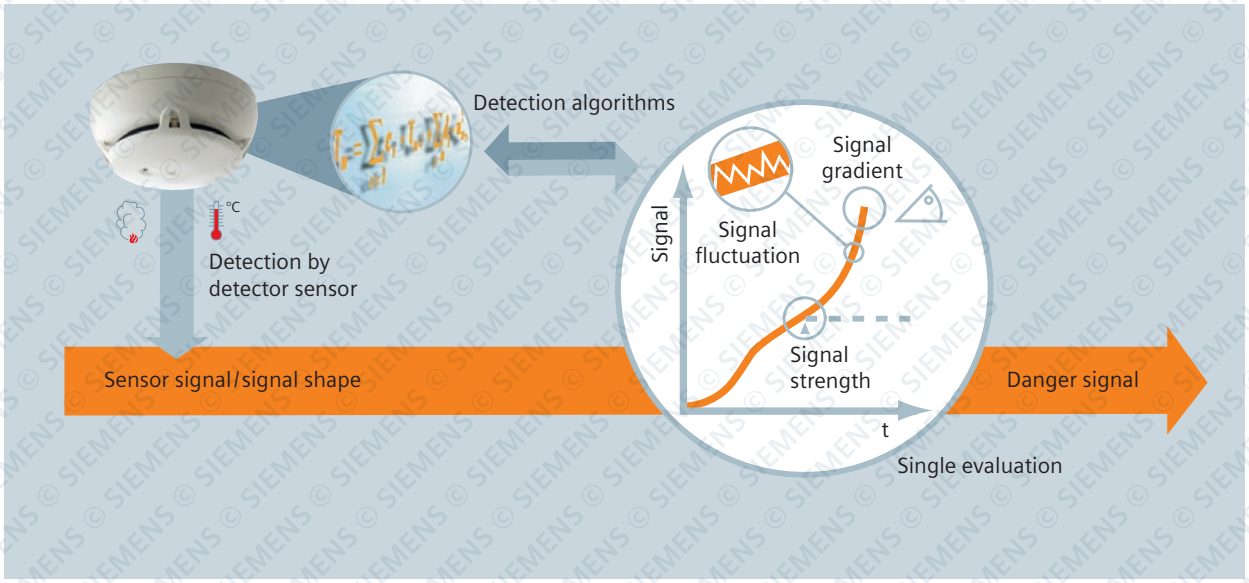
Characteristics

- Communication via Sinteso FDnet Ex line
- Very easy, flexible installation
- FDCL221-Ex line adapter for up to 32 individually addressed Ex units
- FDOOT241-A9-Ex also includes ASA technology. It is highly sensitive but also extremely resistant to deceptive phenomena. The fire detector is also compatible with collective Ex
- The FDM223-Ex with its large housing can be installed in a prominent position for manual activation
- Full galvanic separation in the safety barrier means bonding is unnecessary
- FDCH222 installation housing for installing up to three line adapters

The standard in fire detection

Highlights

- State-of-the-art detection algorithms for preventing false alarms
- Continued use of existing line networks
- Reliable and efficient fire detection
- Fast installation and efficient operation
- Ideal solution for expansion and modernization



Whether in hotels, office buildings or movie theaters, Sinteso C-LINE fire detectors are the first choice of Investors, planners and operators in normal environmental conditions where only occasional deceptive phenomena occur.

Modern, reliable technology – for compatibility and investment protection

The addressable technology in a line network, FDnet (Field Device network) permits fast, fault-tolerant communication between C-LINE fire detectors and the control panel. Fire detectors for special application areas, such as the flame detector FDF221, or the alarm sounder can be integrated in the FDnet without difficulty. All existing line systems and cable types can continue to be used. To accommodate future changes of use, the C-LINE detectors can be easily adjusted thanks to integrated detection algorithms.

Reliable in operation – fewer false alarms

Sinteso C-LINE fire detectors offer very high security on the basis of the newly developed detection algorithms (DA). Before an alarm is activated, the signals recorded by the sensor (such as smoke density, temperature or both simultaneously) are converted to mathematical gradients (intensity, rate of increase and fluctuation) and analyzed by means of detection algorithms.

Fast installation – high efficiency

Comprehensive fire protection with the latest fire detectors – that's what C-LINE fire detectors from Siemens stand for. However, they offer more than reliable security. C-LINE detectors also convince with a short installation time and minimal operating costs. And this makes them appealing not only to safety managers, but also to investors.

Always up-to-date – easily and efficiently

Whether you are expanding or modernizing an existing system, Sinteso C-LINE detectors are the ideal solution. They can even be implemented on existing line systems.

All-around safety

Backed by many years of field experience and proven under numerous operating conditions, C-LINE detectors offer comprehensive safety: They exactly analyze the collected signals thanks to their advanced detection algorithms.

And they include a multi-criteria detector for smoke and heat that operates very reliably thanks to an innovative forward and backward scattering principle and that is highly available thanks to redundant sensors.

In addition, the installation of the detectors on the FDnet loop increases safety: In case of a breakdown, alarms are simply redirected the other way to the control panel. Moreover, they can also be displayed locally on a floor repeater terminal.

C-LINE fire detectors are suitable for use in office buildings ...

... in museums ...

... or in shopping centers

Automatic detectors

FDO221

FDO221
FDOOT221

Applications

Neural fire detector with detection algorithms, for early warning of flaming fires of solid and liquid substances, and smoldering fires.

Description

This DA neural fire detector in the Sinteso C-LINE works in Sinteso FDnet network technology. C-LINE detectors are suitable for applications likely to produce few deceptive phenomena or where fast fire detection is important. In this C-LINE detector, signal processing is based on detection algorithms. The signals captured by the sensors are passed to the algorithm. The algorithm analyzes and evaluates the profile of the signals (signal strength, rate of increase, and fluctuation). The chosen parameter set adjusts the algorithms and therefore the detectors to the expected fire types and environmental influences. C-LINE detectors offer high detection reliability combined with good immunity to deceptive phenomena.

Characteristics

Detection characteristics are selectable with application-specific parameter sets. The high quality optoelectronic measuring chamber keeps stray light out while optimizing the detection of smoke particles. The special, patented measuring chamber makes the detector resistant to environmental and deceptive influences such as dust, fibers, insects, humidity, extreme temperatures, electromagnetic interference, corrosive vapors, vibration, artificial aerosols and atypical fire phenomena.

FDO221

Signals are detected using the scattered light principle with one sensor (optical forward scatter)

FDOOT221

Signals are detected using the scattered light principle with two optical sensors – forward scatter and backscatter – to optimize detection of light and dark smoke, and two redundant heat sensors to optimize detection of fires without smoke

Manual call point

FDM221

Manual call point red, small housing FDM221

FDM225

Manual call point red, small housing, recessed mounting or glass insert FDM225

FDM223

Manual call point red, large housing FDM223 FDM223H

Applications

FDM221
Manual call point for instant alarm activation or hazard alert. Small housing. Housing also available in yellow, green or blue.

FDM225
Manual call point in small housing for instant alarm activation or hazard alert. Additional frame for recessed mounting. This call point is available in two versions. One version is activated by pressing the small glass insert, which must then be replaced. The other version is triggered by pressing a plastic insert – this version can be reset with the key without the need to replace the insert.

FDM223
Manual call point in larger housing. Housing also available in yellow, green or blue.

FDM223H
Very robust housing made of fiber-reinforced thermoplastic for industrial and tunnel applications (IP64).

Alarm indicators

FDAI91

Alarm indicator, door
FDAI91

The FDAI91 alarm indicator is suitable for installation on a door frame.

FDAI92

Alarm indicator, wall
Type: FDAI92

The FDAI92 alarm indicator is suitable for installation on a wall.

Type: FDAI92-Ex

The FDAI92-Ex alarm indicator is suitable for potentially explosive areas.

FDAI93

Alarm indicator, hollow floor
Type: FDAI93

Optical parallel display of automatic fire detectors, for use in equipment, hollow ceilings, hollow floors, switch panels or special housings

Type: FDCAI221

FDnet addressable alarm indicator, suitable for wall installation

Type: FDAI93-Ex

Suitable for potentially explosive areas

Alarm sounder

FDS-221-R

rot
FDS221-R

red
FDS221-R

FDS-221-W

orange
FDS221-W

Applications

For audible alarms along escape routes, corridors and staircases.

Description

Alarm sounder in red or white, works with Sinteso fire detectors in Sinteso FDnet network technology.

Features:

- Addressed, individually controllable
- 11 tonalities selectable, including DIN 33404-3 «evacuation» sound
- 3 sound intensity levels selectable up to 99 dBA
- Different tonalities selectable for «pre-alarm» and «main alarm»
- Periodic testing of the acoustic part (not audible)
- Synchronization of sounds of all units
- Power and communication via FDnet, no auxiliary power supply required
- EN 54-3 compliant

Alarm sounder beacon

FDS-229-R

red
FDS229-R

orange
FDS229-A

FDS-229-A

Applications

For audible alarms along escape routes, corridors and staircases.

Description

Alarm sounder with red beacon, suitable for use in buildings with loud ambient noise, and in nursing homes with hearing-impaired residents for example. Works in Sinteso FDnet network technology with Sinteso fire detectors.

Features:

- Addressed, individually controllable
- 11 tonalities selectable, including DIN 33404-3 «evacuation» sound
- 3 sound intensity levels selectable up to 99 dBA / 1m at three levels
- Different tonalities selectable for «pre-alarm» and «main alarm»
- Periodic testing of the acoustic part (not audible)
- Synchronization of sounds of all units
- Beacon with selectable flashing sequence and mode. Alarm sounder and beacon can be activated together or separately
- Power and communication via FDnet, no auxiliary power supply required
- SN36350 environmental declaration identifying the materials used in the detector

Sounder base

FDSB291

FDSB291

Applications

The sounder base is used as an additional alarm, for example in hotel or hospital rooms, to «amplify» the alarm in the corridor. The sounder base can only be used with a C-LINE or S-LINE automatic detector (FDOOT, FDO or FDT).

Description

- Addressed, individually controllable
- 11 tonalities selectable, including DIN 33404-3 «evacuation» sound, 2 sound intensity levels selectable
- Sound intensity up to 88 dBA
- Different tonalities selectable for «pre-alarm» and «main alarm»
- Synchronization of sounds of all units
- Compatible with addressed detector FDOOT, FDO, FDT
- Power and communication via FDnet, no auxiliary power supply required

Sounder interbase

FDSB221

FDSB221

with beacon red FDSB229

Applications

- For acoustic and optical / acoustic
- alarms, e.g. in:
- Hotel rooms
- Hospital rooms
- Nursing homes, residential rooms, work rooms

This sounder interbase can also be fitted between a sounder base and the fire detector.

Description

- Addressed, individually controllable
- 11 tonalities selectable, 2 activation levels programmable
- Sound intensity selectable up to 83 dBA
- Synchronization of sounds of all units
- Power and communication via FDnet, no auxiliary power supply required
- FDSB229 optical / acoustic: red LEDs, selectable luminous intensity and flashing mode

Input / output modules

FDCIO223

FDCI221
FDCI222
FDCI223
FDCIO221
FDCIO222
FDCIO223

Applications

These input / output modules can be directly connected to the FDnet for local control of devices or equipment (lift, ventilation, fire doors, etc.). Pluggable boards are available for central control directly from the fire control panel.

Description

FDCI221

Line module FDnet, 1 input for one potential-free contact

FDCI222

Line module FDnet, 4 inputs for potential-free contacts

FDCI223

Line module FDnet including galvanic separation for connecting a collective Ex line

FDCIO221

Line module FDnet, 1 input for one potential-free contact and 1 output, monitored or not monitored

FDCIO222

Line module FDnet, 4 inputs for potential-free contacts and 4 outputs, for fire control systems for example

FDCIO223

Line module FDnet, the 2 inputs / outputs can be configured separately from each other, as detector line (collective), contact input, control output, or as control output and input as acknowledgement with selectable monitoring time window.

Floor repeater terminal

FT2010-C1
207 x 283 x 46 (HxBxT)

FT2010-C1

Applications

The floor repeater terminal acts as an FDnet bus element in Sinteso FC20 control panels, for the remote display and operation of alarms and technical messages from the control panel.

Description

The FT2010-C1 floor repeater terminal has the following characteristics:

- Design matching the FC20 fire control panels and FT20 fire terminals
- Addressed terminal to display and process system-wide messages
- Power supply and communication via FDnet
- Display can be limited to a particular part of the building (floor)
- Display of alarms, pre-alarms, technical messages, faults and disconnections
- Start the investigation time and reset the alarm during the investigation time
- Event acknowledgement and resetting
- Configurable sections and groups that can be processed and displayed using the floor repeater terminal
- Automatic transfer of detector group texts
- Scroll button to show previous messages
- The customer's personnel can use a clearly structured user interface for customer-specific texts to locate events
- As an FDnet bus element, the floor repeater terminal can run in a loop or a stub line
- Up to 16 floor repeater terminals can be connected to a control panel

Floor repeater display

FT2011-A1
207 x 282 x 79 mm
(HxBxT)

FT2011-A1

Applications

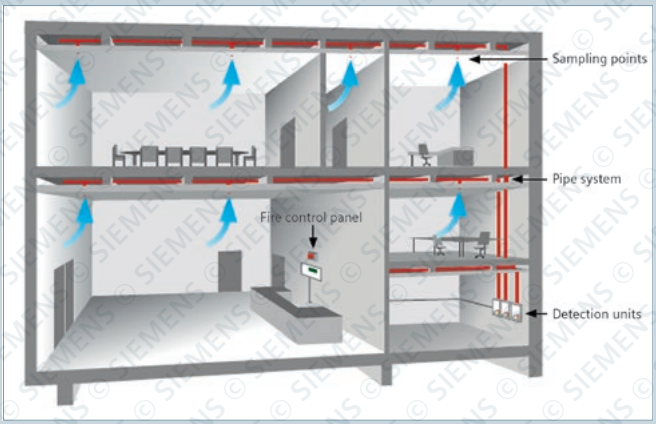
The floor repeater display acts as an FDnet bus element in Sinteso FC20 control panels, for the remote display of alarms and technical messages from the control panel.

Description

The FT2011-A1 floor repeater display has the following characteristics:

- Addressed terminal to display system-wide messages
- Power supply and communication via FDnet
- Display can be limited to a particular part of the building (floor)
- Event texts are the same as the texts in the FC20 control panel and the FT2040 fire terminal
- Large backlit plain text display (6 lines of 40 characters)
- Display of alarms, pre-alarms, technical messages, faults and disconnections
- Configurable sections and groups that can be displayed using the floor repeater display
- Automatic transfer of detector group texts
- Scroll button to show previous messages
- The customer's personnel can use a clearly structured interface for customer-specific texts to locate events
- As an FDnet bus element, the floor repeater terminal can run in a loop or a stub line
- Up to 16 floor repeater terminals can be connected to a control panel

Aspirating smoke detectors growing in importance



Monitored area
The sampling points in the monitored area are staggered so that if possible, the same amount of air is drawn through each opening. Each sampling point covers the same area as a point-type smoke detector.

Aspirating smoke detectors are a clear demonstration of the power of innovation in Siemens. These devices are growing in importance, and the number of applications is increasing:

Clean rooms

The first aspirating smoke detectors were developed for clean rooms, which often contain very expensive and highly sensitive devices and systems demanding high levels of protection. The air is kept clean through the intensive exchange of air, making fire detection a real challenge. Siemens aspirating smoke detectors are already in use in many clean rooms, and the potential applications are growing all the time.

High open rooms

If a fire breaks out in high open rooms like high rack storage areas, interior courtyards, atriums, aircraft hangars, etc., the smoke concentration falls sharply as the height increases. Highly sensitive aspirating smoke detectors pick up tiny quantities of smoke, to allow rapid intervention and damage limitation.

Air conditioning

Strong air flows in ventilated or air conditioned rooms can also thin the smoke or even divert it away from the ceiling smoke detectors entirely. Sensitive and correctly planned and installed aspirating smoke detectors can prevent this and guarantee reliability.

Industrial production facilities

By their very nature, some production facilities have challenging and highly variable environmental conditions (dust, heat, humidity, etc.). Integrated filters in the pipe system can remove these deceptive elements so they cannot influence detection in any way. In high humidity environments, water separators are used in the sampling pipe to mitigate this problem.

Cold stores

The dry air and highly flammable insulation and packaging materials in cold stores constitute a significant fire risk. A fire can break out very quickly, and with so many high-value items in a small space, losses can quickly escalate. Aspirating smoke detectors can look out for particular conditions in cold stores (e.g. thawing), providing constant protection.

Computer centers

The computer centers and communication facilities in modern companies contain extremely valuable tangible and intangible assets in the form of hardware and software.

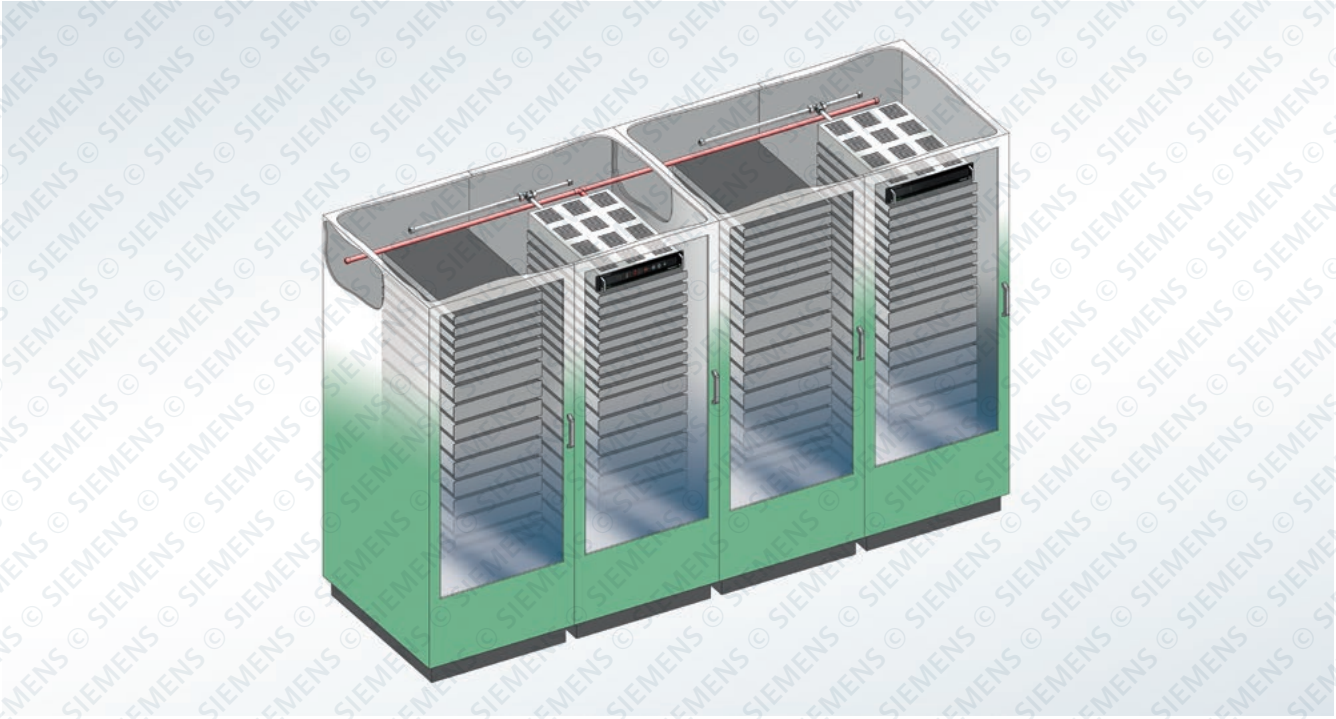
A loss of data, telephone, email or Internet connectivity is often just as serious as a plant shutdown. Consequential losses are enormous and almost incalculable in cash terms.

Designed specially for computer, server and switchgear cabinets, the 19-inch smoke sampling units are available as one or two rack units, with integrated or external extinguishing. The smoke sampling system detects the tiniest quantities of smoke aerosols of the kind released in the first phase of an incipient fire. This creates valuable extra time for interventions such as a soft shutdown, selective disconnection or targeted object extinguishing.

Recycling plants

Aspirating smoke detector technology can also be used in areas with high levels of contamination, for example recycling plants.

Aspirating smoke detectors: fast detection, little residual risk.



Unattractive to vandals

Where there is a risk of vandalism, it is important to avoid anything which might encourage this behavior. That is why the small, inconspicuous openings of the sampling points are so useful in places like penal institutions, metro stations and car parks. There is nothing for vandals to get hold of, so your investment is protected.

Fast evacuation

If large numbers of people have to be removed from the danger zone as quickly as possible, time is of the essence. Metro stations, for example, have long escape routes but fires can spread quickly. In these places, highly sensitive aspirating smoke detectors are perfect for early detection of potential hazards, helping with fast evacuation if necessary.

Hybrid forms are a good idea

In many situations is it a good idea to use aspirating smoke detectors alongside the ceiling detectors in order to protect sensitive objects. And combining them with fast acting fire fighting systems using the right extinguishing agents can prevent losses in rooms and / or objects at particular risk.

Also EMC compatible

Plastic tubes are used to take air samples in the monitored area. This automatically guarantees EMC compatibility.

Extinguishing

The extinguishing control units are perfect for protecting valuable objects, a single area / room or several areas/rooms to the highest standards. The extinguishing control units can be installed independently or as part of a wider fire fighting solution.

No entry!

Many companies keep their production facilities running round the clock. Stoppages for maintenance are very costly. In institutions or zones where secrecy is important, such as operating rooms, nuclear facilities, labs, electrical installations and penal institutions, maintenance is very labor intensive. Hollow ceilings, hollow floors, shafts and other places are difficult to access, making maintenance work on the detectors difficult or even impossible. Aspirating smoke detectors are an elegant solution because it is not always necessary to get to the sampling pipe. The actual detection chamber is outside the production area or the monitored area where it is much easier to access. This means that work can carry on unhindered – outside the critical zones and without stoppages.

Managing even the most difficult applications

Our aspirating smoke detectors FDA221 and FDA241 are ideal for object protection in difficult environments or for concealed detection in high-ceiling buildings.

Our innovative detectors FDA221 and FDA241 take aspirating smoke detection to a new level. Thanks to the intelligent optical dual-wave-length detection technology and our patented detection chamber, they detect fire very early and with the highest accuracy.

A solution for demanding environments

Aspirating smoke detection (ASD) from Siemens ensures reliable fire detection in demanding application areas, where very early fire detection is required and business continuity is paramount. In these environments, detectors with ASD technology are the ideal choice because they actively draw air samples from the areas requiring protection and evaluate these samples for the presence of smoke.

With our FDA221 and FDA241, we introduce two aspirating smoke detectors that further increase ASD reliability even in the most demanding environments: by combining the optical dual-wavelength detection technology with our patented detection chamber.

New technology enables greater detection reliability

The optical detection technology uses two wavelengths – blue and infrared. This enables our aspirating smoke detectors to detect smaller airborne particles as produced in the earliest stages of over-heating or as found in open fires.

The detectors then determine the size and concentration of the airborne particles to differentiate between smoke, dust and steam particles. As a result, FDA221 and FDA241 detect smoke very early and reliably with a high immunity to deceptive phenomena. The accurate detection and classification of airborne particles prevents downtimes and costs caused by false alarms. We back this claim with our Genuine Alarm Guarantee.

Typical application areas

Our new aspirating smoke detectors are particularly suitable for application areas where environmentally challenging conditions prevail, where an aesthetically appealing solution is desired or where high detection sensitivity is needed. This is the case, for example, in

- large spaces such as lobbies, warehouses and industrial production areas,
- hard-to-access areas like cable ducts and metro stations
- or highly ventilated areas, including data centers or clean rooms.

Highly reliable even in difficult environments

To meet the requirements of challenging applications, FDA221 and FDA241 provide up to three modes of operation: ultrasensitive, auto-discrimination and robust. An alarm threshold can be defined and programmed and both detectors have a programmable sensitivity range. Not even conditions in environmentally demanding applications can provoke a false alarm. Our aspirating smoke detectors actively monitor the ambient air for smoke and dust particles, which is especially important for the protected area. The patented chamber inside the detectors was specially designed to keep internal soiling to an absolute minimum. That is why FDA221 and FDA241 also work reliably in very dusty and dirty environments.

Direct integration into the Sinteso™ fire detection system

FDA221 and FDA241 can be directly integrated into an existing fire detection system from Siemens, such as Sinteso, using the detection loop FDnet. The integration ensures full transparency of both message display and operation. It also allows for configuration of the detectors, performance of maintenance work and alarm and fault management directly on the fire control panel, thereby optimizing control and lowering the cost of the overall solution.

Everything from a single source

When it comes to comprehensive fire safety, Siemens is your one-stop shop. Our complete portfolio provides all you need: an intelligent fire detection system, state-of-the-art extinguishing solutions and central operation of all your installed systems via a danger management system. Your big plus: You have only one contact person for all your fire safety and service needs.

Highlights

- Highest detection reliability – immunity to deceptive phenomena prevents false alarms
- Ideal choice for difficult environments
- Genuine Alarm Guarantee based on the optical dual-wavelength detection technology
- Patented chamber design extends product lifespan
- Direct integration into Sinteso fire detection system
- Comprehensive fire safety from Siemens – fire detection, extinguishing and danger management from one source

Siemens ASD

FDA221

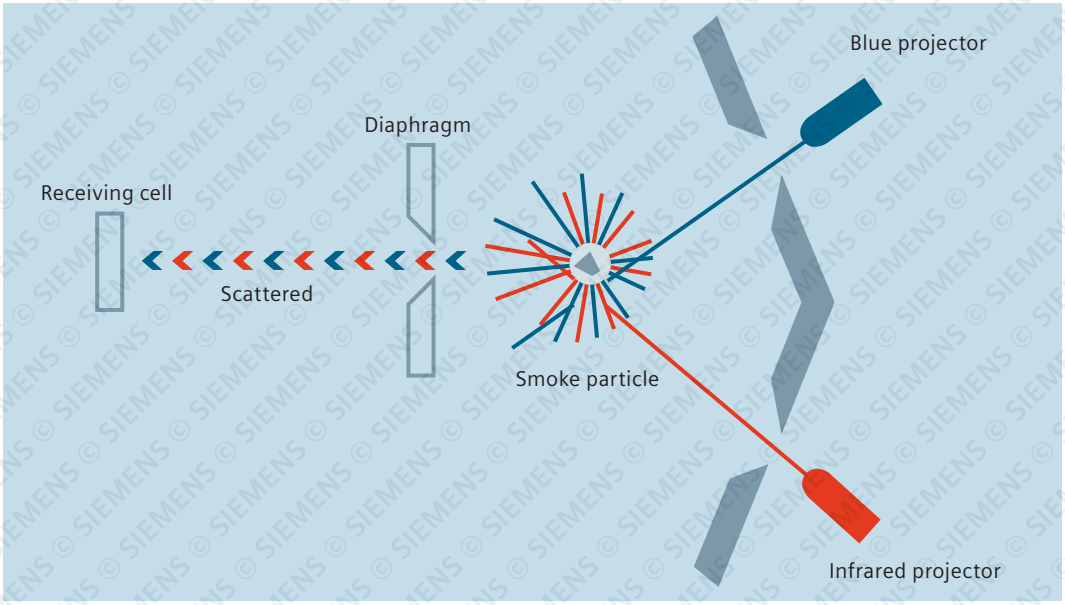
FDA221
FDA241

Applications

Low-cost compact solution to protect small to medium size areas. The patented measuring chamber is highly resistant to dirt, and dual detection with one blue LED and one infrared LED allows a wide range of fire aerosols to be detected.

Description

- Patented technology
- Enhanced optical detection with dual wavelengths (blue and infrared)
- Unique dust-resistant detection chamber
- Intuitive front display showing air flow and smoke density
- Sensitivity 0.03 – 2 %/m
- FDA221, up to 500 m² coverage
- FDA241, up to 800 m² coverage and cleaning function
- Directly integrated in the Siemens FDnet (field device network)
- Programmable alarm thresholds



- The Siemens aspirating smoke detector continuously draws in air through sampling holes in the pipe
- In the detection chamber, the air is tested for smoke
- Dual detection means that dust and smoke can be distinguished
- The high sensitivity provides very early warning to protect important operational facilities.

Titanus

ProSens

ProSens

Applications

The Titanus ProSens is a low-cost, universal air sampling smoke detection system. The unit can be linked to two detector modules to double the coverage. A cold storage option is available for temperatures as low as -40 °C.

Description

- Maximum coverage 3200 m²
- Sensitivity 0.015 – 1 %/m
- Used in computer rooms, warehouses, high rack storage areas, cold stores (down to -40 °C), recycling facilities, tunnels, offices, museums, archives
- For noise-sensitive areas like offices or museums, a Silent version is available
- Titanus ProSens / net is networkable for integration in a danger management system

Titanus

TopSens

TopSens

Applications

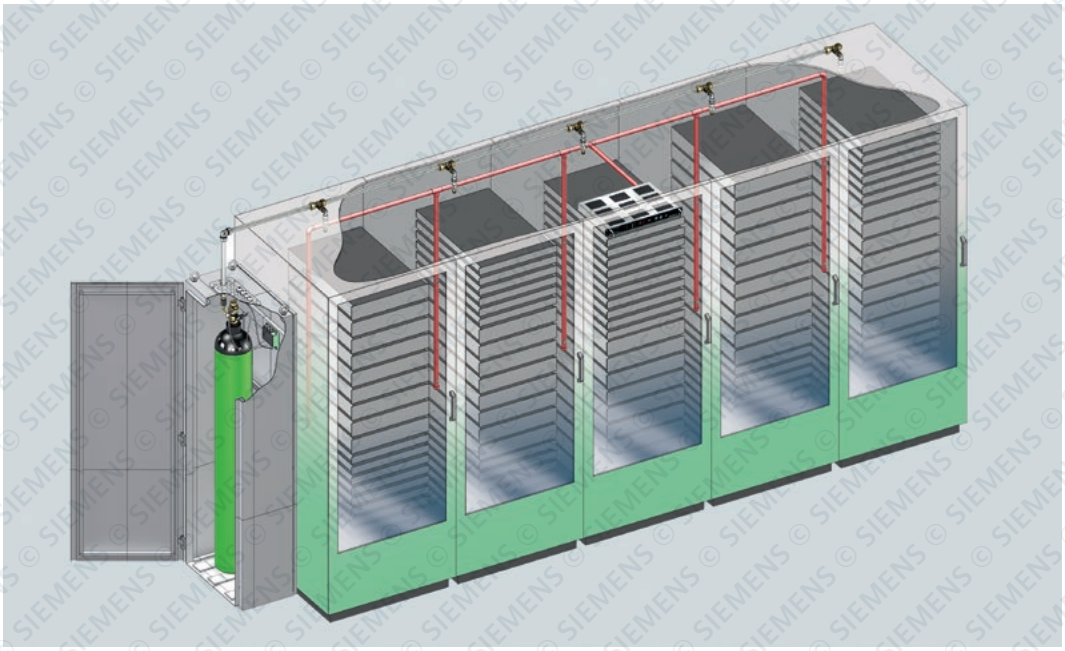
Applications and use as for ProSens

Description

The TopSens has the following additional features compared to the ProSens

- 10-element bar graph display showing the current smoke load in the monitored area
- The TopSens is potentially 10x more sensitive than the ProSens: Sensitivity from 0.0015 – 1 %/m

Titanus smoke detection



Titanus RackSens 1

Titanus RackSens 1 rack unit

Applications

Earliest possible fire detection in computer cabinets

Description

- Fire detection module to protect open ventilated, open unventilated and enclosed air conditioned cabinets
- Can be linked to the room extinguishing system, or used for object extinguishing with a fire extinguisher fitted outside the cabinet
- Networkable
- Sensitivity 0.1 – 2 %/m

Titanus RackSens 2

Titanus RackSens 2 rack units with integrated extinguishing

Applications

Earliest possible fire detection in computer cabinets

Description

- Fire detection module, suitable for protecting enclosed cabinets where the room extinguishing system is ineffective due to slow penetration of extinguishing gases
- For non-destructive extinguishing with minimal storage requirement, the fire suppressant NOVEC™ 1230 is available
- Networkable
- Sensitivity 0.1 – 2 %/m

Linear heat detectors, conventional detection

LWM-1

Linear heat detector
Type: LWM-1

Applications

The LWM-1 linear heat detector is suitable for use in confined areas or harsh environments where conventional detection using automatic detectors is difficult.

Description

The LWM-1 detection unit has the following characteristics:

- Combined fixed and rate-of-rise detection
- Sensor length up to 300 m
- 3840 application specific settings
- Early fire detection (heat detector classes A1, A2, B or C)
- Low probability of nuisance alarms even in rough environments
- Very low space requirement for sensor cable
- Easy installation of sensor cable
- High chemical and / or mechanical resistance using specially coated sensor cables
- Suitable for use in Ex zones
- Control unit may be installed up to 500 m remotely from sensor
- Easy maintenance of the system
- Constant sensitivity over entire length of sensor cable

Thermal image detection with infrared camera

Adicos Hotspot256 Infrarotkamera

Adicos Hotspot 256
Infrared camera

Applications

Early detection for all aspects of storage, handling and transport of flammable substances. Monitoring of storage and production facilities for paper, wood, coal, grain, etc. Monitoring of cargo areas in ships, aircraft, road vehicles. The IR camera is ideal for use in dirty and / or dusty environments like recycling facilities, waste incineration plants.

Description

The infrared camera measures the surface temperature of machinery or stored goods. If the temperature exceeds a certain threshold, the camera triggers an alarm. The camera and housing are designed to be highly robust and are suitable for use outdoors or in dirty environments.

Characteristics

Extremely fast detection -> from 0.5 seconds. Contactless surface temperature measurement (detection of radiated heat) picks up smoldering fires, overheated machinery, etc.

Linear smoke detectors

Linear detector OSID

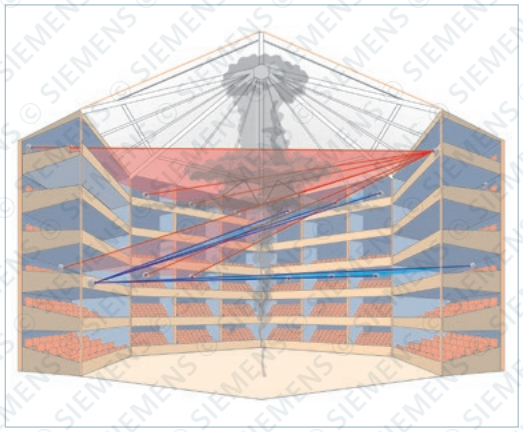
Linear OSID detector with multiple emitters for 3D smoke detection

Applications

Open-area Smoke Imaging Detection (OSID) is based on a linear smoke detector that can be used in high, open spaces such as atriums, opera houses, theaters or stores. The emitter and receiver have a flexible and adjustable eye, so it is quick and easy to align emitters to the receiver, and they can be installed at different heights.

Description

One receiver supports up to seven emitters, allowing 3D detection. OSID also uses dual wavelength technology to distinguish between smoke and dust or vapor. This helps to prevent false alarms, and OSID can be used in normal environments as well as challenging environments.



Characteristics

- Distances up to 150 m possible with the high-power option
- Battery power or external power supply

Enhanced fire protection

Arc-fault detection unit 5SM6

Arc-fault detection unit 5SM6

Applications

The use of AFD units is recommended in residential buildings, public buildings, libraries, museums and business premises with a fire risk.

Description

More than a hundred thousand fires are reported in Europe every year. The figures are shocking: many people killed and injured, plus damage to property worth billions. More than a quarter of these fires can be traced back to defects in the electrical installation – caused for the most part by hazardous arcing faults. Many of these fire hazards, from electric cables to load, can be detected with the 5SM6 AFD units at an early stage, closing the safety gap and protecting human lives, buildings and irreplaceable assets.

Characteristics

- Established technology
- Reliable tripping in the event of a fault
- Comprehensive protection concept based on an application-related combination of devices
- Detection of arcing faults from crushed or broken cables
- Detection of defective insulation, broken cables or loose contacts
- Integrated overvoltage protection release for enhanced safety for people and assets

Sinteso: innovation based on experience – from Siemens

Highlights

- Genuine Alarm Guarantee possible
- Comprehensive fire safety system
- Usability for systems of any size or complexity
- Flexible, efficient system networks (FCnet and FDnet)
- High system flexibility and expandability
- Networking across all building services via BACnet / IP
- Easy integration into a Siemens Danger Management System
- Networking of FCnet panels also via Ethernet

Sinteso™ is a comprehensive system for fast, reliable fire detection, alarm signaling and control. It is designed to protect lives and assets and prevent production losses, thereby safeguarding your company's buildings and very survival. Sinteso not only defines the technological state of the art, but also offers almost unlimited scalability, network capability, and further development in harmony with existing products.

The ideal solution for every requirement

Safe, precise, and reliable – from detection to monitoring

Reliable detection, fast notification, quick response – Sinteso sets the standard in all three areas. At the field level, for example, with everything from state-of-the-art fire detectors to immunity from false alarms thanks to **ASA***technology*™. Fast, fault-tolerant network technology ensures maximum reliability in communication between FDnet devices and the control panel. And the control panels allow simple, intuitive operation, plain text displays and unambiguous instructions – and let security personnel concentrate on the event.

Scalable and versatile – to meet every need from «standard» to «special»

The Sinteso fire detection system was developed using decades of our experience in fire protection. In combination with the Sinteso fire detectors, the Sinteso control panels FC2020, FC2040 and the modular control panel FC2060 offer a comprehensive and homogeneous system.

The characteristic feature of the Sinteso family is its flexibility to meet any requirement. In a standard configuration, for example, two loops can be connected to a FC2020 control panel, and four loops to a FC2040, expandable to 4 or 8 loops while using same number of addresses. A comprehensive range of FDnet devices is available for every task.

The result is a comprehensive fire detection system on a shared technology platform with provision for simple, open-ended expansion in the future.

Homogeneous and expandable – for greater efficiency throughout the entire life cycle

Economic efficiency is a key factor in the installation phase. For example, the FDnet-powered devices require no additional cabling for power feeding or data transport or for connection to the control panel.

Moreover, Sinteso can be expanded or modernized at any time: Additional devices and lines can be simply connected to the system network (FDnet, FCnet) when a building is expanded. The FCnet is expandable by connecting additional panels via Ethernet.

Efficiency is also ensured whenever you upgrade – because new generations of devices and software versions are «members of the family». And if you ever want to use rooms for new functions, newly developed parameter sets can be downloaded.

Increased fire safety – thanks to communication with other security systems

For comprehensive safety, Sinteso can be quickly and easily integrated into a Siemens Danger Management System via BACnet. The benefit: Security personnel can operate the fire detection system centrally – together with other systems such as video surveillance or access control. This offers increased security because a danger area can be easily monitored with video cameras. The recorded film footage can also be used later to help analyze the cause of an event. With access control, escape routes can be monitored and doors opened or closed quickly.

All-around safety – due to reliable detection, high availability, and transparent operation

Innovative functions, such as degrade mode and standby functionality with the control panels, further optimize safety. For example, the video fire controller allows visual verification of an event. Redundant sensors increase the availability of the detectors – and turbo isolators as well as loop installation increase the availability of the floor repeater terminals even in case of an open or short circuit.

Fire control panels

FC2020-CZ
398 x 430 x 165 mm
(HxBxT)

FC2020-CC
796 x 430 x 165 mm
(HxBxT)
FC2040-CC
796 x 430 x 165 mm
(HxBxT)

Sinteso FC2020-CZ
Sinteso FC2020-CC
Sinteso FC2040-CC

Applications

The FC20xx fire control panels with integrated operating unit are compact 2-loop or 4-loop control panels that can support up to 504 Sinteso bus elements.

Description

- The control panels can be used as a stand-alone version or networked:
  - Up to 64 control panels in one EN 54 compliant system in up to 14 clusters
  - Up to 16 control panels per cluster can be networked with a danger management system
- High reliability and system availability with signal processing in the detector and in the control panel
- Event-driven, intuitive operation with integrated operating unit
- Flexible programming of complex, cascading controls – also across multiple fire control panels – using Boolean formulas (AND, OR, NOT)
- Complex controls can be extended with various time functions such as daily program, start and end delay
- Improved alarm verification by combining different danger levels from multiple detectors in multizone logic, which is also used to implement dual detector and dual group dependency
- Application algorithms can be switched on an event-driven basis, either potential-free via an external contact or using a timer
- Integrated emergency function, EN 54 compliant emergency operation
- Integrated Ethernet connection (RJ45) to run a remote operating terminal or a fire control panel via the operator's existing LAN, to connect a danger management system, and for remote access using SintesoView
- License keys can be used to activate different data transmission functions. These are necessary to connect a danger management system or SintesoView to the control panel

Optional extensions:

- Loop extension (FDnet) FCI2003-A1 (doubles the number of loops)
- Network module (SAFEDLINK) FN2001-A1
- RS 232 module (insulated) FCA2001-A1
- RS 485 module (insulated) FCA2002-A1
- Event printer FTO2001-A1
- Operating add-ons LED display groups (internal) FCM2006-A1 and FCM2007-A1

FC2020-CZ
FC2020-CC

- Connection and operation of up to:
  - 2 FDnet loops, line length max. 3300 m with standard fire detector cable, or 4 stubs
  - The loop extension (FDnet) can double the number of loops, with the maximum number of 252 addresses per FDnet line card remaining unchanged
  - Max. 126 addressable Sinteso bus elements per loop
  - Max. 252 individually addressed Sinteso S-LINE and / or C-LINE detectors
  - The FC2020-CZ is one rack unit in height, the FC2020-CC is two, providing more space for larger batteries

FC2040-CC

- Connection and operation of up to:
  - 4 FDnet loops, line length max. 3300 m with standard fire detector cable, or 8 stubs
  - The loop extension (FDnet) can double the number of loops, with the maximum number of 252 addresses per FDnet line card remaining unchanged
  - Max. 126 addressable Sinteso bus elements per loop
  - Max. 504 individually addressed Sinteso S-LINE and / or C-LINE detectors
  - Max. 504 detector groups independently of the physical network
- 150 W power supply, cascading

Fire control panels

FC2030-CC
796 x 430 x 165 mm
(HxBxT)

FC2060 CC
796 x 430 x 265 mm
(HxBxT)

FC2080
2200 x 600 x 600 mm
(HxBxT)

Sinteso FC2030-CC
Sinteso FC2060-CC
Sinteso FC2080

Applications

These modernization control panels are used in phased modernization projects. They contain slots which can take over the detector lines depending on the fire detector type.

Description

- The control panel can be used as a stand-alone version or networked:
  - Up to 64 control panels in one EN 54 compliant system in up to 14 clusters
  - Up to 16 control panels per cluster can be networked with a danger management system
- High reliability and system availability with signal processing in the detector and in the control panel
- Event-driven, intuitive operation with integrated operating unit
- Flexible programming of complex, cascading controls – also across multiple fire control panels – using Boolean formulas (AND, OR, NOT)
- Complex controls can be extended with various time functions such as daily program, start and end delay
- Improved alarm verification by combining different danger levels from multiple detectors in multizone logic, which is also used to implement dual detector and dual group dependency
- Application algorithms can be switched on an event-driven basis, either potential-free via an external contact or using a timer
- Integrated emergency function, EN 54 compliant emergency operation
- 150 W power supply, cascading
- Integrated Ethernet connection (RJ45) to run a remote operating terminal or a fire control panel via the operator's existing LAN, to connect a GMA-Manager, and for remote access using SintesoView
- Support for „Turbo-Isolator" function for fast disconnection of the FDnet peripheral bus if a short circuit occurs This guarantees uninterrupted activation of the alarm sounder in accordance with MLAR 2005 requirements
- License keys can be used to activate different data transmission functions. These are necessary to connect a danger management system, or SintesoView to the control panel.

Optional extensions:

- Loop extension (FDnet) FCI2003-A1 (doubles the number of loops)
- Network module (SAFEDLINK) FN2001-A1
- RS 232 module (insulated) FCA2001-A1
- RS 485 module (insulated) FCA2002-A1
- Event printer FTO2001-A1
- Operating add-ons LED display groups (internal) FCM2006-A1 and FCM2007-A1
- Line card (FDnet) FCL2001-A1
- Line card (collective) FCL2002-A1
- Line card (interactive) FCL2006-A1
- Line card (interactive Ex) FCL2007-A1
- I / O card programmable FCI2008-A1

Sinteso FC2030-CC

- Card holder with 2 slots
- Connection and operation of up to:
  - Max. 126 addressable Sinteso bus elements per loop
  - Max. 756 individually addressed Sinteso S-LINE and / or C-LINE detectors
  - Max. 256 individually addressed AlgoRex detectors

Sinteso FC2060-CC

- Card holder with 5 slots
- Connection and operation of up to:
  - Max. 126 addressable Sinteso bus elements per loop
  - Max. 1512 individually addressed Sinteso S-LINE and / or C-LINE detectors
  - Max. 640 individually addressed AlgoRex detectors

Sinteso FC2080

The FC2080 is a modular fire control panel. It has the following features:

- Optional: redundant 2nd CPU card (hot-pluggable)
- Comes with slots for max. 7 module bus cards
- Integrated control unit
- Integrated power supply
- Networking via FCnet / SAFEDLINK or Ethernet
- Number of addresses: max. 5000
- Optional: extendable up to 120 / 240 loops / stubs
- Max. 6 additional card cages
- Max. 37 slots for additional module bus cards
- Max. 30 line cards (FDnet, collective,MS9i, interactive)
- Max. 30 collective line cards
- Max. 30 MS9i line cards
- Max. 7 I / O cards for alarm and fault transmission
- Max. 37 programmable I / O cards
- Max. 7 I / O cards for alarm and fault transmission

FT2080 – fire terminal

Highlights

- Handy function keys are provided to streamline user operations
- Automatically dimmed when not in use
- Events clearly displayed in list form with larger detailed display of the selected event
- Numerous helpful status indicators for a quick overview

The new, color, touchscreen fire terminal FT2080 is easier to use and presents events so they are easier to read at a glance. Context-sensitive function keys make the unit much more user friendly because only the logical and relevant functions are displayed.

Benefits of FT2080 touchscreen fire terminal

The user interface of the new terminal has a clean look and is very easy to read. Anyone who can use a tablet PC will get started quickly with the FT2080. The design philosophy has been applied consistently throughout in terms of appearance and use.

Handy function keys are provided to streamline user operations. The list tabs on the left provide direct access to all event lists such as alarms, disconnections, active controls, etc. The large panel on top always shows the active list event with all the detailed event information that will help staff and the fire service to locate the incident as quickly as possible.

The menu bar at the very top provides direct access to the function menu, the detection or hardware tree, and instant switching between two languages.

.

Applications

The FT2080 fire terminal is suitable for installation in places where the system is frequently or primarily operated or where the design is important. The terminal can be installed in a separate housing, or recessed in the wall or a console.

Characteristics and description

- Networking in any topology with up to 31 control panels and operating units in the fail-safe cluster (FCnet / SAFEDLINK)
- Operation and display for a particular area or system-wide
- Large 12” display with touchscreen operation
- High resolution color display

Fire terminal

FT2080
Without cover:
398 x 430 x 80 mm (HxWxD)
With cover:
398 x 430 x 108 mm (HxWxD)
Wall housing:
60 x 454 x 268 mm (HxWxD)
Desktop housing:
131 / 80 x 443 x 243 mm (HxWxD)

FT2080

Applications

The FT2080 fire terminal is suitable for installation in places where the system is frequently or primarily operated. The terminal can be installed in a separate housing, or recessed in the wall or a console.

Description

The terminal is operated via a touchscreen. Events are displayed in lists, with the current event shown in detail at the top. The control and display features are similar to a simple control system, and building plans, etc. cannot be displayed. The FT2080 is optimized to run a fire detection system. Various installation options are available, for example in a console, recessed in different housings

Characteristics

- Networking in any topology with up to 31 control panels and operating units in the fail-safe cluster (FCnet / SAFEDLINK)
- System operation and display anywhere in the network
- Selectable configuration options for the fire terminal to view and process messages on a system-wide basis or restricted to one or more fire control panels
- Large 12″ display
- Touchscreen operation
- High resolution color display
- Installed in standard housing, 19″ cabinet (FC2080),console or customer-specific housing
- Various installation options are available for example in a console, recessed in different housings

Fire terminal, Eco housing

FT2040-CZ
398 x 430 x 80 mm
(HxBxT)

FT2040-CZ

Applications

System information in the FCnet is displayed remotely at the fire terminal, which is an FCnet station. Access is via password or key switch.

Description

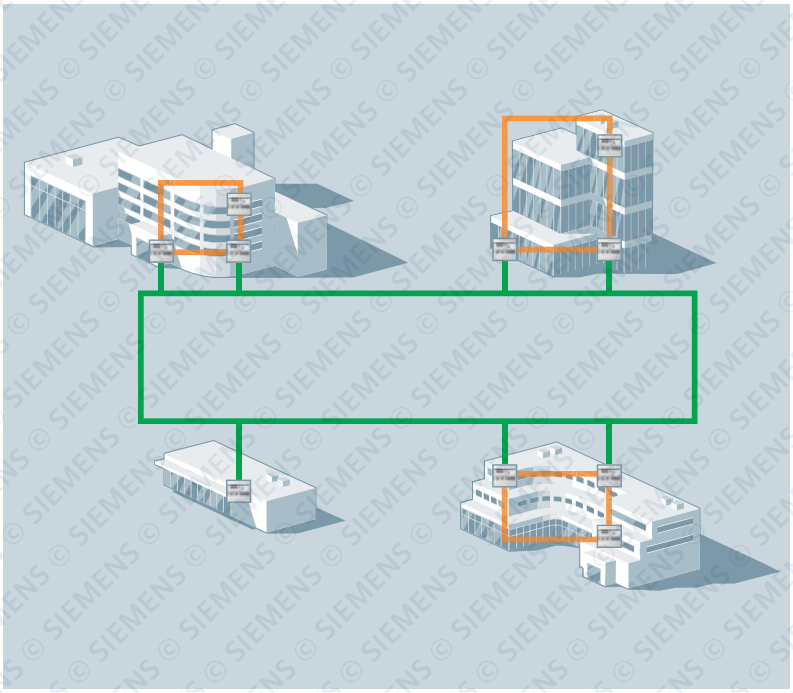
The FT2040-CZ fire terminal has the following characteristics:

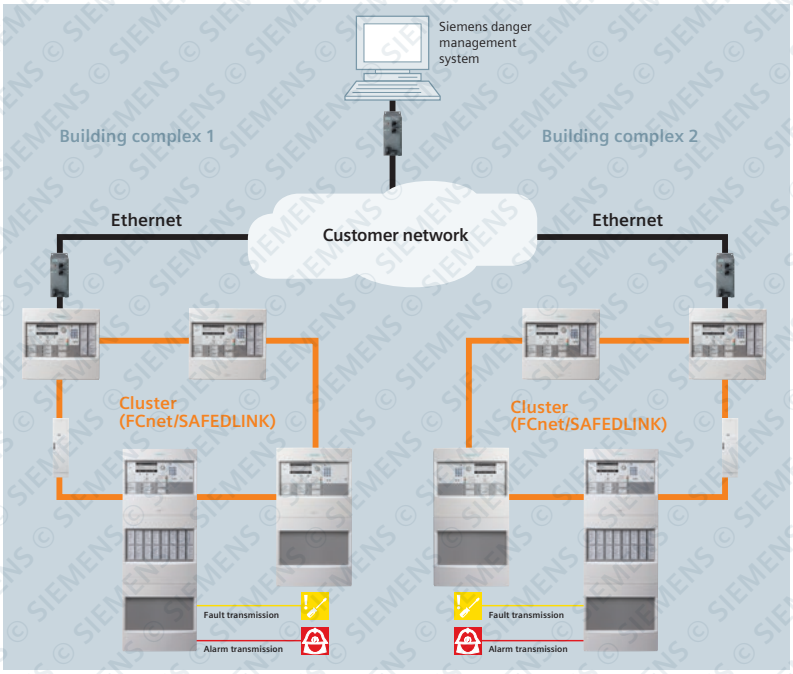
- Networking in any topology with up to 31 control panels and operating units in the fail-safe cluster (FCnet / SAFEDLINK)
- System operation and display anywhere in the network
- Selectable configuration options for the fire terminal to view and process messages on a system-wide basis or restricted to one or more fire control panels
- User-optimized display and context and status-sensitive operation via soft keys
- Operating and indication elements ergonomically organized in functional groups
- Large backlit display (8 lines of 40 characters)
  - Plain text display with two lines of information per alarm event
  - Directly displayed user guidance during alarm situations
  - Additional spontaneous display of location-specific intervention texts
  - Simultaneous display of multiple events
- Display fields, some with keys, 6 programmable LEDs (2 with keys)
- Different operating levels according to user profile
- Operating access via password or optional key switch (for entire system)
- Several fire terminals with equal rights can be connected to a fire control panel with nonreactive operation
- Integrated Ethernet connection (RJ45) to run a remote operating terminal or a fire control panel via the operator's existing LAN, to connect management systems via BACnet, and for remote access using SintesoView
- Integrated emergency function / emergency operation
- Optional slots for networking module FN2001-A1, power supply (70 W) FP2003-A1, battery (12 V, 7 Ah, VdS) FA2003-A1, serial interfaces RS 232 module FCA2001-A1 and RS 485 module FCA2002-A1, event printer FTO2001-A1 and key switch FTO2005-C1
- A license key can be used to activate the SintesoView function

SintesoView is software which emulates the operating panel of station. This means that SintesoView can be used to operate the fire control panels / fire terminals from a PC

- Max. battery capacity 2 x 7 Ah
- Other housings of the Eco type (FH2001) can also be used

Sinteso fire control panels





Networking options

Applications:

- Complex large buildings like hospitals or high rises
- For large corporate or university campuses

Description

- Sinteso control panels can be linked to each other with copper wire to form a cluster. This means all the displays in the cluster show the same information and controllers can be installed independently of the control panel.
- If the site is very large or there are long distances between the control panels, a fibre optic ring can be installed (shown in green). Alarms and information can be read and action taken from one place such as the company fire service building or the main gate.

Characteristics

- The fire control panel can be used in a network:
  - Up to 64 control panels in one EN 54 compliant system in up to 14 clusters
  - Up to 16 control panels per cluster can be networked with a danger management system
- The L2 FCA2013-A1 license key can be used to activate data transmission to the danger management system The L2 license key has the same functionality as the L1 license key (SintesoView) as it is only possible to install one license key per control panel

Network modules

FN2008-A1

Ethernet switch FN2008-A1

The Ethernet switch connects clusters with the backbone. For greater redundancy, a cluster can be connected to the backbone with a second control panel and a second switch.
For example for:

- Clusters with more than 512 detectors / manual call points
- Clusters with remote transmission in systems with more than 512 detectors
- Managed Ethernet switches
- 4x10 / 100 Mbit/s RJ45 connections
- 2x100 Mbits/s Multi Mode BFOC
- LED diagnostics

Modbus gateway (firewall) NK8237.2

Modbus gateway (firewall) NK8237.2

Used as a gateway between Sinteso fire detection systems and Modbus head-end / automation systems. Supports bi-directional communication with Sinteso. Provides firewall protection from:

- Data espionage
- Data manipulation
- Unauthorized access

FN2006-A1

Fiber network modules FN2006-A1 (SM) FN2007-A1 (MM)

Description

These fiber network modules can be used to connect Sinteso stations to the FCnet / SAFEDLINK system bus by fiber over long distances. A redundant power supply allows EN 54 compliant networking even with a remote networking module.

Features:

- Two independent, galvanically separated channels
- SC connector for optical fiber
- Two redundant, monitored EN 54 compliant power inputs
- Ground fault monitoring
- Installed in the station or remotely
- Flat or upright DIN rail attachment
- FN2006-A1: single-mode transmission up to 40 km
- FN2007-A1: multimode transmission up to 4 km

FS20-ESPA G

ESPA interface in housing FS20-ESPA G

Description

The FS20-ESPA interface connects the fire control panel to a telephone or pager system. Messages from the control panel are stored in the interface. Depending on the configuration, alarms and messages are then passed on to the relevant pager system. Transmission is based on the ESPA 4.4.4 standard.

View software control panel

FS20-SIV

FS20-SiV

Description

The Sinteso FS20 fire detection system can be operated from the SintesoView virtual terminal. A standard PC running SintesoView software becomes a remote workstation operating the Sinteso FS20 fire detection system. All functions are available, and status and warning messages can be displayed, e.g. system status or fire door activation.

The functions and appearance of the virtual terminal are exactly as they are in the Sinteso FS20 control panels / fire terminals. SintesoView is connected to the fire control panel via LAN / Ethernet. Secure Wi-Fi networks can also be used.

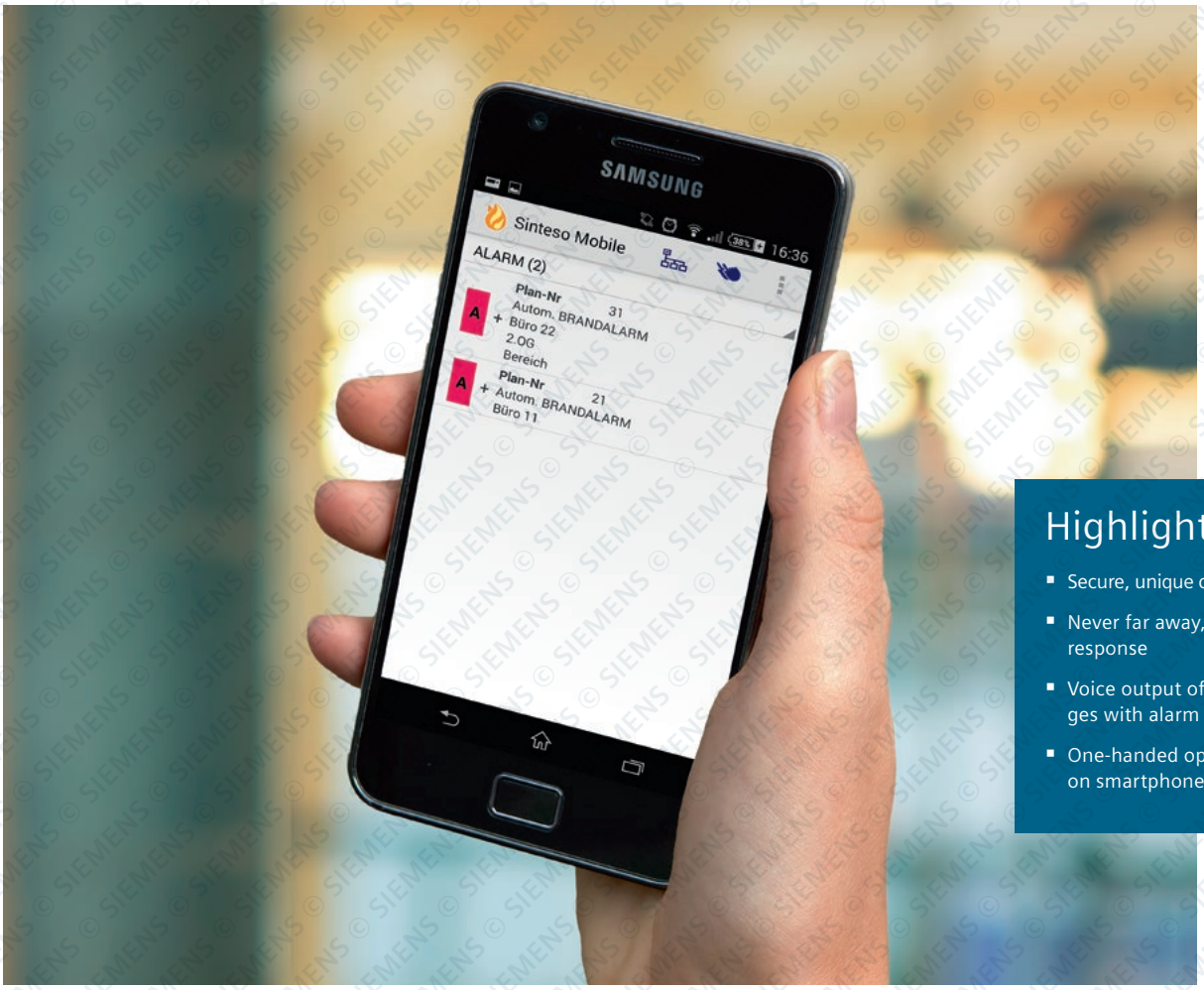
FS20 SiV2080

FS20 SiV2080

Description

The SiV2040 creates a virtual version of the FT2040 on the PC, and the SiV2080 does the same for an FT2080. The software is a copy of a physical terminal, and anything entered on the PC appears simultaneously on the FT2080 terminal.

Sinteso Mobile



Highlights

- Secure, unique connection
- Never far away, faster response
- Voice output of messages with alarm sound
- One-handed operation on smartphone

Never far away – the Sinteso mobile app saves valuable time in an emergency. Unlike siren or pager alarms, you can immediately see all the information on your smartphone or tablet PC so you can respond more quickly. The Sinteso mobile app can be active on multiple devices, providing role-specific information.

Benefits of Sinteso Mobile

Sinteso Mobile can be used with an Android terminal (tablet or smartphone) to access the FS20 fire detection system. Global access is possible (message display only) via cellular data, and the system can also be operated locally via Wi-Fi. A customized message layout optimizes the appearance for a screen (smartphone).

Flexible settings

- Display only: The user cannot send instructions to the system, but alarms, notifications, etc. can be displayed. This is useful for evacuation teams or hotel staff, for example, to speed up rescue or fire fighting. The information displayed can be limited to alarms or to certain areas such as a floor or a building.
- Activation of specified functions: «Acknowledge», «Reset», «Sirens Off» etc. can be individually activated. Safety officers, the company fire service or facility management staff can act quickly in an emergency according to their function, and can reset the system when the danger has passed.
- Authorized for full access: The rights to access the fire detection system can be transferred to the smartphone. This enables the technical department to switch the system off or on in certain rooms, for example during construction work.

Characteristics and description

- Works with the most popular operating system Android (from V4.1)
- Cellular connection (display only) or secure Wi-Fi connection
- High security with individual access authorization based on IMEI (International Mobile Station Equipment Identity)

Sinteso Mobile

Applications

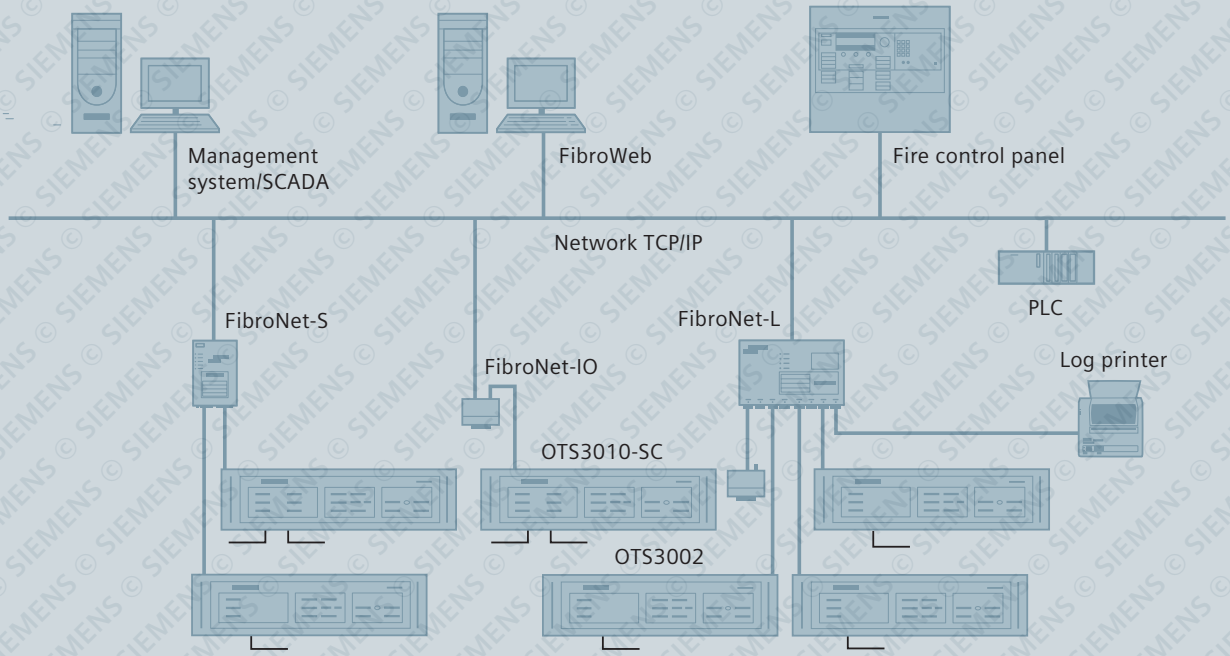
Sinteso Mobile can be used with an Android terminal (tablet or smartphone) to access the FS20 fire detection system. Remote display and remote operation are supported.

Characteristics

- Messages displayed by message category. Commands can be issued according to the selected EN54 access level.
- Messages can be filtered by message category.
- Configurable message categories for notification if app in foreground.
- Configurable message categories for notification if app in background.
- Detection hardware and control tree displayed
- Configurable notification sound for alarms.
- Configurable notification sound for other messages.
- Configurable autostart function.
- Configurable voice output for messages.
- High security with individual access authorization for Android devices based on IMEI (International Mobile Station Equipment Identity)
- The Sinteso Mobile view can be activated at «System» or «Station» level using the configuration tool
- Individual programming of the necessary access level for Sinteso Mobile using the «Acknowledge», «Reset» «Audible Signals» and «Alarm Delay Off»
- The configuration tool can set the app to «Limited Access» (display only) or full access (display and operation), or completely deactivate Sinteso Mobile.
- Displays specific message categories such as alarms, warnings or incidents

The system – speed plus precision equals safety

Tailored for your needs – for the best individual protection. An example.



Highlights

- Consistent safety, compliant with the relevant standards, for an area of up to 20 km in length
- Highest precision and reliability under harsh environmental conditions
- Extremely quick heat detection with maximum safety against error
- Fast alarming and safe evacuation thanks to pre-alarms and detailed information

Cable tray or road tunnel – so different the installations, so clear the demands on fire protection: quick detection and localization of the fire source – and minimizing the time until the fire alarm confirms. FibroLaser is a leader in both regards. Thus, the system satisfies the central requirements to prevent damage to lives and equipment and to protect your business operation.

Reliability over the entire distance – up to 20 km

As a line type heat detection system, FibroLaser offers consistent safety over the entire installation – with a detection area of up to two times 10 km in length. It meets the latest standards for line type heat detection. Through the certification of the VdS according to Pr EN 54-22, FM accreditation, and many other international endorsements, the doors are open to a broad range of applications.

Reliable heat detection – thanks to a robust sensor technology

FibroLaser provides high reliable heat detection also under harsh conditions: Robust sensor technology enables usage even under adverse conditions e.g. dampness, corrosion or dirt. Undiminished precision also during electromagnetic interference such as in cable trays or train tunnels.

Quick detection – precise localization

FibroLaser is sensitive to both convection and radiation heat. They are precisely analyzed within one second up to 0.5 m. As a result, the system is able to detect fires extremely quickly and with precise localization – combined with maximum immunity against deceptive phenomena and the elimination of false alarms.

Reliable alarming – efficient reaction

For fast and reliable alarm and evacuation, pre-alarms can be defined in order to warn the control center before the fire department receives the fire alarm. In order to intervene efficiently, FibroLaser provides the fire department with important information such as the exact location, the fire extent, and the direction of propagation of the fire. Also, necessary sections such as ventilation, smoke extraction systems, guidance system, and extinguishing systems are controlled according to the fire. The transmission of fire alarm and control commands takes place via a standard interface.

Kontroller OTS30xx* (1-channel)

The FibroLaser OTS30xx Controller allows a fast, precise temperature monitoring over distances up to 10 km. The flexible alarm criteria allow an appropriate reaction to critical conditions (pre-alarm) and fast alerting with corresponding controls in the event of fire (alarm). In addition to the localization of the source of fire, the system provides crucial information regarding size and direction of the fire.

Control unit OTS30xx*-SC (2-channel)

The FibroLaser OTS30xx-SC (Switch-Controller) allows a fast, selective temperature monitoring over distances up to 20 km. The «optical switch» installed in the device allows monitoring of two sensor fibres of maximum 10 km each. Through the two optical channels the Switch-Controller also allows the installation of a back-up system used to monitor the entire area in the event of cable break.

Sensor cable for standard applications

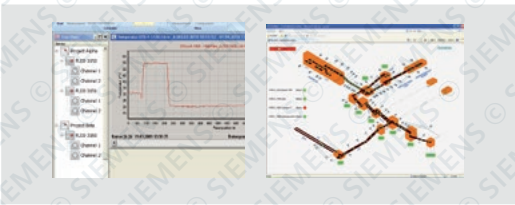
The standard version offers two glass fibre cables. The metal-free MFLT4-FRNC cable is mainly used for tunnel applications. In industrial plants, an extremely high robustness is generally required as regards mechanical impact. Therefore, the SWLT4-FRNC steel-stranded cable is used for such applications. Both cables are equipped with a halogenfree, infrared-absorbing, and retardant cable sheet FRNC (Flame Retardant Non Corrosive)

Sensor cable for special applications

The FibroLaser system is ideal for temperature monitoring in power plants and in the heavy industry. For these sectors such cables are required, which can be easily operated over years at temperatures of several 100 °C, or in areas with high radioactive radiation.

Network components

The available network components allow the integration of FibroLaser control units into a complete system. The FibroNet elements allow an easy network connection of the control units over all standard protocols such as TCP/IP or modules. With the FibroNet-IO the system can be upgraded with hundreds of inputs and outputs. All network components can be preassigned on request.



Visualization

The FibroManager allows an easy overview as regards the temperature values and the system conditions such as pre-alarm, alarm or disturbance in the programmed zones. The FibroWeb PC software allows the visualization of the customized facility with all indicators such as temperature values, alarms, active ventilation, etc. This visualization based on customer demands is adapted individually.

*xx is the monitoring distance in km (xx = 01, 02, 04, 06, 10)

XC10 – A compact solution for high performance

Highlights

- Maximum safety in case of an emergency – panels monitor and control all connected devices
- Quick and reliable identification of event origin – due to event memory and archive for configuration and event data
- Intuitive operation even in stressful situations – thanks to a clear user interface and a uniform operating concept
- System access and immediate operation away from main panel – with our repeater terminals
- Complete, tailored fire safety solution from one source – through intelligent integration with Sinteso and combination with Sinorix

XC10 are reliable and efficient panels for fire detection and extinguishing control. Thanks to the clear layout of the user interface, the panels are easy to operate. Thus, users can gain a complete system overview at a glance. An important feature for emergency situations. In addition, the XC10 portfolio with its sophisticated technology supports both single- and multi-sector applications. XC10 is also compatible with a wide range of fire detectors as well as special detectors and extinguishing solutions.

Efficient panels with strong advantages

Whatever your requirements, XC10 offers the right control panel: XC1001-A is ideal for single-sector applications in small to medium installations, XC1005-A for single-sector applications in medium to large installations and XC1003-A for multi-sector applications.

Maximum safety thanks to advanced features

XC10 fulfills all fire safety needs in one compact panel. In the event of a fire, reliable collective and conventional fire detectors quickly identify the fire phe-nomena. The control panels process all system signals and immediately trigger the alarming devices as well as the extinguishing process. They thus enable fast, safe and automated intervention. XC10 panels also control and monitor important connected peripheral devices such as system release, loss of agent, door control, ventilation control, remote transmission and many more – for maximum safety in case of an emergency.

You can connect XC10 with Sinorix extinguishing solutions based on natural and chemical agents, gas / water-combined as well as water mist solutions. This makes the control panels highly flexible in use and the ideal choice for applications ranging from IT rooms, data centers, generators, trans-formers, turbines, control rooms, clean rooms, cable ducts, storage rooms to libraries, archives and museums – whether the installations are simple or complex.

For evaluation reasons, up to 512 events – such as alarms, releases, faults, disablements and tests, acknowledgements

or resets – can be logged in an event memory. Configuration and event data can be additionally archived for professional reasons. This facilitates identifying the origin of an event, which is highly important especially for insurance matters.

Easily protecting even large and complex applications

You can benefit from our comprehensive application experience when it comes to the protection of different sectors. The technology of our advanced panels XC1003-A makes them a cost-efficient choice for multi-sector applications with up to 16 flooding zones. Only one extinguishing cylinder battery is needed to protect several sectors. This makes XC1003-A a space- and cost-saving solution, as you need less extinguishing cylinders than with conventional extinguishing systems. The panels required to protect different sectors can be installed together in one central cabinet. Thus, you can comfortably control the entire system from one location.

Increasing safety with clear and simple operation

All our XC10 control panels feature a clearly structured user interface that allows safe and intuitive operation. The fact that each panel of the XC10 family has the same operating concept additionally supports ease of operation – because if you know how to operate one panel, you know how to operate them all. This means that your safety personnel needs less training, even if they have to operate different members of our XC10 panel family.

You can enhance safety even further with our additional repeater terminals. They allow quick access to system information and immediate operation away from the main panel. Up to 16 remote terminals can for example be installed close to a flooding zone while the XC10 panels are centralized in your control room. Your advantage? Time savings, as your operator does not have to walk all the way to the main panel to check the system status. And increased safety, as he can immediately initiate appropriate action in case of an emergency at the repeater terminal closest to him.

Investment protection through an intelligent integration concept

Our advanced fire detection and extin-guishing control panels XC10 are a smart choice that protect your investment. Because XC10 can also be easily integrated into larger fire safety systems such as Sinteso. An integration with Sinteso means that you can benefit from a reliable fire detection and extinguishing control management as well as from an overall danger management. Simply connect XC10 with networkable Sinteso control panels, which can themselves be integrated into the Danger Management System from Siemens. This allows you to centrally control and monitor your complete fire safety solution.

Extinguishing panels

XC1001-A

XC1001-A
XC1005-A

Applications

The XC1001-A and XC1005-A are ideal for single-sector use and small to medium size installations. The XC1005-A is used in medium size to large installations. Both units can work independently or as part of a larger fire detection system, and can be combined with an extinguishing application.

XC1003-A

XC1003-A

Applications

The XC1003-A combined unit is based on multi-sector technology. Up to 16 extinguishing sectors are possible. As one extinguishing cylinder battery can be used for more than one sector, less cylinders are needed than with conventional systems. The XC1003-A requires little cabling, which simplifies installation and maintenance.

XT1001
XT1002

XT1001
XT10012

Applications

The XT1002 repeater terminal or XT1001 repeater display can be used to control or display the extinguishing panels remotely. Up to 16 displays and terminals can be installed on the same line.

Sinorix Compact™ Innovation and experience – the ideal combination

Fire damage in server rooms causes IT outages, with serious consequences for the business. A compact extniguishing system with integrated fire detection offers reliable protection for small server rooms up to 90 m^3 – a cost-effective option for all SMEs.

Advantages of the compact system

- Cost advantage:
  cheaper installation and more prefabrication lowers the price compared to individual solutions.
- Flexibility: the compact system is easy to relocate.

From a single source:
Detection, extinguishing and maintenance from the same supplier.

A solution for challenging environments

Siemens aspirating smoke detection (ASD) guarantees reliable fire detection in challenging fields where very early fire detection is essential and business continuity has the highest priority. Here, detectors with ASD technology are the perfect choice because they actively sample the air from the protected areas and check the samples for fire particles.

Technical details

- Wall cabinet:
  Dimensions 600 x 600 x 2000 mm
- Extinguishing control unit:
  Siemens XC10 rack version
- Sufficient potential-free contacts for status indication
- Detection based on Siemens aspirating smoke detector FDA221 or FDA241
- Extinguishing agent: Siemens Sinorix Novec 1230
- Extensions: remote terminal, illuminated display, manual call point, stop button
- Pneumatic control for overpressure flap (hose)

The new aspirating smoke detectors permit maximum detection reliability

The optical detection technology uses two wavelengths – blue and infrared. That means our aspirating smoke detectors can pick up the tiniest smoke particles that occur in the early overheating phase or in open fires. The detectors determine the size and concentration of particles in order to distinguish between smoke, dust and vapor. This means the FDA221 and the FDA241 detect smoke very early and very reliably. They are also extremely resistant to deceptive phenomena. The accurate detection and classification of particles prevents outages and costs caused by false alarms.

XC10 Extinguishing panel: a compact solution for high performance

The clearly laid-out user interface makes these extinguishing panels easy to operate. Users can see a full system overview at a glance – important if the worst comes to the worst. XC10 extinguishing panel also supports single-sector and multi-sector applications with its sophisticated technology. XC10 is also compatible with a wide range of fire detectors, other detectors, and extinguishing solutions.

Sinorix 1230 – fast, reliable and environmentally friendly

Sinorix 1230 is an outstanding solution to protect valueable facilities, business processes and people. It is based on the environmentally friendly 3M™ Novec™ 1230 Fire Protection Fluid and Siemens 42bar technology, allowing a highly efficient and flexible structure. Sinorix 1230 can prevent data loss through fast, reliable and automated interventions, safeguarding business continuity.

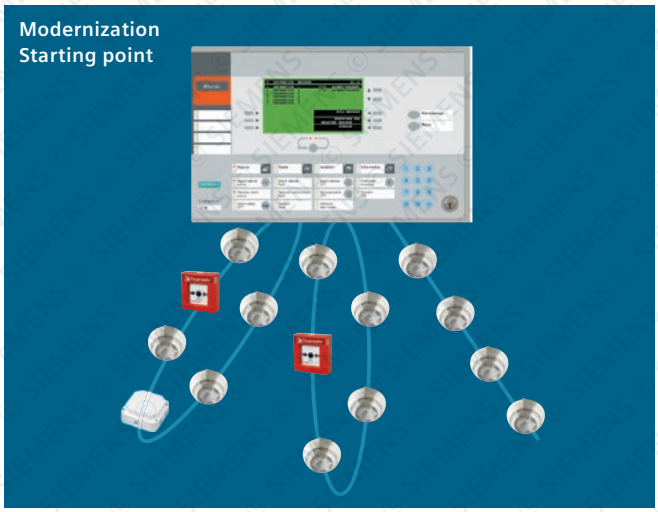
Fast, highly effective and economical

The high efficiency of the Sinorix 1230 system means that the concentration of extinguishing agent can be kept low. In fact, the Novec 1230 extinguishing agent has the lowest working concentration of any agent currently approved. That makes it possible to design a compact layout with less space devoted to installing and storing the containers. The Novec 1230 extinguishing agent is non-corrosive and non-conductive. As a result it cannot damage valuable items like sensitive electronics. It is also harmless to humans.

Highlights

- Maximum extinguishing efficiency and flexibility of structure
- Optimized protection of electrical and electronic equipment
- Efficient high pressure technology from Siemens
- 10 second flood time for rapid extinguishing
- Compact, space-saving system
- Sinorix 1230 extinguishing agent:
  - Non-conductive, no residues
  - Harmless to humans with one of the largest safety margins
  - Innovative, effective and environmentally friendly
- Aspirating smoke detectors with new dual wavelength detection for optimum object protection
- Powerful and flexible extinguishing control unit which is easy to use, with remove display or terminal

Maximum protection of life and property – a question of modernization



Distress, losses, costs, negative headlines or bankruptcy: all potentially caused by fires. We can protect you. Siemens explores all opportunities for your protection and can plan your system upgrade.

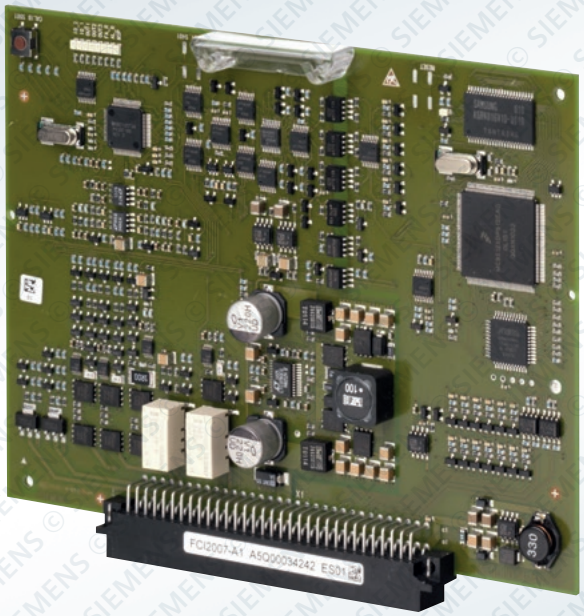
Into the future

When gas detector systems have been installed for a long time and are still in service, they often disguise the fact that they no longer up to the task. As a leading supplier of safety solutions, we provide sophisticated, tried-and-tested modernization concepts. Benefit from our experience of numerous modernization projects to ensure a smooth transition to a state-of-the-art fire protection system.

The many benefits of modernization

The older the fire detection systems become, the more difficult and expensive they are to maintain. In many cases, the system fails to fulfill the latest requirements and spares are no longer available. With phased modernization, you keep in step with the changes and developments in your company, and reduce the consequential impact of fires to a minimum.

The detector automatically recognizes the configured protocol type. With the FDB251 base adapter there is no need to replace the AlgoRex base. So there is no need for electricians or painters, and there can be no wiring errors.



Highlights

- Maximum protection of people and property with deception-free detection, safety functions and Sinteso control panels
- Modernization is a continuous process because conditions in your company are constantly changing
- Reliable, uninterrupted operation with a Siemens service agreement
- Phased modernization allows financial and schedule planning
- Innovative technology platforms to protect your investment long-term

These modernization control panels are used in phased modernization projects. They contain slots which can take over the detector lines depending on the fire detector type.

Long-term investment protection

Modernization is based on the current fire protection concept in your company. Our solutions are so flexible and individual that they perfectly match your preferred pace and available funds. You can choose from the following options:

- Classic: all at once
- Comfortable: modernize the fire control panel first
- Revolutionary: modernize the fire detectors first

When and how is up to you

We work with you to plan modernization over the period you specify according to your needs. This could be all at once or stretched over years. This means you can plan the investments and budget accordingly.

SIEMENS

Ingenuity for life

Extinguishing

buildingtechnologies.siemens.com

10.1. Introduction 344

10.2. Principles and Objectives of Extinguishing 344
10.2.1. Extinguishing Agents 344
10.2.2. Protection Categories 344
10.2.3. Protection Objectives 345

10.3. Fire Physics 345
10.3.1. The Three Elements of Fire 345
10.3.2. Combustion Process 346
10.3.3. Principles of Fire Extinguishing 346
10.3.3.1. Removing the Fuel 346
10.3.3.2. Removing the Heat 346
10.3.3.3. Removing the Oxygen 346
10.3.4. Flooding Time and Holding Time 347

10.4. Water Extinguishing Systems 347
10.4.1. Water as an Extinguishing Agent 347
10.4.2. Water Supply 348
10.4.2.1. Direct Public Water Supply 348
10.4.2.2. Pump Systems with Pressure Boost 348
10.4.2.3. Pump Systems with Tank 348
10.4.3. Sprinkler Systems 348
10.4.3.1. Protection Objectives of Sprinkler Systems 348
10.4.3.2. Setup 349
10.4.3.3. Wet-Pipe Systems 349
10.4.3.4. Wet-Pipe Sprinkler Systems with Anti-Freeze Agent 349
10.4.3.5. Dry-Pipe Sprinkler Systems 350
10.4.3.6. Pre-Action Systems 350
10.4.3.7. Water Spray Extinguishing Systems 350
10.4.3.8. Foam Extinguishing Systems 350
10.4.3.8.1. Foam as an Extinguishing Agent 350
10.4.3.8.2. Foam Types 350
10.4.3.8.3. System Setup and Function 351
10.4.3.9. Sprinkler Heads 352

10.5. Water Mist Extinguishing Systems 353
10.5.1. Cooling Effect 353
10.5.2. Oxygen Displacement 353
10.5.3. Other Effects 354
10.5.4. Fire Suppression and Extinguishing 354
10.5.5. Room Protection and Object Protection 354
10.5.6. Pump-Based Extinguishing Systems 354
10.5.7. Cylinder-Based Water Mist Systems 355

10.6. Powder Extinguishing Systems 355

10.7. Gas Extinguishing Systems 355
10.7.1. Inert Extinguishing Gases 355
10.7.1.1. Carbon Dioxide (CO_2) 355
10.7.1.2. Nitrogen (IG-100) 356
10.7.1.3. Mixed Gases (IG-55 and IG541) 356
10.7.1.4. Argon (IG-01) 356
10.7.2. Chemical Extinguishing Gases 356
10.7.2.1. Material Properties 356
10.7.2.2. Environmental Parameters 357
10.7.2.3. Extinguishing Characteristics 357
10.7.2.4. Toxicity 357
10.7.3. System Technology 357
10.7.3.1. Room Protection 358
10.7.3.2. Object Protection 359
10.7.4 Nozzles 359
10.7.4.1 Extinguishing gas nozzle 359
10.7.4.2 Silent nozzle 359
10.7.4.3 Mist nozzles 359

10.8. System Integration 360
10.8.1. Location of the Fire Extinguishing Control Unit 361
10.8.2. Power Supply 361
10.8.3. Alarm 361

Graphical overview	362
Dry-pipe system	362
Wet-pipe system	364
Sinorix – intelligent extinguishing	366
Sinorix N_2 • Ar • CO_2	368
Sinorix Compact	370
Sinorix 1230	372
Sinorix Silent Extinguishing Technology	374
Sinorix H_2O Gas	376
Water mist systems	378
Extinguishing with water	380

10.1. Introduction

Automatic extinguishing systems are designed either to extinguish or to prevent incipient fires in order to protect objects, rooms or entire buildings from fires and their consequences. The extinguishing agents used for this purpose are liquid (water), two-phase (foam), solid (powder) or gaseous (gases). Depending on the extinguishing agent, heat is removed and/or oxygen is displaced, or the fire is separated from the fuel. The extinguishing or suppressive effect begins with the flooding time and ends when the holding time finishes. Intervention and the automatic extinguishing systems must be harmonized accordingly.

Considerable experience and knowledge are required in order to select the most appropriate extinguishing method, the correct system layout and the optimum integration of the extinguishing system into the building management system. If these conditions are met, the system's fire protection effect will be very high and as planned.

Extinguishing is a crucial part of a comprehensive protection concept.

10.2. Principles and Objectives of Extinguishing

The industrial development that took place particularly during the second half of the 19th century promoted the concentration of production processes. Instead of the small workshops, industrial companies now produced goods mechanically using large-scale facilities in correspondingly large production halls. This process automatically led to a massive increase of fire risk, which could no longer be contained with conventional, manual methods. This environment was the beginning of the first technical extinguishing installations. The pioneers of these extinguishing systems were mills, usually built in wooden constructions that were several storeys high. In these mills, branched piping systems were installed to every room, with simple perforations in the pipes. In the event of fire, water could be fed through these perforations.

The first automatic extinguishing systems, known as sprinkler systems, replaced the perforations with sealed heads and heat-sensitive actuation elements. Today, sprinkler systems are still the most widespread extinguishing systems worldwide. Later, other solutions with foam, powder or different gases were developed, especially for fire risks for which water was not the optimum solution. Today, a variety of possible solutions is available, categorized according to extinguishing agents, protection concept and protection objective. Today, as a result of scientific research, efficient systems are available for rapid extinguishing when used appropriately.

10.2.1. Extinguishing Agents

The following extinguishing agents are internationally known and available today:

- water
- foam
- powder
- gases

Water continues to be the most widespread and best-known extinguishing agent. The most commonly used automatic system using water is the sprinkler system. These systems are used in almost all sectors of industry, larger business enterprises, department stores, garages, meeting places, schools, hospitals, hotels, airports, etc. In addition to sprinklers, automatically actuated water spray extinguishing systems are available. Since the end of the 20th century, water has also been used in systems operating with higher pressures, thus generating smaller droplets. These so-called water mist systems or water spray systems provide the same reliable extinguishing effect of «classic» water extinguishing systems, yet consume considerably less water. This system type will be described in detail below.

For decades, carbon dioxide (CO_2) and Halon were virtually the only known extinguishing gases. As a consequence of the Montreal Protocol of 1987, Halon was prohibited as an extinguishing gas, and industry reacted by developing alternative solutions. This led to the use of other natural gases as extinguishing agents: Today, nitrogen (N_2) and argon (Ar) are the most important natural extinguishing gases apart from CO_2. Compounds of these three natural gases are available too. Other chemical alternatives to Halon have been developed. The most significant group of chemical extinguishing gases not harmful to the ozone layer are the chlorofluorocarbons (CFC), their best-known representative being HFC227ea. The chemical extinguishing gas Novec™ 1230 from 3M™ has been commercially available for some time.
It is an agent with outstanding extinguishing characteristics that neither destroys the ozone layer nor significantly contributes to the greenhouse effect. While powder extinguishing systems are scarcely used due to considerable consequential damage (corrosion), foam extinguishing systems are commonly used to protect chemical and tank storage facilities.

10.2.2. Protection Categories

There is a distinction between building protection, room protection and object protection. Building protection is the complete protection of an entire building, while room protection deals with individual rooms separated by structural fire protection measures. These rooms usually contain high value objects. Object protection separately protects individual equipment, such as industrial machines erected in large halls or outdoors.

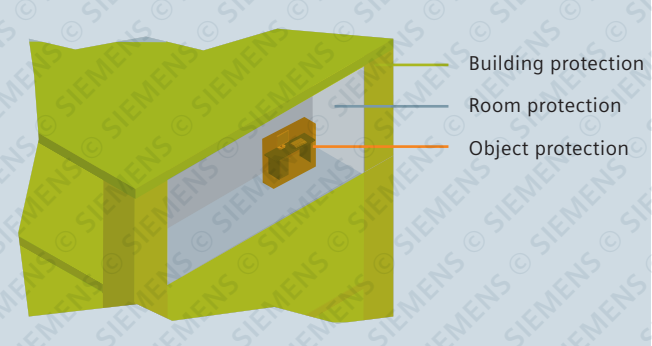


Fig. 10.1: Protection categories

Building protection is almost always achieved by water (usually with sprinkler systems), while extinguishing gases are particularly suitable for room protection. In object protection, only one gas – carbon dioxide – can currently be used as an alternative to water or foam.

CO_2 is stored in liquid form and also transported to the nozzles in liquid form for use. This allows very large quantities of extinguishing agent to be released close to the object very quickly, generating and briefly maintaining a working concentration.

10.2.3. Protection Objectives

In general, the following protection objectives exist:

- fire extinguishing
- fire suppressio

Like most water extinguishing systems, sprinkler systems aim at suppressing a fire. This means that they are not always able to extinguish a fire, but they can fight and contain it until the fire service arrives to extinguish the fire completely. In contrast, gas extinguishing systems aim at actually extinguishing any fire in the protected zone.

10.3. Fire Physics

The aim of this section is to provide an in-depth overview of the physical and chemical processes, specifically looking at the different possibilities of fire extinguishing.

10.3.1. The Three Elements of Fire

In general, a fire requires the presence of each of the three following components:

- heat (ignition energy)
- oxygen
- fuel

These three components are familiar from the so-called fire triangle (see Figure 5.2). Only one or two of these components are not enough to produce a fire – only all three of them together can create a fire, causing a chemical reaction known as combustion. In terms of chemistry, fuel and oxygen are the raw materials which only react under the influence of heat and are converted into combustion products, releasing energy. A fire is simply the consequence of this exothermic (= heat generation) process. These components can be described as follows:

- **Heat (ignition energy)**
  Energy from ignition sparks, hot surfaces or already burning materials (fuel)
- **Oxygen**
  An integral part of our ambient air, usually in a
- concentration of approx. 21 vol % of the atmosphere
- **Fuel**
  - Solid fuels
    such as wood, paper, synthetic materials, i.e. all materials containing carbon
  - Liquid fuels
    such as alcohol, propellants, particularly liquid hydrocarbons
  - Gaseous fuels such as hydrogen, butane, propane, i.e. all gaseous
  - hydrocarbons and a number of other gases, such as carbon disulphide (CS_2) or ammonia (NH_3)

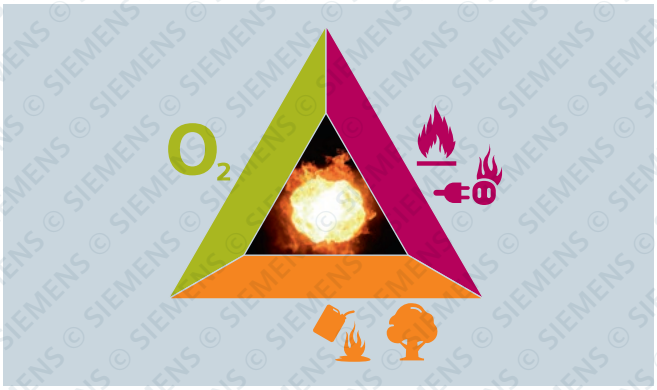


Fig. 10.2: Fire triangle

The specific reaction steps of decomposition occur sequentially but partly also in parallel to the reaction steps of the synthesis (the combination of individual atoms into new molecules). This so-called chain reaction is the basis of the combustion process, which is triggered by the three components heat, oxygen and fuel and is maintained as long as all three components are present. A combustion process is always exothermic, thus producing heat – this is one of the reasons why fire spreads quickly: oxygen and fuel are available in almost unlimited volumes at the beginning of the process.

10.3.2. Combustion Process

Combustion is simply a chemical oxidation process of fuel with the ambient air. The oxidation process can be divided into three different subprocesses. Depending on the type and nature of the oxidation, these different processes are as follows:

- smouldering fire, the decomposition of substances under the influence of heat
- glowing fire, with the fuel burning weakly without flames
- flaming fire or open fire

Depending on the state of matter (see Figure 5.3) of the burning material, different types of fire may result. The diagram below shows these correlations in a more detailed way:

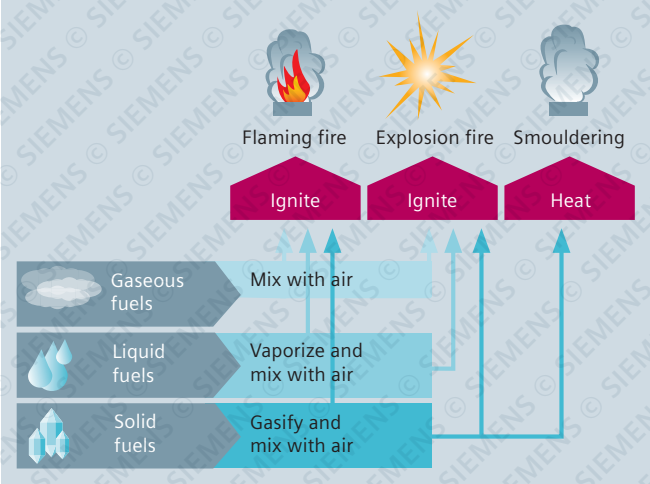


Fig. 10.3: Fire type depending on state of matter

10.3.3. Principles of Fire Extinguishing

Bearing in mind the three components of fire, there are three fundamentally different principles with which a fire can be extinguished. Each of these three principles aims at one of the three fire components.

10.3.3.1. Removing the Fuel

The fire goes out when all unburnt fuel is separated from the heat source, the fire. As the fuel cannot be removed in most cases, this method is generally useless with automatic extinguishing systems. Even manual removal of the fuel from the fire is impossible in most cases. The only way to separate the fuel is to use fire doors or smoke curtains.

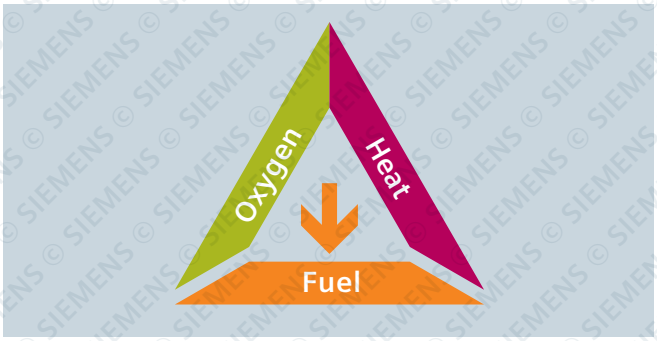


Fig. 10.4: Removing the fuel

10.3.3.2. Removing the Heat

Reduction of the temperature at the seat of fire stops the combustion process, thus extinguishing the fire. This is classically done with water. When the water is brought to the seat of fire, it vaporizes due to the heat. However, since the vaporization process absorbs a lot of heat (energy), the heat is removed from the fire. The resulting cooling effect leads to the breakdown of the combustion process if sufficient water is available.

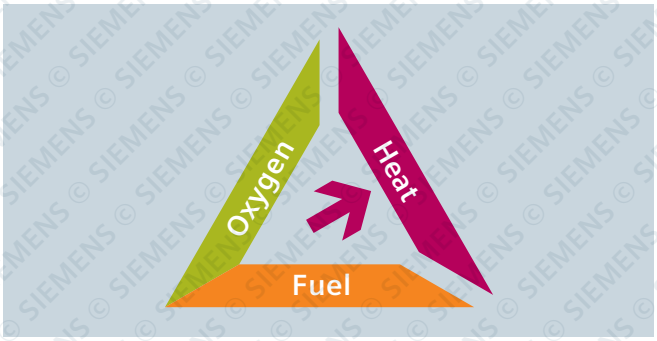


Fig. 10.5: Removing the heat

10.3.3.3. Removing the Oxygen

The reduction of the oxygen concentration near the seat of fire stops the combustion process due to lack of oxygen. The concentration of oxygen in the air is 20.8 vol %. If this concentration drops below 13 vol %, the combustion process will be stopped with most fuels. Automatic extinguishing systems operating with the natural gases carbon dioxide (CO_2), Nitrogen (N_2), argon (Ar) or mixtures of these gases make use of this extinguishing principle. The air – and thus also the oxygen – is partly displaced by the extinguishing gas. This process is known as blanketing.

Note that the residual oxygen concentration (normally between 10 and 13 vol %) normally does not entail danger to life. Breathing in such an atmosphere is comparable to breathing at an altitude of 4000 to 5000 metres above sea level, as the number of oxygen molecules available for breathing is approximately the same in both cases. Even though this method is largely harmless, the extinguishing area must still be evacuated. This is because dangerous combustion gases and smoke are already present before the extinguishing system is activated. The release of extinguishing gases is also very loud, potentially triggering panic.

The comments above about the non-hazardous nature of extinguishing gases do not apply to CO_2. This gas is harmful to people at concentrations as low as around 5 vol %. This has nothing to do with the reduced oxygen share in the air but with the toxicity of CO_2. As concentrations up to 50 % are used for extinguishing purposes, it would be fatal to remain within the extinguishing area.

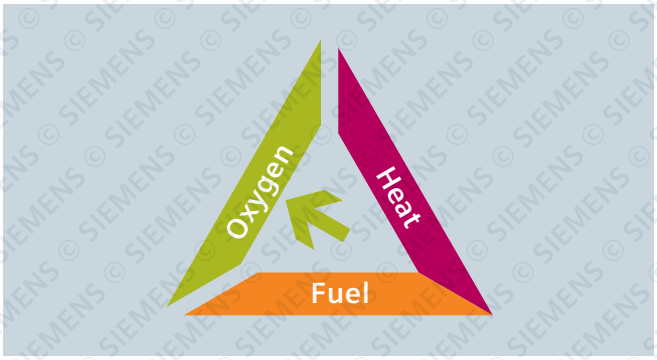


Fig. 10.6: Removing the oxygen

Foam extinguishing is based on removing the oxygen as well. The foam forms a separation layer between the burning material and the oxygen in the air. Chemical extinguishing agents such as HFC227ea or Novec™ 1230 are normally used in concentrations below 10 vol %. They are long-chained molecules consisting of many atoms. When such an extinguishing agent molecule penetrates the reaction zone, it is decomposed into smaller parts, theoretically its atoms. According to the gas law this causes an expansion of the extinguishing gas on the one hand and thus a local reduction of the oxygen concentration. On the other hand, the decomposition of the molecule and the subsequent recombination also leads to heat absorption, which in turn lowers the temperature. Chemical extinguishing agents also remove heat from the fire, while simultaneously reducing the oxygen concentration. Which of the effects will dominate depends on the extinguishing agent used.

10.3.4. Flooding Time and Holding Time

The flooding time is the time between the activation of the extinguishing process and the moment the required extinguishing concentration is reached. The holding time is the period of time during which the required concentration is maintained until it falls below 85 % of the design concentration, measured at 10 % and 90 % of the maximum room height. There is no holding time in wet-pipe extinguishing systems because an extinguishing event does not finish until the fire is effectively extinguished.

Depending on the particular conditions at the seat of fire, a successful extinguishing process must prevent re-ignition. This can only be reliably done when the required flooding and holding times are adhered to. It is important to detect fires at an early stage while they are still small. A consistently high response rate, independent of the cause of the fire, is thus very advantageous in fire detection and subsequent extinguishing. The quality of fire detection is a decisive factor, even when an automatic extinguishing system is installed.

10.4. Water Extinguishing Systems

Without doubt, water is one of the most important substances on earth. Approximately 70 % of the earth's surface is covered by water. Fauna and flora are 60 to 90 % water, and the atmosphere contains a vast amount of water in the form of humidity. Water is a fundamental prerequisite for life. For this reason, in mythology, water has been a symbol of life for thousands of years.

Water has played the main part in fire extinguishing since ancient times, and it is definitely the oldest and most common extinguishing agent. As approximately 90 % of all fires are class A fires (= solid fuels), which can be easily extinguished with water, it is still the most widespread extinguishing agent today.

10.4.1. Water as an Extinguishing Agent

The extinguishing principle of water (H_2O) has already been discussed in section 6.3.3.2. Removing the Heat.
Its main effect is cooling. Water has a high specific heat capacity and a high heat of vaporization:

- To heat up 1 litre of water from 10 to 100°C, 375 kJ or 90 kcal are required.
- To vaporize 1 litre of water from 100°C to water vapour, 2260 kJ or 540 kcal are required.

This cooling effect destroys the thermal foundation for the chain reaction. Moreover, unburnt combustible material is covered with water and hence separated from the oxygen. In addition, water constitutes a heat sink (= absorption of heat). These effects reduce both the rate of fire propagation and – after extinguishing – the risk of re-ignition. A side effect of extinguishing with water is the generation of water vapour. On complete vaporization, 1 litre of water is converted into approximately 1,690 litres of water vapour, which may lead to further blanketing. This side effect is unimportant with sprinkler systems, but it plays a role with water mist systems, which is described in detail in the sections «6.5. Water Mist Extinguishing Systems» and «6.7. Cylinder-Based Water Mist Systems».

How the water is applied to the fire is crucial for its extinguishing capacity. A great number of small droplets have a much greater cooling effect than a concentrated water jet.

10.4.2. Water Supply

Depending on the hazard potential and the type, wet-pipe systems must have sufficient water for fire fighting. The water is taken from the public water supply. There are three categories of water supply in Switzerland:

- very good water supply
- good water supply
- adequate water supply

10.4.2.1. Direct Public Water Supply

Switzerland is fortunate in that 95 % of sprinkler systems can be directly connected to the public water supply.
A direct connection to the public water supply is therefore the preferred option. Unless a recognized system separating device is installed, direct connections must never be supplied with water from open water.
The water supply must always provide all the water required by the sprinkler system and by the fire service to a pressure p = 2.5 bar and 0.1 bar per metre of protected building height (at least 3.5 bar).

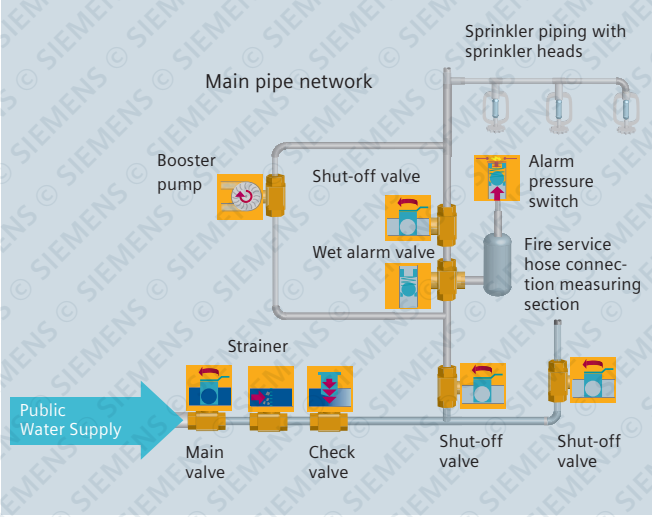


Fig. 10.7: Direct connection to the public water supply

10.4.2.2. Pump Systems with Pressure Boost

If the water quantity is sufficient but the dynamic pressure is not high enough, at least one booster pump must be installed. Depending on the required water supply, one or two booster pumps must be used.

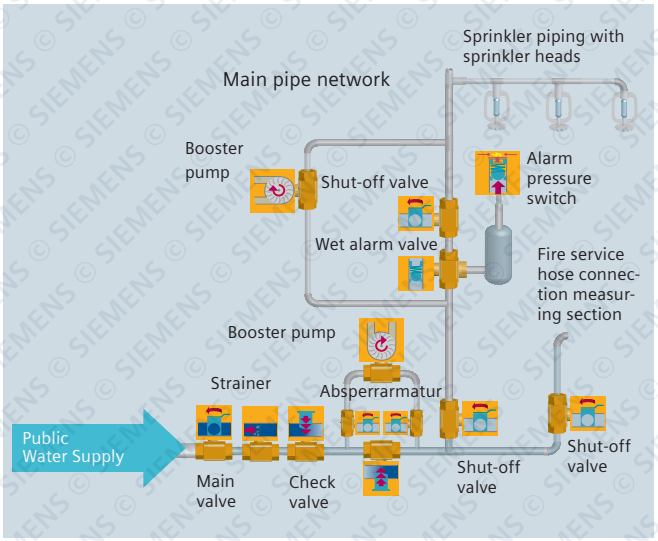


Fig. 10.8: Setup of a pump system with pressure boost

10.4.2.3. Pump Systems with Tank

If there is insufficient pressure and water, tanks must be installed in addition to the pumps. Account must also be taken of the amount of water that can be delivered from the public water supply.

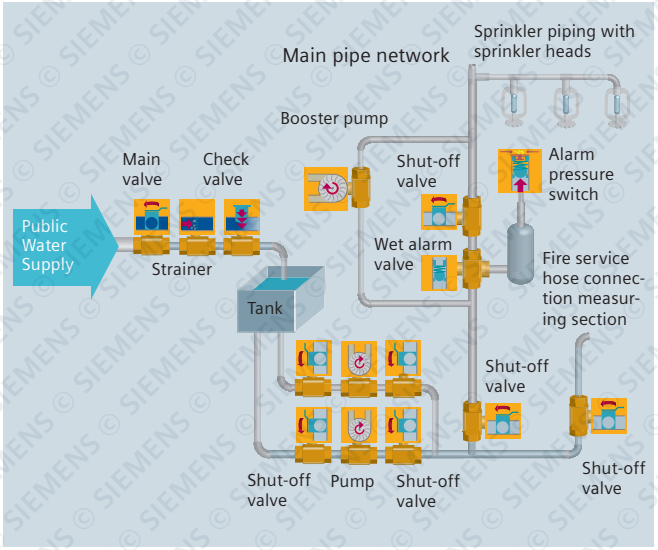


Fig. 10.9: Setup of a pump system with tank

10.4.3. Sprinkler Systems

10.4.3.1. Protection Objectives of Sprinkler Systems

As already mentioned, sprinkler systems primarily serve the purpose of building protection. Although the protection of valuables or people in the building must by no means be neglected, it is basically a consequence of the first protection objective. Sprinklers are automatically actuated individually when the temperature at the sprinkler head exceeds a critical value. As the actuation automatically triggers the water supply, sprinkler systems also serve as fire detection systems and are normally directly connected to the intervention forces on site or to the fire service.

10.4.3.2. Setup

The first patent for a sprinkler system was issued in 1723 to a chemist named Ambrose Godfrey. This system consisted of a tank, the content of which was distributed with a gunpowder charge. Early pipe systems were invented and refined between 1806 and 1852. The first sprinkler head, which was equipped with a fusible link, was patented in the United States in 1874 by Henry S. Parmelee.

Automatic sprinkler systems consist of a pipe system spreading the sprinkler heads as evenly as possible. The sprinkler network is separated from the main water supply by a main alarm valve.

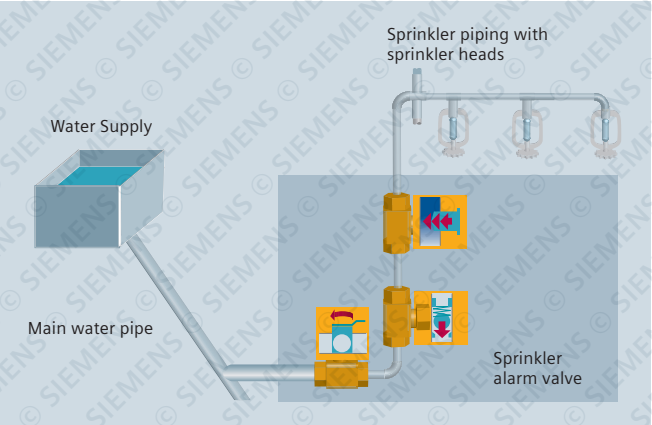


Fig. 10.10: Schematic diagram of an automatic sprinkler system

The alarm valve between the main water supply and the sprinkler network performs various functions:

- Isolates the sprinkler network from the water supply (usually the public water supply or, rarely, a tank) because the water pressure in the sprinkler network is different from the pressure in the water supply.
- allows system maintenance
- activates alarm sirens
- activates alarm relay via fire control panel to fire service

There are basically three types of sprinkler system:

- wet-pipe systems
- dry-pipe systems
- pre-action systems

The water supply must be sized such that the system can keep running for at least 60 minutes. The precise configuration of the water supply and the length of the holding time are determined by the fire hazard class defined for the protected object. The SES guidelines on sprinkler systems describe them in detail.

10.4.3.3. Wet-Pipe Systems

Wet-pipe sprinkler systems are the oldest, most widespread and most reliable sprinkler systems.

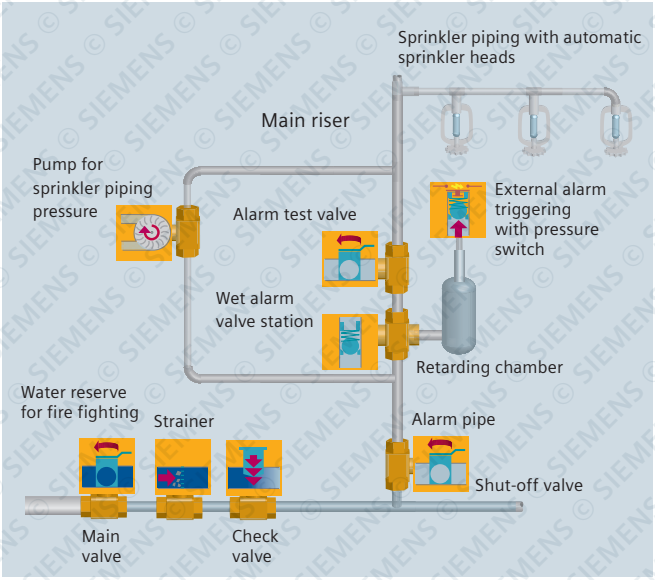


Fig. 10.11: Schematic diagram of a wet-pipe sprinkler system

Figure 5.11 shows the oldest, most widespread and most reliable sprinkler system type. A wet-pipe sprinkler system consists of the main riser, beginning at the sprinkler station and connecting the attached branch pipes on which the closed sprinkler heads are mounted. Normally, the main component of the sprinkler station, the alarm valve, is closed and the full volume of the pipe is filled with water. The water may contain an anti-freeze agent. The pressure is usually slightly higher (approx. 2 to 3 bar) than in the water supply pipe, in order to keep the alarm valve closed. The alarm valve serves different purposes, the most important being the opening of the water supply pipe in case of a pressure drop in the sprinkler pipe network. This is the case as soon as a sprinkler head has been activated. Opening the alarm valve enables the influx of the complete water volume through the riser into the sprinkler pipe network and shows that one or more sprinkler heads have responded. The same valve serves as a test valve and prevents contaminated water from flowing back from the sprinkler pipes to the water supply pipe.

10.4.3.4. Wet-Pipe Sprinkler Systems with Anti-Freeze Agent

Wet-pipe systems are preferable in almost all situations. However, there is sometimes a risk of freezing in areas protected by sprinklers. To solve this problem quickly, glycol can be added to the water in the pipe network. The concentration is determined for at least minus 20 °C. The system works in exactly the same way as a wet-pipe system. To prevent anti-freeze agent entering the drinking water system, a drinking water protection valve must be installed at the service entry point.

10.4.3.5. Dry-Pipe Sprinkler Systems

Dry-pipe sprinkler systems are a derivative of wet-pipe sprinkler systems to guarantee protection of unheated rooms. Dry-pipe sprinkler systems require a pipe network similar to that of wet-pipe sprinkler systems. This pipe network is under positive air pressure instead of water pressure, with the air keeping the alarm valve closed. As dry-pipe sprinkler systems are particularly used for unheated buildings, the water-containing part, i.e. the alarm valve, must be heated.

The air must be blown out before the water can flow, causing a short delay. This delay means the fire has longer to develop and more heat builds up in the room. For this reason, additional neighbouring sprinkler heads are activated, subjecting the building to a correspondingly higher water load.

10.4.3.6. Pre-Action Systems

These systems are installed in rooms where the activation of sprinklers would entail considerable damage, for example in large paper archive rooms or server rooms. For this reason any unwanted activation, for example by mechanical damage, must be avoided under all circumstances. As with dry-pipe systems, the pipe network is filled with pressurized air. The alarm valve station, however, is designed in such a way that it can only open when a fire detection system has also responded. This means that mechanical damage alone cannot lead to a water discharge.

10.4.3.7. Water Spray Extinguishing Systems

Water spray extinguishing systems are stationary water extinguishing systems. In terms of setup, they are similar to sprinkler systems. The two most significant differences compared to sprinkler systems are:

- The system is provided with open sprinkler heads or nozzles; heads have no heat-sensitive elements (glass bulb or fusible link).
- To activate the water spray zone valves, a separate fire detection system is required.

The distinguishing feature of water spray extinguishing systems is their wide coverage through many spray heads. Water spray extinguishing systems were developed for areas with a particularly high fire load, such as fuel storage facilities where rapid fire spread is likely. In such cases, neither wet nor dry extinguishing systems with their individually opening sprinkler heads could control the quickly spreading fire, especially because a limited number of sprinkler heads distribute the water only locally and too late. Due to the very high water volumes discharged in case of actuation, water spray systems require an extremely high capacity of water supply.

A water spray system consists of the following indispensable components:

- reliable water supply
- main valve/shut-off valve
- water spray range valves
- fire detection system with interface to the water spray extinguishing system
- pipe system
- open sprinkler heads

The water supply must have a very high capacity and is therefore normally equipped with stationary extinguishing pumps, as the water supply usually does not generate a pressure high enough to generate a sufficient water flow for all simultaneously opened spray heads. The water spray range valves require an electric, hydraulic, or pneumatic drive and must allow manual activation.

10.4.3.8. Foam Extinguishing Systems

Foam as an extinguishing agent was invented as early as 1880. At that time, the search for crude oil had caused a sudden increase in the number of drilling derricks, frequently causing oil fires. As it is impossible to fight such fires with water alone, soap was added to the water with the aim of reducing the water's surface tension. These conditions were the origin of the use of extinguishing foams in fire protection: a mixture of water and foam-generating additives.

10.4.3.8.1. Foam as an Extinguishing Agent

Foam is usually generated in two steps:
1. mixture: water + foam-generating agent = foam solution
2. generation: foam solution + air = foam

Many different types of foams have been developed, all of which have the same effect on fire – the burning surface is covered, separating the fuel (solid or liquid) from the ambient air and thus from oxygen. In addition there is a cooling effect dependent on the foam type.

10.4.3.8.2. Foam Types

The ideal foam for fire protection purposes must have the following characteristics:

- it retains its water share as long as possible to build a vapour barrier layer over the burning surface
- it flows quickly and easily over a burning fuel surface
- it protects from flashover until the burning material has cooled below the autoignition temperature

In addition, foam should have a number of other properties, for example it should be non-toxic, low-cost, easy to clean, adhere to vertical surfaces, etc. Unfortunately, in reality there is no foam with all these characteristics. This is the reason for the large number of foam agents developed worldwide. This variety is divided into three classes:

- low-expansion foam
  (1 litre of foam solution = up to 20 litres of foam)
- medium-expansion foam
  (1 litre of foam solution = 20 to 200 litres of foam)
- high-expansion foam
  (1 litre of foam solution = more than 200 litres of foam)

These classes are distinguished on the basis of the air volume to be added.

Aqueous Film-Forming Foam

AFFF is a noteworthy type of foam. AFFF is an abbreviation of «Aqueous Film-Forming Foam». The main component of these foam agents is synthetic and capable of generating aqueous films on combustible liquids. All AFFFs contain fluorinated, long-chained hydrocarbons, providing them with particular surface-active properties. Different water-soluble, high-molecular synthetic polymers are added to reinforce the foam bubble walls and to delay the collapse of the bubbles.

AFFF generates air foam combining low viscosity with fast propagation and level compensation. AFFF thus behaves like other foams, acting as an air barrier and preventing fuel vaporization. The main difference is that AFFF is capable of generating a dense aqueous film on the fuel. Combined with water, AFFF can be discharged by conventional water extinguishing systems, without the need for specially designed pipe nozzles.

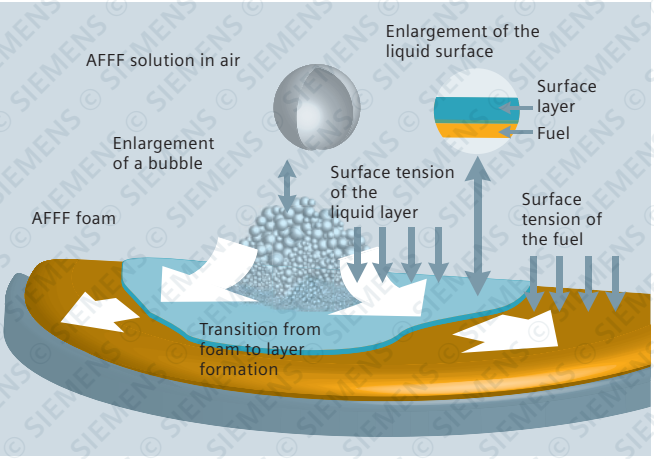


Fig. 10.12: Surface effects of AFFF

10.4.3.8.3. System Setup and Function

Foam extinguishing systems are used for combustible liquid fires.

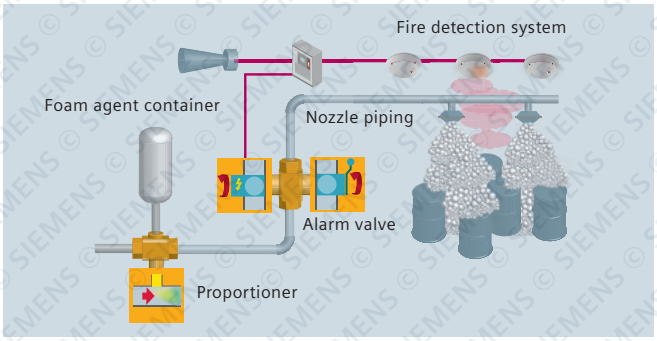


Fig. 10.13: Diagram of a foam extinguishing system

A foam extinguishing system consists of the following major parts:

- fire detection system with alarm and extinguishing actuation
- (alarm valve)
- water supply
- foam proportioning (foam agent container, proportioner)
- foam generation and distribution (nozzle piping)

The first part comprises the fire detection, which must be selected in accordance with the type of risk. The detectors are preferably set up in multidetector logic, as is common practice with automatic extinguishing systems. In the event of an alarm, the fire detection control unit activates all alarm devices and switches off the power supply, air conditioning and other devices in the alarm zone. It simultaneously activates the automatic main water valve of the foam extinguishing system.

The second part consists of the manual foam inlet valve, which separates the foam system from the water supply. The manual foam inlet valve is normally open. The water pressure and the available water supply must deliver the volume and speed of foam generation necessary for the risk in question. If this is not guaranteed, pumps with adequate water storage containers are required. The automatic main valve is normally activated electrically and/or manually. This valve is usually a so-called butterfly valve, which is opened by an electric motor or hydraulically.

The third part is the heart of the system, where the foam is proportioned. Three different proportioning principles are widely used (see Figure 5.14):

- proportioning by the Venturi principle, based on the negative pressure generated by the flow velocity
- pressure proportioning; the foaming agent is subjected to the water pressure (bladder tank)
- proportioning pump driven by a motor

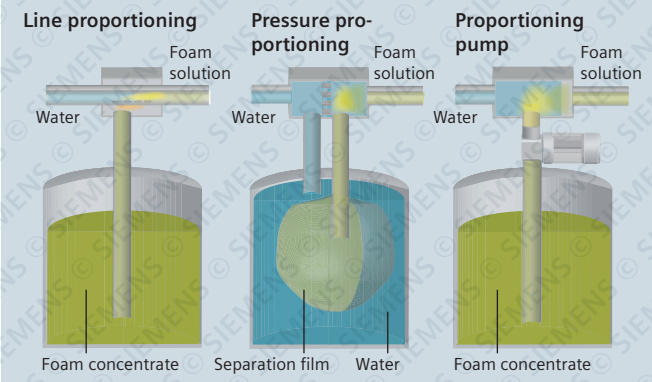


Fig. 10.14: Mixing principles

In the fourth and final part, the foam is generated and distributed. The foam generators distribute the foam mass flowing through the pipe system to the surfaces to be protected.

10.4.3.9. Sprinkler Heads

Sprinklers have two functions:

- selective fire detection
- generation of water droplets in a predefined size and their distribution over the protected area

All sprinklers are of the same design, consisting of the sprinkler head with nozzle, sealing element, actuation element and spray plate. With the glass bulb sprinkler, the actuation element is a glass bulb filled with a liquid. The water bulb bursts when it is heated up, due to the strongly rising pressure of the bulb contents. In a fusible element sprinkler, the actuation element is made up of the soldered joint of two plates. The soldering metal used melts at a defined temperature. With both sprinkler types, the sealing element is thrown from the nozzle by the water or air pressure in the sprinkler pipe network. The water flowing out is divided up into droplets by the spray plate and sprayed over the coverage area. With standing sprinklers, the water flow must also be directed downwards.

Sprinkler Types

The sprinkler types are determined by the nature of water distribution and the potential application:

- normal sprinklers
- spray sprinklers
- flat spray sprinklers
- sidewall sprinklers
- ESFR sprinklers
- wide-range wall sprinklers
- water spray heads
- foam pipe
- light foam cage

Normal sprinklers and **spray sprinklers** are the same except that. normal sprinklers direct more water to the ceiling than spray sprinklers. This was designed to cool wooden ceiling structures, which used to be the most common construction method. Fire tests have revealed that even with spray sprinklers, the temperatures below the ceiling remain within limits that imply no risk of an ignition of the wooden structure. In Switzerland, for example spray sprinklers are the most widely used type.

Flat spray sprinklers are installed when there is not enough free space between the sprinkler and the equipment or stored goods.

Sidewall sprinklers are used with limited ceiling heights and when there is risk of mechanical damage to the sprinklers.

ESFR sprinklers (Early Suppression Fast Response) have been developed for use in high-risk storage facilities with high storage heights, without sprinklers on intermediate levels. In addition to a quicker actuation element, they have a different water distribution spectrum with a very high water flow of more than 40 l/m² per minute. Due to the large nozzle bore and the high minimum pressure, larger drops are ejected at higher speed, being more likely to penetrate the flames and directly extinguish the seat of fire. The installation of ESFR sprinklers requires full adherence to many building construction specifications, such as the inclination angle of the roof, and is therefore not always possible.

Wide-range wall sprinklers were developed for use in small rooms of limited height, fitted to a wall. Hotels and offices are typical applications for this sprinkler type.

Activation Temperature

The nominal actuation temperature of sprinklers should be approximately 30°C higher than the maximum ambient temperature. The standardized temperature levels of the different sprinklers are listed in the table below:

Fusible element sprinklers		Glass bulb sprinklers	
Nominal actuation temp. [°C]	Colour code	Nominal actuation temp. [°C]	Colour code
57 – 77	Uncoloured	57	Orange
80 – 107	White	68	Red
121 – 149	Blue	79	Yellow
163 – 191	Red	93 – 100	Green
204 – 246	Green	121 – 141	Blue
260 – 302	Orange	163 – 182	Violet
320 – 343	Black	204 – 260	Black

Tab. 10.1: Sprinkler head colour codes

Response Sensitivity

In the course of further development, the response sensitivities have been improved. By modifying the fusible elements with heat conductive plates and smaller sizes, the time until opening could be reduced. Over the past few years, smaller glass bulbs with the same characteristics have been developed.

Sprinklers are divided into three response sensitivity classes. These classes and the application limits at the installation are also listed in the SES guidelines.

Response sensitivity	RTI [sec] (Response Time Index)	Intermediate level sprinklers	Ceiling sprinklers over intermediate sprinklers[1)]	Dry-pipe systems	All other systems
Standard	80 – 200	Not admissible	Not admissible	Admissible	Admissible
Special	50 – 80	Admissible	Admissible	Admissible	Admissible
Fast	< 50	Admissible	Admissible	Not admissible	Admissible

[1)] The ceiling sprinklers must have the same or a slower response sensitivity class than the intermediate level sprinklers.

Tab. 10.2: Response sensitivity classes of different sprinkler types

Water spray heads do not have glass bulbs or fusible elements. There are several head types. The spray patterns are much the same as conventional sprinklers. For object protection, foam pipes for heavy and medium foam are used.

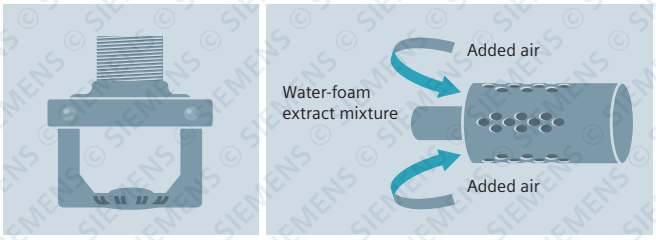


Fig. 10.15: Water spray head (l.) / Foam pipe (r.)

Light foam cages are used for light foam. This system, too, is open. The foam solution is carried through the pipe network. Air is added between the nozzle and the foam cage to create the light foam, which falls from the end of the cage.

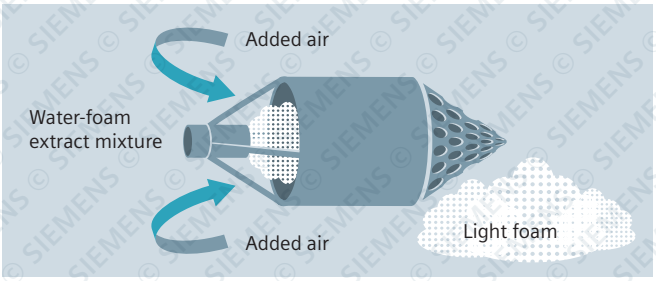


Fig. 10.16: The light foam is created in the foam cage

10.5. Water Mist Extinguishing Systems

Over the past few years, water mist extinguishing technology has gained in importance both for room and object protection. Different products have been developed by various suppliers for a wide range of applications. All these solutions have one thing in common: in contrast to the conventional sprinkler technology, they try to achieve a droplet spectrum with the smallest possible diameters by applying higher pressures (up to 100 bar) and specially designed nozzles, in order to achieve better cooling/vaporization thanks to the large specific overall surface area.

In comparison to sprinkler systems, water mist technology uses considerably lower water volumes, as tests and approvals have shown. The European standard on water mist systems, currently being developed by CEN, will regard these systems as a sprinkler system replacement. Every extinguishing system must successfully pass fire tests for each application, proving that it is at least as efficient as a sprinkler system. The flooding/holding time of all water mist extinguishing systems is up to 30 minutes according to this planned standard. The tank must thus be sized accordingly.

Water mist fights fires with tiny droplets of pure water. Depending on the application, droplet sizes between about 20 to 200 µm are used (class I water mist as defined in NFPA 750, 1996 edition). These systems are particularly effective and work with very small amounts of water. Water mist extinguishing works mainly through the cooling effect and the oxygen displacement effect.

10.5.1. Cooling Effect

Turning the water into mist under high pressure significantly increases the reaction surface available for cooling compared to conventional low-pressure systems. That means high-pressure water mist systems can remove energy from the fire much more quickly and efficiently.

10.5.2. Oxygen Displacement

The small water droplets quickly vaporize at the seat of the fire. Vaporization only takes place where the temperature is high. When it vaporizes, the volume of the water increases by 1640 times, locally displacing some of the oxygen at the seat of the fire. This smothers the fire in an effect similar to an extinguishing gas. Unlike extinguishing gases, the oxygen concentration in the room as a whole does not fall. Compared to low-pressure water mist systems or other conventional water extinguishing systems, the small droplets produced by high-pressure technology are much more effective at fighting the fire, so much less water is used. A system pressure of 50 to 200 bar is necessary in order to create the small droplets and deliver them with sufficient force to the seat of the fire.

10.5.3. Other Effects

Other positive effects are observed in water mist extinguishing, over and above those mentioned above.

- Blocking of radiated heat: the small water droplets effectively block the radiated heat, considerably reducing the impact on people, equipment and other fire loads.
- Thinning: the fine water droplets, which vaporize precisely where the fire is burning, lower the concentration of flammable gases. This helps to combat the fire.
- Smoke removal: soot particles and water-soluble smoke components are partly removed and deposited by the fine water droplets.

10.5.4. Fire Suppression and Extinguishing

Depending on the particular application, fire fighting usually has two different aims. Extinguishing a fire is defined as completely putting out the fire, with blanketing and cooling to rule out re-ignition. This is the aim for applications like these:

- fuel fires in engine test rigs and machine rooms
- oil fires in deep fat fryers
- flammable liquids in storage and production facilities
- oil in transformers, etc.

In these applications, high-pressure water mist replaces the more usual gas or foam extinguishing systems, and sometimes water spray systems. Fire suppression is defined as the significant reduction of temperatures around the fire and the significant inhibition of fire spread until the remaining fire and hot spots are put out by the fire service. Typical applications include:

- office areas
- hotel rooms
- hospitals and laboratories
- archives and libraries
- historic buildings
- car parks

For these applications, high-pressure water mist is an alternative to conventional sprinkler or water spray systems. That is why the term «fire fighting systems» is also used.

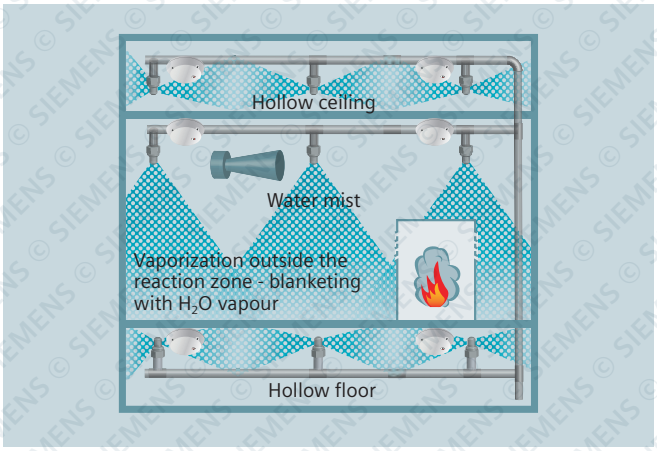


Fig. 10.17: Extinguishing effect of water mist in room protection

10.5.5. Room Protection and Object Protection

Generally speaking, there are two types of fire fighting system: room protection and object protection. Room protection means coverage of the entire room by a fire fighting system. It is used if the items at risk are not linked to a particular location or if there are too many of them, or if object protection is very expensive or otherwise impossible. Typical examples of room protection include hotels, office buildings, archives, server rooms or storage areas. With room protection it is also possible activate the high-pressure water mist system selectively. This can be done with automatic heads (with glass bulbs like conventional sprinklers, also called HPWM sprinklers) or by zoning. Object protection provides coverage for local items at risk or objects in large halls. Here, the HPWM system is installed specifically for the protected object, for example deep fat fryers, all types of machinery, hydraulic systems, transformers, etc.

10.5.6. Pump-Based Extinguishing Systems

Pump systems are always used if a high-pressure water mist system protects a large risk area or if the protection concept requires continuous HPWM. The high-pressure water mist pump system has a modular structure and consists of one or more high-pressure pumps, a header tank and a control cabinet. A pressure maintaining device and a compressor may be added to the system.

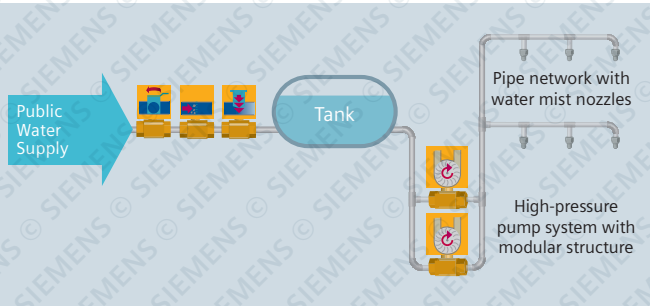


Fig. 10.18: Modular pump system

10.5.7. Cylinder-Based Water Mist Systems

Cylinder systems are primarily used to protect smaller areas. The risks involved are normally covered by a protection concept which states that the fire must be put out within a limited time. Water mist cylinder systems consist of separate pressure vessels filled with water and a propellant (nitrogen) respectively. If the system is activated, the nitrogen flows into the water cylinders and forces the water into the pipes and through the spray heads. Cylinder systems can work independently of any power supply.

The process expels the two-phase extinguishing agent mixture consisting of water and nitrogen, with the added advantage that at 60 bar, low-pressure heads and standard pipe fittings are sufficient to generate a water mist. That means there is normally no need for expensive high-pressure fittings. The system automatically generates the water mist and homogenizes it to a droplet size of less than 50 µm in diameter by creating turbulence, and expels the mixture in two phases.

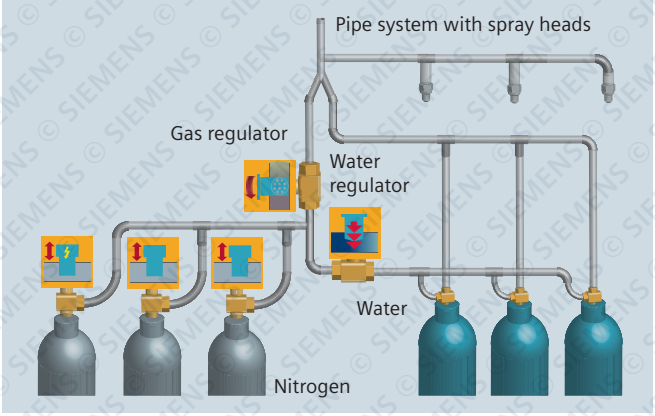


Fig. 10.19: Principle of operation of water mist cylinder systems

10.6. Powder Extinguishing Systems

Powder extinguishing systems are used when there is a risk of liquid or gas fires. For fighting metal fires, special extinguishing powders are available as well. The extinguishing principle is based on the interruption of the combustion process by altering the chemical reaction and depriving the whole process of energy. This system type is used rarely because the very finely distributed powder forms residues that are difficult to remove and highly corrosive. In addition, the powder cannot be used with electric or electronic equipment. The powder is usually stored without pressure and discharged by means of a propellant. The required powder volume is then sprayed through the nozzles.

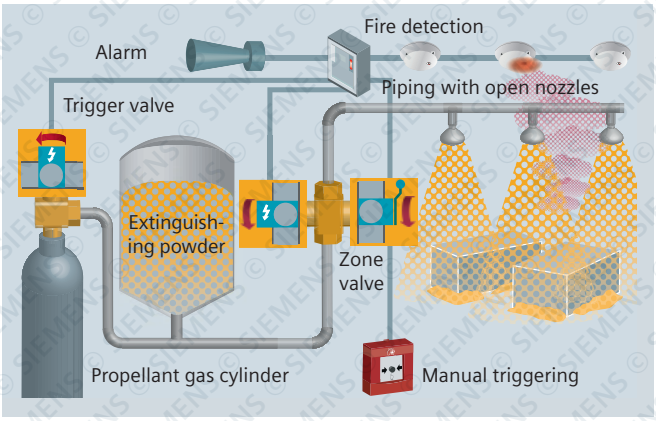


Fig. 10.20: Diagram of a powder extinguishing system

10.7. Gas Extinguishing Systems

Currently, blanketing natural gases and chemically acting extinguishing gases are available as gaseous extinguishing agents. These are explained in more detail below.

10.7.1. Inert Extinguishing Gases

10.7.1.1. Carbon Dioxide (CO_2)

Carbon dioxide can be used for fire classes A and C. In stationary extinguishing systems, carbon dioxide is stored at 56 bar in high-pressure steel cylinders. The extinguishing effect is smothering and cooling. Carbon dioxide is harmful to health at high concentrations so the authorities require special protective measures to be put in place if a threshold of 5 vol % is crossed.

Carbon dioxide is used as an extinguishing agent primarily in electrical and electronic equipment because, unlike all water-based extinguishing agents and most powders, it is not conductive. Carbon dioxide is also ideal for flammable liquids. Carbon dioxide is a respiratory poison, and this must be taken into account when it is used.

Carbon dioxide cannot be used to extinguish burning light metals such as alkaline earth metals because it breaks down into oxygen and carbon (or carbon monoxide) in a redox reaction. Carbon dioxide can be applied in gas, mist or snow form.

10.7.1.2. Nitrogen (IG-100)

Nitrogen is a colourless, odourless and tasteless natural gas. The concentration in our atmosphere 78.1 vol %. In stationary extinguishing systems it is stored in high-pressure steel cylinders. The maximum working pressure is 300 bar. Nitrogen is non-toxic and works by smothering the fire. However, there may be a risk from smoke and a lack of oxygen while the concentration necessary for extinguishing (less than 10 vol % residual oxygen content) is built up – particularly in the context of a fire event. Nitrogen is a cost-effective extinguishing agent with a very wide range of possible applications. Nitrogen is not suitable for metal fires and object protection.

10.7.1.3. Mixed Gases (IG-55 and IG541)

Mixed gases are different combinations of the various inert gases. They work by smothering the fire and they are non-conductive. The compositions differ widely: IG 55 is marketed as Argonite and consists of 50 % nitrogen and 50 % argon. IG541 is known as Inergen and consists of 52 % nitrogen, 40 % argon and 8 % carbon dioxide. Possible applications are similar to nitrogen.

10.7.1.4. Argon (IG-01)

Argon is extracted from the atmosphere and is a noble gas. In stationary extinguishing systems it is stored in high-pressure steel cylinders. The maximum working pressure is 300 bar. Argon is non-toxic and works by smothering the fire. However, there may be a risk from smoke and a lack of oxygen while the concentration necessary for extinguishing (less than 10 vol % residual oxygen content) is built up – particularly in the context of a fire event. As an extinguishing gas, argon is particularly suitable for metal fires.

10.7.2. Chemical Extinguishing Gases

Halon 1211 (CF2ClBr) and Halon 1301 (CF3Br) were the first chemical extinguishing gases used worldwide. In the stratosphere, however, these gases lead to the decomposition of ozone. In an effort to protect the ozone layer, their replacement was decided in the Montreal Protocol of 1987 and subsequent international agreements. With the exception of strategic special applications (aviation, military, nuclear energy technology), the use of Halon is prohibited in fire protection. Refilling of existing Halon extinguishing systems is also illegal in most countries. In the European Union, Halon extinguishing systems were required to be withdrawn by 31 December 2003. In Switzerland there was a compromise arrangement. Halon extinguishing systems may continue in operation. Modifications and refills are not allowed. In other words, if the system is actuated, the Halon must be replaced with an alternative extinguishing agent. In Switzerland, nuclear power plants, the army and aviation are exempted.

To replace Halon, halogenated carbohydrates were introduced on the market in the mid-1990s. However, these extinguishing gases were not authorized for use in Switzerland. It was not until 2003 that 3M™ launched a new chemical extinguishing gas that met the requirements, marketed as 3MTM Novec™ 1230 Fire Protection Fluid. This gas is a fluorinated ketone with the chemical formula CF3CF2C(O)CF(CF3)2, which has demonstrated its extinguishing efficiency for room protection purposes in a range of extinguishing tests. In the EN15004-2 standard, it is listed under the name of FK-5-1-12. It not only has an ODP value of 0 but also a GWP value of 1, meaning that its contribution to the greenhouse effect is not stronger than that of CO_2.

10.7.2.1. Material Properties

The most important physical data of the Novec™ 1230 extinguishing gas is summarized in the table below.

Trade name		Novec™ 1230
Chemical formula		$CF_3CF_2C(O)CF(CF_3)_2$
State of matter		Liquid
Molecular weight		316,04
Boiling point [°C]		49,2
Vapour pressure at 25 °C	[bar]	0,4
Gas density at 25 °C	[kg/m³]	13,6
Liquid density at 25 °C	[kg/m³]	1600
Liquid viscosity at 25 °C	[mPa·s]	0,52

Tab. 10.3: Significant material properties of the most important chemical extinguishing gases

One essential difference between Novec™ 1230 and all other previously used extinguishing gases is the fact that Novec™ 1230 is liquid at ambient conditions (pressure: 1,013 bar, temperature: 25 °C). Novec™ 1230 reaches its boiling point at 49.2°C.

The high boiling point has many advantages, making pressure-free transport of Novec™ 1230 in appropriate plastic containers possible without any problem. For flooding, however, Novec™ 1230 must be brought in the protected zone in the gaseous state. The gas, which is liquid at ambient conditions, must be vaporized. To understand what makes an inherently liquid gas vaporize, it helps to compare it to water at approx. 80°C. When this water is finely sprayed into a room heated to that temperature, it will soon vaporize completely, as it is close to its boiling point and due to the large specific droplet surface area created by fine spraying. To vaporize Novec™ 1230, therefore, it must be introduced into the extinguishing zone in the form of extremely fine spray. Internal tests have shown that at nozzle pressures of more than 10 bar, a sufficiently fine spray can be achieved. The observed jet lengths, i.e. the distance between the nozzle outlet and the point where the droplets have completely vaporized, were up to 2 to 3 metres.

The lower nozzle pressures that are frequently used today for HFCs (and that may be as low as 4 bar) are not sufficient. To ensure a minimum nozzle pressure of 10 bar even in more complex distribution piping systems, Siemens has decided on a storage pressure of 42 bar.

10.7.2.2. Environmental Parameters

The table below shows the environmental parameters of Novec™ 1230. The short service life in the atmosphere (ALT = Atmospheric Life Time) of some days only and the GWP value of 1 characterize Novec™ 1230 as a third-generation chemical extinguishing agent.

Environmental parameter/ extinguishing agent	Novec™ 1230
ODP value (Ozone Depletion Potential)	0
GWP value (Global Warming Potential)	1
ALT (Atmospheric Life Time)	3 – 5 days

Tab. 10.4: Environmental parameters of Novec™ 1230

10.7.2.3. Extinguishing Characteristics

As with all chemical extinguishing agents, the extinguishing effect of Novec™ 1230 is a combination of several processes. First, the extinguishing agent molecule is decomposed into its constituents, i.e. its atoms, in the hot flame zone. In accordance with the gas laws, this is accompanied by x-fold volume expansion («x» standing for the number of atoms) and thus by a reduction of the local oxygen concentration in the flame zone. Therefore, molecule decomposition leads to local blanketing. And second, the molecule takes energy away from the fire, causing a cooling effect.

This shows that the extinguishing effect of the so-called chemical extinguishing agents is largely physical. As the Novec™ 1230 molecule is very heavy, consisting of 19 atoms, its contribution to the first effect is high. This allows for relatively low extinguishing concentrations of chemical extinguishing gases: between 5 and 7 vol % for Novec™ 1230. More detailed specifications can be found in the SES guidelines VdS 2381, ISO 14520 or NFPA 2001. The required extinguishing concentrations are determined as for natural gases.

As with all chemical extinguishing agents containing fluoride atoms, hydrofluoric acid molecules (HF molecules) are generated when extinguishing with Novec™ 1230, due to recombination in the flaming zone. Hydrofluoric acid is strongly caustic and corrosive and causes damage to the respiratory organs after a while when concentrations in the ambient air exceed a certain level. For HF, the LC50 value is 50ppm. The LC50 value («Lethal Concentration») indicates the concentration which, after 30 minutes of exposure, is lethal for 50 % of individuals. An independent institute has conducted comparative measurements of HF formation during extinguishing with Novec™ 1230. The results show that HF formation is no higher than with HFCs such as HFC227ea or HFC125; however, bearing in mind the measuring accuracy, it is not lower, either.

The use of chemical extinguishing agents in protected zones frequented by people should be restricted to risks whereby no large flames are expected at the beginning of the flooding procedure. A fast-reacting fire detection system immune to deception is indispensable in order to keep HF formation as low as possible. Furthermore, natural gases rather than chemical extinguishing agents are generally recommended to contain the risk of rapidly growing fires, such as liquid fires. In contrast, electronic risks can be handled effectively with chemical extinguishing agents, as such fires grow slowly. Examples:

- server rooms
- telecommunication systems
- control rooms
- distribution rooms
- hollow floors containing cables

The prescribed flooding time of 10 seconds (in comparison to 60 to 120 seconds with natural gases) permits the required rapid extinguishing.

10.7.2.4. Toxicity

The NOAEL (No Observed Adverse Effect Level) value of Novec™ 1230 is above the concentration needed when it is used, which means that the extinguishing agent does not constitute any risk to people in the coverage area. However, as with natural gases, the coverage area should always be evacuated prior to flooding as the existing smoke and fumes represent a hazard.

10.7.3. System Technology

The gases are stored in pressure vessels:

- The non-liquefiable inert gases Ar, N_2 and gas mixtures in gas cylinders at pressures of 200 to 300 bar
- CO_2, which liquefies under pressure, in high-pressure systems in gas cylinders at 56 bar or, with low-pressure systems, in large cooled containers (approx. 20 bar)
- Chemical gases are stored in gas cylinders, pressurized with nitrogen, acting as propellant. The storage pressure is either 25 or 42 bar

Extinguishing is controlled either manually or, preferably, automatically by means of a fire detection and control system. Only rapid, fault-free actuation during the initial phase of a fire can limit consequential damage and minimize potential stoppages.

When the system is actuated, the cylinder valves of high-pressure systems, or the container valves of low-pressure systems, are opened. The alarm is triggered to warn people in the protected zone so that the room can be evacuated. Doors and other openings are closed automatically. Further operating equipment such as ventilation systems and fire dampers are activated. The overpressure relief mechanism opens to discharge the excess pressure to the open air. After flooding, the overpressure relief mechanism closes again to maintain the relevant concentration of extinguishing gas in the extinguishing zone.

The extinguishing gas is guided through a piping network to the nozzles evenly distributed on the ceiling. The gas quickly fills the room and an even concentration is built up throughout the room. The following diagram illustrates the process.

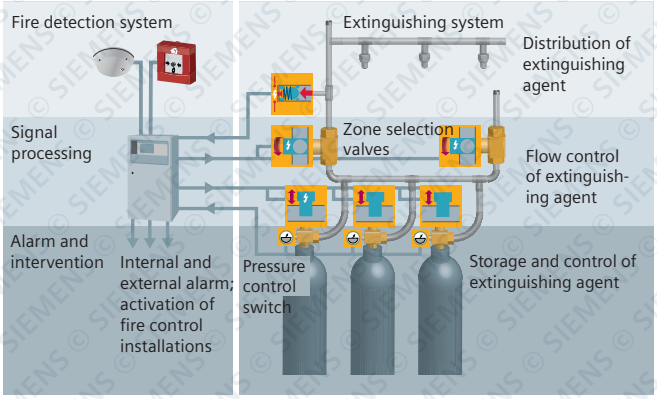


Fig. 10.21: Operating principle of a gas extinguishing system

Inert gas systems for nitrogen, argon or gas mixtures are equipped with a pressure reduction system located behind the collector to which all cylinders are connected. This pressure reducing system usually consists of a membrane with an orifice reducing the pressure from storage pressure to approximately 60 bar, so that no high-pressure fittings are needed in the piping network.

10.7.3.1. Room Protection

The main application of gas extinguishing systems is room protection, i.e. the protection of enclosed rooms. Two different system technologies are used, which are described below.

Centralized and Modular Systems

By definition, centralized systems use a central bank of extinguishing agent cylinders. This bank should be placed in a special storage room outside the protected zone. The main advantage of this arrangement is that the storage room remains accessible in case of fire.

Centralized systems always require an individual design. This means that all pipe diameters and nozzles must be calculated individually for the relevant system. For this purpose, tried and tested calculation methods and programs are available.

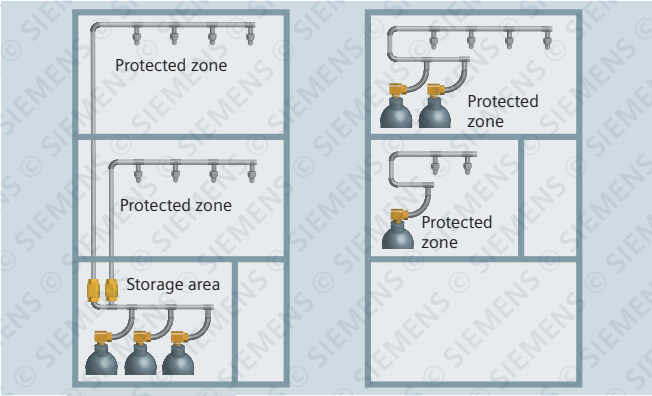


Fig. 10.22: Operating principle of a centralized system and a decentralized system

In contrast to centralized systems, modular systems consist of individual storage containers arranged in the protected zone, with directly connected nozzles. Extinguishing agent containers should only be installed in accordance with the relevant guidelines. Particular attention must be paid to the SES guidelines for gas extinguishing systems and fire detection systems. Other statutory requirements must also be taken into account, especially the EKAS guidelines and the regulations concerning pressure vessels.

Single Zone and Multizone Systems

Single zone extinguishing systems completely discharge their extinguishing agent to a single protected zone. This zone may consist of one or more rooms, with all rooms being flooded completely and simultaneously. Multizone extinguishing systems are capable of protecting several zones.

It is often necessary and reasonable to subdivide the area protected by a single extinguishing system into two or more zones, with one zone comprising one room or several rooms that are usually located close to each other and are flooded simultaneously. To reduce the total amount of extinguishing agent, only one zone is flooded at a time. Note that the other zones can no longer be flooded, thus remaining unprotected. If protection of adjacent zones is required as well, additional extinguishing agent can be provided for the system as a reserve. After flooding the first zone, the system will automatically revert to this reserve. Dividing extinguishing systems into zones is independent of fire detection sectors. Zones are created preferably when a larger number of similar rooms (or groups of rooms) must be protected while the fire risk is not extremely high. In this case, cost savings are possible in terms of extinguishing agent and storage containers.

The basic setup consists of a bank of extinguishing agent containers. For every extinguishing zone, one pipe network is connected to this bank by means of zone valves. The relevant zone valve is opened to guide the extinguishing agent to the desired zone, with the other zone valves remaining closed.

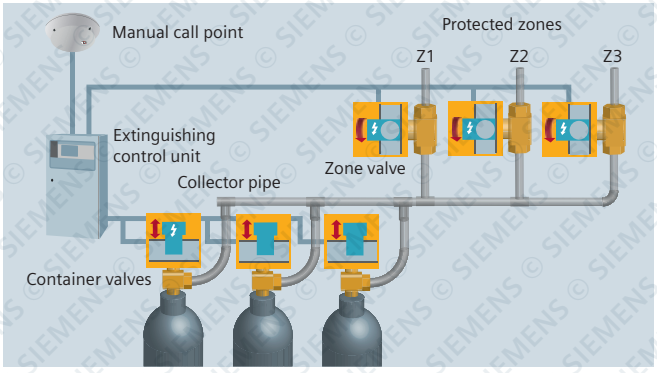


Fig. 10.23: Operating principle of a multizone extinguishing system

The zone valve can be opened either simultaneously with the cylinder valves or beforehand. The extinguishing control unit must be capable of successively actuating the alarm systems, the zone valves and the cylinder valves automatically. Its other functions include the permanent monitoring of the connected components. This includes pipes and power lines, extinguishing agent loss, zone valve position, etc.

10.7.3.2. Object Protection

Free-standing objects can also be protected with carbon dioxide. This protection method is also known as «object protection». Examples of object protection systems include:

- immersion baths, quenching baths, paint spraying facilities, printing facilities
- oil-filled transformers, etc.

The scope of protection for an object protection system comprises the object(s) to be protected as well as additional volume surrounding the objects. This is called the virtual protection volume, which is to be flooded by the appropriate extinguishing agent in the right concentration. For outdoor applications, neither wind nor other weather conditions must be allowed to have a negative effect on protection.

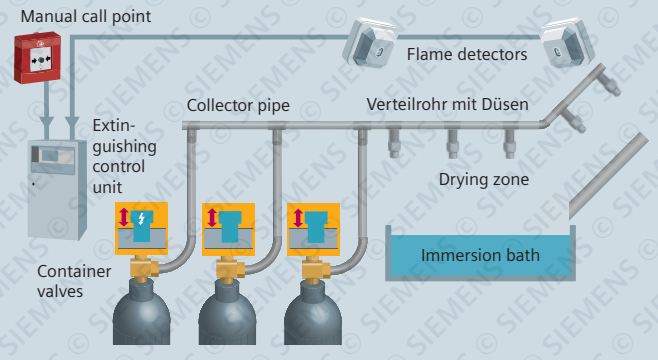


Fig. 10.24: Operating principle of an object extinguishing system

10.7.4 Nozzles

For even distribution of the extinguishing gas, nozzles are built into the pipe network. Each nozzle is calculated and designed with the right holes to allow correct distribution inside the room but also in hollow floors and ceilings.

10.7.4.1 Extinguishing gas nozzle

Extinguishing gas nozzles are designed for room extinguishing systems. The extinguishing gas flows out of the nozzle unimpeded and spreads evenly throughout the room. The small number of holes per nozzle means that the noise level for a conventional nozzle is around 130 dB. The extinguishing gas nozzles can be used for inert and chemical extinguishing gases. The nozzle holes and the spray patterns can differ according to the situation.

Fig. 10.25: Extinguishing gas nozzle

Fig. 10.26: Spray patterns

10.7.4.2 Silent nozzle

The escaping extinguishing gas is divided between a larger number of holes. This reduces noise. The “linear design” of the nozzle allows the extinguishing gas to flow into the room much more evenly and quietly, at reduced pressure and with a specific spray profile. Hissing is the only sound that can be heard. It is also possible to fit a silencer which can reduce the noise even further. The following extinguishing gases can be used with the silent nozzle: nitrogen, argon, gas mixtures (Inergen or Argonite) or Novec 1230. Silent nozzles are mostly used in computer rooms. Here too, different spray patterns are possible depending on the circumstances.

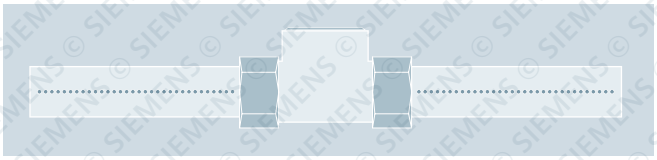


Fig. 10.27: Structure of a silent nozzle

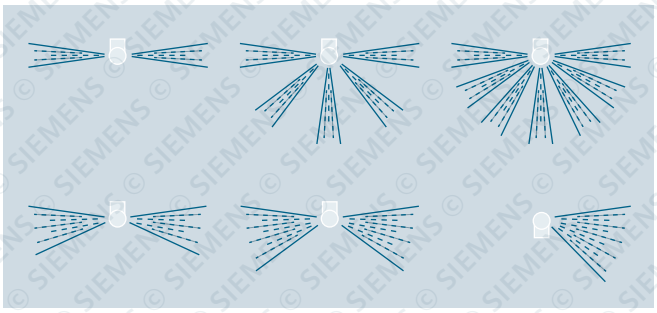


Fig. 10.28: Different spray patterns

10.7.4.3 Mist nozzles

The extinguishing gas does not flow directly into the surroundings, but hits the walls of the mist nozzle. This changes the state of matter from gas to mist, which is ideal for object protection. The extinguishing gas used is carbon dioxide. Because it is heavier than air, a cloud forms around the object, preventing the supply of oxygen and displacing the existing oxygen.

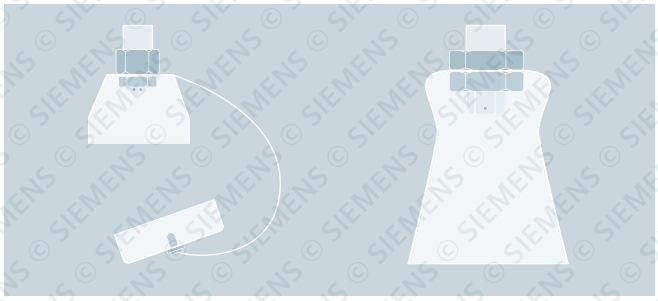


Abb. 10.29: Diagram of mist nozzles

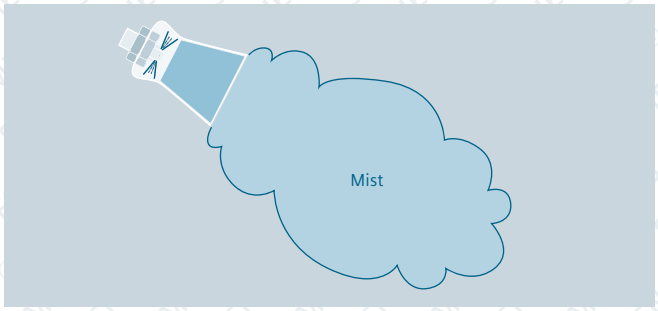


Abb. 10.30: Spray pattern of a mist nozzle

10.7.4.4 Snow nozzle

Carbon dioxide is used with this nozzle as well. Because the gas travels a longer distance, the carbon dioxide cools even further and is discharged in the form of flakes. This snow nozzle is normally used to combat liquid fires in vats or troughs, for example, in solvent baths or deep fat fryers. The snow-like flakes cover the burning liquid like a lid. This stops the supply of oxygen and cools the liquid at the same time. The fire subsides, with no possibility of re-ignition.

Abb. 10.31: Diagram of a snow nozzle

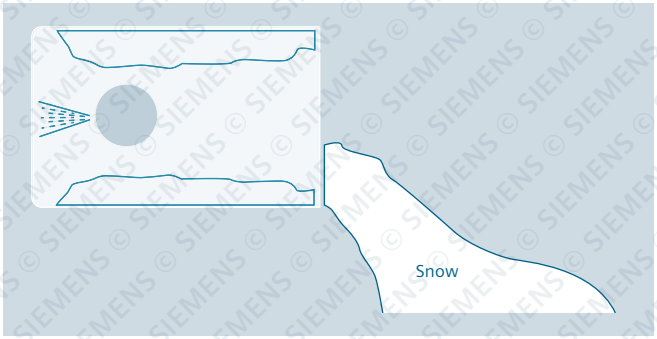


Abb. 10.32:Spray pattern of a snow nozzle

10.8. System Integration

This section describes how the fire detection system, linked to the extinguishing system via the extinguishing control, works with the extinguishing system. The extinguishing control unit makes different variants of extinguishing control possible. Its alarm organization must be optimally adaptable to each individual situation. Extinguishing control units are preferably autonomous, independent units capable of performing actuation of the extinguishing process, on the basis of the alarm signal transmitted by the fire detection control unit.

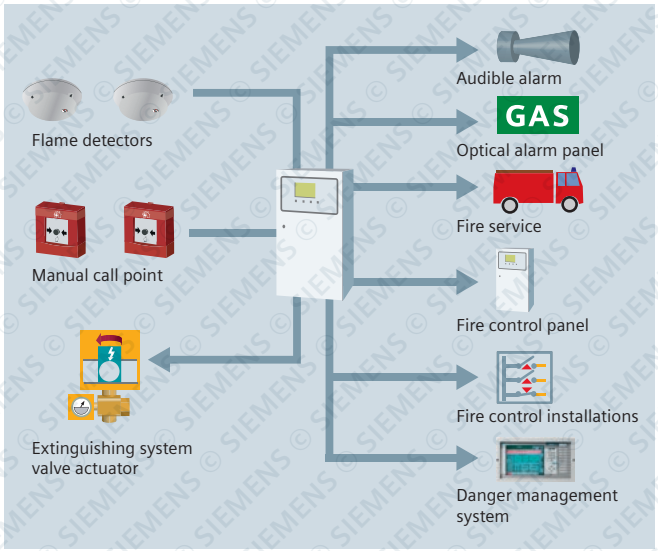


Fig. 10.25: Networking diagram of an autonomous extinguishing control unit

An extinguishing control unit must provide the following functions:

Electric actuation of fixed fire extinguishing systems, such as:

- gas extinguishing systems
- water spray extinguishing systems
- water mist extinguishing systems
- foam extinguishing systems
- powder extinguishing systems

- Suitable for extinguishing systems of all sizes, with the option of multidetector logic; i.e. actuation is only performed when two or more detectors deliver an alarm (see Figure 5.27)

- Suitable for actuation of extinguishing systems with central extinguishing agent storage (including switching to reserve storage), and applicable for modular extinguishing systems with individual storage containers distributed over the entire protected zone

- Adaptability of the extinguishing actuation command to all commercially available valve actuator mechanisms

- If possible, supports multizone extinguishing systems fed by a single bank of extinguishing agent cylinders. In this case, several identical control units are networked, with each control unit in charge of its own extinguishing zone (see Figure 5.28).

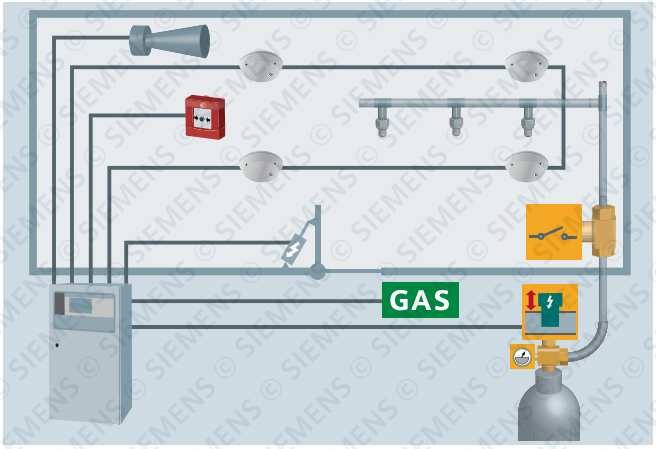


Fig. 10.26: Fire extinguishing control unit with multidetector logic

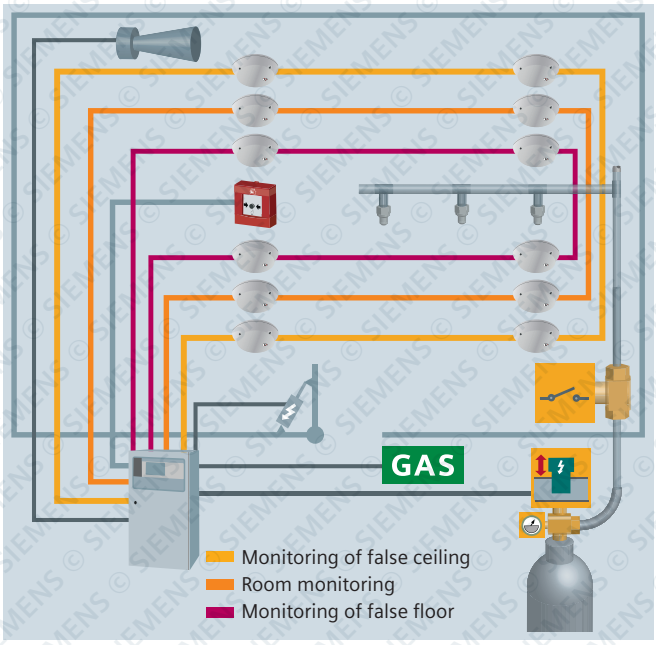


Fig. 10.27: Extinguishing zone with additional detection lines monitoring false floor and false ceiling

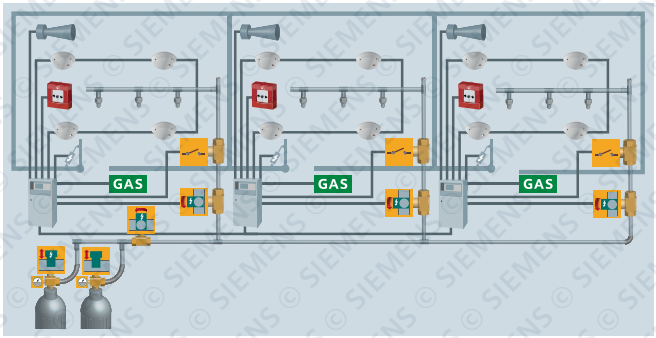


Fig. 10.28: Multizone extinguishing system with slave control units

The slave control units in Figure 5.28 must be networked in such a way that a simultaneous actuation of two zone extinguishing processes is impossible.

10.8.1. Location of the Fire Extinguishing Control Unit

The control unit should be located in the same room as the bank of extinguishing agent cylinders, preferably close to the protected zone. In the case of large zones with multiple entrances, it may be useful to install control units at each entrance, from which full control of the extinguishing system is possible.

10.8.2. Power Supply

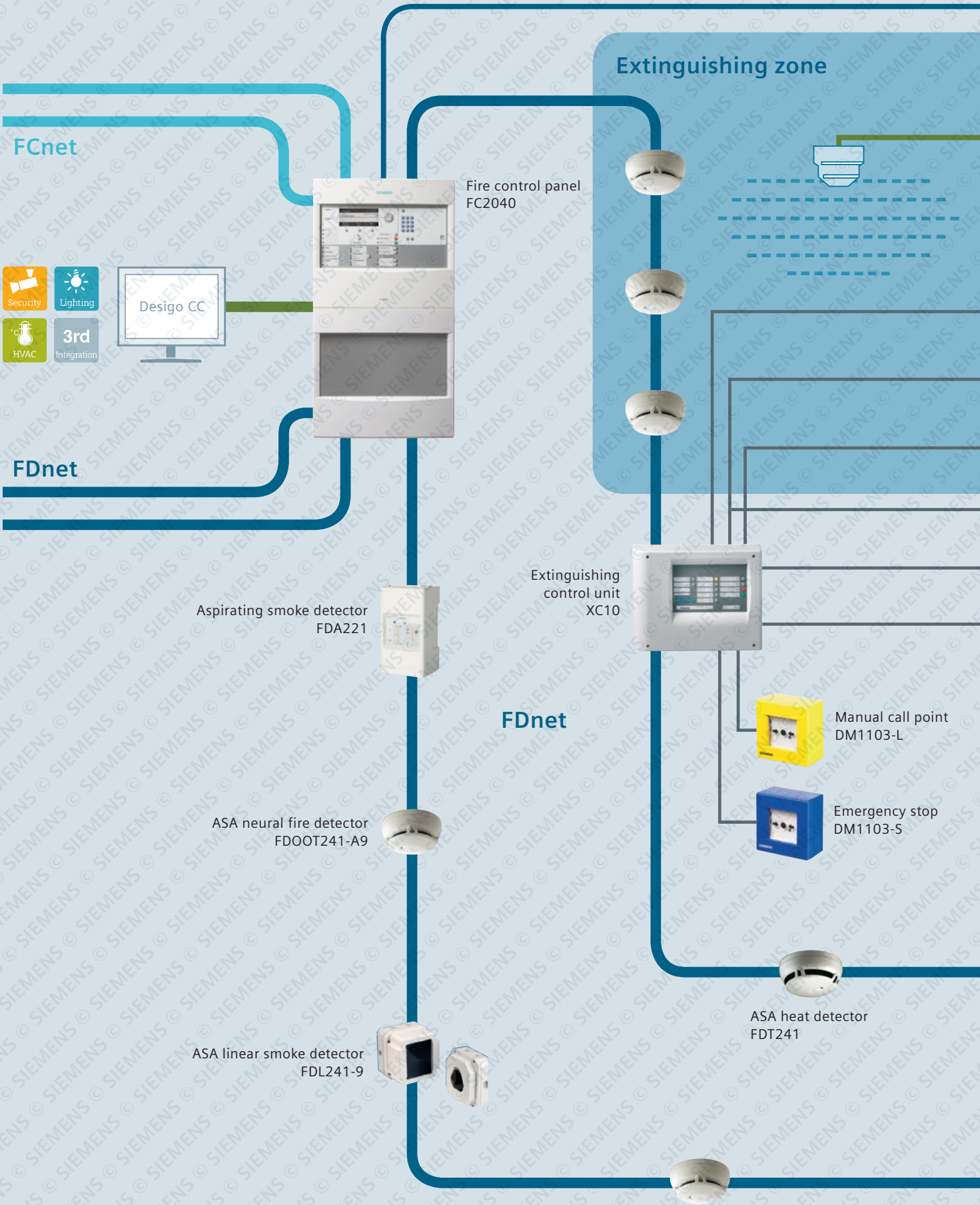
As in fire detection, fire extinguishing control units must also be equipped with two independent power supply sources. Both energy sources must be sized in such a way that one source alone is capable of ensuring the full functionality of the system over a predefined period of time. At least one of the energy sources must be permanent, while the other should preferably be a battery with storage function. The emergency power supply of the extinguishing control unit must be capable of reliably actuating the extinguishing process even after the specified stored-energy time. The total stored-energy time consists of the stored-energy time (e.g. 72 hours) and the alarm time (e.g. 30 minutes).

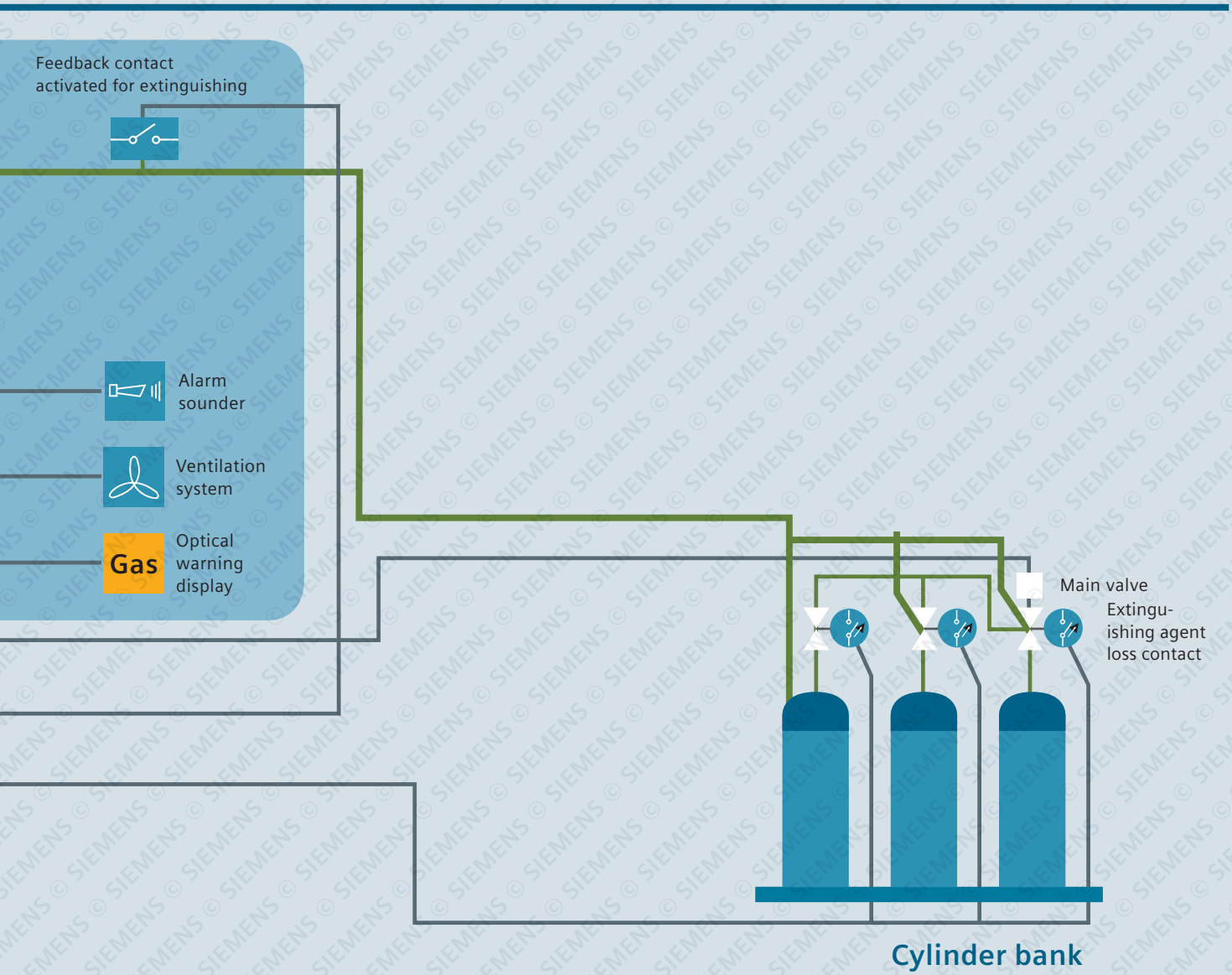
10.8.3. Alarm

If an automatic fire detector is triggered, this in turn triggers a preliminary alarm in the fire control panel. As soon as a second fire detector responds, the extinguishing process is initiated following the mandatory early warning time. However, if a manual call point is triggered, the extinguishing system is actuated directly – even when no automatic fire detector has responded yet.

Single zone alarm	Two zone alarm	Manual action	
			Alarm actuation
Advance warning	Adv.warning extng. comm.	Ext. command	Signal evaluation
			Fire control installations
			Signal horn continuous tone
	GAS	GAS	Single horn two-tone and illuminated warning panel
			Delay (max. 60 s)
	Stop button door contact	Safety stop button	Methods of emergency blocking
			Release of extinguishing agent
	GAS	GAS	Acknowledge and reset

Tab. 10.5: Alarm organization of automatic extinguishing systems


Extinguishing zone
FCnet
Fire control panel
FC2040
Security
Lighting
HVAC
3rd
Integration
Desigo CC
FDnet
Extinguishing
control unit
XC10
Aspirating smoke detector
FDA221
FDnet
Manual call point
DM1103-L
Emergency stop
DM1103-S
ASA neural fire detector
FDOOT241-A9
ASA heat detector
FDT241
ASA linear smoke detector
FDL241-9



ASA flame detector
FDF241-9

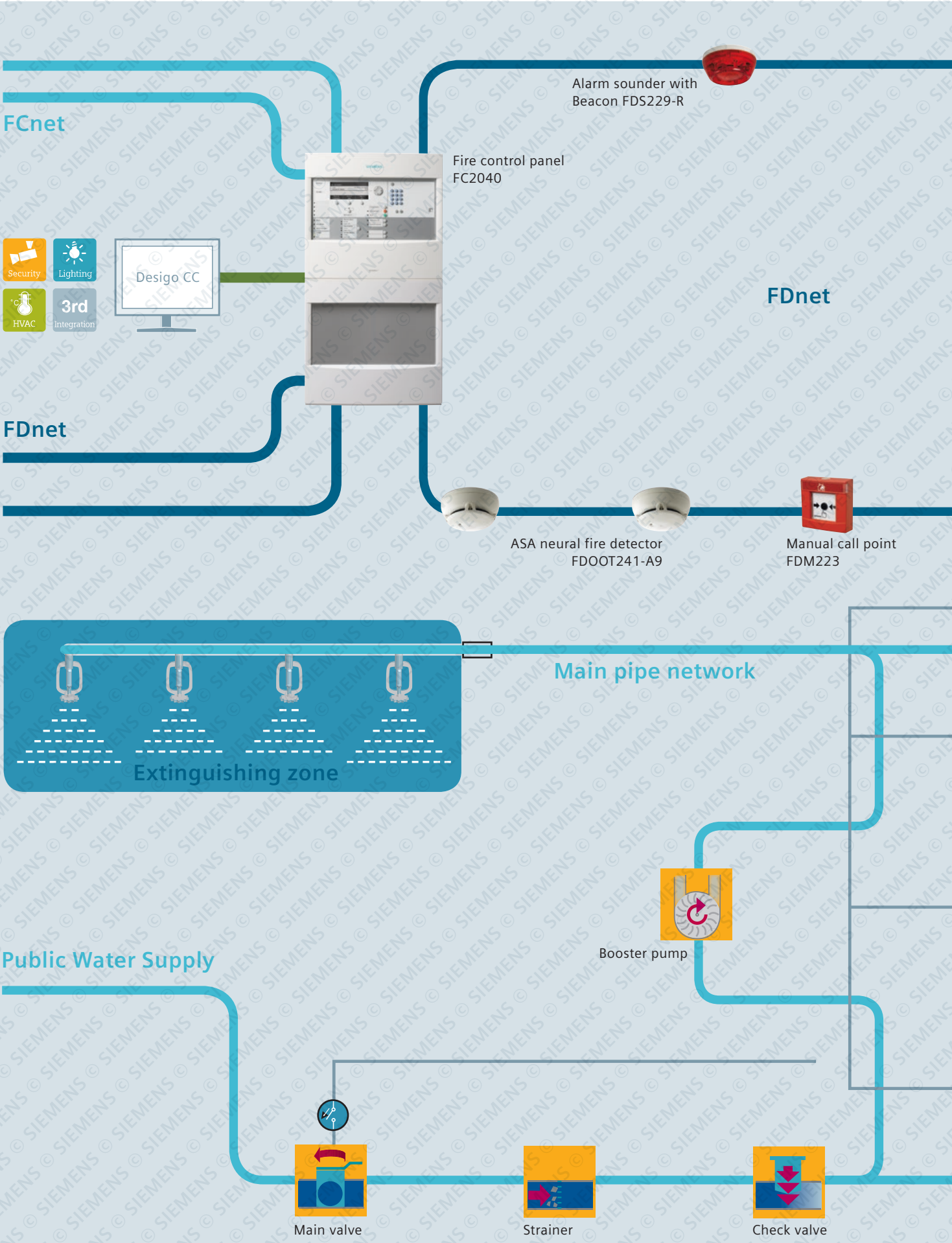
Manual call point
FDM223

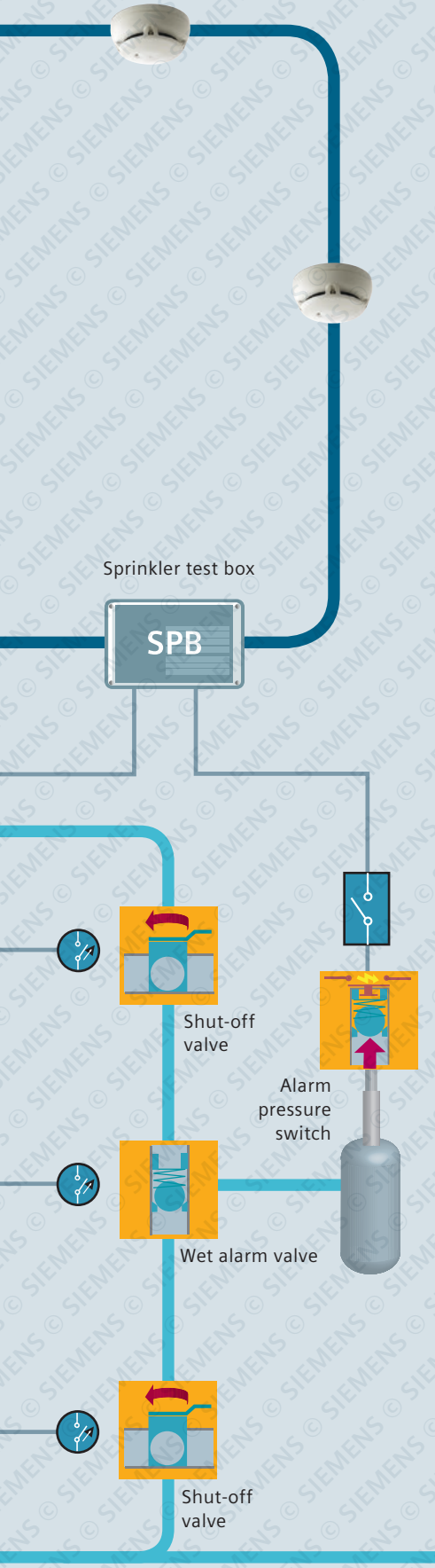
Alarm sounder with
Beacon FDS229-R

Input module
FDCI222

Floor repeater display
FT2011

Air duct detector
FDBZ292


FCnet
Alarm sounder with
Beacon FDS229-R
Fire control panel
FC2040
Security
Lighting
HVAC
3rd
Integration
Desigo CC
FDnet
FDnet
ASA neural fire detector
FDOOT241-A9
Manual call point
FDM223
Main pipe network
Extinguishing zone
Booster pump
Public Water Supply
Main valve
Strainer
Check valve



Uses of extinguishing agents (selection)

		Argon	Carbon dioxide	Nitrogen	Novec 1230	H_2O gas	Water mist, H_2O jet	High-pressure water mist	Sprinkler	Deluge	Foam	Bemerkungen
1	Archives, museums, libraries			■		■		■				
2	Battery compartments	■		■								Argon better for lithium batteries
3	Areas with risk of a metal fire	■										
4	Electrical switching rooms			■	■			□				For "room" protection: water mist possible
5	Closed transformers/ generators		■	■		■		■				
6	Cable ducts			■				■				
7	Kontrollräume			■	■							
8	Machine room, equipment room						■	■				
9	Military depots		■	■	■							
10	Emergency power supply (diesel)						■	■				
11	Object extinguishing, e.g. oil baths, turbines or machines		■									
12	Open transformers/generators						■	■		■		
13	Data centres, server rooms			■	■			□				For "room" protection: water mist possible
14	Clean rooms				■							
15	Telecom equipment/ electrical switching rooms			■	■			□				For "room" protection: water mist possible
16	Vaults			■		■						
17	Turbines					■				■		
18	UPS systems			■		■	■	■				
19	Care homes								■			
20	Shopping centres, exhibitions, retail space								■			
21	Car parks								■			Note: Special solution for electric vehicles
22	Chemical production facilities								■		■	
23	Production areas								■			
24	High rises							■	■			
25	High-bay racking								■			
26	Hotels								■			
27	Power stations								■		■	
28	Warehouses								■		■	
29	Storage for flammable liquids		■	■		■			■		■	Depending on room size
30	Waste bunkers in waste incineration plants									■	■	
31	Tank farms									■	■	

Sinorix – intelligent extinguishing solutions to keep fire virtual

The right extinguishing agent for each application

Partnership – long-term experience of a global partner
With Sinorix extinguishing solutions, you benefit from a global partner with extensive experience in fire protection. Know-how, an innovative approach, and expert solutions from Siemens are available to you worldwide. In addition, we offer a comprehensive service portfolio – we support you from risk assessment, system planning, installation and commissioning through to maintenance.

Innovative – most advanced technologies for maximum effectiveness
The innovative Sinorix extinguishing technologies offer the best solutions for your individual requirements. Siemens continuously invests in research and development delivering new findings and innovations. The latest innovations include Sinorix Silent Nozzle, Sinorix Compact™ and Sinorix H_2O Gas, the highly efficient combination of nitrogen and water mist technology.

Flexible and tailored – customized for your unique requirements
The Sinorix portfolio offers a broad spectrum of solutions that are precisely tailored to your individual applications. Whether you need to protect an object or room, a single zone or multiple zones – we support you in assessing the risk and in choosing the optimal solution for your application and processes.

Reliable – for optimized business continuity
Sinorix extinguishing solutions ensure reliable fire protection and secure the continuity of your business processes – with advanced technologies as well as thorough system planning and installation. Needless to say, they comply with international standards and regulations. Combining the extinguishing solutions with sophisticated fire detection systems and integrating them into a comprehensive fire safety concept from Siemens additionally provides unique protection.

Our intelligent SinorixTM solutions protect people, environment, and processes – they offer you advanced technologies, based on long-term know-how of a global partner in fire detection and extinguishing. The comprehensive portfolio for room and object protection comprises solutions with natural or chemical extinguishing agents, gas/water combined as well as water mist solutions, water or foam technology.

To guarantee the continuity of your business processes, the solutions are tailored to your specific applications, the fire risks as well as local requirements and regulations. In addition, they include a comprehensive service offering – from risk assessment, system design, installation, and commissioning to maintenance.

Highlights

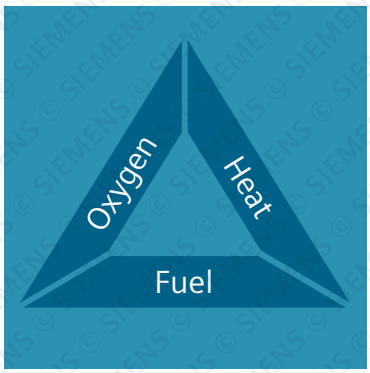
- Worldwide partner for know-how, an innovative approach, and expert solutions
- Tailored solutions from one source, from risk assessment to maintenance
- Innovative, highly effective technologies for optimal protection
- Reliable fire safety ensures continuity of your business processes
- Sustainable protection of environment, people, and processes

Sustainable – protecting the environment, people, and processes

To sustainably protect the environment, people, and processes, you require a solution that is tailored to your application. With Sinorix, Siemens provides suitable solutions and supports you today and in the future. So your investment is a long-term win. Moreover, our solutions are environmentally friendly.

Basic principle of automated extinguishing systems

Every fire needs three elements – oxygen, heat, and a combustible (see graphic below). If only one of these elements is removed, a fire cannot spread and will inevitably go out. Automated extinguishing systems are designed on the basis of this principle.



Sinorix N_2 • Ar • CO_2 – reliable extinguishing with pure natural agents

Highlights

- High flexibility in system planning and design
- Pure natural gases and state-of-the-art technology for fast and reliable extinguishing
- Environmentally friendly because natural gases are used
- Simple, cost-efficient refilling
- VdS-approved silent nozzle to minimize noise emissions in data centres
- CDT technology means smaller overpressure flaps and piping networks

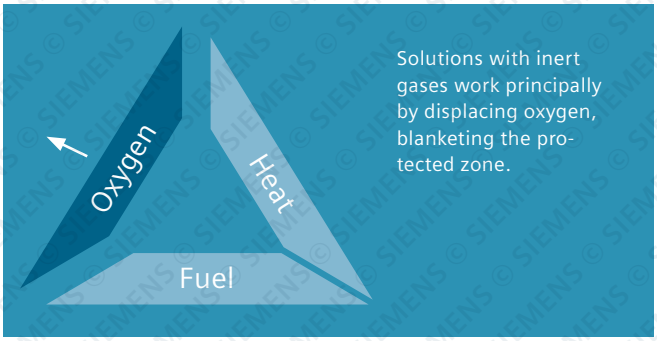
Sinorix N_2 • Ar • CO_2 extinguishes efficiently using pure nitrogen, argon or carbon dioxide and can be flexibly tailored to the respective application. Fire is extinguished effectively by reducing the oxygen within the flooding zone.

Sinorix N_2 • Ar • CO_2 – for reliable extinguishing

Sinorix extinguishing solutions with natural agents offer maximum flexibility in planning and design. The systems can be designed for either nitrogen or argon with 200 and 300-bar technology or for carbon dioxide with 56-bar technology. In addition, systems from small single-zone to large multizone solutions with the respective cylinder banks and selector valves can be realized for all three inert gases. For nitrogen and argon extinguishing systems, CDT (Constant Discharge Technology) can be used for efficient extinguishing at 60 bar without pressure peaks. The VdS-approved valve technology is used to introduce nitrogen to the extinguishing zone under constant pressure during the flooding time. This uniform flooding means that the piping networks can be designed to be smaller than standard extinguishing systems, and the overpressure flaps can be up to 70 % smaller. The cylinders can be centrally located or distributed. Thus, extinguishing systems with inert gases can be optimally tailored to existing building structures, requirements and fire risks, and therefore provide optimum protection.

Extinguishing with pure natural gases

Sinorix N_2 • Ar • CO_2 extinguishing solutions use pure natural gases for particularly reliable extinguishing. They present no environmental hazards and are odourless and colourless. The result is environmentally friendly extinguishing. Moreover, the extinguishing agents have poor electric conductive properties and are chemically inert, which means that there will be no harmful reaction products when they come into contact with fire. This prevents damage to the equipment. Whether nitrogen, argon or carbon dioxide – natural gases offer excellent extinguishing properties for the fire classes A (solids), B (flammable liquids), and C (flammable gases). Argon is additionally suited for fire class D (metal fires).



Solutions with inert gases work principally by displacing oxygen, blanketing the protected zone.

Application example for data centre

1 Fire detection and extinguishing control panel
2 Fire detector
3 Aspirating smoke detector
4 Alarm sounder
5 Combined sounder beacon
6 Manual release for extinguishing system
7 Warning display
8 Extinguishing agent cylinders
9 Piping network with silent nozzles
10 Overpressure flap

Sunrise Communications AG, Zürich
Large and complex Sinorix nitrogen multizone system for optimum, sustainable protection of highly sensitive server rooms.

The VdS-approved Sinorix Silent Nozzle limits noise emissions, to keep data centres running properly. Using pure natural gases instead of a mixture of different gases facilitates refilling because pure natural gases are widely available. Our service offering ensures extremely fast and convenient refilling.

Typical applications:

- Telecommunication systems
- Data centres
- Cable ducts
- Electrical switching rooms
- Closed transformers, turbines, engines, and generators
- Technical and machine rooms
- Control rooms
- Military depots
- Museums
- Areas with risk of a metal fire
- Storage rooms for chemicals
- Storage for flammable liquids
- Unmanned generator and transformer stations
- Local applications such as oil baths, turbines or machines

Sinorix Compact – innovation and experience

Fire damage in server rooms causes IT outages, with serious consequences for the business.

A compact extinguishing system with integrated fire detection offers reliable protection for small server rooms up to 90 m³ – a cost-effective option for all SMEs.

Advantages of the compact system

- Cost advantage: cheaper installation and more prefabrication lowers the price compared to individual solutions.
- Flexibility: the compact system is easy to relocate.
- From a single source: detection, extinguishing and maintenance from the same supplier.

A solution for challenging environments

Siemens aspirating smoke detection (ASD) guarantees reliable fire detection in challenging areas where very early fire detection and business continuity are essential. Here, detectors with ASD technology are the perfect choice because they actively sample the air from the protected zones and check the samples for fire particles.

Technical details

- Wall cabinet:
  Dimensions 600 x 600 x 2000 mm
- Extinguishing control panel:
  Siemens XC10 rack version
- Sufficient potential-free contacts for status indication
- Detection based on Siemens aspirating smoke detector FDA221 or FDA241
- Extinguishing agent:
- Siemens Sinorix Novec 1230
- Extensions: remote terminal, illuminated display, manual call point, stop button
- Pneumatic control for overpressure flap (hose)

The new aspirating smoke detectors provide maximum detection reliability

The optical detection technology uses two wavelengths – blue and infrared. That means our aspirating smoke detectors can pick up the tiniest smoke particles that occur in the early overheating phase or in open fires. The detectors determine the size and concentration of the particles in order to distinguish between smoke, dust and vapour.
This means the FDA221 and the FDA241 detect smoke very early and very reliably. They are also extremely resistant to deceptive phenomena. The accurate detection and classification of particles prevents stoppages and saves costs caused by false alarms.

XC10 extinguishing panel: a compact solution for high performance

The clearly laid-out user interface makes these extinguishing panels easy to operate. Users can see a full system overview at a glance – important if the worst comes to the worst. The XC10 extinguishing panel also supports single-zone and multi-zone applications with its sophisticated technology. The XC10 is also compatible with a wide range of fire detectors, specialist detectors, and extinguishing solutions.

Sinorix 1230 – fast, reliable and environmentally friendly

Sinorix 1230 is an outstanding solution to protect valuable facilities, business processes and people. It is based on the environmentally friendly extinguishing agent 3M™ Novec™ 1230 Fire Protection Fluid and Siemens 42-bar technology for maximum design flexibility. Sinorix 1230 can prevent data loss through fast, reliable and automated interventions, safeguarding business continuity.

Fast, highly effective and economical

The high efficiency of the Sinorix 1230 system means that the concentration of extinguishing agent can be kept low. In fact, the Novec 1230 extinguishing agent has the lowest working concentration of any agent currently approved. That makes it possible to design a compact layout with less space devoted to installing and storing the containers. The Novec 1230 extinguishing agent is non-corrosive and non-conductive. As a result it cannot damage valuable items like sensitive electronics. It is also harmless to humans.)

Highlights

- Maximum extinguishing efficiency and flexibility in design
- Optimized protection of electrical and electronic equipment
- Efficient high-pressure technology from Siemens
- 10 second flood time for rapid extinguishing
- Compact, space-saving system
- Non-conductive, no residues
- Harmless to humans with one of the largest safety margins
- Innovative, effective and environmentally friendly
- Aspirating smoke detectors with dual wavelength technology for optimal object protection
- Powerful and flexible extinguishing control unit which is easy to use, with remote display or operating terminall

Sinorix 1230 – fast extinguishing using chemical agents Sinorix 1230 – fast extinguishing using chemical agents

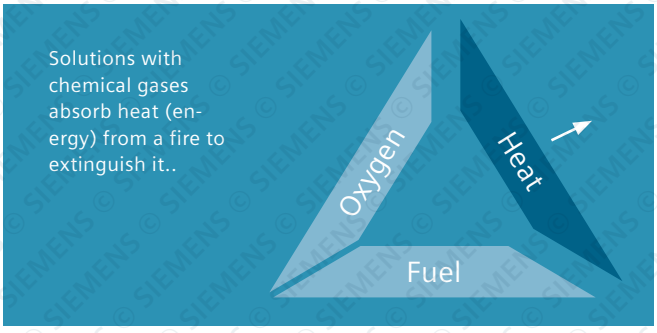
Sinorix 1230 is especially suited for electrical and electronic risks. It uses chemical gases that are neither conductive nor leave any residues. Thus, at the extinguishing concentration, sufficient heat is absorbed to extinguish the fire.

Sinorix 1230 – quick and sustainable

Sinorix 1230 belongs to our latest generation of chemical extinguishing solutions. Siemens 42-bar technology is used, which is especially space-saving and guarantees maximum design flexibility. The high efficiency of the Sinorix 1230 solution means that a low extinguishing concentration can be used. Flooding happens within 10 seconds and its highly effective extinguishing agent ensures rapid extinguishing.

Extinguishing with 3M™ Novec™ 1230 Fire Protection Fluid

The innovative extinguishing agent of Sinorix 1230 provides reliable protection of assets, people, and the environment. It has an ozone depletion potential (ODP) of 0, a short atmospheric life time (ALT) of 3 to 5 days, and a global warming potential (GWP) of 1. As it is neither corrosive nor conductive, it does not damage sensitive equipment.



Thanks to its high safety margin*, it is harmless to people's health. Since the agent is non-toxic, non-flammable, and non-explosive, there are no transport restrictions at all.

Typical applications

- IT and server rooms
- Telecommunication systems
- Electrical switching rooms
- Store rooms
- Military depots
- Clean rooms

* Safety margin: difference between the design concentration and NOAEL (No Observable Adverse Effect Level)

Application example: server room

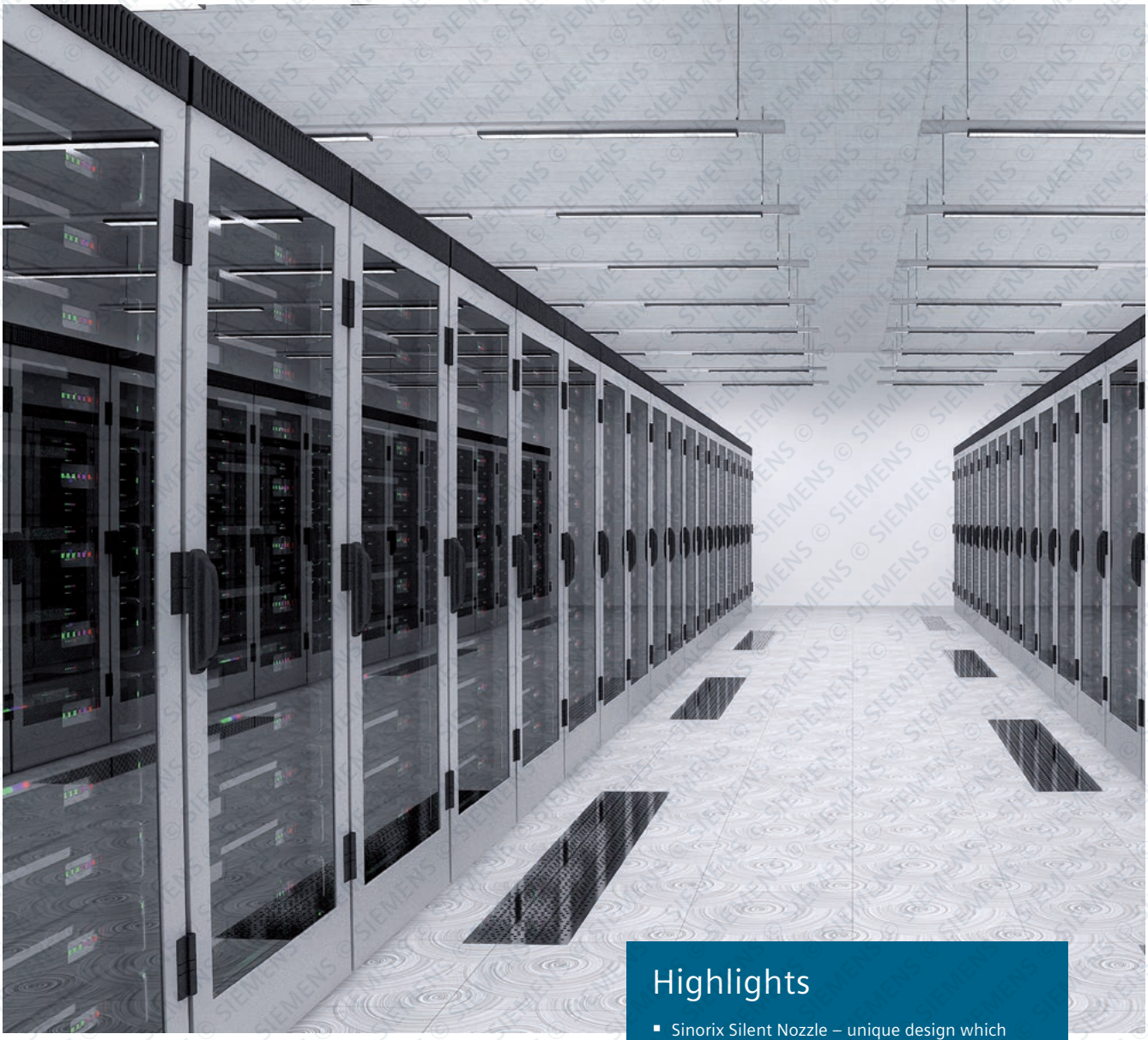
1 Fire detection and extinguishing control panel
2 Fire detector
3 Aspirating smoke detector
4 Combined sounder beacon
5 Alarm sounder
6 Manual release for extinguishing system
7 Warning display
8 Extinguishing agent cylinders with Novec 1230 fluid
9 Piping network with nozzles
10 Overpressure flap

Highlights

- Maximum extinguishing efficiency and flexibility in design
- Optimized protection of electrical and electronic equipment
- Fast and safe solution
- The cylinder bank requires little space because only a small amount of extinguishing agent is needed
- VdS-approved silent nozzle to minimize noise emissions in data centres

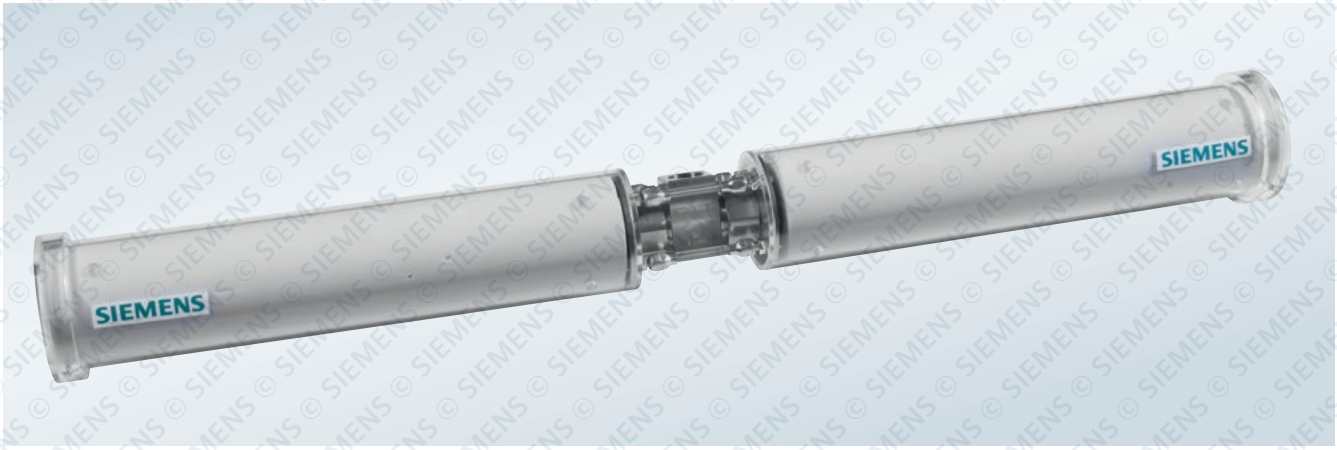
Bedag Informatik AG, Bern
Sinorix 1230 protects server rooms at the corporate head- quarters effectively and sustainably – harmless for people and sensitive assets..

Quiet extinguishing at its best – Sinorix Silent Extinguishing Technology type



Highlights

- Sinorix Silent Nozzle – unique design which reduces the noise level
- Quiet extinguishing in data centres to prevent hard disk damage
- Hard disks are undamaged by the extinguishing process
- Same performance as a conventional nozzle
- Fast and reliable intervention
- Optimized protection for critical applications with sensitive electrical and electronic equipment
- Noise reduction options with modular structure
- Easy to retrofit to nitrogen and argon extinguishing systems



Silencer for silent nozzle

Data centres are highly sensitive spaces. The hard disks in data centres have developed beyond recognition in recent years, performing better and better. One consequence of this greater performance capacity, however, is that the hard disks are more sensitive to noise, which can reduce performance.

Siemens was one of the first companies to identify this issue, and started developing a noise-optimized "silent extinguishing" technology. The aim was to create a system with the same extinguishing performance but a much lower noise level. The result is what is known as a silent nozzle. Unlike the standard nozzles previously in widespread use, the gas does not pass through four holes, but through two elongated pipes with many small holes. This reduces the pressure inside the pipe, which in turn reduces the noise made as the gas escapes. Tests have been carried out showing that the noise level falls by up to 30 dB when the new nozzles are triggered. A further benefit of silent nozzles is that the extinguishing gas is more widely distributed in the room through the longer pipes.

Also compatible with 3M™ Novec 1230

Novec extinguishing systems are not known to cause any impairment in performance in current server and hard disk technologies. The use of silent nozzles may, however, help to further minimize noise emissions during the expelling phase. In both cases, the hard disk performance remains very high.

Modular extinguishing system

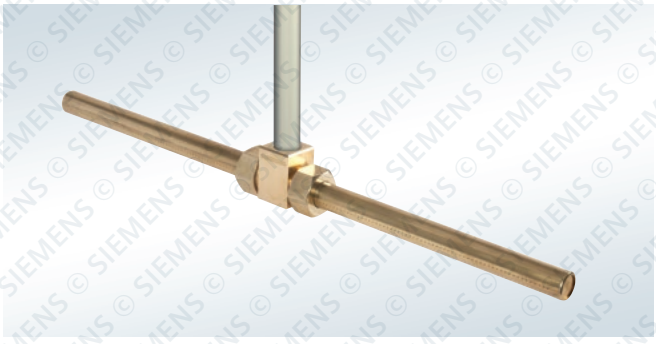
Regulated nitrogen extinguishing systems (CDT) already achieve lower values than conventional orifice extinguishing systems. However, silent nozzles are needed in order to significantly reduce noise emissions even further and thereby guarantee hard disk performance.

Additional silencer as an option

The patented silencer can further bring down the sound intensity. With all these options combined, the noise level is well under 100 dB. In particular, sounds in the upper frequency range are completely removed so they cannot impair hard disk performance.

Easy retrofitting

The nozzles are easy to fit, so even existing systems can be upgraded relatively effortlessly. The existing pipe network can be retained.



Piping network with silent nozzle

Sinorix H_2O Gas – reliable extinguishing plus cooling

Highlights

- Reliable extinguishing, effective prevention of re-ignition
- Highly flexible during planning phase, customized design
- Excellent property protection through minimal water use
- Additional safety for people through the reduction of toxic fumes
- First and as yet only VdS-approved gas/water combined extinguishing solution for room protection*
- Winner of the Security Innovation Award 2008

Sinorix H2O Gas combines highly efficient nitrogen extinguishing with a cooling water mist. Thus, it fights fire in two ways: through oxygen displacement and an additional cooling effect.

Sinorix H2O Gas – tailored to your needs for double protection

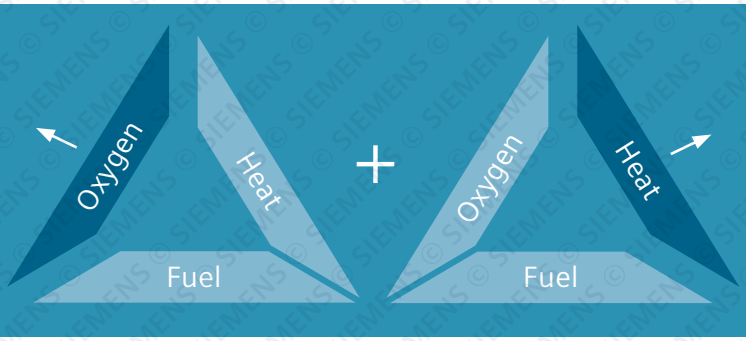
With a perfect mixture of gas and water, Sinorix H_2O Gas provides double protection. Fires are reliably extinguished and re-ignition is effectively prevented. Both extinguishing agents are carried by the same piping network and are distributed by the same nozzles to the flooding zone. Nitrogen is used as the extinguishing agent and as the propellant for the water.

The extinguishing system is designed using a specifically developed calculation program. The program was tested and approved by VdS as part of its system certification process.

Sinorix H_2O Gas minimizes secondary damage with its fine spraying technology, which requires only 30–80 litres of water for each 100 cubic metres of space.

In addition, the water mist reduces toxic fumes in the air. This protects the health of people and prevents smoke damage to property.

Gas/water combined solutions extinguish a fire by displacing oxygen combined with an additional cooling effect..



1 Fire detection and extinguishing control panel
2 Fire detector
3 Aspirating smoke detector
4 Combined sounder beacon
5 Manual release for extinguishing system
6 Warning display
7 Extinguishing agent cylinders with nitrogen and water
8 Piping network with nozzles
9 Overpressure flap

Extinguishing with nitrogen and water mist

The nitrogen provides excellent extinguishing properties for the three major types of fires A, B, and C. At the same time, the sprayed water quickly cools substances to below their minimum combustion temperature and displaces the oxygen as it vaporizes.

Neither nitrogen nor water present any environmental or health hazards. They do not harm the ozone layer or contribute to global warming, nor do they create any harmful reaction products during the extinguishing process. Thus, the extinguishing zone can be vented simply by using ventilation systems or opening windows.

Typische Applikationen

- Archives
- Libraries
- Museums
- Vaults
- UPS systems
- Storage for flammable liquids
- Turbines
- Closed transformers and generators

* without limitations concerning application and room volume

The Royal Archive, Denmark
The extinguishing solution Sinorix H2O Gas offers optimal protection for the irreplaceable, historic documents

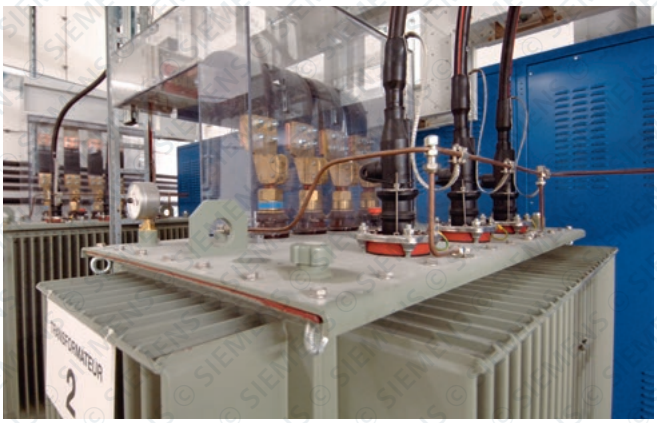
Water mist systems

Highlights

- Approved for all common applications by VKF-certified test labs
- Highly effective energy removal
- Natural extinguishing agent
- Fire suppression or extinguishing
- Low water consumption compared to sprinkler systems

Fine water droplets in the water mist create a cooling effect, which suppresses the fire or efficiently extinguishes it.

Pump-based high-pressure water mist systems can be used for building, room and object protection. The increased cooling effect of the fine water droplets can fight fires more efficiently. The systems are connected to the local water system via a storage tank. A pump moves the water under high pressure (up to 160 bar) to the nozzles where nebulization takes place. Open or closed nozzles can be used depending on the application. High-pressure water mist systems can be controlled from a fire detection system or, like a sprinkler system, they can be autonomously triggered by the heat of the fire.



For transformer and generator rooms, water mist is an alternative to gas solutions, provided they are open and not enclosed.

Archives are a typical application for water mist technology. The water mist contains fine droplets of water, a simple and effective way of fighting the fire through increased cooling.

Extinguishing with water mist

Water mist systems work by removing the heat and displacing the oxygen locally as a result of vaporization. The high pressure creates small water droplets with a large surface area, instantly producing a cooling effect. The droplet size is much smaller than conventional wet extinguishing systems, for a correspondingly greater cooling effect.

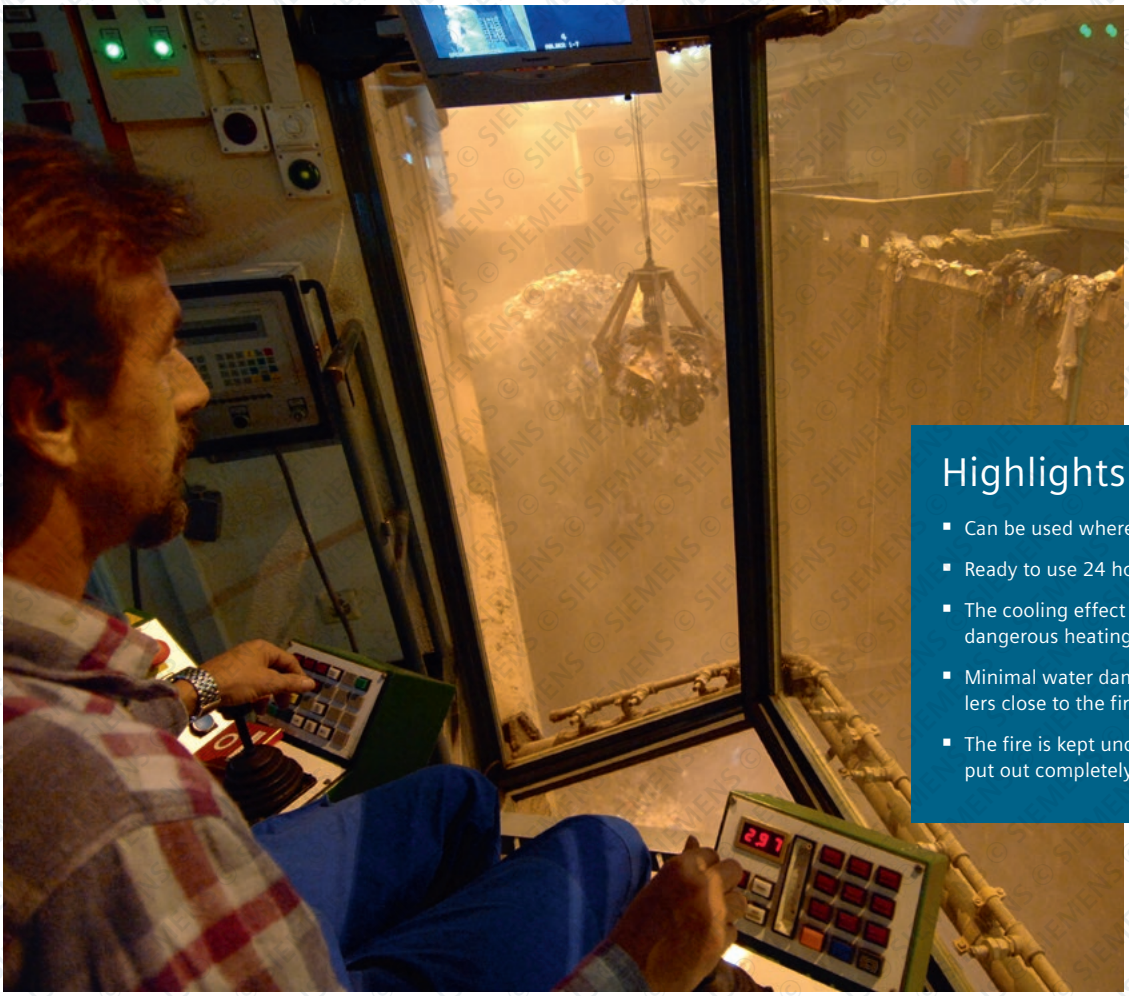
Typical applications

- Archives
- Libraries
- Emergency power supplies
- Open transformers
- Machinery and technical equipment
- Cable ducts

In Partnerschaft mit:

FOGTEC® FIRE PROTECTION

Extinguishing with water or foam – reliable extinguishing through cooling



Special applications with light foam in the ERZ Hagenholz waste incineration plant in Zurich

Highlights

- Can be used where access is difficult
- Ready to use 24 hours a day
- The cooling effect protects from dangerous heating
- Minimal water damage – only sprinklers close to the fire are activated
- The fire is kept under control or even put out completely

Sprinkler and foam extinguishing systems are straightforward yet highly effective. Fires are extinguished reliably through cooling – even in places that are difficult to access.

Sprinkler systems

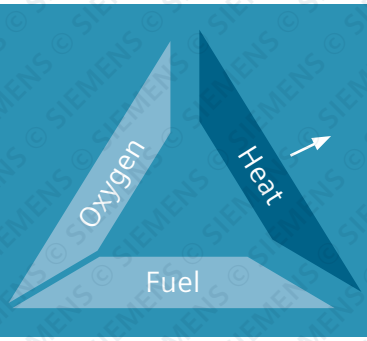
Sprinkler systems are water-only extinguishing systems, fighting fires with water. A pipe network is connected to the local water supply and delivers the extinguishing agent directly to the seat of the fire. Sprinkler heads are on constant alert, day and night, and only operate when the trigger temperature is reached. The sprinkler system can be activated by heat-sensitive glass bulb sprinklers, the fire detection system (water spray systems) or a combination of the two (pre-action systems).

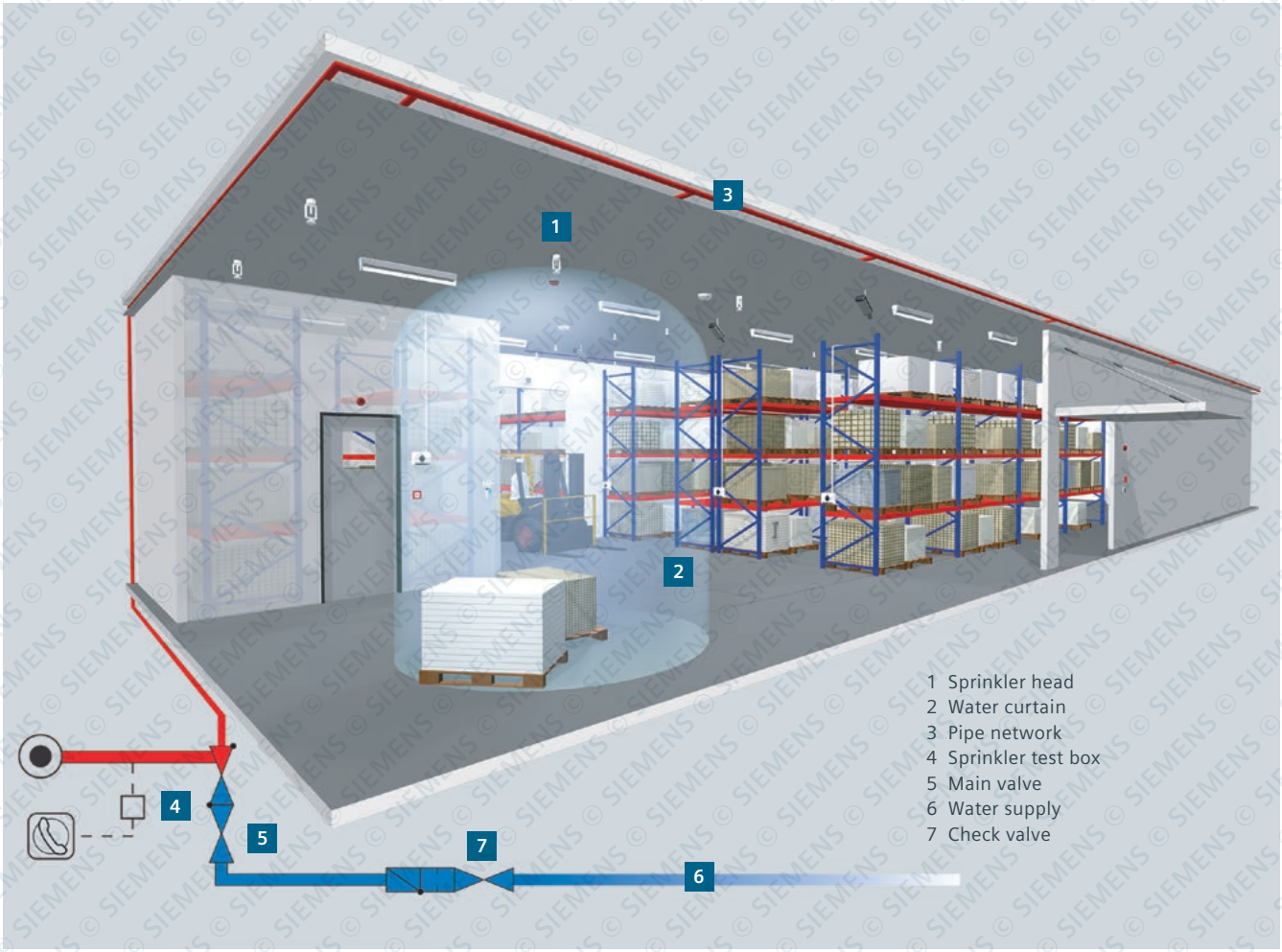
Water makes the perfect extinguishing agent because of its cooling effect. However, it must be available in sufficient quantities. In the event of a fire, only the sprinklers close to the fire are activated. This minimizes potential water damage. Sprinklers extinguish fires in places where it is difficult for the fire service to reach.

Sprinkler systems – typical applications

- shopping centres
- warehouses
- high-bay racking
- retail space
- car parks
- production areas
- exhibitions
- hotels
- care homes

An ingenious idea, yet very simple. Sprinklers work only where the fire is burning.





Foam extinguishing

Foam extinguishing systems are used to put out burning liquids, to cool fuels and sources of ignition, and to prevent the release of flammable gases. Water, foam and air are mixed to form a very lightweight foam solution. This heat-resistant foam solution separates the flames from oxygen, reliably extinguishing the fire

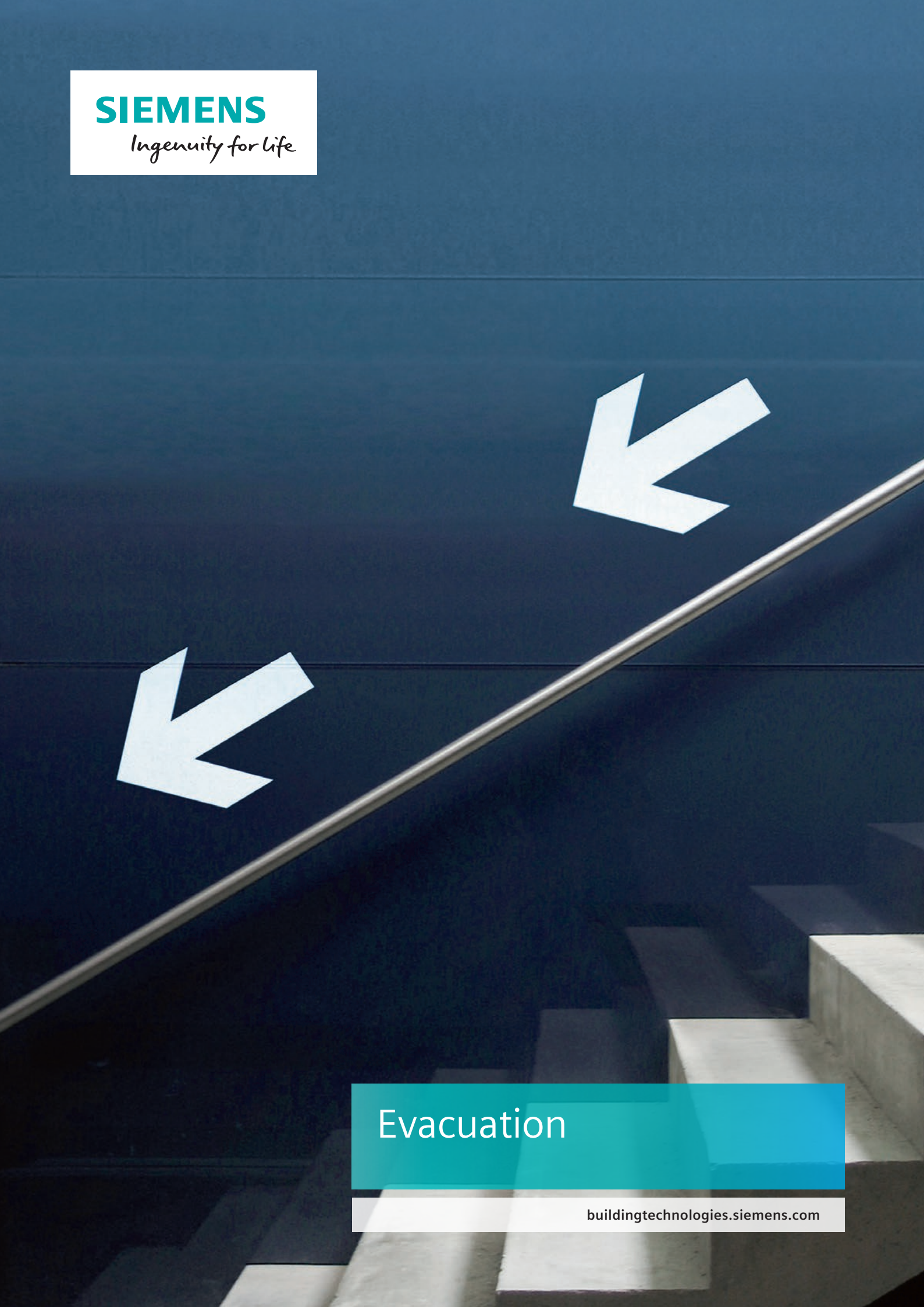
Foam extinguishing – typical applications

- bunkers in waste incineration plants
- tanks
- power plants
- chemical production facilities
- solvent storage facilities
- warehouses

Nespresso, Avenches
Sprinkler solution for the production and sales centre

SIEMENS

Ingenuity for life



Evacuation

buildingtechnologies.siemens.com

11.1. Introduction	386
11.2. Basics	386
11.2.1. Time gain	386
11.2.2. Relevant standards	387
11.2.3. Safety levels	387
11.3. Applications of voice alarm systems	388
11.3.1. Schools	388
11.3.2. Industrial premises	388
11.3.3. Hotels, hospitals, care homes	389
11.3.4. Vehicle tunnels	389
11.4. Implementation concepts	389
11.4.1. Sound alarms	389
11.4.2. Voice alarms	390
11.4.3. Visual alarms	390
11.4.4. Mass Notification Systeme	390
11.5. Voice alarms and evacuation	391
11.5.1. Conditions of evacuation	391
11.5.2. Building evacuation procedure	391
11.5.3. System	392
11.5.4. System configuration and usage concepts	392
11.5.5. Fail-safety	392
11.5.6. Audio power amplifiers	393
11.5.7. Loudspeaker cabling	393
11.5.8. Operating concepts and organizational aspects	394
11.6. Planning	394
11.6.1. Loudspeaker selection	394
11.6.2. System layout	395
11.6.3. Loudspeaker coverage	395
11.6.4. Emergency power supply	395

Graphical overview	396
Voice alarm system applications	398
Mass Notification	408
NOVIGO voice alarm system	414
NOVIGO components	416
Individual components	416
Loudspeakers	422
Overview	422
Loudspeakers	423
Accessories	429

11.1. Introduction

Evacuating a complex or large building in an emergency is no easy matter. Buildings often have different uses or the building's users may be from different cultures. An electro-acoustic emergency notification system is a very effective way of simultaneously alerting everyone to a dangerous situation. Occupants can be prompted to self-rescue in a phased way so that they leave the danger zone in an orderly manner.

11.2. Basics

The purpose of a voice alarm system is to warn people of impending danger by means of voice messages. These messages are aimed at two groups of people in particular: those currently in danger and the personnel who need to respond to the incident. In Europe, emergency services are generally alerted very quickly, but this is not always the case for the actual people who are in danger.

In the past, the self-rescue option for people in danger was considered to be of only marginal relevance. Today, however, it is acknowledged that successful self-rescue is a deciding factor. All the more so, as firefighters will not commence extinguishing operations until the building has been evacuated. Successful self-rescue is therefore also crucial for damage limitation.

While in early building alarm systems, alarm bells were manually operated, the sirens and hooters still used today are automatically activated. However, from the point of view of comprehension, nowadays it is even more difficult to know what they signify. In addition to fire alarms, over the years many more dangerous situations have emerged that require alerts. For instance, flood alerts, environmental alerts, intruder alarms or bomb threats have been added to the list, and these may require different types of responses (such as closing windows following an environmental alert for example).

Doubts about the reason for an alarm (false alarm?) and uncertainty about how to respond to it (what kind of alarm is it?) negatively impact response times. Ultimately, building operators are simply seeking to achieve the following:

- The building's users should remain undisturbed for as long as possible in order not to impair their well-being and comfort.
- If evacuation is necessary, the building should be evacuated as soon as it becomes unavoidable. In some cases, a fire may have been burning for some time already (even before the time that has elapsed since it was reported), so it is not possible to simply rely on the fire resistance properties of the building's construction materials (T30, F60, etc.).
- Evacuation should be performed as quickly and smoothly as possible.

From the point of view of both ensuring personal safety and damage limitation, self-rescue is a key factor that to a large extent determines the success of any operation. While speedy self-rescue without panic has a direct impact on success in terms of personal safety, it is also vital for the self-rescue stage to be completed so that the fire service can commence damage limitation.

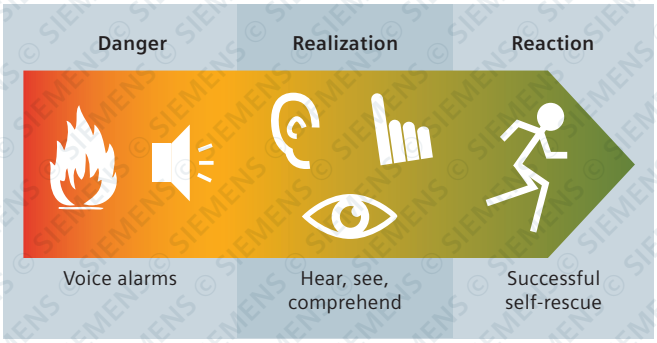


Fig. 6.1: Stages of successful self-rescue

The really innovative aspect of voice alarm systems is that they provide those affected with sufficient information both acoustically and visually so that people accept and comprehend what is happening. The primary purpose of voice alarm systems is to trigger this realization process successfully in the shortest possible time. Successful self-rescue is then only one small step which is straightforward for most people without mobility problems.

Aims of voice alarms

- Get everyone out of the danger zone without injury as quickly as possible
- Save lives
- Inform occupants immediately and initiate a coordinated evacuation of the building
- In amok situations, have people lock themselves in safe rooms

11.2.1. Time gain

In practice, signalling an emergency situation using conventional methods is often ineffective and is usually ignored or interpreted incorrectly. If someone does not understand what the sound from a siren or hooter signifies, they will quickly return to what they were doing. Visitors to public buildings will automatically assume that they will be addressed directly if anything really serious were to happen. Vital life-saving minutes and seconds are consequently wasted before people start to move, and meanwhile the danger is constantly

increasing. When people then notice that it really is an emergency and that they have failed to react quickly, panic often sets in as they try to escape, which can lead to chaos and hysteria.

As a result of this over-reaction, people start running to escape as quickly as possible, but they will not be able to make up for the time wasted. The consequences may be fatal. To save lives in an emergency, the building must be evacuated and people brought to safety in an orderly manner in the shortest possible time.

In such situations, the spoken word is a big advantage. The occupants of a building can be addressed directly over a public address system. This innovation prevents any misinterpretation from the outset. Clear instructions can be given to large numbers of people to quickly motivate them to rescue themselves and thus gain life-saving minutes. This usually happens long before the emergency services arrive on the scene, which in turn constitutes a significant time gain. Moreover, the emergency services will arrive when the building is already nearly empty, making it much easier for them to rescue people and deal with the respective danger.

Building use and user characteristics	Sound signal	Prerecorded message	Live announcement
Offices, public buildings, schools, industry (people are familiar)	>4 min	3 min	<1 min
Shops, museums, gathering places (people are unfamiliar	>6 min	3 min	<2 min
Hostels, halls of residence (people are sleeping and familiar)	>5 min	4 min	<2 min
Hotels (people are sleeping and unfamiliar)	>6 min	4 min	<2 min
Hospitals, retirement and care homes (some people require assistance)	>8 min	5 min	<3 min

Tab. 6.1: Reducing reaction times (study BS DD 240-1)

11.2.2. Relevant standards

From the outset, safety engineering systems are designed to provide the highest possible levels of fail-safety, self-monitoring and redundancy. In electroacoustic alarm systems, monitoring is performed continuously – from the microphone capsule to the central unit and through to the loudspeakers. As a result, professional voice alarm systems (VAS) activated by a fire detection system and manually activated electroacoustic emergency notification systems (ENS) are far superior to traditional public address systems. Compliance with the applicable standards maintains high quality while continuous monitoring ensures that the system detects and indicates any faults. The use of power supply equipment certified to EN 54-4 also ensures that the voice alarm system remains operational even in the event of a power failure.

Current applicable standards	
Product standards for VAS	▪ **EN 54-4:** Power supply equipment ▪ **EN 54-16:** Voice alarm control units ▪ **EN 54-24:** Loudspeakers A VAS must conform to the above EN standards in force since April 1, 2011.
Application standards for VAS/ENS	▪ **SES guidelines for VAS/ENS** Planning, installation and operation ▪ A VAS is automatically activated by a fire detection system. ▪ **EN 60849: ENS – sound systems for emergency purposes** An ENS is manually activated
VKF fire protection guidelines Applicable since Jan 1, 2015	▪ **Fire prevention and organizational fire safety** ▪ Section 6.1.4: Alerts using voice-controlled information systems. Necessity and applications

Tab. 6.2: Current applicable standards

Voice alarm systems

A voice alarm system (VAS) is automatically activated by a fire detection system and constitutes one possible alarm unit in such a system. Consequently, an EN 54-16-compliant VAS should also meet the same high standards as a fire detection system conforming to the EN 54-2 standard. All the components of a voice alarm system must therefore meet the following EN 54 standards for VAS:

- **EN 54-4:** Uninterruptible power supply with self-monitoring and automatic switchover to battery operation in the event of a power failure.
- **EN 54-16:** System control equipment must self-monitor continuously and indicate any faults. These control units must also perform the monitoring function for the loudspeakers and call stations.
- **EN 54-24:** Loudspeakers are subjected to special tests to comply with the mechanical and acoustic standards of a VAS.

Electroacoustic emergency notification systems

Electroacoustic emergency notification systems (ENS) are built to conform to the EN 60849 system standard. In addition to the architecture, this standard stipulates a minimum value for speech intelligibility (Speech Transmission Index, STI).

SES guidelines

In January 2017 the Swiss Association of Installers of Security Systems SES (sicher-ses.ch) published new guidelines for Switzerland which contain certain stipulations concerning the design, planning and maintenance of such systems. The standard covers both ENS and VAS systems,
as well as the VKF requirements for alarm systems with prerecorded messages.

11.2.3. Safety levels

An evacuation system can be designed depending on the safety level required. For instance, operational reliability can be increased by using fire-resistant cabling, dual loudspeaker lines (A/B wiring) or a redundant system design.

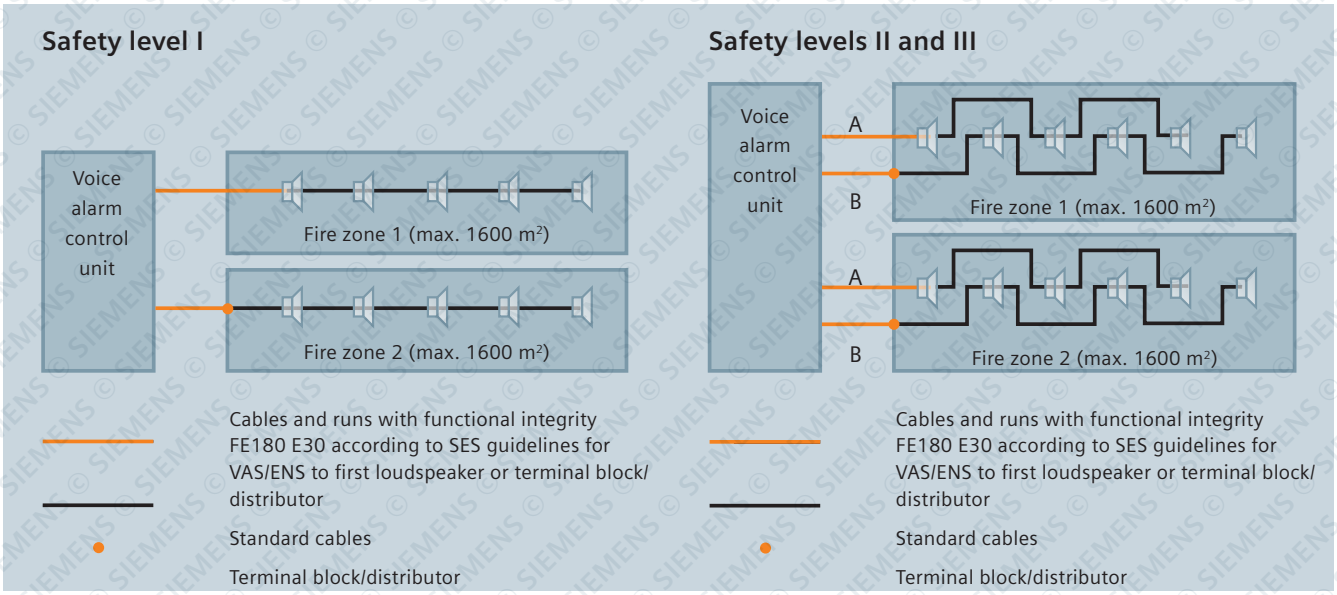


Fig. 6.2: Safety levels I, II and III

Safety level I
If there is a fault on one of the transmission paths (line break, short-circuit or similar), the public address system must not fail on more than one floor within one alarm zone. SES guidelines for VAS/ENS recommends this safety level for buildings having a floor area of less than 2000 m² and accommodating fewer than 200 people.

Safety level II
If a fault develops in an amplifier or on one transmission channel (line break, short-circuit or similar), a maximum sound pressure level reduction of 3 dB (A) is permissible and speech intelligibility (STI) must not fall below 0.45. The equivalent CIS value = 0.65. SES guidelines for VAS/ENS recommends this safety level for buildings having a floor area of more than 2000 m² and accommodating over 200 people.

Safety level III
In addition to the requirements for safely level II, safety level III requires the control centre to be fully redundant. SES guidelines for VAS/ENS recommends this safety level for buildings which require maximum fail-safety.

11.3. Applications of voice alarm systems

11.3.1. Schools

Emergency drills carried out in schools and universities aid prevention. Organizational and architectural measures are taken to make it more difficult for unauthorized persons to gain access to the building. Video surveillance and brightly lit open areas can also act as a deterrent to intruders. However, the rising number of incidents in recent years where gunmen have run amok in schools shows that this does not always succeed. Children and teachers will be at the complete mercy of perpetrators if it is not possible to quickly issue an emergency warning throughout the school. An evacuation system instructs people to exit the building as quickly as possible, or lock themselves in a classroom to protect themselves against an attack. Teaching staff can activate an alarm using concealed alarm buttons in the classrooms.

In the case of fire or bomb threats, the building must be evacuated immediately in order to remove people from the danger zone. The necessary instructions can be broadcast to every room either in plain language or as coded messages. If coded messages are used, a perpetrator will be unaware that they have already been discovered and that the police have been alerted.

Once they have arrived on the scene, the emergency services can make live announcements to actively influence events from outside the building. Using an intercom system, it is also possible to contact specific rooms directly – with video pictures if necessary – in order to assess the situation or initiate evacuation. During normal school days, the electroacoustic emergency notification system can be used to broadcast the break bell, or microphones in lecture rooms can be used to make teachers easier to hear.

11.3.2. Industrial premises

Large industrial premises spread over several buildings present a particular challenge for voice alarm systems. The wide area to be covered and the need to broadcast to all rooms requires a complex system with many loudspeakers. However, a system can be implemented elegantly even in such large premises using distributed system components communicating over a local area network (LAN). Without a voice alarm system, the often complex building layout would make it difficult to contact everyone in a timely manner.

In particular, people who are unfamiliar with the building (e.g. customers, external maintenance firms, subletting companies) can be provided with valuable assistance to escape in an emergency.

Another challenge in industrial plants are the high ambient noise levels that are often present. In this case it is also vital to ensure that the volume of emergency announcements is loud enough and that speech is intelligible so that they are actually understood. Special high-pressure loudspeakers generate high sound pressure levels in such areas. Additionally, strobe lights can also be activated in noisy environments in order to attract people's attention to a dangerous situation. In administrative offices or rooms with normal noise levels, the voice signal is adjusted to the background noise level and the emergency announcement is played more quietly. In this way it is possible to set the volume in each zone so that announcements are audible. It is also usually possible to play quiet background music over the voice alarm system during normal working days, which has been shown to contribute to a good working environment and boost employee motivation.

11.3.3. Hotels, hospitals, care homes

In buildings containing many individually lockable rooms where personnel are also constantly changing, it is difficult to notify everyone in the rooms without delay in an emergency. In hotels with several hundred guest beds, many valuable life-saving minutes would elapse if a voice alarm system were not installed. However, it is not always necessary to evacuate an entire building. An orderly evacuation by floor is often better and prevents congestion in the stairways. Hotels also often have guests from different countries, which makes communication more difficult. In public areas such as lobbies, waiting rooms, etc. it is often desirable to play background music to enhance the well-being of the people present. If an emergency arises, an audio system can be a valuable tool for notifying all residents. Every room can be contacted with a multilingual message prompting people to go to the emergency exit. The seriousness of the situation can be underlined by actuating curtains or lights, or displaying text messages on TV screens.

In hospitals it is additionally possible to use pagers to alert personnel to actively help people in need of assistance. In public areas, the background music will be interrupted in an emergency and digitally stored announcements will be played instead. It is of course also possible to use the audio system for announcements, paging and advertising messages.

11.3.4. Vehicle tunnels

A vehicle catching fire in a road tunnel can very rapidly escalate into a major incident resulting in many casualties. Although it is possible to broadcast instructions over the radio in such a situation, this will only reach the few people who have their radio turned on. Since it is often the case that drivers do not leave their vehicles immediately to look for the nearest emergency exit, they are at great risk. All too often drivers attempt to turn their vehicle around to exit the tunnel in the other direction, which leads to additional congestion and traffic chaos and also prevents firefighters reaching the source of the fire. With a suitable voice alarm concept, drivers can be quickly prompted to escape via the emergency exits. This also makes it much easier for the emergency services to get to the fire.

By its very nature, the long shape of a tunnel causes a great deal of echo and reverberation and represents a major challenge for audio equipment. Studies have identified two different ways of facilitating evacuation from a tunnel. Firstly, vehicle occupants can be addressed directly by means of so-called boundary flare horns fixed to the roof. This type of loudspeaker features highly directional sound projection and a very high sound pressure level. This reduces sound reflections on the tunnel walls, which greatly improves speech intelligibility. Thanks to the high sound pressure, the message is also audible in vehicles over the ambient fan and road noise. The lag or echo effect resulting from the offset placement of the horn speakers is largely eliminated by delaying the output of the voice announcements.

Another way of encouraging self-rescue is to locate high-pressure loudspeakers above the emergency exits. In an emergency, these broadcast messages to attract people to them (such as «Come here», or «The emergency exit is here») and encourage drivers to seek out the nearest emergency exit. Such voice messages enable people to locate the nearest emergency exit by sound even if the tunnel is already filled with smoke.

11.4. Implementation concepts

Alarm systems should inform people. But which of our five senses should be addressed? Hearing and sight are the obvious candidates. And secondly, how much information should accompany an alarm? The following sections present the most commonly used implementation concepts and outline their key aspects.

11.4.1. Sound alarms

With sound alarms, attempts are often made to distinguish different meanings by varying the sound patterns (continuous tone, intermittent tone, etc.). These can often differ between regions, and in some cases even between buildings. As a result, there is great uncertainty about the reason an alarm was sounded and how one should respond. This is even more pronounced for people who are not regularly present in the building (e.g. in a shopping centre or public building) – they have no idea what the particular tone sequences mean.

A further issue with sound alarms are the changes that are happening in society. For example, people are becoming more individual-minded and are less inclined to follow instructions unquestioningly, which means that they are more likely to be motivated if they know the reasons for a particular course of action and are persuaded of the need to follow it. Experiments with randomly selected people have shown that alarm bells or sirens do not motivate

building users to exit the building immediately. If any reaction was produced at all, ten or more minutes passed before people began to take notice of the alarm.

Clearly, a sound signal alone does not enable people to comprehend and interpret an alarm, and consequently it is completely inadequate.

11.4.2. Voice alarms

To ensure successful self-rescue, voice alarms are by far the most effective: people respond to them virtually instantaneously. Giving a reason for the alarm convinces building users of the need to act quickly. And the greatest advantage of voice alarm systems is that those affected receive instructions appropriate to the particular situation. Normally the system is operated in automatic mode in the first few minutes after an alarm is triggered. In a later phase, for example after the fire service has arrived on the scene, the incident commander or other authorized person can then issue individual instructions over the system. To do this, they speak instructions appropriate to the particular hazard into a microphone. The system then relays these instructions directly to the selected loudspeaker zones in the building (live announcement).

To reach everyone in the building as quickly as possible, and simultaneously if necessary, all rooms (including basements, toilets, storage rooms, etc.) must be equipped with loudspeakers. Placing loudspeakers in corridors alone is not enough, as the strong sound damping effect of doors means that it cannot be guaranteed that everyone will hear announcements. In addition, the intelligibility of spoken messages is greatly impaired if doors are closed, and this will be further reduced if someone is talking on the phone for example.

As they are clear and easy to understand, instructions given over a voice evacuation system to all rooms and areas of the building will be very quickly followed. This is especially true if the announcements are multilingual. A warning signal preceding the voice message also increases attention significantly. The sound level produced by a voice alarm must exceed the ambient noise level by at least 10 dBA in order to ensure that people will be able to hear and understand the messages. A minimum loudness level of at least 65 dBA is therefore required, but for the sake of simplicity a uniform sound pressure of 85 dBA is usually provided in office buildings for example. In noisier environments (machine rooms, production lines, etc.), the sound levels must be adjusted accordingly on the amplifiers.

Once the system has been installed and calibrated, acoustic measurements are taken in the individual rooms to verify adequate speech intelligibility and volume of the voice alarms. If loudspeakers were sited only in corridors or individual rooms, the system would not pass these final tests and the system would consequently be inadequate. This would necessitate the (far more expensive) addition of further loudspeakers, in comparison with the more cost-effective option of a fully equipped system from the outset.

11.4.3. Visual alarms

In addition to loudspeakers, visual alarm devices are additionally deployed in very noisy environments or to assist the hearing-impaired. Strobe lights or warning signs installed at clearly visible locations are then activated in addition to the voice announcements. This addresses the senses of both sight and hearing, which gains more attention. Like the loudspeakers, the visual alarm devices are also activated simultaneously by the voice alarm system. Modern alarm systems have special control outputs for this purpose.

11.4.4. Mass Notification Systeme

Mass notification systems (MNS) are communication systems that incorporate all available communication channels in the alarm system. This also includes voice alarm systems. See pages 408 to 413 in this section for further information.

11.5. Voice alarms and evacuation

A voice alarm system is a system that uses electronically stored voice announcements as well as acoustic signals to alert people to an emergency situation. The voice alarm system can be activated manually or automatically, for example by the alarm on a fire detection system, and a preprogrammed evacuation sequence can be initiated.

During normal day-to-day operations, a voice alarm system can also be used for paging, general announcements, advertising messages or soft background music. This has been shown to stimulate well-being among customers, increase sales in department stores and motivate staff. With modern loudspeakers, it is possible to achieve a well-balanced sound even when music is played at low volumes. It is possible to define various loudspeaker zones then individually control them depending on the respective ambient noise levels. The prerequisite for this is a fully automatic override for the voice alarm system so that in the event of an alarm the information from the voice alarm system is automatically prioritized.

Since many people wander around listening to music over headphones or talking on a mobile phone, variable audio playback which can be turned up louder in an emergency is ideal. Choosing the right loudspeaker from the various models on offer can also significantly improve speech intelligibility in acoustically challenging environments. Loudspeakers that blend unobtrusively into the building's architecture can also be chosen. By relaying situation-specific voice announcements over loudspeakers, people are notified and prompted to exit the zone in question or – if appropriate – stay where they are.

11.5.1. Conditions of evacuation

Evacuating a building is a drastic measure so it is vital to be sure that it is actually necessary. The conditions to be met before evacuation is initiated must be determined for each individual building.

11.5.2. Building evacuation procedure

Evacuations always follow the same procedure:

A voice alarm is activated manually or by a fire detection system
The voice alarm system switches all sound systems off
An attention signal is transmitted
A voice announcement follows after 4 to 10 seconds
The announcement is repeated
There may also be a live announcement from the fire service
The building is evacuated

Tab. 6.3: Evacuation sequence

Modern voice alarm systems support the fully automatic and phased evacuation of a building. This has the following advantages:

- Reduced capacity peaks on escape routes and stairways: if the whole building is evacuated simultaneously, then everyone on all the floors will rush into the stairways at the same time, which will result in major blockages.
- Less likelihood of panic: awareness of being in danger and not being able to do anything about it (blocked exits) can easily cause people to panic. This could have more disastrous consequences than the actual fire itself.
- Limiting evacuation to the absolute minimum: clearing a whole building is only advisable if it is not possible to get the fire under control. It is usually sufficient to evacuate one or more fire zones.

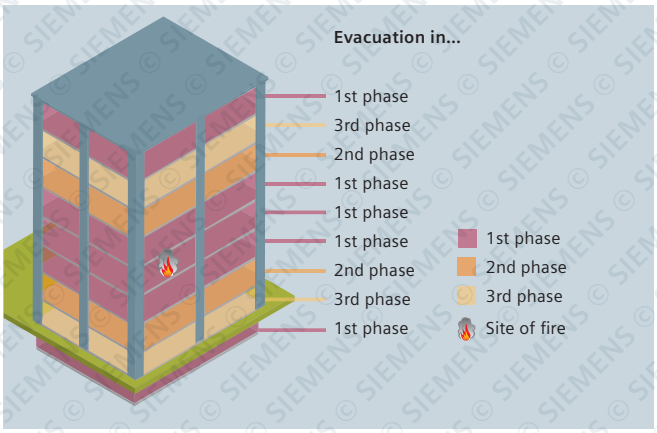


Fig. 6.3: Phased evacuation

The procedure that has become established is to evacuate the floor where the fire is located plus the floors directly above and below it during the first phase. Depending on local prevailing practice, the top floor and all basement floors can also be evacuated at the same time. If the fire spreads, the remaining floors are then progressively evacuated. The occupants of these floors will have been initially instructed to wait during the first evacuation phases.

11.5.3. System

Voice alarm systems consist of a control unit which is protected from power failure, plus a relatively small number of input channels serving a whole network of loudspeakers on the output side.

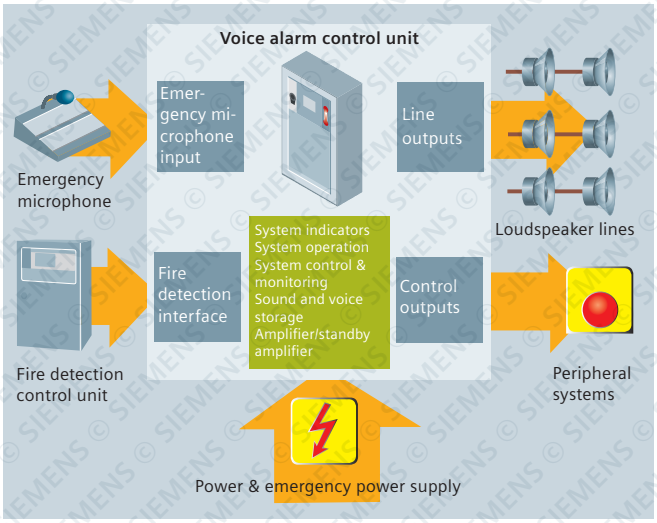


Fig. 6.4: Overview of voice alarm system

Voice alarm control units are equipped with a complete fail-safe path, that is to say full alarm operability is maintained even if any component fails. If this fail-safe path is not present or only partially provided, the system is most probably simply a public address (PA) system for background music and voice annunciation.

11.5.4. System configuration and usage concepts

If a building or a site is to be equipped with a voice alarm system, there must be at least one loudspeaker in every room. This is essential in order to reach people in remote or little-used rooms too. The local loudspeaker peripherals are then connected to various distributed subsystems, grouped by floor for example. The subsystems are interconnected over a network, which also enables central parameterization of the individual system components. However, whether central parameterization is provided or not and the scope of this functionality in practice is something that must be decided beforehand for each system.

This type of distributed structure considerably reduces the amount of cabling required as well as the installation costs, and also ensures optimal system flexibility if the building use changes for example. With modern networkable systems, it is even possible to combine several neighbouring buildings. Each building has an independent control unit, but this can also be controlled remotely from other control units if necessary, which cuts down considerably on staffing costs.

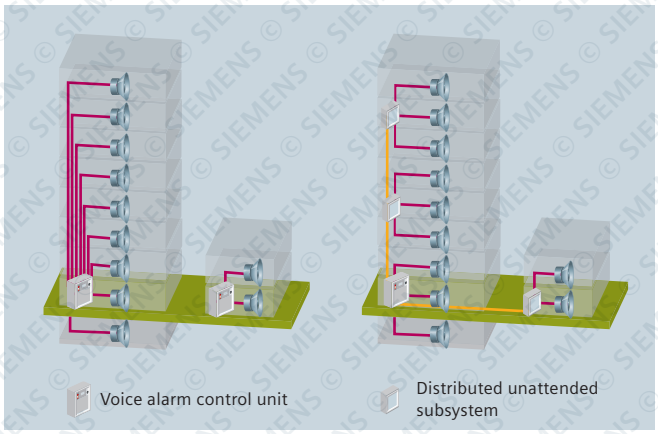


Fig. 6.5: Central and distributed system structure

The cabling from the amplifier stages to the loudspeakers is copper wire of a sufficient diameter for the required power, while the network cabling for digital transmission can be conventional wire or fibre optic cabling. The slightly higher material costs of the distributed solution compare favourably not only with respect to the higher cabling costs of a central solution (length of copper wiring and appropriate diameter for transmission capacity), but also to the higher costs entailed by transmission losses over the total distance which result in a higher power requirement for the emergency power supply.

If lengthy distances are involved, the use of fibre optic cable is always expedient, which is why more and more systems offer this type of networking as an option. Several independent control units at the same site clearly entail much higher personnel costs, which is why distributed unattended subsystems are usually the preferred option.

11.5.5. Fail-safety

In contrast to PA systems for background music and voice annunciation, a voice alarm system must have guaranteed availability at all times, which necessitates a very high degree of fail-safety. This is achieved by the generally high reliability of all the individual components. In addition, these systems have redundant standby amplifiers that are automatically started by the system if an amplifier fails (automatic «hot swapping»). Like the amplifiers, most components should be redundant: from the internal and external cabling to the input interfaces (e.g. microphone) and through to the prerecorded messages, many system components are provided in duplicate or more. This is also one of the reasons why a PA system cannot simply be used as an emergency warning system, for such safety systems must also have much higher functional integrity than systems that are used for every-day purposes.

11.5.6. Audio power amplifiers

Digital audio technology is opening up potential new applications for voice alarm systems. The use of digital signal processing enables several audio channels with different audio signals to be simultaneously transmitted over one and the same digital system bus. Moreover, thanks to the introduction of digitally switched amplifiers, it is now also possible to significantly increase the efficiency of amplifiers. This reduces power consumption during voice annunciation by around a third, the capacity required for the emergency power supply is approximately halved, and the waste heat generated is reduced by around two thirds (compared with analogue amplifiers which often convert more than half the supplied energy into heat).

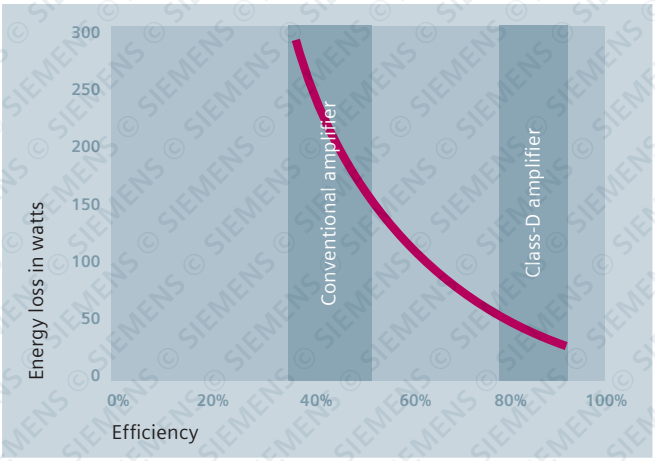


Fig. 6.6: 180 watt amplifiers: efficiency and energy loss

If two or more amplifiers and a distributor card with relays are used, simultaneous transmission on different channels is also possible with central amplification.

Distributed amplification benefits from modern simple electronic channel allocation. This enables cost-effective free allocation of the required sound source to the zone amplifiers, which in turn are connected to the respective loudspeaker zone. Distributed amplification offers the following advantages:

- The standby amplifiers do not have to cover all the loudspeaker groups and can therefore be smaller. Several standby amplifiers are also used in many cases. This also provides a higher degree of fail-safety.
- Different loudspeaker groups can relay different messages at the same time. This is a prerequisite for phased evacuation. The zones adjacent to the danger zone receive a warning message while evacuation is underway in the zones directly affected.
- Distributed amplification enables the infrastructure required to be distributed throughout the building, i.e. to be decentralized. This increases safety and results in shorter power-transmitting cables.

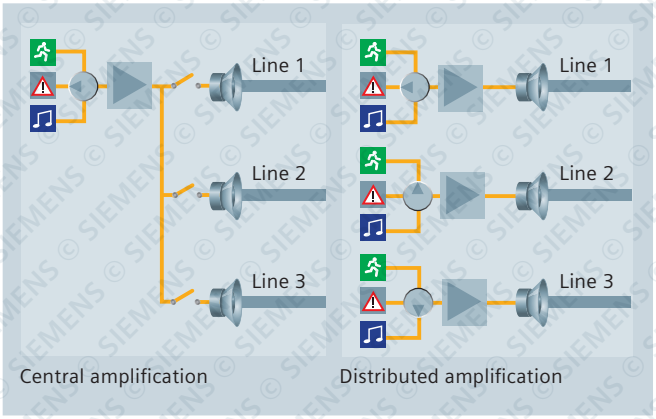


Fig. 6.7: Comparison of central and distributed amplification

11.5.7. Loudspeaker cabling

The simplest form of wiring, Class B wiring, has no redundancy and low fail-safety. In the event of a line break or short-circuit, the whole loudspeaker line will fail.

With Class A wiring, a line break will not impair functionality since the line is led back to the system and can also be supplied from there. If a short-circuit occurs, however, the whole loudspeaker circuit will fail.

With a mix of Class A/B wiring, every second loudspeaker is wired to a separate loudspeaker circuit and the lines are run separately in the building. If one loudspeaker circuit breaks or suffers a short-circuit, every second loudspeaker will still be available. Consequently, the maximum sound pressure level reduction of 3 dB permitted by the standard is not breached and a certain level of speech intelligibility is maintained.

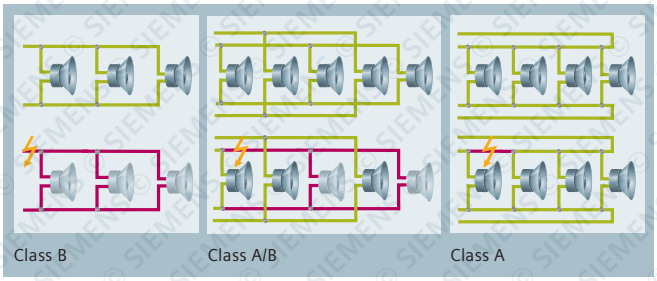


Fig. 6.8: Cable classes and fail-safety following a line break

11.5.8. Operating concepts and organizational aspects

Voice alarm systems are automatically activated by the fire detection system, or they can also be triggered manually by a member of staff or the fire service. By contrast, electro-acoustic emergency notification systems are only ever manually activated. Following automatic activation, a stored voice message is usually transmitted. Following manual activation, either a stored voice message can be broadcast, or the fire service can make a live announcement using the emergency microphone.

The voice alarm system must therefore be able to take account of all the demands that flow from the individual situation in a way which ensures that the overall process is coherent and logical. For a voice alarm system to work properly, therefore, good organizational fire safety is crucial. In particular, the following points should be observed:

- Make sure that escape routes are well signposted and that they remain visible even in smoky conditions.
- Ensure that escape routes are not blocked and that they remain free.
- Organizational fire safety can only work if people are trained and drills are held regularly.
- Those in charge and their deputies are clear about their roles in an emergency and who performs which tasks in what order.
- A notification concept defines who should be notified, under what circumstances, and by what means. Information flows have been tested and are constantly adapted to changing circumstances.

The weak spot of organizational fire safety is virtually synonymous with human beings. And people are at their most reliable if they have already received training in what to do in unfamiliar situations. This is another reason to take drills very seriously.

11.6. Planning

The planning, installation and maintenance of voice alarm systems require planners, installers, operators and service firms to have specific technical expertise. During the planning phase, intensive cooperation is required between the manufacturer and planners, installers, operators, public authorities and the fire service. The procedure and corresponding processes are described in detail in the applicable application standards for voice alarm systems.

The following tasks must be carried out:

- Define alarm zones, taking fire zones and the emergency escape routes into account
- Overlapping of fire detection and alarm zones
- Determine ambient noise levels and therefore the sound pressure levels required
- Calculate the maximum area covered by each loudspeaker
- Determine the usual number of occupants in the rooms and the languages spoken
- Measure the different ceiling heights
- Consider the acoustic parameters of the room, such as reverberation time, echo and time lag for example, and their combined impact on speech intelligibility
- Calculate how many loudspeakers are required and the power requirement for the output stage

11.6.1. Loudspeaker selection

A wide variety of loudspeaker types are available for project planning and suitable for use in different applications depending on their design and acoustic characteristics. For instance, flush-mounted and wall-mounted speakers are ideal for achieving uniform and intelligible wide sound coverage. Projector speakers, on the other hand, are primarily used in corridors where directional sound dispersion is desirable. As they are weather-resistant, horn speakers are predominantly used outdoors. Such speakers are also preferably used in noisy environments where high sound pressure levels are required (such as in industrial settings or production plants). Purpose-built boundary flare horns are available for special tunnel applications which place the highest demands on planning, acoustics and loudspeakers. As a result of their large funnel-shape, these loudspeakers have an extraordinarily high sound pressure as well as a highly limited and concentrated sound field which was optimized for tunnels.

Depending on the sound quality desired, the optimal type of loudspeaker should be selected for the particular application and the technical and acoustic requirements of the room. According to current standards, the desired signal must be at least 10 dBA above the ambient noise level for good speech intelligibility. Reliable information about the noise levels in the prospective system environment is therefore already required during the planning stage.

11.6.2. System layout

The VKF fire protection guidelines on fire prevention and organizational fire safety specify what organizations, in terms of workforce or size of premises, are required to install a voice alarm system. Naturally, the use of targeted alerts with spoken voice messages is also expedient in any organization that wishes to increase its safety by installing state-of-the-art technology in its premises. A voice alarm system will be of little use, however, if announcements are inaudible or cannot be understood.

The DIN 0833-4 and EN 60849 standards consequently stipulate that an evacuation system with annunciation must have a sufficiently high volume (+10 dBA) and good speech intelligibility (Speech Transmission Index (STI) value of at least 0.5). Full loudspeaker coverage is therefore essential, as otherwise speech intelligibility would not be guaranteed in rooms without loudspeakers, or the volume would be too low. This can be the case even when doors are open, since rooms without loudspeakers generally receive too little direct sound.

11.6.3. Loudspeaker coverage

To ensure homogeneous sound distribution and as few interfering reflections as possible, as much direct sound as possible should be provided. The coverage each loudspeaker can provide varies depending on the coverage angle of the speaker and the ceiling height. As ceiling height increases, the sound pressure at the listener's level falls, which in turn can have a negative impact on intelligibility. The current room acoustics, for instance whether a room is empty or is full of people or furniture, also have a major influence on intelligibility.

Ceiling height h	[m]	3	3.5	4	4.5	5	5.5	6
Loudspeaker distance a	[m]	3	4	5	6	7	8	9
Coverage area per loudspeaker	[m^2]	9	16	25	36	49	64	81

Tab. 6.4: Coverage area with good intelligibility – α 90°

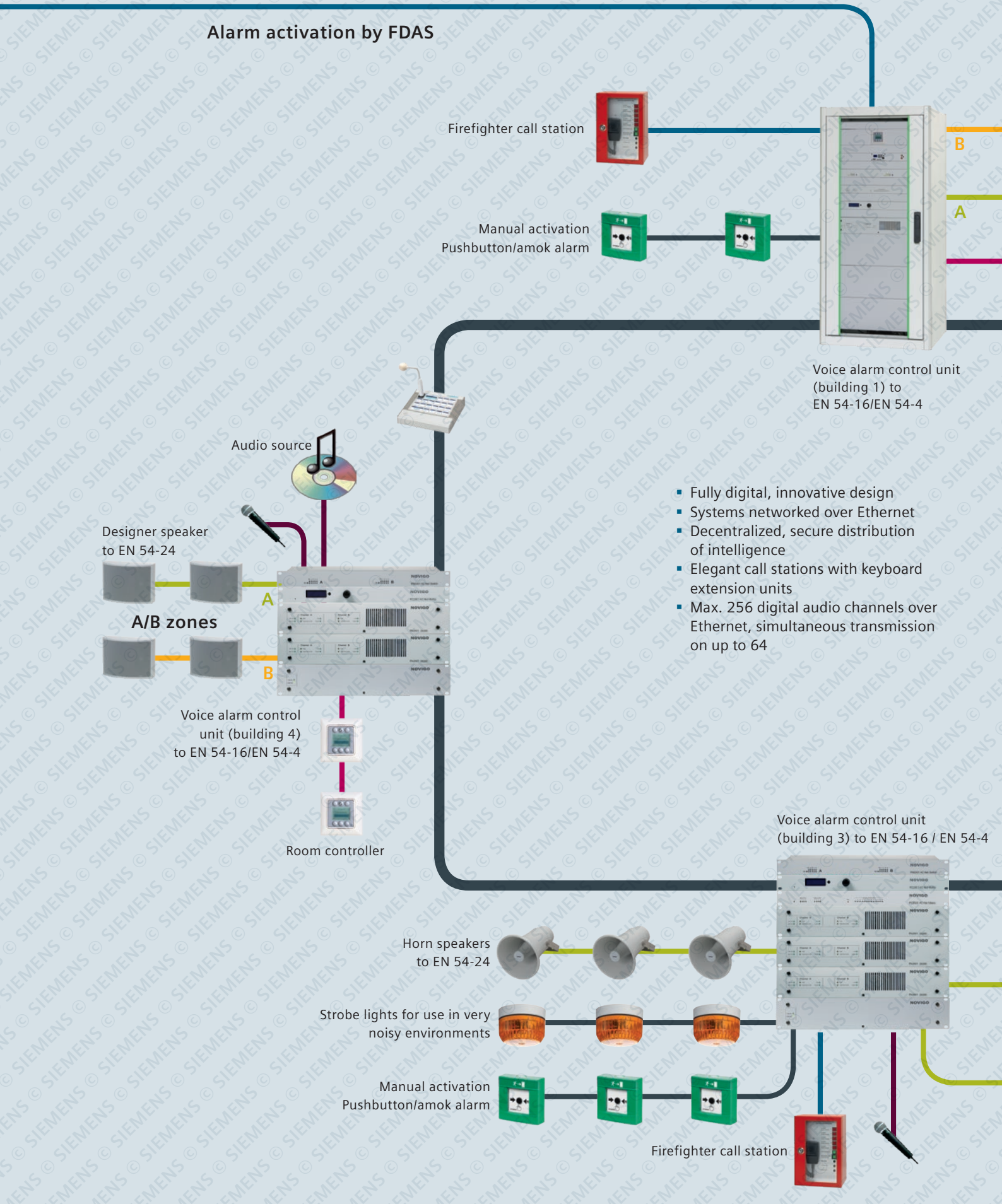
The rule of thumb is that sound-absorbing surfaces such as carpets and curtains reduce both sound volume and reflections while increasing speech intelligibility. Where it is difficult to estimate the acoustic conditions, special computer programs are used to calculate speech intelligibility in advance and the system can then be optimized for the specific individual situation.

11.6.4. Emergency power supply

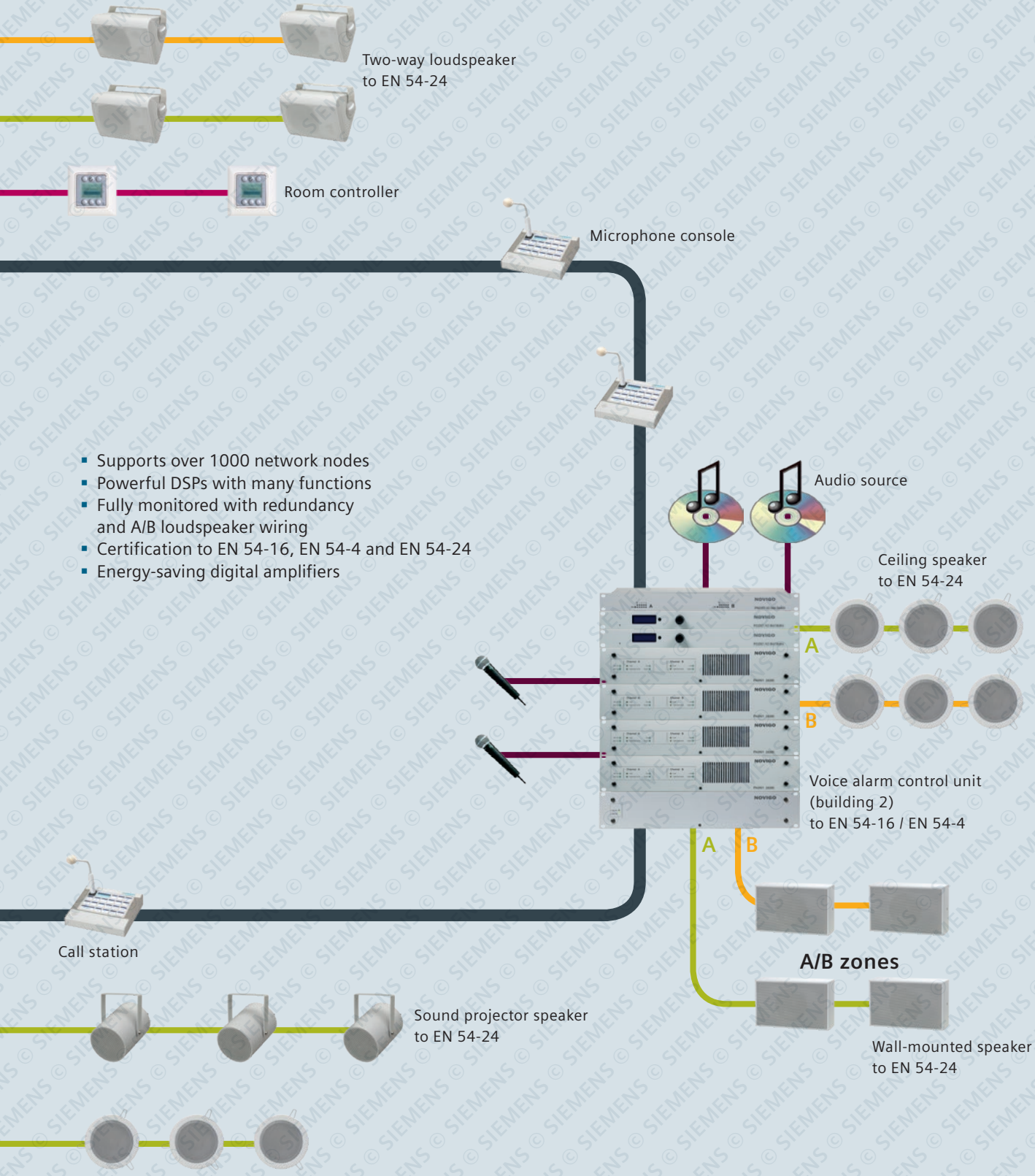
Since a VAS or ENS is an alarm system, it must be ensured that it remains operational even in emergency situations, such as a power failure for example. An emergency power supply certified to EN 54-4 is therefore a requirement for a VAS. In the event of a power failure, this power supply will seamlessly switch over to the connected batteries which will then take over supplying power to the VAS. To maintain emergency operation for as long as possible, only the alarm functions are active and any normal paging or background music functions are switched off. It must be ensured that the system is planned using correct calculations for the emergency power and battery capacity required.

If the voice alarm system is activated automatically by the fire detection control unit, it must be ensured that an alarm is not a false alarm. The fire detection system must therefore be as efficient as possible and not generate false alarms. Manufacturers whose products are truly capable of differentiating between genuine and false alarms will be able to demonstrate this (e.g. in a fire test room for customers in which experiments designed to produce false alarms can be conducted, or with test fires on site).

Alarm activation by FDAS



- Fully digital, innovative design
- Systems networked over Ethernet
- Decentralized, secure distribution of intelligence
- Elegant call stations with keyboard extension units
- Max. 256 digital audio channels over Ethernet, simultaneous transmission on up to 64


Two-way loudspeaker
to EN 54-24
Room controller
Microphone console
Supports over 1000 network nodes
Powerful DSPs with many functions
Fully monitored with redundancy
and A/B loudspeaker wiring
Certification to EN 54-16, EN 54-4 and EN 54-24
Energy-saving digital amplifiers
Audio source
Ceiling speaker
to EN 54-24
A
B
Voice alarm control unit
(building 2)
to EN 54-16 / EN 54-4
A
B
A/B zones
Wall-mounted speaker
to EN 54-24
Call station
Sound projector speaker
to EN 54-24

A clear commitment to building safety

Evacuating a complex or large building in an emergency is no easy matter. Buildings often have different uses or the building's users may be from different cultures.

An electroacoustic emergency notification system is a very effective way of simultaneously alerting everyone to a dangerous situation. Occupants can be prompted to self-rescue in a phased way so that they leave the danger zone in an orderly manner. This prevents panic and crush situations.

Taller, bigger, more complex

It is not only in the USA and Asia that buildings are getting ever taller, bigger and more complex – this is also happening in Switzerland. As well as new builds, existing properties are being repurposed and linked up. This results in large areas to be covered over several floors and spread across different buildings.

Nowadays the use of buildings can change frequently, and many more are becoming multifunctional. Complex architecture and higher occupancy rates make the risks in an emergency significantly higher.

Increased customer footfall, changing personnel, external contractors and suppliers – modern life involves a lot of coming and going. Frequently people are present in buildings where they are unfamiliar with the building layout and have no idea where the emergency exits are located.

Siemens offers the ideal equipment and solutions to build both compact and distributed voice alarm systems and electroacoustic emergency notification systems. The benefits: end-to-end solutions from background music through to phased building evacuation can be implemented, both substantially contributing to safety and creating a pleasant environment.

Good to know that a system that enhances well-being during everyday operation can also be relied on to step in without fail as a warning system in an emergency.

Spoken word instead of sound signals

In practice, signalling an emergency situation using conventional methods is often ineffective and is mostly ignored or misinterpreted. If they do not know what the sound of a siren or hooter signifies, people usually quickly return to what they were doing before. Visitors to public buildings will automatically assume that they will be addressed directly if anything really serious has happened.

Vital life-saving minutes and seconds are consequently wasted before people start to move, and meanwhile the danger is constantly increasing. When people then notice that it really is an emergency and that they have failed to react promptly, panic often sets in as they try to escape, which can lead to chaos and hysteria. As a result of this over-reaction, people start running to escape as quickly as possible, but they will not be able to make up for the time wasted. The consequences may be fatal. To save lives in an emergency, the building must be evacuated and people brought to safety in an orderly manner in the shortest possible time.

Advantages of voice annunciation

In such situations, the spoken word is a big advantage. The occupants of a building can be addressed directly over a public address system. This innovation prevents any misinterpretation from the outset. Clear instructions can be given to large numbers of people to quickly motivate them to rescue themselves and thus gain life-saving minutes. This usually happens long before the emergency services arrive on the scene, which in turn constitutes a significant time gain. Moreover, the emergency services will arrive when the building is already nearly empty, making it much easier for them to rescue people and deal with the respective danger. Once they have arrived, the emergency services can of course directly intervene with live announcements.

Electroacoustic emergency warning systems have been successfully used in the USA for many years already. These are now also being increasingly deployed in Europe and are also making a considerable contribution to greater safety in buildings in Switzerland as well.

Evacuation can be particularly challenging in buildings where large numbers of people congregate such as hotels, offices, shopping centres, schools and universities. Modern voice alarm systems are ideally suited to these situations: the system makes clear announcements to inform people of the danger and gives explicit instructions which can be readily understood and followed. Reassuring voice messages also help to prevent panic.

Escape routes can however often become bottlenecks. Particularly in large buildings, it is not possible for everyone to exit simultaneously. In this case the solution is orderly partial evacuation so that the building can be progressively cleared.

Modern voice alarm systems therefore work with different preprogrammed priorities and scenarios which are automatically initiated as the situation dictates:

- First the people in immediate danger are evacuated,
- then those in the adjacent zones, and
- finally, if necessary, all the other zones in the building.

When safety is paramount

Acoustic requirements according to DIN VDE 0833-4

Minimum alarm level

- 65 dB (A)
- 75 dB (A) in sleeping and rest areas
- However at least 10 dB (A) above the ambient noise level; the ambient noise level must be determined beforehand

Speech intelligibility

Required average speech intelligibility: CIS ≥ 0.7, STI ≥ 0.5.

Intelligibility

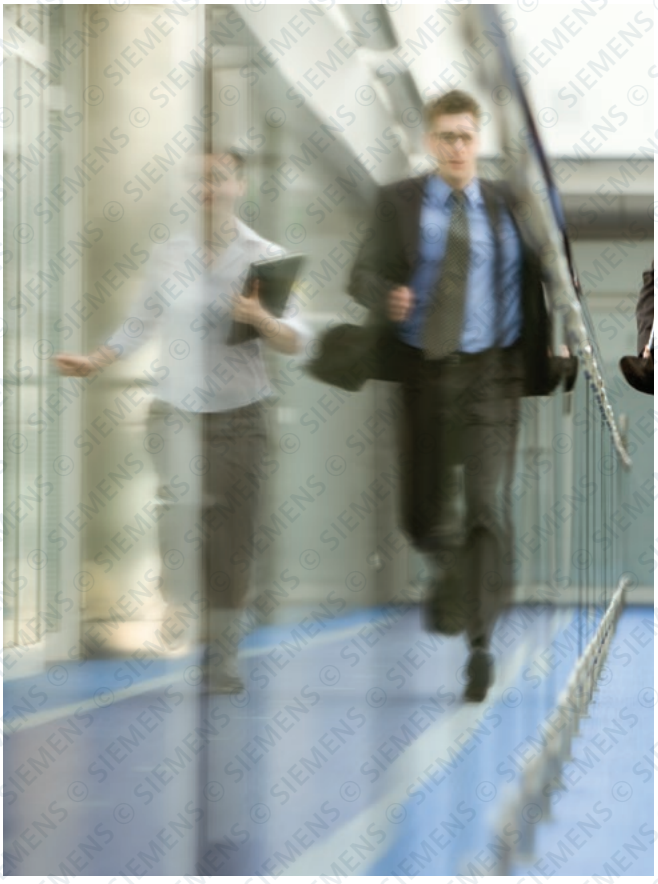
The intelligibility of an announcement is paramount. If announcements are indistinct or unintelligible, even the best public address system is worthless. To ensure that instructions are sufficiently loud and audible, the volume set must be at least +10 dB (A) higher than the ambient noise in the room. The STI (Speech Transmission Index) is calculated from 98 individual measurements and expressed as a figure on a scale of 0 to 1. EN standards stipulate that a voice alarm system should have an STI of at least 0.5.

Pioneering hi-tech

Electroacoustic systems with plug-in modules and measurement cards are obsolete. Owing to its design with many internal contacts, this technology is prone to loose contacts and circuit breaks. In the past, many modular plug-in systems have shown that their reliability deteriorates with age and that the systems require more and more maintenance. Thanks to mature microprocessor technology, modern public address systems are highly integrated, fully digital and extremely compact.

Where previously mechanical controllers on the unit were required, thanks to built-in DSP chips and interfaces many parameters can now be easily set via a menu-driven interface. The compactness of the design does not however mean a loss of flexibility. On the contrary, such systems save space, can be individually programmed and, thanks to the interfaces, can also be used in a distributed configuration. Loss-free digital technology is employed when networking the units, which means that uninterrupted transmission is possible on multiple audio channels over an Ethernet connection.

With experience in fire safety technology going back 150 years, Siemens represents not only innovative solutions and reliable components, but also expert advice and help with planning.



Noise source	dB
Quiet conversation	30...50
Ripping paper	40...60
Ordinary conversation	50...65
Office noise	40...70
Motor vehicle	40...75
Studio speaker	60...75
Vacuum cleaner	45...75
Small orchestra	20...80
Radio music in restaurant	40...80
Street noise	40...85
Large orchestra	20...95 (...105)
Factory noise	50...95
Subway	85...110
Printing shop	85...105
Aircraft at 3 m	110...130

Noise sources and noise levels

Safety plus atmosphere

An atmosphere of well-being

Discreet background music creates a pleasant atmosphere for customers in retail stores or restaurants. It has been shown that sales turnover rises if music appropriate to the time of day is played interspersed with advertising messages. In restaurants, background music creates a discreet atmosphere so that diners do not overhear conversations at neighbouring tables.

VoIP music service providers can provide tailored digital music programs without adverts that can be readily broadcast throughout the building over a public address system. It is of course also possible to connect MP3 players, CD players, radio receivers or smartphones with suitable music to the system units.

In shopping centres with many different stores, each one can be supplied with music over the voice alarm system. It is also possible to equip the system with a separate high-end Hi-Fi music system. In an emergency, it will be interrupted by the voice alarm system which will then feed the emergency announcements to the respective store. Parking garages, on the other hand, are usually equipped with horn loudspeakers so that customers can be alerted to dangerous situations as soon as they step out of their vehicles.

To ensure that the digitally stored emergency announcements can also be understood by foreigners, messages in different languages can be saved in the built-in digital voice storage.

To reach individuals with hearing impairments, it is possible to create alarm concepts which, in addition to making the emergency announcement, also send flashing, easily read alarm messages to existing screens.

Focus on schools

The versatile evacuation system

Emergency drills carried out in schools and universities aid prevention. Organizational and architectural measures are taken to make it more difficult for unauthorized persons to gain access to the building. Video surveillance and brightly lit open areas can also act as a deterrent to intruders. However, the rising number of incidents in recent years where gunmen have run amok in schools shows that this does not always succeed. Children and teachers will be at the complete mercy of perpetrators if it is not possible to quickly issue an emergency warning throughout the school. An evacuation system instructs people to exit the building as quickly as possible, or lock themselves in a classroom to protect themselves against an attack. Teaching staff can activate an alarm using concealed alarm buttons in the classrooms.

In the case of fire or bomb threats, the building must be evacuated immediately in order to remove people from the danger zone. The necessary instructions can be broadcast to every room either in plain language or as coded messages.

If coded messages are used, a perpetrator will be unaware that they have already been discovered and that the police have been alerted. Once they have arrived on the scene, the emergency services can make live announcements to actively influence events from outside the building. Using an intercom system, it is also possible to contact specific rooms directly – with video pictures if necessary – in order to assess the situation or initiate evacuation.

During normal school days, the electroacoustic emergency notification system can be used to broadcast the break bell, or microphones in lecture rooms can be used to make teachers easier to hear.

Alarms on industrial premises

Networking enables wide coverage

Large industrial premises spread over several buildings present a particular challenge for voice alarm systems. The wide area to be covered and the need to broadcast to all rooms requires a complex system with many loudspeakers. However, a system can be implemented elegantly even in such large premises using distributed system components communicating over a local area network (LAN). Without a voice alarm system, the often complex building layout would make it difficult to contact everyone in a timely manner. In particular, people who are unfamiliar with the building (e.g. customers, external maintenance firms, subletting companies) can be provided with valuable assistance to escape in an emergency.

Another challenge in industrial plants are the high ambient noise levels that are often present. In this case it is also vital to ensure that the volume of emergency announcements is loud enough and that speech is intelligible so that they are actually understood. Special high-pressure loudspeakers generate high sound pressure levels in such areas. Additionally, strobe lights can also be activated in noisy environments in order to attract people's attention to a dangerous situation.

In administrative offices or rooms with normal noise levels, the alarm signal is adjusted to the ambient noise and the emergency announcement is played more quietly. In this way it is possible to set the volume in each zone so that announcements are audible. It is also usually possible to play quiet background music over the voice alarm system during normal working days, which has been shown to contribute to a good working environment and boost employee motivation.

Hotels, hospitals, care homes

Many rooms – one solution

In buildings containing many individually lockable rooms where personnel are also constantly changing, it is difficult to notify everyone in the rooms without delay in an emergency. In hotels with several hundred guest beds, many valuable life-saving minutes would elapse if a voice alarm system were not installed. However, it is not always necessary to evacuate an entire building. An orderly evacuation by floor is often better and prevents congestion in the stairways. Hotels also often have guests from different countries, which makes communication more difficult. In public areas such as lobbies, waiting rooms, etc. it is often desirable to play background music to enhance the well-being of the people present.

If an emergency arises, an audio system can be a valuable tool for notifying all residents. Every room can be contacted with a multilingual message prompting people to go to the emergency exit. The seriousness of the situation can be underlined by actuating curtains or lights, or displaying text messages on TV screens.

In hospitals it is additionally possible to use pagers to alert personnel to actively help people in need of assistance. In public areas, the background music will be interrupted in an emergency and digitally stored announcements will be played instead. It is of course also possible to use the audio system for announcements, paging and advertising messages.

Voice alarms in vehicle tunnels

A vehicle catching fire in a road tunnel can very rapidly escalate into a major incident resulting in many casualties. Although it is possible to broadcast instructions over the radio in such a situation, this will only reach the few people who have their radio turned on. Since it is often the case that drivers do not leave their vehicles immediately to look for the nearest emergency exit, they are at great risk. All too often drivers attempt to turn their vehicle around to exit the tunnel in the other direction, which leads to additional congestion and traffic chaos and also prevents firefighters reaching the source of the fire. With a suitable voice alarm concept, drivers can be quickly prompted to escape via the emergency exits. This also makes it much easier for the emergency services to get to the fire.

By its very nature, the long shape of a tunnel causes a great deal of echo and reverberation and represents a major challenge for audio equipment. Studies have identified two different ways of facilitating evacuation from a tunnel.

Firstly, vehicle occupants can be addressed directly by means of so-called boundary flare horns fixed to the roof. This type of loudspeaker features highly directional sound projection and a very high sound pressure level. This reduces sound reflections on the tunnel walls, which greatly improves speech intelligibility. Thanks to the high sound pressure, the message is also audible in vehicles over the ambient fan and road noise. The lag or echo effect resulting from the offset placement of the horn speakers is largely eliminated by delaying the output of the voice announcements.

Another way of encouraging self-rescue is to locate high-pressure loudspeakers above the emergency exits. In an emergency, these broadcast messages to attract people to them (such as «Come here», or «The emergency exit is here») and encourage drivers to seek out the nearest emergency exit. Such voice messages enable people to locate the nearest emergency exit by sound even if the tunnel is already filled with smoke.

Fully integrated routine and emergency communication

Getting through to everyone

In emergency situations, it is doubly important that communications are crystal clear. The right tools will help you send clear notifications about a situation quickly and reliably. As a central portal, Desigo™ Mass Notification combines your local security and communications infrastructure (e.g. public address systems) with common systems for alerting and notifying individuals or large groups of people (e.g. using text messages, e-mail or pagers). This also includes new media such as social networks (e.g. Twitter).

With Desigo Mass Notification you will reliably get through to the right people – whether they are within a single building, are spread across a complex, or even dispersed at several locations. Desigo Mass Notification is a cost-effective, flexible solution. As it is modular, functions can be added at any time. Desigo Mass Notification is highly adaptable, so even if your needs change, you will always be well equipped to meet future challenges.

With Desigo Mass Notification, you get your message through to the right people quickly and reliably, no matter where they are or what they are doing.

Threats

Mass notification systems (MNS) are designed to quickly notify a large number of people (employees, visitors, students, etc.) of impending threats and give them appropriate instructions. Threats can be categorised as follows:

Threats from nature	Threats from humans
Geological threats ▪ Earthquakes ▪ Tsunamis ▪ Volcano eruptions ▪ Landslides ▪ Icebergs	**Accidental threats** ▪ Escape of hazardous substances ▪ Fire/explosions ▪ Transport accidents ▪ Building collapse ▪ Dam failure
Weather ▪ Floods ▪ Wildfires ▪ Avalanches ▪ Hurricanes, tornadoes, sandstorms, snowstorms ▪ Lightning ▪ Geomagnetic storms	**Deliberate threats** ▪ Terrorist attacks ▪ Sabotage ▪ Hoaxes (bomb threats) ▪ Civil unrest ▪ War ▪ Uprisings ▪ Amok incidents (schools, workplaces, etc.)

Important and urgent notifications for employees

Surveys among MNS users reveal that MNS are used not only in the event of emergency situations, but also for relaying important and urgent messages to employees. A study conducted in 2014 showed that 30% of the companies and institutions surveyed broadcast 50 or more messages a year with their MNS. For example, in the event of IT problems, quickly getting information to the people affected helps to keep costs down by minimising interruptions. HR announcements such as «congratulations to X on their 20th anniversary as a valued member of our customer service team» can help boost employee satisfaction levels. If operators regularly use MNS, it also means they get practice and the system is continually tested, both of which strengthen safety when a real emergency arises.

The following types of important/urgent messages are often broadcast to employees with MNS:

Examples of important and urgent announcements for employees or visitors	
General employee notifications ▪ HR announcements («20th anniversary», etc.) ▪ Vacancies ▪ Office closed ▪ Reminders (deadline for submitting employee survey) ▪ Lift out of service from 12:00–13:00 ▪ Energy consumption ▪ Daily production figures ▪ Fire drill ▪ Power failure	**Visitor announcements** ▪ Welcome to customer X ▪ Announcement of upcoming exhibitions ▪ Opening times ▪ Building layout **IT notifications** ▪ Printer not working / working again ▪ E-mail server not operating / operating again ▪ Switch off PCs due to virus infection ▪ SW update ▪ Internet/intranet not working / working again

How it works

MNS can relay audio, visual or tactile messages concurrently on multiple different output channels. Experience with MNS has shown that the impact can be increased if as many parallel communication channels as possible are used, as those affected take messages received via several different channels more seriously and respond more quickly. In an emergency, seconds can save lives.

Advanced MNS support the definition of incident templates which specify which notifications are sent to particular groups of people via which channels. It is crucial to keep employees informed before, during and after an incident, and also to include information about what action they should take. The example below shows the lifecycle of an incident relating to a flood:

Incident cycle

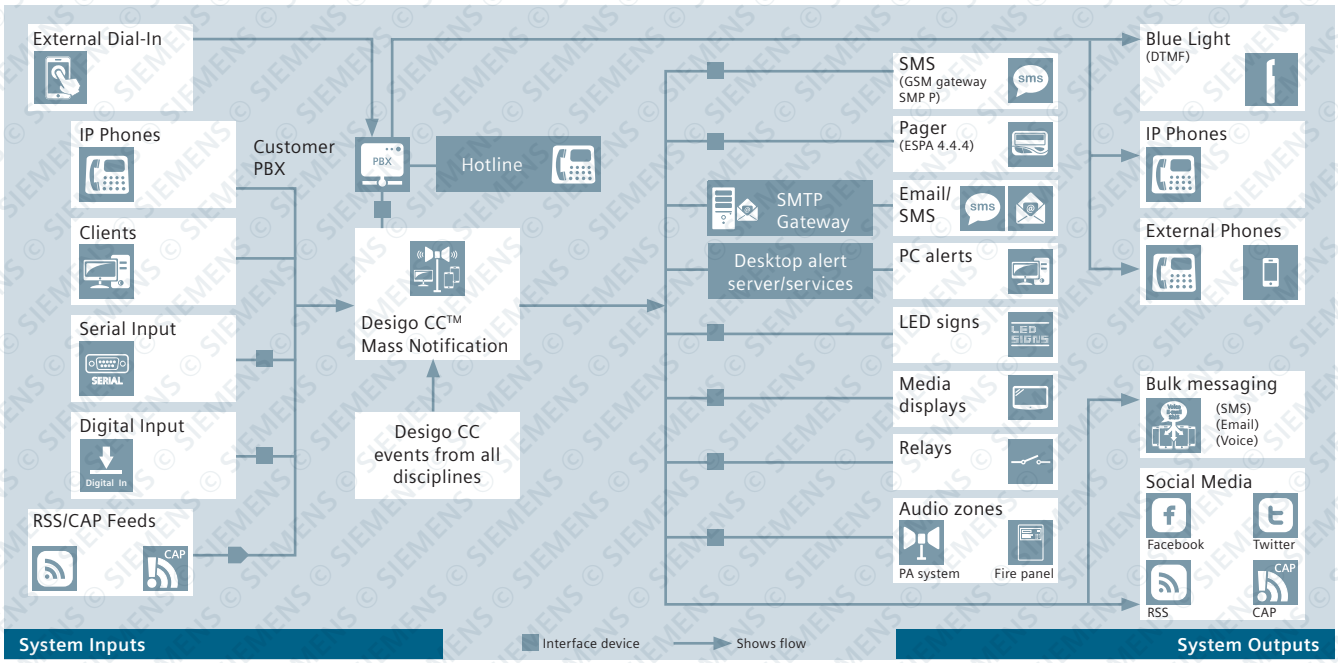
Alert	Repeated alert	Situation ended
«Flood in car park A. Car park A closed.»	«Flood in car park A. Car park A remains closed.»	«Car park A is no longer flooded. Car park A is now open.»

Alarms can be triggered automatically or manually. MNS support the following inputs/outputs for example:

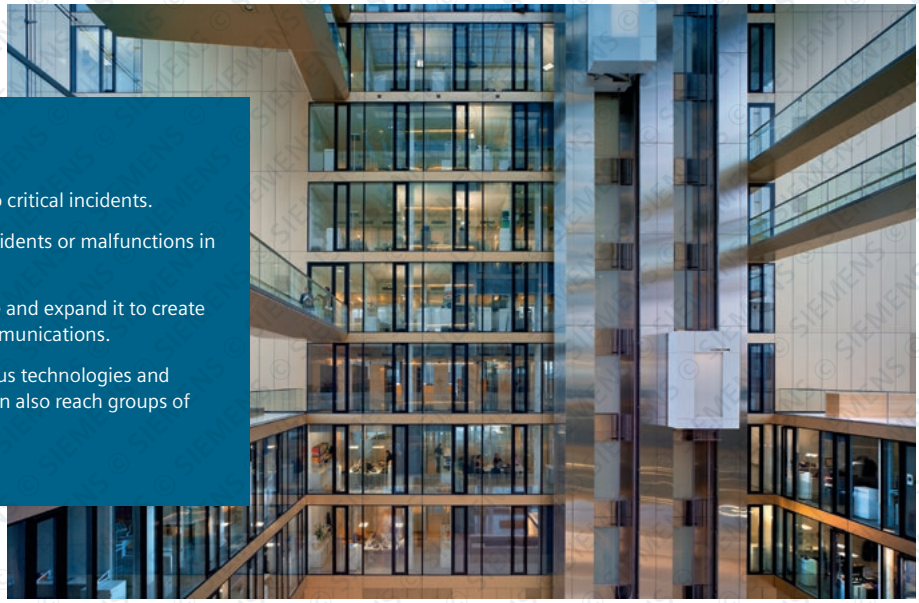
Inputs
- Automatic sensors (fire detectors, gas detectors, air quality sensors, etc.)
- Manual emergency buttons
- Digital/analogue inputs
- Internet RSS feeds
- Serial data
- Manual, graphical buttons

Outputs
- Personal active output channels (cooperation required)
  - E-mail
  - SMS/text messages
  - Pagers
  - Telephone voice messages
  - PC pop-ups
  - Social media (Facebook, Twitter, etc.)
- Non-personal passive output channels (no cooperation required)
  - Voice alarms
  - Strobe lights
  - Tickers
  - TVs
  - Internet RSS feeds

Advanced MNS support all the above input/output channels and have flexible gateways that enable most existing infrastructure to be utilised.



The holistic approach: Total Building Solutions



Highlights

- You can respond quickly and efficiently to critical incidents.
- You can notify everyone about current incidents or malfunctions in a professional, targeted and clear way.
- You can utilise your existing infrastructure and expand it to create an optimised solution for emergency communications.
- By disseminating notifications using various technologies and multiple communication channels, you can also reach groups of people spread across several locations.

Easy-to-use, efficient emergency communication

With Desigo Mass Notification you can reliably get your message through to the right groups and individuals. Thanks to its clear user interface with individually predefined scenarios and notifications, this solution allows you to streamline both routine and emergency communications. By integrating local alarm systems, display and information media, personal communication devices and social media, Desigo Mass Notification lets you simultaneously utilise all of today's most common communication technologies to reach your intended audience in a coordinated way.

Active and passive output devices

When considering MNS, it is important to understand the difference between active and passive output devices. Passive devices are ones that are assigned to individuals, such as mobile phones or staff PCs. The following conditions must be met for these devices to receive messages:

- The person must have the mobile device with them
- The batteries must be charged
- They must be connected to the network
- The network must not be overloaded
- The sound must not have been switched off
- They must not be in use for something else at the same time
- Users are familiar with MSN alerts

In contrast, active systems such as, for example,

- voice alarms
- visual alarms

are direct and do not require the cooperation of recipients. A combination of both types is ideal. MNS that use SMS texts, e-mails, PC pop-up messages, social media etc. should therefore not be used as a substitute for, but in addition to, voice alarm and visual alarm systems.

Make the most of your existing infrastructure

Desigo Mass Notification is highly flexible. It can be seamlessly incorporated in your existing infrastructure and you can choose only the features that you currently need. And if your requirements change over time, your solution can be easily adapted. Based on the Desigo CC building management platform from Siemens, Desigo Mass Notification offers a centralised modular solution for integrating and optimising a wide range of building services – from building automation and security through to mass notification.

A strong partner at your side

By choosing Siemens as your solution provider, you will benefit not only from reliable and flexible technology – our experts can advise you and provide comprehensive support during the design, installation and commissioning phases. Naturally, they will also ensure that your solution stays up to date with software updates and regular maintenance.

Desigo Mass Notification for improving the efficiency of processes and infrastructure

This multi-modal emergency communication solution can also be used for broadcasting routine messages. By integrating a variety of media and communication channels in one central portal, you can eliminate costly manual processes and improve the efficiency of your communications. Such day-to-day routine communications can be used to notify people about full car parks, diversions around blocked buildings or entrances, or to inform them about building work or special events, for example. As a result, you deliver more efficient business processes while lowering costs for your organisation.

Harmonising and streamlining communications

Initiate

Easy activation of notification scenarios

- Phone activation
- Operator console with GUI
- Serial and digital inputs
- RSS feeds
- Alerts from a management system (standard interfaces, various disciplines)

Scenarios are easy to activate using a variety of methods, either manually or completely automatically.

Designate

Assign notifications and select recipients

- Text
- Audio
- Multimedia
- Text-to-speech
- Prerecorded messages
- Live announcements

Sending preconfigured notifications to defined recipient groups saves time and avoids mistakes.

Communicate

Simultaneous targeted notifications via various media and communication channels

- E-Mails
- SMS/Textnachrichten
- Pager
- Telefonanrufe
- Computer Pop-ups
- ELA-Systeme
- Anzeigesysteme (Bildschirme)
- Facebook
- Twitter
- RSS Feeds

The use of different media and communication channels increases the likelihood of reaching everyone, no matter where they are and what they are doing.

Combining and integrating different media and communication channels allows harmonised emergency communication on several levels and increases the likelihood of reaching everyone, no matter where they are and what they are doing.

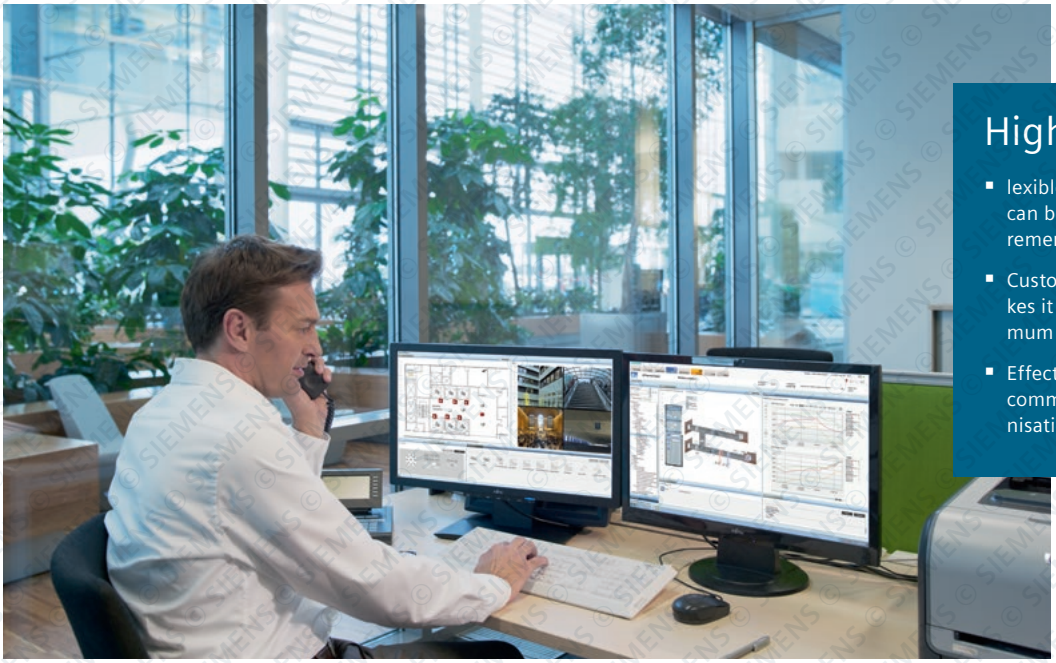
Desigo Mass Notification is a fully integrated multi-modal system for sending notifications over a wide variety of communication channels which is tailored to your needs, providing a tailored optimised solution for both routine and emergency communication.

Initiate. Designate. Communicate.

The clear user interface allows operators to easily manage incoming alerts and outgoing messages, irrespective of the media and technologies involved.
The wizard for initiating notification scenarios provides step-by-step instructions to help users respond quickly and correctly in accordance with your organisation's emergency response plan.

On the edit notifications screen, users can call up predefined message texts and details, then make any changes required before sending them. The browse incident/notification screens allow easy searching for previously initiated incidents and notifications. The user can also pause, cancel and resume notifications or mark them as completed.

Initiating an incident with just two clicks: clicking an Easy Button on the start screen prompts the system wizard to show preconfigured steps appropriate for the current incident. Next the operator simply clicks on «Initiate» and all the intended recipients can be notified with just two clicks.



As the first building management system of its kind, Desigo CC allows customers to integrate all their building services, from heating, ventilation and air conditioning through to fire safety and security, energy management, lighting and shade control. Thanks to the open platform, it can be readily adapted to the building operator's own requirements.

Highlights

- lexible, scalable solution that can be expanded as your requirements change.
- Customisable user interface makes it easy to create the optimum layout.
- Effective emergency and routine communication optimises organisational processes.

Inside. Outside. Wherever people are.

As studies have shown that people take an alarm more seriously if they receive it more than once from multiple sources, Desigo Mass Notification integrates today's most common media and communication channels with your local communications infrastructure to ensure that all parts of your premises are covered.

Inside via public address systems, telephones, computer notifications, display and information media.

Outside via public address systems, sirens or loudspeakers.

Wherever people are via mobile phones, SMS/text messages, pagers, computer pop-ups, e-mails and social media.

Flexible and scalable – tailored to your needs

Desigo Mass Notification gives you the flexibility to adapt and expand in line with your situation and your organisation's particular needs. It makes no difference whether you want to start small with just a few recipients and limited functionality, or whether you require comprehensive multi-modal integration right from the start.

Optimised working conditions

The system allows flexible customisation of both the user interface and the actual steps triggered. A graphical user interface based around workflows supports the reliable management and tracking of multiple incidents. This easy-to-learn and easy-to-use system ensures that operators respond correctly and provides efficient emergency communications when it matters most.

The integration of building and floor plans as well as video inputs allow operators to drill down into incidents in order to respond to them appropriately.

NOVIGO voice alarm system

The NOVIGO voice alarm and public address system is a fully networked digital audio system.
Up to 64 studio-quality audio streams (48 kHz/24 bit) with a constant latency of 1.3 ms are transmitted to all outputs over an Ethernet-based network. Other settings which offer more audio channels, but with a lower audio quality (e.g. CD quality), are also possible if required.
As required by EN 54-16, the system supports full redundancy with monitoring of all relevant components from microphones through to loudspeaker circuits. The NOVIGO public address and evacuation system consequently meets the most stringent safety requirements – without compromising on audio quality.
Direct and secure connections between the fire detection system and the voice alarm system are provided redundantly by means of I/O. The addition of a standardized interface protocol, FVP, is planned.

Applications
Among other things, the Novigo system is used as an automatic or autonomous alarm and evacuation system. As an automatic system activated by the fire detection system when speedy evacuation is paramount, for example in office buildings or shopping centres.
As an autonomous system manually activated by trained personnel, to avoid false alarms or for local emergency voice alerts not accompanied by fire alarms, for example in chemical plants or airports.

Alerts and emergencies
- Fire alarm announcement
- Evacuation instructions
- Alert
- In addition to applications geared to reliability in emergency and evacuation situations, Novigo can also be used in everyday scenarios:
  - Announcements/information (advertising, paging, messages, etc.)
  - Background music
  - Pro Sound (spec. application for audio/video)

The Novigo public address and evacuation system combines the highest safety standards with state-of-the-art audio and network technology.

Highlights

- Ethernet-based multi-channel audio system for voice alarm, public address, music and broadcast applications
- Simultaneous transmission of up to 64 digital audio channels in studio quality (48 kHz/24 bit), with a constant latency of 1.33 ms
- Up to 4000 units can operate simultaneously in the network
- Integrated 2 GB memory card for alert messages and music files. Capacity to store 256 files, total time approx. three hours
- Integrated real-time recorder for time-delayed announcements
- System components certified to EN 54-16

Station types	NOVIGO AC-Net Matrix PC2001	NOVIGO AC-Net Matrix PC2002	NOVIGO AC-Net Matrix PC2003	NOVIGO AC-Net micro-phone console PT2001
Product picture				
Enclosure type Dimensions (W x H x D mm) of speaker	19", 1RU 482x44x180	19", 1RU 482x44x180	19", 1RU 482x44x357	Desktop 225x58x218 (excl. mic)
Weight	3,1kg	3,1kg	8,5kg	2,2kg
Analogue inputs (from/to network)	4	--	4	2 (Mic + 1)
Analogue outputs (from/to network)	4	4	4	1
Digital outputs	4	4	16	--
Optional line monitoring (100V loudspeaker lines)	Yes	Yes	Yes	--
Analogue measurement inputs	8	8	0	6
Digital inputs	8	8	8	2
Digital outputs	8	8	8	--
Serial interfaces for controllers	1 x RS232 1 x RS485	1 x RS232 1 x RS485	1 x RS232 1 x RS485	1 x RS232
Ethernet 10/100BASE-TX port	2 x RJ45	2 x RJ45	2 x RJ45	2 x RJ45
Ethernet 100BASE-FX port	--	--	--	--
LC display	Yes	No	No	Yes
Power supply	24 V	24 V	24 V	24 V
Power consumption	0,3...0,37 A	0,3...0,37 A	0,5...5 A	00,26 A
Audio features	1/4/32-bit digital auto, sample rate 48/96 kHz, fixed latency of 0.6/1.3/2.6 ms, frequency response 20 Hz–20 kHz, dynamic range 103 dB			
Extensive DSP functionality	In each case 4 channels with gain, compressor, limiter, equalizer, delay up to 24.5 s, automatic volume control			
Voice message storage	Slot for 2 GB microSD card for up to three hours of audio data			
Network	Switched Ethernet IEEE 802.3u standard, Layer 2, 100 Mbit/s duplex, Layer 3 coming soon Theoretically up to 4000 units can be networked, simultaneous transmission on up to 64 channels			

NOVIGO AC-Net Matrix PC2003

NOVIGO AC-Net matrix PC2003 EN54-16 PC2003

The PC2003 matrix is an «all-in-one» voice alarm control unit which can also be used as a network component in large systems.
By combining the PC2003 matrix with 2 to 4 power amplifier stages and a standards-compliant power supply, a system can be built to the DIN SES guidelines for VAS/ENS or TRVB S158 standard with up to 8 A/B lines with end-of-line modules.

Functions

- Line multiplexer
- 4 x 16 relay matrix
- Standby amplifier switch
- Text store
- Line and loudspeaker monitoring

Description

- Power amplifier stages with up to 2000 watts total power can be connected to each PC2003 matrix and routed freely on 16 loudspeaker lines.
- The loudspeaker lines are continuously monitored for short-circuits, ground faults, impedance or line breaks and any faults are reported within 100 seconds.
- If one of the monitored alarm outputs fails, a redundant amplifier is automatically activated immediately.
- The PC2003 matrix has an optionally integrated and monitored voice alarm text store with the capacity to store up to three hours of recordings.
- Alarm announcements are automatically controlled by the fire detection system; they can also be activated manually.

Additional features

- Automatic volume control AVC
- DSP functionality for all outputs and inputs
- Compressor limiter
- Delay of up to 24.5 seconds (acoustically equivalent to 8 km time lag), TCP/IP interface
- Serial interfaces to control systems
- Display elements on the front for important status indicators
- Dimensions 482 x 44 x 357 mm (W x H x D), 19"/1RU
- Weight 8.5 kg

NOVIGO AC-Net Matrix PC2001

NOVIGO AC-Net Matrix PC2002

NOVIGO AC-Net Switch PN2001

NOVIGO AC-Net Switch PN2005

NOVIGO AC-Net matrix PC2001 EN54-16
NOVIGO AC-Net matrix PC2002 EN54-16
NOVIGO AC-Net switch PN2001 EN54-16
NOVIGO AC-Net switch PN2005 EN54-16

NOVIGO AC-Net matrix PC2001 EN54-16

PC2001 matrix for 4 analogue audio inputs and 4 audio outputs. In 19"/1RU enclosure with network interface and 24 VDC power supply. Other interfaces and features:

- 2 serial interfaces (RS-232 and RS-485) for control tasks
- 8 analogue measurement inputs
- 8 digital inputs
- 8 digital outputs
- Optional plug-in card for loudspeaker monitoring (4-way)
- Slot for 2 GB microSD card for up to three hours of audio data
- Front display for messages, program selection and volume
- System configuration during operation (online) using supplied Windows PC software from any point in the network using the switched Ethernet protocol IEEE 802.3
- Real-time/online configuration also of all audio functions such as EQs, delay, etc.
- IR remote control (e.g. program and volume)
- Automatic volume control AVC, DSP functionality for all outputs and inputs, compressor limiter, delay up to 24.5 seconds (acoustically equivalent to 8 km time lag), TCP/IP interface, serial interfaces to control systems

NOVIGO AC-Net matrix PC2002 EN54-16

PC2002 matrix for 4 analogue audio outputs. In 19"/1RU enclosure with network interface and 24 VDC power supply.

Other interfaces and features:

- 2 serial interfaces (RS-232 and RS-485) for control tasks
- 8 analogue measurement inputs
- 8 digital inputs
- 8 digital outputs
- Optional plug-in card (line detection module) for loudspeaker monitoring (4-way)
- Line monitoring with end-of-line module
- Slot for 2 GB microSD card for up to 3 hours of audio data
- Front display for messages
- System configuration during operation (online) using supplied Windows PC software from any point in the network using the switched Ethernet protocol IEEE 802.3
- Real-time/online configuration also of all audio functions such as EQs, delay, etc.
- Recording capacity. Alarm announcements are automatically controlled by the fire detection system; they can also be activated manually.
- DSP functionality for all outputs and inputs, compressor limiter, delay up to 24.5 seconds (acoustically equivalent to 8 km time lag)
- TCP/IP interface
- Serial interfaces to control systems

NOVIGO AC-Net switch PN2001 EN54-16

EN 54-16-certified Ethernet switch. Specifically designed for the Novigo AC-Net.

Technical data:

- Power supply: external switched-mode power supply or 24 VDC (18 V < V > 32 V)
- Power consumption 24 V 160 mA no load, +10 mA per active port, 260 mA full load
- Dimensions: 482 x 44 x 125 mm (W x H x D), 19"/1RU
- Weight: 2.4 kg
- EC conformity certificate no. 1293-CDR-0403

Network and ports:

- Standards: complies with IEEE 802u 100BASE-TX, 100BASE-FX and with IEEE 802.3 10BASE
- Copper: 2 x 4 ports on RJ45 connector
- Fibre: 2 x fibre optic ports on SC connector, wavelength: 1310 nm, cable type: multimode fibre

NOVIGO AC-Net switch PN2005 EN54-16

Switch for data communication

- 8 ports for 10/100/1000BASE-T RJ45 connectors and
- 2 ports for 100/1000BASE-SX fibre optic interface
- LED status indicators
- Temperature range: -40...+75 °C

NOVIGO microphone console PT2001

NOVIGO microphone console PT2001

EN 54-16-certified, networkable call station with 19 freely configurable soft keys plus 2-line text display for software version, an XLR microphone socket (dynamic or electret) and a built-in speaker for microphone monitoring, intercom or sounding alarms.
Ports on the rear: 2 x RJ45 network port, power supply: 24 VDC.
Optional keyboard extensions, expandable up to a total of 115 keys (24 keys per extension unit).

Inputs and outputs; features

- Ethernet-based network with 100 Mbit/s duplex (CAT5 cable)
- 2 analogue Mic/Line inputs
- Integrated speaker and additional analogue audio output
- 2-line text display
- 19 freely configurable soft keys
- 2 digital outputs
- 6 analogue measurement inputs
- Power supply: 24 VDC
- Power consumption: 15 VA

Audio features

- 16/24 or 32-bit digital audio
- Sample rate: 48 or 96 kHz
- Adjustable latency: 0.6/1.3/2.6 ms
- Dynamic range: 103 dB
- Distortion factor (THD) < 0.005%
- Frequency response: 20 Hz–20 kHz (±0.5 dB)

NOVIGO microphone console extension unit PTO2001

NOVIGO microphone console extension unit PTO2001

Keyboard extension for NOVIGO microphone console.

Technical data:

- 24 keys (membrane keyboard)
- Three-colour LED for each key, key label inserts
- Powder-coated sheet-steel enclosure
- Stainless steel covers

Dimensions and weight:

- 220 x 215 x 50 mm,
- 1,8 kg

NOVIGO firefighter call station EN54-16 PT2002

NOVIGO firefighter call station EN54-16 PT2002

The firefighter call station for safety-related, high-priority public address situations. The firefighter call station enables the incident commander to start, interrupt or reset alarm and evacuation messages stored on the flash memory card across all zones.
Lifting the microphone off the cradle interrupts any messages being broadcast and a live announcement can be made by pressing another button on the microphone.
All functions at the firefighter call station are continuously monitored in order to maintain operability at all times.
The firefighter call station is connected redundantly to the Novigo AC-Net switches. 24 VDC power is supplied from the Novigo standby power supply.

Technical data:

- Ethernet-based network with 100 Mbit/s duplex (CAT5 cable or fibre optic)
- Handheld microphone with push-to-talk button
- Integrated speaker
- One additional analogue audio output
- Alarm message buttons and acoustic alarms OFF button
- Status indicators for alarm, operational, fault
- 2 digital outputs
- 6 analogue measurement inputs
- Power supply: 24 VDC

NOVIGO PT2009

NOVIGO microphone console PT2009

Elegant and functional microphone console for front desks, departure gates, office master stations and extensions. Zones or texts can be freely assigned to the 8 illuminated keys. The elegant sleek enclosure is perfect for a desk environment. Up to 8 call stations can be connected on a bus and be assigned priorities. The keys can also be individually labelled.

- Dimensions: 185x103x62 mm
- Microphone: Gooseneck 295 mm
- Weight: 1.6 kg
- Power supply: 24 VDC
- Max. distance: 500 m

NOVIGO PTO2004

NOVIGO microphone console extension unit PTO2004

Keyboard extension with 8 freely assignable keys for the PT2009 microphone console. When placed alongside a microphone console, it allows further zones or voice texts to be selected. Up to four PTO2004 can be connected to a call station, adding up to 32 further keys.

- Dimensions: 185x103x62 mm
- Weight: 1.6 kg

NOVIGO PA2007

NOVIGO Class-D power amplifier 1x250W EN54-16 PA2007

Digital 100 V 1x250W durable and dependable amplifier for professional public address systems to EN 54-16. The extremely reliable electronics design guarantees uncompromising transmission quality and many years of trouble-free operation. Low waste heat, over 90% power efficiency thanks to digital signal processing. Technical and audio data:

Other features:

- Maintenance-free cooling system without fans
- Monitoring contacts
- Only 260 mm mounting depth
- Only 10 W in standby mode
- Low power consumption in emergency operation
- Power-up delay
- Automatic standby mode
- Protection circuits for low voltage, short-circuits, overheating and DC
- All ports with plug-in and screw terminals

Inputs and outputs:

- 24 VDC power supply
- 230 VAC power supply
- 1 x analogue audio input
- 100V/50V power outputs
- 2 x status indicator contacts

NOVIGO PA2001

NOVIGO Class-D power amplifier 2x250W EN54-16 PA2001

Digital 100 V 2x250W durable and dependable amplifier for professional public address systems to EN 54-16. The extremely reliable electronics design guarantees uncompromising transmission quality and many years of trouble-free operation. Low waste heat, over 90% power efficiency thanks to digital signal processing

Other features:
- Maintenance-free cooling system without fans
- Monitoring contacts
- Only 260 mm mounting depth
- Only 10 W in standby mode
- Low power consumption in emergency operation
- Volume control on the rear, all operating conditions indicated by LEDs

Inputs and outputs:
- 24 VDC power supply
- 230 VAC power supply
- 2 x analogue audio inputs
- 2 x control inputs
- 2 x 100V/50V power outputs
- 4 x status indicator contacts

NOVIGO PA2003

NOVIGO Class-D power amplifier 4x150W EN54-16 PA2003

PA2003 digital 100 V 4x150W durable and dependable amplifier for professional public address systems to EN 54-16. The extremely reliable electronics design guarantees uncompromising transmission quality and many years of trouble-free operation. Low waste heat, over 90% power efficiency thanks to digital signal processing.

Other features:
- Maintenance-free cooling system without fans
- Monitoring contacts
- Only 260 mm mounting depth
- Only 10 W in standby mode
- Low power consumption in emergency operation
- Volume control on the rear, all operating conditions indicated by LEDs

Inputs and outputs:
- 24 VDC power supply
- 230 VAC power supply
- 4 x analogue audio inputs
- 2 x control inputs
- 4 x 100 V power outputs
- 4 x status indicator contacts

NOVIGO PT2004

NOVIGO system status panel EN54-16 PT2004

Display panel to EN 54-16 for visual and acoustic status indication.

- Colour-coded visual indication of operating, fault and voice alarms, faults indicated by acoustic warning signal
- Button for acknowledging the acoustic warning signal
- 24 VDC power supply
- All inputs and outputs isolated from the supply voltage
- (on-board DC/DC converter)
- Potential-free relay contact signals that the unit is operational (closed when power supply OK/ operational)
- All connections on plug-in terminal blocks
- Form factor: 19"/1RU
- Open frame design

NOVIGO PP2001

NOVIGO power supply EN54-4 PP2001

The Novigo power supply is certified to EN 54-4.
It is used to supply power to the system components and to charge/monitor the emergency batteries.
The power supply is designed for connection to the 230 V/50 Hz (±15%) electricity supply system and should be connected using a two-pole, maximum 16 A fuse.

The integrated power pack supplies up to 300 W with 24 VDC.

In addition to providing the charging current required to charge the batteries up to at least 80% of their rated capacity within 24 hours, there is also sufficient power to supply the 24 V system components (matrix, call station, switch). The supply voltage, the attached batteries and the low-voltage fuses are monitored. Faults are indicated by LEDs on the front and reported via potential-free relay changeover contacts. The internal resistance of the batteries is also measured at regular intervals.
The unit is equipped with a low-voltage fuse that reliably protects the batteries by cutting out if the battery voltage falls below 1.8 V/cell.

NOVIGO PT2005

NOVIGO alarm control panel EN54-16 PT2005

Control panel to EN 54-16

- Button for manually activating a voice alarm (red)
- Voice alarm LED (red)
- Button for manually resetting a voice alarm (black)
- Button for muting a voice alarm (green)
- Muting LED (green)
- Button for acknowledging a fault indication (black)
- Form factor: 19"/1RU
- The panel is installed on access level 2 (restricted access) and only authorized personnel may use the functions indicated.

NOVIGO
end-of-line module
PCA2004

NOVIGO active line monitoring PCA2004

Active, individually addressable end-of-line module: loudspeaker and line monitoring module to EN 54-16, suitable for 100V systems, standard 2-wire loudspeaker line

Technical data:

- Power supply: 8-100 VAC
- Power consumption: max. 150 mW, standard: 100 mW
- Protection class: IP54
- Number of EoL modules per amplifier: 16 (max.)
- Number of EoL modules per loudspeaker line: 16
- Number of EoL modules per PC2003 matrix: 64 (max.)
- Line power: 500 W (max.)
- Dimensions: 71 x 61 x 30 mm
- Weight: approx. 100 g
- Cable connection: 2 x 1.5 mm²

NOVIGO PT2006

NOVIGO remote control panel PT2006

Remote control panel for various applications. In combination with a matrix, it can be used to control the volume and the program in the respective output zone. Up to 16 control panels per matrix can be connected via an RS485 bus system.

Features:

- Volume control
- Program selection
- + On-screen program selection
- Equalizer
- Control digital I/O
- Display time/system information
- Power supply: from 10 to 24 VDC
- 16 modules per bus via RS485, 1 module for each RS232
- CAT5 cabling possible
- Dimensions: 80/80/47 mm (mounting depth = 37 mm)

Application

In conjunction with a voice alarm system VAS or an emergency notification system ENS, the 100V loudspeakers described in this document can be used to output prerecorded messages, voice announcements and music. A variety of models are available to suit different locations and power requirements. Some of the 100V speakers are also certified to EN 54-24 for use in an EN 54-compliant voice alarm system. The respective approval documents are available separately.

Connections

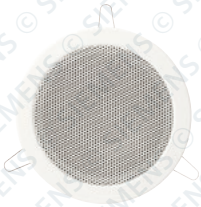
The connection types of the loudspeaker models presented in this document vary and are described individually in each case. All loudspeaker connections must be short-circuit-proof. For EN 54-approved voice alarm systems VAS, the wiring into the zone must be designed to meet E30 functional integrity standards.

Power rating

The 100V loudspeakers listed can be operated with various power ratings. The load rating indicates both the maximum load and the various tapping options on a 100V audio transmitter. Depending on the model, the power rating is selected using a rotary switch or by different wiring of the terminal.

A/B loudspeakers

Using A/B loudspeakers makes it possible to implement the two independent lines required by safety level II with only one loudspeaker enclosure. In order to operate the two channels connected to the A/B loudspeakers independently of one another, the wires must be routed separately. If one channel then fails, this guarantees that the loudspeaker will continue to function, as stipulated by EN 54.

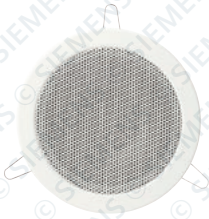


CS130EN-06M1

- Compact ceiling speaker with impact-resistant metal mesh grille. EN 54-24-approved for compliant voice alarm systems. Suitable for installation in all types of ceiling.
- The 130 mm/6 W driver used has a very wide frequency response and a high sound pressure level.

Technical data

Power handling	6 W/100 V (6/3/1,5 W)
Dimensions (DxH)	167x90mm
Cutout size	150mm
Certification	EN 54-24
Accessories	Flush-mounting boxes for solid walls or concrete ceilings
Optional	Other enclosure colours on request



CS200EN-06M1

- Compact ceiling speaker with impact-resistant metal mesh grille. EN 54-24-approved for compliant voice alarm systems. Suitable for all types of ceiling.
- The 200 mm/6 W driver used has a very wide frequency response and a high sound pressure level.

Technical data

Power handling	6 W/100 V (6/3/1,5 W)
Dimensions (DxH)	252x105mm
Cutout size	230mm
Certification	EN 54-24
Optional	Other enclosure colours on request

CS130-06P1

- Inexpensive and compact ABS ceiling speaker with a metal mesh grille. A low depth profile (55 mm) makes it suitable for all types of ceiling.
- The 130 mm/6 W driver used features good directivity and a high sound pressure level in the speech frequency range.

Technical data

Power handling	6 W/100 V (6/3 W)
Dimensions (DxH)	175x55mm
Cutout size	148mm

CS165-06P1

- Inexpensive and compact ABS ceiling speaker with a metal mesh grille. A low depth profile (70 mm) makes it suitable for all types of ceiling.
- The 165 mm/6 W driver used features good directivity and a high sound pressure level in the speech frequency range.

Technical data

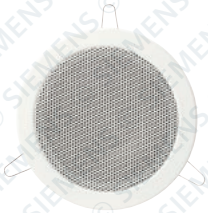
Power handling	6 W/100 V (6/3 W)
Dimensions (DxH)	188x70mm
Cutout size	168mm

CS130-06M1

- Compact ceiling speaker with impact-resistant metal mesh grille. Ideal for installation in suspended ceilings or flush mounting.
- The 130 mm/6 W driver used has a very wide frequency response and a high sound pressure level.

Technical data

Power handling	6 W/100 V (6/3/1,5 W)
Dimensions (DxH)	167x62mm
Cutout size	150mm
Accessories	Flush-mounting boxes for solid walls or concrete ceilings
Optional	Other enclosure colours on request

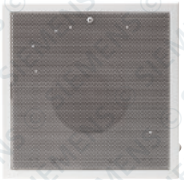


CS200-06M1

- Compact ceiling speaker with impact-resistant metal mesh grille. Ideal for installation in suspended ceilings or flush mounting.
- The 200 mm/6 W driver used delivers very good music and voice reproduction.

Technical data

Power handling	6 W/100 V (6/3/1,5 W)
Dimensions (DxH)	252x82mm
Cutout size	230mm
Optional	Other enclosure colours on request



CS130-06P2

- Square ceiling speaker with a plastic frame which is ideal for installation in suspended ceilings. Its shape allows it to blend unobtrusively into the ceiling elements.
- The 130 mm/6 W driver used smoothly delivers voice announcements or prerecorded messages.

Technical data

Power handling	6 W/100 V (6/3/1,5 W)
Dimensions (LxBxH)	248x248x48mm
Cutout size	233 x 233mm

CS130-15M9

- Compact two-way ceiling speaker equipped with a tweeter and full-range driver. The impact-resistant metal grille also protects it from external damage.
- This speaker is ideal for high-quality background music applications in restaurants and department stores.
- Suitable for all types of ceiling.
- The 130 mm/15 W driver used features a very wide frequency response and a high sound pressure level for music and voice applications.

Technical data

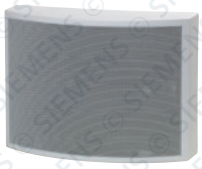
Power handling	15 W/100 V (15/7,5/3,75 W)
Dimensions (DxH)	167x109mm
Cutout size	150mm
Zubehör	Flush-mounting boxes for solid walls or concrete ceilings
Optional	Other enclosure colours on request

WS120EN-06P1

- Stylish designer speaker with slightly curved enclosure for wall mounting. EN 54-24-approved for compliant voice alarm systems. The elegant ABS enclosure is flame-retardant and impact-resistant.
- The 120 mm/6 W driver used provides very good sound and voice reproduction.

Technical data

Power handling	6 W/100 V (6/3/1,5 W)
Dimensions (LxWxH)	230x170x88mm
Certification	EN 54-24
Optional	Other enclosure colours on request

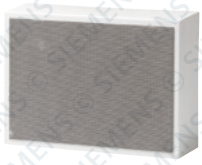


WS130-10P9

- Stylish two-way ceiling speaker with slightly curved enclosure for wall mounting.
- The elegant ABS enclosure is flame-retardant and impact-resistant.
- Equipped with tweeter and woofer.
- Thanks to its wide frequency response, this two-way system is ideal for broadcasting music.

Technical data

Dimensions (LxWxH)	230x170x88mm
Optional	Other enclosure colours on request



WS120EN-6P

- Square wall-mounted speaker made of flame-retardant and impact-resistant ABS material with metal grille.
- Unfussy, elegant design.
- EN 54-24-approved for compliant voice alarm systems.
- The grille can be simply snapped into place from the front.
- The 120 mm/6 W driver used provides good sound and voice reproduction.

Technical data

Power handling	6 W/100 V (6/3/1,5 W)
Dimensions (LxWxH)	230x170x80mm
Certification	EN 54-24
Accessories	Protective cage
Optional	Other enclosure colours on request

WS165-06W1

- Elegant square wall-mounted speaker with rounded edges, comprising an MDF cabinet and a snap-in rear panel.
- The rear panel also facilitates mounting on uneven surfaces.
- The 165 mm/6 W full-range driver used delivers a well-balanced and rich sound.

Technical data

Power handling	6 W/100 V (6/3/1,5 W)
Dimensions (LxWxH)	255x195x85mm
Accessories	Protective cage

WS120EN-06W1

- Traditional and universal square wall-mounted speaker with impact-resistant MDF enclosure and metal front grille.
- EN 54-24-approved for compliant voice alarm systems.
- The 120 mm/6 W driver used delivers high-quality music and voice reproduction.

Technical data

Power handling	6 W/100 V (6/3/1,5 W)
Dimensions (LxWxH)	265x165x88mm
Certification	EN 54-24
Accessories	Protective cage

WS120EN-06P8

- Square wall-mounted A/B speaker made of flame-retardant and impact-resistant ABS material with metal grille.
- The grille can be simply snapped into place from the front.
- Owing to the two independent speakers, when connected via two separate lines, continued operation is ensured even if one of the two lines fails.
- EN 54-24-approved for compliant voice alarm systems.
- The two 120x70 mm/6 W A/B drivers used are ideal for broadcasting announcements and prerecorded messages.

Technical data

Power handling	2x 6 W/100 V (6/3/1,5 W)
Dimensions (LxWxH)	247x198x77mm
Cutout size	148mm
Certification	EN 54-24
Accessories	Protective cage

WS125-06M1

- The perfect speaker for protection against external tampering. Ideal for school corridors or public places. Can also be deployed in protected outdoor areas.
- Compact square wall-mounted speaker with a 125 mm driver for good voice reproduction. Its robust steel enclosure and closed rear panel make this speaker impact-resistant and vandal-proof.
- The enclosure is fixed to the wall with four screws, and the cover is securely and robustly screwed on with three screws. The speaker enclosure features knockouts for attaching two cable connectors.

Technical data

Power handling	6 W/100 V (6/3/1,5 W)
Dimensions (LxWxH)	170x170x60mm

SP130EN-20P1

- Stylish sound projector speaker made of flame-retardant and impact-resistant ABS material with metal grille. Aluminium front grille and mounting bracket.
- The speaker is EN 54-24-approved for compliant voice alarm systems.
- The 130 mm/20 W full-range driver used has a high sound pressure level and excellent directivity in the speech frequency range. The SP130EN-20P1 is also suitable for music reproduction.

Technical data

Power handling	20 W/100 V (20/10/5 W)
Dimensions (LxWxH)	138x205mm (excl. bracket)
Certification	EN 54-24

SP130-20M1

- Elegant and practical wall-mounted sound projector speaker that blends into the architecture.
- The enclosure, front grille and mounting bracket are made of aluminium.
- This speaker is ideally suited for use in corridors, schools and everywhere ceiling speakers are not possible.
- The adjustable bracket ensures optimal direct sound projection.
- The 130 mm/20 W full-range driver used provides a high sound pressure level and excellent directivity in the speech frequency range. It is also suitable for high-quality music reproduction.

Technical data

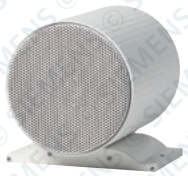
Power handling	20 W/100 V (20/10/5 W)
Dimensions (LxWxH)	138x200mm (excl. bracket)

SP130-30P1

- Weatherproof sound projector speaker made of flame-retardant and impact-resistant ABS material. Aluminium front grille and mounting bracket.
- Also suitable for mounting outdoors if the speaker is angled downward.
- The SP130-30P1 is used primarily on terraces and in sports facilities or parking garages.
- The 130 mm/30 W driver delivers excellent music reproduction, a high sound pressure level and excellent directivity in the speech frequency range.

Technical data

Power handling	30 W/100 V (30/15/7,5/3,75 W)
Dimensions (DxH)	180x220mm (excl. bracket)



SP120-12M6

- Stylish wall-mounted bidirectional speaker with aluminium enclosure, front grille and mounting plate.
- This speaker is ideally suited for use in corridors, schools etc. The bidirectional sound projection ensures well-balanced sound distribution.
- The enclosure is waterproof to IP55.
- The two 120 mm/12 W full-range drivers used provide excellent voice and music reproduction with a well-balanced sound.

Technical data

Power handling	2 x 12 W/100 V (12/6/3/1,5 W)
Dimensions (DxH)	160x186mm (incl. baseplate)

HS200EN-15P1

- Classic horn speaker with weatherproof and scratch-resistant ABS horn. The enclosure is weatherproof and dustproof to IP56. It is installed using the attached V2A mounting bracket.
- EN 54-24-approved for compliant voice alarm systems.
- The HS200EN-15P1 is predominantly deployed outdoors, in parking garages or in noisy industrial environments.
- This horn speaker has a very high sound pressure level and a maximum output of 15 watts.

Technical data

Power handling	15 W/100 V (15/7,5/3,75/1,9 W)
Dimensions (DxH)	208x275mm
Certification	EN 54-24

SP130EN-20P1

- Stylish sound projector speaker made of flame-retardant and impact-resistant ABS material with metal grille. Aluminium front grille and mounting bracket.
- The speaker is EN 54-24-approved for compliant voice alarm systems.
- The 130 mm/20 W full-range driver used has a high sound pressure level and excellent directivity in the speech frequency range. The SP130EN-20P1 is also suitable for music reproduction.

Technical data

Power handling	30 W/100 V (30/15/7,5/3,75 W)
Dimensions (WxHxD)	245x180x165 (185)mm

HS1470-50M1 power horn

High-power horn developed and dimensioned specifically for tunnel applications. The boundary layer design produces a highly concentrated sound field which reduces reflections and consequently improves speech intelligibility and sound quality. Its advanced design and the high-power drivers used deliver a maximum sound pressure of 137 dB which is essential for clean sound projection and emergency notification in tunnels. The exceptional use of two sound drivers greatly improves the frequency response and consequently enhances the audio quality. Protection class IP66 and the material used – 1.4571 (other materials optional) – ensure it is adequately protected from the environment.

Technical data

Power handling	50W (100V)
Dimensions (WxHxD)	1465x520x304mm
Weight	21kg

SP495-80M1 railway station speaker

Specially developed bipolar high-power speaker for railway platforms. The novel design supports bidirectional radiation and has sufficient sound pressure (111 dB) for direct and homogeneous sound projection over platforms. This improves the audio quality and reduces level cancellations while eliminating a significant amount of unwanted extraneous noise. The aluminium enclosure plus the high-quality components and audio drivers used allow both indoor and outdoor use.

Technical data

Power handling	80W (100V)
Dimensions (WxHxD)	495x160x125mm
Weight	5,5kg

Flush Box 130

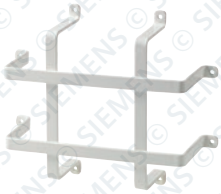
Order number: H420355673
Flush-type box for installation in solid walls suitable for the following models:

- CS130EN-06M1
- CS130-06M1

Flush Box concrete 130

Order number: H420355674
Flush-type box for installation in concrete walls and ceilings.
Suitable for the following models:

- CS130EN-06M1
- CS130-06M1



Protective cage 230

Order number: H420355687
Metal protective cage, suitable for most loudspeakers.

Dimensions (LxWxH)	345x285x115mm
Max. speaker size (LxWxH)	285x225x100mm
Colour	White RAL9010

Access control

buildingtechnologies.siemens.com

12.1. Introduction	436
12.1.1. Function of an access control system	436
12.2. Structure of an access control system	436
12.2.1. Offline access control	436
12.2.2. Online access control	437
12.2.3. Differences between offline and online systems	438
12.3. Medium	439
12.3.1. Types	439
12.3.2. Choosing the right technology	440
12.4. Readers	440
12.4.1. With or without keypad	440
12.4.2. Offline readers	440
12.5. Transmission methods	440
12.5.1. Transmission for chip cards	440
12.5.2. RFID	440
12.5.3. Near field communication	441
12.5.4. Resistive capacitive identification (RCID)	441
12.6. Biometric systems	441
12.6.1. Requirements for biometric features	442
12.6.2. Techniques and methods	442
12.7. Door management	444
12.7.1. Types of door	444
12.7.2. Elements in a door	444
12.8. Core functions of an access control system	445
12.8.1. Authorization structures	445
12.8.2. Door interlock controls	445
12.8.3. Interzone movement control and balancing	445
12.8.4. Lift controls	446
12.9. Add-on features and modules	446
12.9.1. Integration options	446
12.9.2. Visitor management	446
12.9.3. Alarm routing	446
12.9.4. Video surveillance	446
12.9.5. ID card issuance and management	447
12.9.6. Key deposit	447
12.9.7. Interfaces to third-party systems	447
12.9.8. Reporting	447
12.9.9. Time recording	447
12.9.10. Local application vs. web client	448

Use Case	450
Graphic overview	452
SiPass Integrated	454
SIPORT	464
Modernization	478
Siveillance Identity	480

12.1. Introduction

Access control regulates access to buildings or areas in need of protection based on the principle of "Who, when, where" and possibly "With whom". An access control system is an electronic tool that is responsible for access control and automatically checks whether an individual has the authorization needed to enter a particular building, area or room. Alongside actual access authorization, the duration of that authorization is also defined. Authorization can be one-time, for a limited period or unlimited. An access control system significantly increases security and supports operational workflows.

12.1.1. Function of an access control system

An access control system organizes access based on a policy defined by the operator. Access rights are assigned on the basis of criteria relating to the individual, the physical location and time. This makes it possible to grant access only to persons who have identified themselves with a particular credential (e.g. with a card, ID, PIN code or biometric features).

Aims of access control

- An access control system grants proper access exclusively to authorized individuals
- It regulates who has access, when, where and possibly with whom

Modern access control systems are based on electronic, organizational and infrastructure measures. As such, they protect buildings, facilities and primarily people from attack and threats from unauthorized individuals and prevent theft of intellectual property. The real challenge for access control is to minimally impede authorized access while totally denying access to unauthorized individuals. Access control thus has an important preventive role too, by deterring potential offenders. And while it won't prevent attacks committed by authorized individuals, it will enable them to be identified in the event of an incident.

12.2. Structure of an access control system

A system comprises the following three components, at least:

- **Sensor:** The sensor senses the user's means of identification or verification and transmits it to the controller.
- **Actuator:** On positive verification in the controller, access is then enabled.
- **Advanced central controller (ACC):** The controller checks an access request based on specific parameters either itself (offline system) or has this confirmed by a central authority (online system).

The individual elements of an access control system will be described in detail in the sections that follow. The various system concepts differ from manufacturer to manufacturer. Electronic access control systems fall into two different categories – online and offline solutions.

12.2.1. Offline access control

In offline solutions, access rights are written to the digital door components or to the identification media (ID card, key tag, key).

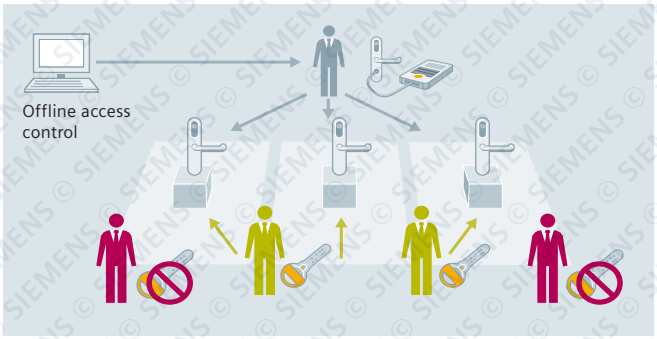


Fig. 8.1: Offline access control with digital door components. The system or the operator loads the authorizations onto the door components. "Green" user has the right authorization on medium, "Red" user doesn't.

Access rights in the digital door components

Offline systems consist of digital cylinders, door fittings and access readers. Some manufacturers offer digital lock cylinders that can be opened with a key or a chip. Access rights and time profiles are managed centrally by software and loaded onto the digital door components using a programmer. This local programming has to be done each time information is changed or deleted.

Advantages
- No wiring needed
- Easy to retrofit doors
- Little assembly or installation required

Disadvantages
- Access rights have to be loaded locally onto the door components
- Access rights are not available immediately
- Card barring does not take immediate effect

Access rights on the ID medium
Software administers the access rights and time profiles centrally and writes them to ID media such as ID cards, tags, etc. with the aid of an update reader. In this scenario, access rights can be changed and then written back to the various media again. If a medium is lost, it is barred in the system. A programmer or ID medium is used to transfer details of this barring to the offline door component.

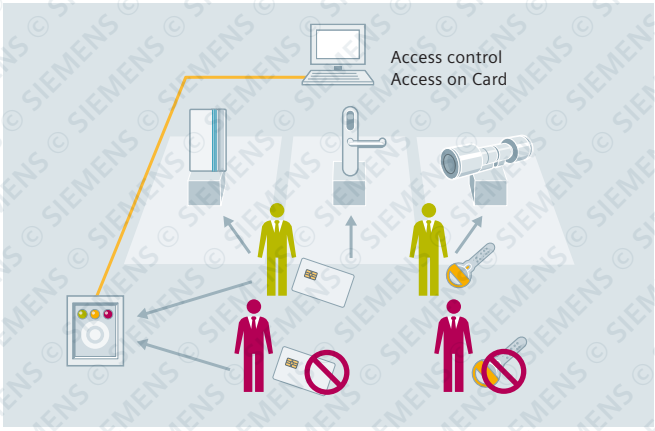


Fig. 8.2: Offline access control with access rights on the medium: "Green" user has used update reader to load authorizations onto medium and update them, "Red" hasn't.

Advantages
- No wiring needed
- Little assembly or installation required
- Easy to retrofit doors
- Access rights are written to the ID medium

Disadvantages
- Access rights are not available immediately
- Card barring does not take effect until the details have been loaded onto the door components locally

Standalone access control
Software administers the access rights and time profiles centrally and loads them into a controller or door manager with the aid of a programmer or a notebook. If the access rights are changed or deleted, they have to be loaded into the controller again in each case. Standalone access control is generally used for sliding doors or doors with motor locks. This type of door cannot be fitted with an offline door handle which is operated manually. These (heavy) doors require actuators in the background to open the doors. This is why a system is needed that can operate offline even in this situation.

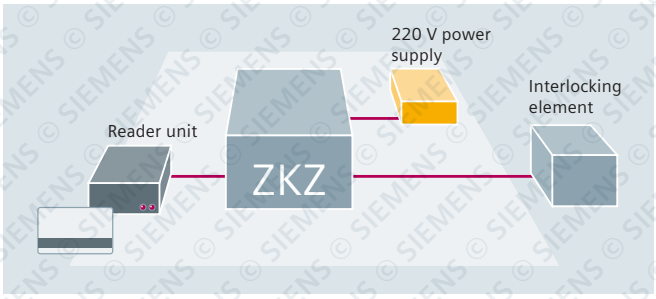


Fig. 8.3: Standalone access control

Advantages
- No network wiring needed

Disadvantages
- Access rights have to be stored locally in the ACC
- Access rights are not available immediately
- Card barring does not take immediate effect

12.2.2. Online access control
With online solutions, the decision whether to grant an individual access or not is taken in the controller. Access rights are usually held redundantly in the controller and on the access server. Access control systems are mostly implemented as a central or distributed topology or as a hybrid form.

Access rights online in the door components
Software administers the access rights and time profiles centrally and loads them into the controller over the IT network. This means that access rights can be changed online and lost ID cards can be barred with immediate effect, for instance. All door control units and access readers are networked with the controller via a bus system and the door control units can be wired centrally or locally.

Advantages
- Access rights immediately available
- Card barring with immediate effect
- Central door monitoring is possible
- Event reports immediately available

Disadvantages
- Wiring effort

Central installation
In a central configuration, all sensors (readers) and actuators (door openers, interlock systems, etc.) are connected to the central controller. They are usually housed in a secure area such as a plant room, for instance. The controller, to which multiple doors can be connected, takes the access decisions for all doors. Door interlock systems and magnetic contacts are also connected to the controller or alternatively to the door control unit. Only the controller, however, is connected to the access server over the IT network (see Fig. 8.4).

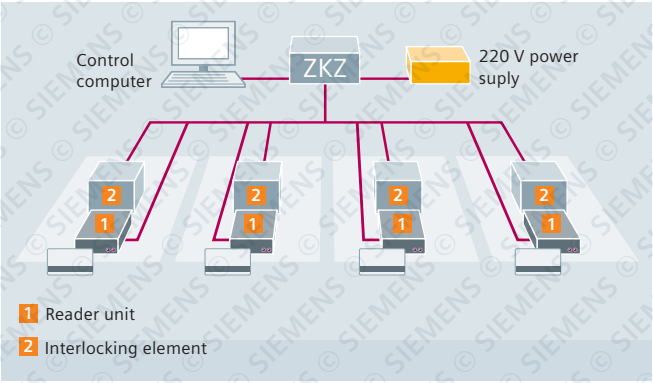


Fig. 8.4: Central installation with reader and interlocking element

Distributed installation

In a distributed configuration, many smaller, often networked controllers are located in the immediate vicinity of the sensor and actuator. The controllers either take all access authorization decisions independently and are networked via Ethernet, EIB or serially via RS485, or in conjunction with a central main controller. Access control readers, door interlocks and magnetic contacts are connected to this controller (see Fig. 8.5). This type of installation is particularly suitable for smaller installations. If a network is required, the appropriate infrastructure must however be in place. If there is no IT network, the more cost-effective bus system is a good option for connecting the individual elements.

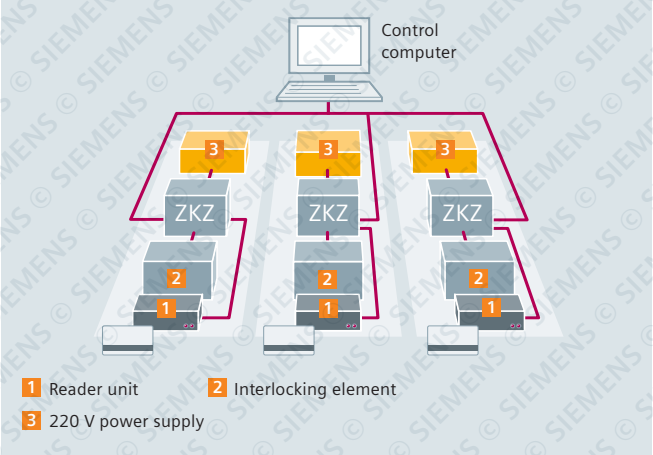


Fig. 8.5: Distributed installation with reader and interlocking element

Advantages

- Low installation costs if there is an existing network
- Central administration

Disadvantages

- Emergency power supply for controller
- Connections to third-party systems (intrusion detection, fire detection, etc.)

12.2.3. Differences between offline and online systems

In online access control systems, the server is always directly connected via a network to the readers and door control interlocks. These exchange authorization and movement data, via the controller. There are also systems, however, where authorizations are checked in online mode by the server, not by the controller. This means that in online solutions, the access decision always depends on the current data in the controller. In online systems, doors can be opened once, opened permanently or locked. It is also possible to bar or to authorize an ID card with immediate effect. This allows a very high level of security on one hand and a high degree of flexibility on the other. Analyses can be generated based on information as to who entered when and where or who was refused entry. Doors on the periphery (e.g. main entrances) and where a high level of security is required (e.g. doors to server rooms, connecting doors, etc.) should always be fitted with online readers. While real-time monitoring and possibly an alarm system are important when securing the exterior of a building, solutions inside the building (e.g. office doors and cleaners' rooms) do not all have to meet the same security requirements. This is why offline solutions have found their place as an ideal add-on. They do not incur the high cost of online integration, yet retain the same high security factor.

The systems are also straightforward to retrofit and extend. This means that all the components can be reused following relocation or conversion work. All the advantages an online system offers for management of access authorizations also apply for the offline solution. If a card is lost, barring it in the system is a simple matter – new ones with up-to-the-minute access rights can be issued anytime.

Today's state-of-the-art access control systems can manage access rights both offline and online. The operator of a facility does not have to opt for one solution over the other, but can enjoy the benefits of the different options. There are providers with both online and offline systems in their product range, enabling them to manage mechanical locking systems too. It is also possible to integrate offline solutions directly into the system. A distinction is made here between partial and full integration. A fully integrated solution is based on a single database, whereas a partially integrated solution has to involve two databases (online and offline).

Managing two databases does however increase the maintenance effort.

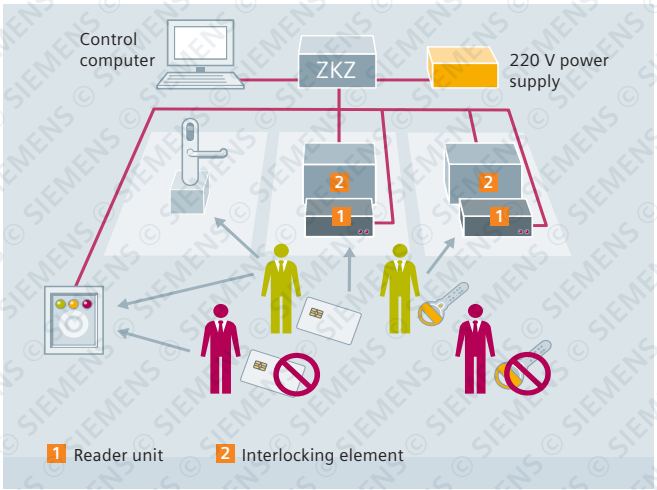


Fig. 8.6: State-of-the-art access control systems with online and offline solution

12.3. Medium

The reader, or sensor, transmits the user's credentials to the controller. In order to be able to identify a user, proof is required in the form of possession (something the user has, e.g. a card or tag), knowledge (something the user knows, e.g. a PIN or code), features specific to that individual (biometrics) or a combination of these. The different methods offer varying levels of security.

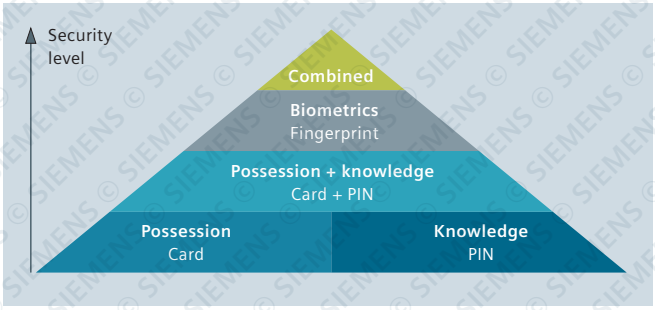


Fig. 8.7: Levels of security offered by the various methods

The security provided by an access control system can be adapted to meet the user's specific requirements. If it relies on checking only possession (of a medium) or knowledge, security is low. The medium (e.g. a card) can simply be passed on to someone else or stolen. The same is true of knowledge (a PIN), which can be obtained fraudulently or passed on to another. If, however, the two methods are combined, security is significantly increased. But the fact remains that knowledge and possession are not inherent to one individual. Security is only as good as the way in which these are managed. Then we have biometrics, which offer the highest level of security because features intrinsically bound to the individual cannot be passed to someone else, obtained fraudulently or forged. In this section we will look at the most commonly used media.

12.3.1. Types

Card

The chip card in credit card format is the most common type and is ideal for dual use as a visual identity card. The chip card, often referred to as a smart card or integrated circuit card (ICC), is a special plastic card with an embedded integrated circuit (chip) containing hardware logic, a memory or a microprocessor. Chip cards are read by special card readers.

Fig. 8.8: Credit card format ID with embedded chip

Design options for plastic ID cards are almost limitless. They are ideal for incorporating company logos, employee photographs as well as security features such as holograms. There are various methods for printing on plastic cards. Using special ID card printers for offset and thermal printing, cards can be issued regardless of which provider supplied them.

Key

In mechatronic solutions where contactless readers and conventional mechanical cylinders operate alongside one another, there are particular advantages to integrating an RFID component into the key. One disadvantage, however, is that the reading distance is limited with this method.

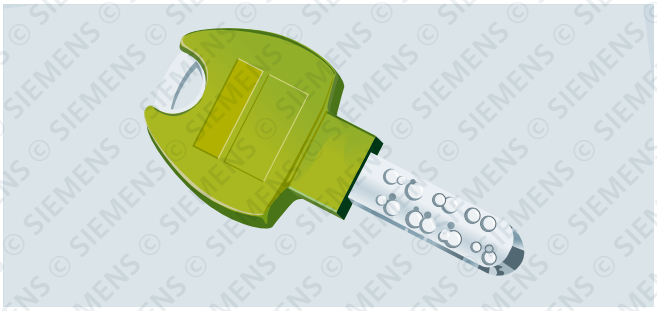


Fig. 8.9: Key with RFID components

Key tags/wristbands

In this method, an RFID component is inserted into a key tag or a wristband. This is a very robust solution, but the reading distance is much shorter than with the chip card.

Fig. 8.10: Key tags and wristband with RFID chip

The following questions may help when assessing the right type:

- Does the ID need to be customizable (e.g. with corporate identity)?
- Do other security features have to be incorporated (e.g. hologram)?
- Does the medium need to be contactless and able to be read from as great a distance as possible?
- Does the medium have to serve as a key too?
- Does the medium need to be very robust (mechanical loads, humidity, temperature)?

12.3.2. Choosing the right technology

To identify the right technology for each project, the following questions need to be considered:

- What level of security is required?
- Where will it be deployed?
- Are technologies already in use? Do all applications have to be able to be used with one and the same card?
- Are other applications planned?
- What reading rates are expected?
- Will data have to be stored on the medium and what size of storage is required?
- What reading distances are required?
- Will the medium be checked by a person or by a device?

12.4. Readers

Readers come in a wide range of types and designs differentiated by the following criteria:

- With/without keypad
- Reader technology (LEGIC, MIFARE, EM, Hitag, etc.)
- Reading distance
- Vandal resistance
- IP rating (indoor/outdoor use)
- With/without display (terminal e.g. for time recording too)
- Standalone operation possible
- Integration in cylinder, door fitting

12.4.1. With or without keypad

RFID readers can be fitted with a keypad for PIN entry. This combination enables both possession and knowledge to be checked. They can also be combined with biometric systems for greater security. A major disadvantage of RFID readers with a keypad is that, depending on product quality, frequent use leaves wear marks on the keys. It is then fairly simple for someone to obtain the PIN code by observing the pattern of wear. To address this problem, special scramble code readers are available for high-security applications. These randomly change (scramble) the position of the digits each time after a PIN is entered. Appropriate types are available for different applications. In Switzerland, Feller-Edizio has emerged as the de-facto standard. Surface-mounted models are generally used for industrial applications, with impact and splash resistant options available. These readers can also be combined with door intercoms and portrait cameras.

12.4.2. Offline readers

In certain cases there are readers that are not integrated into a network and therefore do not communicate with a controller. Such solutions, known as door fitting readers, are suitable for single doors where security is not an issue or in cases where mechanical keys cannot be used.

If these door fitting readers are to be used on fire safety doors and escape doors, it is essential that they are approved by the relevant authorities.

12.5. Transmission methods

Today's access control systems rely almost exclusively on chip cards and contactless technologies. Other card technologies (magnetic strip, barcode, infrared, etc.) can still be found in some older systems where media are used once only or where cost is an important consideration, e.g. in libraries, at trade shows or in car parks.

12.5.1. Transmission for chip cards

Contact chip cards are used in most cases to access a PC workstation as they offer a wide range of coding and security options. The storage capacity is often high, but depends on the particular embedded chip. The potential for altering, forging and cloning cards can be practically eliminated by taking organizational measures (e.g. holograms). The chips are equipped with contacts, the position of which is defined in an ISO standard. This requires complex insertion-style readers that must be able to bring together the contact sensors in the reader and the contact faces on the card.

12.5.2. RFID

RFID (radio frequency identification) is an identification method that uses electromagnetic waves. RFID is the term used to describe a technology for transmitter/receiver systems enabling the automatic, contactless identification and location of objects using radio waves. Such a technology makes data capture significantly easier. An RFID system always comprises a transponder that is integrated in an object (e.g. an ID card) and contains a particular code, and a reader unit to read this code. We refer to this as proximity reading with reading distances of 10 cm maximum. There are also systems for greater distances, however (e.g. for lorries, fork-lift trucks, etc.) that operate at higher frequencies and with their own ID media. In Switzerland, LEGIC and MIFARE are the technologies most commonly used in access control. Other applications include:

- IT access
- Office automation (to authorize use of printers and copiers)
- Time and performance recording
- eTicketing (concerts, sports events, etc.)
- ePayment (cash, vending, catering solutions, etc.)
- Parking solutions, etc.

12.5.3. Near field communication

Near field communication (NFC) is an international transmission standard for the contactless exchange of data via radio technology over short distances of a few centimetres. Access rights are granted "over the air" (OTA), i.e. data is transferred to a mobile phone for example by remote access via GSM and the Internet. This is useful if rights have to be granted quickly and for objects that are physically far apart. This means, for example, that technicians can attend to clear a fault very early in the morning, without a lot of administrative effort, by receiving the relevant authorizations via OTA shortly before their assignment.

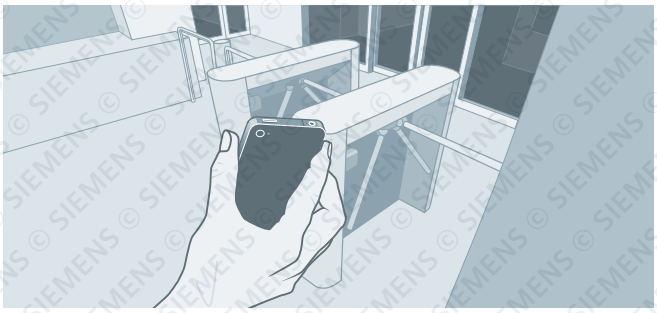


Fig. 8.11: NFC can be used to transmit data and rights via GSM and the Internet.

12.5.4. Resistive capacitive identification (RCID)

RCID is a technology for transmitting information using (quasi-)static electric fields that are completely harmless to the human body. Unlike RFID technology, RCID does not use electromagnetic fields. With electrostatic fields, information transfer takes place via electrodes (not antennae). The send signal couples to the user's body. As soon as the user touches the receiver electrode, one half of the circuit is closed. The other half is closed through the atmosphere. If you are carrying a transmitter (e.g. in your pocket) and touch a receiver (e.g. door handle or footwell mat), the circuit is closed and identification takes place.

12.6. Biometric systems

Biometric identification methods have experienced a huge growth in interest in recent years. Technological advances increasingly allow rapid scanning of biological characteristics (e.g. finger, iris) and evaluation of these at an acceptable cost and with high quality results. This makes biometrics a promising way of addressing the unsolved problem in many security concepts, namely how do you link identities and associated rights with the correct physical person? Fraudulent use of stolen ID cards, for example, is prevented or made more difficult as a result.

When it comes to identification of individuals, biometric methods are among the main authentication methods that can be automated. Here authentication means proving or verifying that information is genuine. While traditional authentication techniques including PIN, password and smart card (chip card) rely on verification based on knowledge or possession (see section 8.4. Readers), by using physiological characteristics, biometrics is based on traits that are not just personal but are intrinsically bound to the individual.

Verification and identification are two of the main recognition methods used for evaluation. Verification means "confirming identity", where a one-to-one comparison is done to check whether the claimed identity can be proven. A person may, for instance, present a card or a PIN as proof of identity. Based on a comparison of that person's biometric data (template) with the sensor reading, the system decides whether to grant the person access. If the reference template is stored on a card, there is no need to maintain a central database. This is a major advantage in terms of data protection.

Identification means "establishing identity" and involves the system comparing a person's biometric features with all the reference data held in the database. This is a one-to-many comparison with a large number of data records. The more reference records held in the system, the longer identification will take.

The initial procurement costs for a biometric reader are usually higher than for an RFID device. This is however somewhat offset by not having to purchase and manage RFID cards.

12.6.1. Requirements for biometric features

A biometric feature should have the following properties, as a minimum requirement:

- **Uniqueness/distinctiveness:** degree to which an identifier differentiates one individual from another
- **Permanence:** something that does not change in an individual. Adaptive methods are able to accommodate slight changes (e.g. minor injury to the finger)
- **Collectability:** something that can be captured easily
- **Universality:** something that every person has

The following properties are also desirable:

- **Acceptance:** no resistance to the collection of data
- **Performance:** robust, accurate, effective and allowing fast analysis
- **Reliability:** resistance to forgery and circumvention

12.6.2. Techniques and methods

Biometric recognition methods fall into two main categories:

- **Physiological characteristics** (or "passive features"): fingerprint, vein pattern, hand geometry, eyes (retina, iris), face
- **Behavioural characteristics** (or "dynamic features"): signature, voice, walking gait, keystroke dynamics

Behavioural characteristics tend to be used in consumer convenience applications, e.g. voice control of equipment, etc. Systems that evaluate static features are used for access control. It is also possible, of course, to use combinations of features, such as facial and voice recognition for example. We will now describe the individual characteristics in more detail.

Fingerprint

To date, no two people have ever been found to have the same fingerprint, so fingerprints are assumed to be unique. Each fingerprint has a total of around 35 different features (minutiae) including ridge crossings, endings, bifurcations and dots. For unique identification, it is generally sufficient to examine between eight and 22 of these features and their distance apart and position relative to one another.

Fig. 8.12: Reader unit and fingerprint minutiae

Advantages

- Small storage space required by template
- Cost-effective

Disadvantages

- Users may have hygiene concerns
- Limitation if fingerprint is missing or weak
- Temperature-dependent

Back-of-hand vascular pattern

A biometric system detects the individual pattern of veins and works with a specific detection algorithm. This detects the vascular pattern extracted by infrared technology and compares it with the reference records stored in the system. Even identical twins will have a different pattern which is not determined by DNA alone.

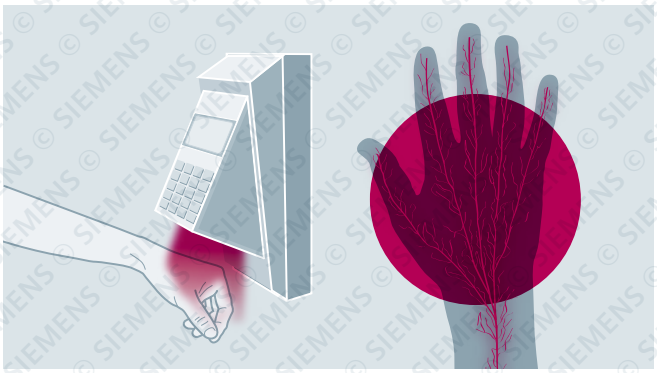


Fig. 8.13: Vascular pattern reader and hand vein structure

Advantages

- No failures as everyone has a vein pattern
- Position of veins does not change over a person's life and is different in each individual
- Skin condition has no effect on the template as scanning is done under the skin
- Minor injuries and dirt do not cause recognition errors

Disadvantages

- Temperature-dependent

Iris

The iris is the pigmented membrane in the eye. It is the most complex feature in the human body that is suitable for biometric analysis. The pattern of the iris is not determined by genetics and thus develops randomly. With its dots, speckles, striations and filaments, the iris has a total of 266 biological features that biometric systems can use for identification purposes.

Fig. 8.14: A video camera analyses the iris

Advantages

- Iris remains unchanged over a person's life and is different in each individual

Disadvantages

- Acceptance, resistance to having one's eyes scanned
- Difficulty scanning people wearing contact lenses/spectacles
- Minor injuries such as a foreign body in the eye can result in false rejections

2D/3D facial recognition

Unique features of a person's face include the chin, mouth, nose, eyes, forehead and their position relative to one another. Obstacles to facial recognition are variable features such as a beard, spectacles or changing lighting conditions. This is why the system has to extract this variable information from the image taken by the camera and concentrate exclusively on the unique facial parameters for analysis. Another factor which may interfere with facial recognition is changes in facial expression.

Particular facial features are captured with the aid of graphs, where a grid is placed over the face. The system places the nodes of the grid on the distinguishing features such as the eyes, corner of the mouth or tip of the nose. The selected points on the face create a "deformed" elastic grid with fixed relationships. This fixed relationship is preserved even if distortions are caused by a change in facial expression or a change in camera position.

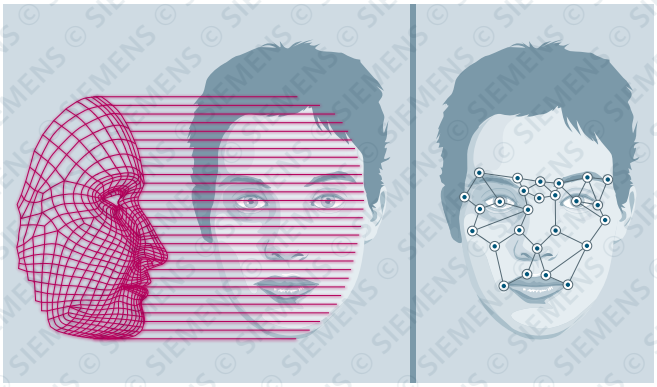


Fig. 8.15: The face is mapped based on certain features and a pattern is generated.

In 2D facial recognition, the features are captured using a camera. The facial capture system consists of an infrared transmitter and an infrared scanner as the receiver. The transmitter projects an infrared grid pattern, invisible to the human eye, onto a person's face. The infrared pattern reflected from the surface of the face is captured by a special scanner and converted into image information.

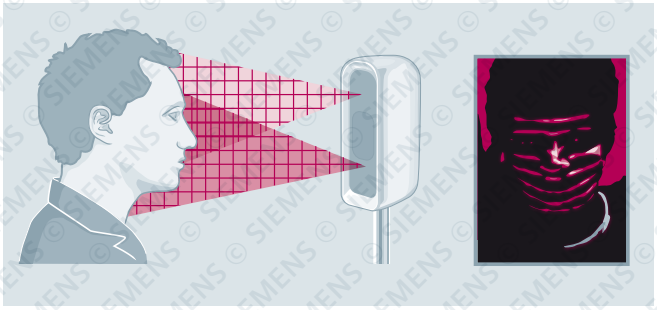


Fig. 8.16: How facial capture works

Advantages

- Low susceptibility to dirt and wear
- Contactless system means high level of user acceptance

Disadvantages

- Complex method

Questions to ask when evaluating biometric systems:

- What are you seeking to achieve with a biometric recognition system?
- Do you want biometric identification or verification?
- Which scanning method is to be used?
- On what grounds is data processing justified?
- How many people will be enrolled?
- Is the biometric data to be stored centrally or locally?
- If it is to be stored locally, which method will be used?

12.7. Door management

Access control systems are also linked to the control system for doors, gates and interlocking systems as well as alarm products. However, this requires special door controllers and components. Here, doors and readers are controlled and monitored by a door manager.

A door manager is only as good as its doors and security components, however. Depending on traffic volume and where the doors are located, hundreds of people may pass through them each day, placing a huge strain on the mechanical and electromechanical components. It is therefore extremely important that planning is done sufficiently early, that it is thorough and involves all the relevant experts. This will avoid components failing prematurely or ceasing to provide the necessary security. It is also important to give careful consideration to the other functions doors serve as protection against intrusion, fire or noise, for example, and to escape route design as well.

In complex installations, the door components are not handled by a single door controller, instead they are routed to a higher-level door management system (DMS), such as a stored program controller (SPC) for example. Increasingly these are replacing hard-wired programmed control. Sensors (door contacts, light barriers, etc.) and actuators (door openers, electric locks, etc.) are connected directly to the SPC. Whether as central modules or in a modular solution with distributed modules, the SPC guarantees a high level of flexibility and scalability. Access control interfaces can also be digital.

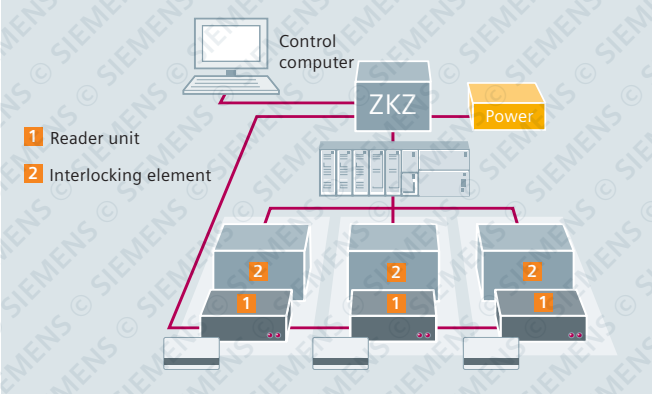


Fig. 8.17: The door management system controls and monitors the door components.

Having an integrated serial interface removes the need for costly wiring. If multiple SPC modules are used, these are interconnected via the network (Ethernet) for added flexibility and speed.

12.7.1. Types of door

There are different type of doors and passageways:

- **Revolving doors:** two or four rotating door leaves in a circular housing, allowing entry and exit simultaneously
- **Double doors:** boundary between interior and exterior areas, lockable
- **Turnstile:** two, three or four vertical wings for one-at-a-time access when managing large numbers
- **Sliding doors:** one door leaf/multiple door leaves, located top and bottom, opening sideways
- **Tripod barriers:** fixed housing with three arms to permit individual entry
- **Interlocking systems:** cubicles with two doors opposite one another for controlled one-at-a-time access
- **Sensor gates:** sensor-controlled passageway with sliding or swing doors

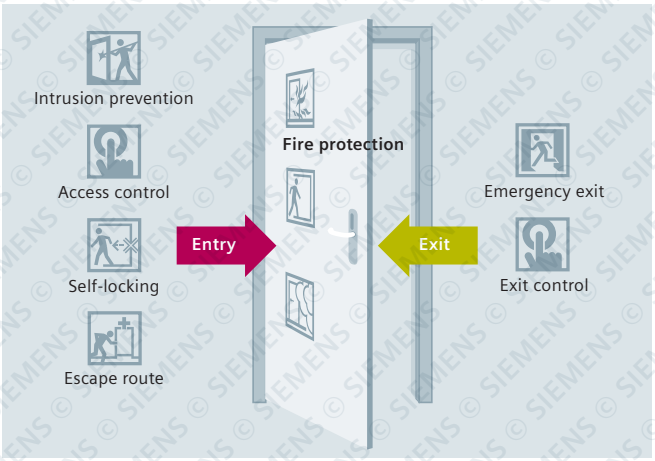


Fig. 8.18: Authorization structures in an access control system

12.7.2. Elements in a door

A door comprises the following elements:

- **Door opener:** a device installed in the door frame with electromagnetic release of the strike
- **Security lock:** an extremely secure (door) lock with a cylinder located by multiple pins
- **Self-locking lock:** the door locks automatically again as soon as the door is closed
- **Multi-point lock:** security lock with multi-point locking (usually three-point) making it difficult to lever the door off by mechanical force
- **Feedback contacts:** to monitor door status (closed, locked, open), predominantly magnetic contacts or bolt contacts are used

12.8. Core functions of an access control system

12.8.1. Authorization structures

The various providers adopt different approaches when it comes to representing authorizations in the system. They all have one thing in common, however – they show who (medium) is authorized to enter, when and where.

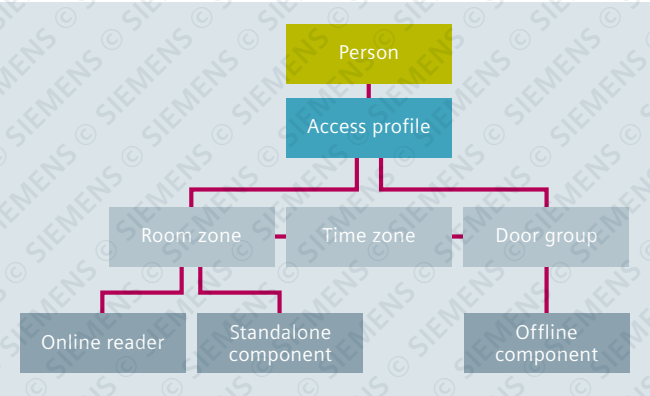


Fig. 8.19: Authorization structures in an access control system

The readers and doors with online and offline components represent the lowest level in an access control system. The second level is made up of the various room and time zones and door groups. The third level, at the top, manages the access profiles for the particular individual.

To make administration simpler and more transparent, doors are combined into groups. This can be done at several levels, logical groupings of readers or access profile. Individuals can be classified by function, activity, department, site assignment or cost centre. The idea of grouping like this is to be able to assign the relevant access rights to an employee as quickly as possible.

The granting of rights is as individual as the system itself, so users should specify their requirements clearly to the provider. The concept must then be developed jointly. Once it has been rolled out, the operator should be in a position to upgrade the model appropriately and to grant rights autonomously.

12.8.2. Door interlock controls

Only authorized persons are permitted to enter a man trap (e.g. a room or cubicle). This must be secured by at least two access terminals. If a room is used as a man trap for access to other security areas, it must not be possible to enter or exit it through more than one door at a time. Booking is only possible if all the man trap doors are closed or if an access booking has been terminated.

A man trap can also be used for one-at-a-time access control. In this case, none of the doors to this room can be opened until the authorized person has exited the room (man trap). Generally, a time limit is imposed; if this is exceeded the person must return to the zone from which he or she has come. The following points should be considered when using man traps:

- Responsibilities must be clearly assigned for the individual monitoring systems (intrusion, fire, video, access).
- Don't forget the emergency exit.
- Operating the man trap takes a lot of electrical power. All the necessary components must continue to work reliably if there is a power failure.
- One-at-a-time access control systems are expensive and should be planned by experts.
- Man traps require regular maintenance. Their complexity requires precise interaction of all components.
- Man traps drastically reduce pedestrian flow. The anticipated number of people passing through must be considered at the planning stage.
- Provision for handling goods or personal items (luggage, PC, etc.)
- Multiperson logic and blocking of access

12.8.3. Interzone movement control and balancing

Room zones are subdivisions of a secure area consisting of one or more rooms with one or more entry and exit points. Only one person at a time is permitted in a room zone. Interzone movement control prevents access to an adjacent room zone if the authorized person is logged as "not present" in the room zone where he or she currently is.

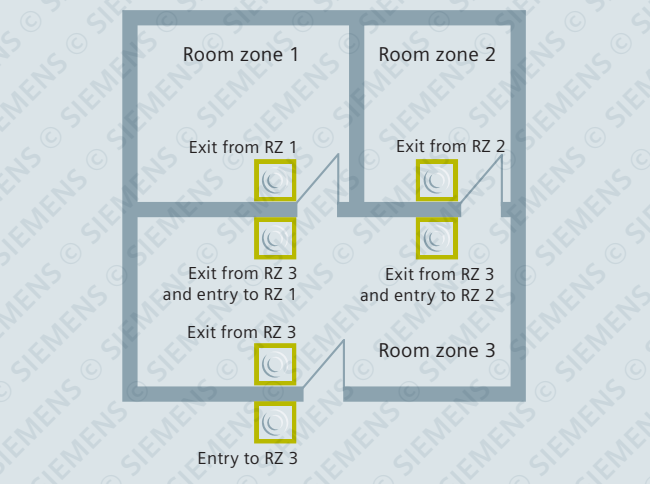


Fig. 8.20: Division into different room zones

All readers for the same room zone can be combined into a group. Other attributes can be assigned to the particular room zone:

- Room zone violation: entry still possible even if there is a zone violation, but will be logged or will trigger an alarm
- Number of people currently in the room zone
- Time zone during which the access authorization for a room zone is valid
- inimum number of people required to be present in a room zone
- Maximum time people are permitted to remain in the room zone

- Room zone unoccupied/occupied – an alarm will be triggered depending on policy.
- Maximum number of people permitted in the room zone at any one time. When the maximum is reached, one person must leave the zone before another can enter.

12.8.4. Lift controls

There are various ways of combining access controls and lift controls:

- The lift can only be called by authorized persons. The access reader is located not in the lift car but on the various floors and is used to call the lift.
- The access reader is in the lift car:
  - Following valid booking, any floor can be selected.
  - Following booking, the lift goes to the floor assigned to the medium.
  - Only floors can be selected for which the user is authorized (lift buttons are enabled).

When considering lift controls, it is important to remember that the earlier the options available from lift and access control providers are coordinated, the better. Note: a lift is not a one-at-a-time access control system.

12.9. Add-on features and modules

12.9.1. Integration options

Other systems and modules can interact with the access control system in a variety of ways. It is important to note the different degrees of integration:

- **Partial integration:** combination of a third-party application – usually an existing one – with an access master application
- **Full integration:** extension of the access control application, the user uses the extension in the same way as the master application
- **Hardware interfaces:** linking various systems via hardware interfaces so that important events and triggers act on both systems
- **Software interfaces:** with minimal connectivity, e.g. via web service, the shared data need only be maintained in one application

Integrating access control into a security management system is common practice. This provides security staff with a single unified environment for operating all security subsystems and gives them a complete overview. A clear graphical user interface ensures ease of use.

12.9.2. Visitor management

Visitor management procedures differ from those for employees in that rights are usually granted for a limited time, ID cards are barred on return, reused by the next visitor, etc. Here too, however, there is full transparency of all activities.

Functionalities and advantages:

- Car parking management
- Pre-registration of visitors and automated welcome
- Regulated access to sensitive areas (prevented, escorted, etc.)
- Archiving of all visits, including person visited
- Access is possible even if reception desk is unattended (self-registration)
- Overview of all visitors present in the building (emergency, evacuation)
- Identification of undesirable individuals or companies (blacklist)
- Visitors can move freely within predefined zones
- Additional functions such as room and resource booking (e.g. catering)
- Enabling of lifts for certain floors
- Access logging is provided at all times

12.9.3. Alarm routing

Any alarms are routed to the police or to private responders, by SMS or e-mail. Such transmissions should be by secure or encrypted means, and internal notification, of the Technical Manager, for instance, may be another useful feature. In many cases, access control is used as an operating element in the intrusion detection system. Depending on the capabilities of the access control system, this can offer effective solutions, enabling workflows to be automated and synergies leveraged. It is important to remember, however, that access control is not a substitute for an intrusion detection system. Also, convenience solutions used for access control cannot be SES-certified.

12.9.4. Video surveillance

It can be very useful to connect the access control system to a video surveillance system. Recordings of authorized and unauthorized accesses support subsequent identification of any misuse of ID cards. As soon as a person approaches the entrance or a door or makes a booking on a reader, the relevant software can activate the video camera via motion detectors. This enables security staff to carry out additional checks either live on the screen or retrospectively using the saved images.

12.9.5. ID card issuance and management

As well as supporting card management, many access control systems also have modules for ID card personalization including printing and programming, for example. In addition to actual access, ID card management also enables applications such as parking management, key deposit, cashless payment, use of copiers, equipment loan management, etc. However, only specialist providers of access control systems offer such modules.

Fig. 8.21: Potential ID card management applications

12.9.6. Key deposit

The use of an electronic key safe has the great advantage that keys do not then leave the company premises. Other advantages of a key deposit system used in combination with an access control system are:

- Alert is triggered if key is not returned by a certain time or person is prevented from leaving the building until the key is returned to the key safe
- Fewer keys in circulation
- Monitoring of keys issued (which keys are missing at the moment?)
- All keys issued and returned are automatically logged: who, when, which key?
- Clear assignment of rights (who is authorized to take which key and when?)

A deposit system can also be used for other things such as tools, equipment (PCs), etc.

12.9.7. Interfaces to third-party systems

Biometric systems, video surveillance equipment and lift controls for example can be integrated via serial interfaces. Data exchange takes place at management level over the network and is usual for the transfer of personnel data from an HR system and eliminates redundant data capture. Since records of hires and exits and changes of department are reliably maintained in the HR system, not only does this simplify the process and avoid errors, it enhances security in particular.

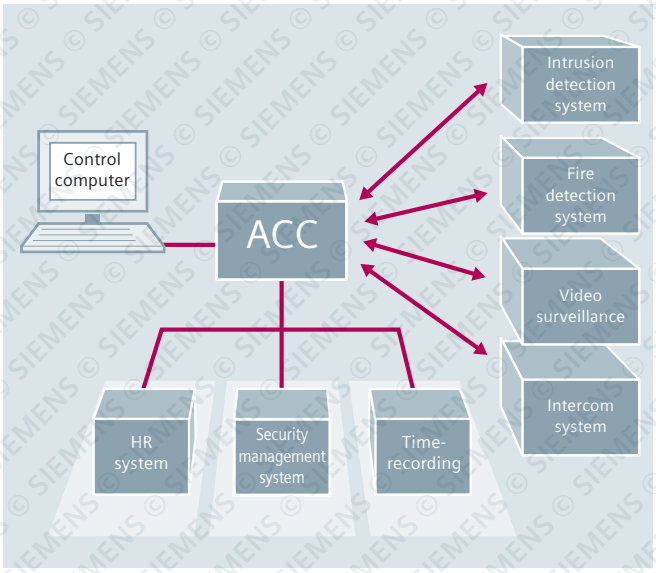


Fig. 8.22: Connecting third-party systems via serial interface

Interfaces can be very complex, depending on the requirement (access method, type of data, procedure for errors and conflicts, frequency, logging, etc.) and type of implementation. A great deal of experience and knowledge of the two systems to be connected is required.

12.9.8. Reporting

An access system should also be able to support the generation of reports and analyses. In addition to predefined queries, it should also be possible to create queries filtered by various criteria and export these to standard Office applications. The more specific the requirements, the more is to be gained by specifying these reports very precisely and reviewing the effort involved.

12.9.9. Time recording

Access control and time recording have two elements in common: master data (personal data) and ID card (identification). Most systems therefore incorporate a time recording and management function, in addition to access control. This has the advantage that access to the building is only possible, for example, if it is at the right time – during the appropriate shift, for instance, not during a holiday period.

Depending on user requirements, each case should be assessed to decide whether an integrated solution or simply connection via an interface is the better option. The following questions should be considered:

- What requirements does the access control system have to meet?
- Which card technology is to be used?
- How are responsibilities assigned (operation, maintenance, etc.)?
- Are there requirements in terms of payroll and HR systems?
- Which database technology is used?
- What are the time recording/time management requirements?
- Are there other links with systems for recording operating data/performance?
- Can data be provided by the HR information system?

12.9.10. Local application vs. web client

In most access control systems, data retention and communication with the peripherals is achieved using a server. There are two methods that can be used for the capture and management of access data: either by means of "normal" clients or web clients. Both methods have advantages and disadvantages.

In an installation with clients, software that accesses the data on the server is implemented on each relevant PC. This technology offers secure, efficient control of the systems as well as fast, effective operation of the access control system. Software updating has to be done on each PC, however, making this type of management correspondingly costly.

In the web client solution, a web application is installed on the access control server and enables access via an Internet browser. This has the huge advantage of eliminating the need to install separate software on the individual PCs. Internet bandwidth today is often not an issue for proper functioning of the web installation, but certain parameters need to be set correctly. Updating is done exclusively on the server.

12.10. Security and data protection

It is vital that an access control system is protected to ensure that an attack does not render the system unavailable or that security is not compromised by technical or simple organizational measures. This requires a structured protection concept, particularly in view of the fact that around 70% of computer crime is committed by a company's own employees.

As well as protecting the system, it is particularly important to protect personal data. The German Data Protection Act (DSG) requires that appropriate technical and organizational measures be taken to protect personal data from unauthorized access. Security can be at odds with convenience – as soon as a system becomes too restrictive for employees or if the reasons for the restrictions are not clear to them, they will find ways to circumvent it.

There are various aspects to a securityconcept:**Availability:** systems that process and store information must ensure the confidentiality, availability and integrity of data. This can be done by encryption, for example.

- **Hardware:** ID cards, readers, door components, controllers, clients, etc. must be protected from access, sabotage, viruses, duplication, etc.
- **Authenticity:** official event data (access, door opening, etc.) must be logged in full and in chronological order and be able to withstand scrutiny.
- **Availability:** access to data must be assured within the agreed timeframe. Availability is high if as few defects and operating errors as possible occur – this can be achieved by selecting the right IT, network and door components and with the right service and training support.

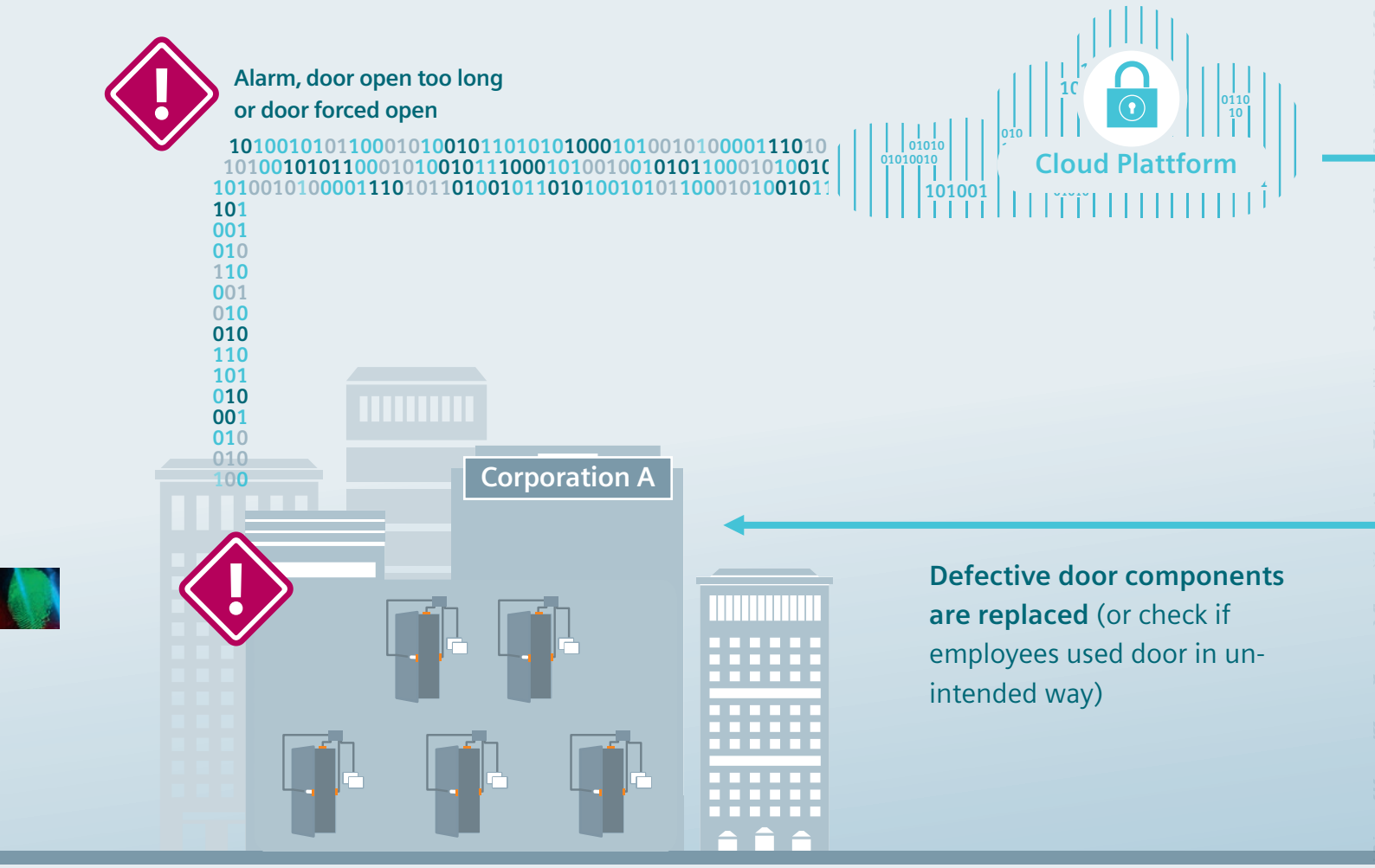
Use Case – Access Control

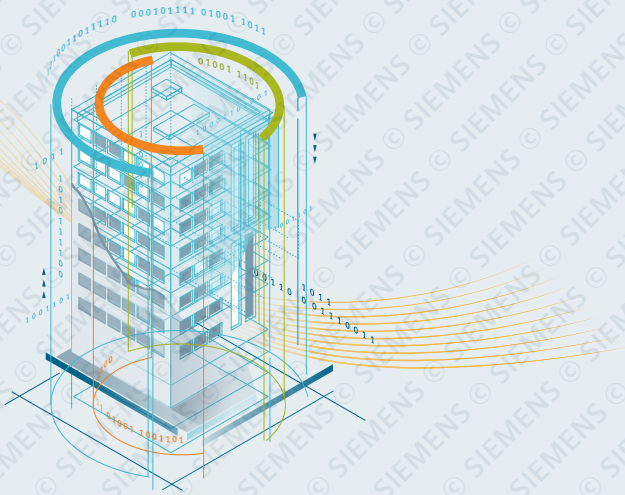
The System detects a “problem” with a door. It may not have been closed correctly for too long or there may be a defective contact. If this occurs on a door defined as important, such as a main entrance or an entrance to a restricted area, then the Digital Service Center (DSC) receives an event alert and immediately informs the customer.

If the problem is considered non-severe, it will be recorded in the log file and reported in the next regular customer report or when the next service is performed. For example, a non-severe issue could involve a less critical door that is frequently open for longer than normal. When this is reported to the customer, he can decide if he wants to follow up to find out the reason. It could be that employees are keeping the door open because they want fresh air for five minutes.

It is important to note that the system’s log file registers every opening and closing of the door, including who opened it, when it was opened, etc. Therefore, a non-severe incident might get lost in this large amount of information if the data isn’t structured and presented in a report with a structured overview.

The actions to be taken depend on the issue identified. For example, the field Service Engineer might need to replace defective door components. Or it could be clarified that the issue was caused by employees using the door in an unintended way.

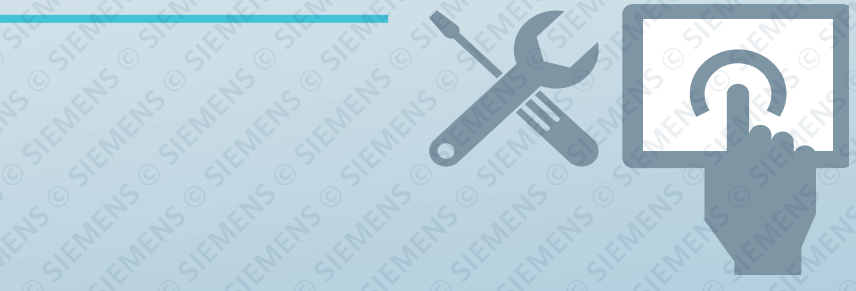




Data power delivers better building performance

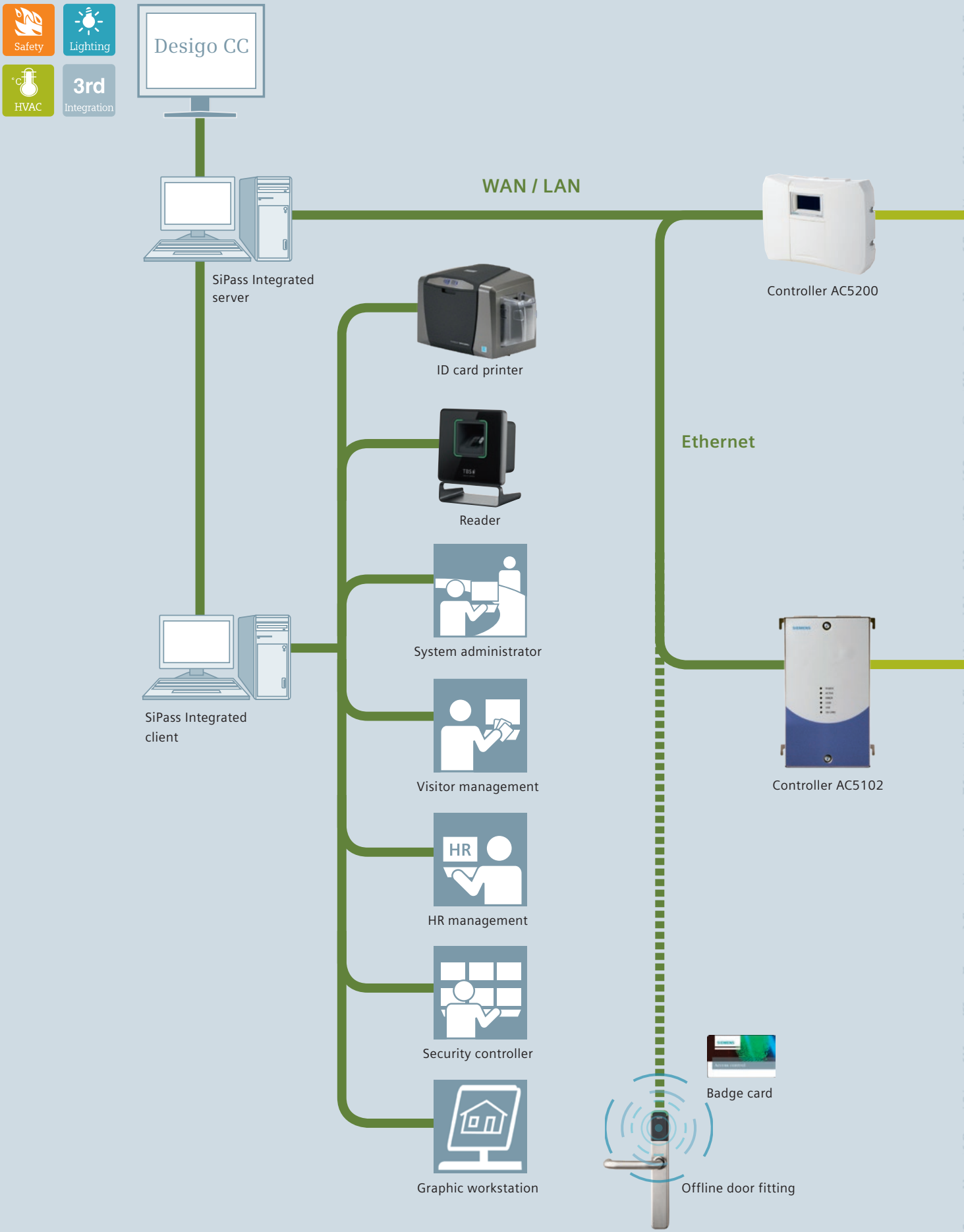
Digital Service Center

- Events are recorded
- Information is sent to local service organization



Local Service Organization

- Customer is informed about potential security risk
- Customer checks situationdoor contact/door wedge

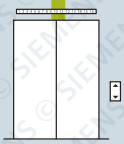

Safety
Lighting
HVAC
3rd
Integration
Desigo CC
WAN / LAN
SiPass Integrated server
Controller AC5200
ID card printer
Reader
Ethernet
System administrator
SiPass Integrated client
Visitor management
Controller AC5102
HR
HR management
Security controller
Badge card
Graphic workstation
Offline door fitting

RS485 Netzwerk

AFO5100
output module

ADD5160
door control module

AFI5100
input module



Lift control

3D fingerprint reader
(biometric reader)

The AFI5100 provides a local interface between the AC5100 and the devices used to monitor a facility, such as infrared detectors

RS485 network

ADD5160
door control module

ADD5160
door control module

ADD5160
door control module

AFO5200
input/output modules

3D fingerprint reader
(biometric reader)

3D fingerprint reader
(biometric reader)

PIN/card reader

Card reader

Badge card

Alarm and
control outputs

SiPass Integrated: freedom of movement with complete security

Highlights

- Modular system architecture allows solutions to be tailored to individual requirements
- Advanced identity management with integrated biometrics and DESFire encryption
- Advanced Security Programming (ASP) for automated security workflows
- Intuitive software that is easy to use and administer
- State-of-the-art interactive reporting
- Supports SALTO offline components
- Operates in an existing IT environment, using TCP/IP over WAN/LAN

SiPass Integrated is a powerful access control system offering virtually infinite flexibility and an extremely high level of security without sacrificing convenience or ease of use. It is also possible to use SiPass Integrated as a security management station (SMS) that integrates access control, intrusion detection and video surveillance into a single system.

With its modular structure, SiPass Integrated will fit into any state-of-the art IT environment and can be upgraded quickly and flexibly to keep pace with changing needs.

Thousands of corporations, airports, ports, government agencies, hospitals and universities around the world rely on SiPass Integrated from Siemens wherever reliable access control is required.

Tailored and interoperable: what access control looks like today

Flexible and highly secure

SiPass Integrated has been developed to meet the full range of access control requirements in facilities of all sizes, large and small, from non-critical to critical security areas, from simple to highly complex installations, in both existing and new buildings and for operations on one or more sites. The number of cardholders and doors in a SiPass Integrated system is practically unlimited. System management can be handled by different administrators with varying levels of authorization.

Thanks to its virtually unlimited flexibility, SiPass Integrated is an equally valuable tool whether managing single low-rise office and residential facilities with just a few doors or huge high-rise complexes with tens of thousands of doors, gates, barriers and lifts at multiple sites around the globe.

Customizable

SiPass Integrated comes into its own in environments where sensitive information needs reliable protection and there is a risk of espionage or misuse of information. Standardized interfaces enable easy integration with existing security processes and business systems. A wide variety of software extensions can be used to customize the system to meet the specific needs of the particular establishment. In cases where an organization has outgrown its access control system, existing readers (Siemens or third-party), cards and cardholder data can generally be incorporated into the new SiPass Integrated system and continue to be used as before. The legacy system is simply integrated into the new – ensuring that past investment is protected.

Interoperability and integration with other systems

As well as providing supremely secure access control functionality, SiPass Integrated also supports integration of video surveillance and intrusion detection systems (either Siemens or third-party) thereby creating an all-round security management station (SMS). Fire safety systems can also be integrated from the ground up. The decades of experience that Siemens possesses in system integration and standardized systems enable us to offer integrated access control, intrusion detection, video surveillance and fire protection systems that combine unparallelled functionality, quality and investment protection.

SiPass Integrated: hardware components

SiPass Integrated can be fully customized to meet a facility's individual requirements. For instance, it can monitor entries only, or both entries and exits (anti-passback), and/or it can be used to control the operation of lifts. Areas of a building where a higher level of security is required can be given added protection with video surveillance technology.

A SiPass Integrated system is built using a variety of different hardware components: advanced central controllers (known as ACCs and ACC-Lites), door modules, signal modules, readers and cards. Automatic backup and restoration of the system database ensures maximum system integrity. Secure data transmission over the entire transmission path – from the ID card to the server – provides end-to-end security.

Controllers

The AC5102 advanced central controller (ACC) and the AC5200 (ACC-Lite) play a crucial role in the SiPass Integrated system, as they are the interface between the SiPass Integrated software and the devices throughout the building (reader interface modules, input/output modules).

The AC5200 provides nearly all the functions of the AC5102. Both types of controller can be mixed on the same site. Communication between all the controllers in the system takes place peer-to-peer, independent of the SiPass server. This has the great advantage that system operation is not affected if the connection to the server is lost.

The AC5102 is generally used in larger installations while the AC5200 is ideal for smaller ones. Based on the SR35i hardware of the SiPass Entro system, the AC5200 can control up to eight doors. This makes it a cost-efficient alternative for branch locations or small remote sites.

Readers and cards

Virtually any Wiegand standard reader can be connected to SiPass Integrated, thanks to Siemens' custom Wiegand interface. Different reader technologies can be combined freely to create a tailor-made system to meet the specific security needs of any facility, including functions such as secure PC login, vehicle identification, and cashless payment, for example.

SiPass Integrated: software components

SiPass Integrated software is the heart of any SiPass Integrated system. Robust and user-friendly, it is capable of managing a virtually unlimited number of controllers. The software features a powerful client/server architecture and is easy to install and administer via its graphical user interface.

Features such as extensive event logging, alarm management, anti-passback functionality (including global and workgroup anti-passback), door interlocking, escort mode, video surveillance and DVR interfaces – as well as Siemens' exclusive custom Wiegand functionality and the ability to download device firmware – all come as standard with SiPass Integrated. A wide range of other features are available as optional add-ons.

SiPass Integrated also offers the option of customized interfaces to other applications, ensuring smooth communication at all times. The software also supports Citrix Services for remote operation, if required.

Core features

Highlights

- Interactive reporting feature
- Partitioning of user rights
- User data management
- Escort control
- Advanced Security Programming
- Full availability

SiPass Integrated includes all the access control features you would expect from a good access control system – DESFire encryption, support for fingerprint readers, support for GSM modems, time scheduling, manual system override, dynamically updated graphical status screen, instructional alarm response windows and a full system archiving and restoration function – and many other advanced features.

Interactive reporting tool

The SiPass Integrated Explorer ensures fast identification and classification of system events. The software includes a tool for generating visual online reports, database reports, audit-trail reports, simultaneous reports as well as advanced search and filtering options and a tree view for a faster overview. The system enables reports to be generated at the click of a mouse, and offers a customizable information structure and targeted sorting of information. It is also possible to define watch lists in order to monitor people who pose a potential security risk.

Comprehensive audit-trail logging

SiPass Integrated offers network operators the opportunity to create multiple logging windows to filter events. Audit-trail logging also ensures that all database changes are captured for total traceability in the system and that changes are logged precisely and displayed on screen. This functionality makes SiPass Integrated very well suited for use in organizations where total traceability is essential. SiPass Integrated can also be used to build access control systems that are compliant with 21 CRF Part 11.

Advanced alarm management
SiPass Integrated's standardized alarm management system enables the configuration of up to 1,000 alarm priority levels. To enable a faster response, the alarms are displayed and highlighted graphically according to priority. To support security personnel, customizable instructions to be followed in the event of an alarm can also be created.

Anti-passback and roll call
The purpose of anti-passback is to prevent the same card from being used to admit more than one person. Once a cardholder is identified as being in the anti-passback area, that card is then barred for further access to that area. Anti-passback also enables roll call, which provides an accurate count of how many, and which, employees are in an area at a particular point in time. This information may save lives in the event of an emergency. SiPass Integrated also includes a workgroup anti-passback feature, which means that once an anti-passback area is set up, it is also possible to limit the number of individuals from a particular workgroup permitted to access that area at any one time. The imposition of this limit can be combined with other access restrictions to the area in question.

Partitioning of user rights
This feature can be used to grant access only to those parts of the system the user needs to access. The system can control which cardholders, units, FLN devices and time periods can be modified by which users. A tree-based structure makes it easy to select and define the appropriate rights for a particular user. When partitioning user rights by cardholder, it is possible to limit access to workgroup fields and/or limit access to the cardholder and visitor dialogues. The result is greater control over information security and the ability to prevent unauthorized assignment of access privileges.

Cardholder management
Entering cardholder data into the SiPass Integrated system is an easy process. If required, you can even assign multiple cards to a single cardholder. The user-defined design template enables a custom layout to be configured by drag-and-drop, including parameter settings for individual fields and buttons. It is also possible to import or export your custom pages in XML format between SiPass Integrated systems.

Escort control
SiPass Integrated provides an escort control feature which means that before a door can be unlocked, two valid cards must be presented at the card reader. This feature is particularly useful in high-security areas that require visitors or employees to be escorted by a security guard or supervisor. In addition to supervisor/escort mode, a self-authorization mode is also available for which on/off times and timeout can be defined.

Door interlocking
This feature makes it possible to define a group of doors and ensures that while one door in the group is open, a second door cannot be unlocked. Door interlocking enables the creation of man traps and air locks, which are required particularly in medical, bio-tech, airport and other high-security facilities.

Advanced firmware download to modules
SiPass Integrated provides a quick and easy method for handling the operation of hardware components directly in the SiPass Integrated graphical user interface (GUI). The firmware on all connected hardware modules can be upgraded simultaneously to the latest version. All this can be done in a fraction of the time it would take to physically update each module manually, thereby saving both time and money.

Interface to SiNVR video management system
This interface is used to connect SiPass Integrated to SiNVR, the Siemens video management system, and enables the recording of camera images based on access events.

Add-on features

Highlights

- Support for SALTO offline components
- MIFARE and MIFARE DESFire card encoding
- Advanced lift management
- Seamless integration of SPC and Sintony intrusion detection modules
- Management station API
- DVR API
- OPC alarm and event interoperability

Optional software modules mean that SiPass Integrated can be tailored to meet virtually any security requirement.

SALTO offline components

This feature makes it possible to add SALTO offline components (doors) to a SiPass Integrated system. Access rights can be assigned to both online and offline components in the SiPass Integrated software.

Personalized IDs and image verification

This option supports the capture and storage of enhanced security features such as photos and signatures.

Export of time and attendance data

Using this feature it is easy to extract all of the logged activity data in SiPass Integrated and export it to your time and attendance application in the appropriate format.

Lift management

SiPass Integrated offers two methods of implementing lift management. When the lift management option is used, each floor is treated like any other entry point in SiPass Integrated, for which separate access control options apply, such as the time during which access is possible, daily check of the access code, PIN and even image verification for complete security.

Message forwarding

The message forwarding option enables the system to automatically send customized text messages to the pagers, mobile telephones or e-mail addresses of designated personnel if a security breach or other relevant incident is detected.

HR data exchange (HR API)

The standard HR API enables third-party business applications to communicate with SiPass Integrated and exchange general data. This eliminates the need to enter identical data in multiple systems. Cardholder and other access control data can be read and modified using a web browser or human resources system, for example. In addition to the standard HR API features, the extended HR API offers more advanced options for third-party applications, such as assigning door privileges to a cardholder or granting temporary access to a visitor.

Management station (API)

The management station API enables straightforward integration with virtually any management system.

Visitor management

The visitor management option allows the same graphical interface that is used for permanent cardholders to be used to register visitors too. It is possible to capture visitors' photo-

graphs and paste these into existing image files, record personal details, print individual visitor ID cards and track the location of the visitor in the SiPass Integrated system.

Graphical maps
The graphics option makes it possible to design, import and construct customized graphical maps that are used by security operators to visually display alarm conditions and monitor the status of all security points within the system at a glance.

MIFARE card encoding (DESFire)
MIFARE technology makes it possible to use a single card for a variety of purposes, including access authorization and paying for goods and services. Complete MIFARE card encoding and profile configuration is a unique feature of SiPass Integrated. The system supports the encoding of 4K MIFARE cards, as well as MIFARE DESFire cards.

DVR application programming interface (API)
This interface allows two-way high-level communications to be established between the SiPass Integrated system and almost any DVR unit. Many DVR management features are available, such as live image viewing, active event recording, image verification, and full PTZ camera movement.

Interface to non-Siemens video surveillance systems
This software extension enables you to connect a wide range of video surveillance systems to SiPass Integrated and to transform the SiPass Integrated client into an interactive video surveillance station. Operation of the video surveillance components can be controlled from the convenience of the SiPass Integrated graphical user interface.

Workstation with video surveillance
This powerful add-on feature makes it possible to view video surveillance images from either IP or analogue cameras directly on the SiPass Integrated client. Using a video capture PC card you can view images from virtually any camera and use the screen tools for standard video surveillance functions like zoom, pan, tilt and general camera movements.

Interface to non-Siemens video recording systems
Using this software interface, it is possible to begin recording from any camera with a single click of the mouse. This is done using shortcuts that can be quickly created and inserted into the graphical map. All recording events and their statuses are captured in real time in the audit trail, and can be played back by simply clicking on the relevant recording event.

Intrusion detection module
The intrusion detection module in SiPass Integrated provides native intrusion detection functionality. If this option is installed, motion detectors can be connected directly to SiPass Integrated and the system can be used both as an access control system and an intrusion detection system. In this version, the same card readers are then used both for access control purposes and to arm and disarm the intrusion detection system. In cases where a certified intrusion detection system is required, the intrusion module can be used to integrate a dedicated SPC or Intrunet SI series intrusion control panel into the SiPass Integrated system.

OPC alarm und event interoperability
SiPass Integrated provides both an OPC server interface and an OPC client. The OPC server interface makes it possible to transmit SiPass Integrated events and alarms to OPC clients such as building management systems and acknowledgements received from those systems. The OPC client makes it possible to connect to OPC servers so that SiPass Integrated can receive alarm and event information from other systems, creating a unified application for real-time monitoring and notification. Once a message is received, SiPass Integrated can display it within its own graphical user interface. This means that the operator does not need to change programs in order to view messages.

SiPass Integrated applications

The flexibility, robustness, and extreme scalability of SiPass Integrated make it the ideal system for virtually any environment. Large office buildings, government agencies, commercial premises, pharmaceutical corporations, and financial institutions are all good examples. The advanced functionality of SiPass Integrated can help individual organizations find the right solution for their particular security requirements.

Universities and other campuses

SiPass Integrated is ideally suited to campus applications as it can manage multiple buildings with differing security levels, as well as storing and processing large amounts of cardholder data. During particularly busy times like enrolment periods, the system has no difficulty assigning access rights, issuing card numbers, and printing large numbers of cards while simultaneously communicating with the university's student database systems.

Airports

SiPass Integrated is an access control system designed for high-intensity use, making it the perfect choice for airports. It provides a complete access control and security solution with integration to video surveillance systems and typical airport security systems. The simple-to-use interface ensures that authorized airport security staff can monitor their security systems effectively at all times.

Multi-segment complexes

SiPass Integrated includes tenancy functionality that enables a number of companies to have full use of the same access control system completely independently of one another. This is particularly useful where residential units, commercial offices and retail outlets, for instance, are all located under the same roof. Each system level can handle different occupant groups. Existing installations can be integrated without difficulty, and the use of different card technologies is not a problem.

Hospitals

Striking the right balance between facility security and accessibility is of critical importance in hospital environments. The high volume of visitor traffic typically associated with a hospital and the combination of low-security and high-security areas make a flexible and user-friendly system like SiPass Integrated the obvious access control choice.

Industrial facilities

Safety is of paramount importance within a manufacturing or industrial facility. SiPass Integrated not only helps keep buildings secure, it also keeps their occupants safe by controlling access, providing anti-passback features, and implementing a roll-call function so that mustering reports can be generated quickly and the location of cardholders identified in an emergency.

Technical overview

SiPass Integrated MP2.6	
System	
Number of doors	Up to 96 per controller (depending on system configuration)
Number of registered cardholders (users)	Up to 500,000 per controller (system-dependent)
Number of controllers	Up to 500 per system
Hardware installation	Plug & play (ACC requires initial configuration)
Client/server architecture	Yes
Networking options for controllers and servers	LAN/WAN/PSTN (redundancy possible)
Standard languages	German, French, Italian, English, Spanish, Russian, Chinese, Norwegian, Danish (other languages on request)
Interfaces	
Integrated interface for Siemens video surveillance systems	SiNVR
Integration of non-Siemens video surveillance systems	Optional
Integration of non-Siemens video recording systems	Optional
HR API	Optional
WebService	Optional
Operation	
Intuitive graphical user interface	Yes
Report generator	Manual or automatic with completely configurable reports
Alarm management	1,000 alarm priority levels and multimedia alarm notification
Extended access control functions	Administration of access rights (for individuals or groups), temporary access profiles, global anti-passback (interzone movement control), four-eyes access control, escort control
Event log	Real-time updating
Graphical status window	Yes
Operator log	Yes
Database	
Extensive personal data administration	Yes
Additional database fields	User-definable
Backup/restoration of system data	Manual or automatic
System requirements	
Operating system	Windows 7, Windows 8.1, Windows 10, Windows Server 2012 R2, Windows Server 2016
Database management systems	MS SQL Server 2012 Standard Edition, MS SQL Server 2012 Express Edition, MS SQL Server 2014 Standard Edition, MS SQL Server 2014 Express Edition, MS SQL Server 2016 Standard Edition, MS SQL Server 2016 Express Edition

Added security and convenience – the new SIPORT system

Highlights

- Verified online access control system thanks to RTC (real-time communication)
- Interfaces to IT, video surveillance, intrusion detection* and alarm systems
- Can be adapted to individual needs, organizational structures and workflows
- Flexible time recording system with interfaces to payroll programs

Those responsible for providing security in today's business environment have to take a strategic, proactive approach if they are to stay ahead of the ever changing risk landscape. Security experts require robust, future-proof solutions that are able to be flexibly deployed as security requirements evolve. Siemens addresses these challenges with the new SIPORT system.

SIPORT is a comprehensive, modular system for reliable access control and time management. This solution allows authorized users – employees and visitors, for example – to move around a building or building complex unimpeded while reliably keeping unauthorized persons out. And it does this in real time. We have also added a new intuitive user interface to SIPORT, which you can configure entirely to suit your needs. This means you can use all SIPORT functions with greater ease and maintain an overview at all times.

Security and flexibility with real-time communication

At a technical level, real-time communication means a door control unit can record 100 events per second while a real-time server can process up to 100,000 events per second. An access control system with a real-time dimension also allows people to be located or tracked on the premises or throughout a building. Such tracking data can either be retrieved permanently or on an event-controlled basis in real time. From a security perspective, real-time communication primarily means reliable up-to-date data with the option of rapid intervention when needed.

Networkable across the globe

SIPORT can provide access control solutions in your organization – either locally for a single location or, leveraging the existing network infrastructure, for numerous networked locations in different time zones around the world.

Open and extendable

SIPORT efficiently supports the workflows in your organization. With its open system architecture, this access control solution can be integrated easily into existing IT environments and can be extended as requirements evolve.

Extensive integration

Advanced management systems mean that important alarm messages from SIPORT can be consolidated on a unified user interface. The result is improved operability and greater transparency for users.

Reliable and secure

All access-related data is saved redundantly and at different locations – on the door control unit or on the server. In case of a network failure, the door control units and readers ensure smooth access control. SIPORT supports the use of a single company card valid worldwide, which also can be used for PC login. All communication channels from the reader to the server are encrypted.

Modular and scalable

With its modular structure, SIPORT can be extended in size and functionality as your requirements grow. The number of ID cards (up to one million) and door control units or ID readers (up to 8,192 per server) can be extended as needed without extra effort.

* VdS certification required in Germany

Key features: secure, convenient and efficient

New user-friendly interface. The home page shows everything at a glance.

All SIPORT 3.0 software modules have a uniform, intuitive and easy- to-operate user interface

Unique, new level of user convenience

The new uncluttered home page allows fast, uncomplicated access to all the system functions. A real plus is that the new SIPORT is browser-independent. This means it doesn't matter whether you are using a desktop or the touch function on your tablet. SIPORT offers unprecedented flexibility and convenience. Moreover, multiple users can log on to the same workstation using their preferred language to work effectively. Multilingual login is available for English, German and French, while other languages can be added on request. Message texts can also be generated in a bilingual format, for example in English and Arabic. This feature is particularly attractive to global organizations with a multinational workforce.

Secure user management

Access to system functions and databases is password-protected. The user management feature of SIPORT access control/time recording allows individual authorizations to be assigned for operating and accessing functions and information. With several user login options, SIPORT offers truly flexible and secure access. Login options include SIPORT's own login, Windows login in accordance with Windows policies, PKI login or login with LDAP support*.

Efficient master data management

Access rights can be changed in a matter of seconds, with the intuitive user interface helping to support security. Staff data, ID card numbers, access profiles and validity dates can be assigned with ease. Changes take effect immediately across the whole system. Multiple master records can be selected and then changed with a single command.

Identity management

As the basis for an identity management system, an active directory enables management of user and member profiles, digital certificates for public key infrastructures, authorization information, access privileges and other attributes relevant to users and members in order to provide protected access to data, network resources or distributed services.

Highlights

- Secure, efficient management – changes are effective immediately
- Easy to assign profiles and define exceptions
- Flexible thanks to multi- tenant functionality and expansion options
- Customizable thanks to freely programmable routines
- User convenience enhanced by multilingual support
- Freely configurable search options
- Regional and local holidays can be defined, in addition to standard holidays

Multi-tenant functionality: different companies in the same building can use the same SIPORT system.

Simple, transparent management of access rights

Management of access profiles can become unwieldy as the number of profiles increases. This is where SIPORT profile management comes in. It helps users create and assign access authorizations quickly and easily. All existing profiles can be searched, listed and changed according to various criteria. These filters provide transparency on where and when individuals have access rights and which card readers are assigned to which zones. The integrated electronic door fittings and cylinders from a wide range of different manufacturers can be managed like card readers.

Traceability of events and alarms

SIPORT captures the precise time of all events and alarms (e.g. authorized and denied accesses, attendance times, sabotage alarms, etc.) in a variety of logs. This data can be easily displayed, sorted, selected, printed in list form or exported for further processing.

Multi-tenant functionality

A variety of different organizations are often housed in the same large building. Their individual areas need to be managed separately while common areas must be accessible to all. Each tenant (e.g. company or department) manages their own data so they only receive the messages (e.g. alarms) intended for them. Other tenants cannot view this data. SIPORT supports multiple tenants and thus offers virtually unlimited configuration options. The same applies for rapidly expanding organizations. A system designed for a single floor can be expanded to cover an entire building or indeed multiple locations around the world.

* Import from directories that can be accessed via an LDAP connection

Software extensions: versatile and customeroriented

The core SIPORT software can be extended with a wide range of additional modules.

ID card personalization (SIPORT SCEM)

SIPORT features can be extended by using SIPORT's MIFARE® smart card encoding module for personalizing card chips.

- MIFARE chips* in ID cards can be personalized via the MIFARE read/write module integrated in card printers or via an external MIFARE read/write module
- MIFARE key management for multiple keys and definable key sets
- MIFARE storage management
- Assignment of a random ID changes the unique ID number (UID) permanently
- Key diversification: permanent modification of the encryption key derived from the master key

ID card creation (SIPORT VAS)

SIPORT has an integrated ID card creation system which supports the production, design, management and personalization of ISO ID cards. Special card printers personalize ID cards in a single step.

Presence screen (SIPORT Display)

The presence screen provides an overview of who is present or absent as well as the current location of individuals. This makes SIPORT Display an ideal tool for reception desks, switchboards or the security department.

Site visualization (SIPORT Graphic)

SIPORT Graphic allows graphical representation of alarm situations, door and contact states or malfunctions in real time. If an event occurs, the site plan opens automatically, and the current situation is highlighted by a change of colour.

Certain functions such as opening, locking or blocking of doors can be manually triggered from the graphic. In addition, it is possible to control video surveillance cameras and to display the video images they capture.

Visitor pre-registration via the Internet (SIPORT Web Visit)

SIPORT Web Visit is a web-based program that allows pre-registration of visitors from any PC connected to the Internet or intranet.

Visitor management (SIPORT Visit)

SIPORT Visit is used to capture visitor data and issue visitor IDs. This software extension supports additional features such as visitor badge printing or picture taking.

Cardholder data management over the Internet (SIPORT Web Cardholder)

SIPORT Web Cardholder is a web-based program for administration of cardholder data.

Door management (SIPORT WebDoor)
SIPORT WebDoor enables web-based control and monitoring of doors and displays status information, various control functions and time schedules.

Host connection
The SIPORT host interface connects the SIPORT system to a higher-level system such as SAP and enables the import of master data from a database via an ODBC interface. This is used to exchange personnel and attendance data with other systems.

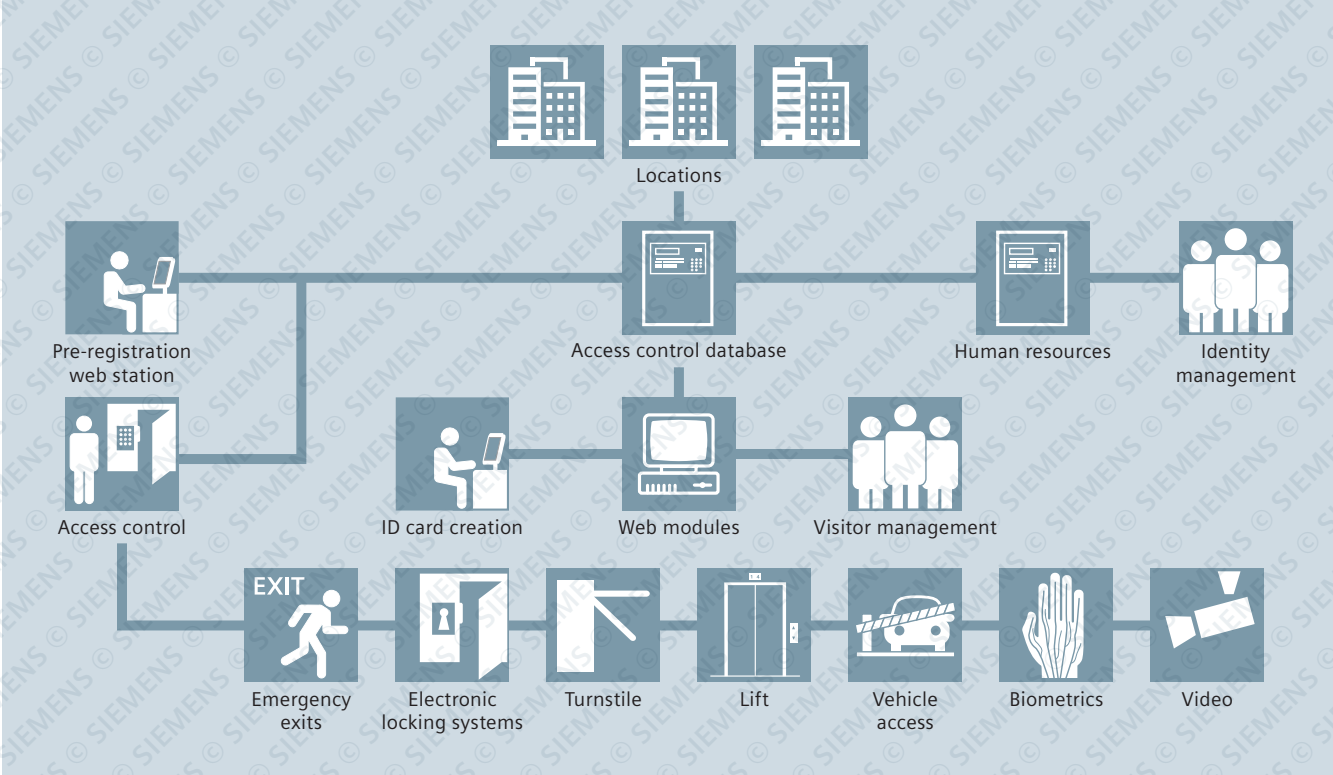
Suitability for pharmaceutical applications
SIPORT meets the requirements of 21 CFR Part 11 and various other international Good Manufacturing Practice guidelines. This allows end-to-end traceability of changes as well as the definition and review of procedures on access to relevant building locations.

Interlocking
The interlocking function can lock certain rooms for a specific time period. Access rights for the various zones, locking time and locking reason are all stored in the employee's access profile. In the pharmaceutical industry, this is used for instance to prevent cross-contamination.

Web Audit Trail
This alarm and logbook management application enables the user to access SIPORT master data via the web from an operator workstation.

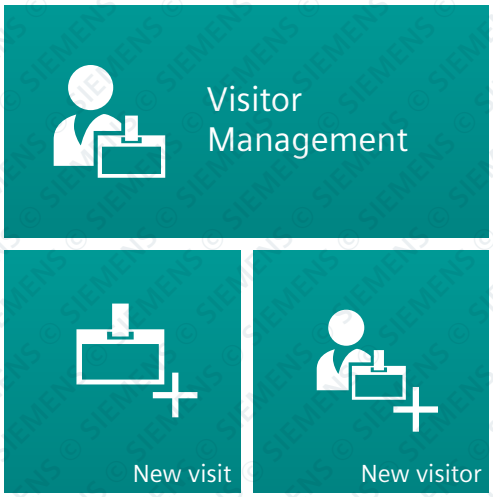
Image comparison
SIPORT allows a saved image to be compared with a live image. Multiple security interlocks can also be operated simultaneously from the same workstation.

* MIFARE Classic, MIFARE DESFireEv1



SIPORT allows assignment of different authorizations, such as access to defined areas, car park access, workstation assignment, etc. The authorizations can also be defined for a limited period.

SIPORT – capable of even more



Room reservation: direct, fast and convenient

To further enhance the efficiency of workflows and infrastructures, SIPORT integrates seamlessly with other platforms and sources of information.

Integration with other systems

SIPORT can be integrated into both hazard and building management systems. The exchange of status information and messages and triggering of actions is supported in both directions.

Integrating SIPORT into Desigo Insight enables interaction between the access control system and the building management system. An energy saving effect can also be achieved by turning lighting, heating and air conditioning down or off in unoccupied areas.

DVR video management

SIPORT and video management go hand in hand. Functions such as alarm output and recording, assignment of images/videos to an alarm or playback of recordings can be taken directly from the SIPORT system. The SIPORT Graphic module makes light work of assigning cameras and monitors and controlling camera functions.

IP cameras

SIPORT supports full integration of IP cameras to record image sequences when alarms or notifications occur. Recordings can be retrieved at any time via the relevant logfile entry. All very simple and user-friendly.

Room reservation

Complex reservations can be managed simply in the system. Users are able to log in via the self-service lobby to reserve individual rooms, make serial bookings, select seating arrangements, order catering, open or close movable partitions and even grant the relevant access authorizations. Real-time management allows for ad-hoc reservations. Users are able to access available rooms directly, quickly and conveniently. This helps achieve cost savings in the organization. Occupancy and utilization of available space is optimized.

Automatic number plate recognition

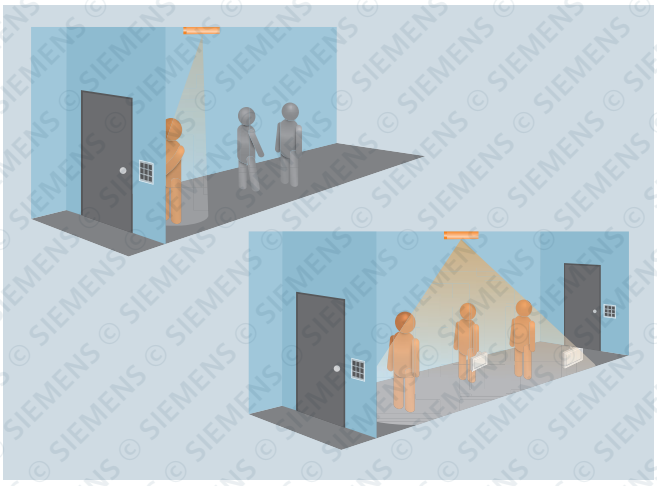
A vehicle number plate can serve as an access ID. Both domestic and international number plates are recognized. Events can be logged in SIPORT as they happen and are readily accessible for verification at any time. This function is useful for vehicle access to parking facilities or for registering visitor vehicles.

3D sensors for recording individuals

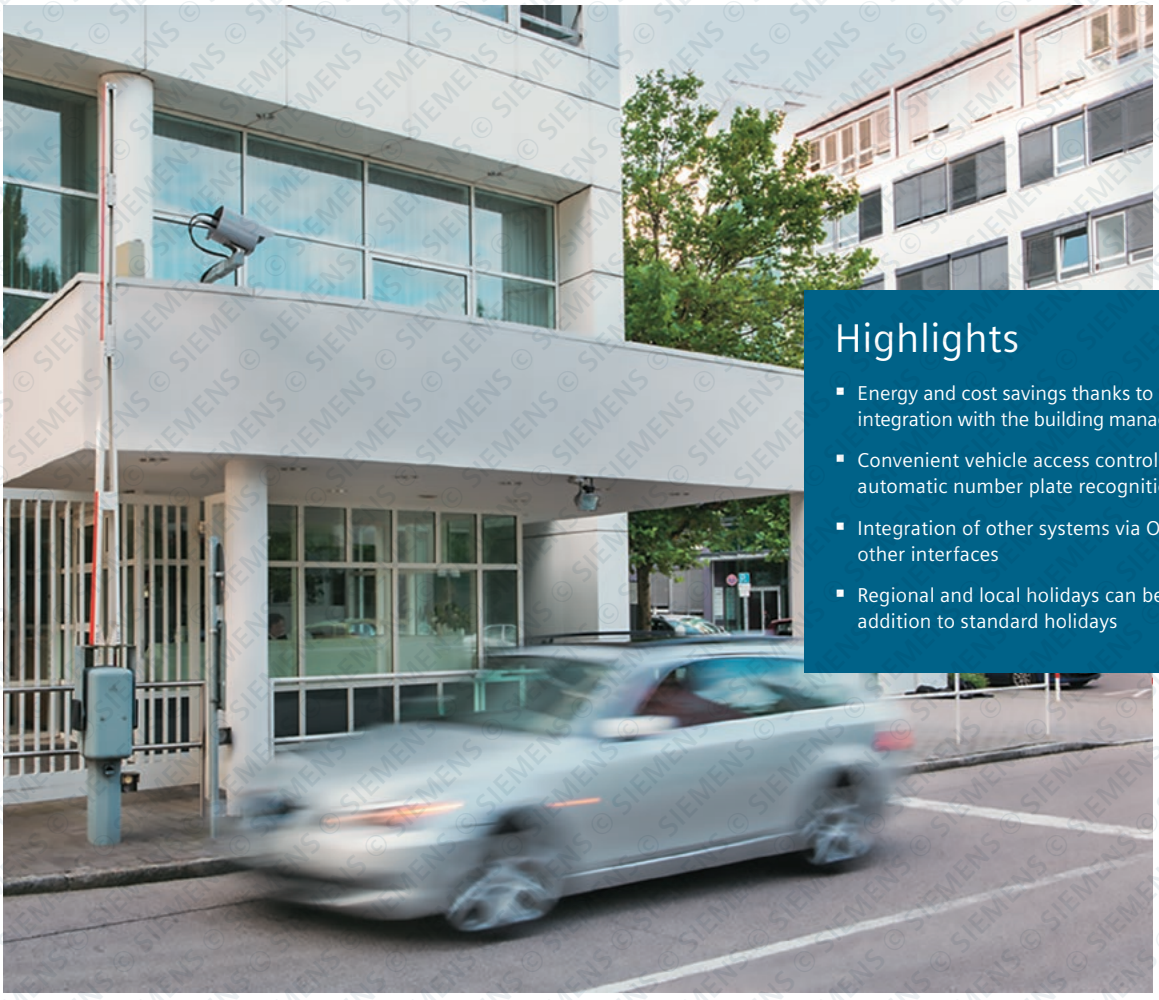
The deployment of conventional video solutions is not always adequate to protect people and infrastructure. 3D sensor solutions that count or isolate individuals but do this anonymously without any data protection issues are therefore a key component in a professional security management system now and into the future.

ODBC interface

A master data interface to all major databases supporting ODBC can be readily parameterized, for both manual and scheduled execution. Standard assignment of any data fields is possible.



The 3D sensor solution detects individuals and prevents access by unauthorized persons.



SIPORT with number plate recognition

Highlights

- Energy and cost savings thanks to SIPORT integration with the building management system
- Convenient vehicle access control thanks to automatic number plate recognition
- Integration of other systems via ODBC and other interfaces
- Regional and local holidays can be defined, in addition to standard holidays

Readers hold the key

Electronic door fitting and cylinder integrated into SIPORT

SIPORT readers offer versatility, performance and impressive design. The new SIPORT family of readers comprises a range of different types allowing flexible implementation in organizations large and small.

Contactless readers

Contactless readers are operated using proximity ID cards, key tags or other transponders. Encrypted access data is transferred by RFID technology between the ID card and the reader.

Reader with keypad

Here, users are required to enter a personal code in addition to presenting their proximity card for enhanced security.

Access readers for switch product ranges and intercom systems

Card readers can also be integrated into intercom systems or switch product ranges (such as DELTA from Siemens), allowing both regular employees and occasional visitors to use a single interface.

Recognition of biometric characteristics where higher security is required

SIPORT supports the use of biometric characteristics for access control. Options include fingerprint capture and facial or hand vein recognition.

Electronic door fittings and cylinders

SIPORT offers seamless configuration and operation with shared authorization management for both online readers and offline electronic door fittings and cylinders. Uploading of historical information for offline door handles and cylinders to the SIPORT logbooks provides end-to-end traceability of all activities and changes. The door position can also be transmitted via a wireless hub.

Biometric authentication, e.g. with 3D and 2D fingerprint readers

Legitimation: simple, yet secure

End-to-end encryption ensures high standard of security

Highlights

- Greater security with writable ID cards, PIN entry and photographs printed on cards
- Multifunction smart cards can be used for physical access, computer access, payment in company cafeteria, etc.
- Writable memory chips let people carry their information and authorizations with them on their card

Convenient

RFID cards enable contactless operation of readers. Combi ID cards offer even greater convenience, combining two integrated technologies (e.g. UHF and 13.56 MHz) for different functions such as vehicle and pedestrian access control using a single ID card.

Greater security

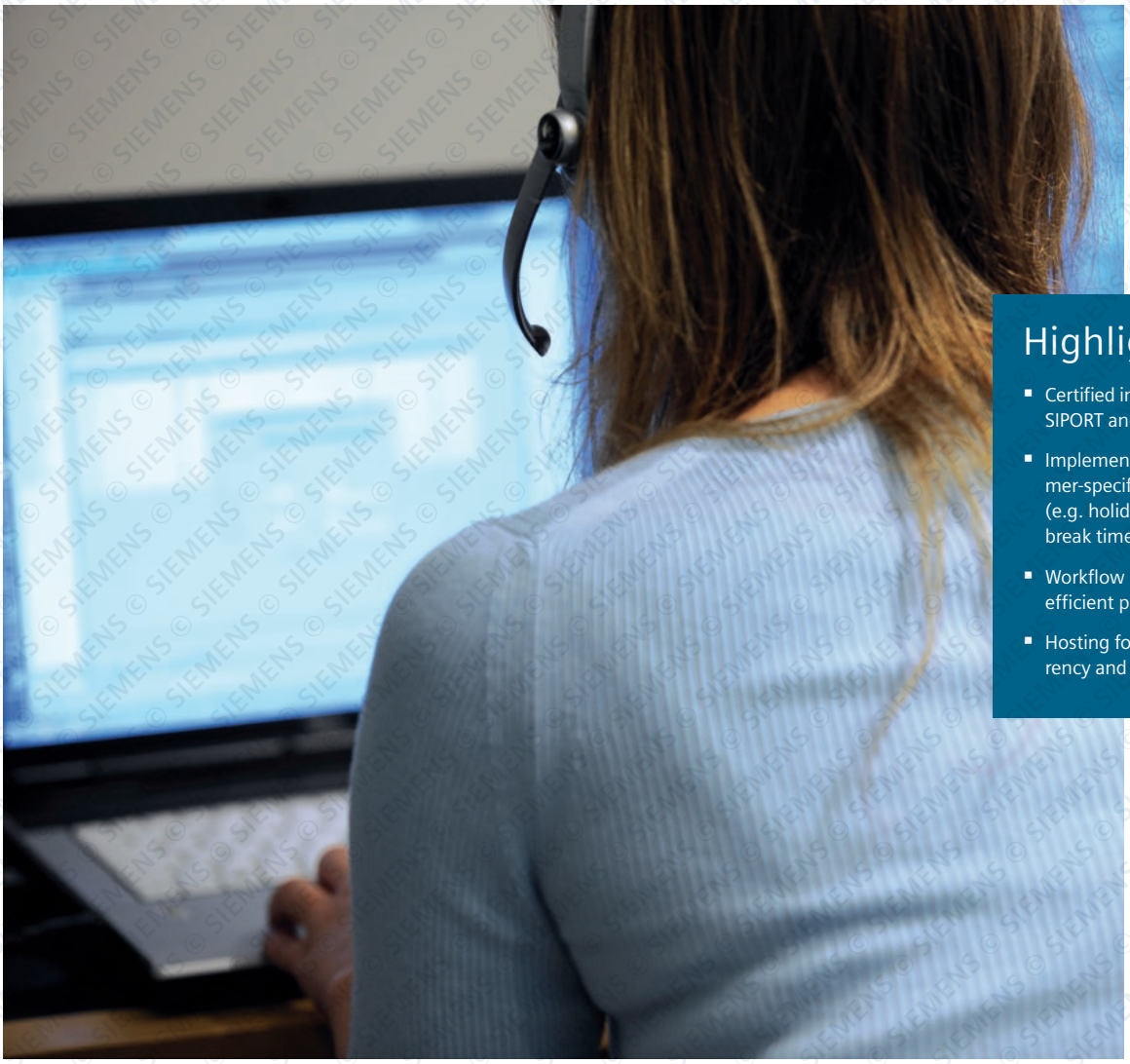
Writable ID cards offer the option of dividing the various applications among several segments or sectors. This means that responsibility and access protection for the individual applications remain separate. Chip cards can also be used for secure data storage. All data transfers from card to reader to server are encrypted. Verification with additional PIN entry or recognition of biometric characteristics (fingerprint, face, iris, veins) increases security even further.

Multifunctional

The multifunctionality of smart cards ranges from building access, computer access and logging into software applications through to cashless payment in company cafeterias, vending machine payment, time and attendance recording and more.

With fast and secure data storage, writable memory chip cards can be used as data media (access authorizations, biometric templates, etc.). This means that users are able to carry their information and authorizations with them on their card.

Time recording and management: efficient solutions for today



Highlights

- Certified interface between SIPORT and SAP R/3
- Implementation of customer-specific requirements (e.g. holiday policies, break times, etc.)
- Workflow module for efficient processes
- Hosting for cost transparency and cost savings

Convenient management of working time models: e.g. in production, IT or logistics

SIPORT time management controls and manages flexible working time models by automatic time recording, convenient time account administration and individual evaluation options for various types of flextime. All time data can be collected and used for payroll and time management purposes..

Time recording and management

The user-friendly system solution allows work hours to be recorded locally and evaluated centrally – including monthly hours, flextime, shift work, holidays and sick days. All the data from the schedules can used for selective processing, planning and analysis and exported to higher-level systems for payroll accounting.

Data capture itself is greatly simplified with special contactless readers and state-of-the-art card technologies or web terminals for mobile applications. SIPORT time management can handle up to 50,000 persons securely and conveniently.

Integration between SAP R/3 and SIPORT for bidirectional data exchange

The SIPORT host interface is an SAP-certified interface for data exchange between SAP R/3 and SIPORT time management. This enables personnel data to be maintained in the SAP system and transferred to SIPORT. Conversely, time data is transferred via the interface from SIPORT to SAP R/3 where it is then available for balance calculation and payroll accounting.

Easy implementation of specific customer requirements
Freely programmable tools (time routines) allow implementation and calculation of customer-specific requirements, such as special break times, holiday policies or exception days.

Workflow module for efficient processes
The workflow module is an efficient portal solution for employee self-service within the time management system. Requests for holiday, leave of absence or corrections are forwarded to the relevant employee, via the web, according to defined authorization profiles.

Worldwide access from any location via the web terminal
Employees can use the SIPORT web client to enter or make changes to their work hours or check their time account, in a standard web browser. They can do this anytime, anywhere, without the need for additional software.

Hosting
We now offer services to ensure the availability of your time management systems with cost transparency. To meet this commitment, all the IT resources necessary are managed by a professional team.

The software with your custom applications is deployed, maintained and updated in our data centre. Our state-of-the-art security and operating resources guarantee a high degree of reliability.

Only authenticated users will have access to this information. Our Siemens Security Network (SiSeNet) is a broadband security network which is available throughout Germany and meets the most stringent security requirements.

By gaining cost transparency and taking the strain off your IT resources, you will achieve a sustainable return on investment (ROI).

From Johannesburg to Paris or Singapore – SIPORT provides access the world over

SIPORT – the details are impressive

1 Building access control
2 ID card production
3 Visitor management
4 Vehicle access control
5 Lift management
6 Access authorization for individual areas
7 Electronic locking systems
8 Meeting room reservation
9 Access control server
10 Parking authorization
11 Electric car charging

More than just access control

SIPORT is much more than simply an access control system. Along with the relevant hardware extensions, SIPORT allows you to manage a range of tasks securely and efficiently.

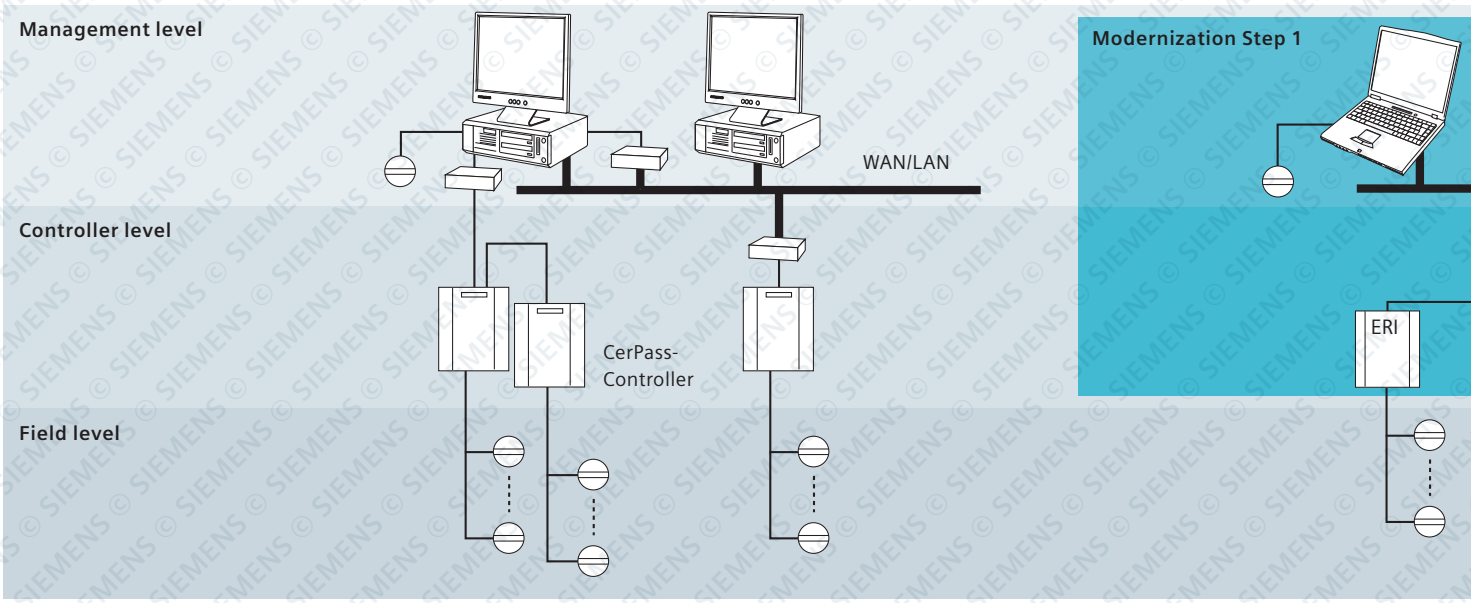
All-round versatility

SIPORT's wide-ranging features can be used in many areas of your business – from vehicle access to the company site, the underground car park, reception area or conference centre, possibly even the charging station for electric cars. This applies equally to a standalone building or a whole campus, as well as company locations anywhere in the world.

Know what's going on

Thanks to real-time communication, all information in the system is up-to-date and available, anywhere and anytime. SIPORT lets you keep track of it all.

Modernization of your access control system



To reliably ensure the security of building users, you have to tackle various challenges – most of which can be met with timely modernization. Security Migration solutions from Siemens support you in successfully addressing your challenges.

A step into the future

Migrating your installed access control system to the latest components introduces many benefits:

- Complete risk coverage
- High level of flexibility for changing needs
- Simplified infrastructure thanks to integration
- Less unplanned downtimes leading to reduced maintenance costs, also decreasing total cost of ownership

As a leading provider of security solutions, we offer our customers modernization concepts that are thoroughly thought through and tested. Use our experience from numerous modernization projects to ensure a smooth transition to a state-of-the-art access control system.

Modernisierung bringt viele Vorteile

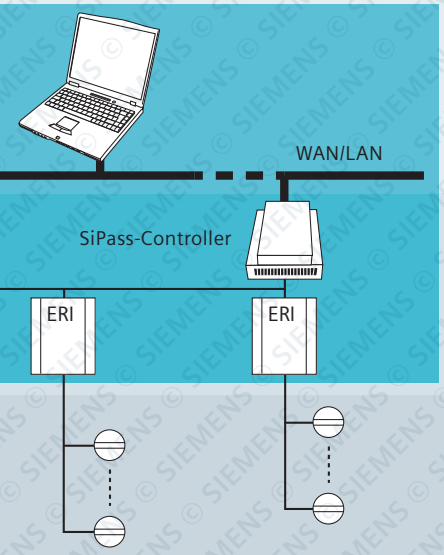
The new access control technology has numerous interfaces for integrated data management. It simplifies the exchange of data with personnel management module, is extremely convenient to operate and reduces process-related costs. These are all good reasons for an incremental transition to cuttingedge technology.

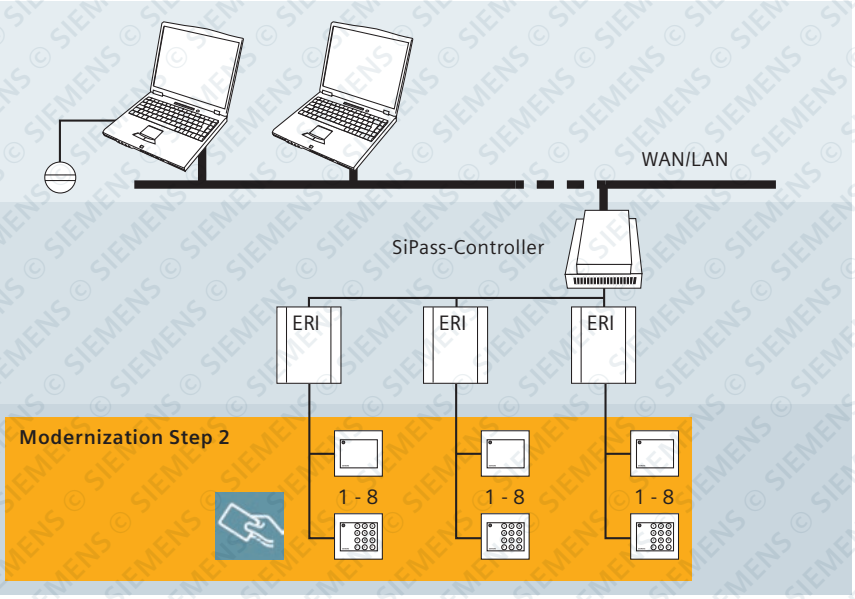
Flexible application

- Configurable for specific requirements, structures and workflows
- Integrated interfaces for time recording and personnel management

Easy to use

- Simple system administration via integration in existing IP networks
- Extremely easy to operate with the user-friendly Microsoft© Windows© interface





Highlights

- Assured investment protection
- Existing CerPass peripherals (wiring, readers) can be integrated into SiPass
- Existing customer-specific data can be migrated
- Extended functionality, including control of video surveillance systems, for improved alarm verification

Siveillance Identity Self-Service Portal

Cost reduction and improved performance

In an increasingly connected, globalized world, employees at different sites collaborate closely, not just on a local level but on an international level too. More than ever, reliable access management is key to ensuring a safe work environment and business continuity.

Thanks to its automated approval workflows, Siveillance Identity Self-Service Portal offers an efficient, easy approach to access request management across multiple sites. Employees and area managers now have a streamlined, fast process for managing access privilege requests - saving time and money.

Designed with the needs of small to enterprise-scale companies in mind and in compliance with company policies and regulations, the portal is the ideal choice for manufacturing industries, offices, higher education, financial and insurance companies looking for the optimal solution to simplify their access management process.

Improved transparency and ease of use

In today's corporate world, legal and regulatory compliance depends on involving the right decision-makers in the approval process for physical access to sites or areas. To facilitate this aspect of day-to-day business operations, Siveillance Identity Self-Service Portal offers workflows than can be easily configured, implemented and audited.

Thanks to Siveillance Identity Self-Service Portal all stages of the request and approval process are clearly traceable, thus increasing both transparency and security within the organization and making it easier to meet both internal and external compliance requirements in an audit-proof manner.

Its intuitive user interface allows employees to request new access rights and be kept updated on the status of their request. They are also able to add information in support of their request and this speeds up evaluation and processing of their application.

This significantly reduces the need for manual processing and the amount of time that normally has to be spent on e-mails and telephone calls to clarify the situation and identify the right person for a decision, lightening the workload of security staff and operators alike.

Flexibility and business continuity

In an ever-changing corporate landscape, the ability to adapt security processes quickly and with maximum flexibility, has become a defining attribute of successful organizations. Siveillance Identity Self-Service Portal offers an easily configurable web-based app enabling system administrators to define all relevant access privileges and identify the decision-makers who must be part of the process to grant those privileges. As the authority to grant or deny access requests rests solely with the relevant area manager, security standards can be enforced company-wide without exceptions.

High level of intuitivity and compatibility

Developed using state-of-the-art technology, Siveillance Identity Self-Service Portal can be easily integrated into the customer's IT landscape. Thanks to its user-centric design with self-explanatory menu structures, context-sensitive online help and tool tips, the intuitive user interface is fully aligned with Siemens' new UI concept. It allows fast user familiarization and can be operated via mouse, keypad or touch screen for use on mobile phone, tablet or desktop. Accessibility from any device also means low training and IT costs and achieves maximum operational efficiency.

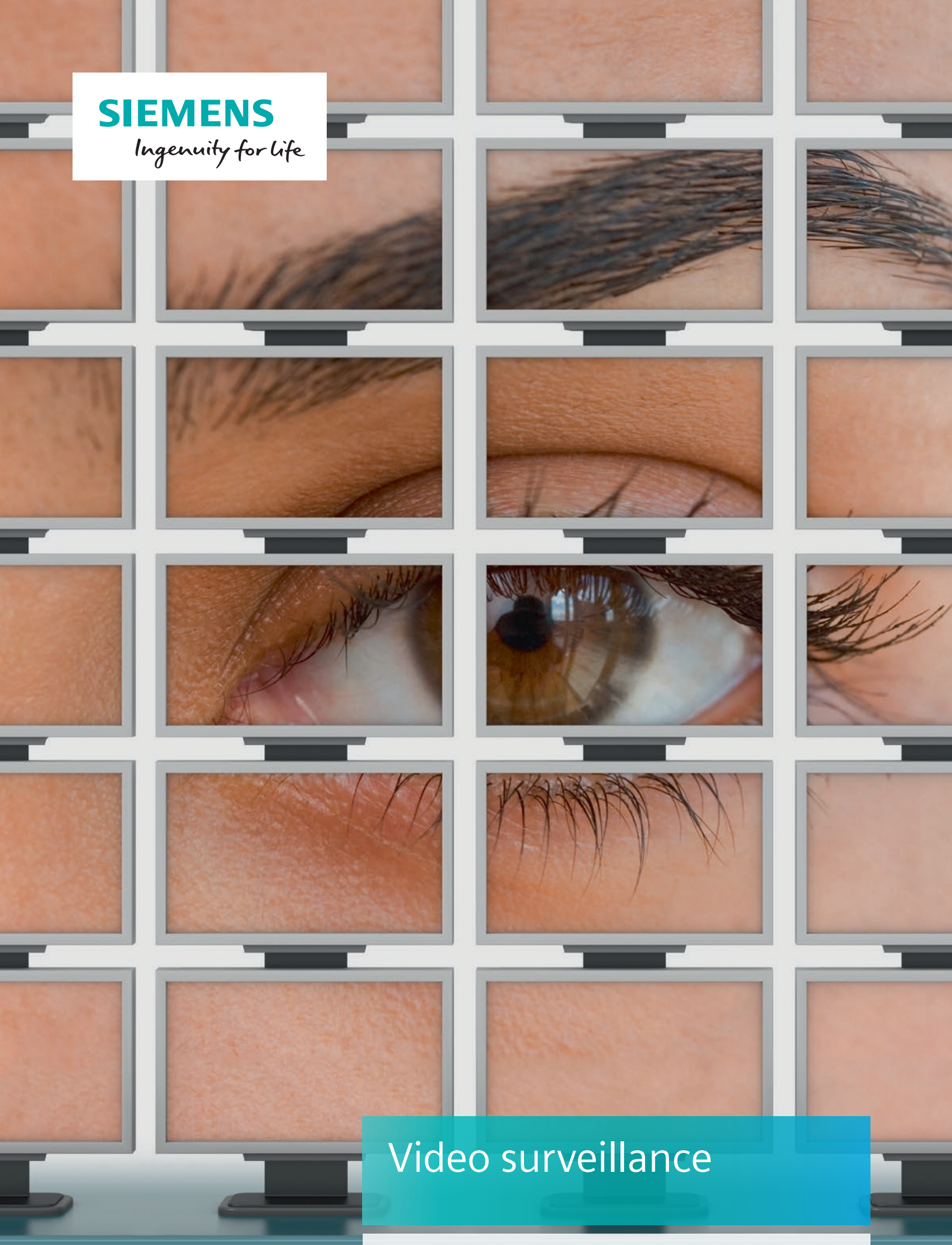
Siveillance Identity™ Self-Service Portal is an intuitive, web-based portal that offers in-house access request management across multiple sites. Designed to streamline and simplify access request management processes, the portal's automated approval workflows allow employees and decision makers to handle access privileges much more efficiently. Whether for a small company or a global enterprise – count on Siveillance Identity Self-Service Portal to boost operational productivity, transparency and security.

Highlights

- Simplified, streamlined access management
- Reduction in time-consuming, manual operations
- Intuitive, easy-to-use user interface
- Improved transparency and traceability of process steps
- Corporate security guidelines are enforced
- Easy to configure, enforce and audit workflows
- Flexible, customizable solution

«Cybersecurity by Design»

«Cybersecurity by Design» has been built into the entire development process for Siveillance Identity Self-Service Portal, with extensive testing and hardening measures. It offers Lightweight Directory Access Protocol (LDAP) for user authentication as well as certificate-based, encrypted communication (HTTPS). Beyond that, Siemens ProductCERT provides an extra layer of cybersecurity and the peace of mind that comes from continuous monitoring of cyber threat activity globally for the benefit of all the company's solutions.



SIEMENS

Ingenuity for life

Video surveillance

buildingtechnologies.siemens.com

13.1. Introduction	486
13.1.1. Aims of video surveillance	486
13.2. Technical principles	486
13.2.1. Lighting	486
13.2.2. Lenses	486
13.3. Camera Technology	488
13.3.1. Principles	488
13.3.2. Image sensors	488
13.3.3. Resolution	488
13.3.4. Thermal imaging sensors	489
13.3.5. HD-SDI cameras	489
13.3.6. IP Cameras	489
13.4. Camera types	490
13.4.1. Box cameras for indoor use	490
13.4.2. Box cameras for outdoor use	490
13.4.3. Mini-domes	490
13.4.4. PTZ IP cameras	491
13.5. Signal transmission	491
13.5.1. Analogue signal transmission over coaxial cable	491
13.5.2. Two-wire transmission of analogue signals	492
13.5.3. Wireless transmission of analogue signals	492
13.5.4. Optical fibre transmission	493
13.5.5. Network transmission	493
13.6. Video management systems	494
13.6.1. Requirements of a video management system	494
13.6.2. Functions	494
13.6.3. Forensic search	495
13.7. Intelligent image analysis	496
13.7.1. Potential uses	496
13.7.1.1. Object classification	496
13.7.1.2. Perimeter protection	496
13.7.1.3. Character recognition	496
13.7.1.4. Face recognition	497
13.7.1.5. People counting	497
13.7.1.6. Abandoned and removed objects	497
13.7.1.7. Tunnels and traffic	497
13.8. Data protection and data security	498
13.8.1. Data protection topics	498
13.8.2. Permanent data security	498

Use Case	500
Video security	502
Image capture	504
Video analytics	506
Data protection and data security	508
Siemens Control Center Server – SiCCS	510
Forensic search in the video archive	512
Sicore – optical character recognition	514
Mobile video system	516
Video security	518
Modernization	532

13.1. Introduction

Video surveillance technology is growing in importance as part of a comprehensive, homogeneous security concept. As well as simply observing and documenting security-relevant occurrences, modern systems are capable of detecting and analyzing specific events in a targeted way. All images can be output to one or more surveillance stations. Video technology can interact with hazard reporting and security technologies to assess situations in detail without direct physical attendance being required.

There have been major advances in video technology in recent years. Whether a system is based on analogue technology or IP technology, the process of selecting cameras, lenses, protective housings and consoles is similar. The differences between analogue and IP technology only need to be taken into account when it comes to signal transmission.

A camera works in a similar way to the human eye. It perceives an object or a person through a lens and stores the recording on a chip. Modern security-relevant installations are becoming larger and more complex, and they have differing security needs. A video surveillance system keeps the security service in the picture 24 hours a day, seven days a week. Solutions available today include a range of camera types, image analysis systems, and video management stations that evaluate the recorded images and automatically notify the relevant personnel if an event occurs.

13.1.1. Aims of video surveillance

The aims of video surveillance include these points:

- Monitoring of rooms, buildings and grounds
- Recording of events of all kinds
- Heat/fire detection
- Face recognition
- Recognition of changes of state
- Crowd detection
- Theft detection
- Character recognition (e.g. number plates)

13.2. Technical principles

13.2.1. Lighting

To make objects visible using a video camera, a light source is required. This could be an artificial light source or just the sun. Apart from normal visible light, there is also infrared light, which is imperceptible to the human eye. Normal visible light or infrared light can be used depending on the location and the requirements. The difference is in the application.

Infrared lighting is used where surveillance is to be as inconspicuous and discreet as possible or where normal light cannot be used. Infrared lighting can also be used in very difficult light conditions, for example in outdoor surveillance or in bars, etc. Unlike normal lighting, IR surveillance requires infrared-compatible cameras with a lens approved for IR use. These cameras provide a normal colour image during the day, switching to IR-sensitive black and white mode in poor light conditions.

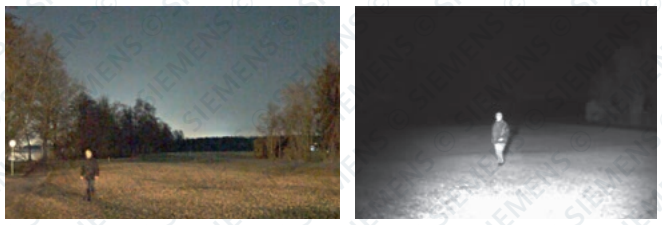


Fig. 7.1: Images left and right without and with infrared lighting

13.2.2. Lenses

The lens of a camera performs many functions. These include:

- Defining an angle of view, i.e. what part of a scene will be captured at what level of detail
- Controlling the amount of light passing through the lens and hitting the image sensor to achieve the correct exposure
- Focusing by moving the individual lenses in the group or changing the distance between the lens and the image sensor

The required angle of view is an important consideration when choosing a camera. The angle of view determines the area covered by the camera and the required level of detail, and depends on the focal length of the lens and the size of the image sensor. The focal length of an optical system is the distance between the optical lens (the optical mid-point of the group) and the point at which all beams of light converge (the focal point). The longer the focal length, the narrower the angle of view.

The angle of view is one of the following:

- **Normal view:** Equivalent to the angle of view of the human eye.
- **Telephoto:** A smaller angle of view with more detail, showing elements that are imperceptible to the human eye. A telephoto lens is used if the object being monitored is small or far away from the camera. The light intensity of telephoto lenses is generally lower than normal lenses. Although they make objects easier to recognize, it is easy to lose sight of the overall picture.
- **Wide angle:** A large angle of view with less detail than normal view. These lenses provide a good overall picture but make it virtually impossible to identify individuals. Wide angle lenses have a large depth of field and work adequately in poor light. Wide angle lenses can also sometimes create geometrical distortions, such as the fish eye effect.

Fig. 7.2: Different fields of view: wide angle (left), normal (middle), telephoto (right)

There are three types of lens:

- **Fixed focal length lens:** This lens type has a fixed focal length and just one angle of view (normal, telephoto or wide angle). A common fixed focal length for camera lenses is 4 mm.
- **Varifocal lens:** This lens type provides different angles of view in the focal length range, and these can be manually adjusted. Whenever the angle of view is changed, however, the lens must be focused manually. Varifocal lenses frequently have focal lengths of 3 mm to 8 mm.
- **Zoom lens:** Zoom lenses are similar to varifocal lenses in that different angles of view can be set. When the angle of view is changed, it is not also necessary to change the focus. The normal focal length range is between 6 and 48 mm. The lens can be adjusted either manually or by remote control using motors. The stated zoom factor (e.g. 3x) is the ratio between the shortest and longest focal length of the lens.

New standard DIN EN 62676-4

The DIN EN 50132-7 standard introduced in April 2013 was a transitional arrangement, and was replaced in 2015 by the new EN 62676-4 standard. It defines application guidelines for video surveillance systems. The new edition of the standard reflects the technical innovations in the field of video surveillance. It takes account of the game-changing switch from analogue to digital video technology, the general improvement in image quality and the new CCTV standards. DIN EN 62676-4 sets out different levels applicable to the definition and classification of objects:

- **Surveillance:** for surveillance or crowd control, the target must not occupy less than 5% of the image height (or more than 80 mm/pixel)
- **Detection:** for detection, the target must not occupy less than 10% of the image height (or more than 40 mm/pixel)
- **Observation:** for observation, the target must occupy 25% of the image height (or more than 16 mm/pixel)
- **Recognition:** for recognition, the target must not occupy less than 50% of the image height (or more than 8 mm/pixel)
- **Identification:** for identification, the target must not occupy less than 100% of the image height (or more than 4 mm/pixel)
- **Verification:** for verification, the target must not occupy less than 400% of the image height (or more than 1 mm/pixel)

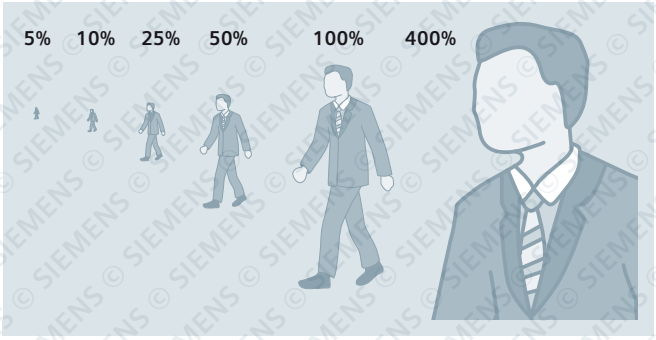


Fig. 7.3: Different levels in the definition and classification of objects

DIN EN 62676-4						
	Surveillance	Detection	Observation	Recognition	Identification	Verification
Width of scene (mm/PX)	80	40	16	8	4	1
Pixels/meter	12,5	25	62,5	125	250	1000
Pixels/16 cm (face)	2	4	10	20	40	160

Tab. 7.1: Overview of sizes for the different classifications

13.3. Camera Technology

Cameras differ from each other primarily in their capacity to supply colour or black and white images, their resolution, and their construction. The particular camera to use for a project depends on what the camera is intended to do.

13.3.1. Principles

The CCD sensor (Charge-Coupled Device) converts the light passing through the lens into electrical charges. These charges then undergo signal processing and amplification and are sent to the video signal output (BNC connector) as a video signal. The standard amplitude of the video signal (VBS for black and white, CVBS for colour)) is 1 Vpp (+/15%) at 75 ohms. The clock pulses for signal generation in the CCD chip are created in the timing generator and passed to the CCD chip via a driver stage. The diagram below illustrates the sequence.

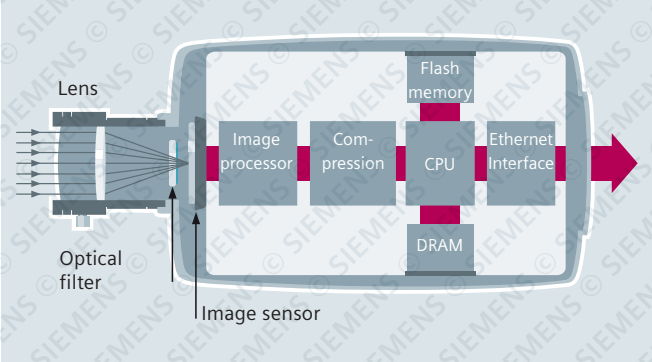


Fig. 7.4: Fundamental principle of a CCD camera

13.3.2. Image sensors

The light passing through a lens is focused on the image sensor. The image sensor contains a large number of photosites, with each photosite corresponding to a pixel on the image sensor. Each pixel detects the amount of light hitting it and converts this into a corresponding number of electrons. The brighter the light, the more electrons are generated. Two image sensor technologies are available to cameras:

- CCD (Charge-Coupled Device)
- CMOS (Complementary Metal-Oxide Semiconductor)

CCD and CMOS sensor technologies are frequently in competition with each other, and each have their particular strengths and weaknesses making them suitable for different applications. CCD sensors have been used in cameras for more than 30 years and offer numerous benefits. They still have better light sensitivity and generate slightly less noise than CMOS sensors. However, CCD sensors are more expensive and they are more costly to install in cameras. In addition, a CCD sensor uses a hundred times more power than an equivalent CMOS sensor.

Constant development is closing the gap between CMOS and CCD sensors in terms of image quality. CMOS sensors also reduce the overall cost of cameras because they already contain all the logic needed to supply digitized video information.

Compared with CCDs, CMOS sensors offer more integration options and more functions.

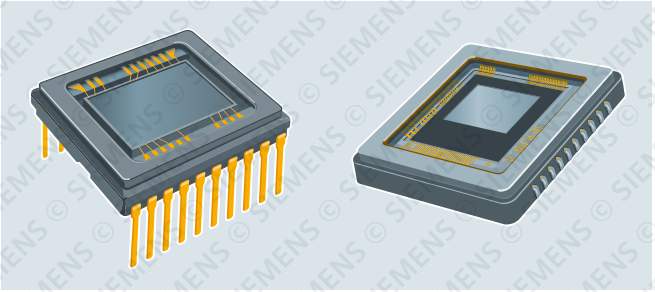


Fig. 7.5: CCD (left) and CMOS (right) image sensors

13.3.3. Resolution

The principles behind resolution are the same for digital and analogue equipment. However there are certain differences regarding definition. Analogue video images consist of lines or TV lines because this technology originated from television technology. Digital images consist of square pixels. There follows a brief description of the different resolutions NTSC, PAL, VGA, Megapixel and HDTV.

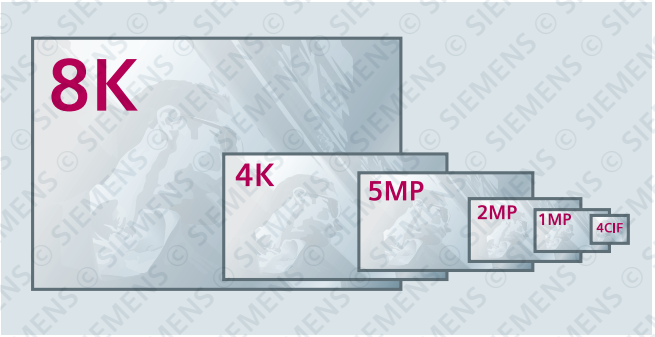


Fig. 7.6: Overview of different resolutions

Resolution	Video format	Pixels	Aspect ratio
8 K	UHD	7680 x 4320	16:9
4 K	UHD	3840 x 2160	16:9
5 MP		2992 x 1680	16:9
2 MP	HD	1920 x 1080	16:9
1 MP	HD	1280 x 720	16:9
4 CIF		640 x 480	4:3

Tab. 7.2: Overview of different resolutions and formats

NTSC and PAL resolution

NTSC (National Television System Committee) and PAL (Phase Alternating Line) resolutions are analogue video standards. In IP video systems, they are particularly relevant in the context of video encoders. Modern IP cameras and dome cameras support NTSC and PAL resolutions because these cameras currently use a camera block (with camera, zoom, autofocus and automatic aperture functions) developed for analogue video cameras in conjunction with a built-in video encoder board.

When analogue videos are digitized, the number of pixels is limited. The maximum number of pixels is based on the number of available TV lines. This means that the maximum size of a digitized image is usually D1, and the most common resolution is 4CIF (Common Intermediate Format).

VGA resolution
Fully digital systems based on IP cameras can use resolutions from computer technology, for which there are global standards. This allows for greater flexibility. VGA (Video Graphics Array) is a graphical display system for PCs. The resolution is 640 x 480 pixels, and the format is standard for IP cameras that do not support megapixel technology. VGA resolution is best suited to IP cameras because VGA-based video creates square pixels which correspond to the pixels on a computer display. Computer displays support resolutions in VGA or multiples of VGA.

Megapixel resolutions
An IP camera with a resolution in the megapixel range uses a megapixel sensor. This creates images containing a million of more pixels. The more pixels a sensor has, the better it is at capturing fine details and producing high-quality images. Megapixel IP cameras can be used to display more details (ideal for identifying individuals or objects) or to increase the area covered by the shot. These are important factors, meaning that the cameras in modern video surveillance systems virtually all have megapixel resolutions.

HDTV resolutions
High-Definition Television (HDTV) provides five times the resolution of standard analogue TV, better colour accuracy and a 16:9 format. The two most important HDTV standards defined by SMPTE (Society of Motion Picture and Television Engineers) are SMPTE 296M and SMPTE 274M. SMTE 296M (HDTV 720p) has a resolution of 1280 x 720 pixels with high colour accuracy in 16:9 format, whereas SMPTE 274M has a resolution of 1920 x 1080 pixels.

13.3.4. Thermal imaging sensors

Every person and every object gives off radiant heat. Thermal imaging cameras can be used to record individuals and objects over long distances without additional light sources. Outdoors they have the advantage that they are virtually unaffected by the weather. In other words, the image is much less affected by snow, mist or backlight. This makes thermal imaging cameras, combined with video sensors, suitable for perimeter protection or facade monitoring.

Some thermal imaging cameras have additional intelligence allowing them to accurately determine temperatures on surfaces. The temperatures are shown in a colour grid. If predefined temperature thresholds are crossed, the camera triggers an alarm which can be forwarded to any remote station.

Fig. 7.7: Thermal imaging camera for perimeter protection

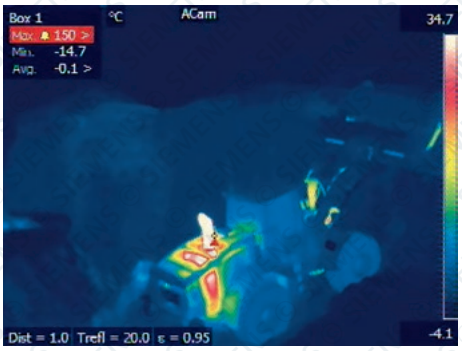


Fig. 7.8: Thermal imaging camera for early fire detection

13.3.5. HD-SDI cameras

The abbreviation HD-SDI stands for "High Definition Serial Digital Interface". HD-SDI supports the uncompressed transmission of digital signals. What makes HD-SDI technology special is that analogue interfaces are also able to render HD signals. It therefore supports high resolution images without the need to upgrade to IP video. This technology originated in the studio environment and is now widely used to record HDTV programs. The technology makes it possible to transmit and display analogue surveillance images in real time. All HD-SDI recording equipment comes with high resolution as standard. HD-SDI surveillance systems are very easy to install because they are closed systems.

13.3.6. IP Cameras

An IP camera, also known as a network camera, consists of a camera and a computer forming a single intelligent and compact unit. The main components of an IP camera include a lens, an image sensor, one or more processors, and some memory. The processors are used for image processing, compression, video analysis and network functions. The memory is used to record video sequences locally and to store the firmware (operating system) of the IP camera.

Like a computer, the IP camera has its own IP address and is directly connected to the network. That means it can be installed anywhere a network connection is available. An IP camera is a fully autonomous system, able to transmit videos independently within a network. It also provides web server, FTP and e-mail functionality and supports a range of IP network and security protocols.

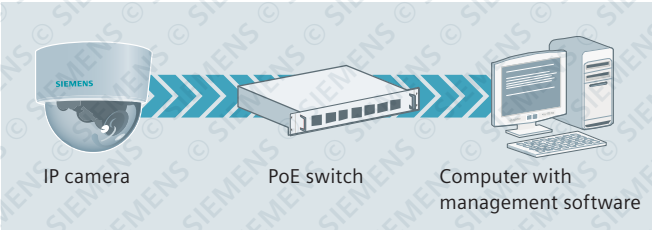


Fig. 7.9: IP camera connected to the network

An IP camera can be configured to send video data over an IP network for live display and/or recording. Using various network protocols, captured images can be sent as Motion JPEG, MPEG4 or H.264 data streams or uploaded as individual JPEG images via FTP, e-mail or HTTP (HyperText Transfer Protocol).

IP cameras use analogue CCD or CMOS sensors in exactly the same way as analogue cameras. In addition, the images are also processed in the DSP (Digital Signal Processor) in the same way as analogue cameras (highlight compensation, backlight function, etc.). Finally the images are digitized and compressed by the integrated encoder.

Some IP cameras have digital input and output contacts. The inputs can be connected to alarm sensors, allowing a differentiated response from the camera. For example, the alarm could trigger the sending of images, e-mails or text messages. The outputs could be used to activate lighting, for example, or security and protection systems. IP cameras often use circular buffer video recording, allowing specific pre-alarm images to be transmitted. Modern IP cameras have analysis functions and intelligent analysis algorithms for real-time detection of safety-relevant object or events. They also support event data transmission and the display of metadata in a web browser and in video management systems.

13.4. Camera types

Cameras come in many shapes and sizes so that they can be installed in every situation. The following section contains a brief overview of the various types and their possible uses.

13.4.1. Box cameras for indoor use

This camera type is particularly suitable for indoor use. Various mounting frames are available for roof or wall installation. The camera should not be directly exposed to moisture. To protect the camera from tampering, the place and height of installation should be selected so it is difficult to reach.

Fig. 7.10: Standard camera types

13.4.2. Box cameras for outdoor use

If a camera is used outdoors, an outdoor housing is essential. To prevent condensation on the glass, all housings have integral heating. The roof of the housing acts as a sunshade, blocking direct solar radiation and preserving the image quality.

Fig. 7.11: Different standard cameras with outdoor housing

Special housings for extreme environmental conditions are available for standard cameras. For example there are stainless steel outdoor housings able to withstand highly aggressive vapours, for use in road tunnels for example. Some production facilities handling flammable substances require the housings to be explosion-protected.

13.4.3. Mini-domes

The main component of a mini-dome is a stationary camera installed in a small domed housing. A mini-dome has the same basic functionality as a standard camera, and it can be installed pointing in any direction. The main advantage is the inconspicuous design. It is also very difficult to see which direction the camera is facing. In addition, the domed housing protects the camera from attempted tampering. The cameras often have a varifocal lens allowing the angle of view to be adjusted. Mini-domes are usually fixed cameras without a motorized zoom.

Fig. 7.12: Mini-dome camera

13.4.4. PTZ IP cameras

A PTZ camera (Pan-Tilt-Zoom) can be manually or automatically panned and tilted and can magnify or demagnify an area or an object. Mechanical PTZ IP cameras are mainly used indoors and in situations where an operator is available, and they can be installed on the ceiling or on the wall. The optical zoom of the PTZ IP camera is usually between 10x and 36x.

PTZ dome IP cameras

PTZ dome cameras can cover a larger area because they have more flexibility to pan, tilt and zoom. They support 360 degree panning and a 180 degree tilt. PTZ dome cameras are inconspicuous by virtue of their design, the method of installation and the hidden angle of view of the camera. PTZ dome cameras are also characteristically robust for continuous operation in sequential monitoring mode, in which the camera automatically switches from one predefined position to the next, either in a specified order or randomly. Normally, up to 20 sequences can be set up and activated at different times of day. In this mode, one PTZ dome camera can cover an area that would otherwise need a number of fixed cameras. However, the disadvantage is that only one partial area can be monitored at a time, leaving the other positions unobserved. The optical zoom of the PTZ dome camera is usually between 10x and 35x. This type of camera is usually fixed to the ceiling for indoor use or to a mast or a wall for outdoor use.

Fig. 7.13: Magnification of an area monitored by a PTZ dome camera (source: AXIS)

13.5. Signal transmission

In the case of analogue cameras, the transmission of video signals depends on the video standard used. The video standard determines how the images are sent from the camera (data source) to the playback equipment (data sink). It lays down how the mixture of image signals (colour or black and white), synchronization signals and blanking signals (CVBS or VBS) is transmitted and specifies the signal voltages and the complex line resistance. This means that cameras from any manufacturer can be connected to an analogue video surveillance system, however complex it is.

Different compression techniques exist for IP cameras (MJPEG, MPEG4, H264, H265 etc.). There is also the global and open industry forum ONVIF (Open Network Video Interface Forum, www.onvif.org) which aims to facilitate the development and use of a global open standard for IP video technology. ONVIF means that video systems from different manufacturers can communicate with each other. The forum was established originally by Axis Communications, Sony and Bosch in 2008 and now has over 500 members.

It is a mixed-environment digital system technology, classed by some manufacturers as a hybrid solution, and it still uses analogue video inputs. Cable properties such as attenuation, distortion of the transmission frequencies and installation method affect, to a predicable extent, how the signal is transmitted. Signal transmission can also be affected by climatic and electromagnetic conditions and noise. The main transmission types are described in brief below.

13.5.1. Analogue signal transmission over coaxial cable

Figure 7.14 shows the simplest way to transmit analogue video signals between the camera and the monitor. The same conditions also apply to all coaxial-based transmission paths between data sources (e.g. video control panel technology, other signal receivers) and data sinks (e.g. video monitors, recorders, video printers, etc.).

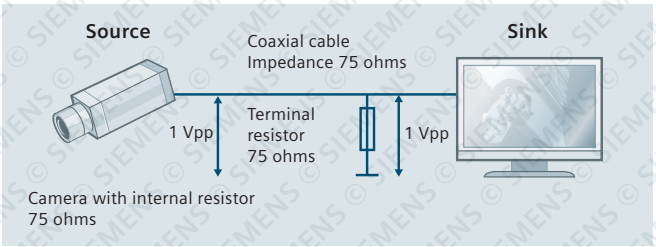


Fig. 7.14: Transmission of analogue signals between camera and monitor

The maximum length of the transmission path depends on the coaxial cable type used. The cable type most widely used indoors is the RG-59 (0.6; 3.6 mm) and outdoors the RG-11 (1; 6 mm). The attenuation value determines the maximum length of the cable between the data source and data sink. Between the two, the maximum attenuation of the video signal is 6 dB (0.5 Vpp remaining at the data sink).

13.5.2. Two-wire transmission of analogue signals

One established transmission technology for analogue video signals uses a twisted pair in a shielded telecommunication cable. Both a transmitter and receiver are necessary unlike coaxial technology, in which an amplifier is only used on the receiver side (see figure 7.15).

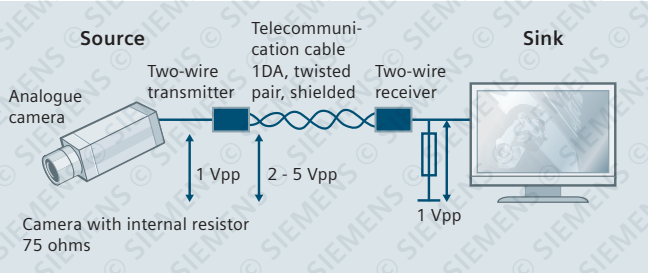


Fig. 7.15: Established transmission technology over telecommunication cable

The length of the transmission path depends on the properties of the twisted pair and of the transmitter and receiver. Wires with a core diameter of 0.8 mm are used in most cases and they must be twisted with each other. If wires from different pairs are used, transmission is virtually impossible and there are no benefits from balanced transmission. Increasing the core cross section by connecting multiple cores in parallel causes a deterioration in the transmission properties or makes transmission impossible.

In this transmission technology, a different internal resistance must be taken into account in the transition from unbalanced transmission (coaxial cable) to balanced (two-wire) transmission. There are therefore technologies which perform only balancing and a change of resistance as passive elements. The signal is not amplified in the transmitter or the receiver and the signals arriving at the receiver are not equalized. This approach is certainly possible for short distances (up to 100 m) but should be ruled out for longer distances (regardless of the claims made by the manufacturers).

Depending on transmitter and receiver quality, two-wire technology can be used to carry video signals from several hundred metres to 2000 m. For greater distances, repeaters can be installed. The repeater spacing should never reach the maximum section length between the transmitter and receiver (see figure 7.16). The number of repeaters is limited, and the maximum overall transmission distance is about 8000 m. When analogue signals are amplified, the interference affecting the cable between the repeaters is amplified too. This seriously affects the quality of the images transmitted.

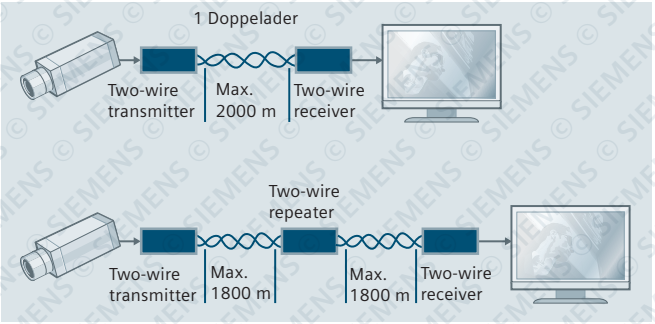


Fig. 7.16: Repeaters to extend the distances

Balanced transmission of the signals generally helps to eliminate interference signals affecting the cable. This means that two-wire transmission can also be used where interference levels are high (industry, railway). The transmission paths should nevertheless not be too long.

Only a limited number of video signals can be carried over a multicore cable. In cables, two separate cores are twisted together to create a twisted pair. If there are more twisted pairs, they too are joined to each other in pairs. This creates something called a “quad”. No two video signals should be carried in a quad because of cross-talk. Even in two-wire transmission, images may be distorted by potential equalization currents. In this situation, the procedure for coaxial transmission is followed.

13.5.3. Wireless transmission of analogue signals

Video signals are transmitted wirelessly where it is impossible or prohibitively expensive to lay cables. A full survey should always be carried out to make absolutely certain that physical cables are not an option. Thought should also be given to the camera and transmitter power supply cables. If the camera is completely wireless, the power will come from solar cells or batteries.

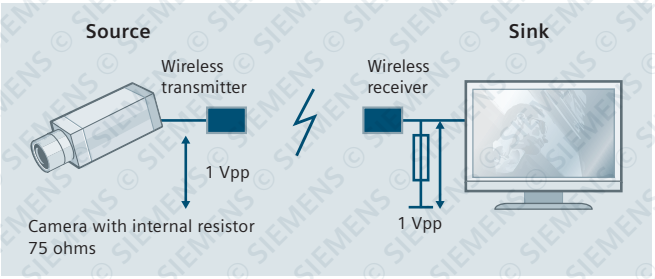


Fig. 7.17: Wireless transmission

Figure 7.17 illustrates wireless transmission. Cross-talk issues mean that not all the available communication channels can be used – one adjacent channel must be left unused. Wireless transmitters and receivers are also able to transmit audio and control signals alongside the video signals. However, radio signal transmission requires government approval. Approval is granted automatically for low-power technologies operating in the “public bandwidths”. This also covers the antennas used with the technology. The transmission frequen

cies are in the order of several GHz, which means that environmental conditions have a considerable impact on ranges. For example, thick fog can seriously limit the range.

It is best to aim for a line of sight between the wireless transmitter and receiver. Outdoors, widely available technology can be used to span several hundred metres, or several tens of metres indoors. The only way to be certain that wireless technology will be up to the task is to carry out testing at the camera's intended location. Testing should also establish whether the transmission technology requires a direct connection to the camera. The wireless link between the transmitter and receiver can often be made more reliable by adjusting where the equipment is installed.

Note also that wireless transmitters and receivers may be operating nearby in the same frequency band. This may cause transmission problems. There is also nothing to prevent signals being received by third-party receivers. For a degree of security, wireless transmission technology is available with encryption of the video signals. The encryption techniques used must be carefully analyzed to ensure they meet internal security requirements.

A further option for wireless transmission of IP signals over WLAN or mobile telephony services is described in section "7.5.5. Network Transmission"

13.5.4. Optical fibre transmission

Optical fibre, or fibre-optic cable, is cable consisting of light guides and sometimes fitted with connectors and designed to transmit light. The light is carried in fibres made of silica glass or plastic (polymer optical fibre). They are often called optical fibre cables, although these usually carry a number of optical fibres and also include mechanical reinforcement to protect and stabilize the individual fibres.

In telecommunication, optical fibre cables are used to transmit information over short and long distances with a large bandwidth. Low-cost multimode fibres are used for short distances, whereas single-mode fibres can cover distances from several tens to over 100 km without repeaters. Where the optical fibre cables terminate, the optical signals are generally converted into electrical signals which can then be taken to individual households over coaxial cables.

Optical fibre transmission is compatible with both IP and analogue technology. In both cases, however, a transmitter and a receiver are necessary in order to send signals.

13.5.5. Network transmission

When IP or analogue cameras are used with an encoder, it is often assumed that there is no need to worry about the transmission paths because there is a network virtually everywhere. However, this cannot be taken for granted, as IP networks are often unavailable at perimeter fencing, facades, in basements or in underground car parks. There are also security concerns – it does not take long for intruders to break into the network in publicly accessible locations. That makes it important to seal off the network and to provide adequate firewall security. The transmission of video images places a considerable load on the network due to the high transmission rates. It is very important to check that the video data will not overload the network. The recommendation is that a dedicated, protected structure is established within the network for the video system. This prevents unauthorized users from accessing video images and stops the video data mixing with other sensitive data using the network. Network overload can also be avoided by defining a maximum video transmission rate. For large-scale video systems, a network specialist should be involved in the design, planning and installation phases.

The planning of transmission and network capacity should take place alongside video system planning. The backbone should have at least 50% spare capacity. Issues concerning system security must be resolved at this early stage. There is little point building a video system with plenty of redundancy if the transmission of images in the network can be easily interrupted. Measures to interconnect transmission paths, redundant servers and power supplies, USPs and secure network management must all be considered right from the start.

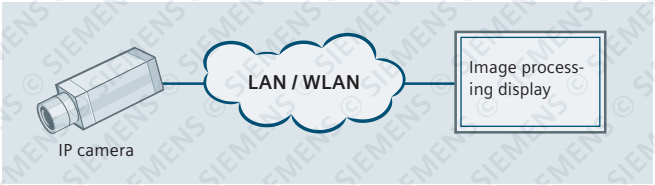


Fig. 7.18: IP camera connected to the network

Figure 7.18 shows an IP camera connected to a network. Unlike analogue technology, the images created by the camera can be displayed directly on a computer either in a standard browser or in special video playback software.

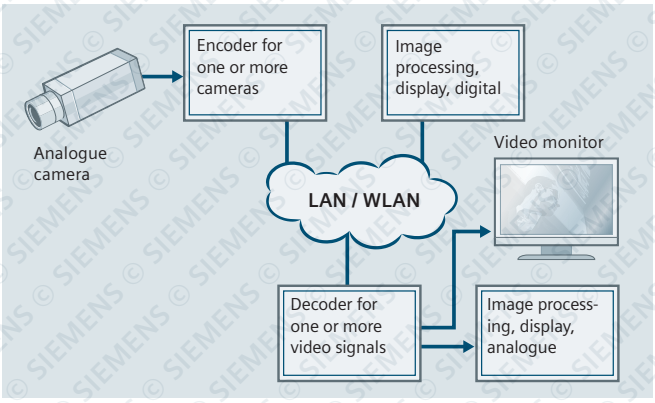


Fig. 7.19: Converters change a digital signal back into an analogue signal.

Apart from digital image processing and display, decoders can convert digital signals back into an analogue video signal (see figure 7.19). Existing video monitors or other analogue equipment can be connected directly to the decoders. Repeatedly converting signals, however, can impair quality.

In a network, the data can be transmitted over cables or over a WLAN. Cable solutions use copper (CAT cables) and optical fibre.

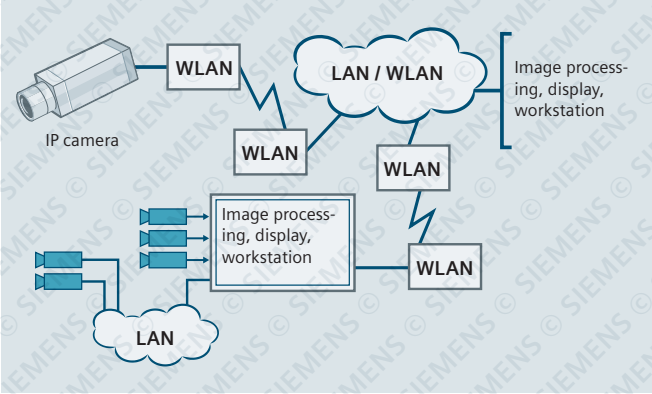


Fig. 7.20: Transmission over WLAN

Wireless network technologies such as WLAN are a flexible, cost-effective and fast way of installing cameras for video surveillance applications, especially in large areas such as car parks and inner cities. This removes the need to lay cables in the ground. Wireless technology is often the only option in old heritage buildings where no new cables can be laid. WLAN is based on wireless Ethernet according to the IEEE-802.11 standard. Here, the conditions described for the wireless transmission of video signals must be taken into ac-count. The transmission power in WLAN, however, is limited, meaning that ranges are shorter too. In particular, the transmission rate can change according to the distance. For this reason, the technology must be adapted to support live image transmission. Under some circumstances, the high data volume of megapixel cameras may reduce the quality of live image transmission. As with all wireless connections, serious thought must be given to eavesdropping/encryption.

13.6. Video management systems

13.6.1. Requirements of a video management system

The flexibility of a video surveillance system depends largely on the nature of its control and administration. Figure 7.21 sets out the main functions of the video management system.

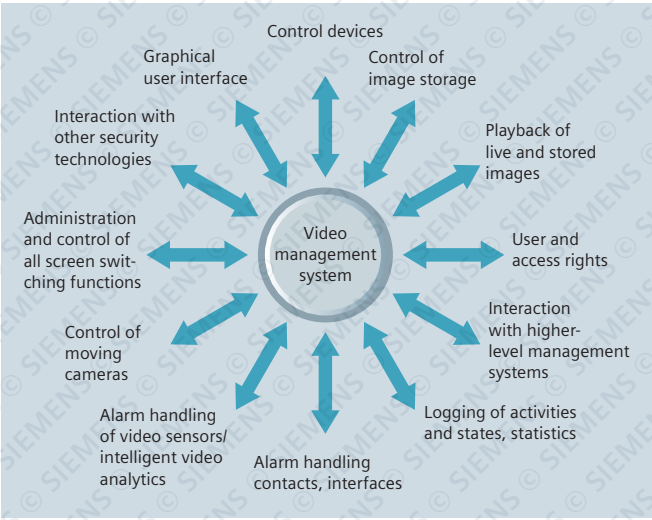


Fig. 7.21: Functions of a video management system

Video management systems are generally based on a client/server architecture, allowing existing systems to be expanded easily or more subsystems to be added. Despite the complexity of the management system, it must be kept intuitive and easy to configure by straightforward means without special programming skills. In addition, the architecture of the video management system must be designed with redundancy. Special care should be taken with systems in sensitive security areas, which must continue to operate without interruption if system components stop working.

13.6.2. Functions

Administration and control of all screen switching functions

One thing a management system must do is to control all screen switching functions whether or not there is an alarm situation. These include:

- Manual switching of images to preview monitors or viewers in monitors with multiple image display
- Automatic and manual cyclical switching of images
- Event-based or alarm-based switching of images

Control of moving cameras

The management system can be used to control cameras manually. For example:

- Manual preset (including zoom and focus) to objects with variable speeds
- Automatic start and end of preprogrammed patterns
- Camera moved to preprogrammed fixed positions in alarm situations

Operating the system
A management system allows the system to be operated with control units (if an outage occurs) or a graphical user interface. A mouse and keyboard or a touchscreen can be used. Other important considerations:

- Ergonomic design of control units and user interfaces so they are intuitive and easy to learn
- Short training period
- Reliable user interface in stressful situations and during alarms
- Clear display of the state of the system as a whole and the components
- Remote configuration of cameras with the relevant user rights

Complex alarm handling
Alarm handling includes all the functions that must be managed if an event occurs. It makes no difference whether the event notifications are generated by the video system itself or by other security systems via an interface. The main functions include:

- Prioritization of alarm and event notifications and formation of queues
- Variable switching to event/alarm images
- Linking events with actions for screen switching, storage and interaction of system components
- Handling notifications to external system components (e.g. lighting)
- Passing on alarm and event notifications to lower levels
- Comprehensive logging of alarms and the actions taken by operating staff

Storage and playback of images
Recordings of images during alarms must allow the situation to be assessed without ambiguity. If an event occurs, it must be possible to show images from the time of the event as well as the live images. To do this, the following functions are necessary:

- Storage of alarm and event images based on predefined criteria
- Display of images from the time of the event as individual frames
- Inclusion of sequences when alarm and event images are shown
- Fast, targeted search for images based on relevant search criteria

Logging of activities, states and statistics
The management system must support the comprehensive documentation of events and alarms including the causes, the actions taken, and all operator actions. This proves that the system was working properly and the staff took the correct action, which is very important in insurance cases in particular.

Interaction with other security systems
The video management system must be able to integrate notifications from other security systems and include them in alarm handling. There are several ways in which the system can interact with external components of other security systems. These include:

- Use of contact status notifications
- Transfer of notifications over serial interfaces
- IP-based interaction with functionality coordinated between the two systems

13.6.3. Forensic search

Large quantities of video images are recorded, transmitted and stored. It must possible to locate the data relating to an event as efficiently as possible. Intelligent forensic search saves a lot of time, taking a matter of seconds to scan a database of recordings for events.

Benefits of intelligent analysis of video archives
Forensic search revolutionizes the quality of work done in video archives. Video images are searched with a range of adjustable parameters, allowing the situation to be analyzed quickly. Decisions can be made quickly on the basis of the located video images. Defined search screens are stored in a database so they can be used in future search jobs.

Metadata
The video sensors have the task of analyzing image content and generating alarms, but they also create metadata describing all themes and objects in a scene and their characteristics. This metadata is streamed with the video over the network and stored in a database. The metadata can be used with the forensic search client to search recordings.

Search filter
Depending on the search object, specific criteria are selected such as object size, speed, bidirectional direction of movement, relative size and colour. Virtual fields or lines can be defined in the scene to further enhance the search function. Virtual fields can help track the route of vehicles for example. It is also easy to find objects crossing a virtual trip wire in a specific direction.

Intuitive graphical user interface
Straightforward navigation in the intuitive user interface makes it easy to configure the intelligent search functions. When search scenarios are created, multiple filters can be used in any combination in order to accurately locate the desired object properties.

13.7. Intelligent image analysis

Image analysis is the backbone of reliable video detection. Image analysis searches the video image for defined patterns of movement. As the performance of computers and signal processors increased over time, it became possible to recognize patterns in the image, leading to more reliable detection and ignoring other parts of the image. The algorithm must always be tailored to the particular task and it is directly integrated in the video system. Intelligent image analysis algorithms often need a great deal of processing power.

Intelligent image analysis can do much more than protect objects and areas. As the number of cameras increases, it is no longer possible to keep track of all the screens in the control centre and respond to a security-related event captured by one or more cameras. The operator in a video control centre can quickly tire of watching a large number of screens, becoming less able to pay attention. It is highly likely that brief events happening in the monitored scene will go unnoticed. To solve this problem, screens are not switched until an event occurs, drawing the operator's attention with visual and audible cues.

13.7.1. Potential uses

Intelligent image analysis has a vast range of potential applications. A selection of applications is described below.

13.7.1.1. Object classification

Video analysis with classification is based on the detection of certain objects sharing the same characteristics. Because the objects are organized into classes, the process is called object classification. Classes can be individuals, vehicles and other objects. The video image is analyzed in order to detect individuals and/or vehicles. When objects are recognized they are marked with colour-coded borders during playback.

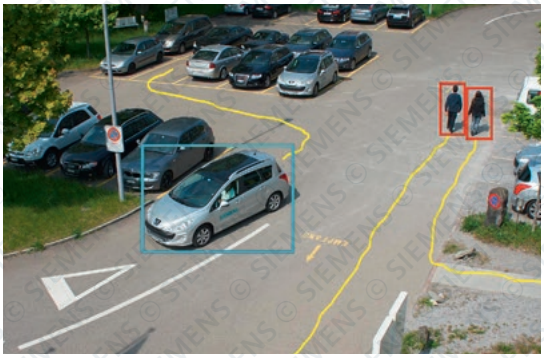


Fig. 7.22: The recognized objects are marked with colour-coded borders

If alarm zones are defined, the alarm is only triggered if the objects move into the zone. All objects moving inside the image and not recognized as persons or vehicles are reported as other objects by the video analysis. Because of differences in the size of objects and of the same object in the foreground and background, parameters such as object size in the foreground and the background must be carefully configured. The angle and direction of view of the camera is also important. Other events can be detected depending on the selected algorithm, for example the arrival and departure of vehicles and the length of time spent in parking spaces.

13.7.1.2. Perimeter protection

The opportunities for total perimeter protection are more varied and complex than ever before. Extensive grounds are often monitored with video cameras. If a person, for example, leaves the predefined zones in a particular direction, the alarms are triggered as stated in the escalation plan. Virtual lines, too, can be used to create alarm scenarios of all kinds. These algorithms are perfect for perimeter protection.

3D tracking image analysis can make perimeter protection even more effective, simultaneously recognizing any number of objects in the video image and automatically tracking them using the camera zoom or tilt functions. Alternatively, recognized objects can be displayed by clicking on the zoom region.

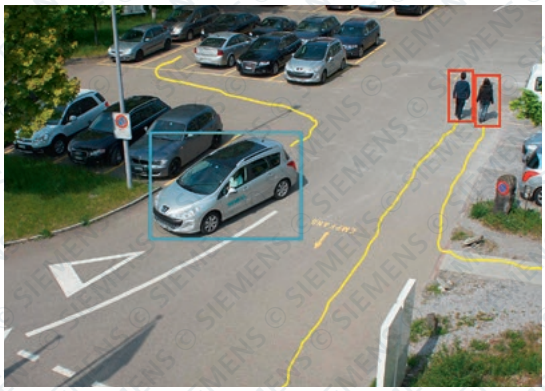


Fig. 7.23: Image analysis with 3D object tracking and virtual trip wire

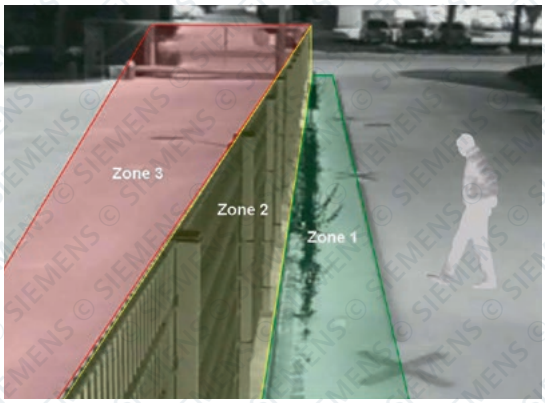


Fig. 7.24: Multiple zone monitoring in perimeter protection

13.7.1.3. Character recognition

Video-based optical character recognition solutions are used in a wide range of applications, for example on toll roads. Toll evaders are only detected if the number plates can be recognized and analyzed. The technology must also work reliably when the vehicles are moving quickly (up to 200 km/h). Another possible application is to monitor entries and exits to/from secure areas. A camera installed in the entry/exit zone captures the number plates of vehicles driving in and out, and cross-checks against a database. If there is a match, the barrier opens. The length of time spent can also be recorded.

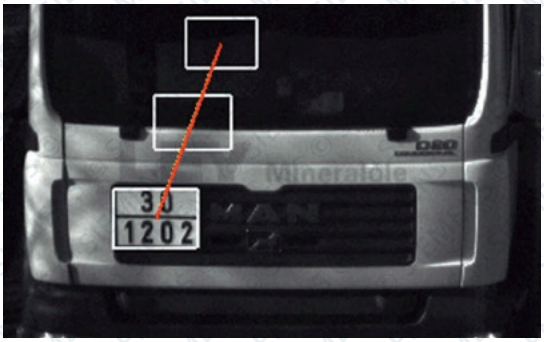


Fig. 7.25: Recognition of dangerous goods signs

Alternatively, the same technology can be used to recognize dangerous goods signs (with HIN). In road tunnels or sections of road where the consequences of accidents involving dangerous goods would be particularly serious, it is crucial to know what vehicles are in the danger zone and what they are carrying. Video-based character recognition reliably identifies the substances being carried, allowing the right steps to be taken if something out of the ordinary occurs.

13.7.1.4. Face recognition

When a passport photograph is taken, biometric features are recorded. The photograph is used to create patterns allowing an individual to be identified. If the stored patterns are compared with images taken by video cameras, individuals can be recognized with varying degrees of certainty. The persons face must be captured from the front and there must be sufficient pixels to allow for effective analysis. In facial recognition, the system looks for patterns within an image that might be a face.

Detection is much more difficult with a large number of people standing next to each other – in this situation, effective facial recognition is very resource-intensive. A great deal of computing power is needed to compare large numbers of stored patterns with the images captured by the video camera.

13.7.1.5. People counting

It is useful to count people moving in both directions at certain points in major events, but also for marketing purposes or for market research. A camera pointing down onto the moving crowd captures the people entering and leaving. The analysis unit uses an algorithm to analyze the data and count the people. Here, too, it is more difficult to detect large numbers of people packed tightly together.

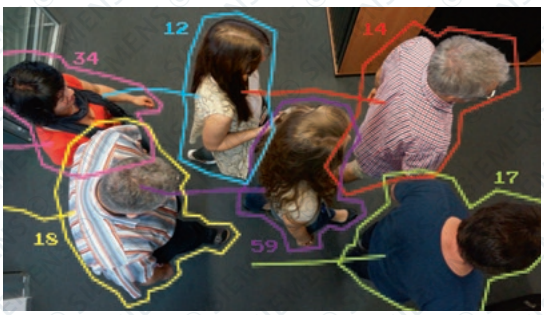


Fig. 7.26: People counting

13.7.1.6. Abandoned and removed objects

Intelligent image analysis can also detect objects left in the monitored area and not taken away again within a specified period. Systems of this kind require a thorough analysis of the local area, video images that can be analyzed, clearly-defined system requirements and ongoing work to ensure the system keeps performing effectively.

Intelligent video analysis can detect removed objects as well as abandoned objects. In art galleries, for example, paintings can be monitored. If a painting is removed, the missing object triggers an alarm. Proximity detection is another possibility – an alarm is triggered if someone walks within a certain distance of the painting.

Fig. 7.27: "Removed Object" algorithm

13.7.1.7. Tunnels and traffic

Intelligent video analysis can perform a wide range of functions in traffic surveillance. Before an emergency lane can be cleared for use by traffic as an extra lane, it must be checked to ensure there are no stationary vehicles (breakdowns). This can be done using cameras and a suitable intelligent video analysis algorithm. Of course, the relevant section of the emergency lane must be fully covered by cameras. The traffic flow can be analyzed to detect events like congestion, accidents, vehicles driving in the wrong direction, etc., or to classify and count vehicles as part of traffic analysis. This is only possible if analyzable video images are available from the relevant locations. In stationary traffic, for example, incorrectly parked cars can be detected.

There are many potential applications for intelligent video analysis to improve safety in tunnels. If the number plates of vehicles carrying dangerous goods can be read as they approach the tunnel, the information can be used to determine whether the vehicle is allowed to enter – if not, steps must be taken immediately to deny access. Video technology can also be used to check vehicle heights. It is important to know whether vehicles have broken down, constituting a hazard for moving traffic. In tunnels, after all, seemingly insignificant events can quickly escalate. These systems are normally based on video surveillance and use algorithms to analyze video images, detecting deviations from "normal" patterns and automatically alerting operators of exceptional situations. Automatic hazard reporting systems reliably identify, monitor and report on objects and situations that could cause accidents or fires. Universal platforms for video applications trigger an alarm if safety rules are violated, for example slow-moving or stationary traffic, vehicles driving the wrong way, or shed loads. The systems can be linked to a traffic management system and automatic barriers, and automatically warn drivers before they enter the tunnel.

13.8. Data protection and data security

People today are increasingly willing to share personal details in social networks. Even so, it is extremely important to treat data protection issues seriously. Data security includes all activities designed to protect stored and collected information from loss or destruction.

The aims are as follows:

- The data must be available when it is needed.
- The programmes and data must be protected from unauthorized access.

13.8.1. Data protection topics

Scrambling is an important part of data protection, especially in public areas in which rules apply to the way sensitive video data is handled. If image analysis recognizes objects that might invade someone's privacy, they are pixellated by an encryption algorithm. In archived and live images, an authorized person can disable this encryption at any time.

In the modern IT environment, data security in the network is becoming increasingly important. Video management systems should use the Common Criteria IT security standard, based on the video profile. This guarantees that the data is verified with regard to integrity and authenticity. Changes to data are detected and the activity can be reproduced at a later date. The action carried out can be unambiguously assigned to a single communication partner. The four-eyes principle is another way to guarantee data confidentiality.

13.8.2. Permanent data security

To guarantee permanent data security, the systems must be designed to provide high availability. This can be done with redundant systems and networks. Backup concepts are needed which can be used individually or in combination with others. Various levels of service can be provided, from a single backup server to 1:1 mirroring of all central servers. Backup availability is sometimes a crucial factor in the data security concept.

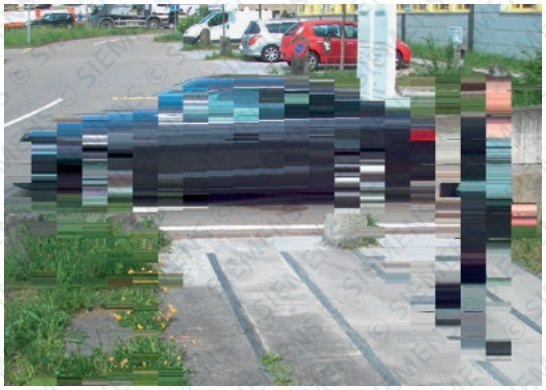


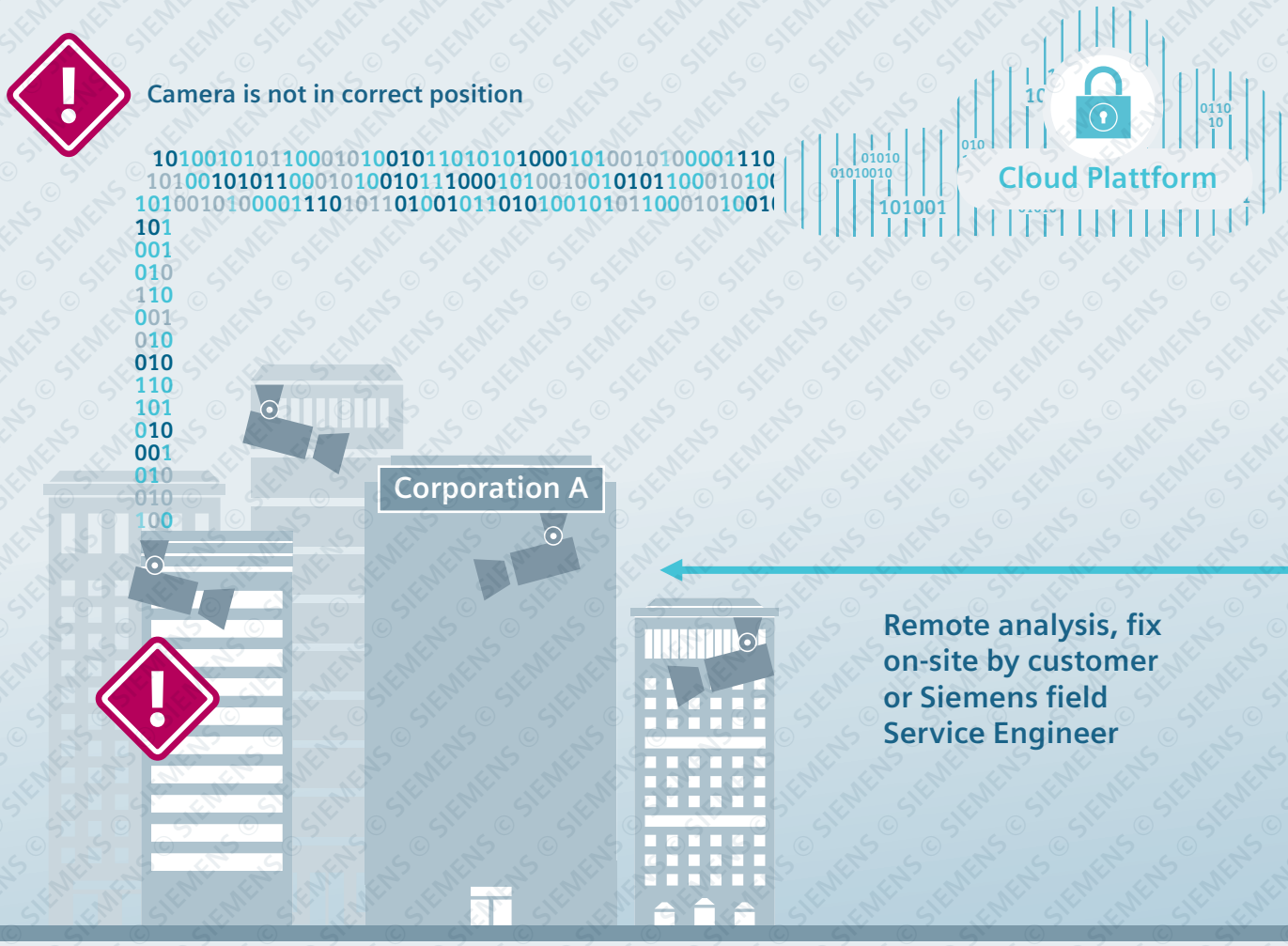
Fig. 7.28: Scrambling pixellates moved objects

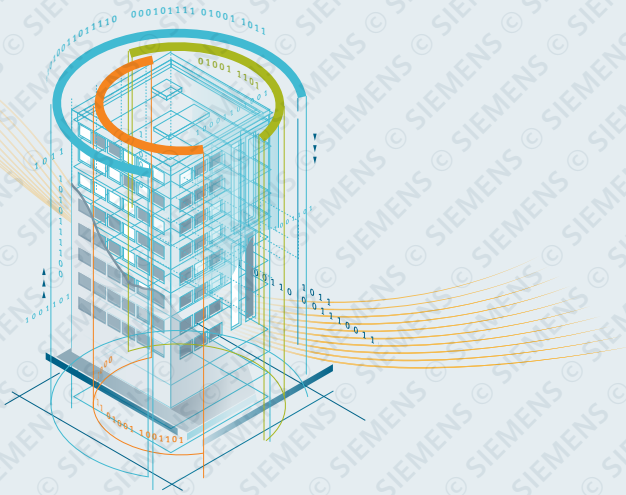
Fig. 7.29: Authorized users can access the original live/archived images

Use Case – Video Surveillance

If a video camera is not in the right position, the camera is no longer working as expected to cover the intended risk. When the deviation from the reference position is detected, the information will be seen in the Digital Service Center (DSC). The DSC then logs into the camera to try to get more information about the situation in order to create a clear picture of the incident. After assessing the situation, the DSC informs the field Service Engineer so he can contact the customer.

The field Service Engineer then works with the customer to define the actions to be taken. The field Service Engineer might go to the customer's building to fix the problem on-site or the customer might try to fix it by himself first. In either case, the problem will be evaluated to determine if it was caused by sabotage or if it was a coincidence. It can be also decided if the camera is in the right position or if it needs to be repositioned.

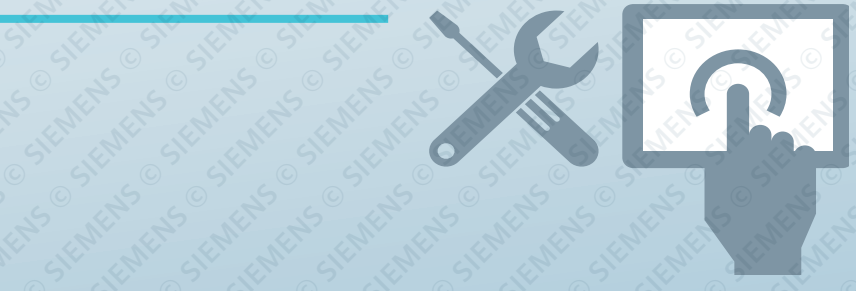




Data power delivers better building performance

Digital Service Center

- Customer is informed about potential security risk
- Customer decides: Fix now or wait



Local Service Organization

- Customer is informed about potential security risk
- Customer decides: Fix now or wait

Undivided attention for your security

Capturing, storing, analyzing, displaying and sending. Video management systems guarantee maximum flexibility and functionality when monitoring congestion, vehicles driving the wrong way or intruders. They support business processes and work seamlessly with other systems. Video surveillance systems guarantee undivided attention for your security, at all times.

Always in the picture – 24 hours a day, 7 days a week

For security that pays for itself

Video surveillance systems are increasingly being used in security systems – for good reason. Video cameras deter criminals, and potential hazards can be spotted at an early stage. Any damage that does occur can at least be minimized with fast and appropriate intervention. As potential hazards and consequent losses continue to mount, video surveillance is an extremely valuable and cost-effective way to improve the protection given to people, buildings and valuables.

Tailored to security needs

Security-relevant installations are becoming larger and more complex, and they have differing security needs. Siemens has innovative digital product and system concepts supporting intelligent video analysis and sensor inputs, allowing the system functions to be tailored to the needs of users. That is why our comprehensive video surveillance solutions offer a unique approach to security management in critical infrastructure, large facilities and complex buildings.

Video never gets tired

A video surveillance system keeps you in the picture 24 hours a day, seven days a week. You do not even have to sit in front of a screen. As soon as anything unusual happens, a predefined location is notified, for example a cellphone. This means that action can be taken immediately to minimize losses.

Siemens video surveillance is an open platform system, allowing digital and analogue components to work together and supporting interoperability and interfaces with third-party systems. Intelligent image analysis tools also provide great functionality focused on customer needs.

Image capture technologies

High-resolution colour camera with WDR backlight function

High-resolution colour cameras render images with high brilliance and colour fidelity. Where there are large differences in contrast, WDR (Wide Dynamic Range) is used. The light and dark parts of the image are processed electronically to create a uniform visual impression. This means that people can be recognized in spite of a strong backlight.

Lowlight camera

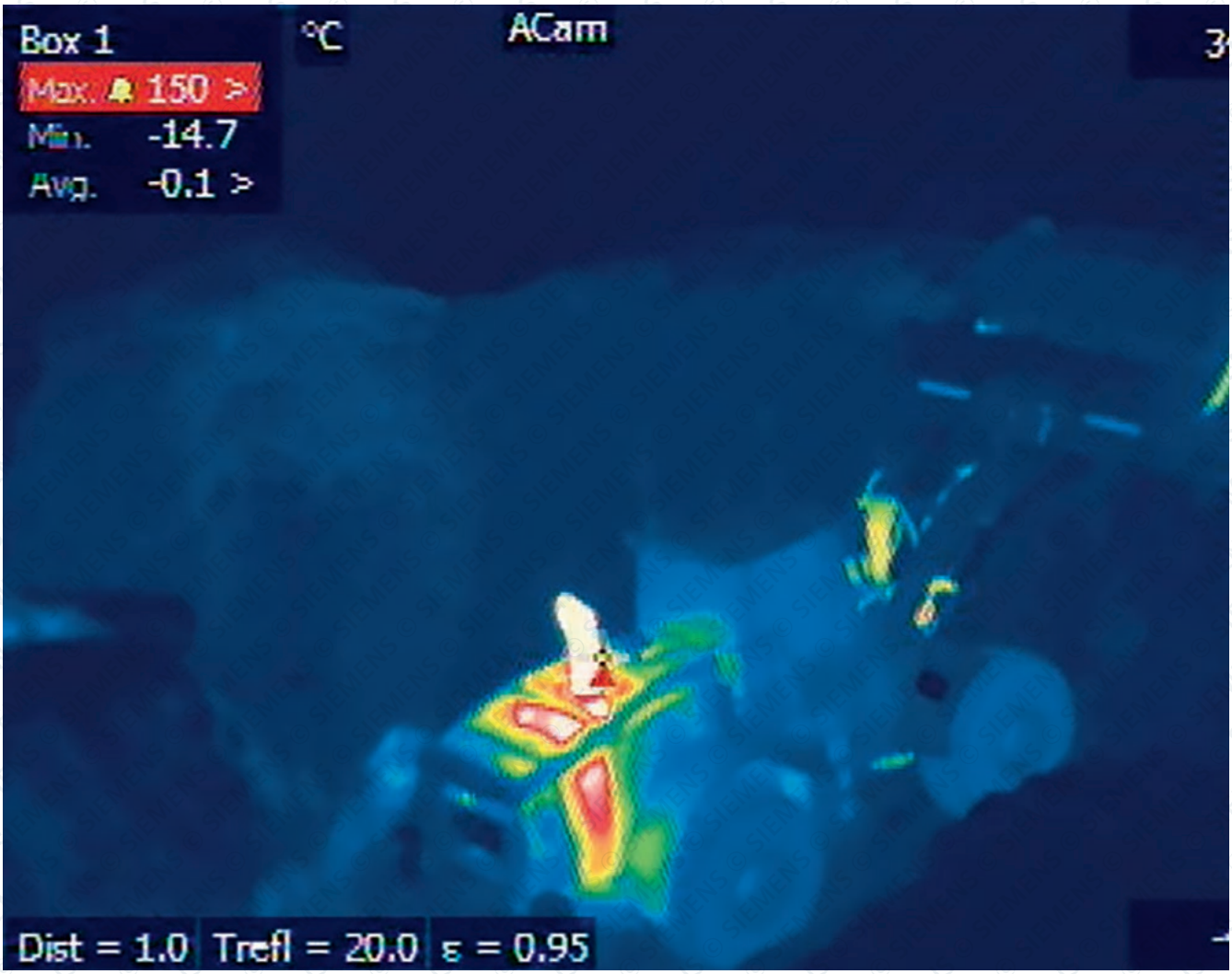
Highly sensitive image capture chips with intelligent digital image processing can produce great images in the dark. What conventional cameras and the human eye cannot see is made visible with this technology. Even under these conditions, objects and people are discernible in colour.

Lowlight camera at night

Day/night camera in black and white mode with infrared lighting

Highlights

- Improved detail recognition with higher-resolution IP cameras
- Light-sensitive cameras reduce the lighting needed
- Wide range of camera technologies, shapes, etc. for all sorts of applications
- Intelligent cameras with features like analysis, image storage, logic, etc.



Thermal imaging camera for early fire detection

Day/night camera with infrared lighting

At night, day/night cameras switch to black and white mode. That means an area can be lit with infrared light, which is detected by the camera. The quality of lighting depends on factors such as the distance and angle of the infrared light source. Infrared light is invisible to the human eye.

Thermal imaging camera for perimeter protection

Every person and every object gives off radiant heat. Depending on their optical components, thermal imaging cameras can be used to record individuals and objects over long distances without additional light sources. Thermal imaging technology is highly resilient, making it ideal for outdoor use especially in fog, rain or snow, or where there is strong backlight. This, combined with high-performance sensors, makes them suitable for perimeter protection or facade monitoring.

Thermal imaging camera for early fire detection

Dedicated thermal imaging cameras have additional intelligence allowing them to accurately determine temperatures on surfaces. The temperatures are shown in a colour grid. If predefined temperature thresholds are crossed, the camera triggers an alarm which can be forwarded to any remote station.

Camera resolutions

To allow details to be recognized in the video images, IP cameras have resolutions ranging from QCIF to HD/Full HD. Even higher resolutions are supported by cameras with 3 and 5 megapixel image capture chips. Analogue cameras, on the other hand, have a fixed resolution of 4CIF.

Video analytics

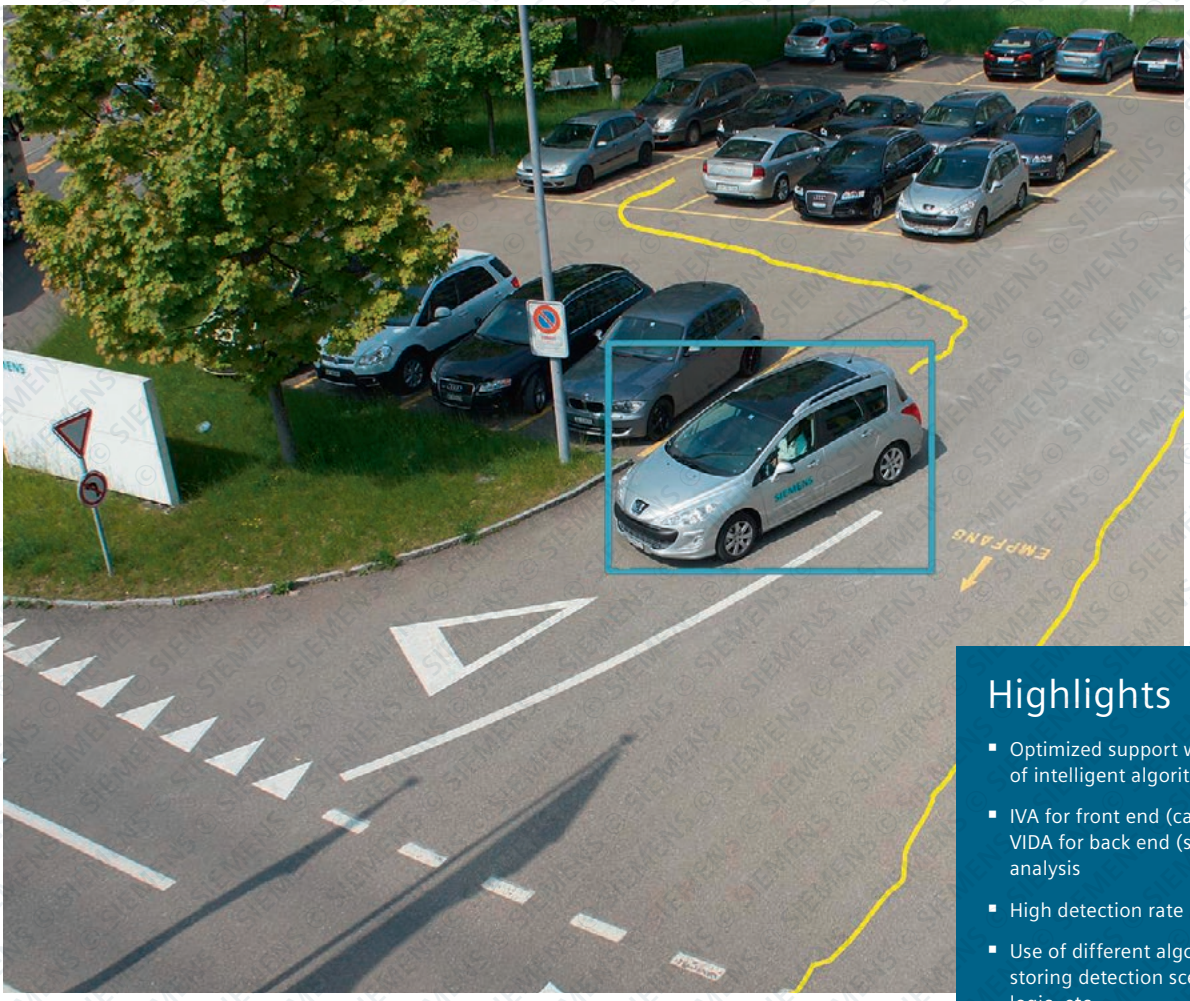
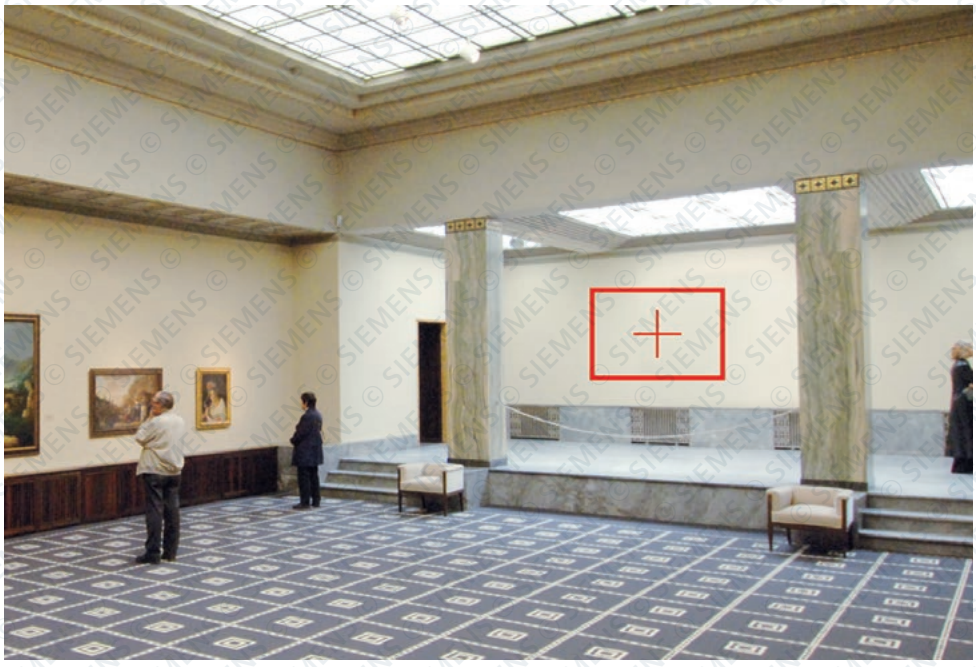


Image analysis with 3D object tracking and virtual trip wire

Highlights

- Optimized support with a range of intelligent algorithms
- IVA for front end (camera) and VIDA for back end (server) video analysis
- High detection rate
- Use of different algorithms for storing detection scenarios, logic, etc.



"Removed Object" algorithm

IVA and VIDA video analysis is the backbone of reliable video detection. Image analysis searches the video image for defined patterns of movement. You can use rules and logical operations to define specific actions for each channel in response to events.

Directional zone or line crossing
If a person leaves the predefined zones in a particular direction, the alarms are triggered as stated in the escalation plan. Virtual lines, too, can be used to create alarm scenarios of all kinds. Experience shows that these algorithms are perfect for perimeter protection.

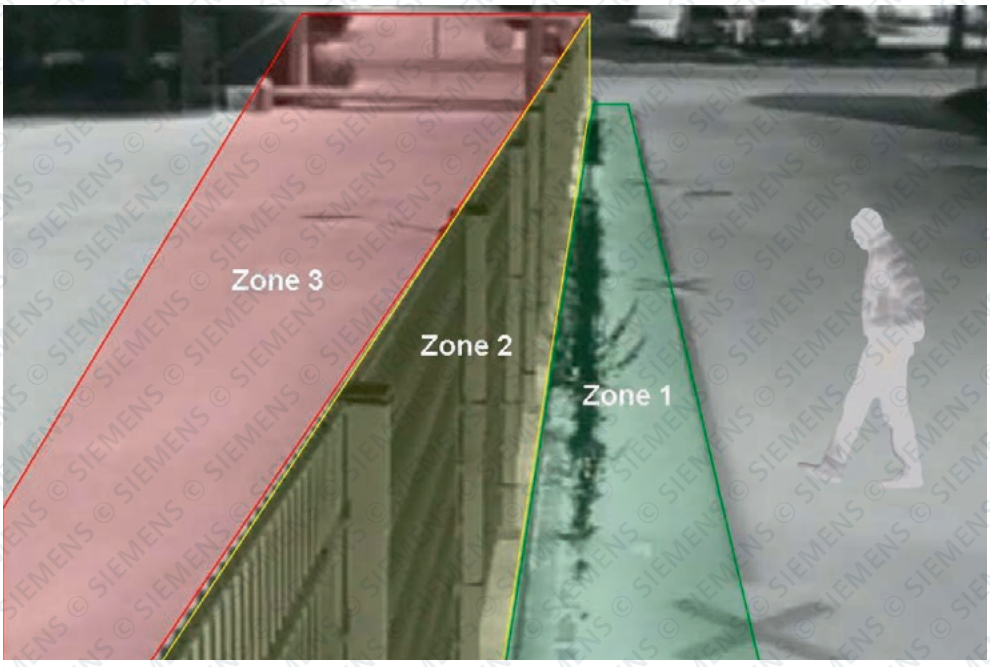
Loitering
An alarm is triggered if the same individuals spend too long in the selected field at a particular location (e.g. in front of an ATM).

Removed object
In art galleries, for example, paintings can be monitored. If a painting is removed, the missing object triggers an alarm. Proximity detection is another possibility – an alarm is triggered if someone walks within a certain distance of the painting.

Crowd detection
This application is useful in places like bank lobbies. The video solution can detect if more than a certain number of people gather in the predefined teller area. More teller positions could be opened as a result.

Abandoned objects
At critical locations it is important that no objects are left unattended. An alarm is generated if an object like a suitcase is left in a particular area for more than a certain time.

Automatic object tracking
3D tracking image analysis simultaneously recognizes any number of objects in the video image and automatically tracks them using the camera zoom or tilt functions. Alternatively, recognized objects can be displayed by clicking on the zoom region.



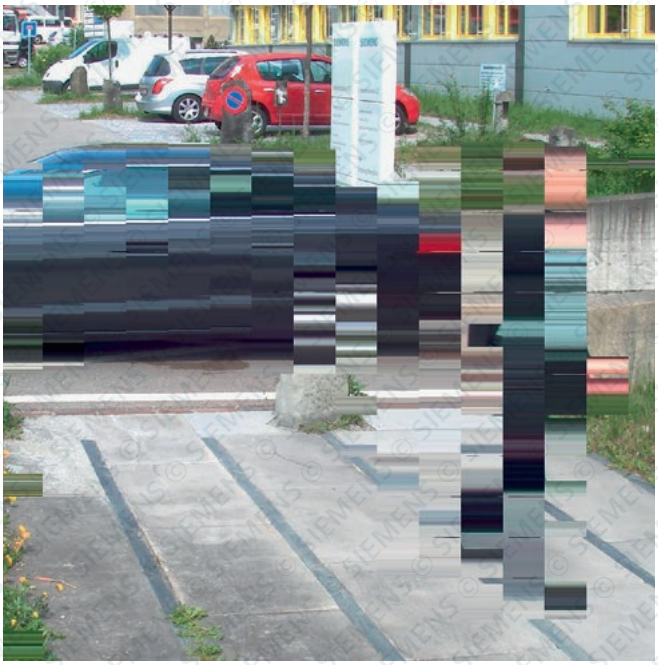
Multiple zone monitoring in perimeter protection

Data protection and data security

Highlights

- Pixellation of image content for sensitive video data
- Data protection with IT security standard Common Criteria
- Guaranteed authenticity, integrity and confidentiality of data
- Flexible backup strategies for data security
- Redundant system and network topologies

Authorized users can access the original live/archive images



Scrambling pixellates moved objects

People today are increasingly willing to share personal details in social networks. Even so, it is extremely important to treat data protection issues seriously.

Scrambling

Scrambling is an important part of data protection, especially in public areas in which rules apply to the way sensitive video data is handled. If image analysis recognizes objects that might invade someone's privacy, they are pixellated by an encryption algorithm. In archived and live images, an authorized person can disable this encryption at any time.

User log administration

The Siemens Control Centre Server – SiCCS – systematically logs all user actions. This helps with process optimization. For example it is very easy to see whether encrypted video sequences have been watched in unencrypted form.

Data security in the network

In the modern IT environment, data security is becoming increasingly important. SiNVR, combined with the SiCCS, uses the Common Criteria IT security standard, based on the video profile. This guarantees that the data is verified with regard to integrity and authenticity. Changes to data are detected and the activity can be reproduced at a later date. The action carried out can be unambiguously assigned to a single communication partner. The four-eyes principle is another way to guarantee data confidentiality.

Data redundancy

To guarantee permanent data security, the systems must be designed to provide high availability. Redundant systems and networks are the solution. The SiCCS provides flexible backup concepts which can be used individually or in combination with others. Various levels of service can be provided, from a single backup server to 1:1 mirroring of all central servers. Backup availability is sometimes a crucial factor in the data security concept.

Siemens Control Center Server – SiCCS

IP video systems are becoming increasingly complex. Combining all the various data in a single place guarantees that nothing is missed. The Siemens Control Centre Server – SiCCS – significantly improves security and availability in the management and control of the video system.

Central user administration

Central user administration is essential in systems with multiple workstations. Once user data has been entered, all applications connected to the SiCCS (video systems, communication servers, SiP5, third-party systems, etc.) are automatically notified of changes.

Enhanced message management

"Enhanced message management" means central alarm processing using a database. The SiCCS is the only component that communicates directly with the database, informing all the clients of the changes. If a registered component fails, the SiCCS automatically generates a corresponding error message entry and passes it to all connected systems.

Central configuration management

The SiCCS is also used to manage application configurations. This means that the SiCCS automatically stores all server and client configurations. The SiCCS can also be used to distribute a new configuration to one or more servers and to automatically activate it.

Common Criteria user logging

The SiCCS improves the video system by adding the benefits of the Common Criteria IT security standards. As well as safeguarding the integrity, authenticity and confidentiality of data, it is also possible to log user actions. A large database makes it easy to access data.

Dynamic text display

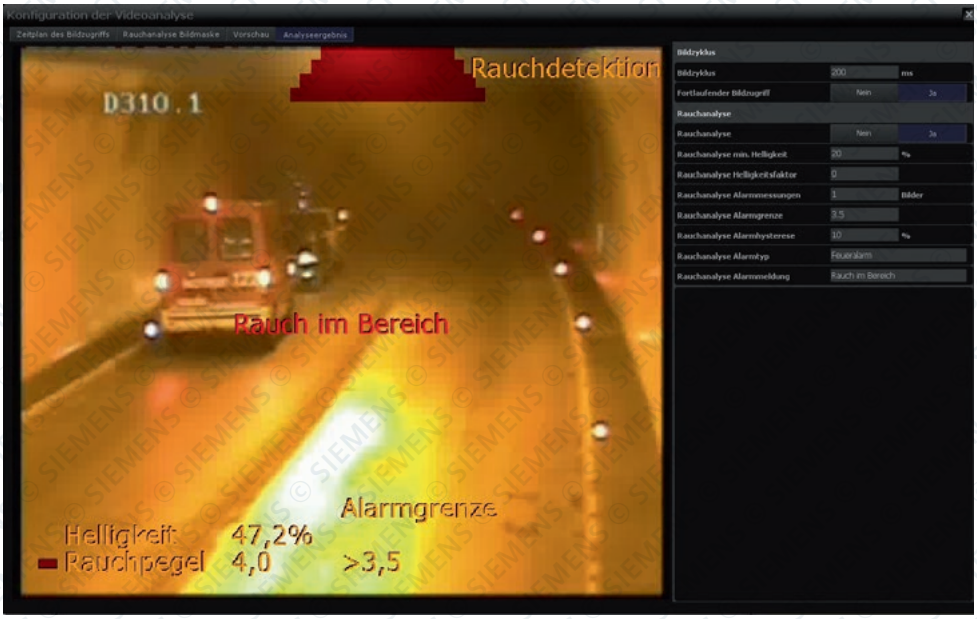
Alarm images can be verified more quickly when relevant texts are added to the display. For example, the triggering algorithm in a tunnel application could be flashed on screen (smoke, congestion, etc.).

Web interface

The SiCCS has a web client for the display of live images. The intuitive user interface can control PTZ cameras and perform switching functions.

Backup mode

The SiCCS has powerful backup functions for use in high-availability video surveillance systems. If the central server fails, the standby server is activated automatically. When the server is up and running again, an automated process copies the data back to the central server from the standby server.



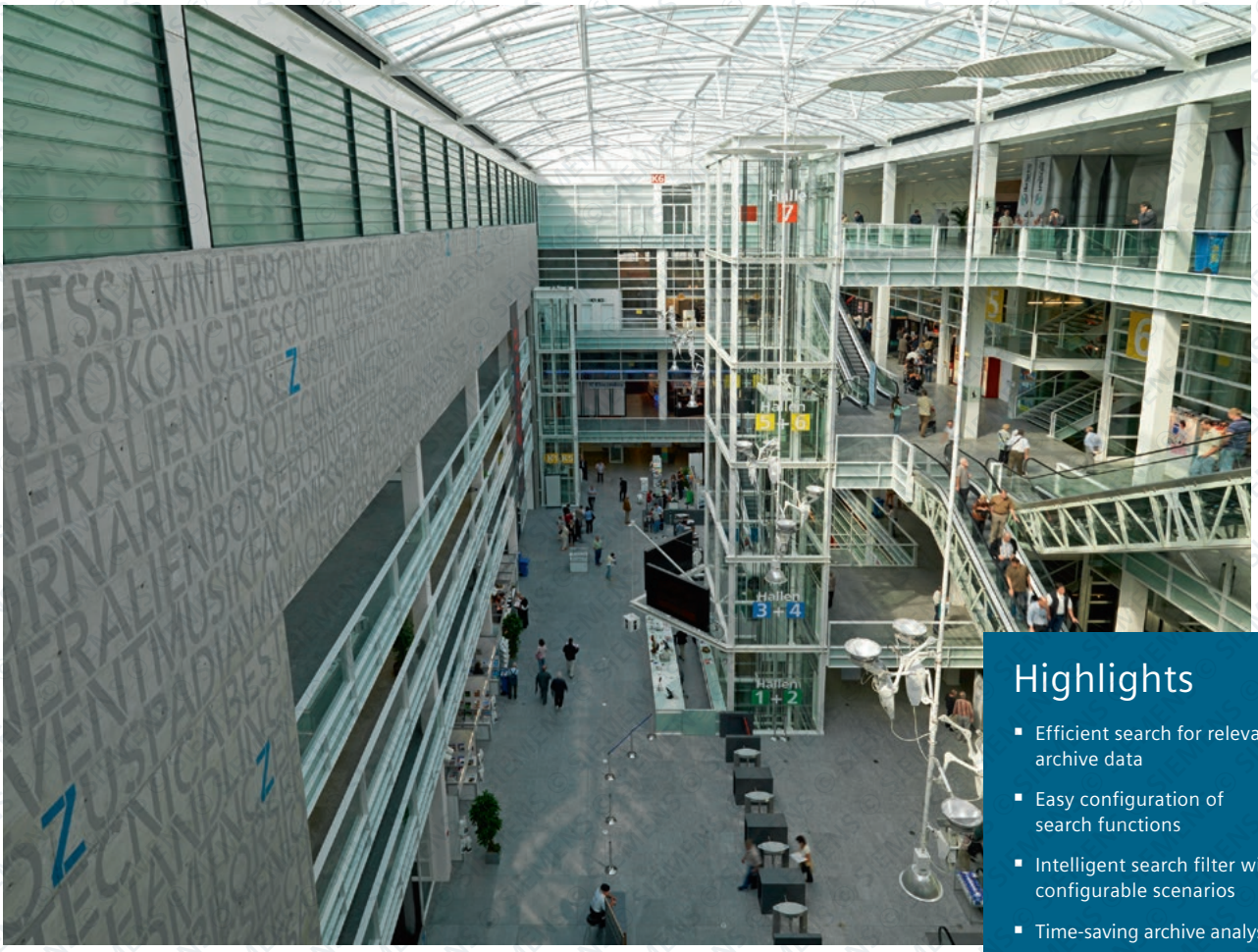
Dynamic text display

Highlights

- Central administration server for user data and system configuration
- Sinalyse as the watchdog for SiCCS
- Easy distribution and activation of modified configuration data to all servers
- Backup concepts for high-availability data
- Common Criteria standardization for high IT security
- Comprehensive alarm management

Common Criteria

Forensic search in the video archive



Highlights

- Efficient search for relevant archive data
- Easy configuration of search functions
- Intelligent search filter with configurable scenarios
- Time-saving archive analysis
- Convenient and intuitive user interface

Large quantities of video images are recorded, transmitted and stored. It must possible to locate the data relating to an event as efficiently as possible. Intelligent forensic search saves a lot of time, taking a matter of seconds to scan a database of recordings for events.

Benefits of intelligent analysis of video archives

Forensic search revolutionizes the quality of work done in video archives. Video images are searched with a range of adjustable parameters, allowing the situation to be analyzed quickly. Decisions can be made quickly on the basis of the located video images. Defined search screens are stored in a database so they can be used in future search jobs.

Metadata

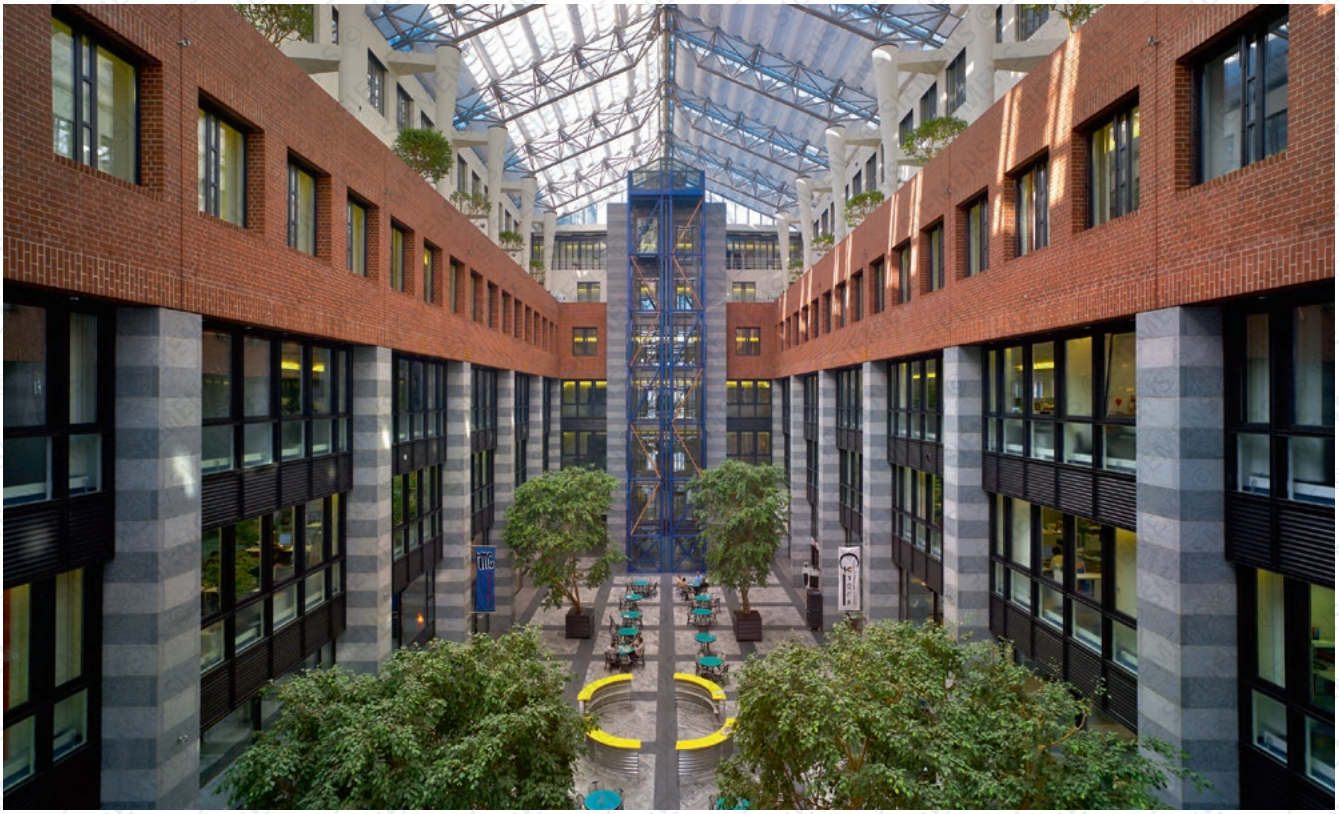
The video sensors have the task of analyzing image content and generating alarms, but they also create metadata describing all themes and objects in a scene and their characteristics. This metadata is streamed with the video over the network and stored in a database. The metadata can be used with the forensic search client to search recordings.

Search filter

Depending on the search object, specific criteria are selected such as object size, speed, bidirectional direction of movement, relative size and colour. Virtual fields or lines can be defined in the scene to further enhance the search function. Virtual fields can help track the route of vehicles for example. It is also easy to find objects crossing a virtual trip wire in a specific direction.

Intuitive graphical user interface

Straightforward navigation in the intuitive user interface makes it easy to configure the intelligent search functions. When search scenarios are created, multiple filters can be used in any combination in order to accurately locate the desired object properties.



Sicore – optical character recognition

Video-based optical character recognition solutions are used in many different applications.

Character recognition with intelligent analysis software

For number plate recognition, a Sicore solution is the obvious choice. Its strong image capture concept combined with the reading software guarantees peak recognition performance. The Sinalyse ANPR Pro or Sinalyse ANPR Ultimate software is used to evaluate and process the number plate data.

The data is cross-checked against blacklists and whitelists in the database, triggering actions, tripping contacts and starting search tasks. Sinalyse ANPR Pro is a standalone concept. The Sinalyse ANPR Ultimate application can be combined with SiNVR. In SiNVR, video data from an overview camera is stored alongside the number plate data.

Access control

The number plate details of authorized vehicles are recorded centrally. A camera installed close to a barrier detects the number plate of the approaching vehicle and cross-checks it against the database. If there is a match the barrier is raised.

Recognition of dangerous goods signs (HIN)

In road tunnels or sections of road where the consequences of accidents involving dangerous goods would be particularly serious, it is crucial to know what vehicles are in the danger zone and what they are carrying. Video-based character recognition reliably identifies the substances being carried, allowing the right steps to be taken if something out of the ordinary occurs.

Parking and access control

For parking and access control, data relating to the car park ticket and the number plate is linked. The vehicle can only exit using the ticket purchased for it. This makes it harder for thieves to operate in a car park. In many locations such as airports, it is necessary for security reasons to identify all vehicles entering a certain area and to record the time they leave.

Tolls

In toll tunnels or toll roads, number plate recognition is used as a deterrent. Unregistered drivers can be prosecuted for contraventions.

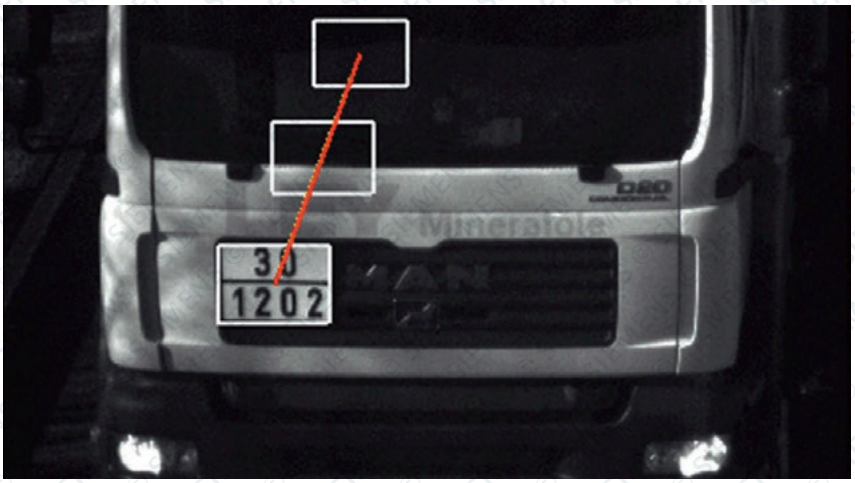
Vehicle recognition

In cross-border traffic, number plate recognition can be used for policing purposes. If stolen or wanted vehicles try to cross the monitored border, an alarm is triggered automatically. This prepares the border guards for potential hazards.

Number plate recognition for automatic barrier control

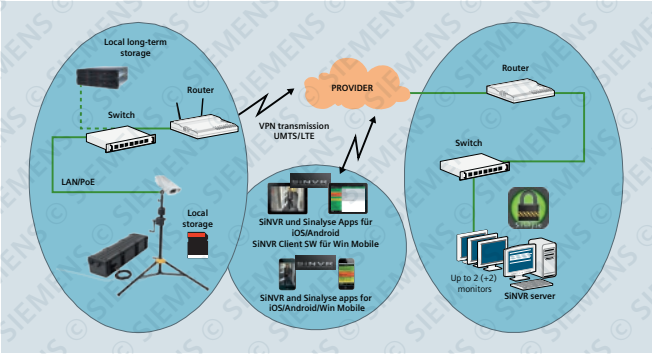
Highlights

- Number plate recognition at high speeds
- Used for parking control, detection of speed and dangerous goods, toll information
- Powerful analysis software Sinalyse ANPR Pro and Ultimate for integration with SiNVR
- Full functionality both day and night
- Software applications to control equipment such as car park barriers
- Database with blacklists and whitelists



Recognition of dangerous goods signs (HIN)

Mobile video system



Concept for mobile video solution: live image display, local and distributed image storage, image transmission, security aspects

The portable video solution for temporary use – at all times and in any location

Do you need to keep an eye on potential trouble spots at a local event, or monitor waste disposal, or check work on a building site etc.? The mobile video surveillance solution from Siemens, with its quick and easy installation, is the tool you need. UMTS or LTE video transmission provides maximum flexibility for sites without communication links. This means that surveillance measures can be planned with a short lead time and implemented efficiently. The well-designed and very compact equipment box can accommodate the very latest components and can withstand the worst weather conditions.

State-of-the-art camera technology

High megapixel colour cameras render images with high brilliance and colour fidelity. The latest Low Light technology delivers outstanding images in low-light situations. When you can see nothing but blackness, IR spotlights and thermal imaging turn night into day for video cameras. The cameras are easy to install on stands, masts, walls and ceilings.

Alarms on mobile devices

IVA and VIDA video analysis is the backbone of reliable video detection. Various algorithms like directional zones or line crossing detect events and send alarms to smartphones, tablets, PC clients and control centres. The associated applications support live view functionality for direct access to the video system.

SiNVR Open Video Platform for mobile use

SiNVR is a state-of-the-art video management system for administration, archiving and display of video signals. The system is scalable and customizable with video channels and functions like georeferenced site plans, forensic search, pixellation, data redundancy, etc.

VPN and Sinalyse Watchdog for secure image transmission

The dual security concept is a measure of how seriously security is taken. To guarantee secure transmission across the Internet and in networks, the video signal is tunnelled with VPN. The Sinalyse watchdog also monitors the IP components and their applications. For example, a break in communication is detected immediately and push notifications are used to inform mobile devices and PC clients.

Flexible data storage

The video data can be stored locally on a memory card in the camera or in a video server. The webcam function could document the progress of construction work in this way, for example. The relevant video images are stored on an FTP server. Access to the video images is very straightforward. You can use a browser to access the video archive in the camera directly. Event searching is also very easy with the SiNVR client on Windows tablets and PCs.

Programmable user interface

ONVIF
Driving IP-based physical security through global standardization

Full HD 1080

Highlights

- Flexible use of weather-proof components
- Compact equipment box for a complete system
- The latest remote clients (smart-phone, tablets, etc.)
- Local and distributed storage concept
- Battery charger for free-standing operation (optional)

Intelligent IP video management tailored to your needs

Highlights

- Easily extendable as business needs change
- Consolidated overview over multiple locations for increased situational awareness
- Pre-defined policies and procedures in response to events
- Multistage video storage including video grooming

Increasing security breaches and the intensity of threats, combined with more stringent regulations and an ever-increasing amount of video data to be managed, are just some of the challenges that today's video management systems need to provide an answer to. The advanced video management system Siveillance™ VMS from Siemens allows efficient visual verification of events. Its modular structure and scalability make it easy for any organization to adapt to changing needs. The emphasis on openness enables Siveillance VMS users to perform any necessary upgrades and modernizations in a cost-effective manner. To address the specific requirements of small and medium-size businesses up to complex deployments, Siveillance VMS is available in three versions: VMS 100, VMS 200 and VMS 300.

Siveillance VMS 50
A powerful solution for small to medium-size installations

With more than 100 features and functions, the Siveillance VMS 50 system is designed for small to medium-size installations requiring robust single-server surveillance software with full functionality and advanced management, flexible scheduling, rapid searching and analysis. The system supports up to 48 cameras simultaneously with a large number of network video and computer hardware devices.

Siveillance VMS 100
Extendable surveillance for small to medium-size installations

Best suited for small and medium-size installations, Siveillance VMS 100 provides a complete visual overview of up to 128 cameras. Using scheduled and event-driven rules, a single interface allows users to easily automate security actions and control external systems, reducing the amount of manual tasks required.

- Increases operator productivity via a consolidated overview of security installations
- Ensures intuitive operation through the Alarm Manager's clear overview and appropriate actions
- Easily extendable as business needs change and grow

Siveillance VMS 200
Powerful control for advanced surveillance

Siveillance VMS 200 has a powerful central management interface, allowing large systems with multiple recording servers to be efficiently managed as one uniform system.

With multilayered maps and the add-on option of the Siveillance VMS monitoring wall, the software provides a consolidated view over multiple locations. Ideal for operators who want sophisticated live monitoring, Siveillance VMS 200 facilitates efficient alarm handling and the ability to bookmark suspicious incidents for forensic post-incident review.

- Centrally manages and controls all connected cameras, devices, storage and users via a single user interface
- Automates multiple aspects of the system-based predetermined policies and procedures in response to events, minimizing the need for manual control
- Operates with high redundancy for increased availability, including edge storage in the event of a network or server failure
- Allows you to efficiently manage video data by utilizing markers and descriptive notes for the quick sorting and archiving of video data

Siveillance VMS 300
High performance for high security

With its centralized management of recording servers, users, storage units and devices, Siveillance VMS 300 is designed for large-scale and high-security deployments with unlimited cameras and servers. Its centralized management interface enables efficient administration of the system, including all cameras and security devices, regardless of the system's size or geographical distribution across multiple sites.

- Ensures that video recording is never interrupted using fail-safe recording servers and redundant management servers
- Provides multistage video storage, including video grooming possibilities, for efficient long-term storage, without interfering with active video
- Secures availability of video for investigations via evidence lock, overriding normal video retention and grooming policies
- Enables encryption of sensitive data

Investment protection, better security, higher efficiency

- Lower total cost of ownership
- Flexible and scalable system
- Cost-effective upgrade and modernization

- Increased operator productivity
- Intuitive operation
- Efficient management of video data

- Ensured security of people and assets
- Compliance with local regulations
- Enhanced information
- High system redundancy and availability
- Safe handling of supporting evidence

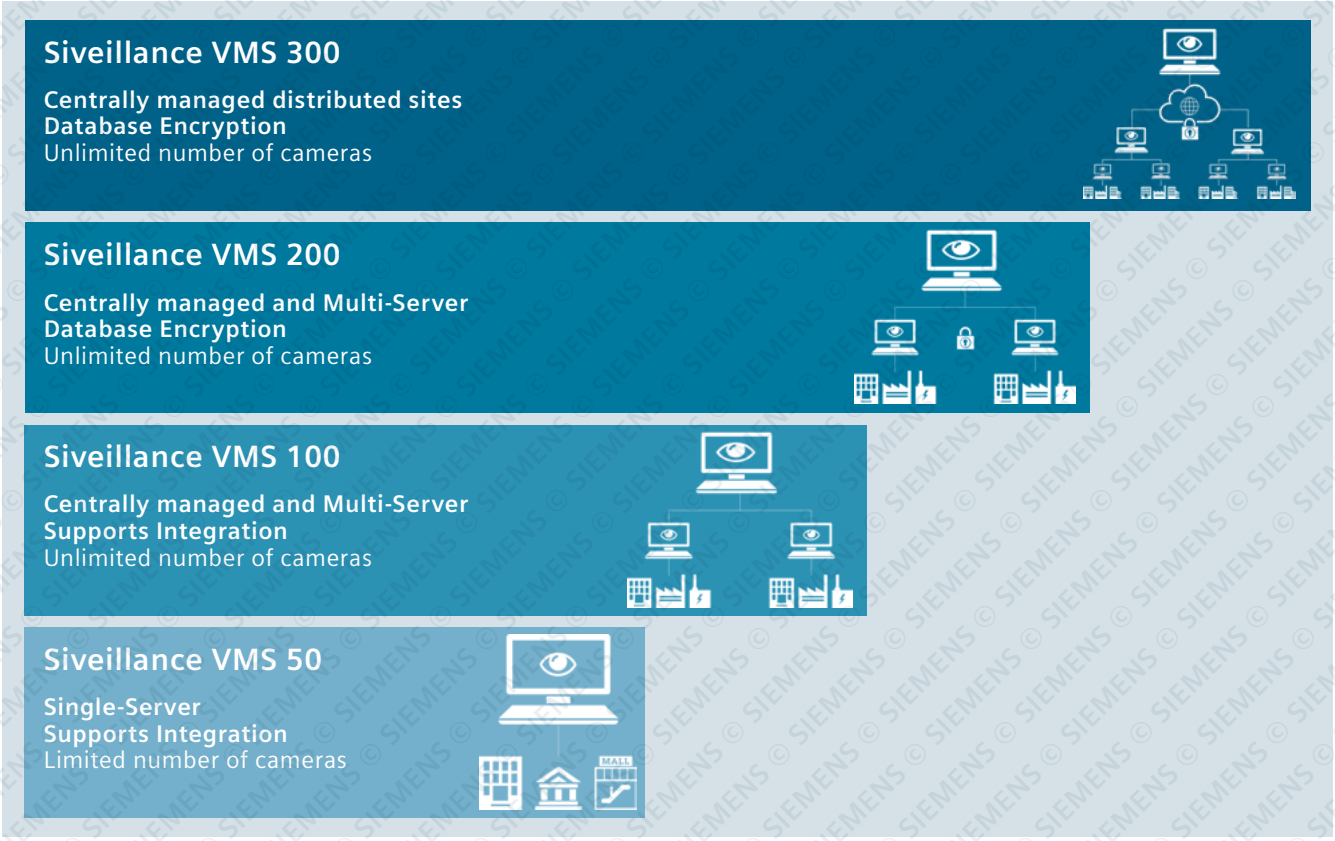
Siveillance VMS has a unique approach to tightening up security management for critical infrastructures, large areas, public areas, buildings and public safety authorities.

Highlights

- Intuitive operation for increased operator productivity
- High system redundancy and availability to maximize uptime and security of people and assets
- Flexible and scalable system providing lower total cost of ownership

	VMS 50	VMS 100	VMS 200	VMS 300
Recording server manager	•	•	•	•
Alarm manager	•	•	•	•
Smart map	—	•	•	•
Event control	•	•	•	•
Edge storage	—	•	•	•
Monitoring wall	—	—	•	•
Multi-live streaming	—	—	•	•
Manual bookmarking	—	—	•	•
Multicast support	—	—	•	•
Fail-safe event server redundant cluster	—	—	•	•
System monitor	—	—	•	•
Fail-safe recording server	—	—	—	•
Evidence; lock, retrieve set retention times	—	—	—	•
Rule-based bookmarking	—	—	—	•
Data grooming	—	—	—	•
Multistage storage	—	—	—	•
Video database signature	—	—	—	•
Video data encryption	—	—	—	•
Tiered management rights	—	—	—	•
Time schedule control	—	—	—	•
SNMP trap	—	—	—	•

System overview



Centrally managed sites, support for integrating an unlimited number of cameras

Siveillance VMS is a powerful IP video management system family ranging from small and medium-size solutions to large, complex installations. The Siveillance VMS portfolio contains four versions: Siveillance VMS 50, VMS 100, VMS 200 and VMS 300. With these four versions, Siveillance can be customized to meet the customer's specific needs. As the customer's requirements grow, the Siveillance VMS can simply be upgraded from one version to another so that the system can be expanded from a small system with just a few cameras to a large, complex solution.

User friendliness

The Siveillance VMS Video Client and Management Client are clearly structured and easy to use for efficient and problem-free operation. These components are based on an intuitive, rule-based workflow engine which makes even complex systems easy to run.

Siveillance VMS meets the operational needs of a video management system with user-friendly operation. Comprehensive alarm handling and video handling scenarios can be processed quickly using the intuitive GUI (Siveillance VMS Video Client). The workflow flexibility of the Siveillance VMS Management and Video Clients means the events and alarms can either be processed straight away or postponed.

Scalability

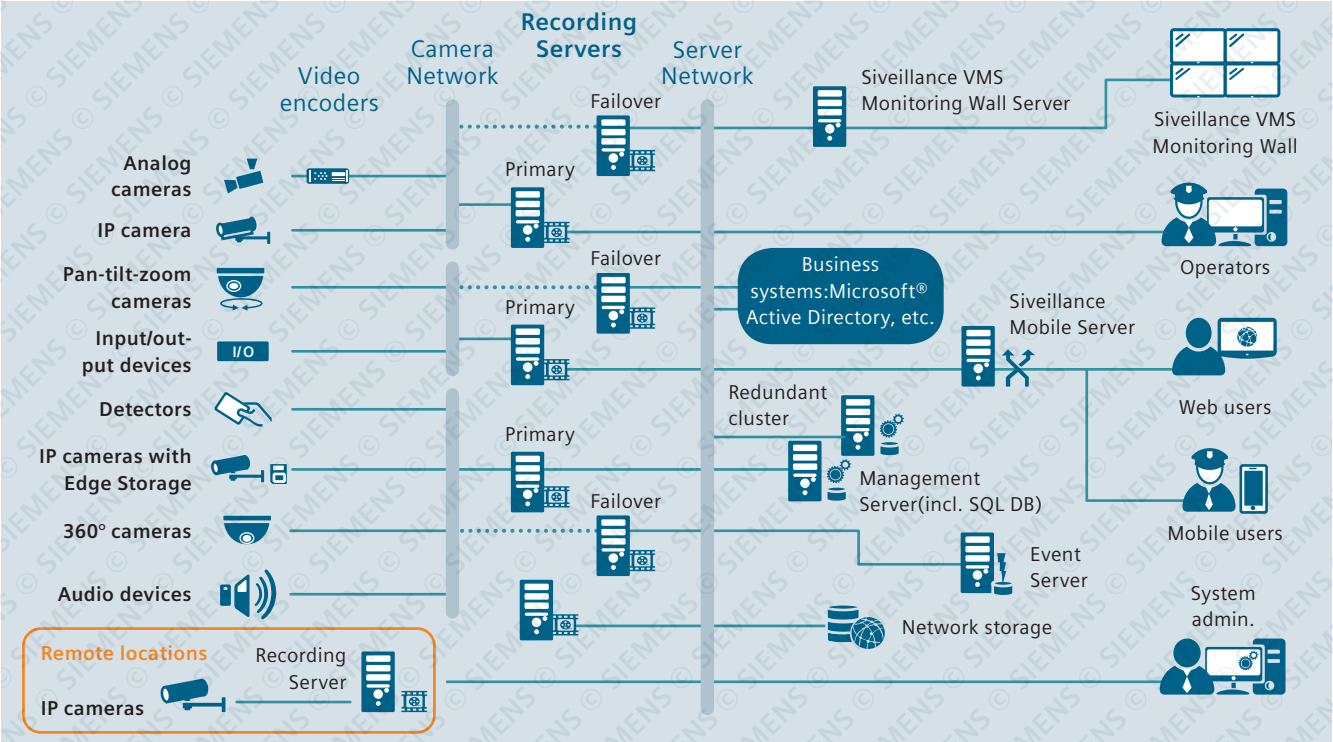
Siveillance VMS supports projects with small systems or with large, extended Multi-Server and/or distributed systems.

Stability – server redundancy

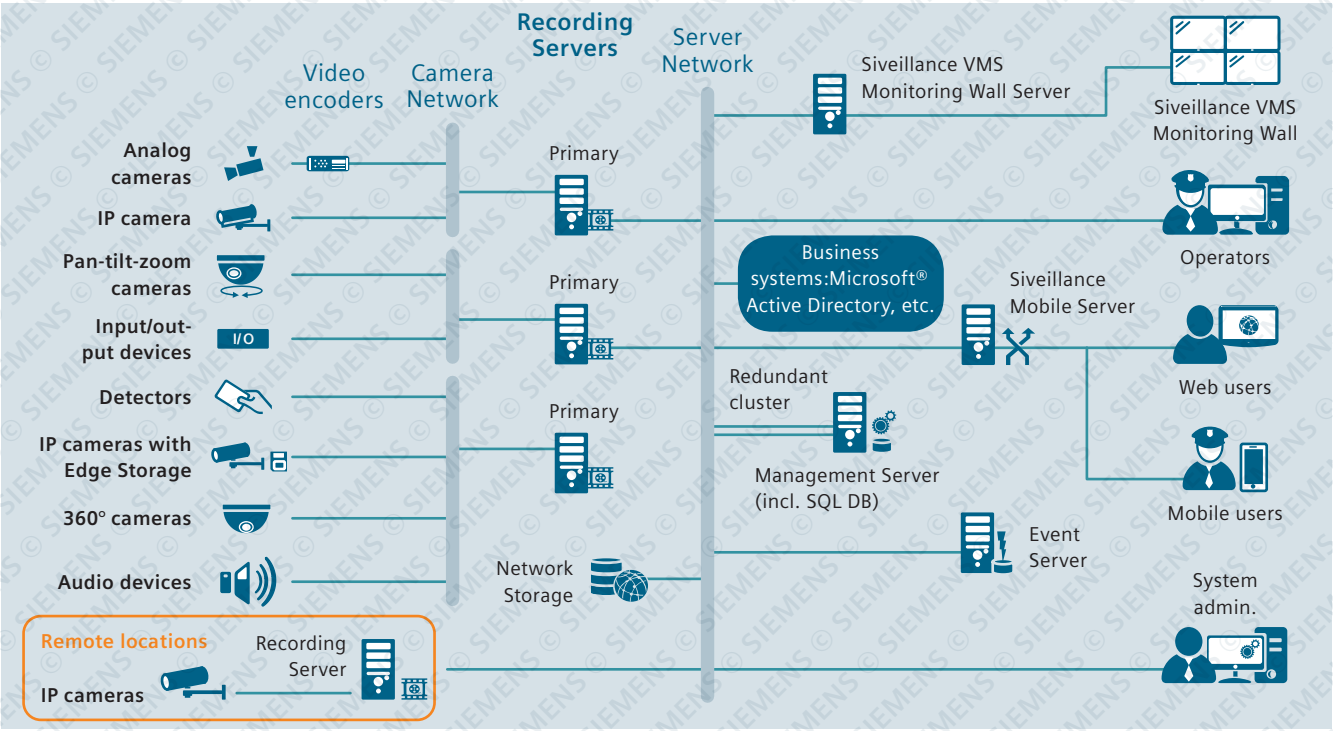
Siveillance VMS 200+300 offers two redundancy levels for the recording servers: cold and hot standby outage protection. Both mechanisms provide fully automatic outage protection which is transparent for the user, with automatic synchronization when the system is restored after a hardware or system failure.

- Cold standby outage protection is a cost-effective redundancy solution in which one or a group of failover recording servers act as a backup for one or more recording servers.
- Hot standby outage protection is a high-security redundancy solution in which a dedicated failover recording server is preconfigured, and only minimal interruptions in recordings and livestreams are permitted. This provides flexibility in terms of the recording servers used in the Siveillance VMS Management and Video Client.

Siveillance VMS 300 and Siveillance VMS 200



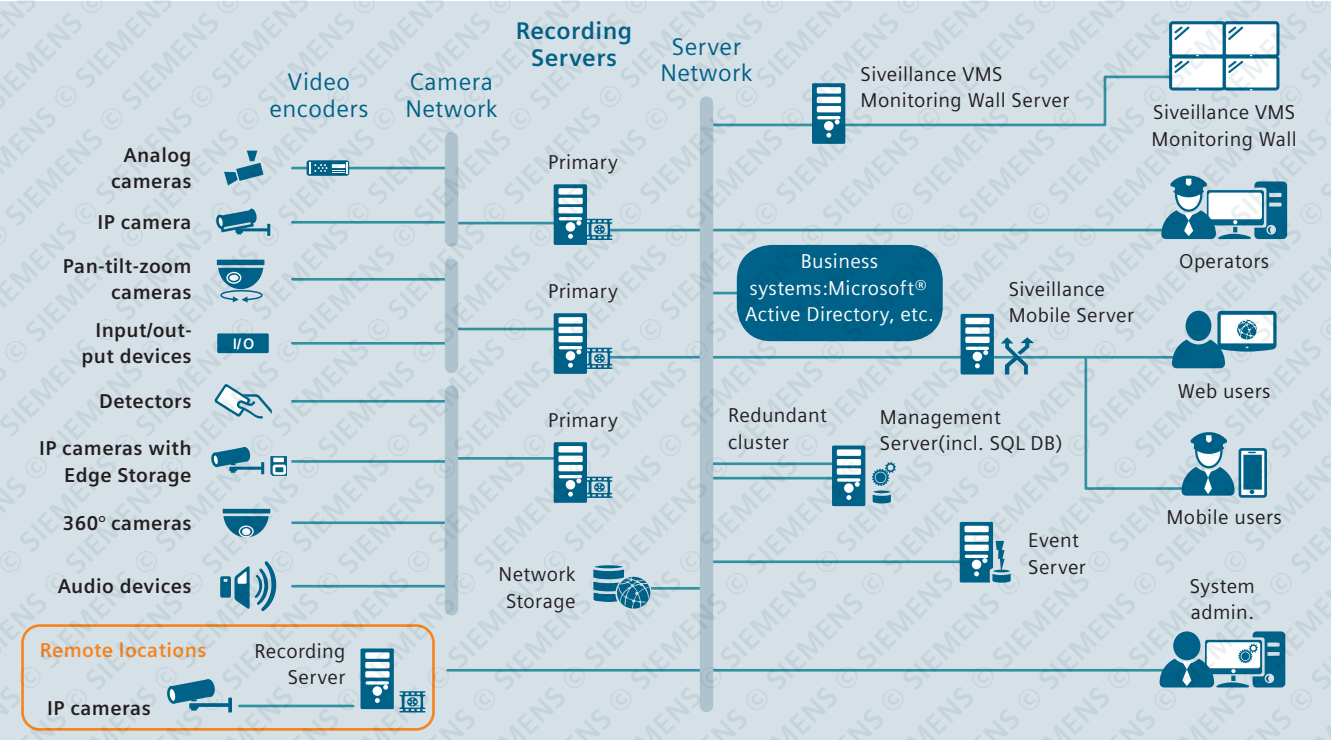
Siveillance VMS 300
For large, distributed site solutions, centrally managed and distributed sites Unlimited cameras and recording servers, failover recording, monitoring wall included



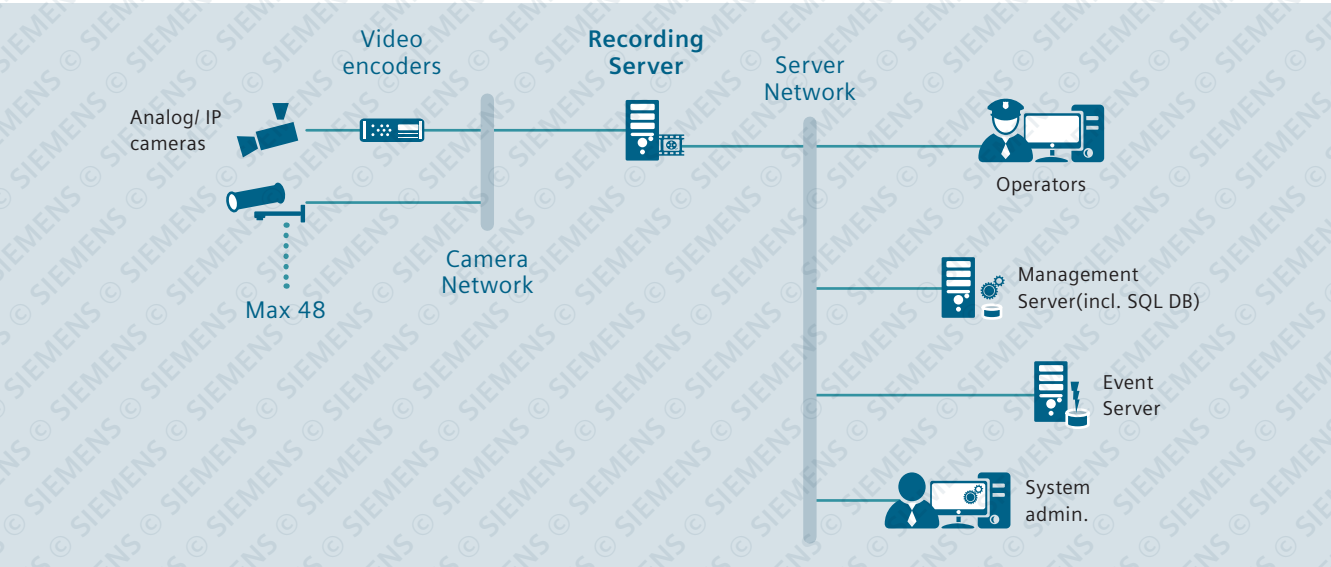
Siveillance VMS 200
Centrally managed and Multi-Server. Unlimited cameras and recording servers

The Siveillance VMS 200 and VMS 300 systems were developed for centrally-controlled, dispersed solutions (VMS 300) and centrally-controlled Multi-Server solutions. Both versions are intended for large installations with multiple sites and servers requiring 24/7 surveillance and supporting multiple devices. The solution provides central management of all equipment, servers and users, and supports an extremely flexible rule engine which is controlled by schedules and events.

Siveillance VMS 100 and Siveillance VMS 50



Siveillance VMS 100
For medium-size to large solutions Centrally managed and Multi-Server Unlimited cameras and recording servers



Siveillance VMS 50
For small to medium-size solutions Single-server, up to 48 cameras, centrally managed as a uniform system. Planned and event-based rules, actions which are easy to automate, smaller number of manual tasks

The Siveillance VMS 100 system is intended for small to medium-size installations requiring robust single-server surveillance software with full functionality and enhanced management, flexible scheduling, rapid searching and analysis. The system supports unlimited cameras with a wide range of network video cameras and encoders.

Siveillance VMS main components (all versions)

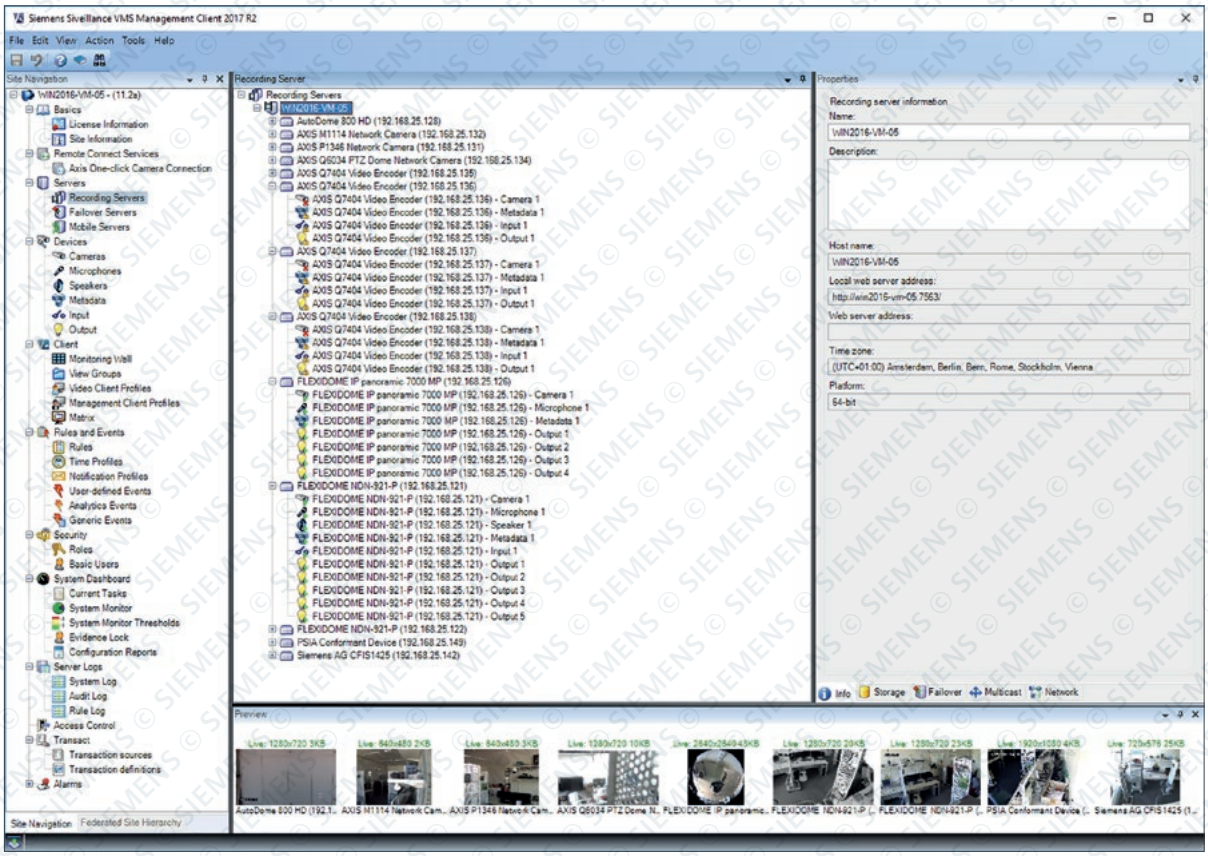
The Siveillance VMS consists of the following main components:

- **Management server** – the centre of the installation, one or more servers
- One or more **recording servers** (single VMS 100, multiple VMS 200 & 300)
- One or more **Management Clients**
- One or more **Siveillance VMS Video Clients**
- One or more **Siveillance VMS Web Clients** and/or **Mobile Clients** (as needed)

The system contains a fully integrated matrix function for distributed viewing of videos from any camera in the surveillance system, on any computer on which Siveillance VMS is installed. For distributed sites, the Siveillance VMS system can be installed on virtual servers or multiple physical servers.

The system makes it possible to include the standalone Siveillance VMS Video Client/Player when supporting video evidence is exported from the Siveillance VMS Video Client. The Siveillance VMS Video Client/Player allows the recipients of the supporting evidence (e.g. the police, internal or external investigators, etc.) to search and play back the exported recordings on their computer. The system also supports IPv4 and IPv6.

Management Client



Siveillance VMS has a Management Client which is the same for all systems. It is an intuitive tool allowing all system requirements to be adjusted, from camera settings to rule-based alarms and events.

Video Client

Video Client example of use

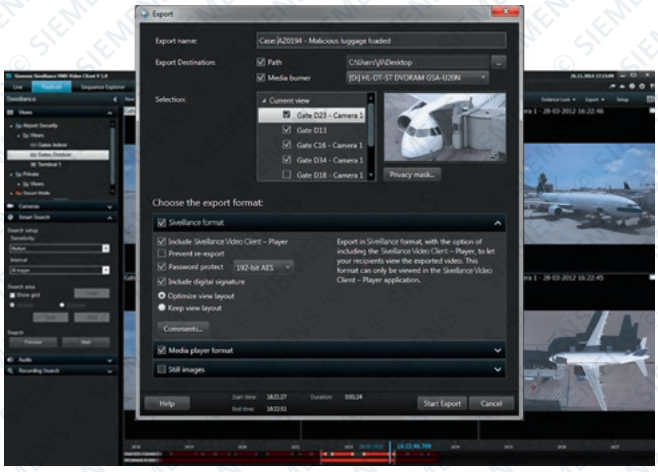
The Siveillance VMS Video Client is an application which is easy to use for viewing videos. The modernized user interface contains intuitive and powerful functions that can handle any surveillance system whatever the size.

- The work environment can be optimized for the various duties and needs of the operating personnel.
- Advanced investigation tools allow users to examine incidents quickly and accurately, with a video timeline that is easy to navigate.
- The Storyboard function, a complex export option, makes it possible for users to link relevant video evidence with the documented incidents.
- The client is available in 27 languages so operators can use the application in their own language.

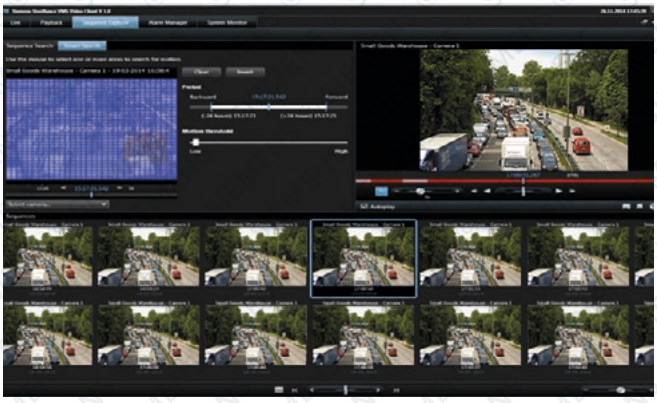
In the Siveillance VMS Video Client window, a live video can be viewed in the "Live" tab, and recorded videos in the "Playback" tab. When you click the Live tab, the Siveillance VMS Video Client connects to the server of the surveillance system and displays the live video of the cameras in the selected area. If more than one physical display is connected to the computer, the images can be sent to different windows so they can be viewed side by side.

Main features of the Siveillance VMS Video Client:

- Live tab for viewing live videos
- Playback tab for viewing video recordings
- Sequence Explorer tab for navigating video sequences and bookmarks
- Alarm Manager tab for investigating incidents and alarms
- System Monitor tab for viewing system information



Example of Video Client export



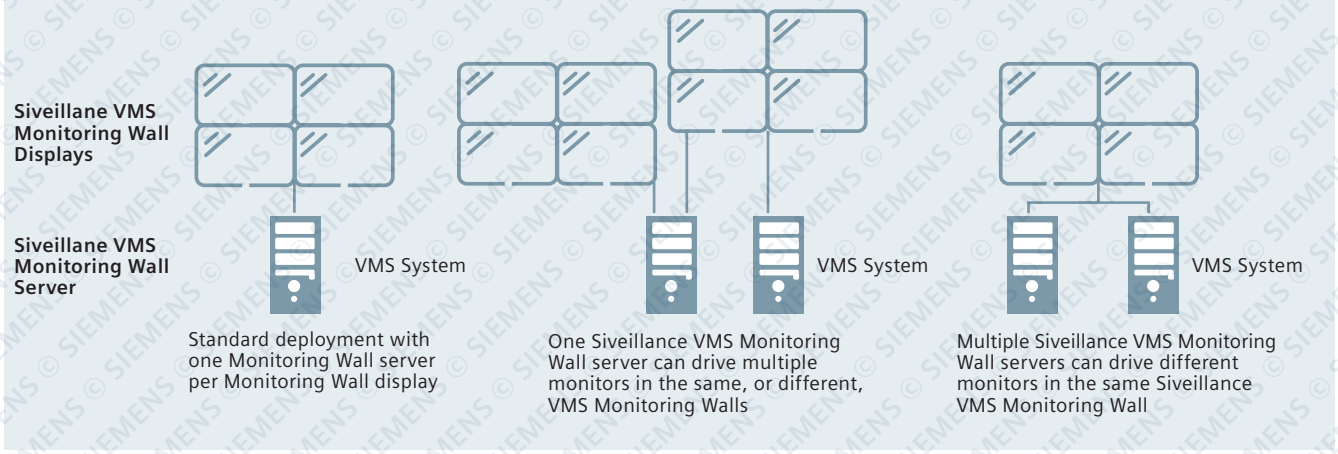
Example of Video Client Sequence Explorer

Monitoring Wall

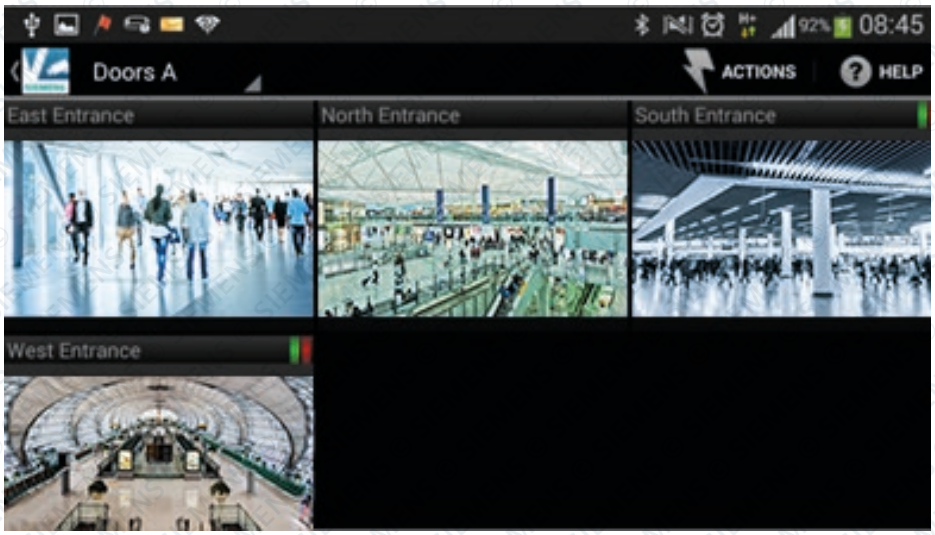
The Siveillance VMS Monitoring Wall is a versatile video wall solution that does not rely on expensive proprietary hardware. The Siveillance VMS Monitoring Wall is fully integrated with the Siveillance VMS Video Client and its map functions. It is based on a logical viewing concept which allows Monitoring Walls to be installed in multiple locations while remaining under central control.

- The Siveillance VMS Monitoring Wall is an add-on solution that works seamlessly with the Siveillance VMS 200 and VMS 300 platforms and also with the Video Client Viewer. (VMS 100 does not support the Monitoring Wall)
- The video wall uses standard servers and monitors, so the system can be configured freely at an acceptable price. (Included with the VMS 300 at no extra cost)
- It is easy to create a layout using the Monitor Wall Builder. You have dynamic control of the layout, and to add content, you simply drag & drop cameras into the monitor view. You can also create rules, process events and configure views to create unparalleled situational awareness.

The system supports any combination of monitors in a video wall, any number of video walls in the system, and any physical location of the video wall.



Web Client



The Siveillance VMS Web Client is an intuitive, Internet-based interface for viewing, playing back and sharing videos. It provides instant access to all the main functions and is easy for users of all abilities to master and operate.

The Siveillance VMS Web Client provides remote access to the surveillance system from all standard browsers and computer operating systems. It runs on any Internet-enabled computer or device without the need to install special software. It is also scalable and delivers a great user experience in systems with many users.

- Intuitive user interface
- Convenient to use anywhere
- Optimized user interaction

Mobile Client

The Siveillance VMS Mobile Client is a free app for Apple®, Android™ and Windows Phone 8 devices, allowing users to view videos instantly on their smartphones or tablets. Siveillance VMS Mobile works with wifi, 3G or 4G connections. Users can view, play back and export videos, control outputs and stream live video from the camera, so they can stay in touch from wherever they are.

Federated Architecture

Siveillance VMS Federated Architecture can be used to connect VMS 200 and VMS 300 systems in a parent (VMS 300) / child (VMS 200 or VMS 300) hierarchy from linked sites. Each site in the hierarchy is a standard Siveillance VMS 300 or VMS 200 system, complete with management server, SQL server, recording server(s), outage protection server(s) and cameras. Once a system becomes part of the hierarchy, all the individual systems appear as one complete system, although they can still be controlled as separate Siveillance VMS systems.

Federated Architecture means that users, depending on their user rights in the individual systems, can access video, audio and other resources across all other individual Siveillance VMS 200 and VMS 300 systems in the hierarchy. Administrators are also able to control all the systems in the hierarchy centrally via remote access, again depending on their user rights in the individual systems.

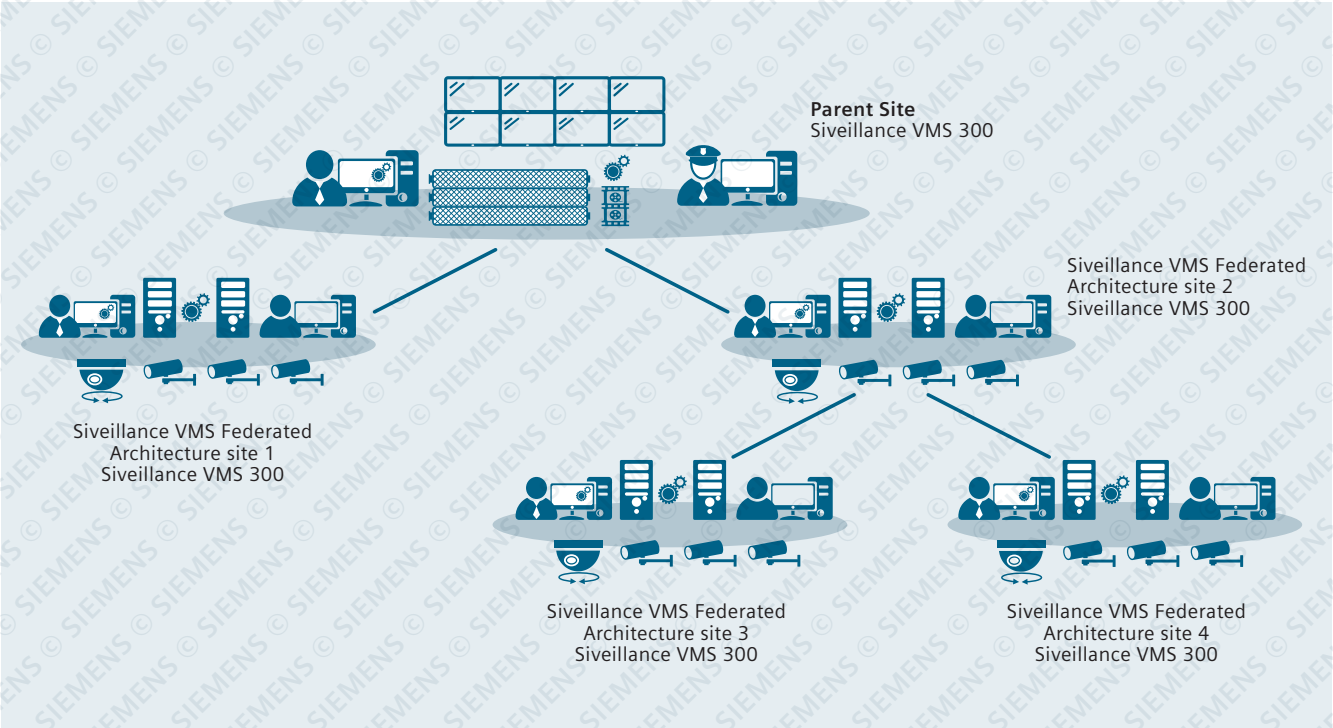
Siveillance VMS Federated Architecture is a solution for large installations spanning multiple buildings, a campus or an entire city. This gives major organizations unlimited scalability, flexibility and accessibility for more efficient and cost-effective video surveillance across multiple sites. The number of sites that can be added to the hierarchy is unlimited. You can also decide how you want to connect them.

Main benefits of Siveillance VMS Federated Architecture:

- Each site can be conceptualized independently of the others, only incorporating the cameras at the site and following user requirements.
- Each site can be configured independently of the others, reducing the complexity of the system as a whole.
- User and administrator rights can be assigned on a site-by-site basis.
- Users in a central site can access the entire federated system seamlessly via single log-in.

Example of Federated Architecture

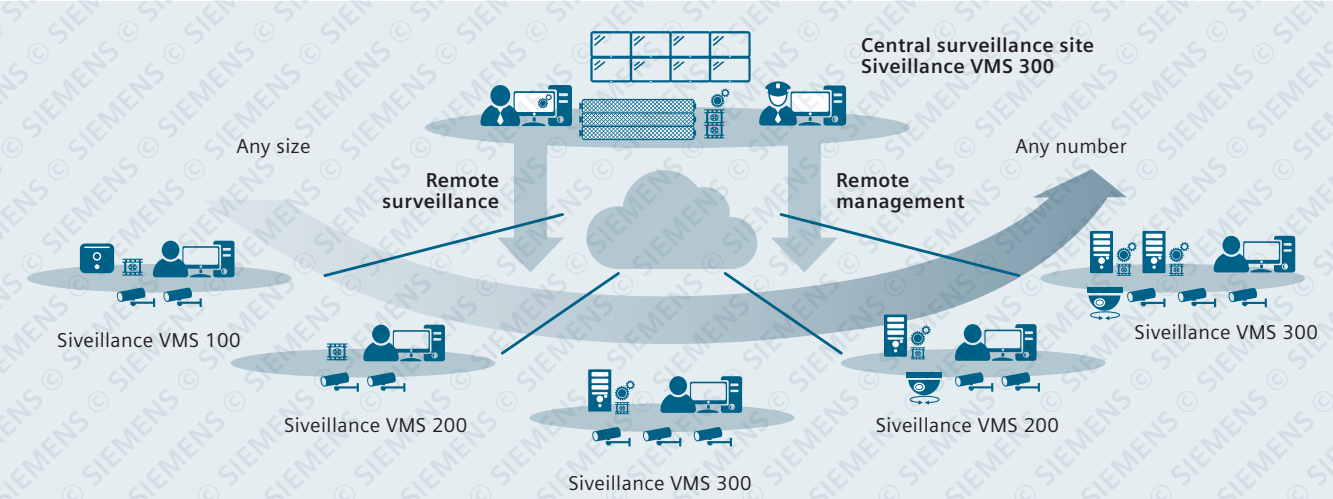
Local users in a remote site can access their own site's system even if the connection to the central site is lost.



Interconnect Architecture

Siveillance VMS Interconnect is a unique concept allowing the VMS products (VMS 100, VMS 200 and VMS 300) to connect with Siveillance VMS 300. This means that a large-scale, geographically dispersed video surveillance system can be built. Each individual surveillance system is procured as normal on the basis of functionality and price, yet the benefits of a centralized surveillance system are retained. Siveillance VMS Interconnect is similar to Siveillance VMS Federated Architecture in many ways, but the system architecture is different and many other functions are provided:

- Supports cloning of system configurations
- Video and audio recordings can be obtained over an unreliable network connection to the remote site
- Video and audio recordings can be obtained from a connected system to the central system
- Direct playback of recordings from the remote system
- Time-triggered, event-triggered or manual access to recordings in the remote system by the central system
- Short and constant log-in duration regardless of the number of connected systems
- Full camera rights for the networked cameras
- Remote administration of the Interconnect systems



Aspect	Interconnect	Federated Architecture
Main application	Optimized for connecting many small sites	Optimized for connecting a smaller number of large sites
Compatible products	All embedded products of Siveillance VMS, Husky NVRs and Arcus	Siveillance VMS 200 and Siveillance VMS 300
Scalability	An unlimited number of remote sites can be linked with a central Siveillance VMS 300 system	An unlimited number of federated sites can be linked with a central Siveillance VMS 300 system
Video storage	Video can be stored in a remote or central system with a combination of manual, event-triggered or time-triggered uploads	Storage only possible in the remote system. Video data transfer is not possible for storage
Network requirements	Tolerates interruptions to network connections. Video can be uploaded when the network is available, with an option to limit the bandwidth used (1)	Stable network connections are necessary between federated sites (2)
IT dependencies / user management	Users in a remote system can be authenticated with basic authentication in Siveillance VMS, Windows Users or Active Directory Users, and domain trust is not required between the central systems and linked remote sites	Requires users to be defined in a shared Active Directory domain, or domain trust to be established between the central and federated sites
Administration	Administration of remote sites via integrated remote desktop connection	Central administration via site navigation in the Management Client of the federated sites
Map and alarm management	Maps and alarms are defined in the central system	Maps and alarms are defined in each federated site and displayed together in the video client
Bookmarking	Bookmarks can be added centrally to all networked cameras regardless of the type of connected system	Bookmarks can be added centrally to all federated cameras, with bookmarks stored in the federated system
Licensing	An Interconnect device licence is required for each camera in a networked system that is made available in the central Siveillance VMS 300 system	Federated Architecture can be used freely and requires no additional licensing apart from the normal Siveillance VMS licence

Notes:
1. Sufficient network bandwidth is required for live viewing of networked cameras and playback of videos stored in remote systems
2. Sufficient network bandwidth is required for live viewing and playback of federated cameras

Main features

Main features of Siveillance VMS 300 (only)

- **High availability failover recording server:** Redundancy option for recording server to guarantee maximum system availability and minimum interruptions to video if there are problems with the system. There are two modes: cold standby and hot standby.
- **Evidence lock:** Guarantees availability of videos for investigations by overriding normal video backup and retention policies.
- **Multistage storage:** Unique data storage solution which combines outstanding performance and scalability with video data management for cost-effective long-term video storage, with the option to encrypt and digitally sign stored video and audio recordings.
- **Partial control rights:** Partial control rights can be assigned to system administrators from the Management Client.
- **Rule-based bookmarking:** Formulates rules to create particular bookmarks.
- **Digital signatures:** The video database of the recording server can be used to verify the recorded videos and to prove that they were not tampered with when they were saved in the VMS 300 system or after they were exported.
- **Video data encryption:** The data can be protected.

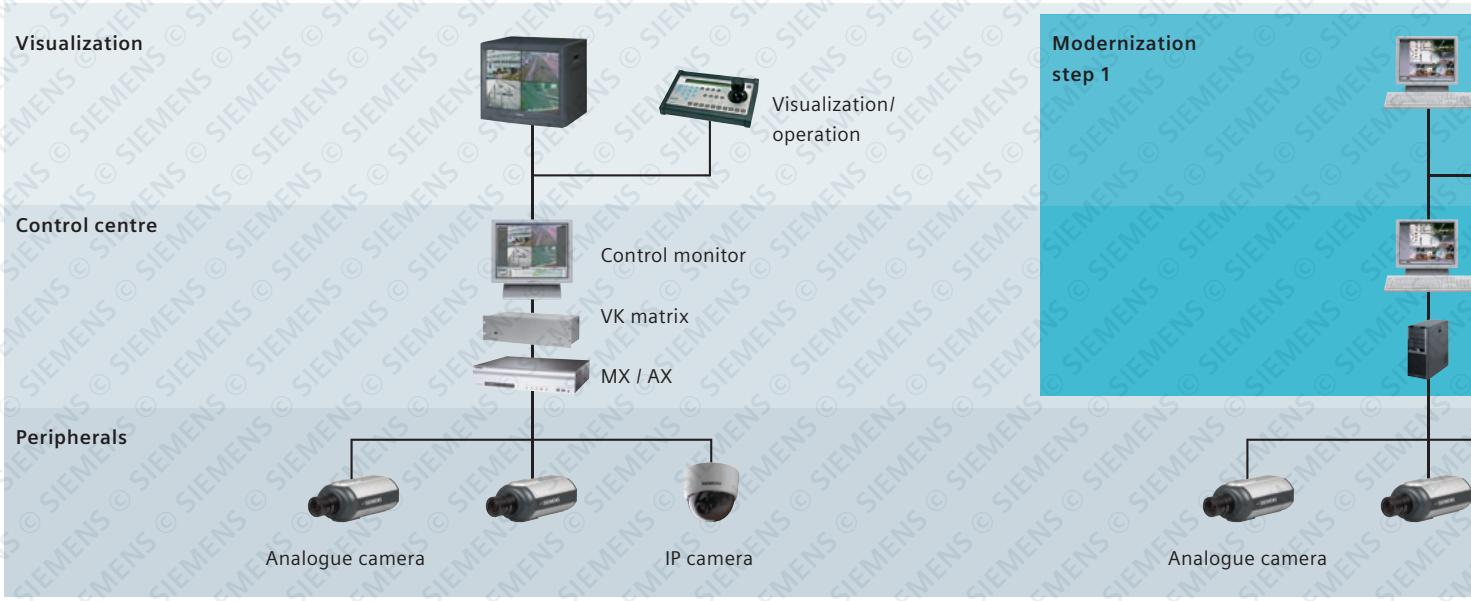
Main features of Siveillance VMS 200 and VMS 300

- **Unlimited scalability:** Siveillance VMS 300 and VMS 200 support an unlimited number of users, cameras, servers and sites, and allow any installation to be seamlessly extended.
- **Siveillance VMS Interconnect:** This unique concept allows all Siveillance VMS versions to be linked with Siveillance VMS 300, for central surveillance across geographically dispersed sites.
- **Siveillance VMS Federated Architecture:** The system concept allows a number of individual Siveillance VMS 300 and VMS 200 systems to be connected to a central VMS 300 system in a hierarchical structure, providing unlimited scalability and central administration.
- **Siveillance VMS Monitoring Wall:** Flexible and hardware-independent video wall function which integrates seamlessly with the Management Client and the Siveillance VMS Video Client.
- **Metadata support:** Supports receipt, storage and export of metadata, including metadata from video analyses from cameras and site information in video push from the Siveillance VMS Mobile Client.
- **Edge store:** Camera-based storage to supplement central storage in the recording servers. Flexible video access can be time-triggered, event-triggered or manual.
- **64 bit recording server:** Multiple cameras can be run on a single recording server.
- **Unlimited solution for Multi-Server and multiple sites:** Siveillance VMS 300 supports an unlimited number of users, cameras, servers and sites, allowing any installation to be extended as necessary.
- **System upgrades:** Supports trouble-free upgrades from one Siveillance system to a higher version (e.g. Siveillance VMS 200 to Siveillance VMS 300).

Main features of Siveillance VMS 100, VMS 200 and VMS 300

- **Built-in video motion detection:** Video recording is often started when motion is detected in order to avoid unnecessary recordings.
- **Alarm manager:** Provides a central overview of system events, status and any technical issues.
- **Flexible event rule engine:** Configures different events and rules to meet application requirements.
- **Archiving options, for example in network storage:** A number of storage options are available to back up video information.
- **SiteIQ PSE Analytics:** Included free of charge – Siemens high-end outdoor security analysis.

From analogue technology to digital IP – with SiNVR video management solutions



Analogue video technology is increasingly reaching its performance limits. By switching to digital video security solutions, you can combine your existing analogue installation with the digital world.

A step into the future

Modern digital video security components can be directly integrated in IP networks, giving you maximum freedom of movement as you adapt your system to meet increased security requirements. As a leading supplier of security solutions, we provide sophisticated, tried-and-tested migration concepts. Benefit from our experience of numerous migration projects to ensure a smooth transition to a state-of-the-art video surveillance system.

Modernization brings many benefits

Migrating to digital IP-based video security solutions removes the technological limitations of analogue installations and instantly improves system performance significantly in terms of security. Good reasons to integrate the latest technology in stages.

Investment protection

Minimal outlay on CCTV/IP cabling:

- Direct installation in existing IP infrastructure
- Existing cabling can be used

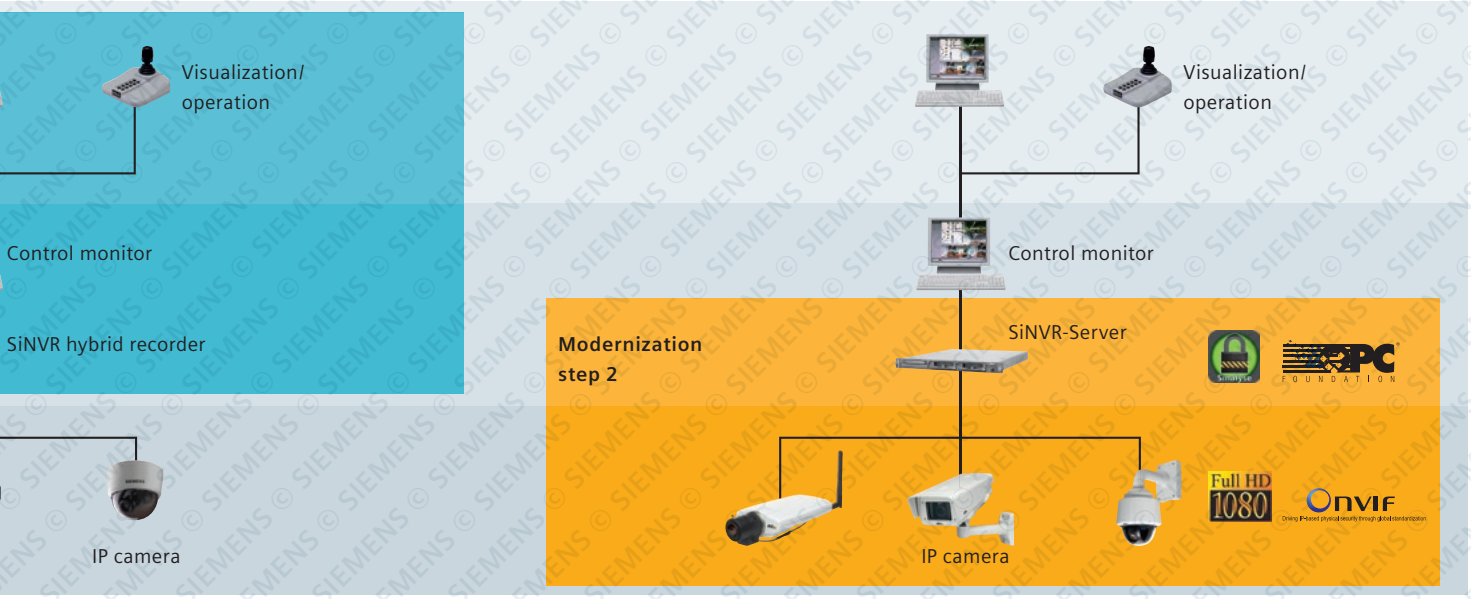
Flexible in use

Video formats and compression levels can be selected flexibly depending on the network bandwidth and storage space:

- Image quality much better than Full HD
- Data transmitted with no range limit

Easy to use and extend

- Intuitive user software
- Scalable video workstations
- Unlimited LAN extension possible



Highlights

- State-of-the-art image analysis software
- Monitoring/control of software and hardware functions
- Integration with Siseco security management system and/or third-party systems via OPC
- Interoperability with other security-relevant fire protection and safety systems
- ONVIF compliant – to integrate the vast majority of IP cameras

Intrusion

buildingtechnologies.siemens.com

14.1. Introduction	538
14.2. Intrusion detection system	538
14.2.1. Basic principle of intrusion protection	538
14.2.2. Protection concept	538
14.2.3. Structure of an intrusion detection system	539
14.2.4. Detector line	539
14.2.5. Sabotage resistance	540
14.2.6. Confidentiality	540
14.3. Standards and requirements	541
14.3.1. Standards for intrusion detection systems	541
14.3.2. Requirements for intrusion detection systems	541
14.3.3. Test and certification authorities for intrusion detection systems	541
14.4. The project	541
14.4.1. Configuration guidelines	541
14.4.2. Project workflow	541
14.5. Detection principles	542
14.5.1. Seismic detectors	543
14.5.2. Glass break detectors	543
14.5.3. Alarm glass	543
14.5.4. Seismic detectors	544
14.5.5. Passive infrared detectors	544
14.5.6. Infrared barriers	545
14.5.7. Ultrasonic motion detectors	545
14.5.8. Dual motion detectors (IR/US)	545
14.5.9. Dual motion detectors (IR/MW)	545
14.5.10. Microwave barriers	546
14.5.11. Leaky cable systems	546
14.5.12. Vibration detectors	546
14.5.13. Magnetic contacts	547
14.5.14. Surveillance contacts	547
14.5.15. Surface protection	547
14.5.16. Manual alarm callpoints	547
14.5.17. Foot-rail alarms	547
14.5.18. Wireless manual callpoints	548
14.6. Alarm monitoring and verification	548
14.6.1. Introduction	548
14.6.3. System integration, alarm receiving centre	550
14.7. Operation and maintenance	551

Use Case	552
Perimeter security	554
Overview	558
Sectors	560
Detection principles	561
Interoperability	564
System integration	565
Graphic overview: Guarto	566
Guarto	568
Detection principles	571
Operation	572
Network capability and system integration	574
Lifecycle	575
Protecting cultural objects	576
Graphic overview: SPC	578
SPC	580

14.1. Introduction

This section contains a summary of the key aspects of intrusion detection technology. The intention is to give the user a solid grounding in this specialist area.

Definition of intrusion
"Intrusion" is a collective term covering the use of force or dishonest means to gain unauthorized access to an enclosed area. Entry is gained for the purpose of theft, damage or improper use and all the associated offences including threatening behaviour and extortion. In its widest sense, the term covers all types of criminal act.

An anti-intrusion system in this context is a comprehensive package of devices, controllers and organizational measures put together to enable automatic detection of unauthorized entry (intrusion). When an intruder is detected it is important to initiate appropriate silent or clearly perceptible measures (intervention) in a timely manner to prevent loss.

Purpose of intrusion protection
To minimize the risk of loss to people and assets by:
- Preventive effect
- Deterring and disrupting the intruder
- Early notification of intervention agencies
- Theft prevention

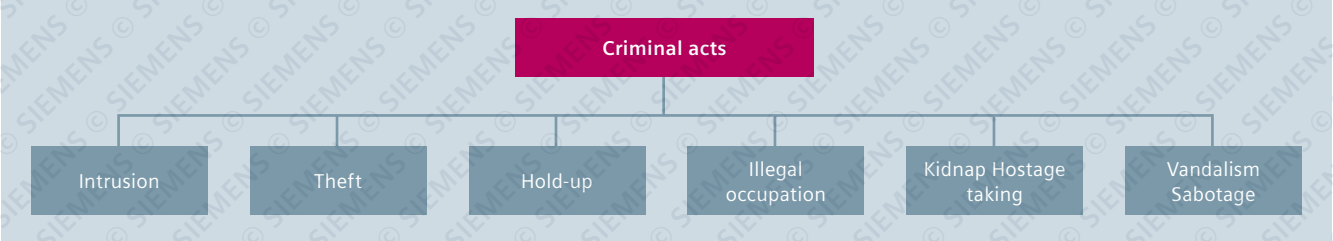


Fig. 14.1: Criminal acts

14.2. Intrusion detection system

14.2.1. Basic principle of intrusion protection

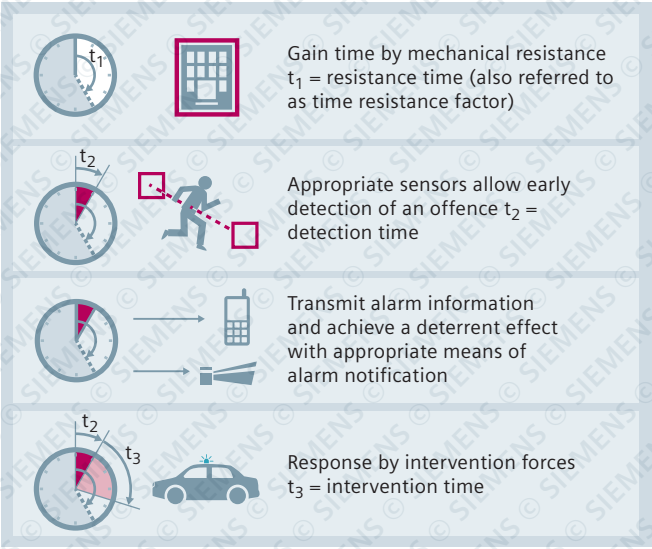


Fig. 9.2: Requirements to be met by an intrusion protection system

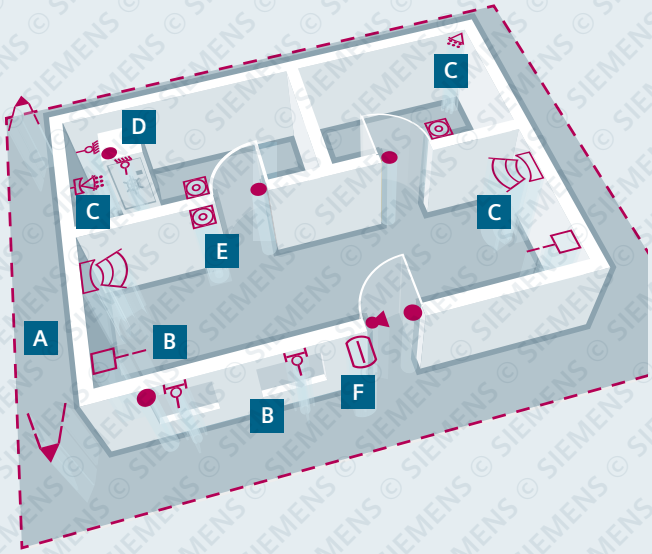
14.2.2. Protection concept

Every intrusion detection system must be based on a protection concept. This contains all the individual measures needed in order to achieve the desired protection objectives. The aim should be an effective combination of mechanical protection and electronic surveillance. If the types of threat are not known, they must be identified as part of an appropriate risk analysis. For each type of threat identified, a protection objective must be defined in order to mitigate the risk and determine an effective surveillance concept.

Classifying protection concepts by sector (e.g. commercial premises, office buildings, jewellers, banks, museums) and subconcepts by specific applications (e.g. repositories for valuables, strongrooms, airlock systems) allows prior experience to be leveraged and also makes planning work much easier.

A protection concept should always include the measures needed to achieve the protection objectives – both structural (e.g. wall thickness, door construction) and organizational measures (e.g. security arrangements, confidentiality of lock plans).

Professional planning and configuration of an intrusion detection system also includes measures to prevent false alarms (e.g. instruction, appropriate operating concept, etc.).



A **Perimeter surveillance**
Protection objective: to signal unauthorized intrusion or entry to premises.

B **Periphery surveillance**
Protection objective: to signal an attack on the periphery of a building or part of a building.

C **Room surveillance**
Protection objective: to signal movement in or entry to certain rooms or areas within rooms.

D **Object surveillance**
Protection objective: to signal an attack on individual objects in the building.

E **Hold-up alarm**
Protection objective: ability to trigger an alarm (silent or audible) and/or capture images of the threat event.

F **Access control**
Protection objective: to grant access to certain individuals to certain parts of the building at certain times.

Fig. 9.3: Surveillance concepts

14.2.3. Structure of an intrusion detection system

An automatic intrusion detection system detects an attempted intrusion by sensing associated phenomena including changes of shape, position or pressure, motion, structure-borne or room noise, changes in temperature, etc. The hazard level is automatically determined on the basis of preset parameters and appropriate measures are initiated in the form of alarm and control functions.

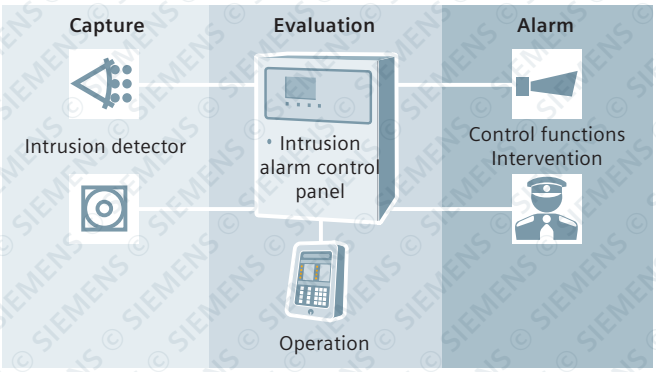


Fig. 9.4: Structure of intrusion detection systems

Capture

Automatic detectors convert physical parameters into electrical signals. This enables them to monitor enclosed areas, rooms, walkways and objects. Manual callpoints allow people on the scene to set off an alarm and summon help immediately. The detectors are connected to the intrusion alarm control panel.

Evaluation

The intrusion alarm control panel is the brain of the system. State-of-the-art control panels feature many different parameterization and programming options to enable users, areas, time profiles, input circuits and input/output characteristics to be programmed. Intrusion alarm control panels usually also incorporate transmission systems enabling them to communicate simultaneously with users via keypads, PCs or apps as well as with higher-level management systems, remote service centres and alarm receiving centres. Defining all these parameters is a key aspect of system engineering.

Alarm notification/control functions

Alarm notification (internal, external, local, remote) is controlled by the intrusion alarm panel. If necessary, it is connected to a higher-level (building) management system or networked locally with other interoperable subsystems such as access control systems or video surveillance systems.

14.2.4. Detector line

The detector line connects the detectors with the control panel. There are two different types of detector line, namely "collective" detector lines and "addressable" detector lines.

Collective detector line

A collective detector line (physical connection) generally has multiple detectors connected to it. Only one location indication is possible per detector line. It is not possible to identify individual alarm locations/an individual detector unless the detector line contains only one single detector.

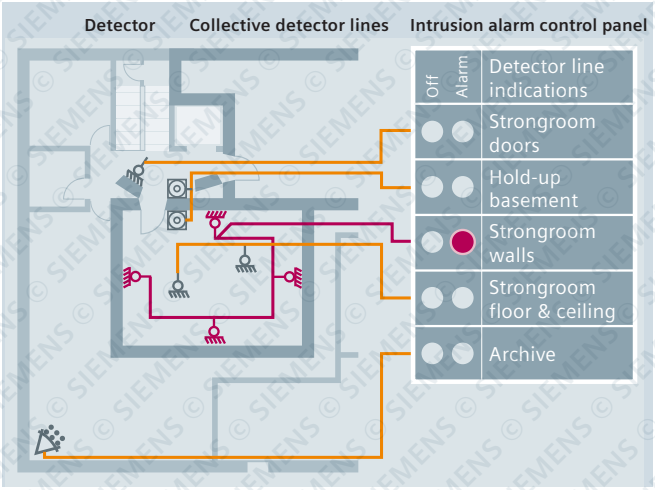


Fig. 9.5: Principle of collective detector line

Addressable detector line

An addressable detector line enables the individual locations of the connected detectors to be displayed. The individual detectors are connected to the detector line via bus modules or alternatively via addressing elements. Some detectors have the bus modules already integrated.

The detector line is generally a four-wire configuration, with two wires used to transmit data to the control panel and the remaining two wires needed to supply power to the electronic detectors. This is necessary as intrusion detection systems have a higher power consumption than, for example, the detector line in a fire detection system.

Addressing systems allow data traffic in two directions, i.e. it is possible to transmit (multiple) states from the detector to the control panel as well as control commands from the control panel to the detector. If only one detector is connected per address, we call this individual addressing. If multiple detectors are connected per address, these share the same location designation.

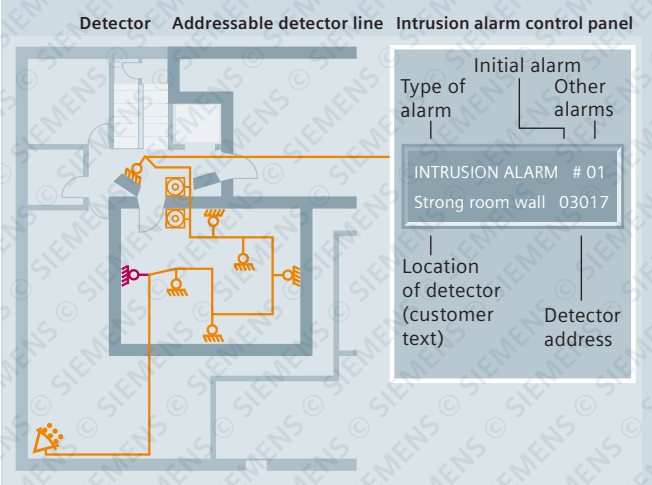


Fig. 9.6: Principle of addressable detector line

14.2.5. Sabotage resistance

Sabotage resistance is an essential requirement for any intrusion detection system. The measures involved include the proper placement of equipment and wiring, combined with continuous sabotage monitoring of the detectors, wiring and control panel and of the operating, alarm notification and transmission devices.

Where possible, devices and wiring for intrusion alarm systems (control panels, connection and junction boxes) should be placed within the secure area. Wiring outside the secure area should be protected from unauthorized access by special measures (concealed wiring or in an armoured conduit). In addition, continuous sabotage monitoring of all devices and wiring should be provided to ensure that any attempt at unauthorized intervention/tampering is detected and an alert is triggered.

14.2.6. Confidentiality

On acquiring an intrusion detection system, the customer expects it to provide an adequate level of security. Delivering this security means denying unauthorized access to confidential information. With this aim in mind, intrusion protection requires strong security awareness across every activity (planning, configuration, implementation). The necessary behaviours have to be instilled in all stakeholders through a process of ongoing training.

Maintaining confidentiality when handling files and documents, and also in verbal communications with third parties, must be standard practice.

Confidentiality of files and documents

Any files and documents that identify buildings involved, security measures (devices, functions, installations) or organizations (individuals, workflows) are to be treated in confidence. These include, for instance:

- Functional specifications, submissions, bids, invoices
- Plans, schematics, diagrams, programming documents
- Equipment lists, device specifications, instructions
- Security arrangements (alarm notification/intervention)
- Notes

These files and documents are to be kept under lock and key. They should never be left unattended in plain view. They must only be transmitted to persons for whom they are intended and only copied in verifiable quantities.

Attempts to gain unauthorized access to information often exploit “weak points” that may occur unintentionally in everyday processes, including:

- Open-plan offices
- Wastepaper baskets
- Construction sites
- Company vehicles
- Dispatch methods (electronic or physical)
- Copies
- Minutes of meetings
- Electronic files
- Internet data transfer

Confidentiality in verbal communication

Discretion based on security awareness must be standard practice. Specifically, this means:

- Information (including by telephone) must only be disclosed to identified and relevant individuals
- Limit information to the minimum necessary
- Disclose information about systems only with the consent of the customer involved
- Do not discuss systems in public

14.3. Standards and requirements

14.3.1. Standards for intrusion detection systems

Basic provisions for Switzerland

The EN guidelines for alarm, intrusion and hold-up detection systems apply generally for Switzerland. On various individual requirements, the EN 50131 European standards may not meet or only partially meet the requirements that applied in the past in Switzerland, in terms of operation, sabotage monitoring and alarm notification, for example. In order to maintain the existing level of security in Switzerland, the Association of Swiss Installers of Security Systems (SES) issued the "Technical Guidelines on Intrusion and Hold-up Alarm Systems" in order to close certain gaps and in the interests of quality assurance. These guidelines contain the Swiss requirements for the technical execution of intrusion and hold-up systems. These are based essentially on the EN 50131 series European standards:

Alarm systems – intrusion and hold-up systems

- EN 50131-1: System requirements
- EN 50131-2: Intrusion detectors
- EN 50131-3: Control and indicating equipment
- EN 50131-4: Warning devices
- EN 50131-5: Interconnections equipment
- EN 50131-6: Power supplies
- EN 50131-7: Application guidelines
- EN 50131-8: Security fog device/systems
- EN 50136: Alarm transmission systems and equipment
- EN 54-4: Power supply equipment for fire detection systems*

*For installations with multiple systems (e.g. fire and intrusion detection systems) and with shared transmission equipment that is installed in the intrusion detection system for reasons of sabotage protection, the power supply unit for the intrusion detection system must also comply with EN 54-4.

14.3.2. Requirements for intrusion detection systems

To safeguard other application-based interests and to ensure functional capability generally, regulations are also issued by various agencies, including for example:

- Insurance companies
- Police
- Customers (banks, industry, etc.)
- Associations

14.3.3. Test and certification authorities for intrusion detection systems

These are organizations that operate at a national level. They issue guidelines for intrusion detection products and systems. They also conduct special test procedures to monitor compliance with their guidelines and relevant standards and, if the criteria are met, they award approval and certification for their scope of application.

14.4. The project

14.4.1. Configuration guidelines

Product-specific configuration guidelines

Issued predominantly by product manufacturers, these guidelines are meant to ensure that a product is used in accordance with its performance characteristics.

General configuration guidelines

Issued by approval authorities or insurance organizations and also by public bodies, these guidelines usually contain general rules for the use of intrusion detection products.

Application-based configuration guidelines

These guidelines are issued by system installers, customers (e.g. banks, industry), product manufacturers, public bodies (e.g. police, etc.) and insurers.

They address application-specific issues and usually relate to specific sectors (e.g. banks, museums), specific risks (e.g. IT systems), environmental conditions (e.g. power plants, transmitters) and public interests (population).

14.4.2. Project workflow

An intrusion protection project contains several subtasks that need to be completed correctly. A methodical approach ensures an efficient project workflow:

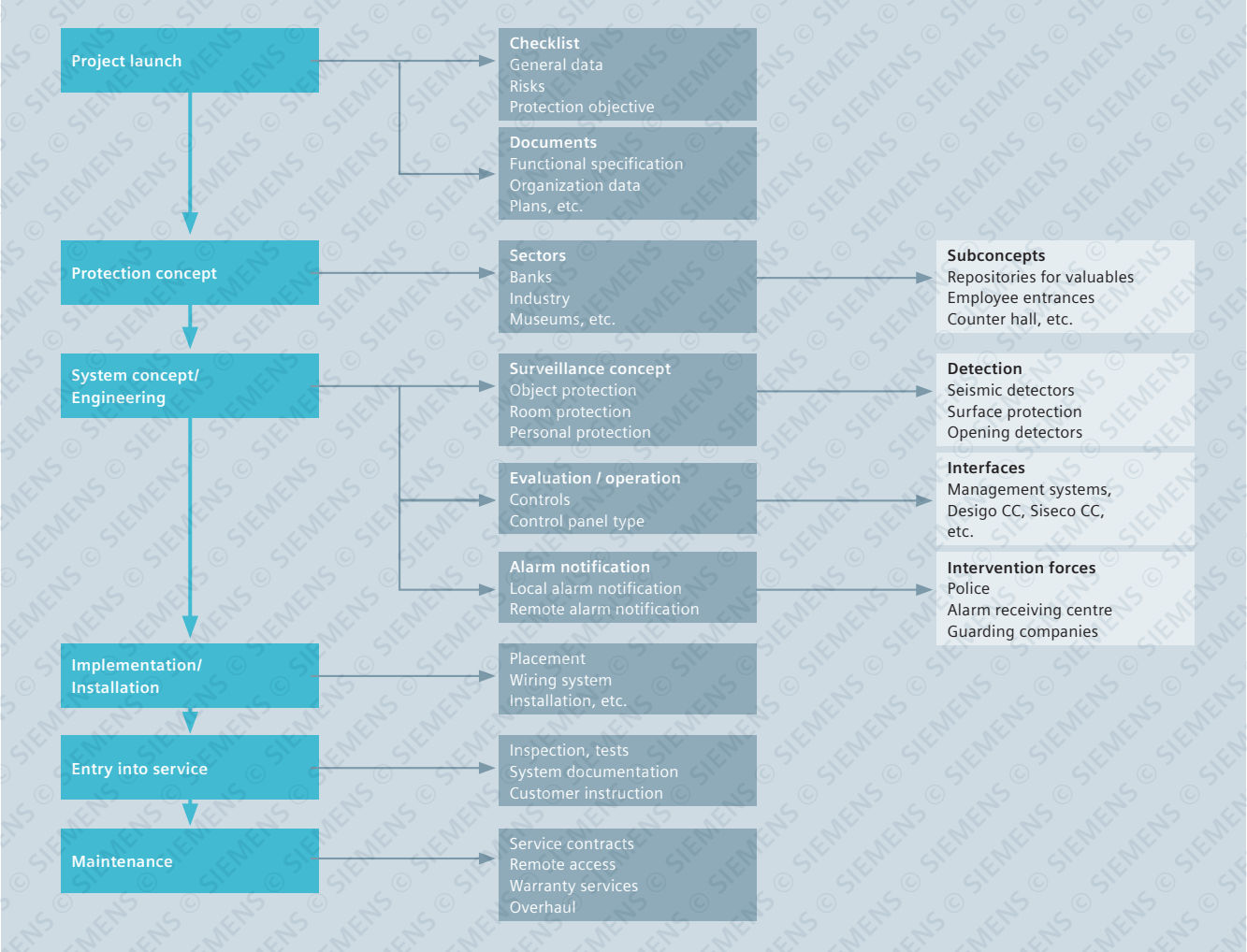


Fig. 9.7: Project workflow

14.5. Detection principles

Putting aside the physical differences in detection principles, there are essentially two different types of intrusion detector namely “passive” and “active” detectors.

Passive detector systems
These operate purely as “receivers”. Using an appropriate sensor, a passive detector can register the occurrence of or change in certain physical values and detect this as an “alarm situation”. The basic physical values that exist within the sensors perception range under normal conditions (no threat) represent the reference point for alarm detection. The more stable these basic values are, the less risk there is of spurious alarms. The useful signals are usually weak and this generally means a high standard of evaluation is required. Account is taken of environment-induced changes by means of filtering and in some cases by adjusting the response sensitivity.

Examples of passive detector systems:
- Passive infrared motion detectors
- Seismic detectors
- Vibration detectors
- Picture monitoring systems
- Glass break detectors
- Acoustic detectors
- Contact detectors

Active detector systems
These operate with a “transmitter” and a “receiver”. An active detector system consists of a transmitter part which generates a defined signal in an electronic circuit and transmits it, and a receiver part which receives and monitors the transmitted signal and detects changes as an “alarm situation”. Comparing the transmitted and received signal provides additional parameters and as a result active detector systems have better alarm detection properties and additional means of avoiding spurious alarms. Environment-induced interference is eliminated by filters. Transmitter and receiver can be housed in the same or in separate devices.

Examples of active detector systems:
- Ultrasonic detectors
- Light barriers
- Microwave detectors
- Field change detectors
- Capacitive detectors

14.5.1. Seismic detectors

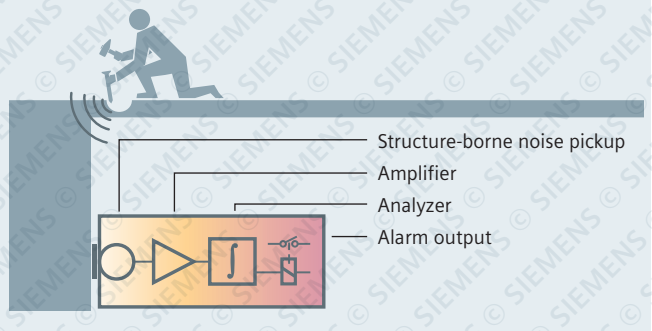


Fig. 9.8: Principle of a seismic detector

Using "breaking and entering" tools on solid materials produces mechanical vibration which propagates through the material as "structure-borne noise". This is picked up by a sensor (usually piezoelectric) in close contact with the material, analyzed in an electronic circuit and evaluated in order to trigger an alarm. Seismic detectors operate as passive systems. They identify an alarm situation based on the criteria "amplitude", "frequency" and "duration" of the detected signal.

Structure-borne noise can only be successfully detected on compact materials such as steel, concrete, etc. Structure-borne noise is damped, in particular its high frequencies, in any material. Used correctly, good seismic detectors are able to detect all methods of destructive attack on walls, ceilings, floors and doors of strongrooms, safes and other such repositories.

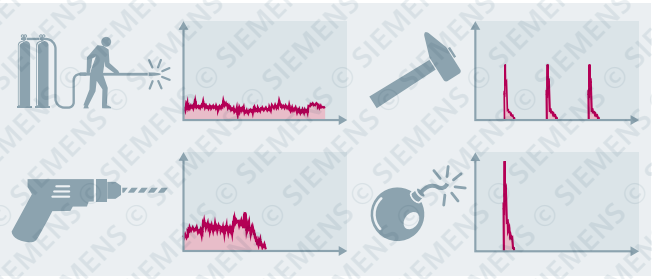


Fig. 9.9: Structure-borne vibration produced by typical breaking and entering tools

14.5.2. Glass break detectors

When a pane of glass is broken, this produces vibrations which propagate as mechanical oscillations in the glass. The detectors sensor picks up this vibration and converts it into electrical signals. The detector electronics amplify the frequencies typical of breaking glass and analyze the processed signals in order to trigger an alarm.

A variety of different detection principles are used for monitoring glass surfaces:

- Passive glass break detectors
- Acoustic glass break detectors
- Active glass break detectors

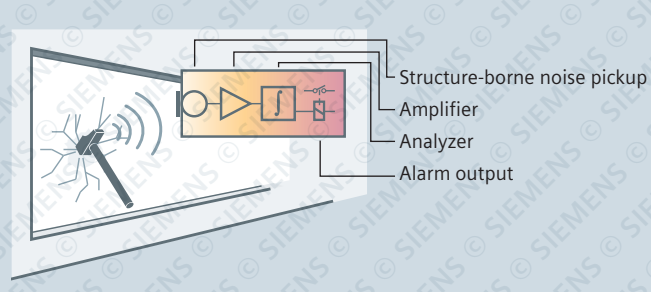


Fig. 9.10: Principle of a passive glass break detector

Passive and acoustic glass break detectors identify an alarm situation (glass breakage) based on the criteria "amplitude", "frequency" and "duration" of the detected signal. The frequencies typical of glass breakage are in the range 0.1 to 1 megahertz (MHz). Glass break detectors are suitable for monitoring all common glass types including:

- Crystal glass
- Insulating glass
- Security glass
- Opal glass (milk glass, opal flashed glass)

For glass with higher attenuation values such as

- Multi-layer glass (laminated and reinforced glass),
- Glass covered with adhesive shatterproof film, solar control film or posters

suitable options are alarm glazing or prestressed alarm loops installed in the glass.

Glass break detectors are not suitable for monitoring synthetic panes. For synthetic glass or glass with embedded wire mesh and an uneven surface, the preferred solution is to use vibration detectors that detect low-frequency attack noises.

14.5.3. Alarm glass

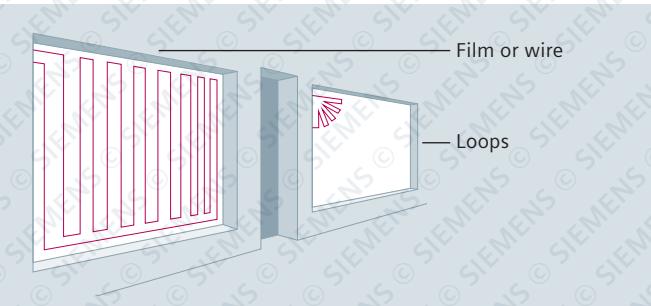


Fig. 9.11: Principle of alarm glass

Alarm glazing refers to panes of glass monitored for breakage with the aid of extremely fine electrical conductors. The conductors form a normally closed circuit which is opened if the glass is broken. The electrical conductors can be inserted into the pane as wires, attached to the pane as a film or as a small loop fused into one corner of the pane.

14.5.4. Seismic detectors

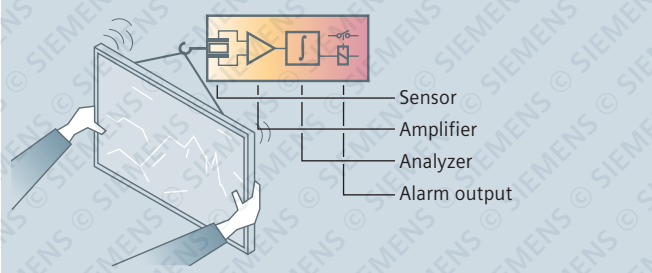


Fig. 9.8: Principle of a seismic detector

Various detection methods are used to monitor pictures, paintings and other cultural objects. These include:

- Piezoelectronic picture alarms (example above)
- Capacitive proximity sensors
- Laser scanning systems
- Optical distance detectors
- Contact detectors

The graphic above shows a piezoelectronic detector that serves a dual purpose as a picture hanging mechanism. This system is particularly suitable for use in changing temporary art exhibitions.

Attempted attacks on pictures (theft, vandalism) produce changes in tension and pressure on their hanging systems. These changes are registered by a sensor (piezoelectric transducer) connected to the hanging device (hook), analyzed in an electronic circuit and evaluated to trigger an alarm. The picture monitoring system works as a passive system. It detects an alarm situation based on the criteria “amplitude” and “frequency” of the signal detected by the sensor. Picture monitoring systems are suitable for monitoring any wall-hung objects including paintings, weapons, tapestries, masks, etc.

14.5.5. Passive infrared detectors

Every object (environment, e.g. walls, furniture) and every body (human, animal) emits infrared energy depending on its surface temperature. Unlike the static environment, humans and animals are moving infrared sources. Alternatively there are completely invisible systems that trigger an alarm or pre-alert if someone gets too close to pictures or objects.

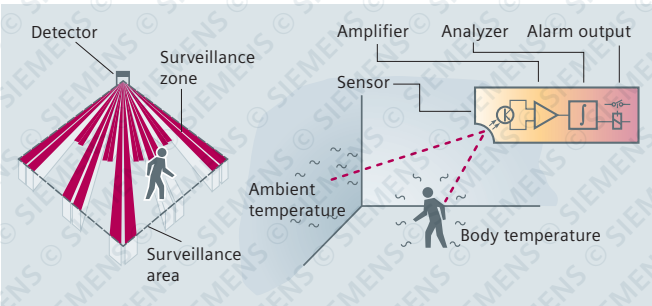


Fig. 9.13: Principle of zoned surveillance and infrared detection

Using an appropriate optical system, the infrared energy present in the area under surveillance is conveyed concentrically, zone by zone, to a pyroelectric sensor. This continuously measures the incident infrared energy. If a body (e.g. a person) crosses one of these zones, the sensor measures the associated change in temperature.

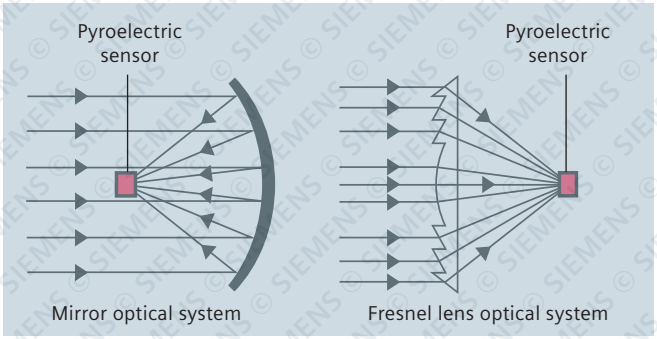


Fig. 9.14: Principle of mirror optical system and Fresnel lens optical system

The temperature change signal is analyzed in an electronic circuit and evaluated to trigger an alarm. Passive infrared detectors operate, as the name suggests, as passive systems. They detect an alarm situation based on the temperature difference and rate of temperature change registered by the sensor. Passive infrared detectors employ two types of optical system, “mirror optic” and “Fresnel lens optics”.

Mirror optic detectors

In a mirror optical system, infrared radiation is collected using a hollow mirror and conveyed concentrically to the pyroelectric sensor. Multiple mirror segments are used in order to create coverage zones. In high-quality detectors, these mirrors are precision milled. This creates precise optical detection zones, which in turn produce a rapid increase in the measurable signal thanks to the mechanical properties of the mirror itself. Also, the milled sections in the mirrors are adjusted and curved so that – in the same way as a high-quality lens in photography – carefully calibrated near and distant zones are produced. These enable human figures to be represented at optimum size over the entire detection area.

Fresnel optic detectors

The Fresnel principle is based on dividing a lens surface into small optical segments which convey the infrared radiation concentrically to the pyroelectric sensor. Coverage areas are created by specific shaping of the optical segments and curvature of the entire lens system. This type of detector is easier to manufacture and for this reason usually has a somewhat lower initial purchase price.

Passive infrared detectors are suitable for use as motion detectors for partial or full room protection and, depending on type, can also be used for outdoor surveillance.

14.5.6. Infrared barriers

Infrared barriers consist of transmitters that emit invisible infrared beams, and receivers that collect and evaluate the incident infrared energy.

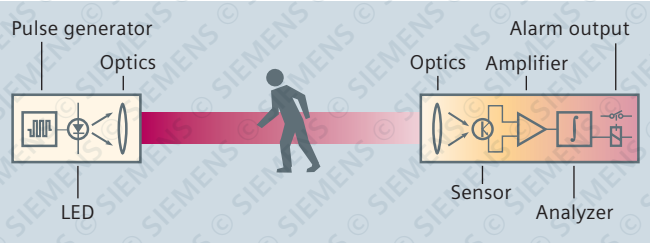


Fig. 9.15: Principle of infrared barrier

In the transmitter, infrared energy is emitted by a light-emitting diode (LED) and concentrated by an optical system. The infrared beam is generally modulated to prevent interference from other light sources (sabotage, sun, etc.). The incident infrared energy is conveyed by the receiver to the sensor, a photo semiconductor, via an optical system. The signal detected by the sensor is analyzed in an electronic circuit and evaluated to trigger an alarm. Infrared barriers operate as active systems. They identify an alarm situation based on the intensity of the infrared energy received and, if the infrared beam is modulated, based additionally on pulse length, edge gradient and frequency. For increased security, the phase shift of the signal can also be checked.

Infrared barriers are suitable for monitoring corridors, passageways, walls, windows and doors as well as other confined areas.

Special versions can also be used outdoors (perimeter surveillance). Here, the range achievable in practice is limited by the fog density liable to be experienced at the installed location. There are also devices with "fog circuits" that suppress the alarm function in foggy conditions and issue a separate signal instead.

14.5.7. Ultrasonic motion detectors

An ultrasonic motion detector consists of a transmitter that continuously emits sound waves in the inaudible frequency range via an electroacoustic transducer, and a receiver that uses a microphone to pick up the sound energy reflected by the environment, analyzes it for frequency shift and evaluates it to trigger an alarm.

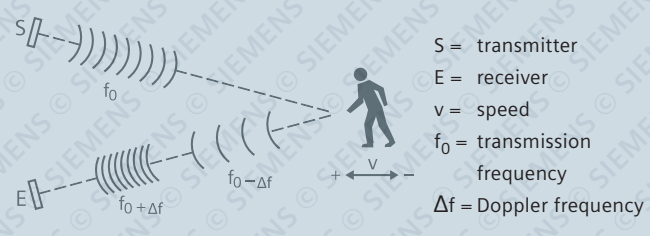


Fig. 9.16: Principle of ultrasonic motion detectors

Frequency shifts are caused by bodies (humans, animals, objects) moving in the sound field. This frequency shift is called a "Doppler frequency" and is proportional to the speed of motion which is measured radially relative to the detector. The effective speed component, and thus the frequency shift, is at its greatest with motion towards or away from the detector and decreases the closer the direction of motion is to an arc around the detector.

Ultrasonic motion detectors operate as active systems. They are suitable for full room coverage of any size of internal room and also for partial room coverage.

14.5.8. Dual motion detectors (IR/US)

Dual motion detectors combine the properties of two physical detectors. This type of detector is extremely robust and immune to false alarms. In the example shown of a detector with an ultrasonic element (US) and a passive infrared (IR) element, reliable intruder detection is provided by sophisticated signal processing and system integration. Both subsystems are subjected to complex multi-criteria analysis and interference in the individual subsystems is detected and suppressed.

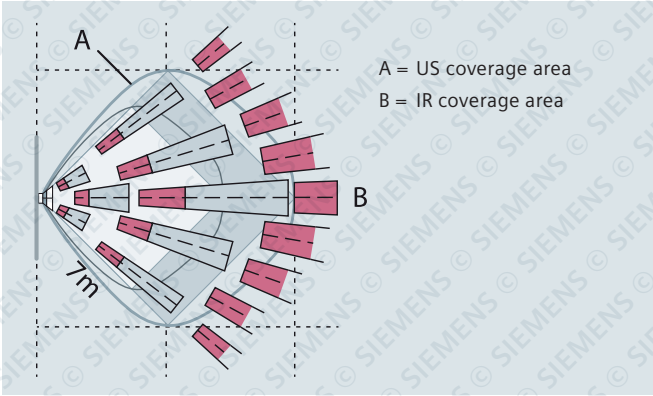


Fig. 9.17: Zones in a dual motion detector combining infrared and ultrasonic systems

14.5.9. Dual motion detectors (IR/MW)

Like the ultrasonic motion detector described above, the microwave detector part in these detectors works according to the Doppler effect principle (see 9.5.7.). The microwave motion detector however operates with high frequency waves in the 9 to 11 gigahertz (GHz) range.

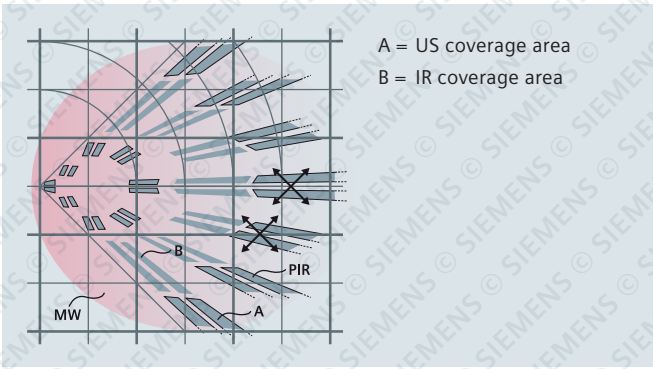


Fig. 9.18: Zones in a dual motion detector combining infrared and microwave detectors

The direction of the arrows in Fig. 9.18 indicates the optimum direction of motion for the infrared part. When using microwave motion detectors it is important to remember that the high-frequency waves penetrate certain materials (e.g. thin walls, glass or wood), hence the risk of false alarms.

When deploying this type of detector, which is somewhat more expensive initially, the end justifies the means. This does not necessarily mean just high-risk applications, it can also apply to applications in retail for instance. Interference caused by ceiling danglers or thermal disturbance from open chiller cabinets can make retail stores a more demanding environment for detectors.

Taken together with factors such as long travel times for intervention forces or maintenance personnel, for instance, the use of this type of detector in such an application is entirely reasonable and appropriate.

14.5.10. Microwave barriers

A microwave barrier consists of a separate transmitter and receiver unit, between which an electromagnetic field in the 10 GHz range is created. A body moving in this field produces a field change which is analyzed in the receiver and evaluated to trigger an alarm. Environmental factors such as fog, rain and snow have little impact on the detection reliability of microwave barriers. They are therefore suitable for use in perimeter monitoring. Microwave barriers operate as active systems.

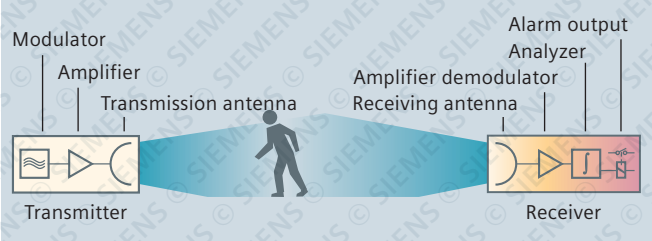


Fig. 9.19: Principle of microwave barrier

14.5.11. Leaky cable systems

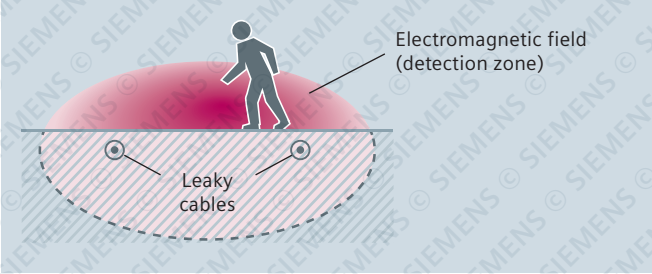


Fig. 9.20: Principle of detection using leaky cables

This consists of two special coaxial cables buried in the ground. These cables have defined openings known as "leak holes" in their outer shield. One of the two cables works as a transmission cable, the other as a receiving cable. A 40 MHz signal is applied to the transmission cable. The effect of the leak holes is to create an electromagnetic field along the cable in the vicinity of the holes. If a body – a person, for example – enters this field, it produces a change in this field/the connection to the receiving cable. As a result, the signal applied to the receiver changes and this leads to an alarm being triggered. Leaky cables operate as active systems. They are used for perimeter protection.

14.5.12. Vibration detectors

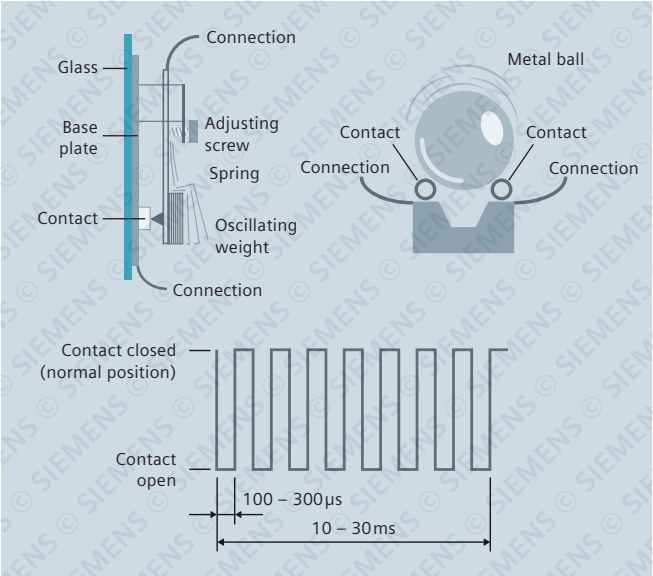


Fig. 9.21: Principle of mechanical vibration detector

Mechanical vibration detector

Vibration detectors detect the use of force in an attempted break-in by sensing the resulting vibration. This vibration sets an oscillating weight in motion so that an electrical contact opens and closes in time with the vibrations and as a result triggers an alarm. The contact movements typically generated by the vibrations produce extremely short signals. As a result, vibration detectors cannot be connected directly to the alarm inputs of control panels or addressing elements, instead they must be connected via an electronic analyzer unit.

Electronic vibration detectors

The majority of vibration detectors in use today are electronic. They pick up structure-borne noise by means of a sensor – usually piezoelectric – in contact with the material. The signals are analyzed in an electronic circuit and evaluated to trigger an alarm. These detectors are suitable for object and periphery monitoring of panes of glass (min. 6 mm thick), glass blocks, glass surfaces with adhesive or painted coatings, multi-layer glass, etc. or indeed for other materials subject to prior testing.

14.5.13. Magnetic contacts

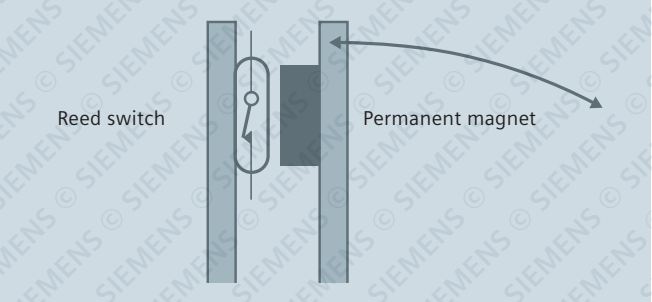


Fig. 9.22: Principle of magnetic contact

A magnetic contact consists of two elements – a reed switch and a magnet. These are mounted on the object monitored so that in the normal position (no alarm) they are in close proximity to one another. In this position, the reed switch is closed by the effect of the magnetic field. If the magnet moves away from the reed switch, the effect of the magnetic field diminishes rapidly until finally the reed switch opens and sets off an alarm. Magnetic contacts operate as passive systems and signal the opening of doors, windows, revolving doors, roller doors, equipment enclosures, drawers, etc.

14.5.14. Surveillance contacts

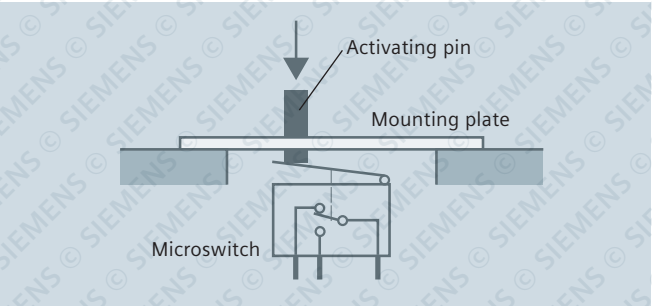


Fig. 9.23: Principle of surveillance contact

A surveillance contact consists primarily of a microswitch with design changes to optimize it for use in intrusion detection systems. The surveillance contact is mounted on the object monitored so that in the "no alarm" position, the activating pin is depressed. Surveillance contacts are passive detectors that signal the opening of doors, windows, cabinets, equipment enclosures and the like. They are particularly suitable for monitoring the locked position in closure control systems.

14.5.15. Surface protection

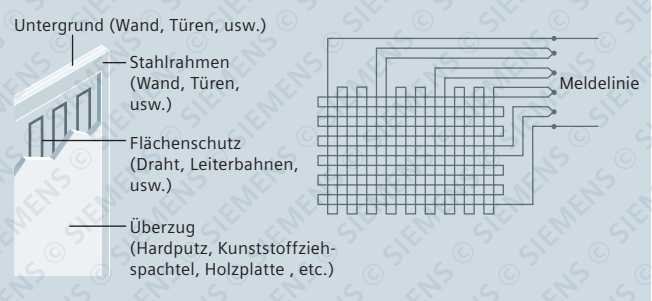


Fig. 9.24: Principle of surface protection

Surface protection consists essentially of electrical conductors covering the surface to be monitored, in a loop or mesh configuration. The conductors form a closed circuit which is broken if the monitored surface is breached, thus setting off an alarm. Surface protection is suitable for monitoring walls, doors, equipment enclosures, etc. and is used on concrete, steel, brickwork, wood, etc.

14.5.16. Manual alarm callpoints

Fig. 9.25: Principle of alarm callpoint

Alarm callpoints are used for manual alarm activation. Pressing the button operates an electrical contact and sets off an alarm. Alarm callpoints are used to activate an alarm and/or cameras in response to a hold-up threat.

14.5.17. Foot-rail alarms

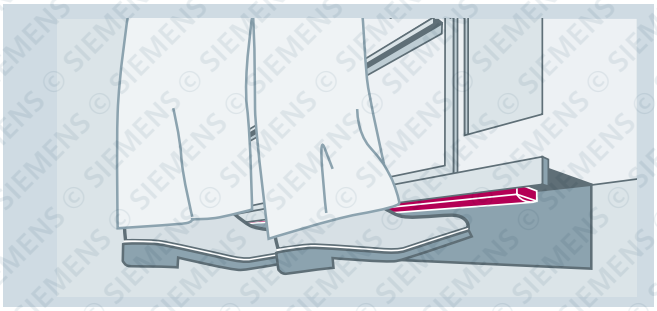


Fig. 9.26: Principle of foot-rail alarm

These are foot-operated contact strips that are used to set off an alarm. The foot-rail alarm consists of an activation component (pedal) approximately 60 cm long, flexibly mounted in a housing of the same length. The installed electrical contact sets off an alarm if pressure is applied to any point on the pedal. Foot-rail alarms are fitted in teller counters, shop counters, office desks and similar locations. They are suitable for discreet alarm activation if there is an imminent threat of hold-up and can also be used to activate cameras.

14.5.18. Wireless manual callpoints

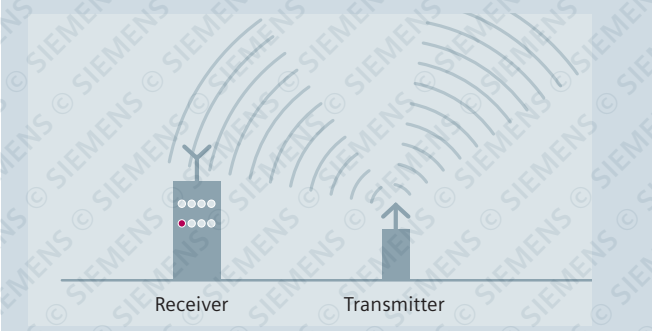


Fig. 9.27: Principle of wireless alarm system

Wireless alarm callpoints enable an alarm to be triggered over a wireless connection. The radio signal is activated on and transmitted by a transmitter carried on the person. A receiver located centrally evaluates the radio signals to trigger an alarm. Wireless alarm callpoints are used to protect security guards, plant security personnel and similar staff. Multiple transmitters can be operated on one receiver. The transmitters are activated manually or by a change in position (man-down alarm).

14.6. Alarm monitoring and verification

14.6.1. Introduction

Given that in Europe generally, of all alarms triggered and transmitted by intrusion detection systems, more than 98 % are false alarms, and most of these are caused by users themselves, the whole issue of alarm handling must be given serious consideration at the outset, in the system design phase.

This document describes the fundamentals of alarm verification and alarm processing in intrusion detection systems and the alarm-handling centre. The document describes general approaches beyond the draft standard under discussion, «prEN50131-9 Alarm verification – Methods and principles» and as such provides all-round information.

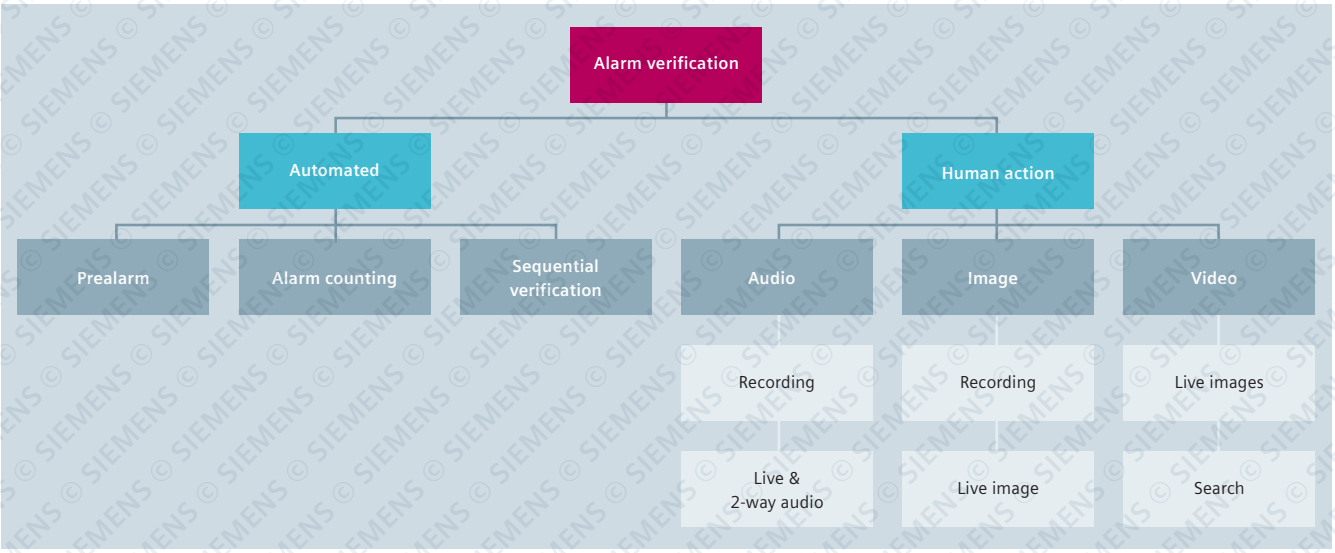
Automatic verification can be done in two different ways. It can either be done locally on-site by the intrusion detection control panel or at a distance, using appropriate alarm transmission protocols, by the alarm receiving centre and its alarm processing software.

14.6.2. Principles of alarm verification

The principles and methods of alarm verification can be divided into the following main groups:

Prealarm

Prealarms are used in virtually all intrusion detection systems. When someone enters the entry zone of a secured area a prealarm countdown starts. This allows an authorized user locally to disarm the system and thus reset the alarm within a certain time window. If the preset time window is exceeded, an alarm is triggered. Depending on the system, automatic verification if time is exceeded can be implemented by adding a second time in the alarm processing system in the alarm receiving centre. This means that after the alarm is reset, a special type of signal known as a «cancel signal» is sent to the alarm receiving centre.



Alarm counting

Unlike the prealarm method, with alarm counting, not only entry zones but specific, defined zones or detectors are defined for alarm verification by counting («zone twinning».

For example, as shown in Figure 1.29, two detectors may be installed in the same room. If one of the two devices activates an alarm, a defined time window starts running during which confirmation is expected from the second detector. If that detector also activates during the time window, it means there is a real alarm. In the alarm counting method, which one of the two detectors activates first is not critical. If there are no further signals within the time window, the counter is reset.

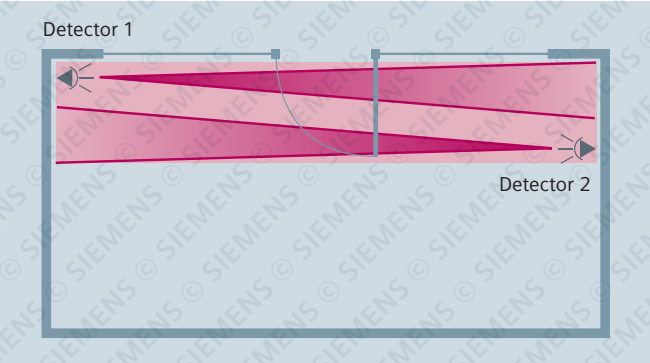


Abb. 14.29: Alarm counting

Sequential alarm (A/B alarm)

In a wiring configuration with A/B groups, different detectors are assigned either to Group A or B. If a detector within a group activates, a defined time window starts running. If a Group B detector activates within this time window, this is then processed as an alarm.

In sequential alarm verification, it is also possible to define the required sequence, for example A must activate before B.

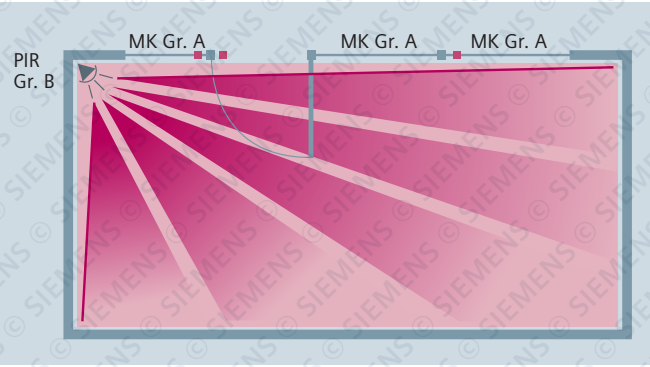


Abb. 14.30: A/B alarm

Audio verification

There are two different methods of verification using audio components. Firstly, there are systems that allow "live" listening-in to premises to assess the situation in the event of an alarm. This is done with or without recording an audio file lasting several seconds at the time of the alarm.

The second system additionally supports 2-way communication. This method enables rapid verification, especially in cases where the user has triggered an alarm, eliminating the need for a callback by the alarm receiving centre. Being connected directly to the alarm-processing centre gives the system user great peace of mind. In audio verification systems, to avoid acoustic interference, audible alarms are silenced for the duration of the connection.

Unlike image or video verification, audio components are omnidirectional and depend on light for visualization.

Audio components should be positioned so as to avoid noise sources that affect the ability of the alarm receiving centre to receive acoustic information. Also, in larger installations, only those audio components located in the alarm zone shall be activated.

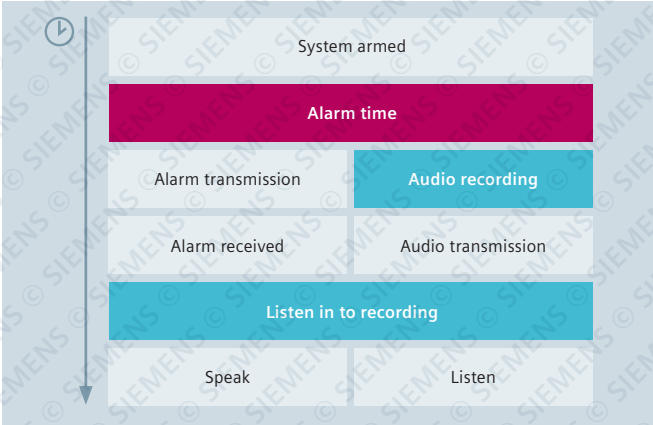


Abb. 14.31: Time sequence of alarm verification using 2-way communication

Image verification

This section describes the integration of imaging elements for alarm verification.

To support image verification, an image capture unit is added to the alarm system. This is achieved either using combined devices such as detectors with a built-in camera or by fitting additional cameras. When installing and aligning the camera, it is important to remember that its coverage area should be larger than that of the associated detector.

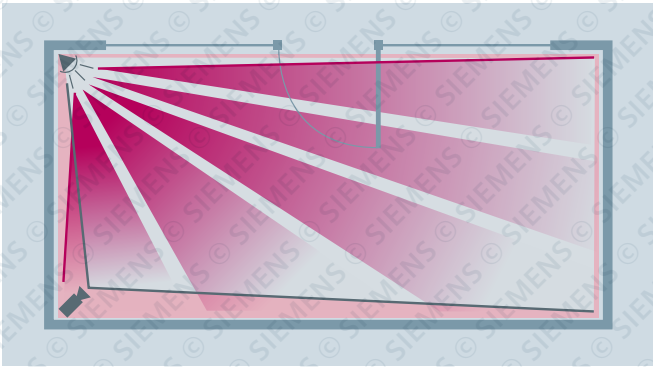


Abb. 14.32: Arrangement of detector and camera with overlapping coverage areas

Draft standard prEN 50131-9 contains the following requirement:

A minimum of three images in all must be transmitted to the alarm receiving centre, at least one of which must be at the time of alarm activation. Also, two additional images should be recorded and transmitted within five seconds of alarm activation. All detectors should be located within the coverage area of the camera.

Time sequence

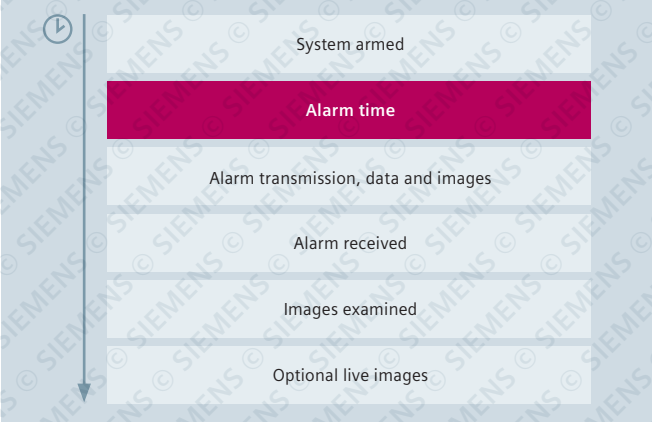


Abb. 14.33: Time sequence of image capture and transmission

It is important that the images used for alarm verification are sent at the same time as the digital alarm transmission. To achieve this, special alarm transmission protocols are used, e.g. SIA IP, EDP, etc. This means that at the time alarm processing starts, the data must already be present in the alarm receiving centre so that no time is lost when assessing the alarm. This is the only way to ensure rapid, timely processing of alarms.

As well as captured images combined with audio data, it should also be possible to view live images from the relevant cameras to obtain additional information.

Video verification

Verification using a direct link to a video system is an effective, optional method of intervening directly in the premises. Connecting a video surveillance system allows further investigations to be carried out, depending on the premises. These further measures include, specifically, activating other cameras or searching the system archive. Forensic searching, for instance, enables the search to be widened, based on specific parameters, in order to obtain information quickly and efficiently.

Linking a video surveillance system to an alarm receiving centre is a very effective solution in higher-risk situations and especially for perimeter protection. It means that unnecessary interventions can be avoided and costs optimized.

14.6.3. System integration, alarm receiving centre

To enable rapid, smooth processing of alarm verification methods, the level of integration into the alarm processing software in an alarm receiving centre is of the utmost importance.

The Figures below show potential features of such integration. The headphones and camera icon on the far left, under «AV status» indicate that additional data is available for the alarm event. A Context menu shows other options – clicking on «Show AV Data», for example, displays the relevant audio visual data.

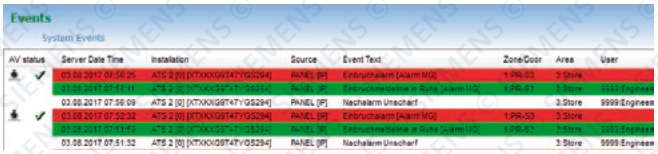


Abb. 14.34: Event screen of a system with AV data

In this example, the intrusion detection system provides both. The relevant data has already been transmitted to the alarm receiving centre, along with the alarm, and is on the local servers in the alarm receiving centre.

When the Context menu is opened, the following edit screen appears.

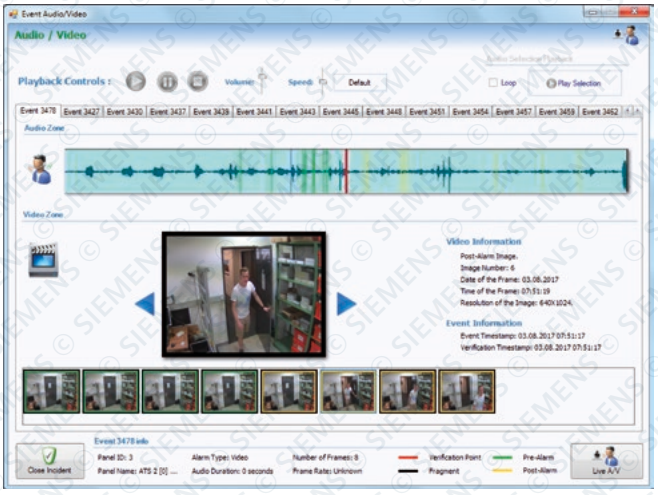


Abb. 14.35: Detailed screen for an alarm event with visual and audio data

The recording contains data before, during and after the alarm event. The audio track is displayed at the top of the screen, with the relevant images underneath. The mask allows the sequences to be played back, paused and individual images can also be viewed full screen.

Timely, fast operation of the system is extremely important if quick decisions are to be taken on whether or not to intervene.

14.7. Operation and maintenance

If an intrusion detection system is to continue to provide effective protection, regular inspection and maintenance work is required to preserve its functional integrity.

Special test and measurement tools facilitate such work:

- Test software to monitor operational workflows
- Test modes and automatic tests in the intrusion detection control panel
- Multimeters for level monitoring
- Logic testers
- Continuous-line and dotted-line recorders
- System test devices e.g. in the form of smartphones to check that individual detectors are working properly
- Maintenance equipment suitable for the various detector systems

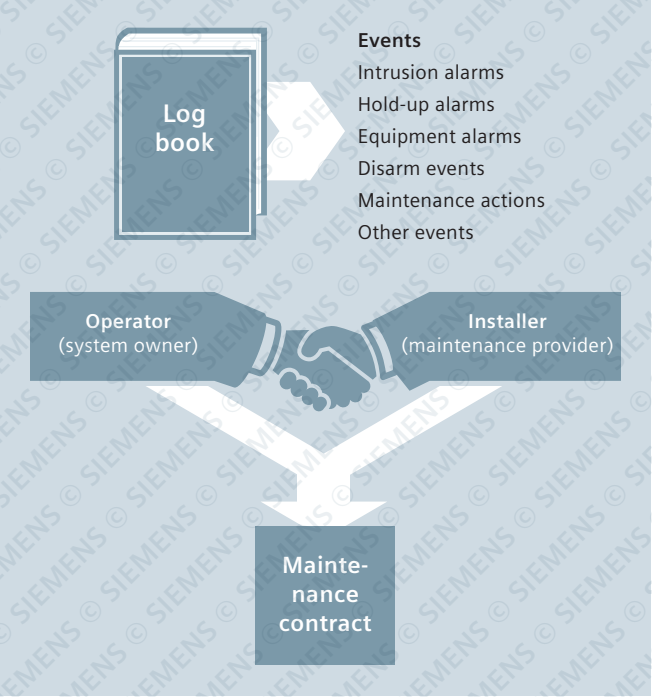


Abb. 14.36: Log book and maintenance contract

A log book provides information on the operational readiness of the intrusion detection system. The system operator shall enter details of the following in the log book:

- Intrusion alarms
- Hold-up alarms
- Equipment alarms
- Disarm events
- Other operational events

The system installer's personnel shall record:

- Maintenance events including inspections, servicing and repairs

It is advisable for the intrusion detection system operator and the system installer or manufacturer to enter into a maintenance contract (service contract):

- This will ensure full operational availability of the intrusion detection system.
- Overhaul and inspection intervals are defined.
- Conditions for fault clearance during and outside working hours (on-call service) are defined.
- Capturing and analyzing statistics for all events will enable manufacturers/installers of intrusion detection systems to continue to optimize the equipment and its application.

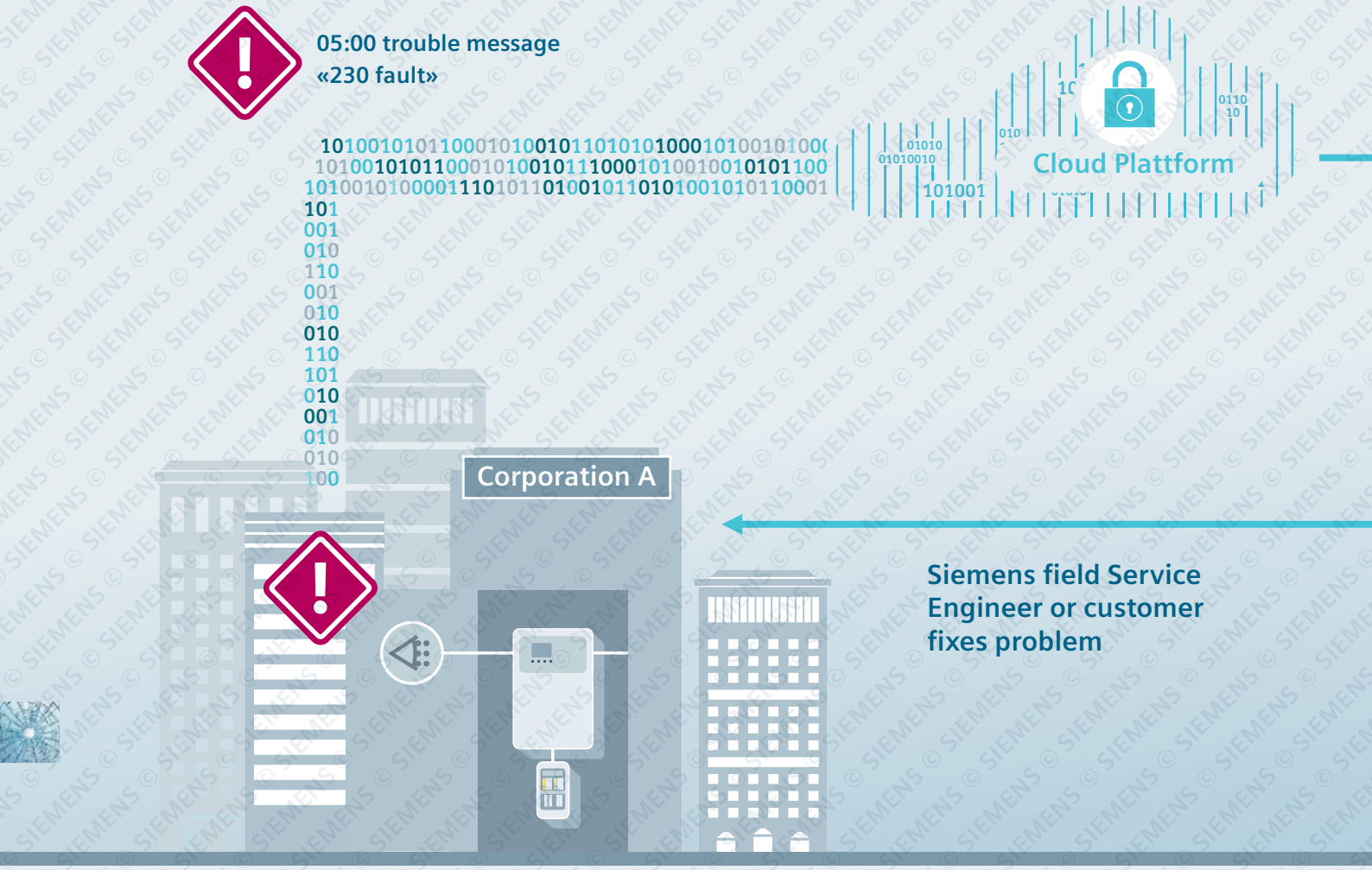
Use Case – Intrusion

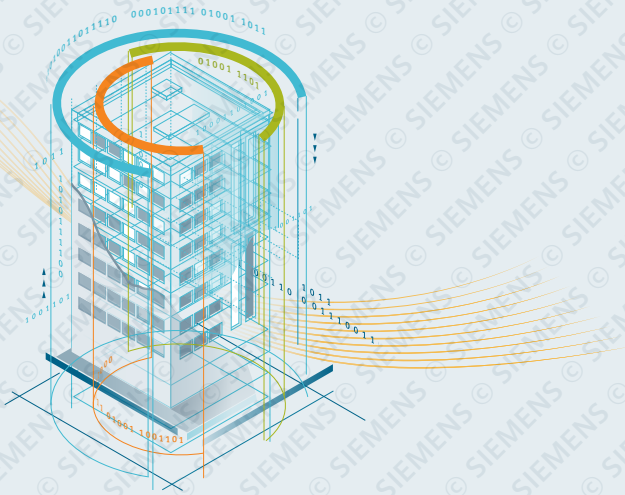
The system detects that there is no more external power and transmits a «230 fault.» The system is now running on power provided by the backup battery, which will last for at least 24 hours. The Digital Service Center (DSC) receives an event alert and logs into the system to see how long there has been a power problem. If it just happened 2 minutes ago, the situation will be monitored to see if the external power returns quickly.

If the power is back in a short time, the outage will be recorded in the protocol and closed. The field Service Engineer can check to see if there is something he needs to do on the installation the next time he makes a service visit.

If, for example, it should take longer than 1 hour for the external power to come back on, then the DSC will inform the field Service Engineer. Then the field Service Engineer will immediately contact the customer to inform him and to agree on the necessary actions.

Depending on the reason for the power outage, the action could be to call an electrician or have the field Service Engineer go on-site and correct the issue.





Data power delivers better building performancer

Digital Service Center

- Events are recorded
- Information is sent to local service organization

Local Service Organization

- Information is checked: Backup battery will power system for min. 24hrs
- Customer is informed during office hours 07:30 to check system on-site
- Result: system is fully operational by 11:00, no further intervention was necessary

Perimeter security – it's about more than just barriers

Highlights

- Intelligent, integrated concepts for all-round perimeter security
- Development of a vendor-neutral solution optimized to your individual needs
- Expertise from the security concept through to implementation of different technologies
- A dedicated contact provides the transparency needed in a complex field
- Broad portfolio for diverse applications
- All technologies brought together in a single user interface
- Integration of existing infrastructures
- Integrated service concept and high availability of service technicians

Fences, walls, intelligent detection technology and the latest surveillance measures: the options for providing comprehensive perimeter security around a property are more diverse and complex today than ever before. And that's a good thing. Whether it is to protect VIPs or airports, prisons, industrial premises requiring a high level of security such as logistics and chemical companies, solar plants, outdoor storage facilities or power plants, appropriate preventive measures help avoid or minimize damage. Such measures facilitate early detection of intruders and support rapid response to counter an imminent threat.

But, just as there is more to building a wall than putting one brick on top of another, perimeter security too needs the right "mortar" to integrate all the parts reliably and ensure optimum stability. We are happy to provide this integration for you. With customized security concepts that have one overriding aim – complete security at every level.

Every site is different – so too is each of our solutions

Having a strategic thinking partner like Siemens by your side will give you access to our collective expertise and extensive experience. Together we can prepare the ground for your individual perimeter security solution.

Planning is the best prevention

A large industrial site will have different security needs than a museum in a building of special historic interest. There are good reasons why perimeter security today has a diverse product portfolio with intelligent technologies. However, if perimeter security is to be able to perform its core preventive tasks, one thing above all else is required – meticulous planning.

All to achieve the best possible solution

Threat scenarios are many and varied. Which is why we survey your site, with you, to identify your specific protection objectives and analyze what makes your "terrain" special. This knowledge combined with our 160-plus years of experience enables us to select the ideal components from the product ranges of different manufacturers to ensure the best integration possible – into your existing infrastructure or into a completely new system.

Right where you are

Think globally, act locally. This is a real advantage, particularly where the complex matter of perimeter security is concerned. Your dedicated Siemens representative on site will take on board your specific needs and be there for you during prepa ration and wrap-up and throughout installation. The on-site representative will be backed by the expertise and resources of a global network of specialists. Our expertise in developing bespoke security solutions means you can be confident in the long term that you are in the best hands. For maximum investment protection, naturally we offer all the other services needed to ensure smooth operation of your security systems, over and above the actual development and implementation of your solution.

First things first: 360 degree proactive thinking

What do potential threat scenarios look like? What type of individual has targeted your company in the past? What is the area surrounding your premises like? When it comes to prevention, we will do the proactive thinking for you. We will put ourselves in your situation and develop, step by step, a security concept totally tailored for your company.

Security is a feeling – and a fact. A sense of security is in some ways very subjective, which is why we start by analyzing your actual security needs and then proceed to develop an integrated security concept that factors in all the security-related aspects of perimeter protection. This will give you an overview – with optimum transparency and maximum decision confidence.

First comes the risk analysis

Every property is different and is "predisposed" in its own way to particular threats or to be targeted by specific individuals. For this reason, we always start our analysis by identifying the nature of potential threats to your building periphery and by profiling individuals or groups who pose a security threat. Following site inspections and interviews, we work with you to produce your individual security profile. A factor to consider here is that the threat to a property can arise from two different scenarios. First, targeted criminal acts such as sabotage, hold-up, hostage taking, intrusion, theft or espionage. Second, non-targeted criminal acts such as vandalism and demonstrations by people prepared to use violence. The anticipated extent of damage and its probability of occurrence determine the risk potential, from which the protection objectives and vulnerabilities can be identified.

Defining your protection objectives

Before we consider what your ideal security concept would look like, we first need to define more precisely the area to be protected. Depending on the local conditions, as part of a risk analysis we define if and how the legal boundary is drawn and if any specific security measures are already deployed inside this perimeter. We also examine the best way to protect you from intrusion, breakouts, vandalism or from the unauthorized transfer of goods and money.

All good things come in threes: your security measures

Following this preparatory work, we can then identify further security measures, from the technical solution through to its coordination and integration.

Step by step to the security concept

Step 1: Risk analysis
Description of potential threat scenarios, perpetrator profiles, calculation of risk potential and identification of vulnerabilities.

Step 2: Protection objectives
The most important protection objectives are defined, depending on local conditions, e.g. marking the boundary of the property or protection against vandalism.

Step 3: Security measures
The mechanical, electronic and organizational security measures are derived from the protection objectives.

Security concept-
The end result is an integrated concept, in which all the measures are perfectly coordinated.

Essentially, a property is only well protected if the resistance time of a mechanical barrier is equal to or greater than the response time needed for security guards to reach the location.

Mechanical security measures

One of the first steps in defining a security concept is to devise appropriate – and durable – mechanical security measures. The purpose of mechanical security systems, apart from marking the boundary of a property, is to prevent intrusion into or movement within a secure area. In many cases, existing natural features such as ditches and embankments, thorn bushes, moats and ponds provide good perimeter protection that can be reinforced with fences, boulders, bollards and road blocks. It is important to remember that mechanical security features must still be effective if weather conditions change.

Electronic surveillance

For a whole range of applications from fence surveillance and ground detectors to detection systems covering areas large and small, Siemens has the right solution for you.

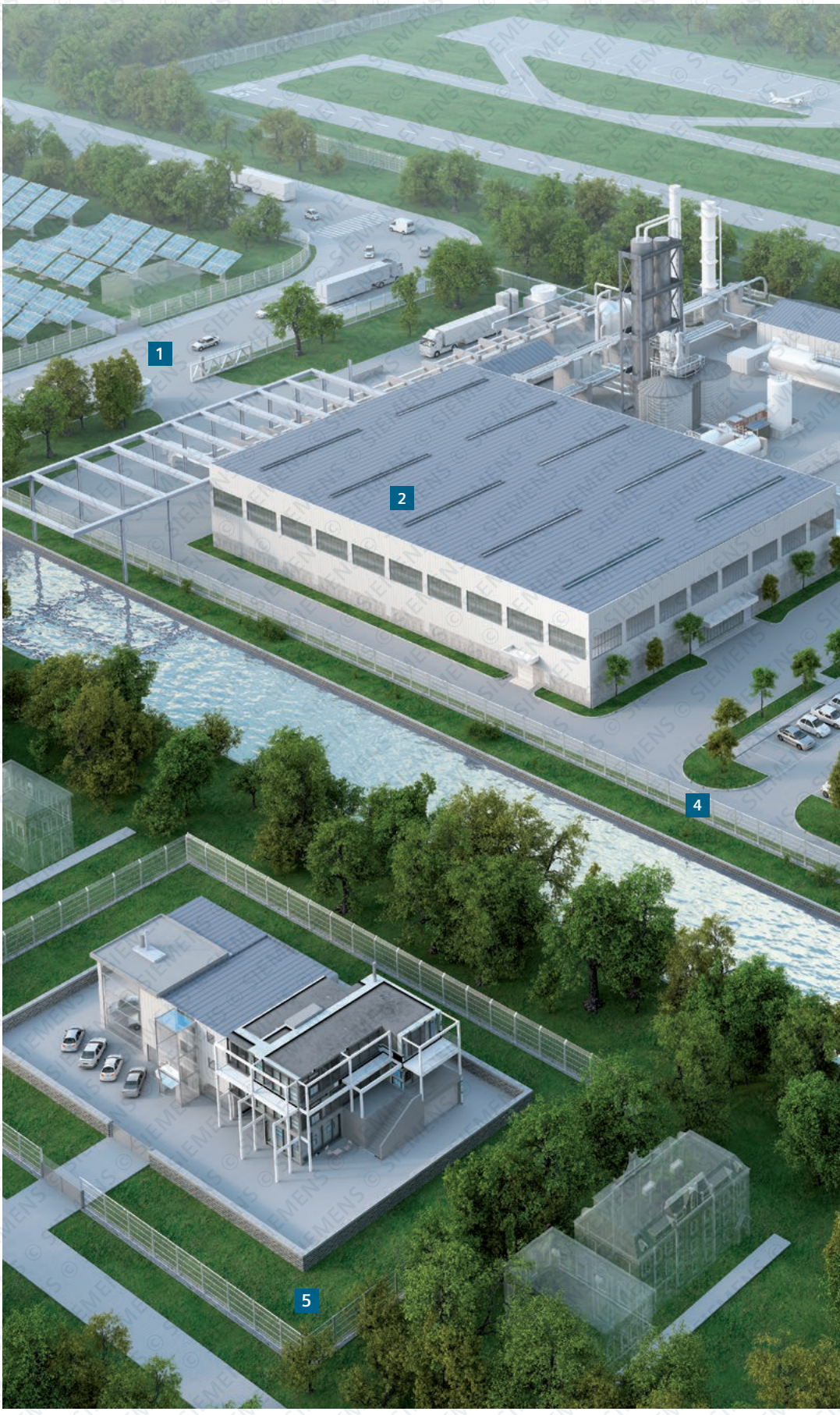
Organizational measures

If an event is detected, it needs to be reported to the relevant personnel. The interventions agreed specifically for your premises can then be initiated. The perfect response every time.

The end result – an integrated concept

An integrated concept includes security for both the interior and exterior of the building. It is the synergistic sum of the individual measures to achieve the protection objectives. Let our experience work to your advantage. Opt for an integrated solution – for complete peace of mind.

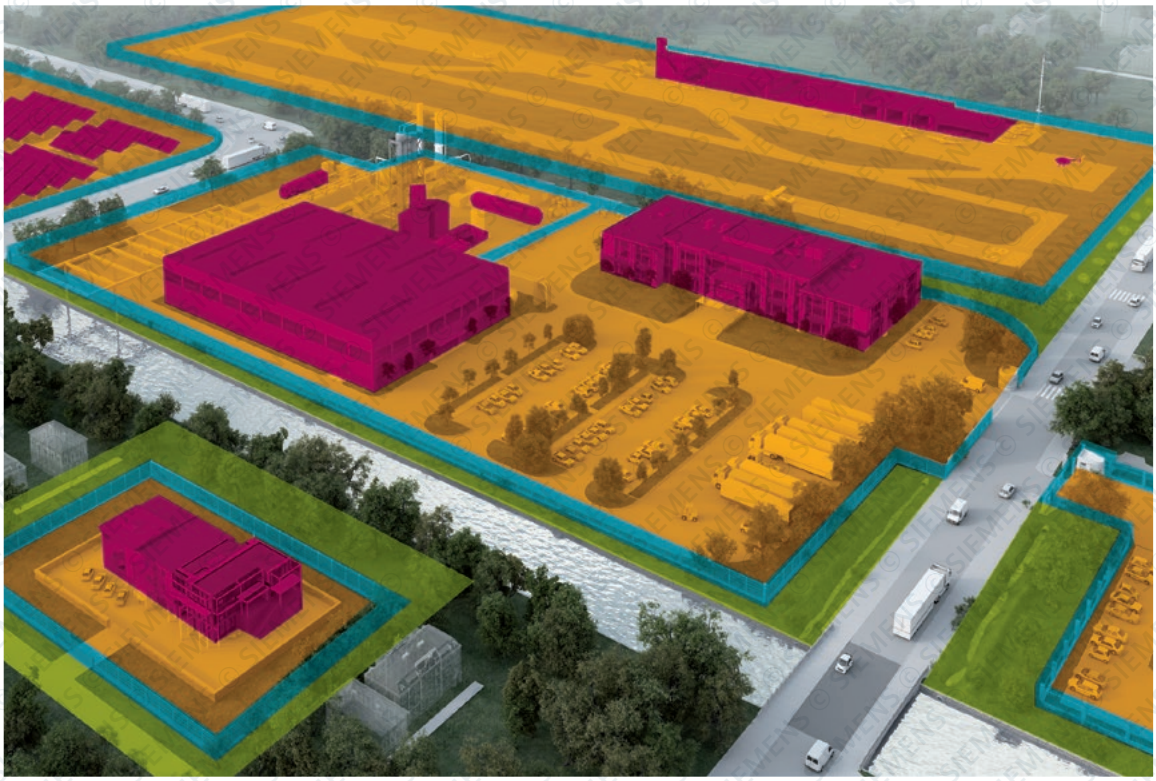
Our building blocks for perimeter security



1 Active IR light barriers
2 Laser scanners
3 Video sensors
4 Microphone sensor cables
5 Microwave detectors
6 Radar sensors
7 Fibre-optic sensor cables
8 IR motion detectors
9 Pressure-change system
10 High-frequency signal cables
11 Vibration sensors


6
7
8
9
10
3
1
11

Four sectors for all-round security



Threats to your property can come from any direction. Dividing the perimeter into clearly defined sectors can help to coordinate a range of security measures, so you are ready to respond quickly and effectively to potential scenarios.

Monitored perimeter areas are divided into four sectors for effective guidance and planning. Both mechanical and electronic measures can be assigned, depending on your protection objective.

Sector 0
An individually defined wide strip of land outside the perimeter area to be protected. In this sector, it is possible to deter or detect an unauthorized approach.

Sector 1
A solid boundary enclosing the perimeter area; the boundary may be defined by a fence, wall or moat and will prevent or detect an attempt to cross this sector.

Sector 2
The entire area within the perimeter excluding buildings or facilities to be protected. The objective is to deter or detect entry into or movement within this sector.

Sector 3
An area within sector 2 occupied by buildings or facilities to be protected. A potential surveillance objective is to detect or prevent entry into, scaling of or damage to such buildings.

The effectiveness of the various detection methods in the individual sectors is indicated by the sector colour codes in the overview below.

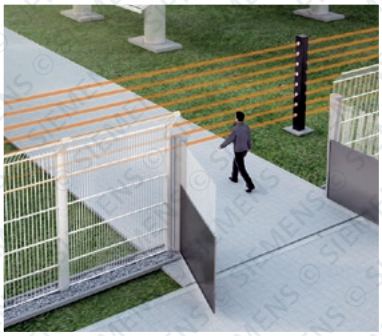
Sensitive sensors – reliable detection

Different protection objectives demand different sensors. When selecting electronic detection measures, the following criteria should therefore be considered:

- Reliability of detection
- Number of unwanted alarms
- Defeat mechanisms
- Tamper resistance
- Transmission security
- Interfaces with other subsystems
- Ease of installation
- Ease of maintenance
- Visibility

Active IR light barriers

Effectiveness: Sector 0 Sector 1 Sector 2 Sector 3



Light barriers are suitable for linear surveillance of fences and gates and for curtain surveillance of objects, windows and walls. They monitor pedestrian and vehicle activity as well as climb-through and reach-through.

Detection principle and specification

- Systems consist of transmitters and receivers with one or more light beams
- Light beam is monitored for interruption and manipulation by extraneous light
- Reliably detects any interruption of the light beam by an intruder

Pros and cons

Good surveillance of linear tracts. The surveillance height can be flexibly varied by individually configuring the mounting columns. Operation is impaired in poor visibility (surveillance approx. 1.5 m x visibility range).

Surveillance area/detection

- Range up to approx. 100 m, height: 0.5 to 5 m
- Good detection rate/few false alarms
- Beams per column: 2 to 16
- It is not possible to identify the exact location of an object within the zone

Microwave detectors

Effectiveness: Sector 0 Sector 1 Sector 2 Sector 3

Microwave detectors are used for linear surveillance along fences, on roofs and in open spaces; they detect pedestrian and vehicle activity in a monitored area.

Detection principle and specification

- The sensor consists of separate transmitting and receiving units and creates a volumetric electromagnetic field between them
- Changes to the field as a result of absorption or reflection by objects or people in the scanning area are reliably detected

Pros and cons

Thanks to its high sensitivity, this solution offers good detection in virtually all weather conditions at a height of up to 15 m. It is less suitable, however, if narrow detection zones of less than 2 m are required.

Surveillance area/detection

- Height/width of field max. 500 m depending on type and distance
- Large areas of overlap in detection fields are necessary if large distances are monitored with multiple sensors in series

Laser scanners

Effectiveness: Sector 0 Sector 1 Sector 2 Sector 3

Laser scanners are used as curtain detectors for objects and break-through detectors for walls and also on larger, flat open spaces (e.g. zones between two fences) and monitor possible reach-through and pedestrian/vehicle activity.

Detection principle and specification

- They scan the surrounding area in two dimensions with laser beams
- Objects and people are detected using time-of-flight measurement and their size, distance and speed relative to the sensor are determined

Pros and cons

This first-rate solution has an impressively low false alarm rate and can be installed easily in all areas. Concealed installation is also an option.

Surveillance area/detection

- Range approx. 100 m, scanning angle max. 270°
- Precise location of object can be identified,
- universally adjustable scanning areas and object properties (size, time spent in scanning area), ability to select multiple alarm zones with different parameters

Video sensors

Effectiveness: Sector 0 Sector 1 Sector 2 Sector 3

Video sensors are used to automatically detect persons or objects within the field of view of a video camera.

Detection principle and specification

- Video sensors use algorithms to define objects to be detected or tracked in the video image; such analysis is usually done not in the camera but in downstream servers
- In the video image, objects or persons that move within the camera's field of view are detected by the algorithms

Pros and cons

A camera allows easy tracking of objects. Algorithms enable reliable detection of alarm situations. Video sensors are very dependent on visibility conditions.

Surveillance area/detection

- Up to 50 m for standard video cameras and approx. 80 m for thermal imaging cameras
- Many detection parameters can be set including speed, direction, distance, size, time or area

Microphone sensor cables

Effectiveness: Sector 0 Sector 1 Sector 2 Sector 3

Microphone sensor cables monitor attempts to tamper with a fence, such as cutting through or climbing over chain link or lattice fences, for instance.

Detection principle and specification

- The sensor cable is attached to the fence
- The slightest vibration of the fence affects the electrical behaviour of the cable
- Any fence vibration caused by an intruder is thus detected and analyzed
- Unlike analogue systems, digital systems can identify the precise alarm location by time-of-flight measurement

Pros and cons

This measure can be installed simply and quickly and has the advantage of low cost and ease of maintenance. Bear in mind however that it is also vulnerable to attack.

Surveillance area/detection

- Up to approx. 400 m of sensor cable per analysis unit
- Fence height up to 2 m can be monitored with one cable
- Digital systems: identification of alarm location accurate to within 3 m
- Analogue systems: one alarm per sensor section

High-frequency signal cables

Effectiveness: Sector 0 Sector 1 Sector 2 Sector 3

High-frequency signal cables detect pedestrian and vehicle activity on a site and are ideally suited to area surveillance of open spaces or paths or to surveillance of uneven ground or areas under trees.

Detection principle and specification

- Invisible HF field between two concealed sensor cables buried in the ground
- Changes in the field caused by an intruder are detected and analyzed

Pros and cons

Installation effort is significant – but so too are the benefits: the surveillance field follows the actual terrain and matches it exactly. Also, the cables are buried in the ground and so are not visible.

Surveillance area/detection

- Up to approx. 2 x 400 m cable per analysis unit
- Surveillance field is approx. 2 to 3 m high and wide
- Identification of alarm location accurate to within 3 m

Pressure change systems

Effectiveness: Sector 0 Sector 1 Sector 2 Sector 3

Pressure-change systems also react to people/vehicles entering a site and are ideal for area surveillance of open spaces and paths or of uneven ground.

Detection principle and specification

- Individual concealed sensors are interconnected in a network
- They operate dynamically and convert changes in pressure into electrical signals by means of piezo elements
- Changes in pressure caused by an intruder are detected and analyzed

Pros and cons

Detection is very dependent on installation (installed depth) and installation in turn is fairly costly. The main advantage: the ability to precisely define detection areas

Surveillance area/detection

- Surveillance area up to approx. 1.5 m
- in diameter per sensor
- Up to 2 x 50 sensors can be networked, approx. 1 m apart and one alarm per sensor line

IR motion detectors

Effectiveness: Sector 0 Sector 1 Sector 2 Sector 3

IR motion detectors detect pedestrian and vehicle activity in large areas or climb-through of a curtain detector system on a fence.

Detection principle and specification
- IR detectors can measure changes in temperature, enabling them to detect heat-radiating objects
- Temperature changes in the surveillance area caused by a moving intruder are reliably detected

Pros and cons
This solution is cost-effective and is easy to install and maintain. Sensitivity can also be adjusted individually for each sensor. Its dependence on weather conditions is however, a disadvantage. Detection capability is greatly impaired in poor visibility.

Surveillance area/detection
- Range: up to approx. 100 m depending on type
- Division into zones in some cases
- Available as curtain/barrier detector or volumetric detector

Radar sensors

Effectiveness: Sector 0 Sector 1 Sector 2 Sector 3

These detectors monitor pedestrian and vehicle activity and are used for linear surveillance of fences and area surveillance of roofs and open spaces.

Detection principle and specification
- Transmitter and receiver in one device
- Detector transmits electromagnetic waves
- and analyzes the echo reflected by objects
- Objects and persons are thus reliably detected and speed and precise location are determined

Pros and cons
Determining an object's coordinates allows a surveillance camera to be operated with pinpoint accuracy. The invisible surveillance area can be set individually and makes it difficult to defeat the sensor.

Surveillance area/detection
- Depending on the product, up to 800 m radius and 15 m height
- Object can be located precisely
- Universally adjustable sensing areas and object properties

Fibre-optic sensor cables

Effectiveness: Sector 0 Sector 1 Sector 2 Sector 3

This solution is particularly suitable for monitoring linear infrastructure, e.g. long fences, solar panels and pipelines, and offers protection against attempts to climb over, climb through or dig under.

Detection principle and specification
- The sensor cable is attached to the fence
- Fence vibration caused by an intruder affects the optical behaviour of the fibre-optic sensor and is detected
- Analogue systems measure and analyze the light intensity, while digital systems identify the precise alarm location

Pros and cons
This solution can be implemented over long distances and the cable can also be used for other applications, e.g. video, thus saving costs. The technology is only cost-effective, however, for distances of 8 km and above.

Surveillance area/detection
- Up to 1.5 km (for analogue systems) and up to 80 km (for digital systems)
- Fence height up to 2 m can be monitored per cable
- Identification of alarm location accurate to within 25 m (digital only), zoning is possible

Beschleunigungssensoren

Effectiveness: Sector 0 Sector 1 Sector 2 Sector 3

These are used primarily to monitor fences and walls and detect attempts to climb over or through secure areas.

Detection principle and specification
- Single-point piezoelectric or capacitive sensors measure vibration caused by intruders (structure-borne sound) and convert this into electrical signals
- Capacitive sensors can also verify the installed location to some extent

Pros and cons
This solution offers ease of installation and maintenance, with the added advantage that sensitivity can be adjusted individually for each sensor. One weakness is the system's vulnerability to attack.

Surveillance area/detection
- Up to approx. 4 m
- Single-point alarm or can be grouped into segments

Ultimately what matters most is perfect integration

It is good to know what gives a security environment its core cohesion. Draw on our expertise and make your perimeter security concept perfect. We can offer you many different ways of integrating into higher-level systems enabling central management of all the components in your security system.

SiNVR Command: wide area surveillance for a complete overview of the situation on the ground

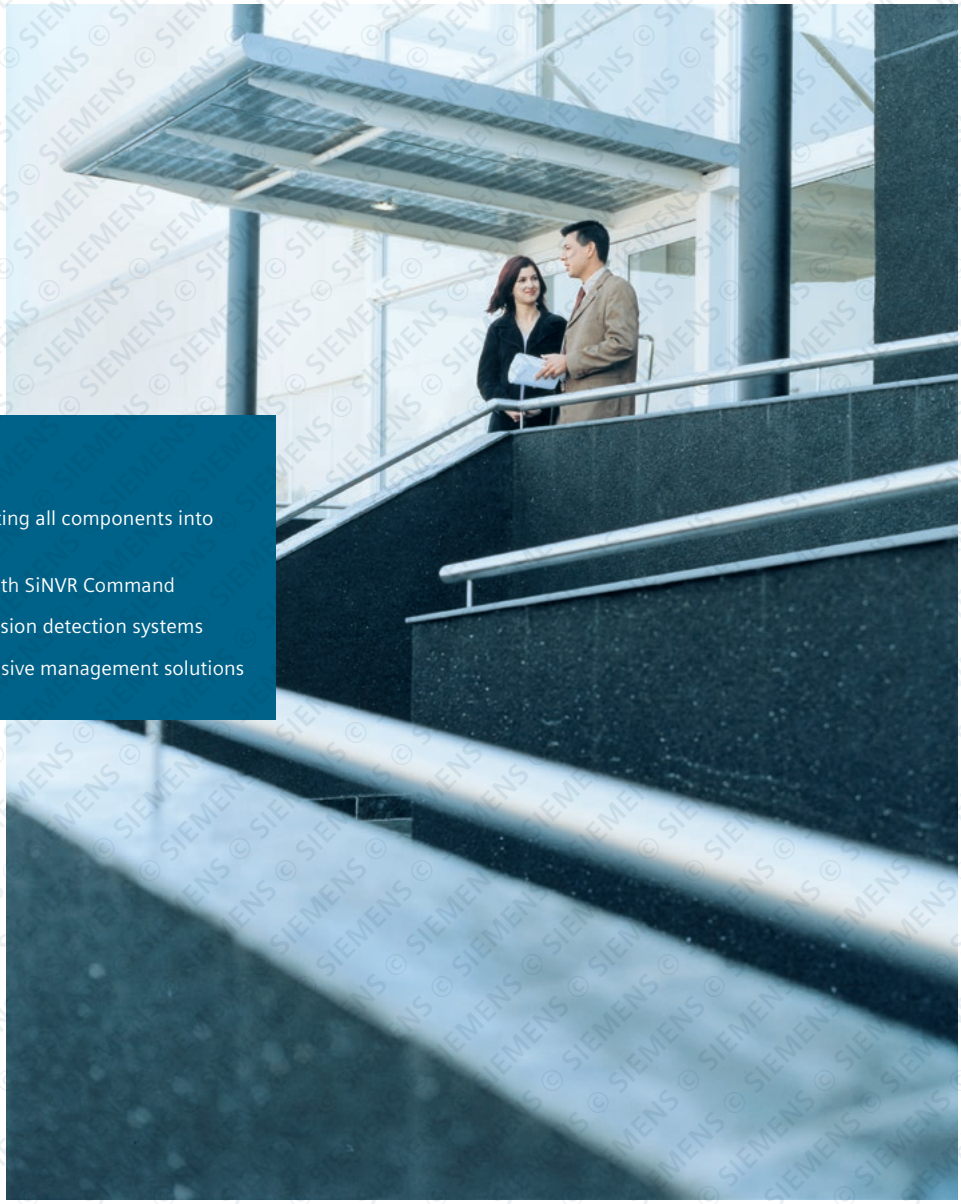
Our SiNVR Command solution allows you to stop attempted security breaches before they occur. This automatic wide area surveillance solution combines conventional perimeter surveillance using fence and other sensors with intelligent video technology. It displays security-related data on a monitor in real time and keeps your security staff constantly updated on everything that is happening in the security environment. SiNVR Command easily adapts to site-specific operational and security conditions and can be integrated into higher-level hazard management systems and control stations.

You can limit access to selected areas or to the entire site, establish different levels of security within one site and upgrade or downgrade the current security level as appropriate.

Intrusion detection systems at the highest level

Perimeter alarms are usually connected to intrusion detection systems. Siemens has an extensive range of products to give you a customized solution. You can be confident that alarms from the perimeter system are correctly prioritized. In the intrusion detection systems, the perimeter alerts can be interpreted and processed in the same way as conventional intrusion, theft or hold-up alarms. Professional handling of all alarm reports from the security system means the right help will be on its way quickly. No matter what response is required. Whether it is immediate intervention by security personnel or coordination of support by our service technicians: it will all be handled reliably and with the utmost care.

Unified information management – respond rapidly, stay secure



Highlights

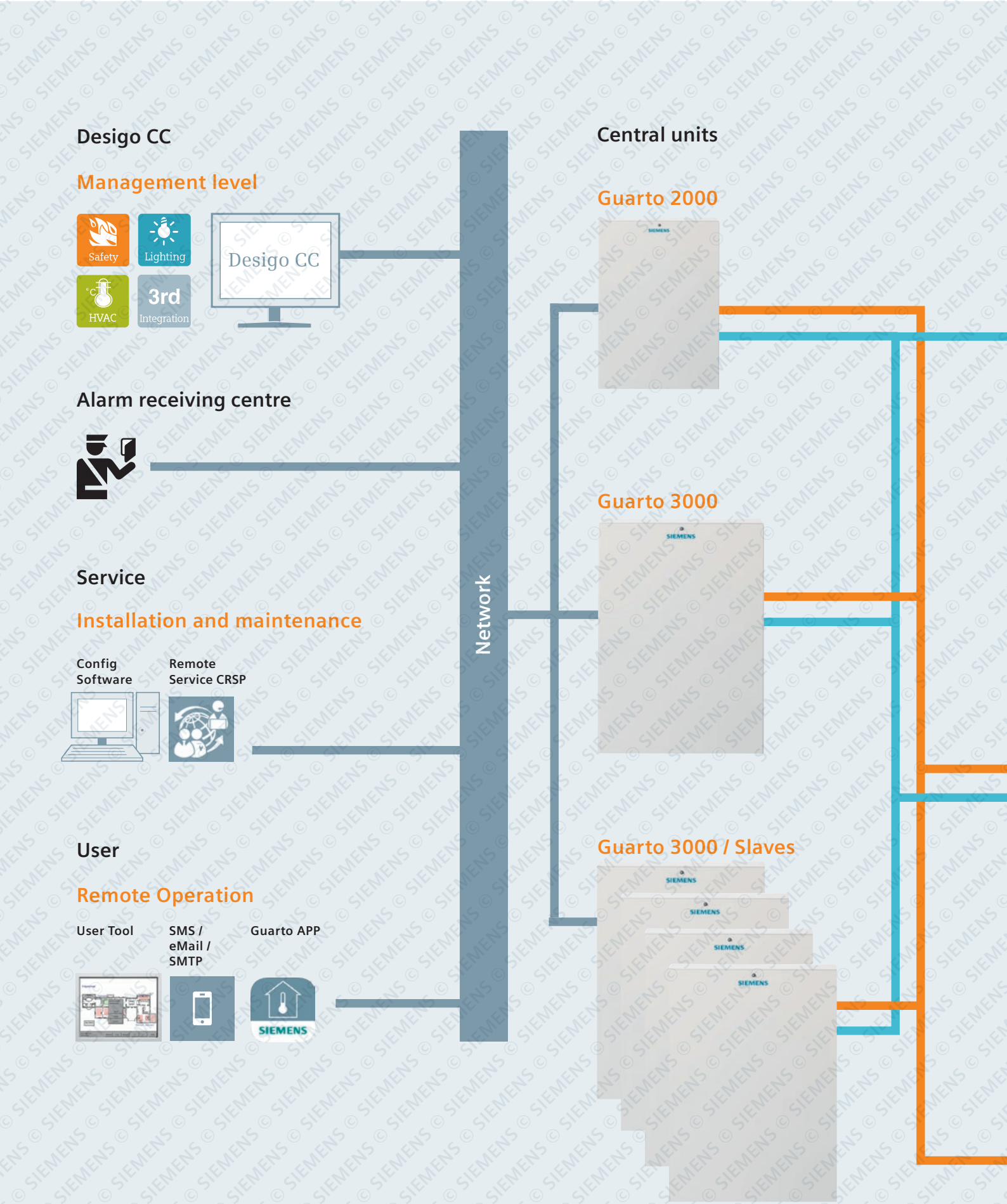
- Versatility when it comes to integrating all components into existing systems
- Automatic wide area surveillance with SiNVR Command
- Reliable intervention thanks to intrusion detection systems
- Security at a glance with comprehensive management solutions

The very act of combining different security mechanisms can itself sometimes create a security vulnerability around the monitoring of the various components. Our systems combine information on a common platform and offer you an added security dimension – a solution that is uncomplicated, low-maintenance and scalable.

Security management systems for all-round security

It is only by bringing together all alarm reports from the various security solutions that you will have control over the system and dependable security. Siemens can offer a range of different security management systems to achieve this.

The advantage is that all alarms are brought together on a single user interface. The management systems differ in the complexity of their capabilities and their particular primary application. Your security requirements have to be integrated into a single security concept that takes account of local conditions. In the same way that the management system has to be adapted to the requirements. Our Siemens security management systems offer you a reliable, scalable, user-friendly solution for central management of your access control, video surveillance and intrusion detection systems. The multisite approach of this solution allows you to receive alarm reports from different locations and to operate all systems as if they were a single unified system.


Desigo CC
Management level
Safety
Lighting
HVAC
3rd
Integration
Desigo CC
Alarm receiving centre
Service
Installation and maintenance
Config
Software
Remote
Service CRSP
User
Remote Operation
User Tool
SMS /
eMail /
SMTP
Guarto APP
SIEMENS
Network
Central units
Guarto 2000
Guarto 3000
Guarto 3000 / Slaves

Integrated interfaces

MOD BUS

OPC

Virtual detection

Alarm transmitters

Alarm receiving centre

Internet

Control panels

Main control panels

CPC/CPC-M
Comfort keypad

K10
Add-on keypad

P10
Add-on displays

Device combination for flush mounting

Graphical Touch Screen

Wireless detectors

Detection

CS9 ADI
4 in 4 Out

Expanders and BUS modules

CS9 MIO
4 in / 8 Out

CS9 O32
32 Out

Bus expanders

Access control

CMU

Biometric fingerprint reader

External PSU

PS2 / PS5

State-of-the-art, adaptable and open

With intrusion detection systems from Siemens you can be assured of state-of-the-art performance and upgradability for many years to come. All thanks to the latest computer architecture and a modular, open software structure. Extreme flexibility allows you to replicate mid-size to large complex systems exactly in your customized security concept. But that is just one aspect – Siemens' innovation goes much further.

Security thanks to intelligent technology

Operation

Operation in normal status and in response to an incident was high on the list of priorities when developing Guarto. We combined the concepts from several generations of systems. And we took it a step further by having detailed discussions with customers and users. This yielded valuable input for the new operating concept. You will find this reflected, for example, in elements that draw on past analogue ease of use. All of which makes day-to-day operation easier and ensures enhanced security and efficiency in a crisis.

Seamless integration

All sorts of systems can be integrated seamlessly into Guarto – from electronic access control, video surveillance and fire detector systems to the huge installed base of proven Siemens detectors (including wireless picture alarms). The alarm control panel too can be integrated into a higher-level building management system without any difficulty. All thanks to an awareness that the interaction of multiple systems significantly increases overall security.

Continuity and investment protection

Continuity and investment protection are two constants that inform all Siemens solutions. You can connect existing intrusion detection systems to the Guarto control panel easily and with virtually no need for changes or adjustments. The MBus Gateway developed specifically for this purpose makes upgrades and updates a cost-effective, straightforward and quick process.

Scalability, security and services

Guarto features impressive scalability, security and add-on services from Siemens. To provide redundancy or for large, complex installations you can network several control panels – via TCP/IP if you wish. All control panels and keypads comply with European (EN) standards and with the Swiss SES-EN-CH standards and guidelines. Siemens will support you over the entire lifecycle of your system, from planning and installation through to regular maintenance and fault clearance. Discover the specific benefits Guarto can bring you in the pages that follow.

System architecture for optimum security and availability

Highlights

- Security Grade 3 certification (EN 50131, SES-EN-CH)
- Flexible and adaptable thanks to software-based mapping of functions
- Multiple control panels can be networked
- Virtually unlimited expansion

Its state-of-the-art computer architecture and open software structure provide optimum levels of security and availability for the Guarto intrusion detection control panel. Flexibility and adaptability are assured thanks to software-based mapping of all functionalities.

Housed in a solid steel casing, the control panel consists of the highly integrated CPU and I/O board, transmission unit, power supply unit and batteries for emergency power supply. In compliance with Security Grade 3, the unit has electronic anti-drill and tamper protection and an opening contact to protect it from damage and sabotage.

If the power supply fails, the system responds

A sophisticated concept ensures an uninterrupted power supply in the event of a mains failure – up to 8 hours at full load. The power supply unit also tests the batteries every day and displays an alert if necessary. Supply voltages in the peripheral components can be measured online and recorded statistically. This makes troubleshooting much simpler.

Latest CS9 bus technology with wide range

The Guarto intrusion detection control panel has three integrated and fifteen expandable CS9 bus connections. The buses run over standard 1x4 cable, can be up to 1200 m long and, with the use of repeaters, can be extended almost indefinitely. For virtually unlimited extension, Ethernet or glass fibre is recommended. Up to 600 devices can be connected, e.g. keypads, input/output units, card readers, temperature sensors, etc. You can also network several control panels together if you wish – either to provide redundancy or to achieve virtually indefinite expansion of overall capacity.

Highest security category

The peripheral CS9 modules are integrated in standard, anti-sabotage plastic housings. Each of these modules has a unique factory-programmed system address for the highest level of security. All inputs and outputs are freely programmable using configuration software. The modules are connected to the system via the encrypted CS9 bus. Guarto complies with all current European and Swiss standards (EN + SES).

Maximum availability – and with wireless technology

The system also has a radio receiver for wireless detectors, e.g. the CS9 THT temperature sensor or the CS9 TXM wireless picture alarm. Up to 64 receivers and 2000 wireless detectors can be operated in each system.

The perfect detector for every situation

Proven in countless installations, Siemens' detectors are acknowledged the world over as being synonymous with technical excellence and reliability. The Guarto intrusion detection control panel can be connected to all current models – including special detectors. This enables seamless integration of existing installations.

Infrared detectors

Siemens continues to perfect its intrusion detection technology with extensive research and development effort. A key focus here is to distinguish between real and false alarms. The patented black triplex mirror technology remains unsurpassed. It is not susceptible to interference from white light, sunlight or lamplight that is not in the frequency range of infrared radiation emitted by the human body. Compared to motion detectors with Fresnel lenses, black mirror technology produces far fewer false alarms. Combined with ultrasonic detectors or installed cameras, infrared detectors offer unbeatable detection reliability and sabotage resistance.

Seismic detectors

These highly sensitive microphones are suitable for protecting repositories for valuables including strongrooms, cash dispensers and safes. They are attached to the repositories where they measure the frequency and amplitude of structure-borne sound. Depending on the parameter settings for sensitivity and signal duration, they reliably trigger an alarm.

Contact and glass break detectors

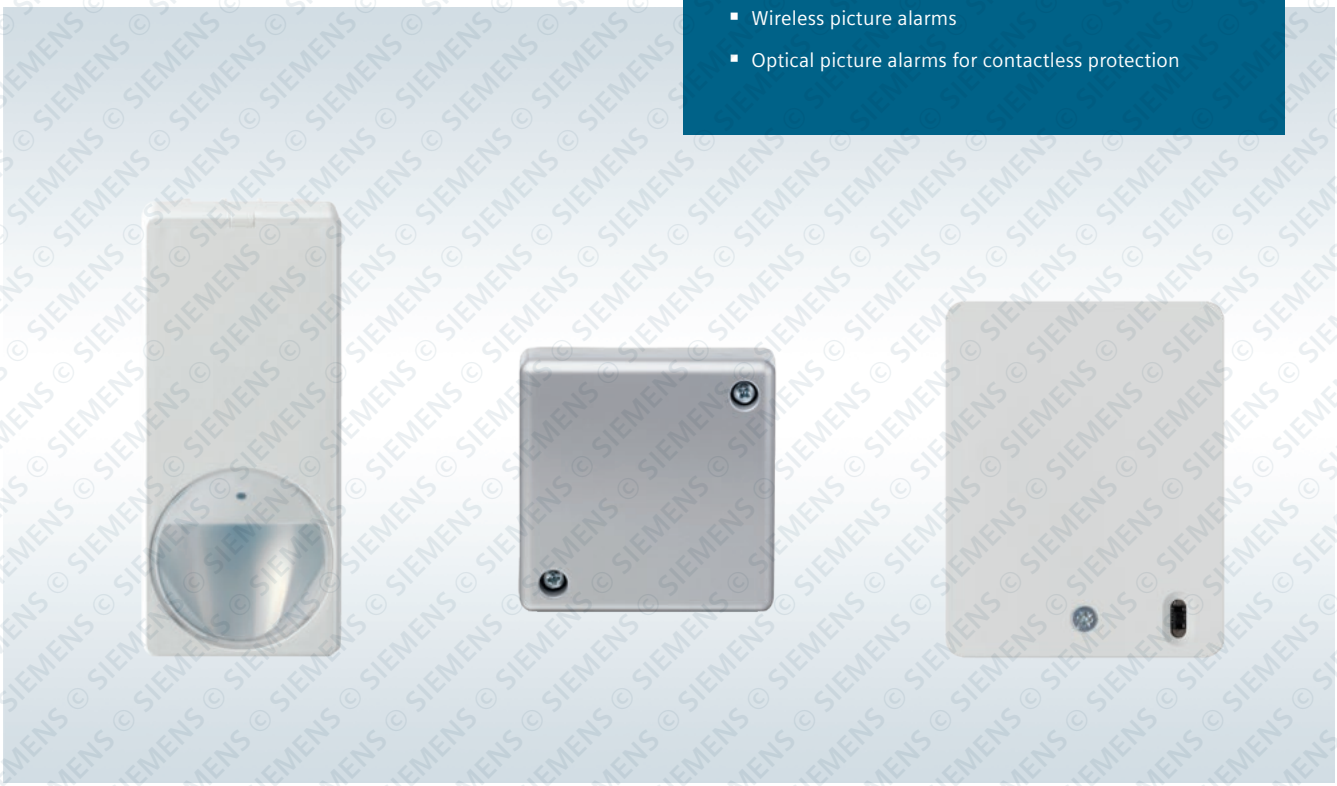
Separate brochures are available with detailed information on our extensive range of magnetic contacts, glass break detectors, bolt contacts, surface protection and perimeter technologies. Our experts will be happy to help.

Wireless picture alarms

CS9 TXM wireless picture alarms provide invisible, reliable protection for pictures, paintings, glass display cases and artefacts. They have an integrated vibration and change-of-position detector with adjustable sensitivity. The detectors can be attached quickly and easily to the object without detracting from it in any way. Signal transmission is extremely immune to interference and uses a frequency specifically licenced for security applications. Each of the maximum 64 receivers per control panel can have up to 2000 detectors connected – each of them individually addressable. The CS9 TXM detector also has an external input, for a contact placed under a vase for example.

Highlights

- Seamless integration of existing installations thanks to backward compatibility
- Infrared detectors with patented black triplex mirror technology
- Seismic detectors with high-sensitivity microphones
- Wide range of contact and glass break detectors
- Wireless picture alarms
- Optical picture alarms for contactless protection



Ease of use on every level

Controlling complexity simply and reliably

You quite rightly expect that the technical specification of your new Siemens control panel will meet all your requirements, in terms of the number of detectors and zones you require for example, or timer sequences. Another key practical consideration, however, is how the system "feels" in day-to-day operation. It must be simple, easy to understand and self-explanatory, not only for experienced, technically minded staff but also for casual/pool personnel assigned at short notice.

Routine and non-routine tasks must be accomplished smoothly and without any misunderstanding: arming and disarming individual zones (when replenishing a cash dispenser, for instance), night/day changeover or resetting a false alarm or a real alarm at two o'clock in the morning accompanied by response professionals.

CS9 CPC comfort keypad combines analogue operating philosophy with state-of-the-art technology

The demanding requirements outlined above are met by the CS9 CPC comfort keypad, on its own or combined with one or more CS9 K10 add-on keypads. With or without an add-on keypad, it combines an analogue operating philosophy with state-of-the-art technology. The LED display shows the system status intuitively – even from a distance.

Mobile and secure – the keypad provides a convenient overview and optimum security even when you are on the move. Thanks to its integrated interface, the keypad can also communicate with mobile phone operating systems, e.g. with Android and Apple iOS. Security is further enhanced by the additional, individual transmission key.

No need for risky interpretation of numbers and symbols, no need to search through confusing submenus looking for reasons. Users can see at a glance which zone cannot be armed, or whether an alarm has already been transmitted. The information on the eight-line display is in plain text so everyone knows exactly what needs to be done.

Respond instantly and intuitively

Users can log on using a PIN code, key switch or badge. The language associated with the user profile appears immediately (different languages are supported simultaneously if multiple users are logged on at different operator terminals). The user can then process and acknowledge alarms. Direct select buttons with icons or functions printed on them can be used to initiate an action instantly and intuitively: e.g. switch off a horn or arm a twinsafe. In each of the freely programmable buttons there is a two-colour LED that indicates a status even from a distance, e.g. an open window that is preventing the system from being armed.

Touch panel: building floor plan provides overview

The touch panel displays alarms and statuses directly in the building floor plan – e.g. armed/disarmed zones, or alarms in different colours and/or flashing. Authorized users can reset alarms, arm zones and access all operation and configuration menus directly on the screen. This means they can manage without an additional conventional keypad, but they can integrate one if necessary.

CS9 CPL panel: clear text

The operating concept for the light panel is essentially the same as for the comfort panel, for which a keypad and eight-line display are available. It is suitable for any situation where small numbers of users operate the system and are willing to forego the convenience of direct select buttons and LEDs. Alarms are displayed directly and in clear text. There are two arrow keys for swiping and scrolling up and down. To the left and right of each arrow key, there is a soft key to which context-sensitive functions can be assigned, e.g. to confirm an alarm or to access a submenu directly.

PC operation

Using software, Guarto can also be operated and monitored entirely via a PC, e.g. to change authorizations or areas in user profiles. Depending on your individual requirements, you can manage and access the system via TCP/IP locally or across different sites: e.g. to read the event log, to support staff in branch offices at off-peak times or for remote maintenance on a controlled scale.

CS9 UPE code keypad

Stylish, elegant keypads are available for flush or surface mounting with integrated buzzer and LED status displays.

Colour floor plans indicate events and statuses quickly and clearly. The floor plan on the touch panel can also display alerts from a Siemens fire detection system, for example, installed in the same building. This allows both systems to be operated from a single panel, which has advantages in terms of architecture and ergonomics. In the event of a fire, emergency response personnel still of course have the keypad for the separate fire detection system at the entrance. Customer-specific functions can be programmed using virtual buttons.

The Guarto intrusion detection control panel can be operated in a variety of different ways: via the easy-to-use, menu-driven standard control panel, ergonomic comfort control and display panels, touch panel or as a subsystem or part of an integrated system. Naturally, controllers and control panels have the highest level of SES certification (Swiss Association of Installers of Security Systems), making them suitable for use in high-security installations.

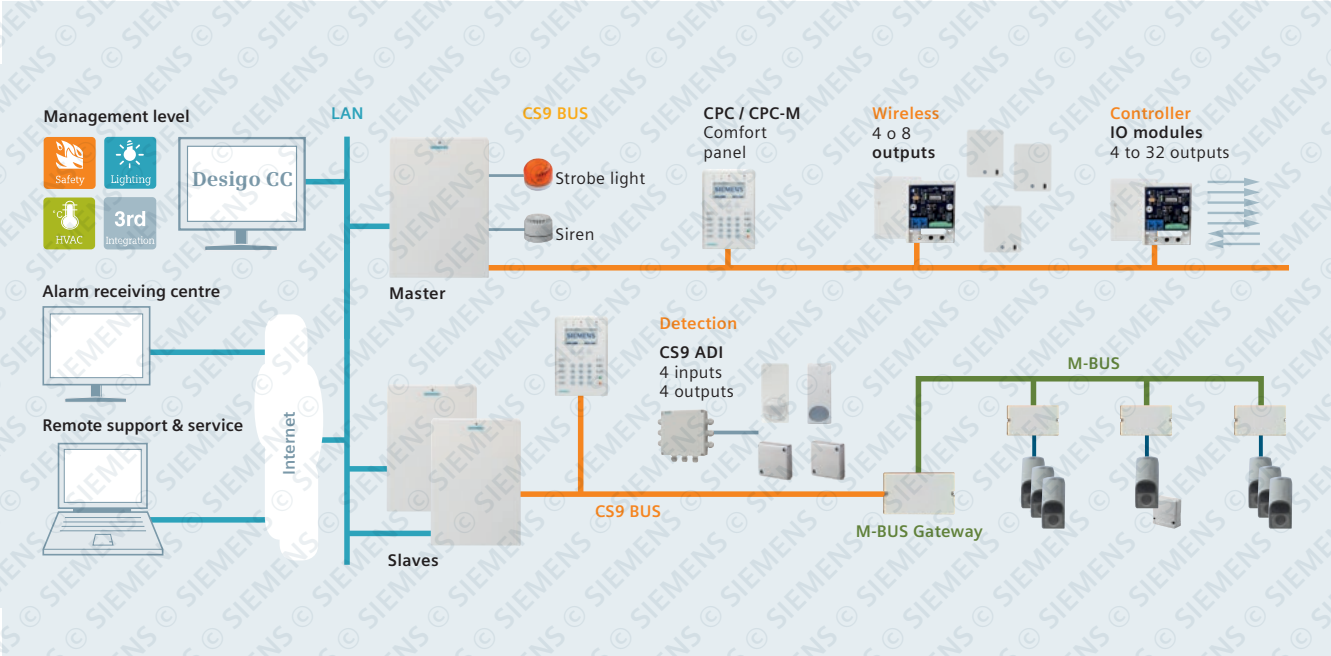
Full system integration with other security systems

Guarto can be integrated fully into higher-level management systems, including the Desigo CC management platform and the Siseco CC security system. All areas, objects and the system status can then be represented graphically and controlled from one central point. Other security functions can also be easily integrated into the alarm control panel, including electronic access control, image activation (CCTV) and display of fire alarms.

The ability to connect conventional and also biometric access readers is included as standard. Similarly, IP cameras can be integrated for monitoring rooms or for displaying live images in the event of an alarm. This significantly extends the available surveillance and intervention options. The images can also be displayed on the touch panel – directly with the touch of a finger or triggered by events.

For fire detection systems too, Siemens offers integrated security: Guarto is able to display fire alarms graphically on the touch panel. This allows integrated operation of two key building management disciplines. The open system architecture also enables certain comfort applications to be in-tegrated, including multimedia terminals in private homes or building and room control systems for instance.

Using fibre-optic cable, several complete Guarto systems can be networked, sometimes over considerable distances, and operated transparently. This is a definite advantage when protecting multiple buildings and segments. Alternatively, this can also be done to achieve redundancy. Guarto can also be connected to IP networks and operated remotely. Remote maintenance and diagnosis in the event of a fault can significantly reduce costs and intervention times.



With its state-of-the-art open system architecture, the Guarto intrusion alarm control panel can be seamlessly integrated into other security systems.

Siemens provides full lifecycle support for your solution

Siemens protects your investment in security technology over the longest possible service life – with long-term support and maintenance, ongoing modernization and replacement at the optimum time.

Despite the rapid advances in technology, lifecycles for intrusion detection systems are still extremely long, often as much as 15 to 20 years. There comes a time, however, when spare parts are no longer available, use of the building changes or the company expands and the system needs to be upgraded or updated as a result.

To protect your investment, Siemens makes its technologies sustainable and largely backwardly compatible. This is true for the Guarto intrusion detection control panel too.

MBus Gateway

Peripherals and building wiring are significant cost factors in an intrusion detection system. This is why it is desirable to retain them when upgrading an existing system to state-of-the-art technology. A special gateway between the existing installation based on MBus technology and the new CS9 bus makes this possible. In most cases, when upgrading and updating systems, this enables extremely efficient replacement of the central control panel and keypads. Depending on the concept and the cost situation, existing installations can be updated with conventional technology or with the new CS9 bus technology. Different communication protocols mean that existing keypads will have to be replaced in any event, but this does allow users to benefit from improved ergonomics.

OPC FOUNDATION

Guarto can be integrated into higher-level or control systems via Mod-Bus IP or OPC. ModBus is integrated into Guarto and requires no additional hardware. Entry/area statuses can be queried, areas armed/disarmed and acknowledgements implemented. The OPC interface is offered with the separate Guarto OPC server. This enables specific authorizations and time limits to be assigned. The server connection is continuously monitored and synchronizes automatically if the connection is lost or the application crashes.

Protecting cultural objects

Security versus public access

Museums face a difficult balancing act as they reconcile their dual roles as custodians of cultural artefacts and as public spaces. One role requires them to provide maximum protection against theft, damage and tampering, while the other means the security components must be as unobtrusive as possible so as not to interfere with the visitor experience. Spectacular art thefts in recent years have also demonstrated that a new generation of art thieves are increasingly willing to use violence. As museum directors seek to respond to these new threats, they will have to rethink their security precautions and concepts.

Contactless and invisible

In the past, cultural objects were only protected against theft and mostly by means of contact alarms (triggered if a painting is taken off the wall). To prevent damage caused by carelessness or by malicious actions, as well as the need to be invisible, another important criterion today is the contactless protection of works of art. There are three possible solutions: pure proximity detection, conventional anti-theft protection or a combination of the two.

Laser-based proximity detection

This electro-optical laser scanning system provides proximity protection. It measures the surrounding area in two-dimensional polar coordinates. Optical light curtains (vertical or horizontal) are generated in the process. The laser scanning system is totally invisible and contactless and supports several surveillance fields as well as a large surveillance area. The object size can be freely selected for alarm evaluation and can be changed at any time. The laser can also be installed behind glass.

Optical sensors to protect against theft

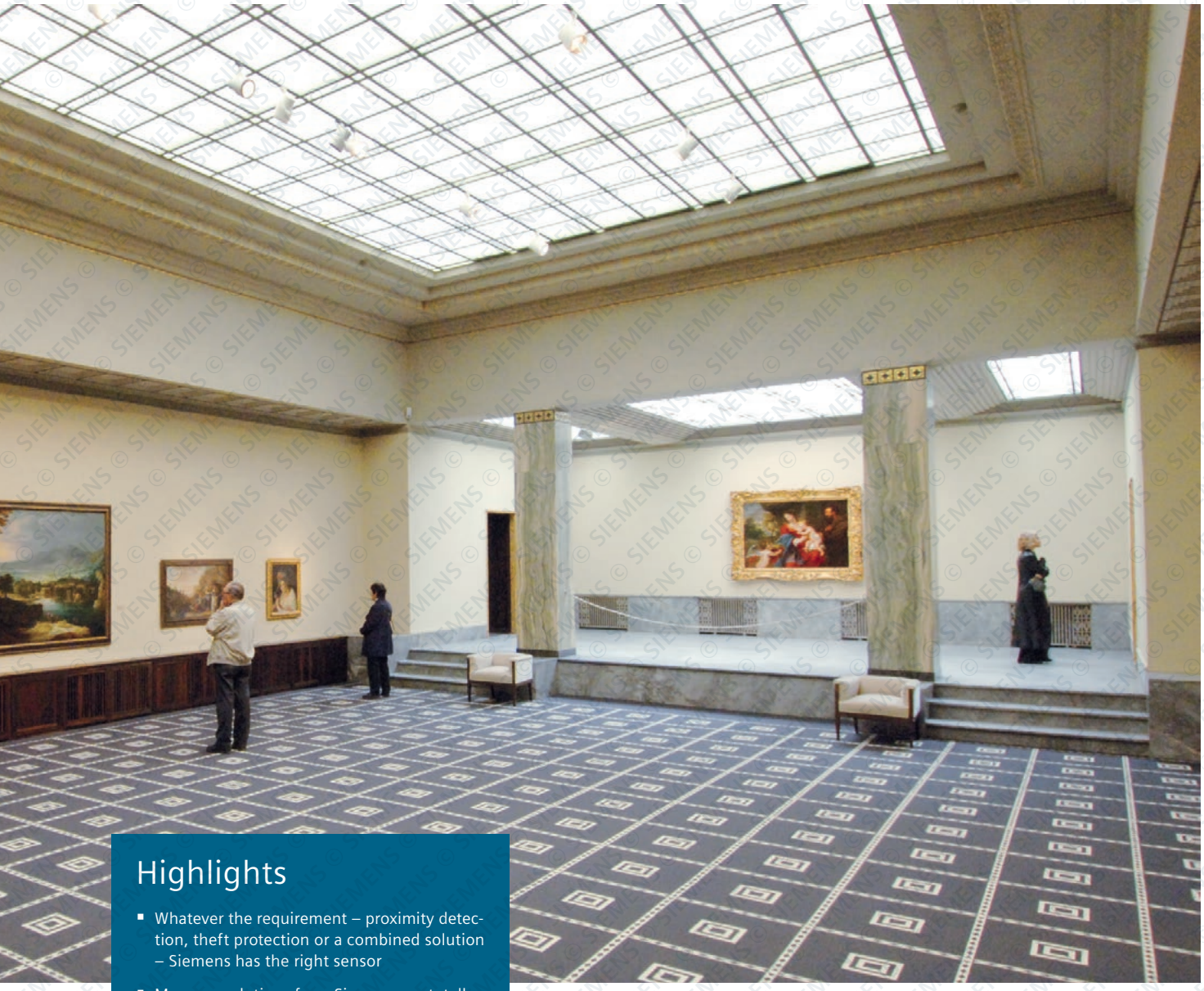
Optical sensors are a contactless solution to protect pictures, paintings and other objects from unauthorized removal or tampering. The opto-electronic sensor illuminates the part of the object facing it (e.g. back of a picture) with infrared light and monitors the reflected radiation, to ensure reliable canvas monitoring. The sensor adjusts automatically to its operating conditions, is extremely reliable as well as tamper and defeat resistant. It is available as either a hard-wired or a mobile wireless solution.

3D sensor

The 3D sensor is a special optical sensor used for proximity detection, e.g. for sculptures. Reflected infrared light is used to capture the distance profile of an object in real time and create a topographical image of the monitored area. The sensor immediately detects any violation of this freely configurable security zone by a person entering it. Privacy is ensured as the sensor transmits only data, not video images. Another advantage is that the 3D sensor does not require any illumination and is not sensitive to variations in temperature.

Capacitive sensor for a combined solution

A capacitive picture sensor generates an invisible electrical surveillance field around the artefacts to which the sensor is fitted. If a person gets unacceptably close to the object, the sensor reacts extremely quickly with an alert. At the same time, even the slightest contact with the object is registered. The capacitive sensors can be hard-wired in the wall or deployed as a mobile solution with wireless transmission and a battery. Major advantages include combined proximity detection and theft protection on each sensor face, adjustable trip distance, ability to monitor even when there is a "presence" and resistance to light and noise interference.



Highlights

- Whatever the requirement – proximity detection, theft protection or a combined solution – Siemens has the right sensor
- Museum solutions from Siemens are totally contactless (not installed on the actual artefact) and are virtually invisible to the casual observer
- Effortless integration into Guarto (including video surveillance, perimeter protection, etc.)

Seamless integration into

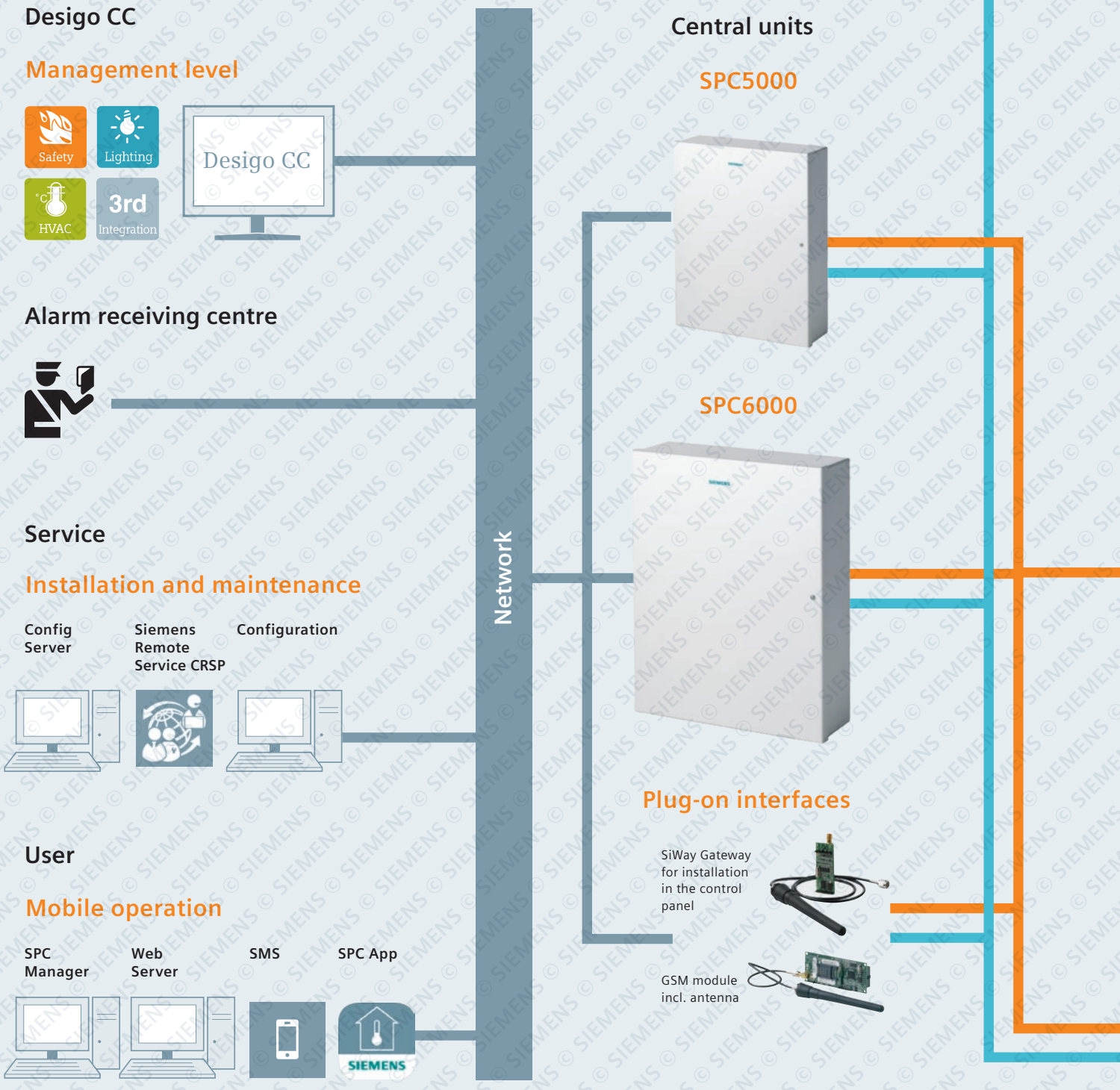
All these Siemens sensors can be integrated seamlessly into Guarto. Security of the objects to be protected can be further enhanced by integrating electronic access control, video surveillance, fire detection systems, perimeter surveillance, etc. The central alarm panel can of course be integrated into a higher-level management system without any problem.

The right solution whatever the customer requirement

Irreplaceable artefacts require absolutely reliable protection. Comprehensive, needs-based security solutions call for customized planning and reliable components. Siemens uses detectors that have been developed specifically to protect objects in museums and can be adapted to their individual requirements. Similarly dedicated decision logic in the sensors ensures high levels of quality, reliability and security.

Intrusion detection technology – simple and integrated

The SPC series is a totally variable and reliable security system, with compatibility for tomorrow available today. Depending on individual requirements, a controller from the SPC family is the heart of the security system. An extensive range of panels is available for operation and programming; these are operated by keypad, key or code card. All control panels are wired. The detectors can be connected to the controller either hard-wired or wirelessly. This allows flexible system planning and fast installation.



Interfaces

KNX interface

Detection

Wireless detectors

Wireless operation

Wired detectors

Operation

Operation

Standard Keypad

Comfort Keypad

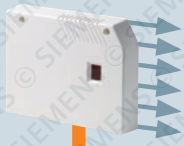
Keyswitch Expander

Indication Expander

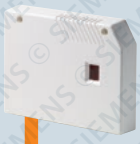
Bus Expanders

SPCW130
SiWay wireless expander

SPCE433
Expander; 8 relay outputs



SPCE650
Expander 8 inputs and 2 outputs



x-Bus 1

Verification

Audio Keypad

Audio Expander

IP Cameras

IP (Ethernet)

Access control

SPCA210
2-door expander

External PSUs

PSU I/O

PSU 2-Door

Loop

x-Bus 2

Things change. What remains constant is the need for security.

Highlights

- Ideal for every application: industrial, commercial, residential
- Easy installation and expansion
- Extremely user-friendly
- Multifunctional connectivity to higher-level systems and subsystems via X-BUS
- Integrated access control
- Up to 60 security areas, 512 inputs, 512 users are possible
- Variety of communication options for programming and alarm transmission, e.g. via Ethernet, web or GSM-GPRS
- Reliable avoidance of false alarms
- Service either on-site or via remote access
- EN 50131-compliant

There is no more reassuring feeling than knowing that your family, your possessions and your place of work are well protected. Being able to rely on a competent partner is crucial to this. Siemens represents the perfect synergy of alarm and communications technology and has done so for decades worldwide. We develop milestones. For your security.

The components of the Siemens SPC series deliver reliable security management now and into the future. With both wired and wireless options available, this professional security concept creates an infrastructure that can be readily adapted to meet changing needs without any structural alterations.

Planning for tomorrow's security today

Modernization, conversion, extension, renovation

There are all sorts of reasons for structural alterations to a building: the need for more space, for a different configuration, a desire for a new, more transparent room layout, to integrate a service area or create additional storage space – the list is endless. Older intrusion detection systems often lack the flexibility to keep pace with these changes. With the SPC series, clients are ideally equipped for many years to come. A variety of interfaces such as the integrated Ethernet, IP and bus technology ensure that the dynamism needed to accommodate any future changes is built in. New surveillance areas can be created quickly and easily using wireless detectors, for example, ensuring optimum protection of facilities.

New build

Anyone planning a new building needs to look to the future. Opting for the future-proof technology of the SPC intrusion detection systems is the best possible foundation for the future of the building you are protecting. The combination of wired and wireless detectors in a new building provides a solid basis for continuously upgradeable security.

Managing your own security

Life is not always the same. Which is why every system is preprogrammed with individual security settings. Activating these as required on the comfort keypad is simplicity itself. Or you can query the status of your system wherever you are in the world, by mobile SMS or over the Internet.

Ease of installation

Extensive consulting and expertise

	SPC5330	SPC6350
Number of areas	16	60
Total number of detector groups min./max.	8 – 128	16 – 512
Number of wireless detector groups min./max.	0 – 120	0 – 120
Outputs	6 – 128	6 – 128
Users	256	512
User groups	100	100
X-bus devices	48	128
Bus topology	2 stubs/1 loop	2 stubs/1 loop
Calendars	32	64
Number of readers/doors	16	64
Event log intrusion/access	10 000/ 10 000	10 000/ 10 000

	SPC5330	SPC6350
Web server	integrated	integrated
IP interface	integrated	integrated
Integrated IP transmission	yes	yes
GPRS back-up	plug-in	plug-in
Audio verification	yes	yes
Remote access/remote diagnosis	supported	supported
Mobile access	Apple iOS/ Android	Apple iOS/ Android
Voice annunciation on keypad	yes	yes
EN 50131 Grade 3	yes	yes
EN-CH 50131 Grade 3	–	yes
VdS – C	–	yes

Complete control anytime, anywhere

SPC Connect for iOS and Android smartphones and tablets puts you in control of your intrusion detection systems.

The SPC series is a new generation of security system combining advanced intrusion and access control with cost-effective, future-proof technology.

SPC Connect is a mobile application for iOS and Android that supports iPhone, iPad and Android devices. This appealing app is ergonomic and user-friendly, and provides a powerful interface that allows users to control their SPC intrusion detection systems remotely – anytime, anywhere. As a password-protected user, SPC Connect lets you monitor and operate your SPC intrusion detection systems reliably wherever your system may be installed. You can arm and disarm SPC intrusion detection systems, open doors and check the status of all detector lines (detectors) in your system.

Another important feature is the ability to call up live images of your monitored facilities by accessing the IP cameras connected to your SPC system.

Highlights

- **Multiple locations**
  You can manage multiple locations remotely with ease and switch between these if necessary.
- **View and operation**
  Monitor the status of your premises, arm and disarm alarms and cameras, control your surveillance zones across the individual facilities.
- **Door control**
  You can remotely manage all doors controlled by the SPC system and grant or refuse access.
- **Graphic map (floorplan)**
  You can position the detectors freely on a graphic map (floorplan) and represent the system visually with direct control functions and status reports.
- **Live camera view**
  You can view all images from the IP cameras connected to the SPC system by remote access in PCanywhere.

Technical data	
Requirements	▪ Device: Smartphone + tablets ▪ Operating system: Android, iOS4 or higher
Screen view	▪ System selection ▪ Area overview ▪ Line overview ▪ Status of connected doors ▪ Camera images ▪ Event log: intrusion log, access log, WPA log ▪ App configuration

Tracking systems

buildingtechnologies.siemens.com

15.1. Introduction	588
15.2. Use and potential applications	588
15.2.1. Personal call button	588
15.2.2. Distress signal system	588
15.2.3. Care system for disoriented persons	589
15.2.4. Panic button	589
15.2.5. Prevention of infant abduction and mix-up	589
15.2.6. Tracking of mobile assets	590
15.3. Construction and technical solution	590
15.3.1. Tags/transmitters	590
15.3.2. Readers	590
15.3.3. Server	591

Use Case	592
Tracking systems	594

15.1. Introduction

In an ageing population, the number of long-term patients is increasing. The prevalence of dementia is rising sharply and with it, the level of care needed. At the same time, growing cost pressures in the healthcare system mean that fewer and fewer staff are available. Which is why it is so important today to optimize efficiency in care delivery to ensure comprehensive support for patients and residents at all times. This is where people and asset tracking systems can help to support efficient processes and workflows in hospitals.

The growing numbers of in-patients and out-patients combined with cuts to budgets and staffing levels are making it increasingly difficult for nursing staff to maintain a high standard of care around the clock. Their role includes keeping dementia patients under constant supervision while also dealing with aggressive patients or worried relatives and making sure that neither newborn babies nor costly medical equipment fall into the wrong hands.

Thanks to the latest wireless technology, the location of objects and individuals can be identified in real-time enabling patient flows to be analysed and optimized. This technology can be used in clinics and other healthcare facilities, for instance, to prevent patients wandering, infant abduction and mismatches and theft of portable equipment. By pressing a button, nursing staff or patients can send a wireless distress signal indicating their name and current location so that help can be directed to the right place without delay.

For hospital and care facility managers, a people and asset tracking solution not only provides greater security for patients and staff, it also reduces their liability exposure. The resulting savings in time and money increase cost-effectiveness, ease the pressure on healthcare staff and enhance the quality of care.

15.2. Use and potential applications

People and asset tracking systems can be used for a range of different applications. They address the challenges of our time:

- The elderly and vulnerable people with orientation problems, patients who are liable to get lost in hospitals/clinics or indeed leave the building unnoticed (e.g. Alzheimer's patients)
- Infant abduction
- Infant mix-up
- Attacks in the emergency department by patients under the influence of alcohol or drugs
- Patients (e.g. in a psychiatric unit) who become violent
- Expensive medical equipment is becoming increasingly mobile, i.e. easier for organized criminals to steal (e.g. ultrasound, cardiology and gastroenterology equipment)

This type of solution relies on an antenna infrastructure being installed in the building.

15.2.1. Personal call button

The personal call solution consists in most cases of a portable button worn on the wrist. Patients or the elderly can summon help at any time, wherever they are in the building. They simply press the button and the relevant member of staff is notified immediately of their location. The alarm is personal which means that the member of staff can bring along any colleagues, medication or equipment that is needed (e.g. if the patient has suffered an epileptic seizure or has a heart condition).

Fig. 15.1: With the wearable button, help is at hand quickly

Advantages:

- Patients enjoy greater security and mobility
- Patients feel well looked after while their family has peace of mind
- Patients can be located by staff to administer treatment
- Efficient, automatic alarm acknowledgement

15.2.2. Distress signal system

If a hazardous activity is being undertaken by a lone worker (e.g. service technician, maintenance fitter, laboratory technician, test bay technician, etc.), the employer has a statutory duty to put in place appropriate technical and organizational personal protection measures, over and above general health and safety precautions.

The line manager is required to conduct a risk assessment that includes an assessment of the reliability of the devices used and the response times achievable with these devices, based on the operating conditions. A distress signal system (PNA) that complies with the regulations of the employers' liability insurance associations, enables the employer to meet this obligation. These distress signal systems provide technical assistance in emergencies for assembly, service and maintenance staff working alone or in hazardous work environments.

Most PNAs have a button that is activated if an incident occurs. This has a feature that can detect if a worker falls. An alarm is triggered either by pressing the alarm button or by a change in position as the result of a fall.

Components and functionality
The PNA comprises a distress signal unit (PNG) and an emergency call receiving centre (PNEZ). In most cases, an emergency and service control centre (NSL) operated by the provider serves as the emergency call receiving centre. In an emergency, the alarm can be triggered by the worker consciously activating the button.

The alarm can also be raised automatically, however, (position alarm, no-motion alarm or time-based alarm), if the employee is incapacitated as the result of an accident, for example. If the unit is worn on the belt, for example, a short cord can be attached to a belt loop. As soon as the unit tilts into a horizontal position, e.g. as a result of the wearer falling, or if it becomes detached from the cord and falls, an alarm is triggered. To prevent false alarms, the unit has a pre-alert feature so that the wearer can reset the alarm before it is transmitted.

In the event of an alarm, the PNG sends an alarm call to a PNEZ and also transmits the coordinates of the PNG's main station, which may be installed in a field service vehicle, for example, in order to locate the casualty. The NSL uses central software featuring a detailed map view to identify the location of the casualty. Alternatively, in cases where casualties are unable to summon help themselves, a voice connection can be established. This makes it much easier to locate the person. In such cases, the NSL is able to trigger an audible signal on the PNG unit from the NSL end. Using the nationwide mobile phone network, a distress signal system is a solution that offers optimum protection for workers with extremely simple set-up and full telephony integration.

Fig. 15.2: The transmitter can also communicate its position via Bluetooth.

15.2.3. Care system for disoriented persons
Dementia patients are given a tag/transmitter to wear on their wrist. An alert is triggered (call light, DECT, pager, siren, etc.) as soon as the patient leaves a secure area. The relevant member of staff is notified of the patient's name as well as the location where the alarm was triggered. Doors can also be left open without the risk of dementia patients leaving a permitted area.

Advantages:
- Sending an immediate alert, identifying the patient and their location, avoids having to mount a search
- Vulnerable patients cannot leave the care facility unobserved
- Relatives have peace of mind, knowing their loved ones are safe
- An alert is triggered if the resident removes the tag/transmitter

15.2.4. Panic button
Staff wear a tag/transmitter that has two emergency call buttons. If an incident occurs, the member of staff presses the emergency call button. Activating this button will trigger different alerts, as appropriate (call light, DECT, pager, siren, etc.). The person's location and name are also transmitted with the alert. This system is particularly suitable for use in emergency departments, psychiatric units and closed facilities.

Fig. 15.3: The transmitter with two emergency call buttons

Advantages:
- Fast, effective assistance for staff under duress
- More discreet and more readily accessible than conventional wall-mounted alarm buttons
- Protective casing available, e.g. for use outdoors (in the grounds, car park, etc.)

15.2.5. Prevention of infant abduction and mix-up
Newborn babies can be fitted with a tamperproof miniature tag worn around the ankle. This will transmit an alarm immediately if the baby is removed without authorization. Mother/baby tag matching prevents baby mix-ups, including in cases of multiple births. Escort features and multiple births can also be configured in the system.

Fig. 15.4: The miniature tag is placed around the baby's ankle

Advantages:
- Protection against infant abduction
- Free movement of mothers, visitors and staff on the maternity unit is not unnecessarily restricted
- Protection against mother/baby mismatches and transmission of disease through breastfeeding (hepatitis)

15.2.6. Tracking of mobile assets

The tag/transmitter on mobile hospital equipment triggers an alarm if the equipment leaves its designated area without authorization. This protects against theft and misuse. Using transmitters to identify mobile hospital equipment can also save the service department a great deal of time locating an item of medical equipment when scheduled maintenance is due. Mobile inventory tracking systems also support additional analysis features, enabling for instance bed capacity management and as-incurred billing.

Fig. 15.5: Help can be summoned quickly with the wearable button

Advantages:
- Equipment can be located quickly in an emergency
- Protection against theft or misuse
- Optimization of rental and leasing contracts thanks to automatic statistical analysis

15.3. Construction and technical solution

Innovative wireless tracking systems enable the location of a person or an item of equipment to be identified quickly and with full site coverage. Active RFID and IR transmitters are worn by a person or attached to an equipment item. At the same time, ceiling or wall mounted readers report the position and identity of the tag/transmitter to a central server. In an emergency, the server immediately alerts the relevant member of healthcare staff.

15.3.1. Tags/transmitters

The transmitters work with different technologies depending on the reader used (radio frequency, infrared and LF exciters). These enable precision location tracking, at all times and with full coverage and support flexible applications. The active RFID transmitters cannot be sabotaged or shielded, destroyed or deactivated without triggering an alarm, as they are permanently connected to the system. The tags/transmitters are powered by a long-life battery that is easy to replace. Continuous battery monitoring ensures extreme operational reliability.

15.3.2. Readers

There are three different technologies used for readers.

RF readers

Radio-frequency (RF) readers are wireless receivers. They operate in the 433 megahertz (MHz) frequency band, with a range of up to 20 metres for active positioning and monitoring. The tags/transmitters transmit their own unique identifier wirelessly. This is received by the reader and the position is forwarded to the server.

Fig. 15.6: An RF reader

IR readers

Infrared (IR) readers are used for precise location down to room-level. They receive the infrared signal with which the tag/transmitter transmits its own unique identifier. This tells the IR reader exactly where the person or equipment is located at that precise moment. The infrared signal cannot pass through walls, so room-level location accuracy is assured. The range is around 10 metres.

Fig. 15.7: An IR reader

LF exciters

Low-frequency (LF) exciters are the third option that can be used for precise room location. The signal is transmitted at a very low frequency of 125 kilohertz (KHz). A range of between 0.3 and 3 metres is achieved. This technology is thus only suitable for shorter distances, for monitoring the area around an exit for instance. If a person with dementia approaches an exit alone, the exit can be locked. If the person is accompanied by an authorized member of staff, the exit can be unlocked again.

Fig. 15.8: An LF exciter

Whichever technology is used, the transmitters are mounted in a suitable place on the ceiling or on the wall. This ensures ease of wiring for data and power supply. Ethernet technology supports existing networks and enables easy installation and integration of the system. Thanks to the existing IP input/output modules (e.g. for lifts, fire detection systems, etc.), the tracking systems can be installed directly at field level without difficulty. Precise identification of reader locations is key to high-quality tracking.

15.3.3. Server

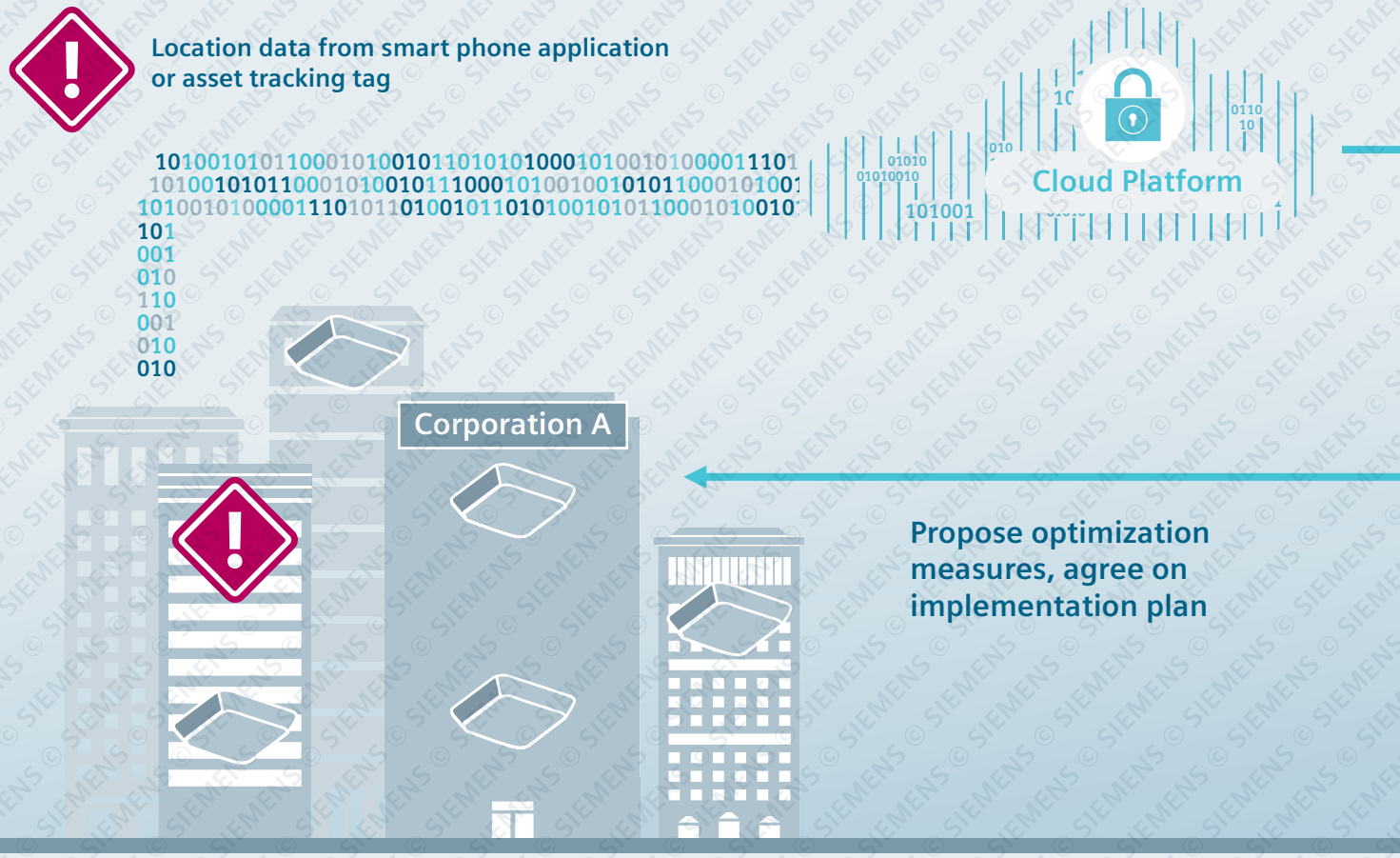
The server in a tracking system creates and manages system logic, floor plans, zones, any rights, etc. It is primarily responsible for alarm standby management and transmission (e.g. horn, text messages on DECT phones, call light, etc.). In most systems, the client/server architecture is based on Microsoft Windows. The system also supports multisite application for large campuses or multi-building complexes. Most systems also have an OPC interface for integration into third-party systems (hazard management station, access control, building automation, etc.). The software is generally versatile and scalable with many options and special application modules.

Use Case – Tracking systems

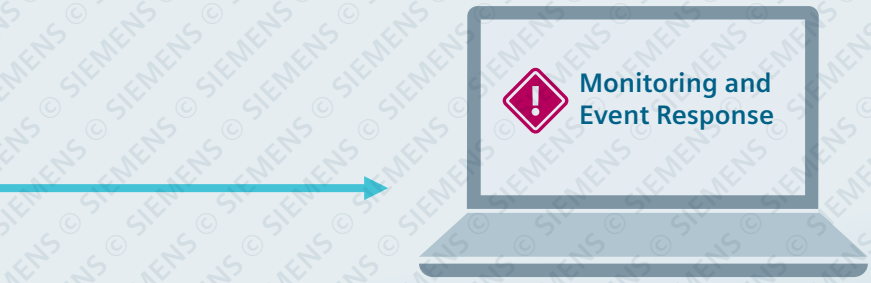
Thanks to tracking systems, data from devices such as Bluetooth beacons, locator nodes and smartphones can be tracked and made available for a variety of purposes. Here are some typical applications:

- Tracking how many people use the rooms in a building. This information can then be used to analyze and improve room utilization.
- Smartphone tracking allows the room to be personalized and adapted to the individual needs of users. Room controls are displayed directly on the smartphone by the tracking system. Also, based on the number of persons present, room controls can be varied to ensure an optimum room climate at all times.
- Emergency management. Precise patient tracking enables the following important safety measures to be taken – for example, alarm notification if patients leave certain areas or spend longer than normal in them (e.g. bathrooms). It also helps people with disabilities, e.g. by automatically summoning the lift.
- Navigation and visitors: Tracking systems enable coworkers to be located more easily and can guide others to them using an indoor navigation system. Similarly, visitors and coworkers can be granted temporary access to certain areas when they present themselves at a locked door.
- Tracking where medical equipment is located in a hospital. If hospital equipment is fitted with locator nodes, staff can locate it quickly and easily when needed.

The Digital Service Centre (DSC) can analyze room utilization and suggest optimization measures to the Service Engineer. The Service Engineer can then discuss potential ways of reducing costs, boosting efficiency and security and optimizing building utilization with the client and agree an implementation plan.



Data power delivers better building performance



Digital Service Center

- Space usage analytics
- Building and asset usage is recorded on dashboard
- Security enhancements

Local Service Organization

- Offers location-based services
- Proposes optimization measures

Intelligent monitoring systems for enhanced security and process efficiency

In an ageing population, the number of long-term patients is increasing. The prevalence of dementia is rising sharply and so too is the level of care needed. At the same time, growing cost pressures in the healthcare system mean that fewer and fewer staff are available. Which is why it is so important today to optimize efficiency in care delivery to ensure comprehensive support for patients and residents at all times. The people and asset tracking system from Siemens has a key role to play here.

Technology that works built on years of experience

Responding to new challenges

The growing numbers of in-patients and out-patients combined with cuts to budgets and staffing levels are making it increasingly difficult for nursing staff to maintain a high standard of care around the clock. Their role includes keeping dementia patients under constant supervision while also dealing with aggressive patients or worried relatives and making sure that neither newborn babies nor costly medical equipment fall into the wrong hands Thanks to the latest wireless technology, the location of objects and individuals can be identified in real-time enabling patient flows to be analysed and optimized.

Intelligent systems play their part

This technology can be used in clinics and other healthcare facilities, for instance, to prevent patients wandering, infant abduction and mismatches and theft of portable equipment. By pressing a button, nursing staff or patients can send a wireless distress signal indicating their name and current location so that help can be directed to the right place without delay.

Reducing risks and costs

For hospital and care facility managers, a people and asset tracking solution not only provides greater security for patients and staff, it also reduces their liability exposure. The resulting savings in time and money increase cost-effectiveness, ease the pressure on healthcare staff and enhance the quality of care.

Teaming up with Siemens gives you the edge you need to get control of rising costs in healthcare.

One system for many applications

Personal call button: Help is on hand for patients and residents

Patients or the elderly can summon help at any time, wherever they are in the building. They simply press the wearable button and the relevant member of staff is notified immediately of their location. The alarm is personal which means that the member of staff can bring along any colleagues, medication or equipment that is needed (e.g. if the patient has suffered an epileptic seizure or has a heart condition).

- Patients enjoy greater security and mobility
- Patients feel well looked after while their family has peace of mind
- Patients can be located by staff to administer treatment
- Efficient, automatic alarm acknowledgement

Care system for disoriented persons

Dementia patients are given a tag/transmitter to wear on their wrist. An alert is triggered (call light, DECT, pager, siren, etc.) as soon as the patient leaves a secure area. The relevant member of staff can be notified of the patient's name as well as the location where the alarm was triggered. Doors can be left open without the risk of dementia patients leaving a permitted area.

- Sending an immediate alert, identifying the patient and their location, avoids having to mount a search
- Vulnerable patients cannot leave the care facility unobserved
- Relatives have peace of mind, knowing their loved ones are safe
- An alert is triggered if the resident removes the tag/transmitter

Panic button: Enhanced security for staffl

Staff wear a tag/transmitter that has two emergency call buttons. Activating this button will trigger different alerts, as appropriate (call light, DECT, pager, siren, etc.). The person's location and name are also transmitted with the alert. This system is particularly suitable for use in emergency departments, psychiatric units and closed facilities.

- Fast, effective assistance for staff under duress
- More discreet and more readily accessible than conventional wall-mounted alarm buttons
- Protective casing available, e.g. for use outdoors (in the grounds, car park, etc.)

Prevention of infant abduction and mix-up

Newborn babies wear a tamperproof miniature tag on their ankle. This will transmit an alarm immediately if the baby is removed without authorization. Mother/baby tag matching prevents baby mix-ups, including in cases of multiple births. Escort features and multiple births can also be easily configured in the system.

- Protection against infant abduction
- Free movement of mothers, visitors and staff on the maternity unit is not unnecessarily restricted
- Protection against mother/baby mismatches and transmission of disease through breastfeeding (hepatitis)

Tracking of mobile assets

The tag/transmitter on mobile hospital equipment triggers an alarm if the equipment leaves its designated area without authorization. This protects against theft and misuse. The service department can also save a great deal of time locating an item of medical equipment when scheduled maintenance is due. Statistical analysis is also possible, for instance bed capacity management, as-incurred billing, etc.

- Equipment can be located quickly in an emergency
- Protection against theft or misuse
- Optimization of rental and leasing contracts thanks to automatic statistical analysis

Personal call and tracking solutions

Siemens: expertise in all areas of safety and security

Alongside a range of building security solutions encompassing fire safety, video surveillance, access control and intrusion detection, Siemens also offers innovative tracking systems. These are designed specifically with the needs of hospitals and care facilities in mind. Our global experience is your guarantee of quality, reliability and sustainability.

Challenges of our time

- Elderly and vulnerable people with orientation problems, patients who are liable to get lost in hospitals/clinics or indeed leave the building unnoticed (e.g. Alzheimer's patients)
- Prevention of infant abduction
- Infant mix-up
- Attacks in the emergency department by patients under the influence of alcohol or drugs
- Patients (e.g. in a psychiatric unit) who become violent
- Expensive medical equipment is becoming increasingly mobile, i.e. easier for organized criminals to steal (e.g. ultrasound, cardiology and gastroenterology equipment)

Tracking systems add real value

- Enhanced comfort and security for patients, residents and their relatives
- Positive image and enhanced competitive edge for the hospital, clinic or care facility
- Healthcare staff feel safe and do not have to spend time performing checks and searches
- Reduced inventory by optimization of excess capacity
- Reduced shrinkage of mobile equipment
- Less time spent looking for equipment items
- Increased cost transparency for mobile assets and equipment, e.g. beds
- Reduced costs for the emergency services, recourse claims, litigation
- Potentially lower insurance premiums

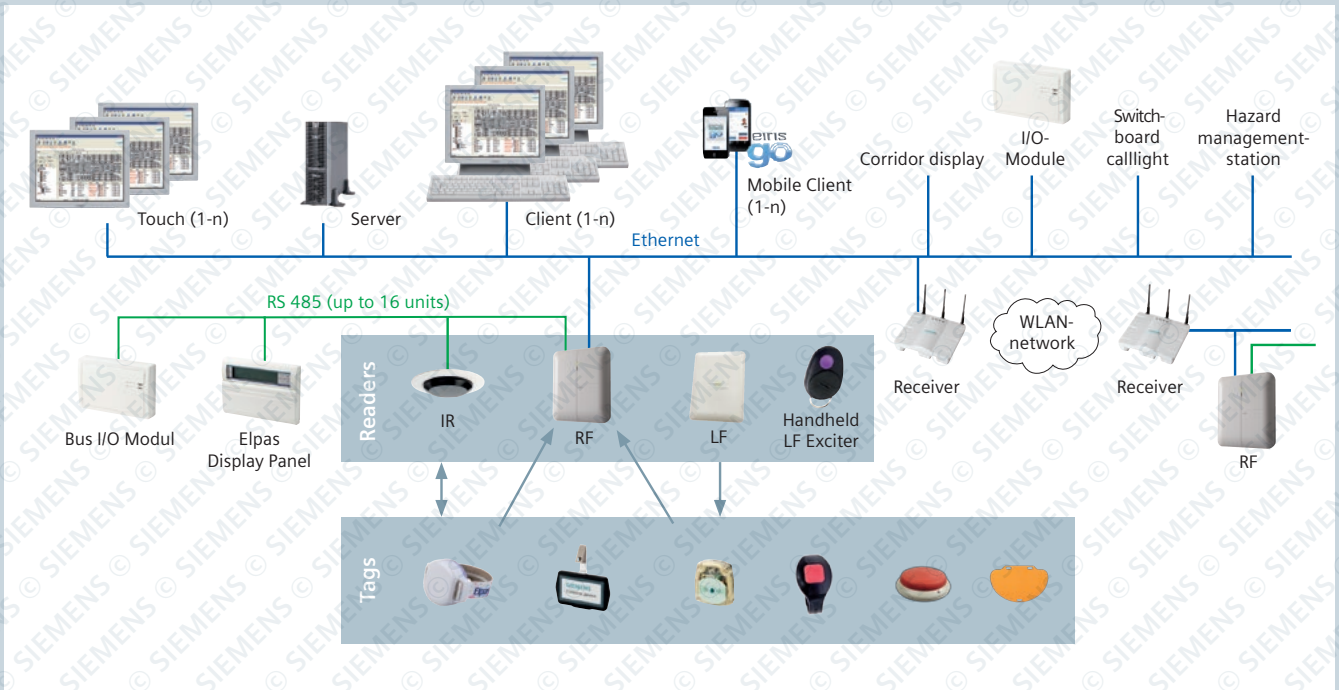
And this is the solution

Innovative wireless tracking systems enable the location of a person or an item of equipment to be identified quickly and with full site coverage. Active RFID and IR transmitters are worn by a person or attached to an equipment item. Ceiling or wall mounted readers report the position and identity of the tag/transmitter to a central server. In an emergency, the server immediately alerts the relevant member of healthcare staff.

Highlights

- Proactive security management enhances patient and staff security and ensures customer satisfaction
- Complete control of the situation and efficient management of patients, staff and assets
- Identification of bottlenecks and optimization of processes
- Siemens has outstanding technology and all-round experience in security for healthcare facilities

Technical solution



Tags/transmitters

- The triple technology employed by the transmitters (infrared, long-range radio and local exciter antenna) enables precision location tracking, at all times and with full coverage, and supports flexible applications
- Active RFID transmitters cannot be sabotaged or shielded, destroyed or deactivated without triggering an alarm, as they are permanently connected to the system.
- The tags/transmitters are powered by a long-life battery that is easy to replace
- Continuous battery monitoring ensures extreme operational reliability

Readers

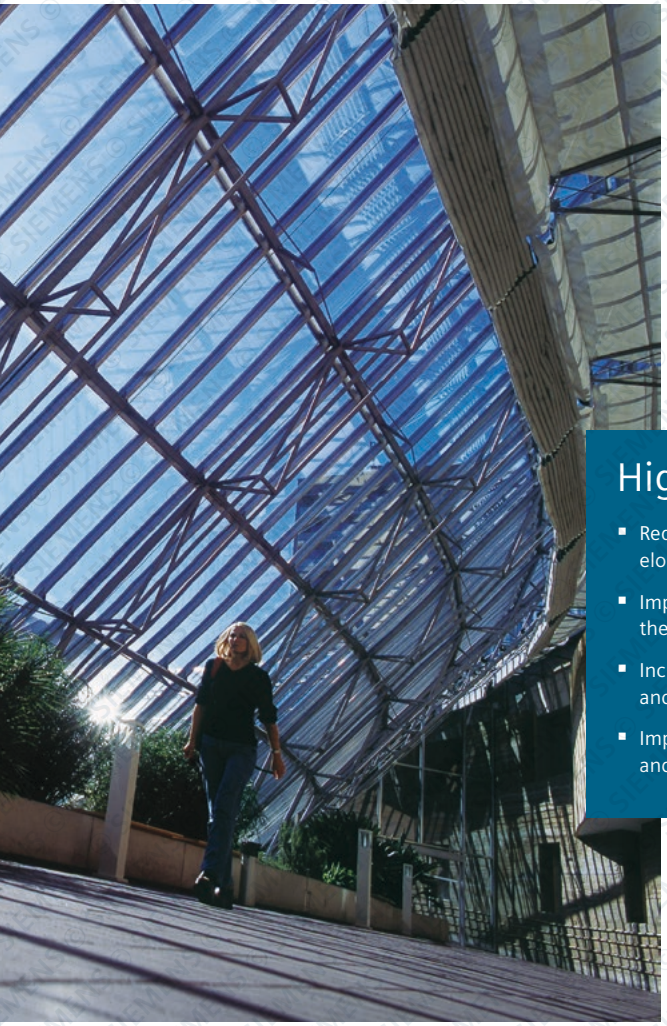
- High-frequency (RF) IP readers with a range of up to 20 metres for active positioning and monitoring.
- Infrared (IR) for precise room location
- Low-frequency (LF) exciters with an adjustable range of up to 3 metres for monitoring entrances and exits
- Ceiling or wall mounted
- Elpas Display Panel for simple, reliable operation without PC knowledge
- Simple wiring for data and power supply

Stay fully operational

- Ethernet technology supports existing networks and enables easy installation and integration
- Straightforward integration at field level thanks to IP input/output modules (lifts, fire detection systems, etc.)
- The handheld LF exciter allows manual reset of resident call button and mother/baby match tests

Server

- Creates and manages system logic, floor plans, zones, rights, etc.
- Alarm standby management and transmission (horn, text messages on DECT phones, call light, etc.)
- Client/server architecture based on Microsoft® Windows™
- Multisite application, for large campuses or multi-building complexes for example
- OPC interface for integration into third-party systems (hazard management station, access control, building automation, etc.)
- Versatile, scalable server software with many options and special application modules



Highlights

- Reduced liability exposure by minimizing risk of infant abduction, dementia patient elopement and staff injuries as the result of attacks
- Improved operational efficiency thanks to regular resource utilization statistics, fewer thefts and more efficient maintenance
- Increased staff efficiency thanks to minimized supply lines, shorter intervention times and less time spent looking for patients
- Improved customer satisfaction thanks to greater freedom of movement for patients and visitors, an enhanced sense of security and optimized service

SIEMENS

Ingenuity for life

Automation of primary plants

buildingtechnologies.siemens.com

16.1. Introduction	604
16.1.1. Building types	604
16.1.2. Air quality and comfort	604
16.1.3. Building automation	604
16.2. Building protection	605
16.2.1. Climate protection	605
16.2.2. Security	605
16.2.3. Energy	605
16.3. Building technology	606
16.4. Disciplines	606
16.4.1. Heating	606
16.4.2. Ventilation	606
16.4.3. Air conditioning	607
16.4.4. Cooling	607
16.4.5. Piping	607
16.4.6. Electrical	607
16.4.7. Practical tips	607
16.4.7.1. Identifying potential savings for heating plants	607
16.4.7.2. Unoccupied mode in HVAC plants with residual heat optimization	608
16.4.7.3. Reduced maximum air flows and shorter operating times	608
16.5. Building automation	609
16.5.1. The intelligent building	609
16.5.2. Planning of building technology	609
16.5.3. Building automation systems	609

System Desigo	610
Use Case	610
Graphical overview	612
General	614
Applications	615
Desigo PX	623
Desigo PX Automation Station	624
Desigo TX	626
Desigo PX Open and TX Open	627
Desigo Control Point	628
Desigo BACnet Router	631
Simatic S7	632
Field devices	635
Synco	636
Synco living	640

16.1. Introduction

16.1.1. Building types

Look around any cityscape and you will notice many different types of building. There are residential buildings, office buildings (sometimes with shops and homes for mixed use), schools, theaters, sporting venues, hospitals and factories. All these different buildings have certain things in common: they protect users from external factors, they guarantee indoor and outdoor security, and they maintain a pleasant indoor climate for users. In industrialized countries, people spend 95% of their life in buildings. That is why the quality of the indoor world is so central to health and well-being. The importance of well-being was not fully recognized until complaints about building-related ailments and symptoms started to build up. There are many reasons for a lack of well-being indoors – some are objectively measurable whereas others depend on how each individual is feeling on the day and on the social context.

16.1.2. Air quality and comfort

Among the more objective factors are poor air quality, a low or high room temperature, humidity, drafts or bad lighting. Although people are able to adapt to changing environments outdoors, indoors there is a specific range – the comfort zone – within which people feel most comfortable. The range cannot be strictly defined, however, because many other factors also affect comfort.

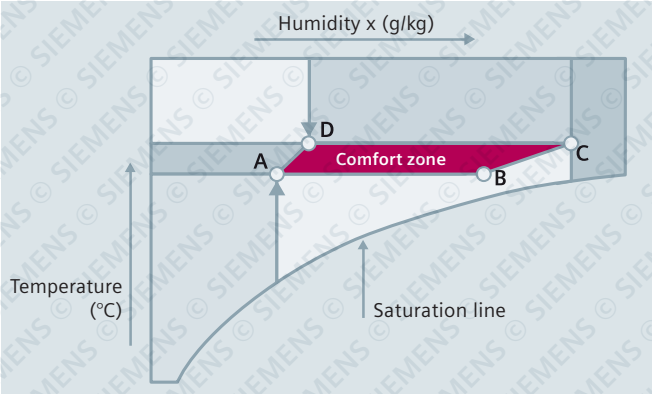


Fig. 12.1: Comfort zone for humans

Humans want to feel comfortable not just at home or at work – shopping malls, exhibition centers, gyms, museums and theaters are also places where acceptance is closely related to the perceived indoor air quality. Comfort inside the building or room, as experienced by the individual, plays a big part in creating a sense of well-being.

16.1.3. Building automation

These days, good «building performance» – in other words the harmonious interaction of architecture, system technology and room comfort – is based on modern measurement and control installations combined with building automation. Even though most processes are described as automated, modern building concepts place great importance on human input.

The DIN definition of building automation is as follows: Term describing the installations, software and services relating to automatic control, monitoring and optimization and relating to user control and management, aimed at the energy-efficient, cost-effective and safe operation of the technical building equipment. The primary plants are the assemblies and machines responsible for supplying the HVAC+piping+ electrical disciplines. They produce hot and cold water for direct and indirect use. They also supply the required volume of fresh air and ensure that the old (stale) air is taken out of the building, recovering as much heat from it as possible.

16.2. Building protection

16.2.1. Climate protection

In terms of the climate, the building shell acts as a buffer between the controlled room climate and the external seasonal environmental influences such as temperature differences (+/–), sunlight, wind, rain, frost and snow. Particular attention must be given to potential combinations of these influences, for example wind and rain, sunlight and heat or cold. The building shell must be designed to handle these weather conditions and to respond appropriately using building technology. Depending on the location, the building shell must also provide protection from noise coming from road, rail or air traffic or from industrial sources.

Fig. 12.2: External and internal influences on a building

16.2.2. Security

The inhabitants or users of a building also want to be protected from intruders and unauthorized access to their property. Another vital function of the building shell is to provide adequate protection from fire.

16.2.3. Energy

Environmental policy requires less energy to be used for heating and cooling buildings, and one of the first effects of this was to vastly improve thermal insulation in the building shell. On the other hand it also led to a purely static view of the thermal conductivity of the building shell. Although the measure of thermal conductivity (k value) does show the specific energy loss, it tells us nothing about the thermal storage capacity of the building shell which, when used effectively, can potentially save a great deal of energy. For example, it is a statistically proven fact that the mean daytime temperature on the Swiss Plateau never exceeds +22 °C, and we should take advantage of this knowledge by using the cool nighttime temperatures to compensate for the warmer daytimes. In modern commercial and school buildings, which are unoccupied at night, forced air ventilation means that cool night air can lower the temperature of the building shell from the inside too. If the building structures (concrete, masonry) have adequate heat storage capacity, the inside of the building remains pleasantly cool during the hottest part of the day without additional cooling. This cooling effect can be enhanced with sun blinds protecting the entire external facade (not just the windows) from direct sunlight.

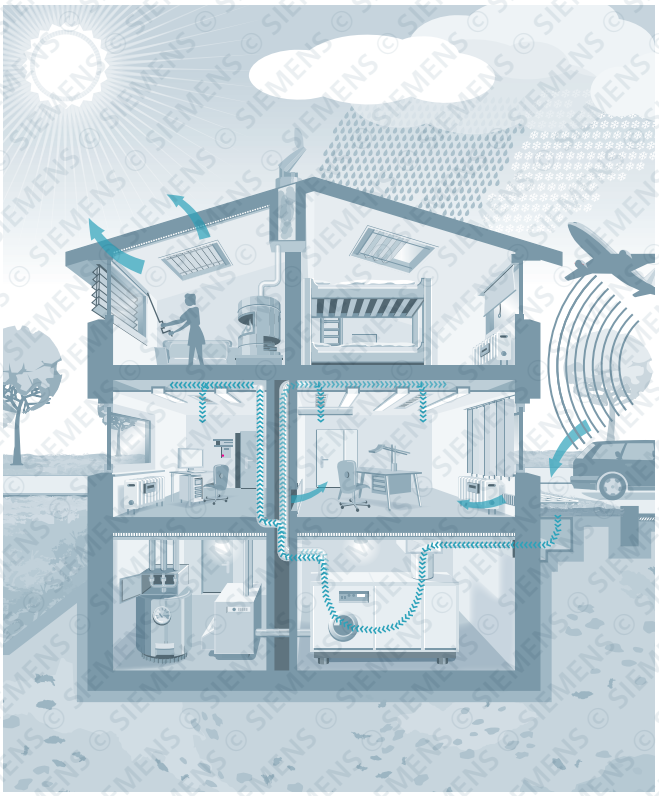


Fig. 12.3: Technical equipment in a building

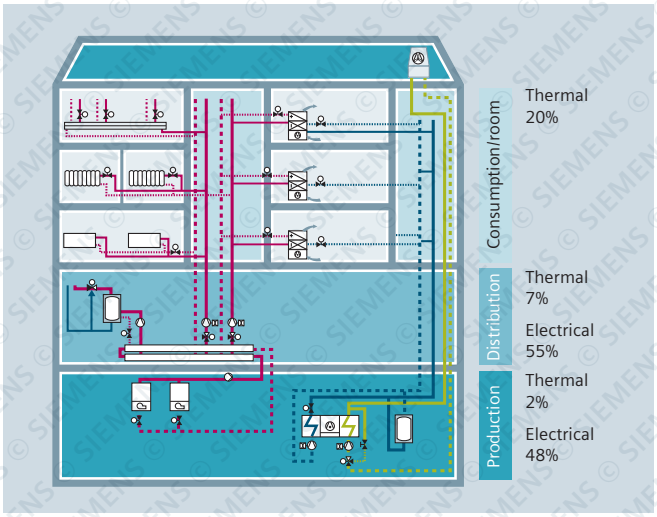


Fig. 12.4: Overview of energy flow in the building

16.3. Building technology

Buildings contain a wide range of technical infrastructure with an ever-growing complexity. The term «building technology» or the term standardized in SIA «operational installations» is defined as all permanently installed technical equipment inside and outside buildings which support the correct operation and the general use of the buildings. The term «technical building equipment» was introduced because «operational installations» could be confused with industrial production facilities. Building technology primarily covers the following systems and installations:

- Heating, ventilation and air conditioning systems
- Heat recovery systems
- Energy supply and distribution
- General building lighting
- Sun blind systems
- Transport systems for people (elevators, escalators)
- Automatic doors and gates
- Security systems (fire, burglary)
- Compressed air systems
- Sanitary facilities and installations
- Disposal systems for wastewater, exhaust gases, refuse, etc.

The way the individual systems interact with and influence each other is becoming increasingly important. In particular, the building shell is no longer treated as an unchanging, static object – instead it dynamically adapts to the different operating states of the building technology.

Depending on the purpose of the HVAC plants, their functions can be divided into two categories:

- The term «comfort systems» is used for all systems which create and automatically maintain a pleasant room climate that keeps people healthy and productive, in residential buildings, offices, schools, hospitals, restaurants, cinemas, theaters, department stores. To ensure that the systems run efficiently, the demand for energy must always be directly related to the defined and required room climate. The effective demand can only be determined by rooms in which users are actually present. These requirements (e.g. heat, cooling) must be passed to the primary plants. When this communication happens in a straightforward way without the need for interfaces, the setup can be described as an integrated solution.
- The term «industrial systems» is used for all systems which create and maintain a room climate or conditions allowing certain production processes, warehouse operations or ripening processes to take place. This does not include production facilities of any kind nor technical equipment directly required for certain work processes.

16.4. Disciplines

The most important systems and installations in a building are described below. They are often collectively termed «disciplines».

16.4.1. Heating

The heating system aims to create a constant, comfortable room temperature throughout the heating season. It produces the hot water for space heating and also, in most systems, running hot water. Heating in a building involves the production, distribution and release of heat. The production of heat is a very complex part of the heating system. There are conventional oil, gas, wood or coal fired boilers, also heat pumps, block heat and power plants, solar energy or a combination of sources of heat (bivalent heat production), as well as district heating substations The heating system is closely related to the piping system.

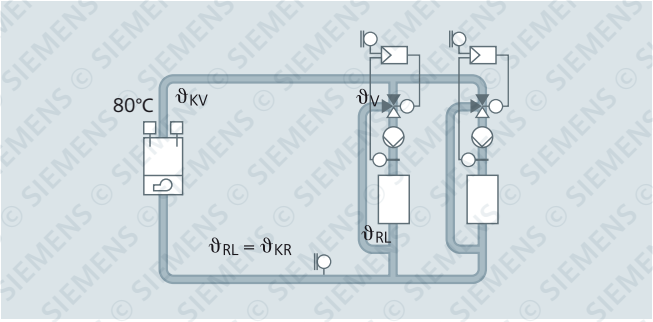
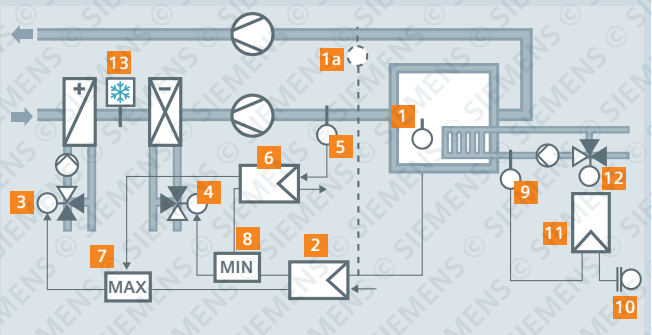


Fig. 12.5: Typical heat production with heating groups

16.4.2. Ventilation

The ventilation plant has the task of renewing the air in places like manufacturing halls, cinemas, theaters or restaurants – in other words buildings in which the air is quickly used up or contaminated. During the heating season, the room temperature must be maintained despite all the fresh air being introduced. Air heaters are usually run on hot water but they sometimes use electricity or steam.



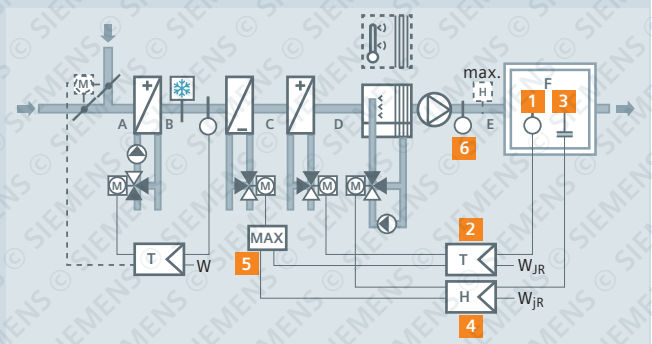
1 Room temperature sensor (or exhaust air temperature sensor 1a)
2 Room temperature controller
3 Actuator with heating valve
4 Actuator with cooling valve
5 Supply air temperature sensor
6 Supply air temperature – minimum temperature limiter
7 Heating valve override
8 Cooling valve override
9 Supply temperature sensor
10 Outside temperature sensor
11 Supply temperature controller
12 Actuator with heating valve
13 Frost protection thermostat

Fig. 12.6: Typical ventilation system with air conditioning and air transport units

16.4.3. Air conditioning

Our well-being and our productivity are affected not just by the room temperature but also by the humidity, purity and freshness of the air – in other words by a room climate as closely aligned as possible to how our bodies work and feel. These factors can be altered by an air conditioning plant. The air is conditioned by heaters, coolers and humidifiers. These days, the scope of air conditioning has grown from individual rooms and residential blocks to major facilities such as office buildings, shopping malls, airports, etc. All systems must use energy as efficiently as possible and must run automatically.

Using air conditioning systems to create well-being in buildings need not cost the earth any more. Heat recovery systems, facade cooling, concrete core temperature control (thermoactive structures), shading and solar energy (photovoltaics) have almost become standard components of building technology.



1 Room temperature sensor
2 Room temperature controller
3 Room humidity sensor
4 Humidity controller
5 Override
6 Supply air temperature sensor for minimum temperature limiter
A-F Air states

Fig. 12.7: Air conditioning system with direct humidity control

16.4.4. Cooling

Cooling plants produce and distribute the cooling performance needed for the particular applications. They can be technical cooling plants and chilled ceilings, or air conditioning plants. Depending on requirements and the application, various cooling methods can be used. Examples of possible options include seawater cooling, groundwater cooling with heat pumps or refrigerating machines with different technologies and performance levels. At low temperatures, if water is used as the medium it is usually replaced with an antifreeze/water mixture to prevent freezing. Heat exchangers are often used in these situations to separate the different media and temperatures.

16.4.5. Piping

In private and public buildings, the piping system concerns areas relating to hygiene and human health. In particular, these include technical installations for water supply and wastewater removal. In a building, piping is about more than private bathrooms – it supplies process water for industrial use too. It is also deployed wherever it is particularly important to maintain hygienic conditions – for example swimming pools, saunas, commercial kitchens or abattoirs.

16.4.6. Electrical

Electrical systems in buildings are responsible for energy distribution, energy monitoring and redundant systems ensuring that the building keeps working properly. Apart from infeed, distribution and monitoring, this involves the direct use of electricity for lighting, shading, audio/video systems and security systems. Virtually every part of the building technology uses the supplied electricity to run.

Aspects such as lighting and shading are increasingly becoming integrated with classic building automation. This is because energy-efficiency is only possible if all energy consumers are designed to work efficiently with each other, and also because building users these days expect the system controls to be standardized and easy to understand. This can only be achieved if the system is planned and implemented as a single whole. If some systems are installed independently of each other, some functions will overlap, making the operating concept difficult to understand.

16.4.7. Practical tips

16.4.7.1. Identifying potential savings for heating plants

Modern building technology is sophisticated and complex. Producing and converting energy requires significant initial investment as well as ongoing operating costs which, combined with other costs, quickly mount up. Now more than ever, a responsible attitude to natural resources and a business-minded approach call for technically competent planning, expert installation and skilled management. Management is particularly important as buildings can only be run economically if they adapt to constantly changing user needs. Respected institutions have conducted studies of the existing building stock and have shown that after just a few years, the building technology originally installed no longer met the new standards in terms of comfort, reliability and cost-effectiveness. To safeguard the long-term viability of a property, and therefore protect the investment, specialist

companies offer a wide range of services aimed at optimizing building technology. There are also innovative energy-saving components that pay for themselves very quickly. There is a new career path – energy engineering – focused on holistic planning with a business-minded approach. New services such as energy saving contracting, also called energy performance contracting, open up new finance opportunities for modernizing existing systems with contractually guaranteed cost savings.

16.4.7.2. Unoccupied mode in HVAC plants with residual heat optimization

Switching off room heating at night or out of working hours is an efficient way of saving energy. However, inflexible step-back and stop cycles usually make the building less comfortable – this depends on the outside temperature, the fabric of the building and the times the heating is switched on and off. In large buildings that are unused and unoccupied at weekends it is normally worth using something called residual heat optimization on the basis of an Optimum Start Stop Program (OSTP). In schools, administration buildings, offices and department stores, additional (!) energy savings of up to 20% are achievable if inflexible setback times are replaced.

16.4.7.3. Reduced maximum air flows and shorter operating times

Reducing air flows in HVAC plants can reduce costs in several ways. Electricity consumption and the drive power are reduced along with the consumption of heating and cooling energy. In systems with air humidification, the cost of supplying water and generating water vapor can also be lowered. Further savings can be made in the maintenance of the air filters and fans – a cost which is often underestimated in large systems. There are two basic approaches to air flow reduction:

- Reduction of maximum air flows
- Reduction of air flows by shortening operating times, using pole changing or speed controlled drives

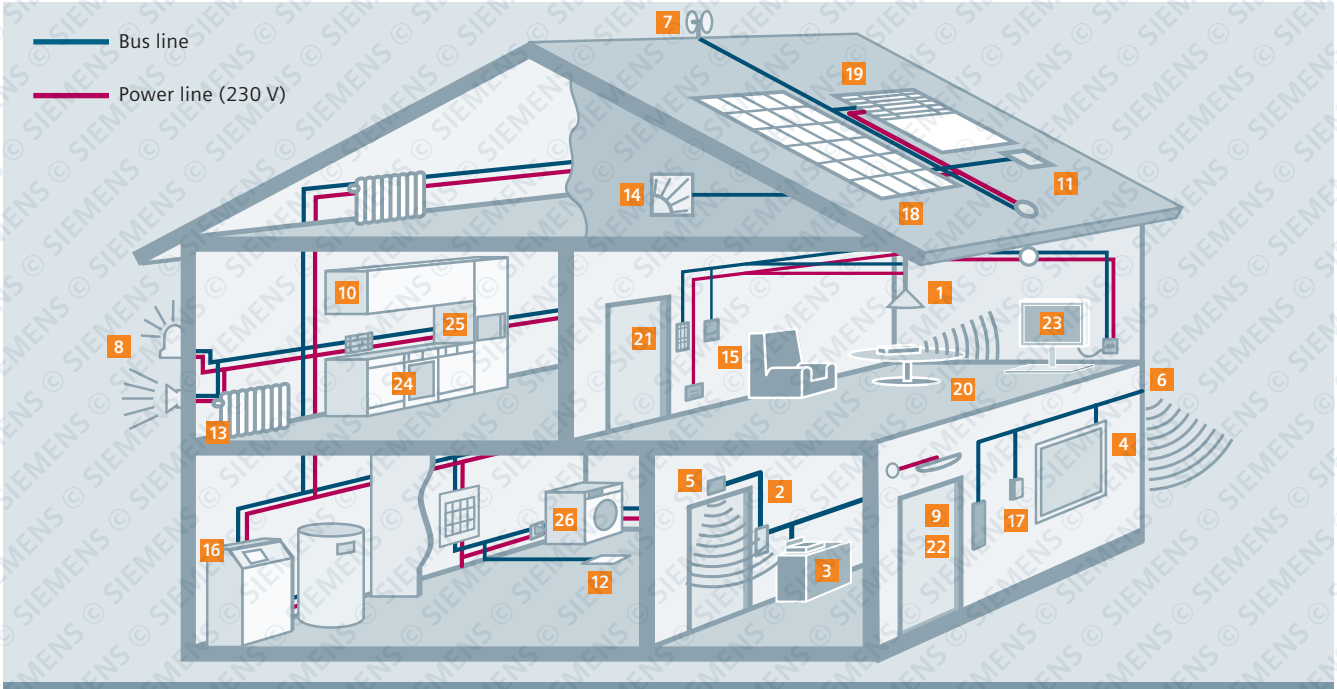
16.5. Building automation

The demands placed on the building technology differ according to how the building is used. But it always faces the same three main challenges:

- Human needs in terms of well-being and comfort inside the building shell, determined by how the building is used, must be adequately met whatever the external factors.
- The residents and users must be adequately protected from potential hazards, and property must be protected from fire and water, technical damage or attacks by intruders.
- It must be possible to meet these requirements with an acceptable cost of investment and low follow-on costs for energy, operation, maintenance and loan servicing.

16.5.1. The intelligent building

Apart from safety and comfort, one of the most important functions of building automation is to ensure that the supplied/available energy is used efficiently. This requires intelligent functions and a suitable system architecture – precisely the features of an intelligent building. Predictive rule strategies are used with end-to-end communication from the individual room to the primary plant in order to make the necessary resources available at the right time and with the necessary conditioning. Here, the room represents the specific user requirements. High-level building functions take effect as necessary and are responsible for management.



1 Lighting control, automatic and timed
2 Central and group circuits
3 Remote querying, remote control
4 Window contacts
5 Motion sensors
6 External monitoring
7 Wind speed (e.g. to protect awnings)
8 Outdoor siren with beacon
9 Bolt switch contact
10 Socket outlet, switchable
11 Rain sensor, automatic roof window closing
12 Water sensor
13 Heating actuators
14 Sun blind control based on the position of the sun
15 Room temperature control
16 Condensing boiler
17 Outside temperature sensor
18 Solar thermal system/ photovoltaic linked to the EIB
19 Shutter, sun blind and awning control
20 IR remote control
21 Conventional control or via BUS
22 Building intercom with video camera
23 TV to monitor and control the system
24 Cooker
25 Dishwasher
26 Washing machine

Fig. 12.8: The intelligent house

16.5.2. Planning of building technology

There is no need to do everything just because it is technically possible – it must also be beneficial and environmentally friendly. This is why the planning phase is so important, taking account of all local circumstances and carefully analyzing all requirements. To get the concept right for building technology, the planner must have extensive knowledge of building physics, thermodynamics, fluid mechanics, chemistry and ecology, and how they all interact with each other. Intelligent building technology requires skilled planners who are able to master and consistently apply interdisciplinary, integrated planning methods.

16.5.3. Building automation systems

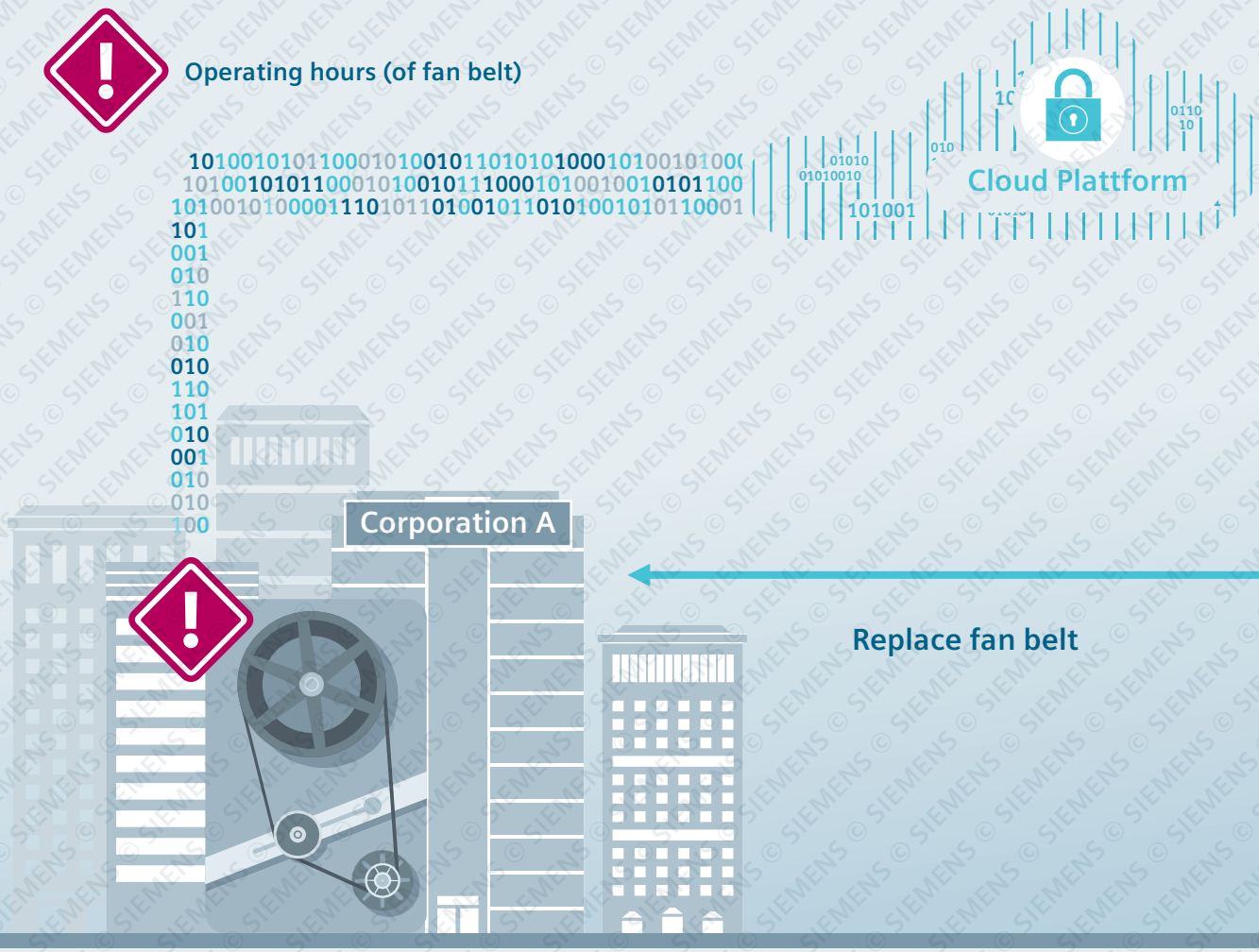
Siemens supplies the equipment and systems required to perform control functions, but it also formulates the associated recommendations for use and supports the customer with project engineering, commissioning and maintenance.

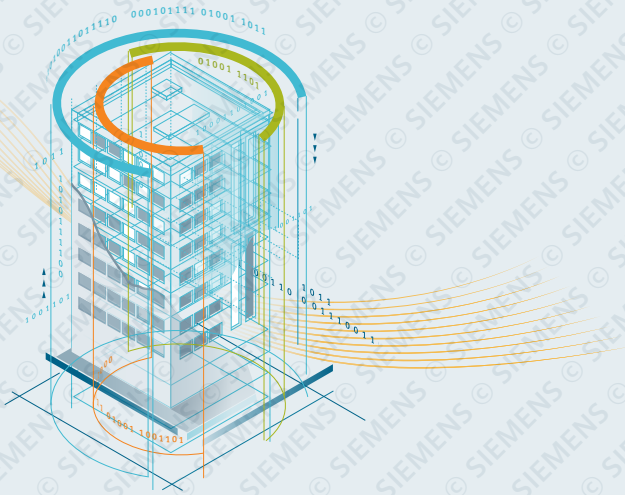
Use Case – Automation Primary Systems

The system measures data about fan belt usage and sends an alert to the Digital Service Center (DSC) when a certain amount of time has been reached. The DSC will inform the field Service Engineer. Then the Service Engineer will inform the customer about replacing the fan belt before it breaks and interrupts the availability of the HVAC system.

In agreement with the customer, the fan belt will be replaced before it is damaged and before it is having break down.

Monitoring usage data like this reduces the risk of system failure and ensures that building occupants have ideal conditions at all times.

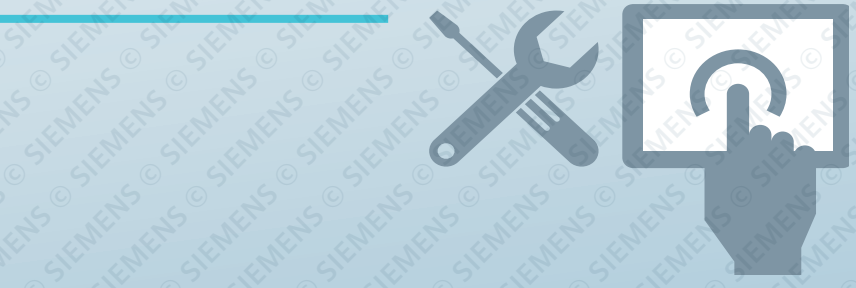




Data power delivers better building performance

Digital Service Center

- Data analysis
- Information is sent to local service organization



Local Service Organization

- Customer is informed about potential risk
- Customer decides: Relace now or wait

Air quality sensor

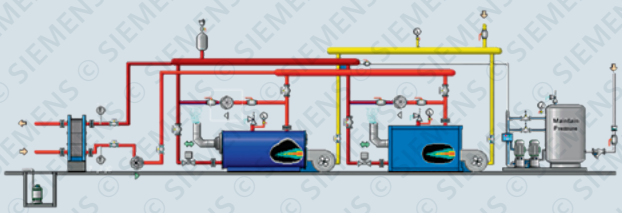
Pressure sensor

Temperature sensor

Combi sensor humidity/temperature

Certified combi sensor humidity/temperature

Thermostat



Ethernet/IP

Programmable automation station Simatic S7.

BACnet

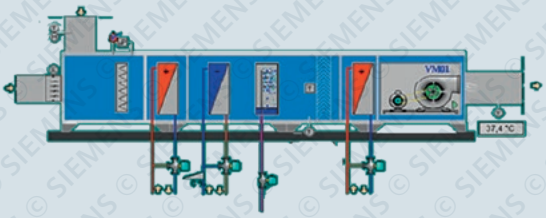
Heat meter

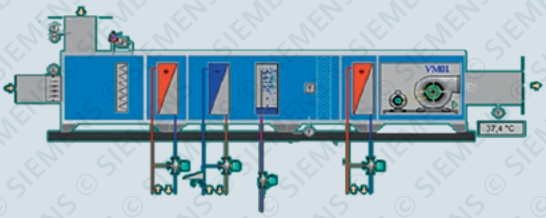
Dew point detector

Frequency converter

Valves and actuators

Damper actuator





Desigo System

General

The Desigo PX range of programmable automation stations and controllers for primary plants offers outstanding scalability and consistent system openness. Desigo PX reliably performs all the tasks required of building technology. It has a modular system concept to make it a perfect match for the relevant requirements and needs. In smaller HVAC plants, too, it can be used to deploy DDC technology in a cost-effective way. In new buildings as well as modernization projects, this means it is only necessary to invest in the system components that are actually needed. The innovative system concept means that Desigo PX can be gradually scaled up to a building automation system at any time. Desigo is consistent in its support of open communications, making it easy to connect a wide variety of building systems on the basis of standard open data interfaces:

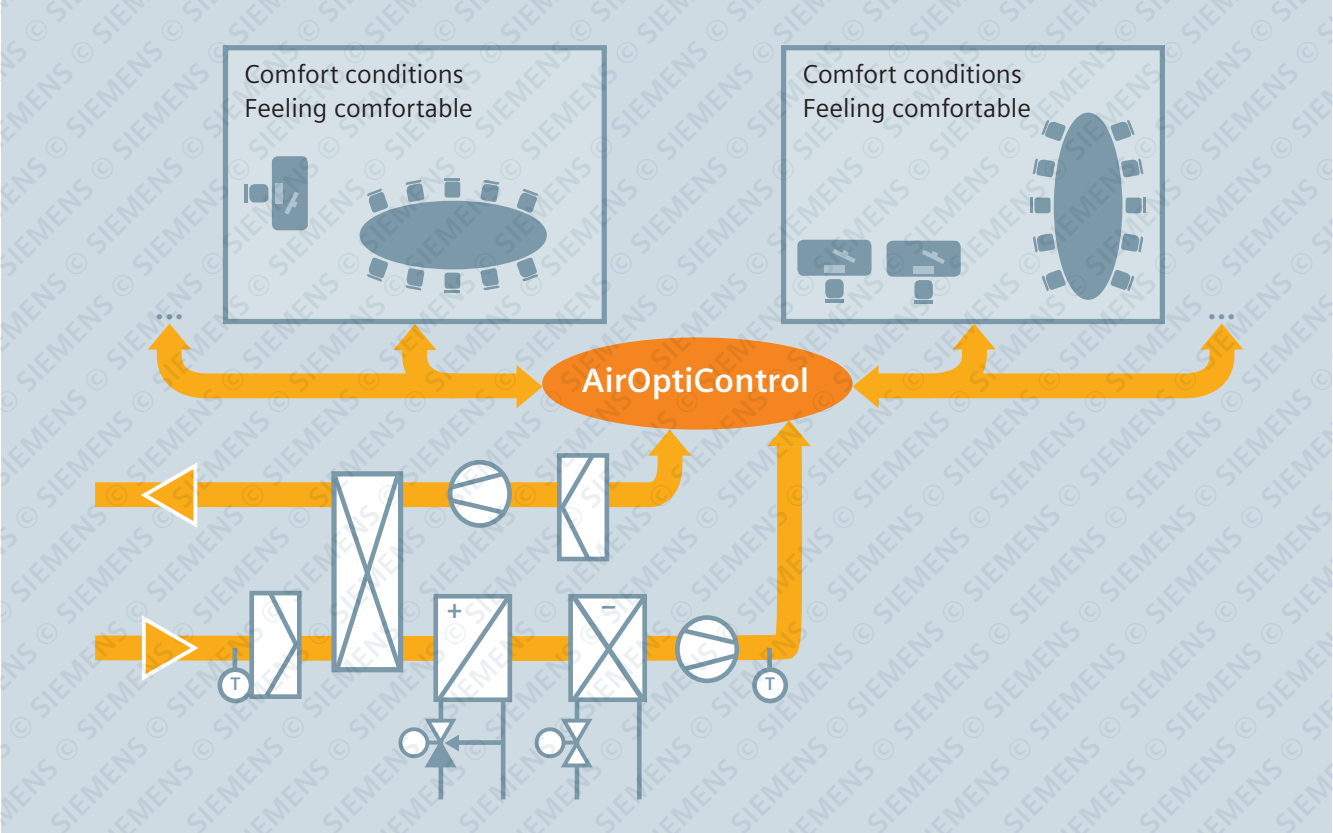
- BACnet™ – from room automation to the management level
- KNX®, DALI, EnOcean® and LonWorks to link room automation and secondary processes
- M-Bus, Modbus, OPC, MS/TP and other interfaces for universal connection of third-party devices and systems
- Ethernet TCP/IP network protocol

Wide variety of applications for enhanced energy efficiency

Using Desigo™ heating, ventilation and air conditioning plants as well as other building systems, such as lighting and shading, can be controlled and monitored flexibly and based on demand. Intelligent applications – tested under practical conditions – prevent unnecessary energy usage. And since the Green Leaf of the operating unit indicates the plant's current state of efficiency with a clear change of color, room users can take action and save energy. At the Desigo Insight management platform level, the Green Leaf indicator supports Eco Monitoring and suggests ways to optimize the primary plants. This way, the use of innovative applications sustainably cuts building operating costs, preserves energy resources and lowers CO_2 emissions, thus saving money and protecting the environment.

- Added plant value due to the use of energy-saving, modern equipment
- Contribution to meeting the requirements of EN 15232 in the highest efficiency classes
- Room users actively save energy thanks to the Green Leaf
- Leveraging of energy-saving potential at the level of the primary plants with Desigo Eco Monitoring
- Sustainable reduction of energy and building operating costs

AirOptiControl: optimized volumetric air flow saves costs

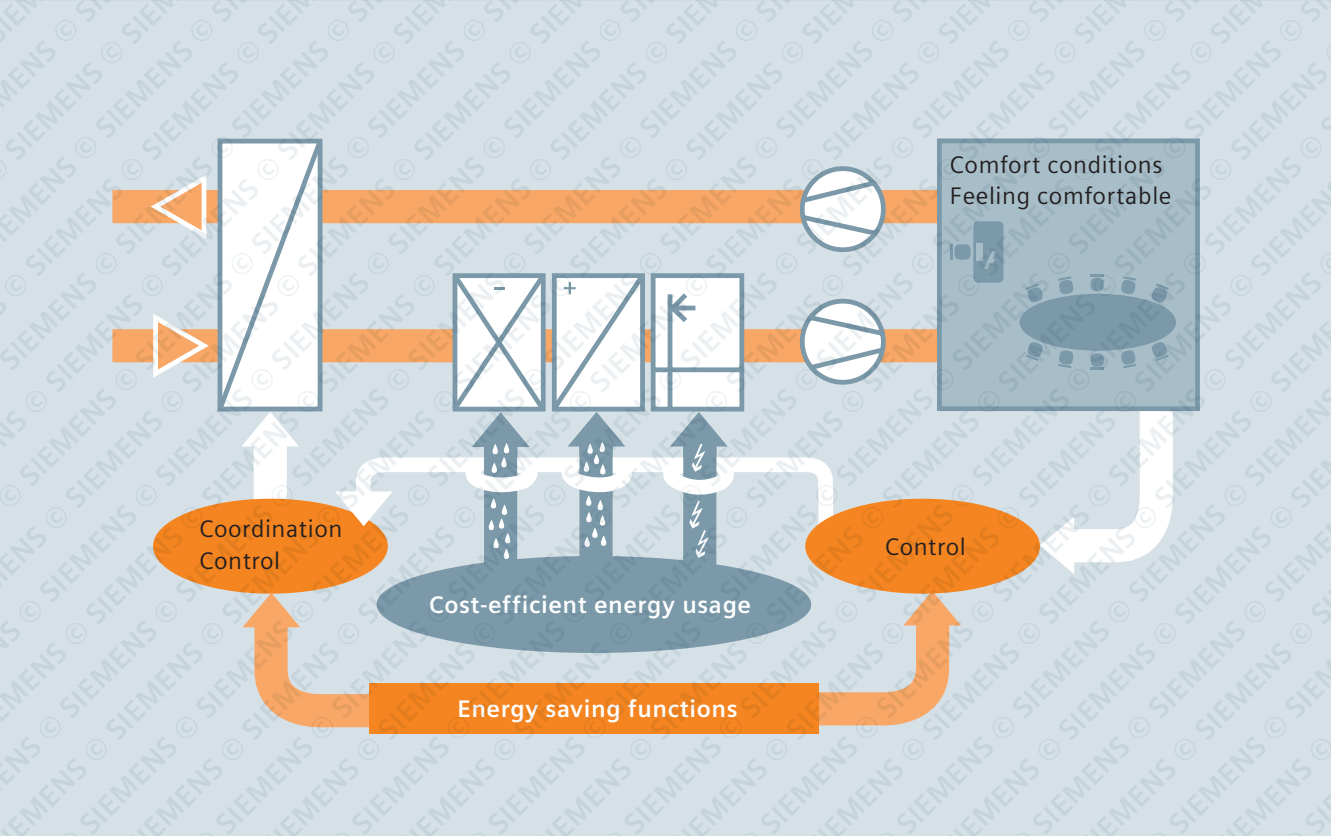


Use: ventilation and air conditioning

AirOptiControl optimizes the volumetric air flow, thus providing an excellent basis for energy-efficient operation of ventilation and air conditioning systems. At the same time, comfort control ensures that temperature, indoor air quality and humidity limits are respected. The innovative, modular application offers a number of function variants for the control of air handling plants or for optimum fan operation. Demand control can be varied depending on the design of the VAV (variable air volume) controls installed in the plant. AirOptiControl is suited for individual room systems or several zones and also controls basic load heating.

- Energy costs reduced by up to 50 percent in comparison with constant pressure control systems thanks to unique energy efficiency mode for demand-based air volume control
- Full adherence to the required temperature, indoor air quality and humidity levels
- Existing plants can be upgraded while ensuring short payback times

tx2 Economizer: energy-optimized control of air conditioning plants

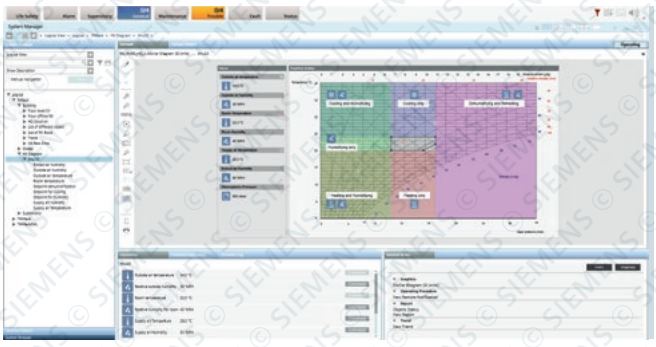


Use: air conditioning

Desigo tx2 Economizer controls air conditioning plants with a focus on energy and CO_2 optimization. The air supplied to the rooms is always conditioned by utilizing the most favorably priced form of energy. Using the patented process, the air conditioning costs are continually calculated to be able to choose the cheapest air handling method. If, for example, a plant calls for cooling in the summer, the application selects the most suitable way of cooling, depending on energy costs: for example cooling coil, air humidifier or a combination of both. The tx2 Economizer ensures the required comfort level and delivers energy savings of up to 50 percent compared with conventional air conditioning systems.

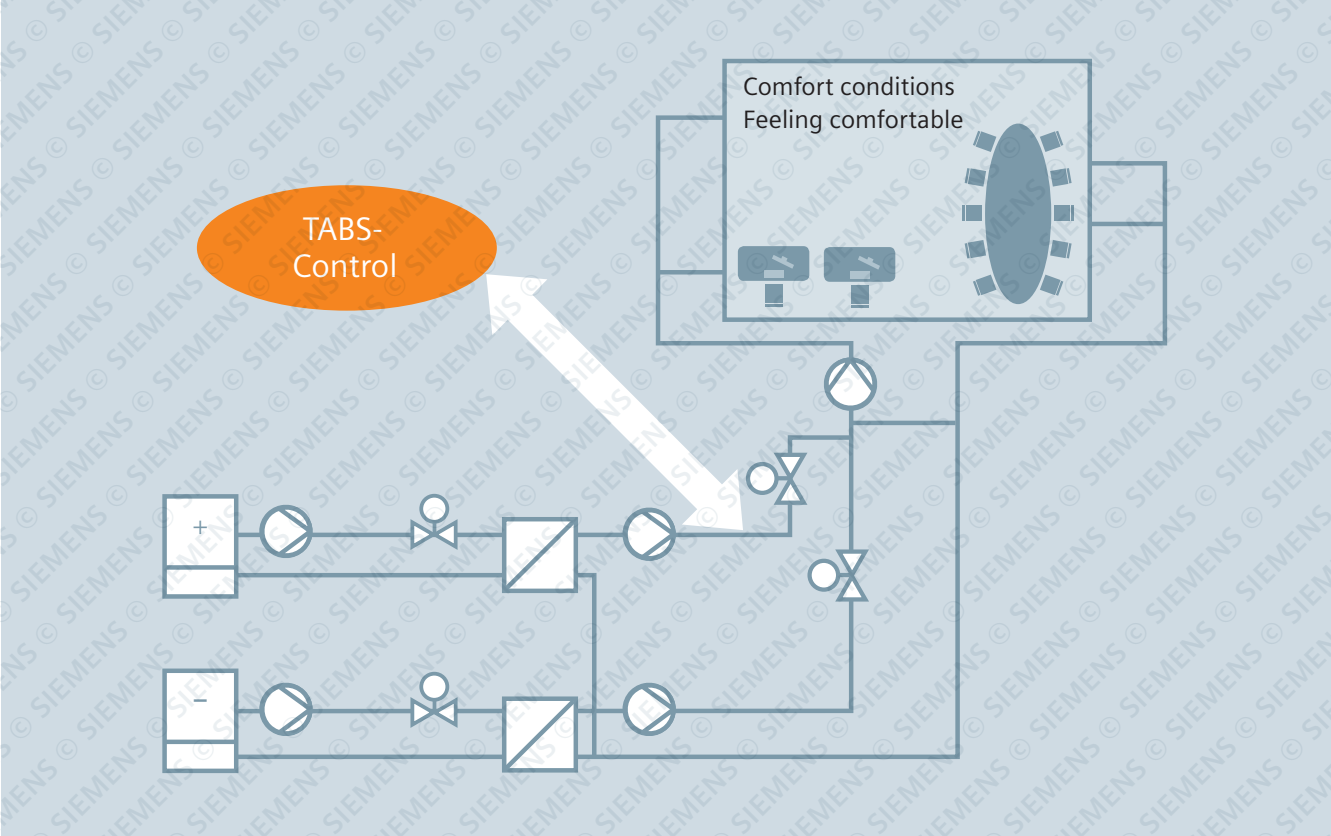
- Targeted usage of the most favorably priced form of energy and of the associated heating or cooling method
- Cost savings based on a selectable setpoint zone for temperature and humidity

Specific display options to control and monitor energy-efficient operation with Desigo CC.



The comfort zone is selected with the help of the graphical user interface of the Desigo CC management platform and is clearly presented on the h,x chart.

TABS-Control: unique control of concrete building structures

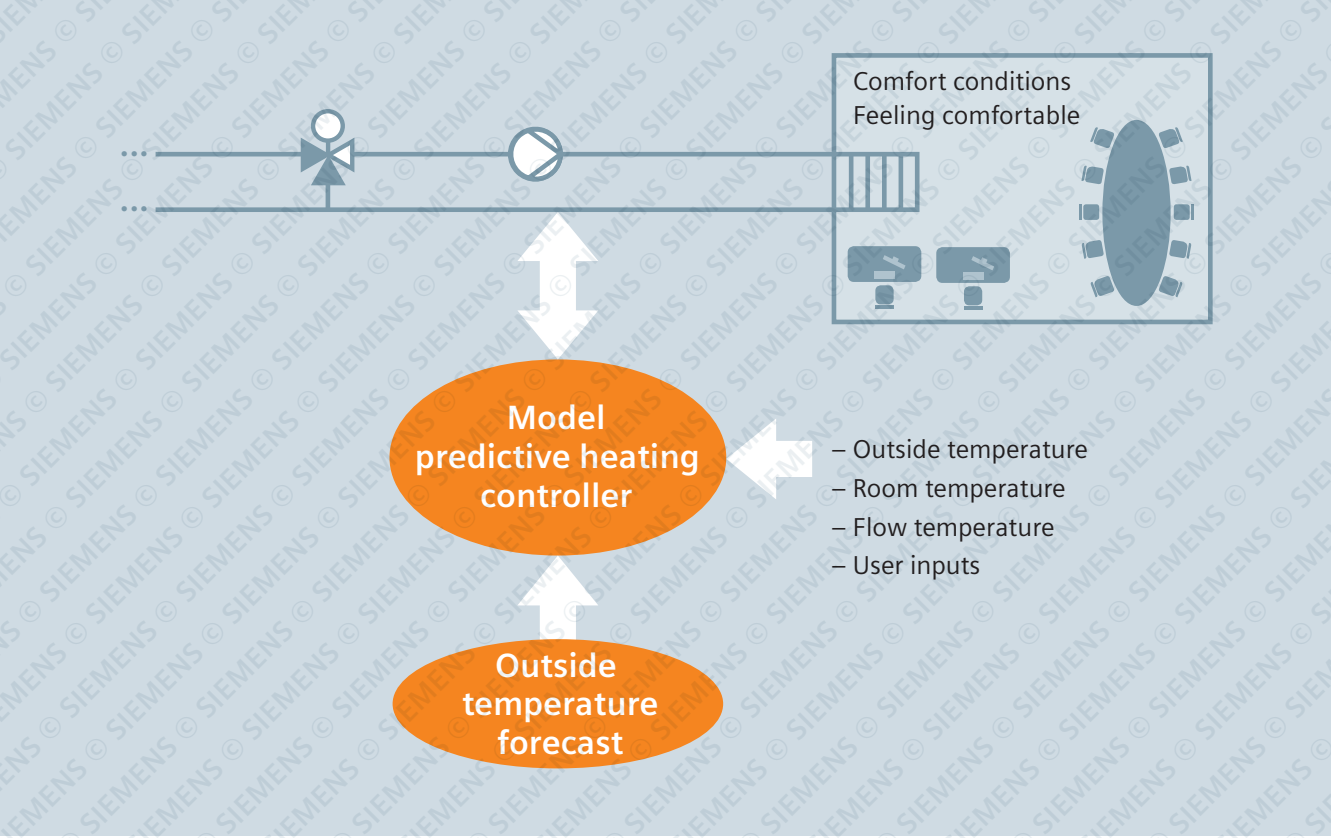


Use: heating and cooling

Using thermally active building structures (TABS), entire concrete slabs are heated or cooled. This room air conditioning process requires a highly sophisticated control system. Desigo TABS-Control meets the requirements with a patented process. Additional benefits are offered by advanced control functions like the one for the cycling module that controls the pump for circulating water through the concrete structures. In case of a typical office building, up to 75 percent of pumping power can be saved.

- Innovative control functions like cycling pump operation for reduced energy usage
- Lower maintenance costs thanks to automatic operation throughout the year
- Optimum adjustment of control using calculated values during commissioning and when usage changes

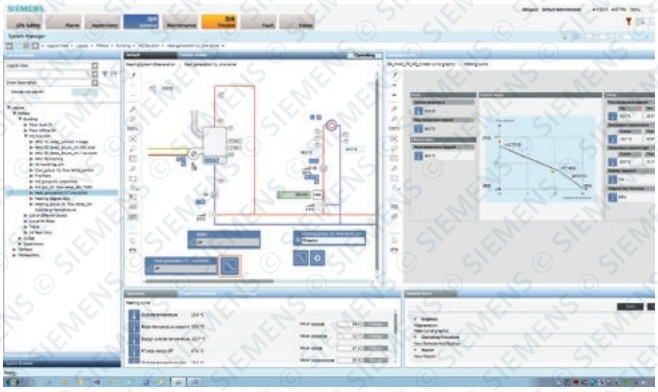
Predictive heating controller: saving energy and costs



Use: heating

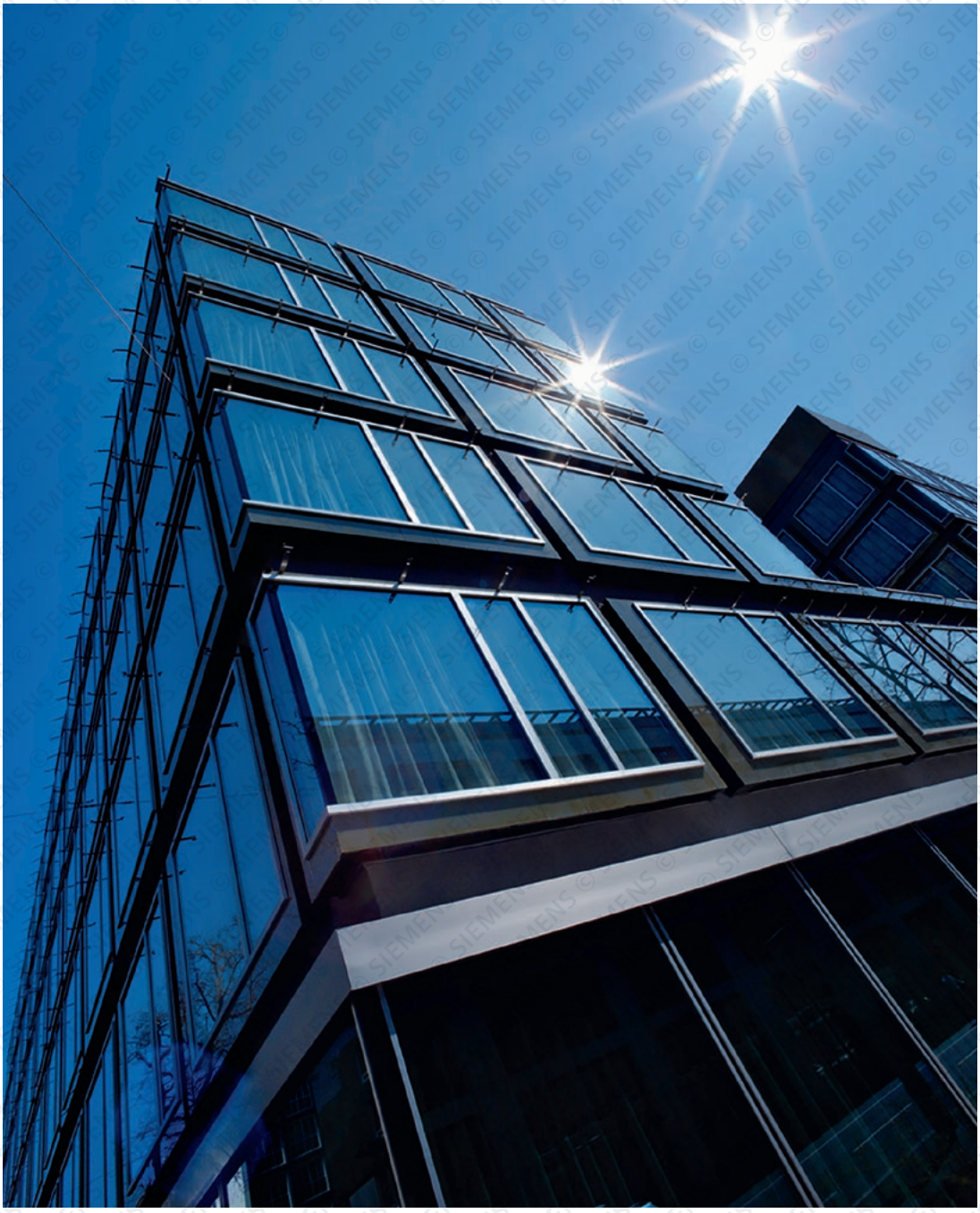
The innovative, patented predictive heating controller combines the following elements: outside temperature forecast (based on previously recorded outside temperature data or weather predictions), adaptation of heating curve and building model parameters, model-related prediction of room temperature, start/stop function, plus optimization of flow temperature setpoint. The building model parameters are fully adaptable, cutting commissioning and maintenance costs and achieving energy savings. Excellent system management improves both the transition from boost heating to comfort mode and the behavior in case of undersized heating output.

- Shorter pump running times and lower energy costs
- Upgrading with no need to install extra plant components
- Inherently correct behavior in different heating plants and with different types of usage



Desigo CC graphical user interface for display and readjustment of setpoints, and for optimum plant operation

Heat storage charged by solar energy for more energy efficiency

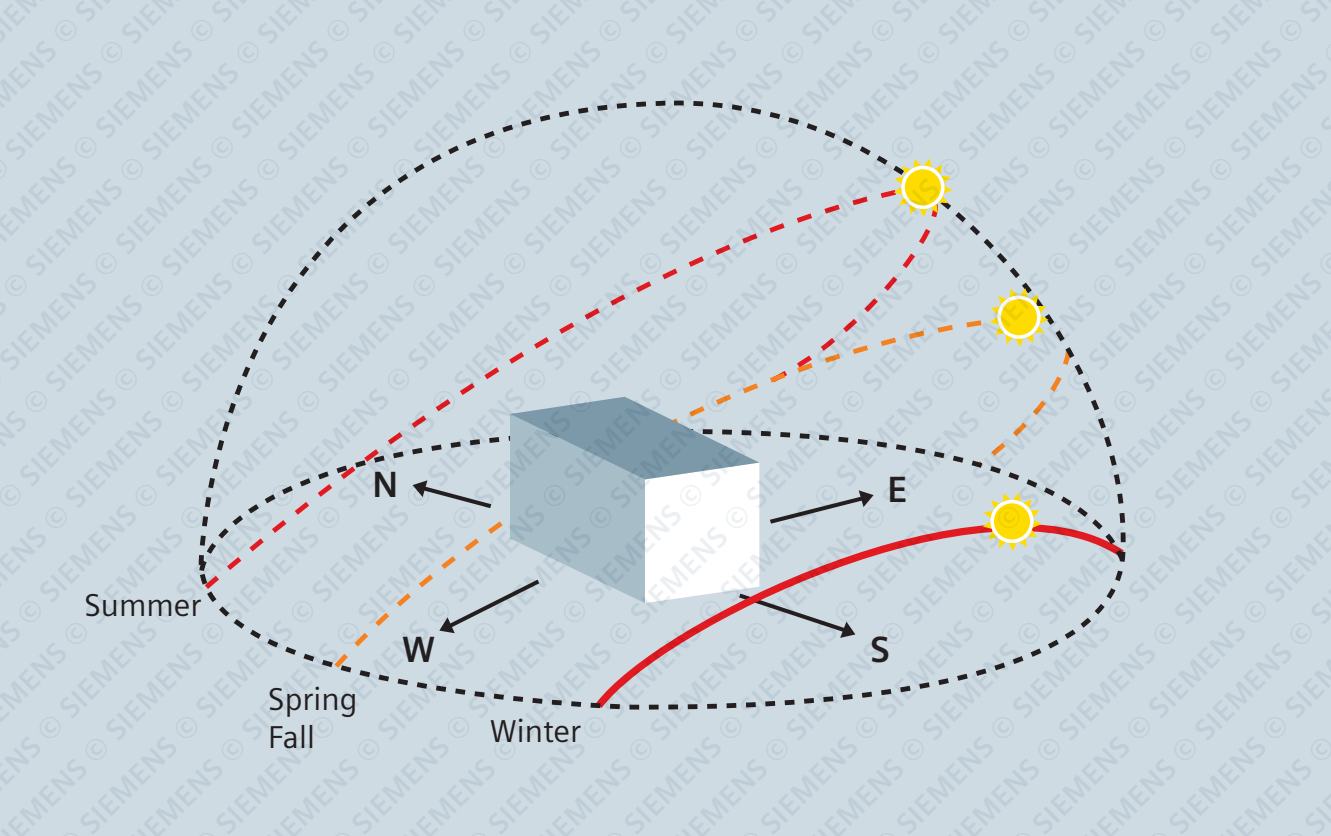


Use: heating

The Desigo application ensures optimum charging and discharging of heat storages. Charging takes place primarily through solar energy, and secondarily by heat supplied by a heating boiler. When using solar collectors, discharging and consumer return can be operated at two levels. The integrated charging level indication shows the operating status of heat storage.

- Cost savings and lower emission levels to protect the environment thanks to efficient usage of renewable energy sources
- Investment protection due to high plant reliability and availability
- Low costs thanks to quick and straightforward commissioning and maintenance

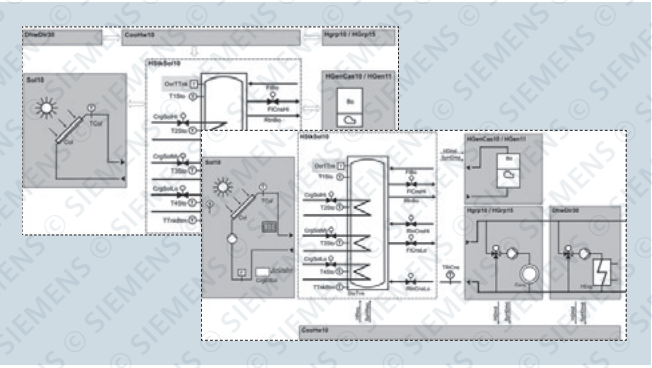
Calculating the sun's position to save valuable energy in the building



Use: optimization of the building's energy balance

The sun as the largest energy source has an impact on a buildings energy demand. Depending on the situation, the energy delivered by the sun is either desirable, or it adversely affects the energy balance and comfort. The application for calculating the sun's position gives consideration to vertical and inclined building facades and – depending on the situation – makes it possible to take appropriate actions, such as blind control providing protection against sunlight and intrusion or for greater comfort, or lighting control. Furthermore, it ensures optimum utilization of the solar collectors.

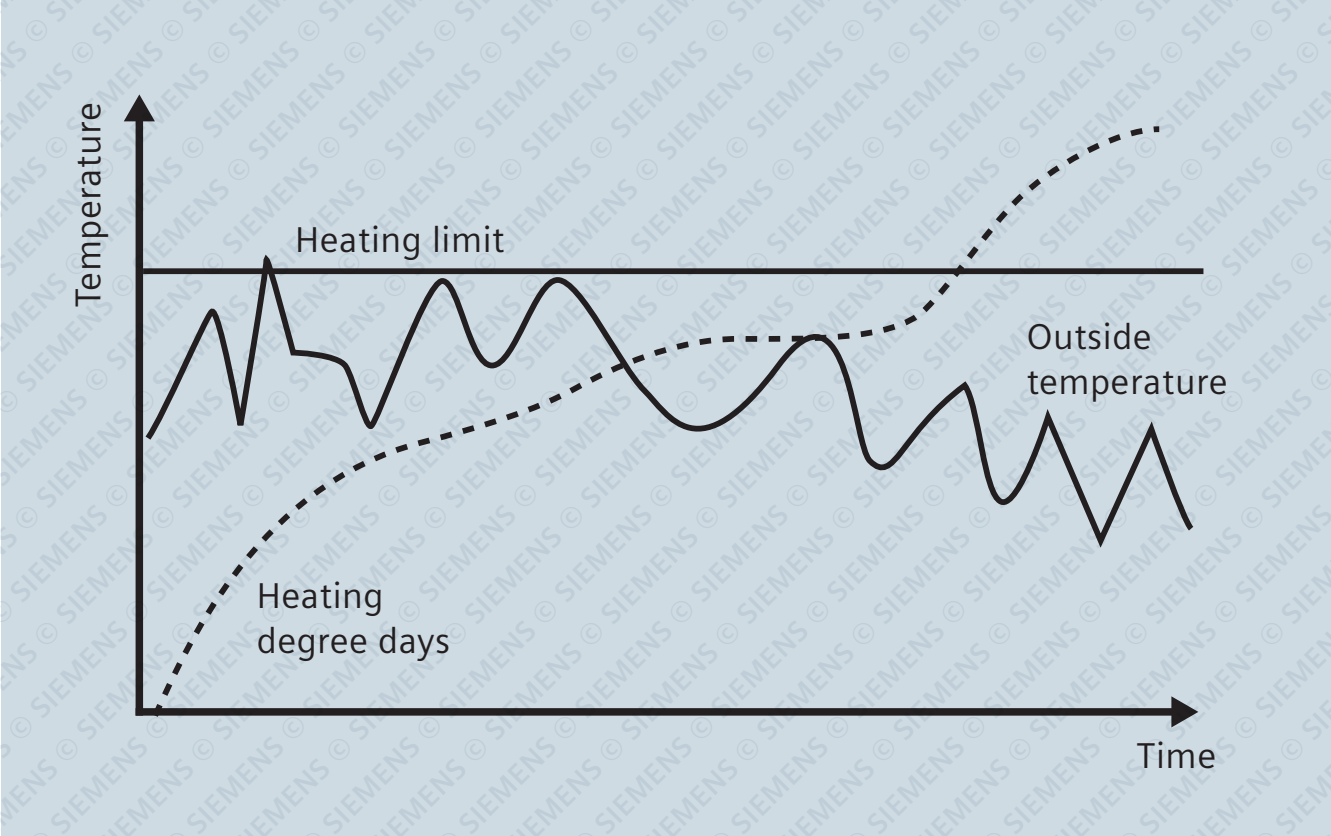
- High investment protection thanks to compliance with DIN 5034-2 (daylight in interior rooms)
- Implementation of room automation functions as per VDI 3813
- Low investment costs since installation of sensors is not required
- Inherently correct behaviour in different heating plants and with different types of usage



Thorough documentation of all applications ensures efficient service, even after years of operation.

Calculation of the sun's position with regard to geographical location, date and time of day. Graphic visualization of sun's position on the Desigo Insight management platform.

Heating degree days: the basis for successful optimization

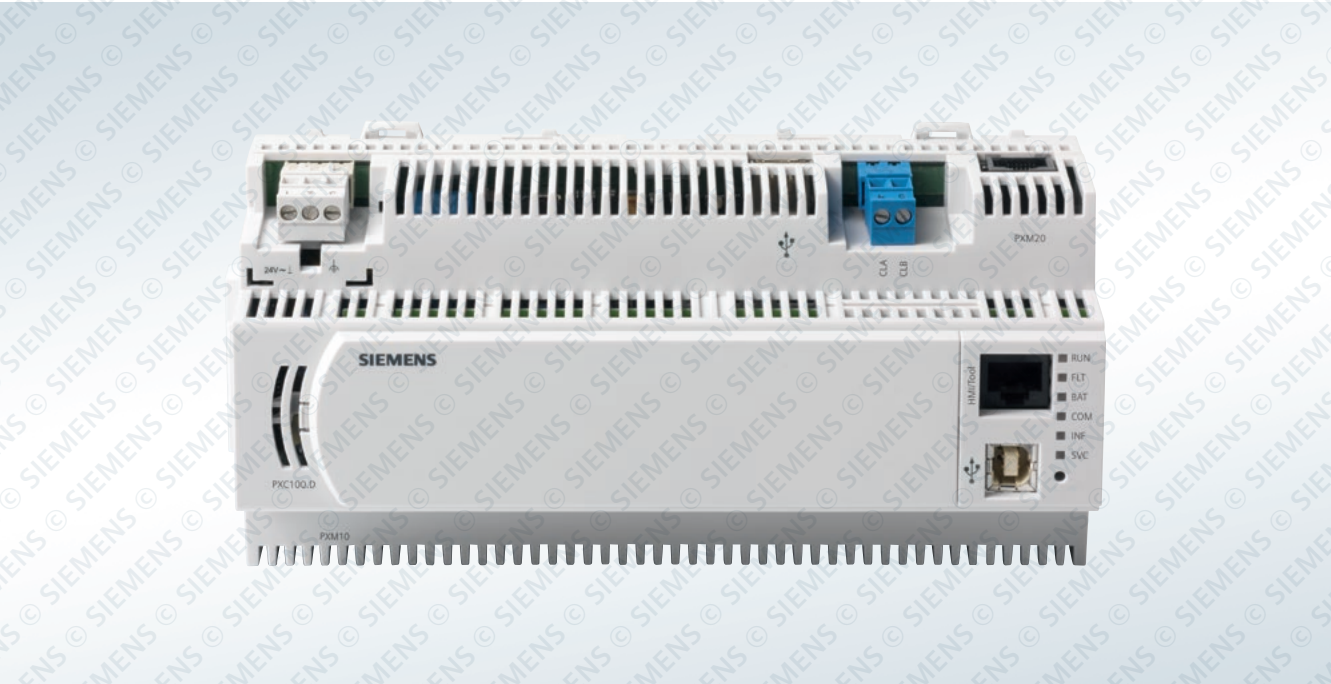


Use: optimization of building's energy efficiency

Heating degree days are used to calculate the impact of the climate on a building's energy consumption. Heating degree days in connection with a building's energy usage show the success of the optimization measures taken and reveal the weak points of a plant at an early stage. The application calculates the number of heating degree days from the difference of daily average of outside temperature and daily average of room temperature. If the daily average lies below the heating limit, the day is classified as a heating day. The calculated heating degree day is added to the total number of heating degree days and stored.

- Reference value for making consumption comparisons and a basis for energy data
- Helps reveal weak points at an early stage to support energy-optimized building operation

Desigo PX



Desigo PX works with standard communication technologies like BACnet over LonTalk or Ethernet/IP, so it can use resources and infrastructure already in place in the building. This reduces installation and maintenance costs and protects your investment over the long term.

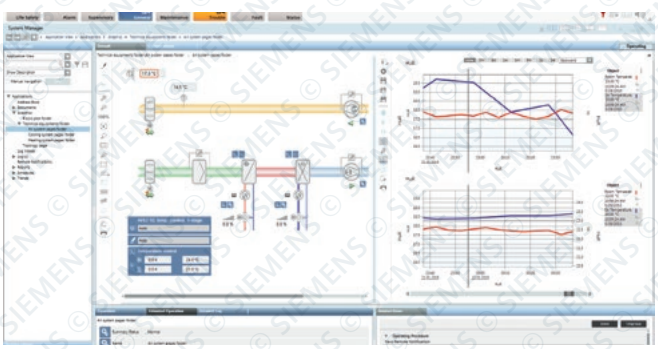
In addition to the standard technologies, in order to make maximum use of system potential, the automation stations and the Desigo Open solutions have been designed for integration. The range of programmable Desigo PX automation stations has two different series: compact and modular. They also differ in terms of installation type, distribution, quantity and data point mix.

Automation stations – compact series

The installation method and fixed I/O components of the compact series make it perfect for carrying out control functions in small and dispersed sets of controllers. The I/Os can be adapted to different signal types. The automation stations are installed in the control cabinet. The control units are connected to the BACnet via a web interface, the PPS bus or an HMI link. Desigo PX is setting standards for present and future communication technologies. BACnet/LonTalk or BACnet/IP illustrate the openness of Siemens systems and the use of the latest communication technologies, allowing third-party systems and components to be integrated without issues.

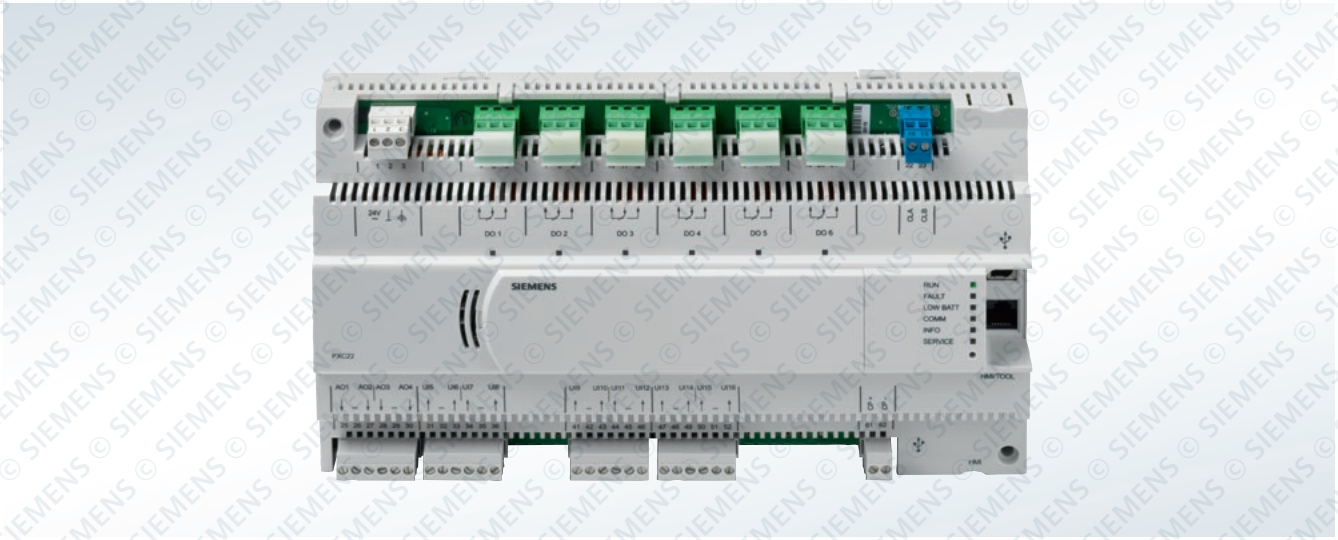
Automation stations – modular series

The automation stations of the modular series PXC..D have flexible I/O components and are optimized for DIN-compliant cabinet installation. They primarily control and monitor large sets of controllers. The flexible range of TX-I/O modules for signaling, measuring, metering, switching and positioning can be seamlessly integrated with the automation station. The I/O modules with local manual control on the module housing permit the operator to control the equipment manually directly from the cabinet. This local manual access is sent directly to the process equipment and its control units as a remote/local message. In an emergency it is independent of the automation station and acts as a standalone emergency control level. With expansion modules and I/O modules, interfaces can be used in a flexible way to upgrade the automation stations and connect equipment with different communication protocols such as LonWorks, Modbus, M-Bus, etc.



The comprehensive documentation of all applications allows an efficent service over years.

Desigo PX Automation Station



Automation stations – compact series

Automation stations – compact series

Compact, programmable automation stations for HVAC and building service installations. The fixed data point mix is perfect for use with frequently recurring applications with standard signals.

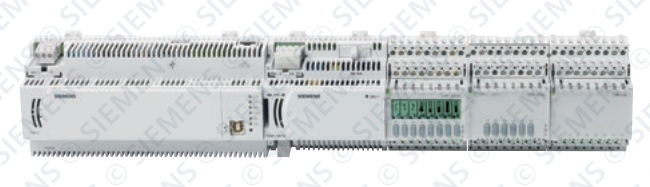
- Direct connection of field devices, management functions (alarm management, schedulers, trend functions, access protection, etc.)
- Standalone or as part of a linked system
- Connection of operator units
- BTL tested BACnet communication on LonTalk, PTP or IP compliant with the BACnet standard (Rev. 1.12 – from Desigo V6.0) including B-BC profile
- AMEV profiles AS-A and AS-B according to recommendation «BACnet 2011 – Version 1.2 (from Desigo V6.0)»
- Expansion possible with TX-IO and TX Open data points for automation stations PXC22.1 and PXC36.1

	Automation station types – compact series			
BACnet/LonTalk	PXC12.D	PXC22.D	PXC22.1.D	PXC36.1.D
BACnet/IP	PXC12-E.D	PXC22-E.D	PXC22.1-E.D	PXC36.1-E.D
Number of I/Os (onboard)	**12**	**22**	**22**	**36**
UIO	8	16	16	24
DI	2	0	0	4
DO	2	6	6	8
Number of I/Os via TX-IO modules	-	-	16	16
Number of TX Open modules	-	-	5	5

Automation stations – modular series

The programmable automation stations of the modular series PXC..D have flexible I/O configuration, are DIN compliant, and are optimized for cabinet installation. They control, regulate and monitor medium to large sets of controllers. The flexible range of TX-I/O modules for signalling, measuring, metering, switching and positioning can be seamlessly integrated with the automation station.

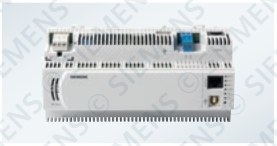
- Management functions (alarm management, schedulers, trend functions, remote management, access protection, etc.)
- Standalone or as part of a linked system
- Integration of Modbus, M-Bus, LonWorks subsystems
- Connection of operator units
- BTL tested BACnet communication on LonTalk, PTP or IP compliant with the BACnet standard (Rev. 1.12 – from Desigo V6.0) including B-BC profile
- AMEV profiles AS-A and AS-B according to recommendation «BACnet 2011 – Version 1.2 (from Desigo V6.0)»



Automation station with connected TX-I/O modules

Automation station types – modular series				
BACnet/IP	PXC00-E.D	PXC50-E.D	PXC100-E.D	PXC200-E.D
BACnet/LonTalk	PXC00.D	PXC50.D	PXC100.D	PXC200.D
Number of data points via TX-IO modules	–	Up to 52	Up to 200	Over 200
Number of TX Open modules for e.g. Modbus, M-Bus	–	5	5	5
Number of LonWorks devices via PXX-Lx	60 oder 120	10	60[1] oder 120[1]	60[1] oder 120[1]

[1]When combined with PXC100/200...D and if TX-I/O modules are used in parallel, the number of devices falls depending on performance.

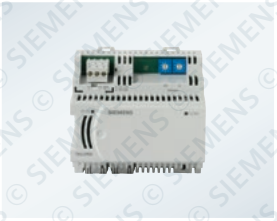


PXC00/50/ 100/200...D

Range of programmable, **modular** automation stations **optimized for building automation.**

TXM1..

A flexible range of TX-I/O modules for signalling, measuring, metering, switching and positioning. The TX-I/O modules have LEDs or optional LCDs with signal and warning pictograms to indicate the status of the plant and facilitate manual or emergency operation depending on the type of module.



TXI2.OPEN

Flexible TX Open Platform to integrate third-party systems and devices via RS232/RS485, e.g. Modbus or M-Bus. Tested integration solutions and applications based on our extensive know-how.

PXX-L11/12, PXX-P-BUS

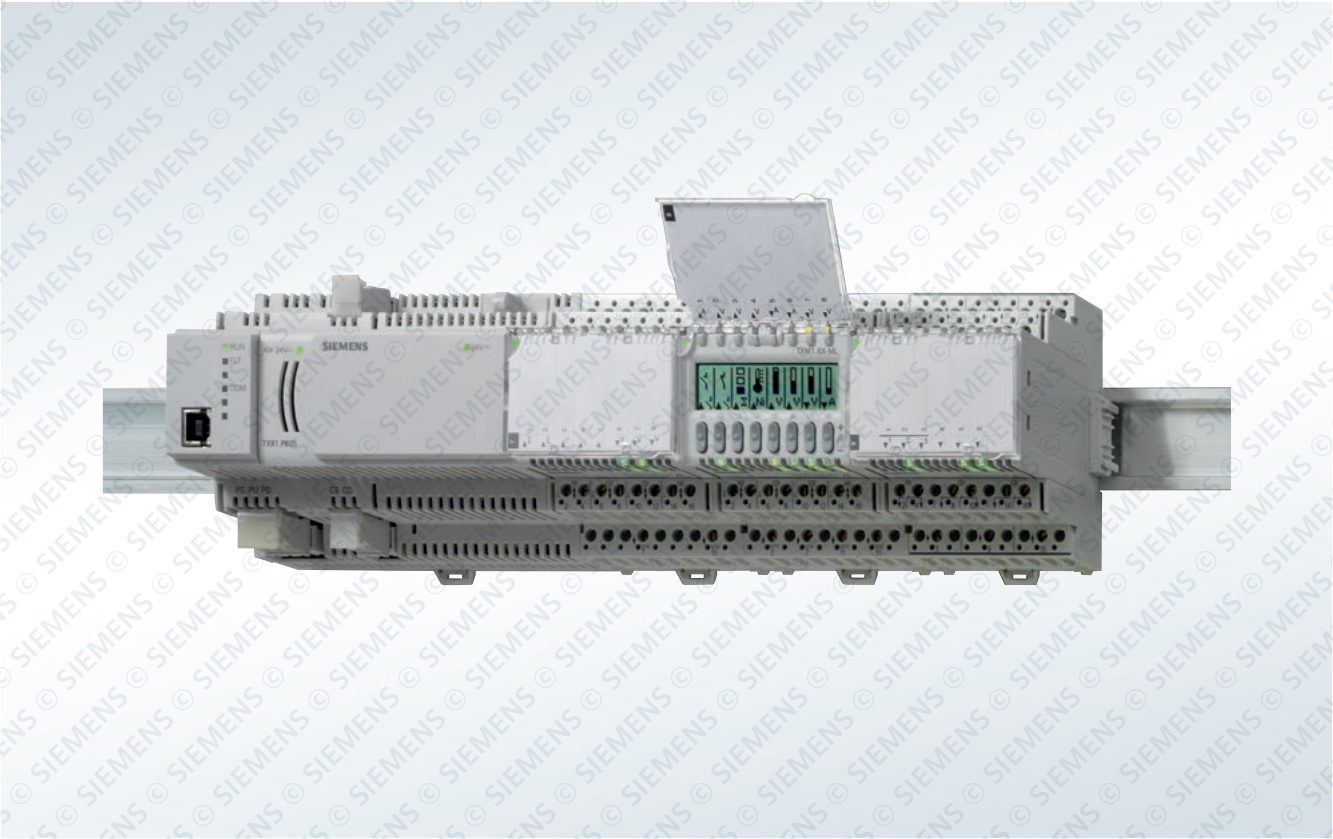
Expansion modules PXX-L11/12.. support the flexible connection of LonWorks devices such as room controllers and third-party devices.

Expansion module PXX-PBUS supports the connection of installed PTM-IO modules to automation stations PXC50/100/200...D, making it a perfect solution for migrating legacy systems.

TXA1.IBE

Remote IO islands with integration A simple adapter enables remote TX-IO and TX Open islands. No programming/configuration necessary.

Desigo TX

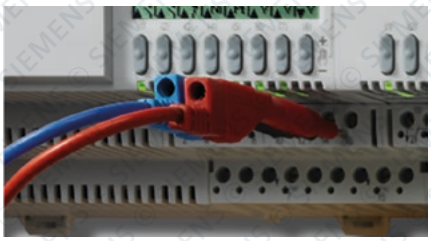


Desigo TX-I/O modules provide the interface to the devices at the field level, the sensors and actuators, and the shading (blinds) and lighting. They communicate with connected Desigo PX modular automation stations or Desigo TRA room automation stations and can be interconnected in application-specific configurations. A space-saving, flexible product range of compact TX-I/O modules is available for signaling, measuring, metering, switching and positioning. The I/O module system is DIN-compliant in design and optimized for panel mounting, and supports decentralized, remote module installations. The TX-I/O modules have LEDs or optional LCDs with signal and warning display programs to indicate the status of the plant and facilitate manual or emergency operation depending on the type of module. The integrated isolating terminal strip allows hardware testing during commissioning.

The combination of Desigo TX-I/O modules with proven PTM modules within a plant is also possible.

Optional manual control, multicolor LEDs and LCD

The LEDs and the optional LCD show the field devices' operating state at any time. Faults will be reliably detected and displayed as easy-to-understand error pictograms.



Direct wiring and connection terminals with tapping points

All field device cables can be directly connected, with no need for using auxiliary terminals, thus saving installation time and material. Furthermore, the terminals feature tapping points to make servicing simpler and more convenient.

Parking position

To facilitate servicing, selected modules can be removed or brought into parking position. In that case, the respective module will be disconnected from power but the other modules will continue to work normally.

Desigo PX Open and TX Open

Desigo PX Open

The native BACnet automation station PX Open is a multi-functional integration platform used to connect third-party automation stations and open field-bus networks to the BACnet network:

- PX LON for the connection of LonWorks devices and networks and the Desigo RXC room automation system
- PX Modbus, PX M-Bus and PX SCL (Structured Control Language) to connect Modbus, M-Bus or simple ASCII protocols for RS232 or RS485 (free SCL programming)
- PX KNX to connect KNX S-Mode (EIB) devices and networks, Desigo RXB and RXL room automation as well as Synco 700 standard controllers

The data points of the third-party system are mapped to input/output functions in BACnet and are then available as fully communicating data points for further processing and further connection, e.g. for:

- Alarm handling and prioritization
- Overriding, priority control and commands for central operation
- Grouping
- Scheduler programs
- Trend logging

PX Open integrates up to 2000 items of information per device.

The bidirectional exchange of data is event-driven, i.e. the systems only exchange information if the data point changes. Peer-to-peer communication can be implemented without difficulty in the BACnet network. The PX Open integration stations are positioned in a flexible configuration in the BACnet network and can be operated via the local LCD operator units.

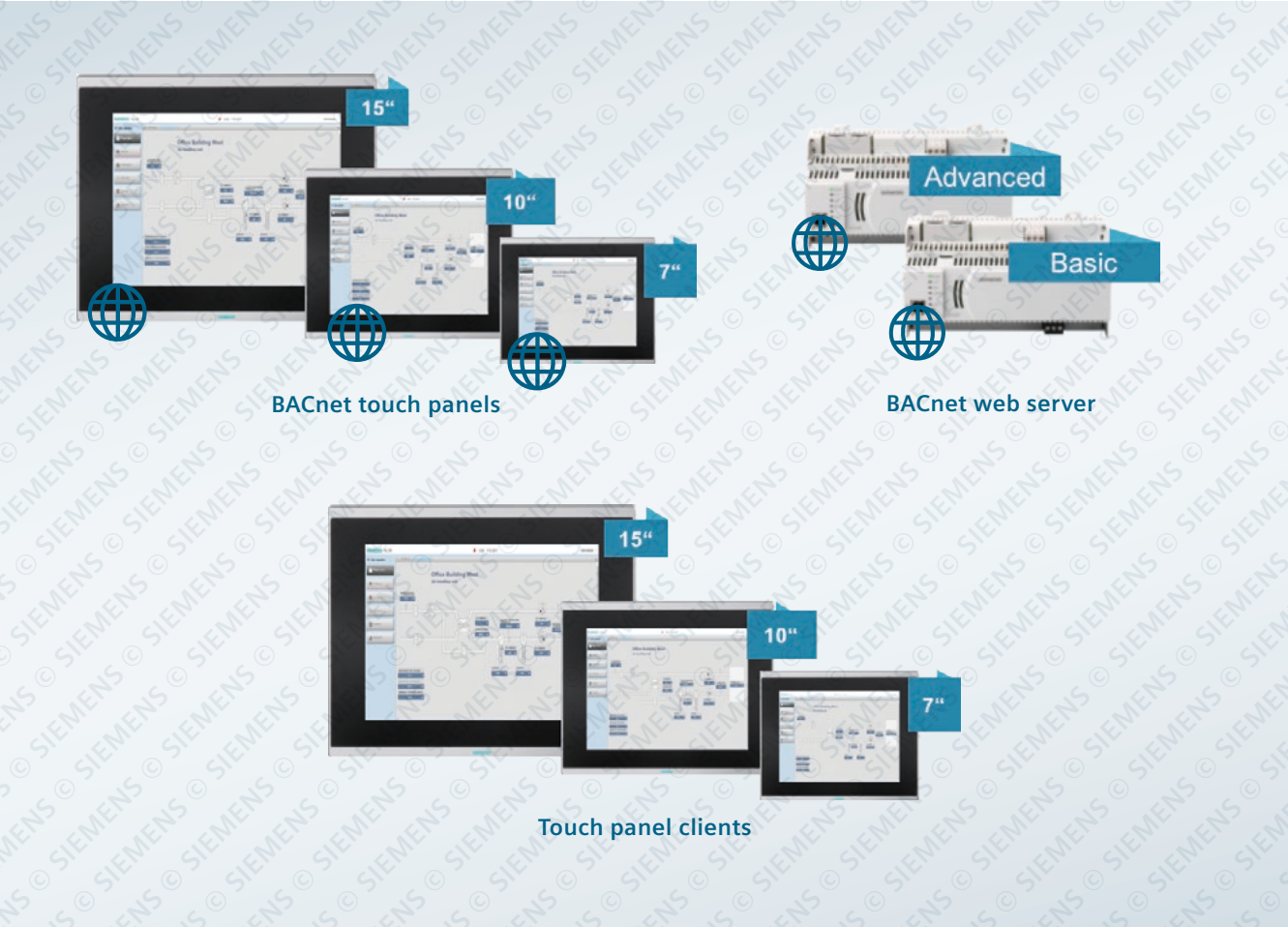
«Simple» protocols based on ASCII strings can be connected directly to PX Open by use of SCL in conjunction with a freely programmable RS232 or RS485 port. The following vendor-neutral protocols are supported:

- BACnet
- LonWorks
- KNX S-Mode (EIB)
- M-Bus
- Modbus

Desigo TX Open

A few decentralized, distributed third-party devices can be connected quickly and cost-effectively via Desigo TX Open and processed in the automation system. The microprocessor-based Open modules connect selected third-party devices via RS232 or RS485 to the decentralized I/O bus of the Desigo PX automation station.

Desigo Control Point



Desigo Control Point is an embedded management station with a comprehensive product range.

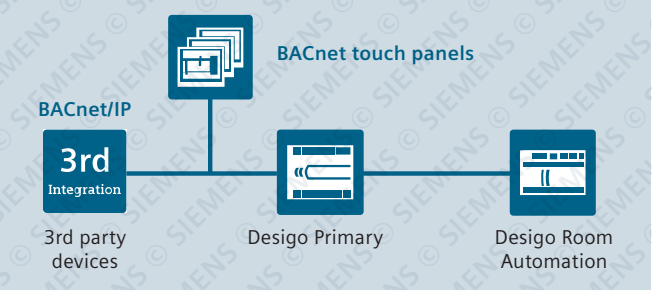
Desigo Control Point is used to monitor and manage the building. It works equally well with primary plants and room automation. Desigo Control Point makes light work of everything, for example the technical management of schedulers, creating trend curves for a specific unit, generating reports for all installations, creating an overview of animated system graphics, or handling alarms.

HTM5.0 web support is possible for all clients including smartphones, touchpads, touchpanels and standard browsers. Depending on the size of the system and the requirements, the three embedded touchpanels 7, 10 or 15 inch or the two web servers are sufficient for a medium to large system. The powerful touchpanels are also available as simple clients. The operator units have a high-resolution colour display and are optimized for continuous plant monitoring. Even users who are not logged in can see if there is a fault in the system.

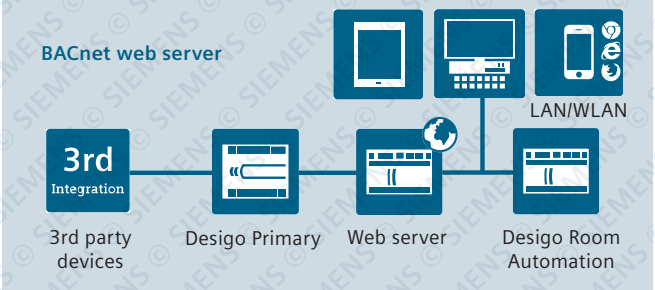
Desigo Control Point – products and functions:

Eigenschaften / Merkmale	PXM30.E PXM30-1	PXM40.E PXM40-1	PXM50.E PXM50-1
Capacitive touchscreen	✓	✓	✓
Multi-touch gestures (swipe and zoom, etc.)	✓	✓	✓
Widescreen format	✓	✓	✓
LED for alarm display	✓	✓	✓
Brightness sensor	✓	✓	✓
Panel mounting	✓	✓	✓
AC 24 V voltage supply	✓	✓	✓
RJ45 Ethernet connection	✓	✓	✓
Plastic frames	✓		
Wall mounting		✓	✓
Aluminium frame		✓	✓
Anti-theft protection		✓	✓
Power over Ethernet (PoE)		✓	✓
Wall mounting accessories		✓PXA. V40	✓PXA. V50

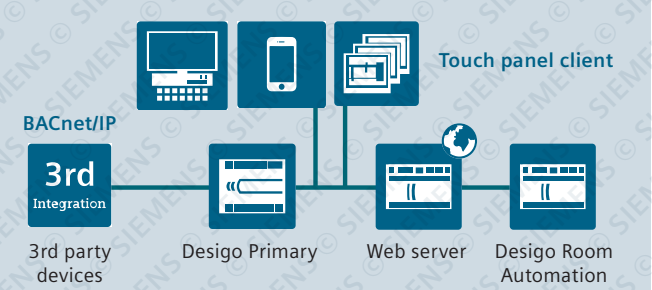
Desigo Control Point has great flexibility in terms of topology:



- Embedded touchpanels directly in the IP network.
- Communication with the subsystem via BACnet.
- Works with primary and room automation with Desigo and with third-party systems speaking BACnet.



- Standard web clients that communicate directly with the dedicated web server.
- E-mail alerts are possible with all variants at all times.



- Embedded touchpanels directly in the IP network.
- Communication with the subsystem via BACnet.
- Standard clients are also possible. They communicate directly with the touchpanels or with the dedicated web server

Desigo Control Point – the main functions at a glance:

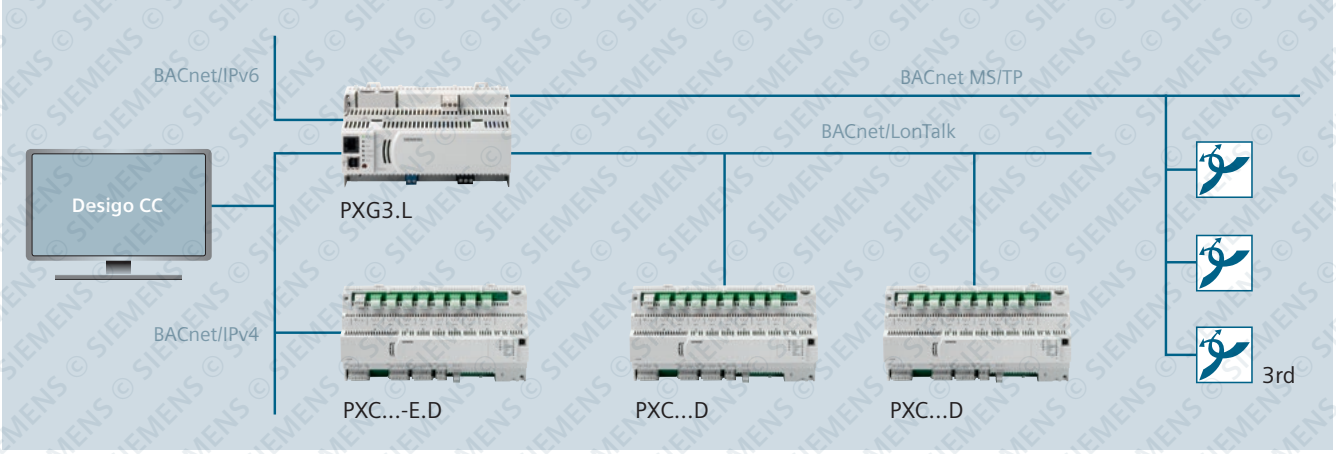
- Generic management of all objects and features
- Standardized management philosophy
- User administration (add, delete, change)
- User access for data point commanding
- Management of schedulers
- Display and configuration of online/offline trends
- Alarm overview
- Alarm and event history
- Setup and adjustment of alarm forwarding
- Animated system graphics
- Display and adjustment of heating curves
- Energy dashboards
- Support for BACnet devices from third-party systems

Desigo BACnet Router

Highlights

- Routing between BACnet/IP, BACnet/LonTalk (only PXG3.L) and BACnet MS/TP networks
- Supports BACnet/IPv4 and BACnet/IPv6
- Compliant with ANSI/ASHRAE 135-2012 (Rev. 1.10)
- Compliant with ISO 16484-5
- Supports BBMD (BACnet Broadcast Management Device)
- Access to network statistics via web browser
- LED display for Ethernet link and activity
- LED display for BACnet/LonTalk and BACnet MS/TP (diagnostics)
- 2-port Ethernet switch for low-cost cabling (10/100 baseT)
- DIN rail mounting
- SNMP (v2), MIB-2
- BACnet NAT

The Desigo PXG3 is a router to connect a BACnet/IP network to a BACnet/LonTalk and/or BACnet MS/TP network. The BACnet objects are transmitted simultaneously over any of these networks.



Simatic S7

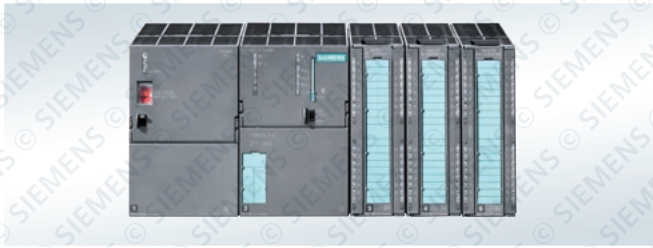
Simatic S7 industrial automation meets high standards in terms of control technology and availability of the plants, and can be added onto existing process automation. This can save on costs and simplify operation and maintenance because the same components are used.

Simatic S7 product range		
Features		
Wide acceptance and many applications in process technology	▪ Same components for process automation and building automation ▪ Same operating personnel	▪ Pharmaceuticals ▪ Industrial ▪ Hospitals ▪ Airports
Extended applications	▪ The feature is integrated within hardware components ▪ Components easy to replace	▪ Applications in Ex zone ▪ Outdoors IP54, temperature -25 °C to 80 °C
Redundancy/high availability	▪ Maximum availability of systems ▪ Easy programming and configuration	▪ Maximum availability ▪ Short or no down times

Solutions for building automation

Simatic S7 with Desigo CC

User-friendly Linux-based management station for top-level control, monitoring, analysis and optimization of all integrated systems and processes. The management station is an engineering tool, solution library and display all in one. The automation level is based on Simatic S7. For medium to large projects.



Simatic «standalone»

Scalable automation system based on Simatic S7 for controlling primary plants. High-availability version available if necessary (redundancy). Engineering uses Step 7 or the TIA Portal with a standalone solution library. Touchpanel display and/or link to existing control system (e.g. WinCC, PCS7, Wizcon, PVSS, etc.)

Comprehensive system for process-linked, high-availability building automation

Simatic S7 with Desigo CC

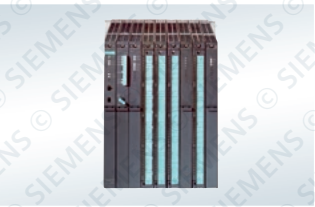
User-friendly management station for top-level control, monitoring, analysis and optimization of all integrated systems and processes.

Simatic S7-300

Scalable automation system based on Simatic S7 for controlling primary plants. All types in this range are available, including Redundancy.

Simatic S7-1500

Scalable automation system based on Simatic for controlling primary plants. All types in this range are available, including Redundancy.



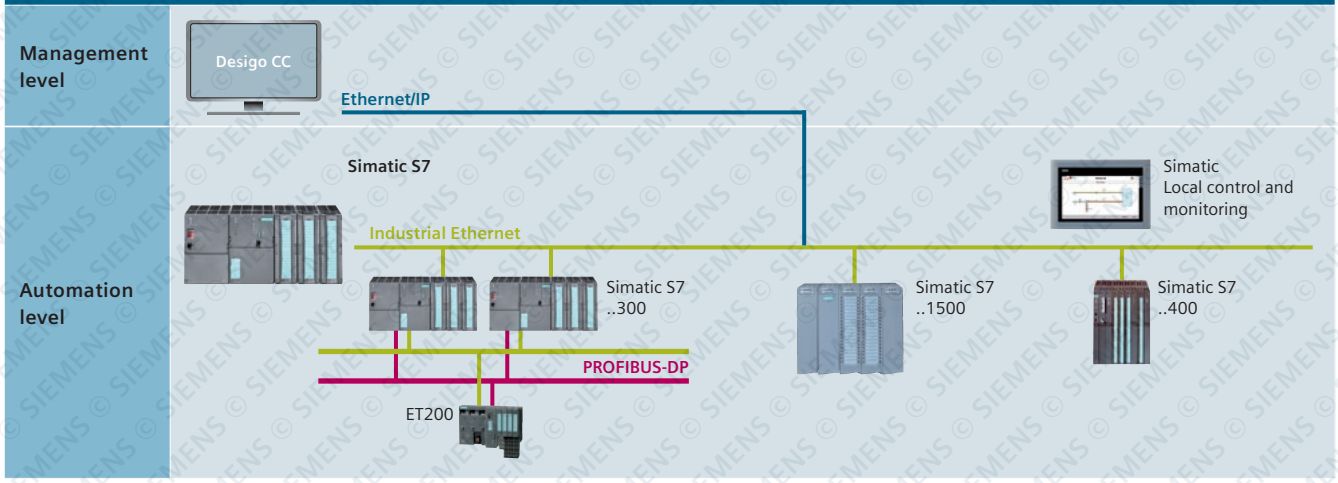
Simatic S7-400

Scalable automation system based on Simatic for controlling primary plants. All types in this range are available, including Redundancy, High-Availability and Intrinsically Safe.

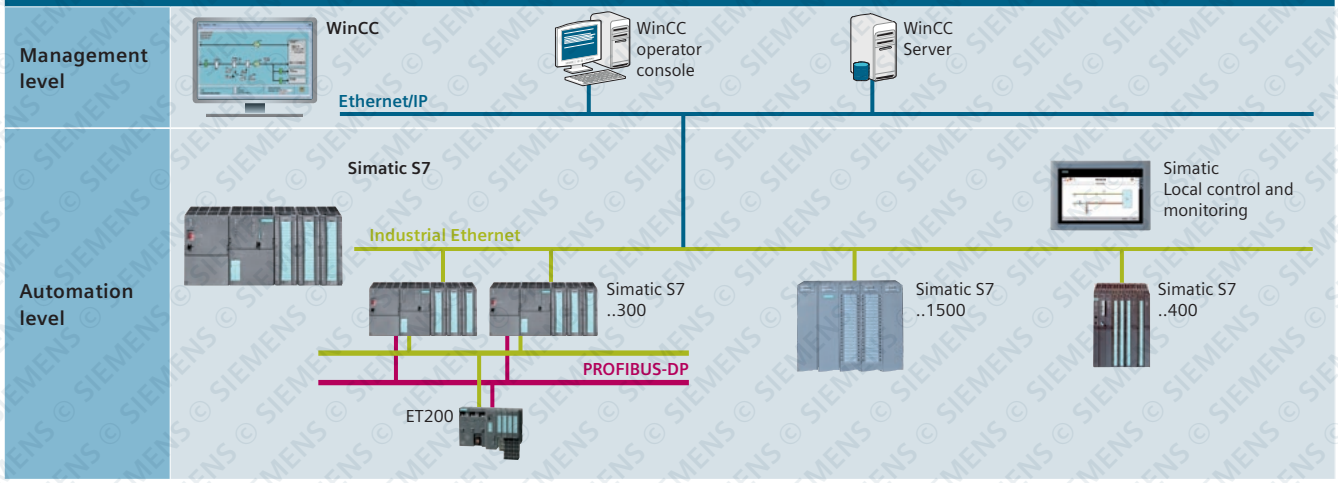
Open Profinet communication to integrate automation and management level

Modbus to integrate third-party automation and distributed secondary processes

Building automation with Desigo CC



Building automation with Simatic «standalone»



Field devices

- Room control units
- Sensors
- Thermostats
- Valves and actuators
- Dampers
- Frequency converters
- Heat and energy metering

Synco

Highlights

- Energy savings thanks to intelligent building automation
- Comprehensive product range for any requirements
- Versatility and expandability for future use
- Straightforward operation and quick commissioning
- Optimum control and fast setting options through remote plant access
- Superior support through a reliable partner
- Highest quality and reliability backed by decades of experience and high standards

Simple, versatile and reliable

Comprehensive product range
From basic temperature control to complete HVAC plant control – from heat or refrigeration generation control through distribution to individual room control: Synco offers an extensive range of standard controllers for all types of applications.

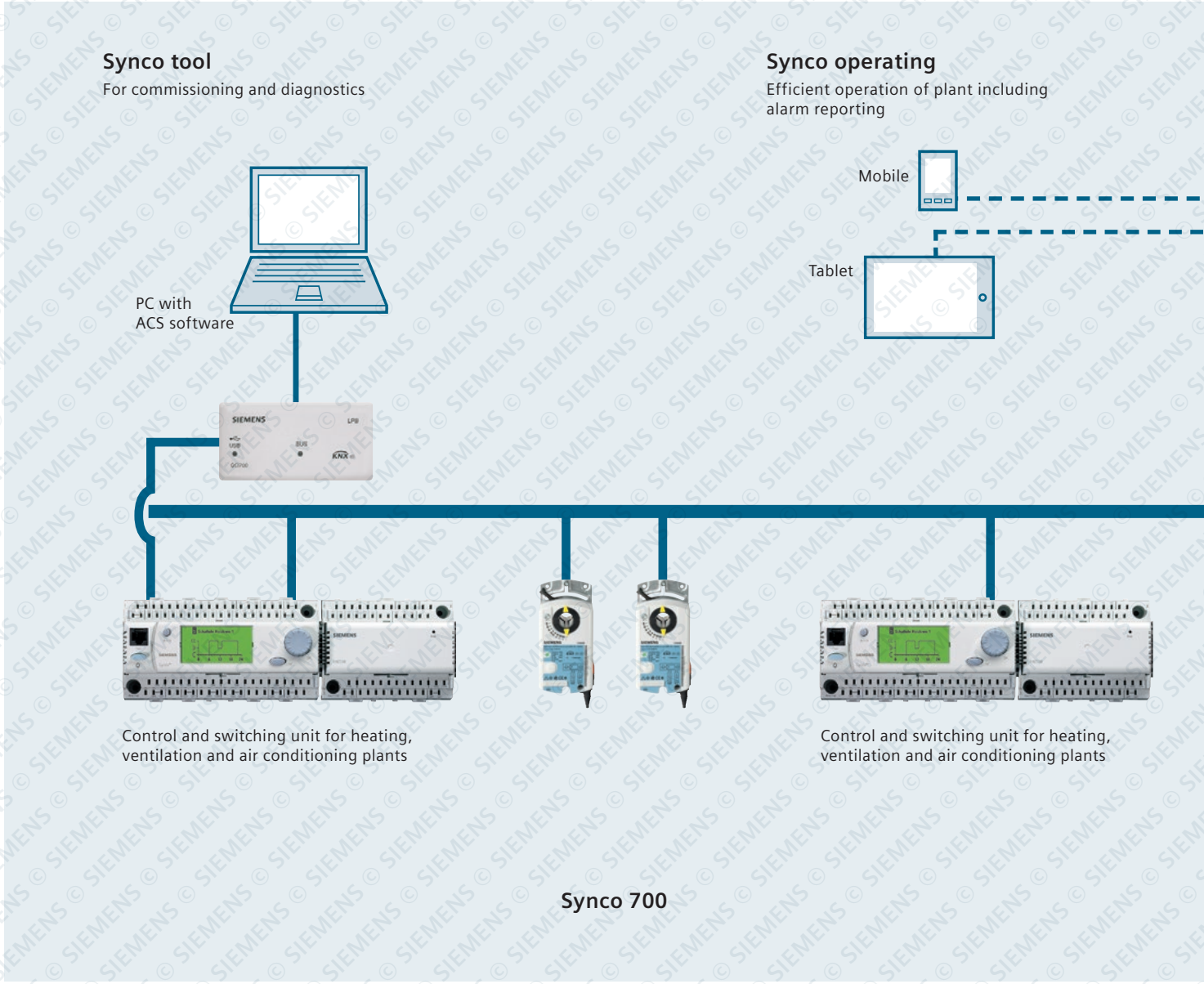
Versatile and expandable for future use
Synco supports the entire life cycle of a building. Whether you change the usage of a building, in case of a staged construction or when you expand or modernize a plant – Synco is the ideal solution for you. Thanks to their modular concept and backward-compatible communication, the controllers can be expanded and adapted at any time. This means that the functionality of HVAC plants can grow depending on new requirements, and investments can be made in stages.

Straightforward operation and quick commissioning
Synco excels in high levels of user and service friendliness, owing to straightforward and efficient operation. Proven and preprogrammed applications and energy saving functions are integrated, enabling you to save time and costs in terms of planning, engineering and commissioning.

Competent support for your work
With Siemens, you have a strong and competent partner at your side. Backed by our in-depth know-how, we offer you extensive support for Synco – for example different training modules, e-learnings as well as comprehensive technical documentation and application descriptions.

Decades of experience and high quality standards
HVAC plant control is one of the challenges we have been facing for more than 70 years. The incremental development of our products benefits from our in-depth application know-how resulting from decades of practical experience and extensive research work.

We attach great importance to quality management and systematically subject our products to stringent tests. Controllers and their functions are thoroughly tested in our own HVAC laboratory. This ensures the highest levels of product quality and puts us in a position to work with you as your competent partner.



Synco 700

Universal controllers

RMU710	modular universal controller, 1 control loop
RMU720	modular universal controller, 2 control loops
RMU730	modular universal controller, 3 control loops
RMS705	switching and monitoring device

Universal extension modules (for all types of controllers)

RMZ785	universal module
RMZ787	universal module
RMZ788	universal module

Operator units (for all types of controllers)

RMZ790	plug-in type operator unit
RMZ791	detached operator unit (3 m)
RMZ792	bus operator unit

Field devices

GDB181.1E/KN	VAV compact controller (5 Nm)
GLB181.1E/KN	VAV compact controller (10 Nm)

Heating controllers

RMH760	modular heating controller
RMK770	boiler sequence controller

Extension modules for heating controllers

RMZ782	heating circuit module
RMZ783	DHW module
RMZ787	universal module
RMZ789	universal module

Room unit

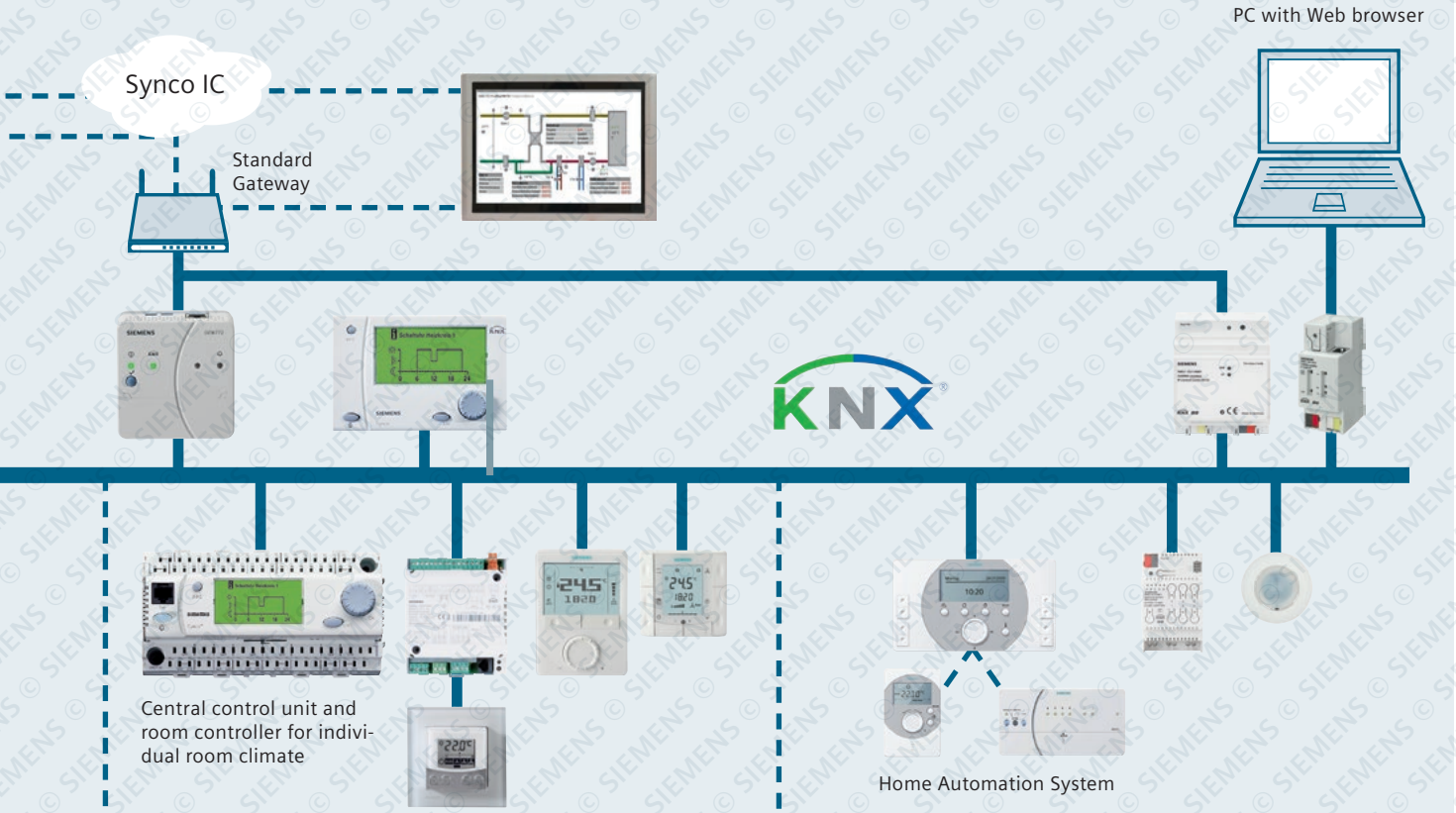
QAW740	room unit

Synco operating

OZW771	central communication unit
OZW772	Web server (Ethernet)

Synco tool

OCI700.1	service tool
ACS790	commissioning software



Synco RXB/RXL room controllers, Synco RDG/RDF/RDU room thermostats

Central control unit RMB795
– Central control unit for room controllers

Room controllers
RXB21.1, RXB22.1, RXB39.1
– Fan coil units

RXB24.1
– Chilled ceilings or radiators

Room thermostats
RDG100KN
– Fan coil units
– Universal system, chilled/heated ceilings and radiators

RDG400KN
– Variable volume flow system

RDF600KN
– Fan coil units
– Heat pumps

Synco living

Synco living

QAX903	Central apartment unit
QAX913	Central apartment unit
QAW910	Room unit
QAA910	Room temperature sensor
SSA955	Radiator valve actuator
RRV912/918	Heating circuit controller
QAC910	Meteo sensor
ERF910	Wireless repeater

GAMMA wave products
– Lighting and blind actuators
– DELTA reflex smoke detectors
– Door and window contacts

Synco living

This is how easy it can be to save energy

Comfortable room automation
Synco living is a reliable system that thinks for itself and controls things like room temperature and ventilation in the background. It adjusts the blinds and lighting for you and supports scene controls. The system can also be accessed at all times and from anywhere by smartphone.

Reliable security
Synco living simulates an occupied property by switching lights on and off, reports water damage and monitors doors and windows for enhanced security.

Lower energy consumption
Energy-efficient automation reduces energy consumption with highly accurate values, precise control and minimal error, while also improving comfort. Synco living is one of the first systems to be awarded the Minergie quality label for room comfort.

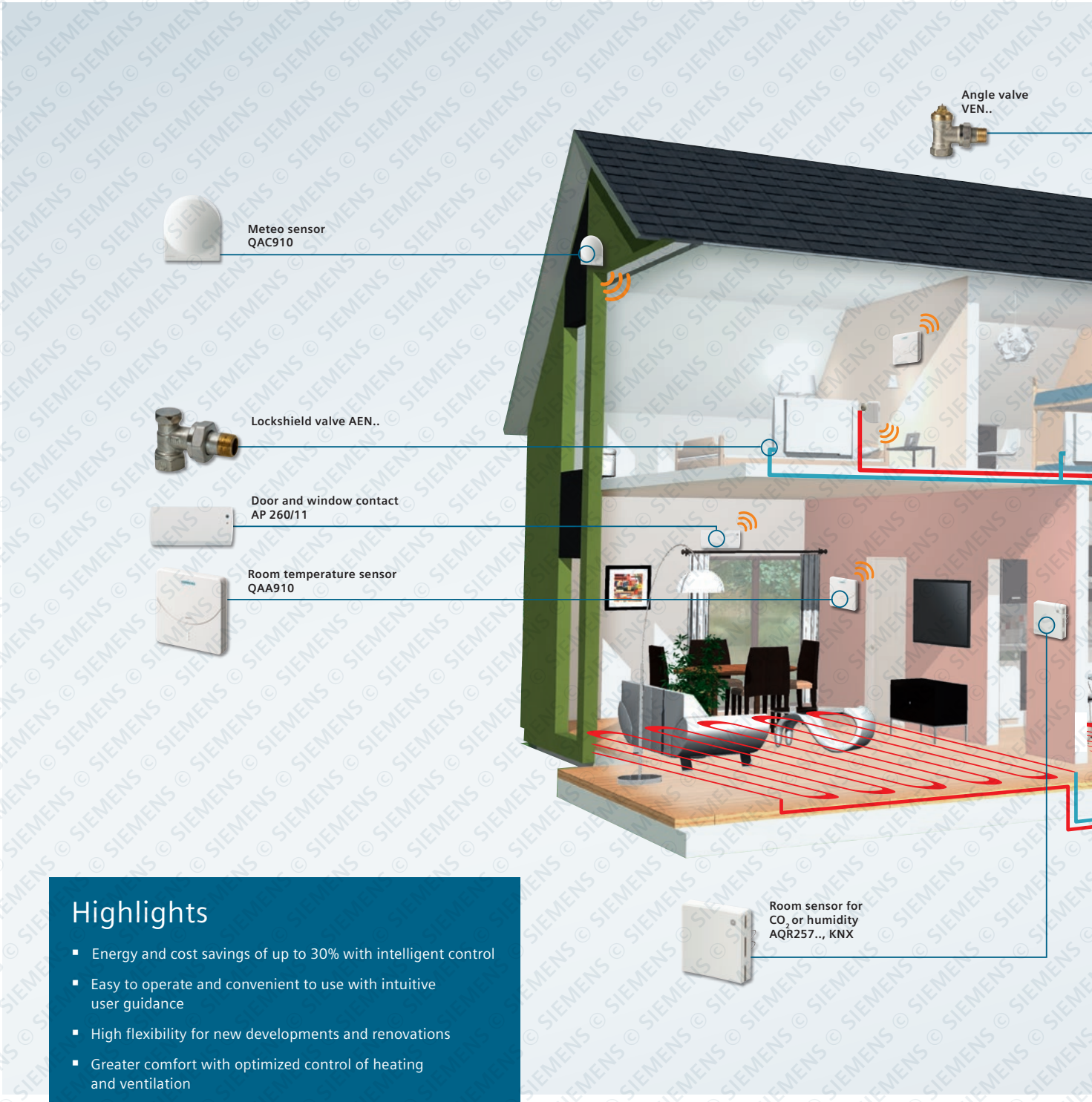
Transparent consumption data
The system also displays how much heating, cooling, water, electricity, etc. has been used so far. To access the data, no one needs to enter your home any more: the consumption data can be obtained by remote access.

Adaptable to meet your needsr
Apart from easy operation, a pleasant room climate, energy efficiency and security, Synco living also provides great flexibility because new functions and devices can be added to the system at any time.

Remote operation via Internet or text message
Easy remote access: use a PC, tablet or smartphone to adjust the settings of your Synco living system online. Did you forget to turn down the heating or switch off the lights? No problem: with Synco living and the HomeControl app you can access the system via Internet, smartphone or text message. Simply scan the QR code below and download the app directly from the App Store or Google Play.

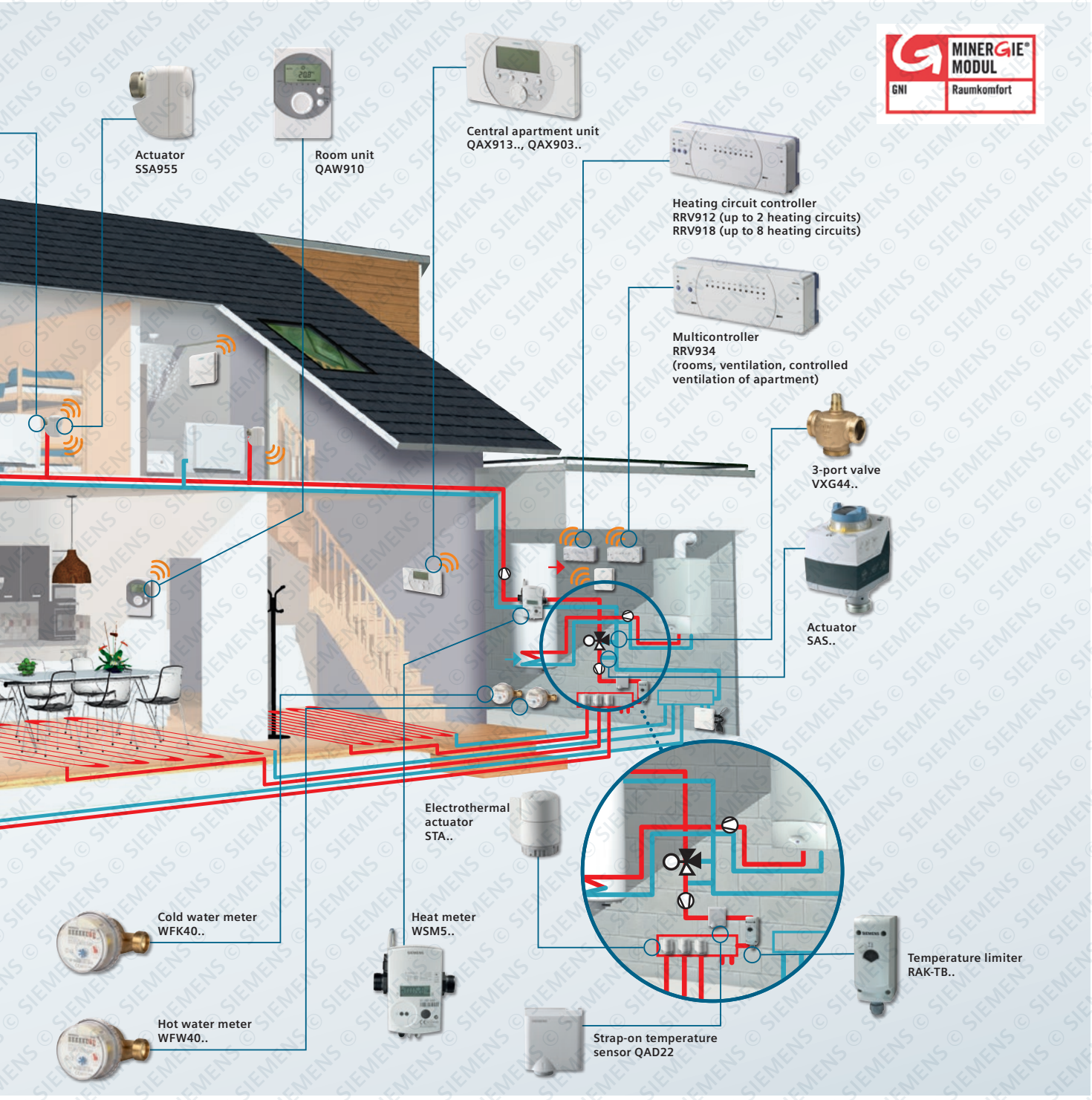
Energy efficiency requirements met
Synco living meets the energy efficiency requirements of the Foundation for Climate Protection and Carbon Offset (KliK). And Synco living energy efficient applications meet the requirements of class AA in eu.bac.

Synco living



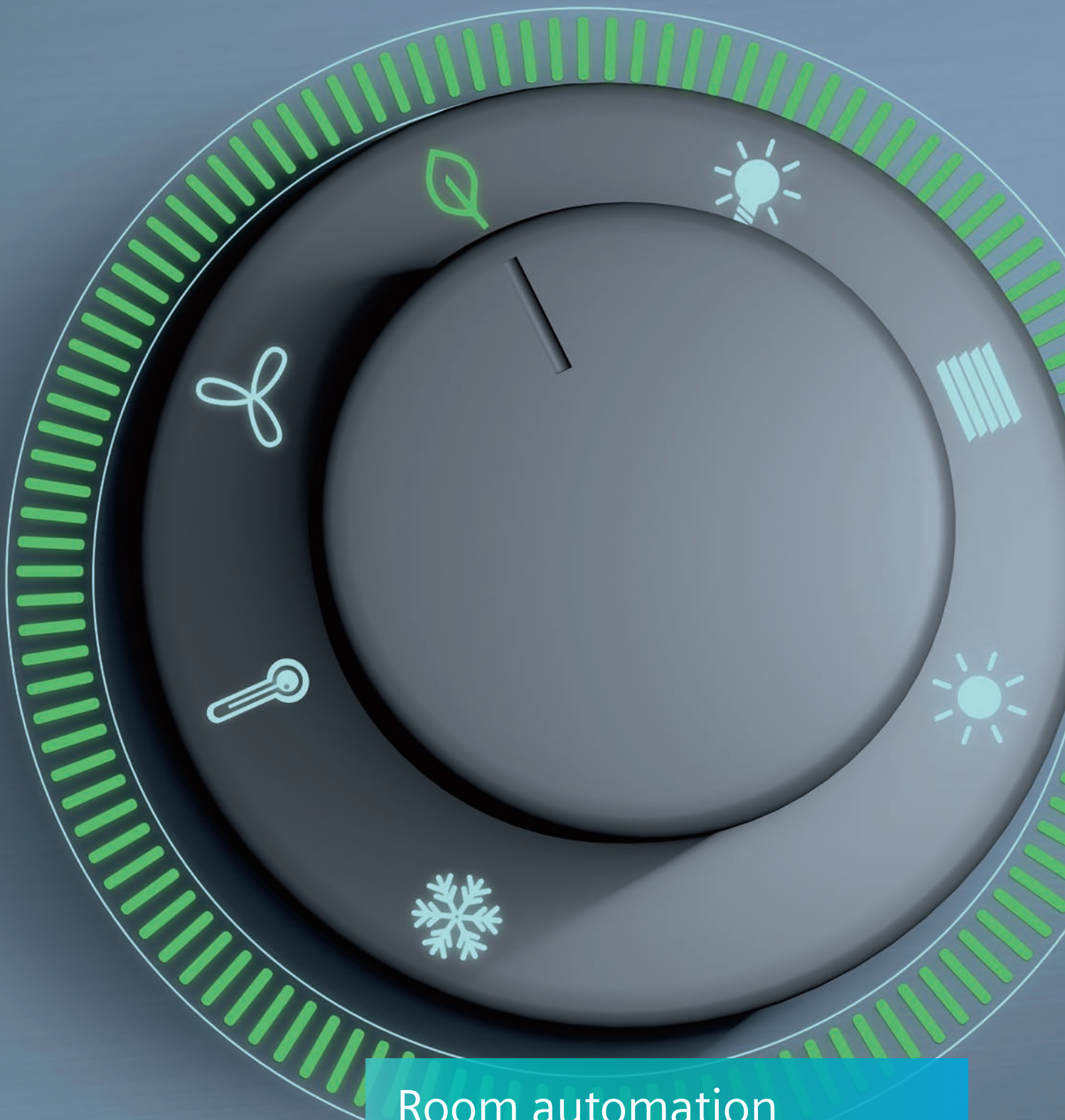
Highlights

- Energy and cost savings of up to 30% with intelligent control
- Easy to operate and convenient to use with intuitive user guidance
- High flexibility for new developments and renovations
- Greater comfort with optimized control of heating and ventilation
- Greater security with monitoring of door/window contacts and lights that are switched on from a panic button
- Alarms forwarded via a web server or text message relay, for rapid intervention in an emergency
- Settings can easily be changed remotely via PC, tablet or smartphone
- Lower cost of administration with easy analysis of consumption data, and access via the Internet


MINERGIE® MODUL
GNI
Raumkomfort
Actuator
SSA955
Room unit
QAW910
Central apartment unit
QAX913.., QAX903..
Heating circuit controller
RRV912 (up to 2 heating circuits)
RRV918 (up to 8 heating circuits)
Multicontroller
RRV934
(rooms, ventilation, controlled
ventilation of apartment)
3-port valve
VXG44..
Actuator
SAS..
Electrothermal
actuator
STA..
Cold water meter
WFK40..
Heat meter
WSM5..
Temperature limiter
RAK-TB..
Hot water meter
WFW40..
Strap-on temperature
sensor QAD22

SIEMENS

Ingenuity for life



Room automation

buildingtechnologies.siemens.com

17.1. Introduction	648
17.2. Room automation as a subset of building automation	648
17.3. Requirement profile of modern room automation systems	649
17.4. Room automation functions	649
17.5. Energy efficiency through room automation	650

Use Case	652
Schematic diagram	654
Room automation	656
Desigo Total Room Automation (TRA)	656
Desigo TRA	658
«Green Buildings»	662
Desigo TRA – List of Main Applications	664
Application examples	666
Smart Room Operator	668
Desigo TRA	670
Human Centric Lighting	670
Emergency lighting	672
Shading calculators	674
Product lists and product selection tools	676
Overview of room automation station products	676
Desigo TRA	678
Compact Room Automation Stations DXR2.E..	678
Compact and Modular Room Automation Stations DXR2.E.. / PXC3.E..	679
Product lists and product selection tools	680
Overview of TXM1.. I/O Module products	680
Overview of KNX PL-Link room controller products	681
Desigo TRA	682
Room Units with KNX PL-Link	682
Fan coil I/O block with KNX PL-Link	683
Übersichten und Auswahlhilfen	684
Touch room operator Ethernet/IP	684
Desigo TRA	685
KNX-PL Link units	685
Room units with KNX PL-Link	686
CET – Critical Environment Technology	688
Introduction	688
Room pressure and fume hood control with Desigo room automation	690
Room pressure and fume hood control with Desigo room automation	691
Example of the room pressure control principle	692
Components	693

17.1. Introduction

Room automation is the subset of building automation that performs multi-discipline automation functions inside rooms in buildings. Heating, ventilation and air conditioning (HVAC) plants, lighting and shading are adjusted to keep the temperature and air quality comfortable and to maintain pleasant lighting conditions. The aim of room automation is to improve user comfort, and to reduce costs by making efficient use of energy.

Fig. 13.1: Room automation controls the various disciplines in a room.

17.2. Room automation as a subset of building automation

Buildings can only be built if they are designed, planned and constructed using suitable methods. Splitting the building into segments is an important way of reducing investment costs. Specifically, costs are reduced because industrial production processes can be used for the plants specified by integration planners, and the building automation software can be reproduced cheaply. Changes of use are also made easier because they are done by reconfiguring the segments – a low-cost, quick and non-disruptive process. This optimizes operational aspects and lowers the costs of use.

The shell model establishes the functional boundaries between the "room" system and the other systems – segment, area, building, property and property portfolio. The graphic below illustrates the boundaries:

Fig. 13.2: The shell model shows how a building is split up.

A segment is the smallest spatial unit in the shell model that is relevant for room automation functions. The grid spacings used in new buildings are a good basis on which to define the subdivision into segments. A grid spacing defines the arrangement of interiors in structures. It normally depends on different building types. Architects always plan their buildings according to grid spacings, which determine the positions of windows and/or columns. For example, with a reinforced concrete skeleton frame structure, an office space could be subdivided into segments on the basis of the column grid.

A room consists of one or more segments. A room is defined structurally with enclosing facades, walls or ceilings (e.g. closed office, hotel room) or organizationally (e.g. as a distinct zone) in an open plan office. In an office building, for example, if a number of segments are combined to form an open plan office, the controlled variables of a room temperature system or a constant light control system act in the same way on the corresponding actuators of all segments in the room.

An area consists of one or more rooms (arranged horizontally, vertically or both). This could be a corridor, a story or an atrium.

A building consists of one or more areas.

A property consists of one or more adjacent or neighboring buildings.

A property portfolio consists of all properties.

17.3. Requirement profile of modern room automation systems

The current market trends in building automation for modern office and administration buildings are characterized by calls for innovative room automation offering the highest standards in:

- Energy efficiency from functions acting on multiple systems
- Full flexibility in terms of equipment options and needs
- User-specific operating concepts
- Reliable compliance with comfort and ergonomic standards
- Seamless integration with building and energy management

Room automation is crucial to the way modern buildings are used. It offers significant benefits for a building owner, improving the quality of the building while reducing costs.

17.4. Room automation functions

A room automation function describes a particular task or a typical effect of the automation system. A function is characterized by its structure, the internal status variables and input/output variables, which may also act as interfaces with other functions. Functions must be specified and described as clearly as possible, normally with a verbal and/or formal function description. Room functions of the same kind are organized into the following function groups:

- **Central functions for all disciplines**
  For example for service, blind cleaning, in emergencies, for weather protection (wind and frost), shading or lighting control, scheduling programs
- **Room functions for shading**
  For example manual local control (up, down, step up/down, move to preset/height/angle), presence sensors and automatic glare protection, monitoring of shading with fault notification
- **Room functions for lighting**
  For example manually controlled or dimmed lighting, automatic daylight control, presence-based or daylight and presence-based lighting control, constant light control, lighting monitoring with fault notification
- **Room functions for HVAC**
  For example for heaters, chilled ceilings, fan coils, VAV systems
- **Room coordination functions**
  For example support for standard room operating modes, scheduled control of room operating modes, central control of room operating modes, local presence detection, analysis of thermal load supporting energy-efficient coordination of HVAC and shading, control of scenes and sequences

Fig. 13.3: Overview of function groups for room automation

17.5. Energy efficiency through room automation

Energy efficiency through room automation

Energy efficiency means using energy in a sustainable way, in other words only using the energy needed to achieve a defined goal, for example providing enough lighting in a workplace to allow the required productivity to be achieved. So energy efficiency does not always mean saving energy. Instead it means not pointlessly wasting it, for example by constantly adjusting the lighting to meet current needs through constant light control.

European standard EN 15232 («Energy Performance of Buildings. Impact of Building Automation») describes methods to evaluate the impact of building automation and technical building management on the energy consumption of buildings. The standard was adopted in Switzerland as «SIA 386.110».

If the described room automation functions of the highest class A are implemented consistently, there are significant potential savings for thermal and electrical energy. The standard subdivides building automation systems into four energy efficiency classes A to D.

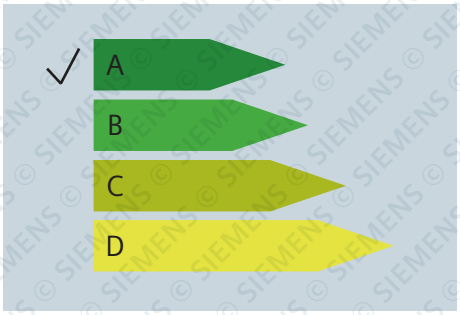


Abb. 17.4: Energy performance classes SIA 386.110 and EN 15232 define four BACS performance classes (A, B, C, D) for building automation systems

Class A
High energy performance building automation system
- Networked room automation with automatic
- demand control
- Scheduled maintenance
- Monthly energy monitoring
- Sustainable energy optimization by trained staff

Class B
Advanced building automation system
- Networked room automation without automatic demand control
- Annual energy monitoring

Class C
Standard building automation system
- Networked building automation of primary plants
- No electronic room automation, e.g. thermostatic valves for radiators
- No energy monitoring

Class D
Non energy efficient building automation system
Buildings with such systems are recommended to be retrofitted.

A standard building automation system in energy efficiency class C is used as a reference to measure the impact of the energy efficiency classes. In office buildings, for example, upgrading the building automation system to energy efficiency class A could save 30% of thermal energy. Thermal energy is defined as the energy consumed in order to increase or reduce the temperature in the occupied rooms.

	Potential savings – thermal energy					
	D-A	D-B	D-C	C-A	C-B	B-A
Offices	54 %	47 %	34 %	30 %	20 %	13 %
Lecture halls	60 %	40 %	19 %	50 %	25 %	33 %
Educational buildings (schools)	33 %	27 %	17 %	20 %	12 %	9 %
Hospitals	34 %	31 %	24 %	14 %	9 %	5 %
Hotels	48 %	35 %	24 %	32 %	15 %	20 %
Restaurants	45 %	37 %	19 %	32 %	23 %	12 %
Wholesale and retail buildings	62 %	53 %	36 %	40 %	27 %	18 %
Residential buildings	26 %	20 %	9 %	19 %	12 %	8 %

Tab. 13.1: Potential savings for thermal energy in different building types. Extract from SIA 386.110/DIN EN 15232: Building automation efficiency factors.

The importance of building automation in energy consumption and therefore the sustainability of a building is reflected in the standards regulating the permissible energy consumption of buildings.

EN 15232 places buildings into energy performance classes determined by the degree of automation, just like the energy consumption classes we have been familiar with for years for white goods like fridges and washing machines.

The tables summarize room automation functions and BACS energy performance classes for non-residential buildings. In order to obtain a BACS energy performance class of A or B, all automation functions in the building must be in the relevant BACS energy performance class.

For example, if nine out of ten functions are in BACS energy performance class A and just one is in BACS energy performance class B, the building is assigned to BACS energy performance class B.

	Einsparpotenzial elektrisch					
	D-A	D-B	D-C	C-A	C-B	B-A
Offices	21 %	15 %	9 %	13 %	7 %	6 %
Lecture halls	16 %	11 %	6 %	11 %	6 %	5 %
Educational buildings (schools)	20 %	13 %	7 %	14 %	7 %	8 %
Hospitals	9 %	7 %	5 %	4 %	2 %	2 %
Hotels	16 %	11 %	7 %	10 %	5 %	5 %
Restaurants	12 %	8 %	4 %	8 %	4 %	4 %
Wholesale and retail buildings	16 %	12 %	7 %	9 %	5 %	4 %
Residential buildings	15 %	14 %	7 %	8 %	7 %	8 %

Tab. 13.2: Potential savings for electrical energy in different building types. Extract from SIA 386.110/DIN EN 15232: Building automation efficiency factors.

The first two columns of this table contain the room automation methodologies of DIN EN 15232 for these subsystems: lighting, sun shading, heating, cooling, ventilation and room climate.

The third column shows the achievable BACS energy performance class, and the next column sets out the reason why an energy saving is possible.

Column 5 "VDI 3813-2 function" is particularly important for implementation and tendering because it cross-references to the room control functions described in the guideline VDI 3813 Part 2.

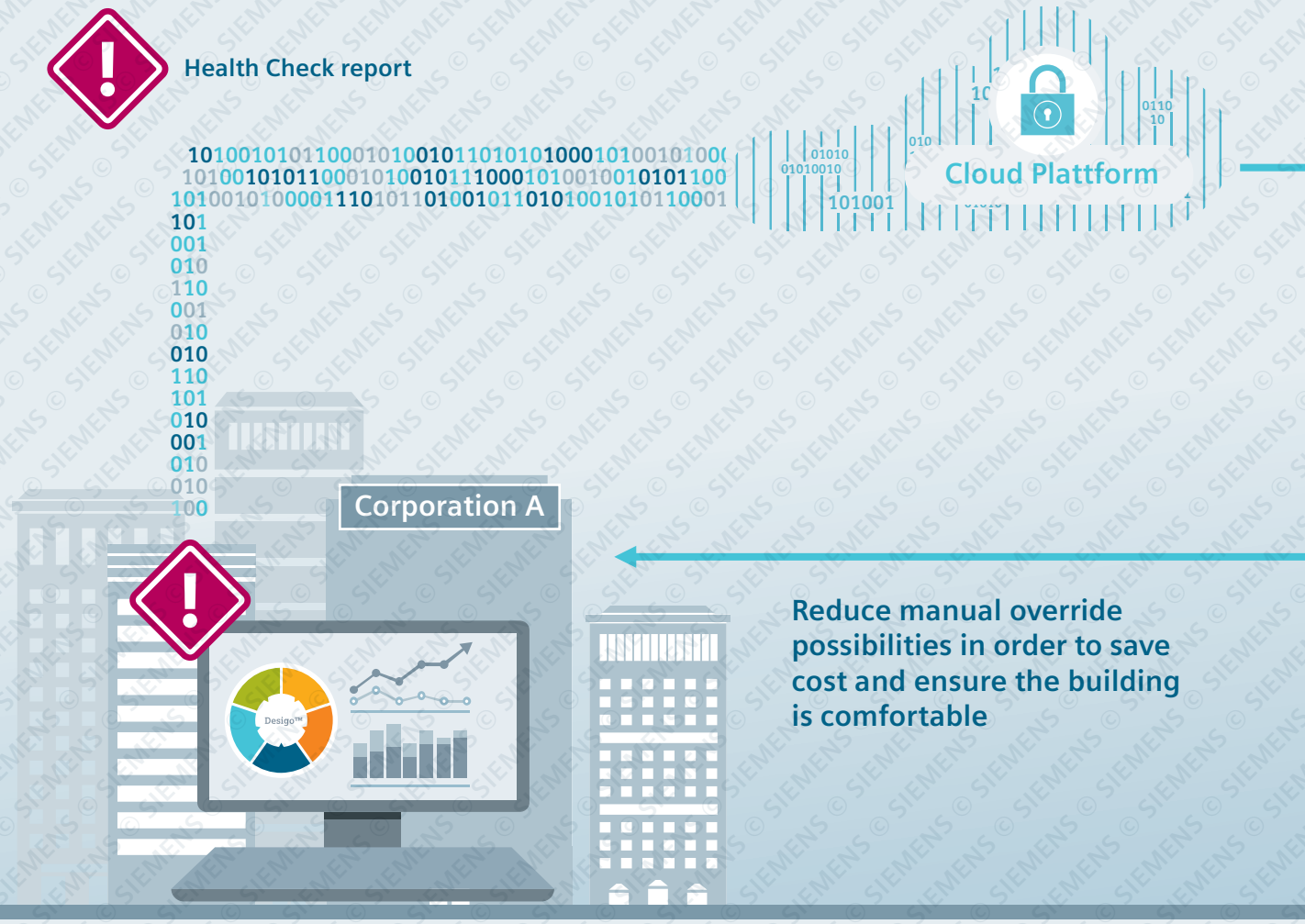
The last column lists the Siemens Desigo TRA devices which provide the required VDI 3813 room control functions.

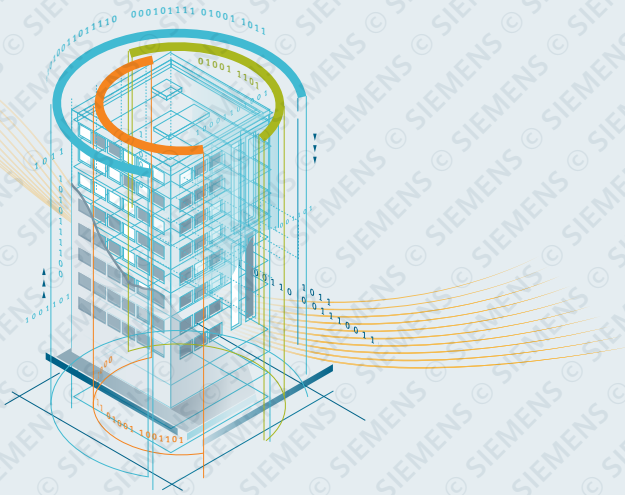
Use Case – Room Automation

The Desigo CC Management Platform will generate a Health Check Report of the HVAC system. It shows all the manual overrides that took place in any of the rooms and whether there are any deviating measures like higher than normal energy consumption.

Using the Health Check Report, the Digital Service Center (DSC) will analyze the impact of the findings. For example, manual overrides of room temperature or the blinds leads to x% higher energy usage. The analysis and recommended actions will be sent to the field Service Engineer.

The field Service Engineer will take the report to his customer and discuss the manual overrides that have occurred and how they are impacting energy usage and costs. The field Service Engineer also recommends where it could make sense to limit the possibility for manual overrides and let the system work automatically. In this way, the comfort of building occupants is assured at a lower cost.





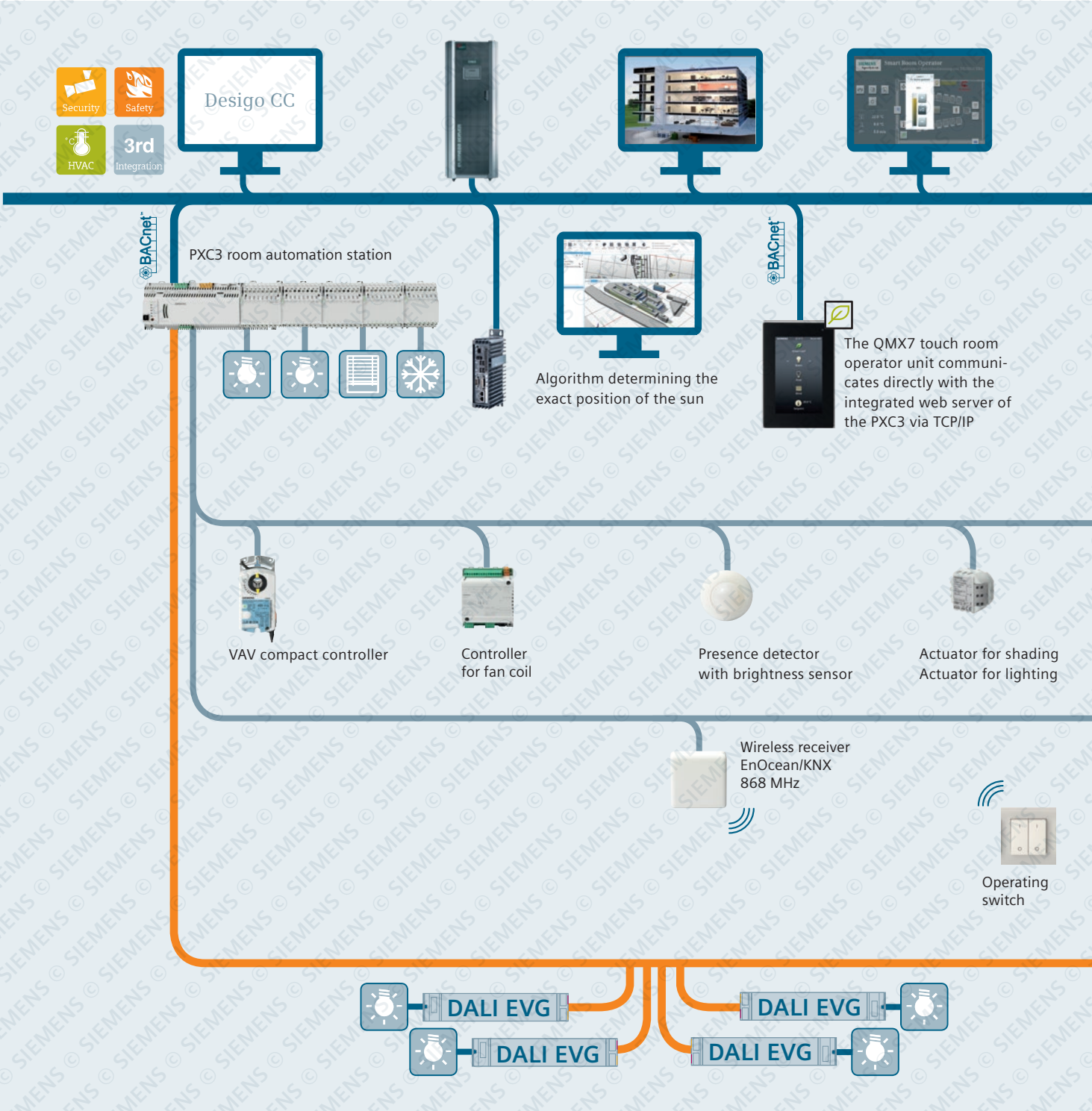
Data power delivers better building performance

Digital Service Center

- Repot is generated and analysed
- Information is sent to local service organization

Local Service Organization

- Preparation of Service Technician
- Talk to customer about manual overrides



Desigo TRA – Total Room Automation

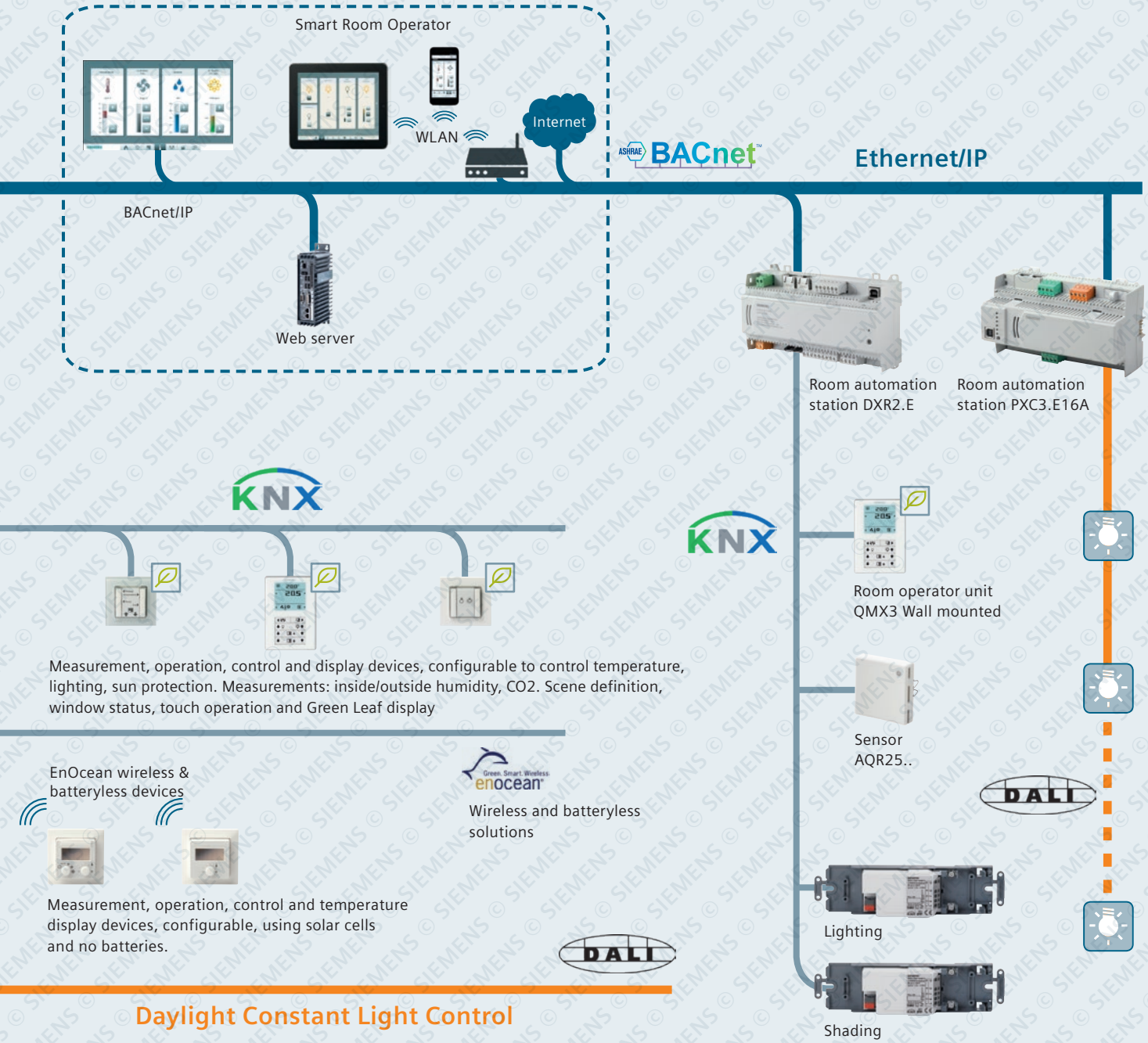
Room automation stations
The modular, compact and programmable room automation stations of series DXR2.E.. /PXC3.. are able to perform a range of control functions for several rooms. They communicate with each other and with other system components over BACnet/IP. PXC3.E7.. room automation stations use integrated interfaces to communicate with KNX and, as an option, the DALI bus..

Integrated control of all disciplines
Desigo TRA can be used to control all disciplines in a building. These include air conditioning, temperature control, ventilation, lighting, shading and load profiles. This integration permits automatic optimization of energy efficiency.

Standardized communication
The disciplines are programmable using the standard communication protocols BACnet, DALI, KNX and EnOcean..

Plug & play devices with auto-configuration
Selected Siemens field devices support KNX-PL-Link and can be connected to the bus with plug & play.

Continuity and investment protection
The BACnet standard, in use throughout the world, provides interoperability between devices of different manufacturers. The programmable room automation station Desigo PXC3 – the core of the Desigo TRA system with BACnet/IP communication protocol – allows the Desigo TRA solution to be seamlessly integrated with a comprehensive building automation system in a new or existing Ethernet network, protecting your investment in the long term.



Free choice of room unit
The modular hardware and software structure and the interdisciplinary integration mean that Desigo TRA supports a very wide range of room units.

RoomOptiControl – automatic optimization of energy efficiency
This intelligent energy efficiency function across all disciplines automatically detects unnecessary energy consumption locally and has these benefits:

- Functions optimized for energy efficiency
- Unnecessary energy consumption identified as potential savings

A simple push of a button is all it takes to return to the optimal energy efficiency settings

Energy efficiency class A
Energy efficiency class A as defined in EN 15232 is achieved through the integration of system devices, automatic detection of energy consumption and the exchange of information with the primary plants. Desigo TRA also meets other global and European standards like BACnet and eu.bac, ensuring that its building and room automation is state of the art.

eu.bac Cert

Global solution for the room

The integrated complete solution for room control

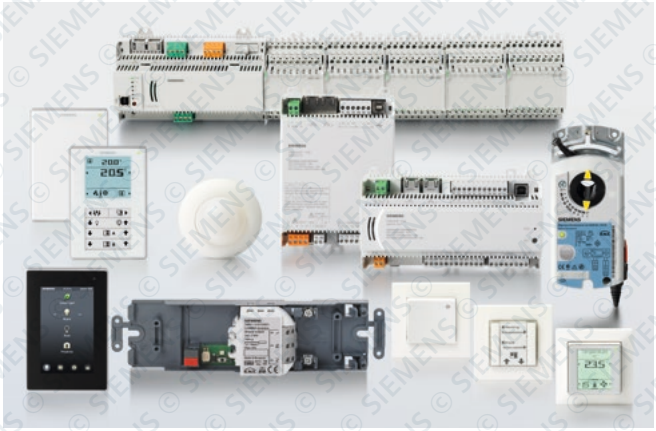
For maximum comfort and energy efficiency, the Desigo TRA automation combines the control of heating, ventilation, air conditioning, lighting and shading to create a single, integrated solution. The intelligent interaction of the different sensors and actuators and the central system functions make it easy to satisfy the various room requirements and to optimize comfort and energy savings.

With Desigo TRA, it is possible to produce and distribute precisely the amount of energy that is actually needed. And using the innovative RoomOptiControl application, Desigo TRA actively involves the room user in the energy saving process.

The system offers users many benefits:

- Maintaining the right ambient temperature
- Perfect lighting conditions
- Outstanding inside room air quality at all times, while optimizing energy consumption and reducing associated CO_2 emissions to protect the environment

Desigo TRA, the system for integrated room automation, allows the combined control of HVAC plants, lighting and shading, all within a single, perfectly coordinated solution with the versatility to optimize comfort and energy efficiency in room automation.



Integrated room automation with Desigo TRA

System topology

Room automation stations

The modular, compact and programmable room automation stations of series DXR2.E../ /PXC3.. are able to perform a range of control functions for several rooms. They communicate with each other and with other system components over BACnet/IP. PXC3.E7x room automation stations use integrated interfaces to communicate with KNX and, as an option, the DALI bus.

Integrated control of all subsystems

Desigo TRA can be used to control all subsystems in a building. These include air conditioning, temperature control, ventilation, lighting, shading and load profiles. This integration permits automatic optimization of energy efficiency.

Standardized communication

Control of the subsystems is programmable using the standard communication protocols BACnet, DALI, KNX and EnOcean.

Plug & play devices with auto-configuration

Selected Siemens field devices support KNX-PL-Link and can be connected to the bus as field devices with plug & play.

Continuity and investment protection

The BACnet standard, in use throughout the world, provides interoperability between devices of different manufacturers. The Desigo PXC3/DXR2 room automation stations – the core of the Desigo TRA system with BACnet/IP communication protocol – seamlessly integrate the Desigo TRA solution with a comprehensive building automation system in a new or existing Ethernet network, protecting your investment in the long term.

In buildings with higher functional requirements regarding comfort, energy savings and flexibility, the Desigo room automation stations are the ideal solution for the intelligent and interdisciplinary control of the various room systems. Each Desigo automation station is able to simultaneously control multiple rooms with different requirements. For simple, secure and rapid cabling, there is a 2-port Ethernet switch.

The Desigo automation stations exchange information with other stations in the overall Desigo building automation system and the Desigo PX automation stations via the communication protocol BACnet/IP in the general network. This makes the Desigo TRA a fully integrated solution – not just at the level of room automation, but also relating to the entire complex of plants in the building. As a result, this optimizes the energy efficiency of the primary plants.

BACnet – investment protection and uniformity

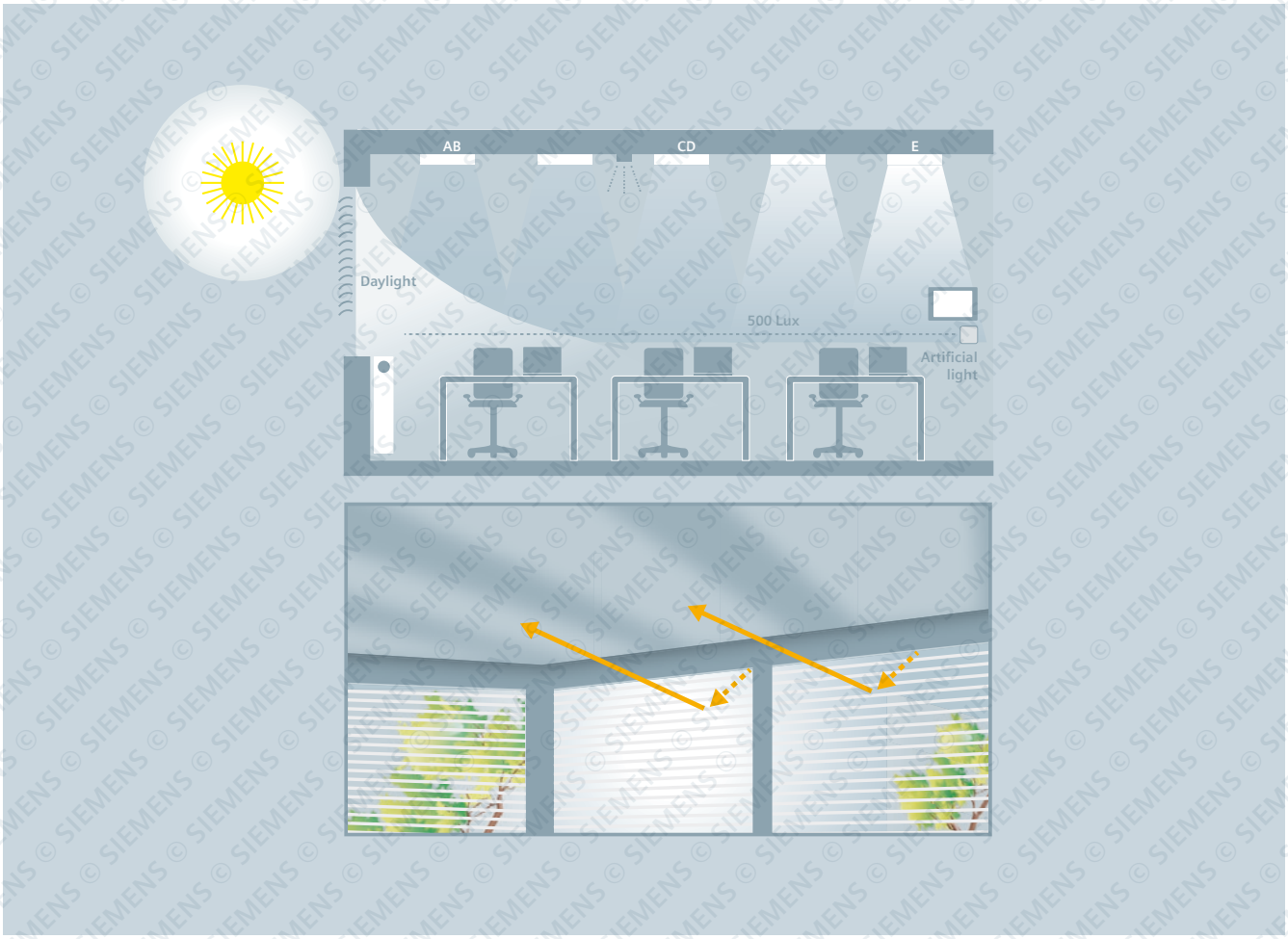
The programmable Desigo room automation station with BACnet/IP communication allows the Desigo TRA solution to be perfectly integrated in a general building automation system over a new or existing Ethernet network – protecting your investment over the long term. The BACnet standard, in use internationally, provides interoperability with devices of different manufacturers.

EnOcean – the wireless solution

The wireless transmission technology EnOcean uses the principle of «energy harvesting». The energy needed to run the sensors, buttons and switches is taken from the environment as solar energy, thermal energy, mechanical energy, wind energy or stored energy. The main advantage of this technology is that the devices do not need batteries, boosting functionality as well as the environment: self- powered wireless technology.

And with EnOcean technology, the wireless devices require no maintenance. The wireless signals use a frequency of 868 MHz, and the signal lasts just one thousandth of a second. Each device has a 32 bit identification number, ruling out interference with other devices. The EnOcean ambient sensors connect to the Desigo PXC3 room automation station via the EnOcean/KNX interface.

With intelligent, energy saving control of lighting and shading, Desigo TRA can optimize lighting in the workplace. Artificial light is controlled with presence detectors according to the daylight entering the room, and is adjusted with integrated brightness sensors. The blinds are automatically positioned to reduce glare, to maximize natural daylight, or to protect from heating or cooling.



Energy-optimized operation

Unnecessary energy consumption: Potential for energy savings

RoomOptiControl: Interdisciplinary, intelligent efficiency function to automatically detect unnecessary energy consumption in the room. A simple push of a button to return to energy-optimized operation

Energy efficiency class A as defined in EN 15232 – potential energy savings

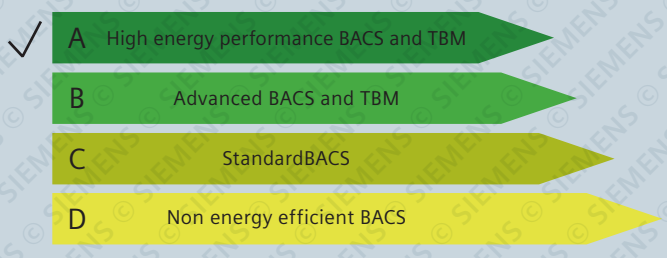
The four energy efficiency classes A to D provide clear information about how electrical and thermal energy is being used in a building. The key factors in achieving energy efficiency class A are efficient contact and communication between the systems and coordination of the various disciplines (HVAC, lighting, shading – awnings, blinds, etc.). Desigo TRA permits simple yet full control of the individual disciplines, delivering significant potential energy savings and thereby helping to obtain energy efficiency class A.

Active energy management by room users

The RoomOptiControl energy efficiency function detects unnecessary energy consumption and automatically indicates it by changing the color of the Green Leaf symbol on the room operator unit from green to red. Simply pressing the display returns the room control to energy-optimized operation. The Green Leaf symbol changes back to green.

Studies by TU München show that energy savings of up to 25% are achieved through energy-optimized behavior by room users. RoomOptiControl enables room users with no technical knowledge at all to participate in building management and save energy and costs. The Green Leaf shows them how and when.

Energy efficiency classes



BACS – Building Automation and Control System
TBM – technical Building Management System

Desigo TRA for efficient room assignment: The unique segment concept means that particular floors, offices and rooms in the building can be reassigned quickly and easily without the need to modify the electrical and HVAC installations. The initial investment is lower with a basic configuration, which can then gradually be extended and easily customized for a particular use when changes are made.

Flexibility and scalability

Operational and organizational structures, architectural features and environmental standards change over time, requiring great adaptability – in short, the rules keep getting tougher. Desigo TRA was designed to work in this increasingly challenging context. Scalability, flexibility and standardization are the three main reasons why this building automation system is a pioneer among systems providing integrated room automation.

Desigo TRA supports a wide range of room configurations thanks to the modular structure of the hardware and software, the comprehensive library of predefined application functions, and the ability to program the automation station. Desigo TRA is the best control solution for heated and chilled ceilings, fan coils, heaters or VAV systems, while simultaneously controlling all the lighting and shading systems nearby.

Desigo TRA offers customized solutions to control all the systems present. The innovative building automation system is ideal for fundamental requirements as well as customer-specific configurations depending on how the rooms are used. If the use of the room changes, all it takes is a software modification to accommodate an increase in size or a change of layout without the need to alter the basic installation. This reduces operating costs across the entire building life cycle.

Operating concepts

Different room uses and fixtures and fittings require individual operating options and adjustable display and control concepts for users. Individual and shared offices, open plan areas, conference rooms or superior offices.
Desigo TRA supports the use of standard products ranging from simple flush-mounted devices, to premium solutions with web servers for operation at the workplace, and touch-panels.

Convenient room operator units

Basic type

A comprehensive range of room operator units is available for direct operation and monitoring of settings and readings in individual rooms. The operator units can use anything from conventional buttons to Feller room controllers and can be combined with well known switch manufacturers.

Integrated operation

The integrated room operator units are ideal for the various subsystems, e.g. lights, blinds, HVAC. The common operating philosophy for all subsystems replaces the old «island solutions» like thermostats, light switches and blind buttons. The room operator units have illuminated displays which can show users the important information in graphical form so it is easy to understand.

Touch operation

The IP-compatible QMX7 room operator unit with intuitive touch operation concept and capacitive colour display is the latest member of the Desigo TRA family. It has a modern slimline design and the range of operations can be adapted to meet the customer's needs, making it great for displaying all the disciplines in the room. The room unit works well with the new compact room automation stations and makes the room user feel part of the energy saving process with the Green Leaf display.

Green Buildings and the sustainability

Room automation – support for «Green Buildings»

In 1713, Hans-Carl von Carlowitz wrote in his Silvicultura oeconomica «Only fell as much timber as the forest can sustain! Only as much timber as is able to regrow». The principle of sustainability started with the economics of forestry.

What does sustainability mean in the real estate sector? Numerous certification systems such as LEED, DGNB and SGNI are used to assess the sustainability of buildings and properties. All of them make the claim that buildings constructed with sustainability criteria in mind are superior to conventional construction in many ways, for example:

- The life cycle costs are lower
- The environment is protected
- The buildings are much more useful
- Maximum prestige

In order to compare buildings, a building certification system must take account of the latest relevant technological developments and use established criteria to determine whether the objectives of sustainable construction and the specified sustainability requirements were met during planning and construction. The buildings are usually assessed with a points system, and a certificate is issued.

The demand for sustainability and corresponding certification in the construction sector is growing all the time throughout the world.

Sustainability certification for new and existing buildings is becoming increasingly popular as a way of demonstrating that properties are attractive and eco-friendly. Investors and building owners know how important a holistic approach is in project development as a way of taking account of modern developments in sustainability and life cycle cost reduction.

Desigo TRA helps enormously in these efforts, optimizing the most important ecological, economic, sociocultural and functional qualities. Issues of sustainability are similarly assessed in the prestigious certification systems DGNB and LEED.

For example, DGNB criterion 22 «visual comfort» covers the functional qualities of daylight availability through light redirection with glare protection, line of sight to the outside (made possible by active glare protection = sun tracking), freedom from glare (daylight with light redirection and blocking of direct light).

Similarly, an integrated operating concept for all disciplines in the room based on criterion 23 «user influence» is a good way of improving performance in this area. The influence of these indicators is assessed: ventilation, blinds, temperature settings, lighting and user-friendliness. Parts of the system can be operated room-by-room (max. 3 people).

Applications

As set out in EN 15232 and VDI 3813, and implemented as «integrated room automation» in the Desigo TRA system, energy-efficient operation of buildings and rooms is only possible if the control of HVAC plants, lighting and shading (blinds, glare protection equipment, etc.) works together as efficiently as possible.

This interdisciplinary interaction is only guaranteed if either all functions are combined in one device, or multiple devices are able to share functions and information with each other using a standardized communication protocol like BACnet.

EN15232

Central Functions

- Central operation
- Energy efficiency functions
- Green Leaf (RoomOptiControl)
- Trend

- Room control
- Local operation
- Scheduling program
- Thermal load analysis
- Alarms
- Scenes

- Shading
- Manual control
- Daylight dependent
- Glare protection
- Sun tracking
- Privacy

- Lighting
- Manually switched/dimmed
- Stairwell lighting
- Presence detectors
- Presence detectors and daylight sensors
- Constant light control
- Constant light control groups

- Collision detection
- Service function
- Emergency mode
- Weather protection

- Emergency mode

- HVAC
- Heating
- Cooling
- Heating and cooling
- Ventilation
- Air quality
- Humidity

- Supply function
- Emergency mode
- Free cooling

eu.bac Cert

Siemens performs testing in its own lab as well as in eu.bac accredited test centers. eu.bac certification based on European standards verifies the high quality, control accuracy and energy efficiency of Desigo TRA devices.

Desigo TRA – List of the most important applications

Area	Application/function VDI3813	Description
 Lighting	**Light control** Manual control of lighting on/off and dimming	The lighting is switched on and off and dimmed manually using local operating switches.
	Light control with timer Timed automatic control of lighting	The lighting is switched on and off with a timer, manual adjustment is possible using local operating switches.
	Automatic light Automatic control of lighting with presence detectors and outside brightness sensors	The lighting is switched on and off on the basis of presence detectors and outside brightness sensors. Manual adjustment is possible using operating switches.
	Daylight control Lighting controlled by the amount of daylight	The lighting is switched on and off and dimmed on the basis of presence detectors and daylight sensors. Manual adjustment is possible using operating switches.
	Constant light control Control of lighting with constant lighting level	The lighting is kept at a constant level with brightness sensors and presence detectors. Manual adjustment is possible using operating switches.
 Sun protection	Local manual control	The sun shade systems are manually controlled with operating switches.
	Priority control Automatic control	The sun shade systems are automatically controlled with central measurement of sunlight. Manual adjustment is possible using local operating switches.
	Automatic sun shade Automatic control of sun shade systems according to sunlight	The sun shade systems are automatically controlled with automatic calculation of the sun's position and local sunlight sensors on the facade to detect shading by objects nearby like buildings or trees. The control system is only optimized for facades facing the sun. Manual adjustment is possible using local operating switches.
	Slat tracking Automatic control according to the calculated position of the sun	The sun shade systems are automatically controlled according to the sun's calculated position. Commands are executed depending on the position of the sun, maximizing the use of daylight. Manual adjustment is possible using local operating switches.
	Shadow correction Automatic control of sun shade systems with SMI/KNX gateway command	The sun shade systems are automatically controlled with central measurement of sunlight. Commands can be run via an SMI/KNX gateway link.

Area	Application	Description
 **HVAC heating, ventilation, air conditioning**	Plants with variable air flow AirOptiControl Application for plants with variable air flow, VAV	The application controls systems with variable air flow with VAV box control, indicating the position to the primary controller so it delivers the correct plant pressure.
	Plants with variable air flow AirOptiControl Application for plants with variable volumetric air flow and temperature control	The application controls systems with variable air flow with VAV box pressure and temperature control, indicating the position to the primary controller so it delivers the correct plant pressure.
	Control of room temperature with heated or chilled ceilings	The application adjusts the room temperature with heated or chilled ceilings and their control system.
	Control of room temperature with fan coils	The application adjusts the room temperature with fan coils and their control system.
	Control of plants with variable flow	The temperature and flow of incoming and outgoing air flow is controlled with VAV boxes.
	Control of room temperature with heaters/coolers	The application controls the room temperature with heaters/coolers and their control system.
 **Intelligent management of all disciplines**	RoomOptiControl	The application controls and coordinates the operation of all room systems, and the Green Leaf display actively involves the user in decisions about comfort and energy efficiency.
	Scenes	The application supports the easy and efficient control, configuration and storage of functional scenes for HVAC systems, lighting and shading.

Intelligent management of all disciplines

"Scenes" application

There are various applications allowing complex functional scenes to be stored and retrieved for HVAC systems and lighting. You can simply press a button for the right scene, combining maximum comfort with energy efficiency in every situation.

With the "Scenes" application, the user can simply press a button on the operator unit to save or retrieve the settings defined for the particular room. The scenes can contain a combination of functional instructions for lighting, shading and air conditioning.

You can use the "Scenes" application to:

- restore previously defined scenes by pressing a button
- store and retrieve the functions of a scene manually by pressing a button
- manage a combination of predefined and new scenes
-

Benefits

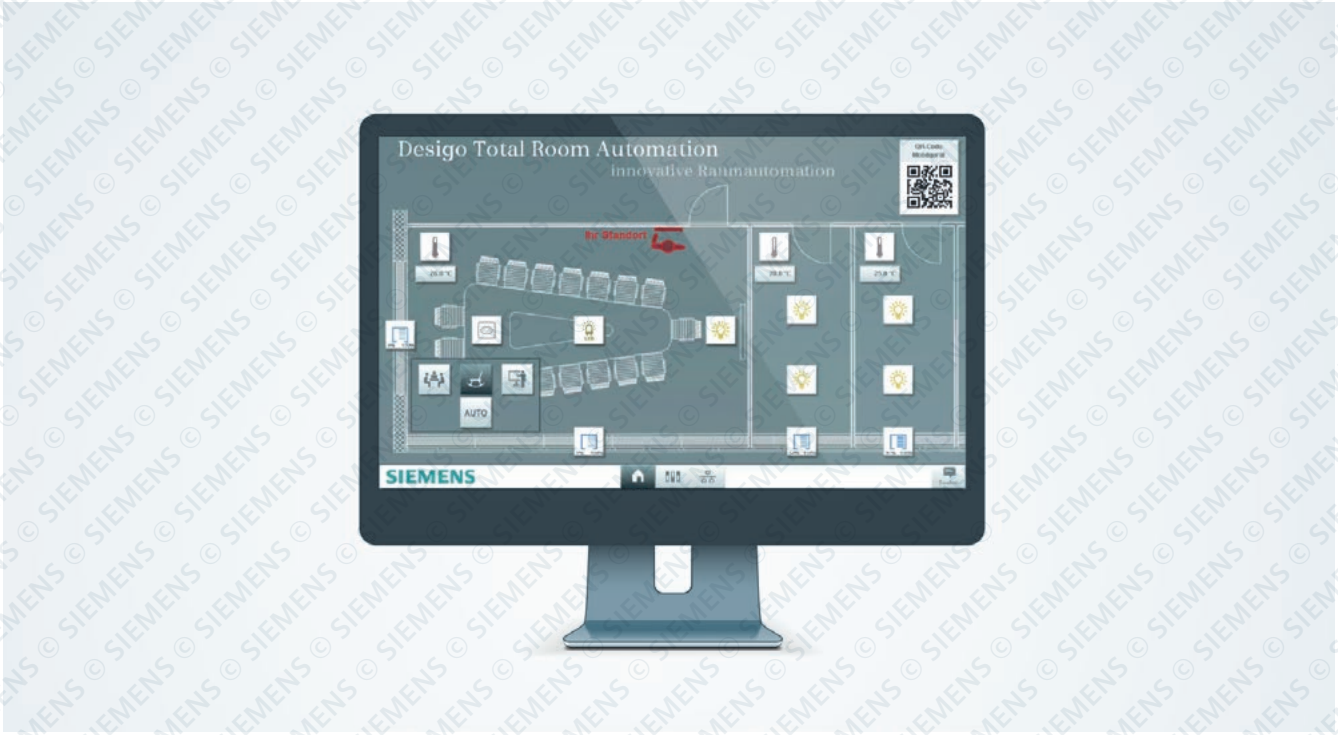
- easy for users to operate
- the microclimate is optimized according to how the room is currently being used
- minimal use of equipment to implement the solution

Scene A – Presentation

Room lighting lowered to make the overhead projector easy to read, sun blind systems adjusted to prevent glare and to provide the lighting needed in the room. The climate parameters are set to Comfort mode.

Scene B – Break in presentation

The sun shading is opened to let in the daylight, with artificial lighting lowered or switched off if it is not needed. Ventilation is increased for a specified period to cool the room and speed up the exchange of air.



Possible reasons why the Green Leaf display might switch from green to red:

Lighting:
- Threshold values adjusted manually
- Lights switched on manually during the day

Sun shades:
- Sun shades closed on a sunny winter's day while the heating is on
- Sun shades open on a sunny summer's day while the air conditioning is on

Temperature control:
- Temperature limits adjusted manually
- Fan speed limits adjusted manually

Intelligent management of all disciplines:
- Manual increase of working hours in a room

"RoomOptiControl" application

This functional application is designed to improve energy efficiency through the conscious engagement of the user. The user can look at the Green Leaf display on the room operator unit to see if the systems for HVAC, lighting and shading are working efficiently, if necessary taking action to restore energy-optimized operation while maintaining the preferred comfort level.

The "RoomOptiControl" application constantly checks if the climate parameters in the room match the energy-efficient settings and changes the display accordingly:

- On the room operator unit, the "RoomOptiControl" function is displayed
- The Green Leaf display uses a leaf symbol which changes to green when the plants are being operated in an energy-optimized way

Benefits

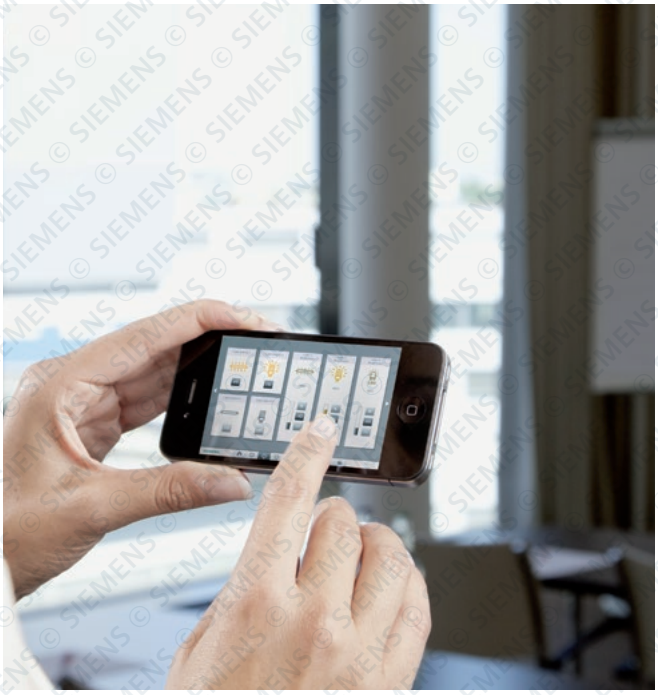
If the climate parameters are adjusted manually, the plants may no longer be working in an energy-optimized way. If so, the Green Leaf display changes to red.

- Pressing the Green Leaf button on the room operator unit restores the room control to energy-optimized operation with no loss of comfort.

Temperature, ventilation, lighting and sun shade positions are reset to the values for energy-optimized operation for this room, and the Green Leaf display changes back to green

- Automatic detection of unnecessary energy consumption in the room
- Automatic detection of manual adjustment of microclimate parameters adversely affecting energy efficiency
- Direct involvement of the user in energy saving measures
- Active involvement of the user:
  The RoomOptiControl application with Green Leaf display allows the user to make a personal contribution to the efficient and sustainable use of the building.
- Studies by TU München show that energy savings of up to 25% are achieved through energy-optimized behavior by room users.

Smart Room Operator – flexible room control for maximum comfort and lower costs



Smart Room Operator

Smart Room Operator provides innovative room control via PC, smartphone and tablet. The control pages are based on the latest web technology (HTML 5) and run on any up-to-date browser. Plug-ins or apps are not necessary.

- More comfort and user satisfaction
- Lower running costs and higher productivity
- Flexible and easy to adapt if the room is rearranged
- Modern and flexible design

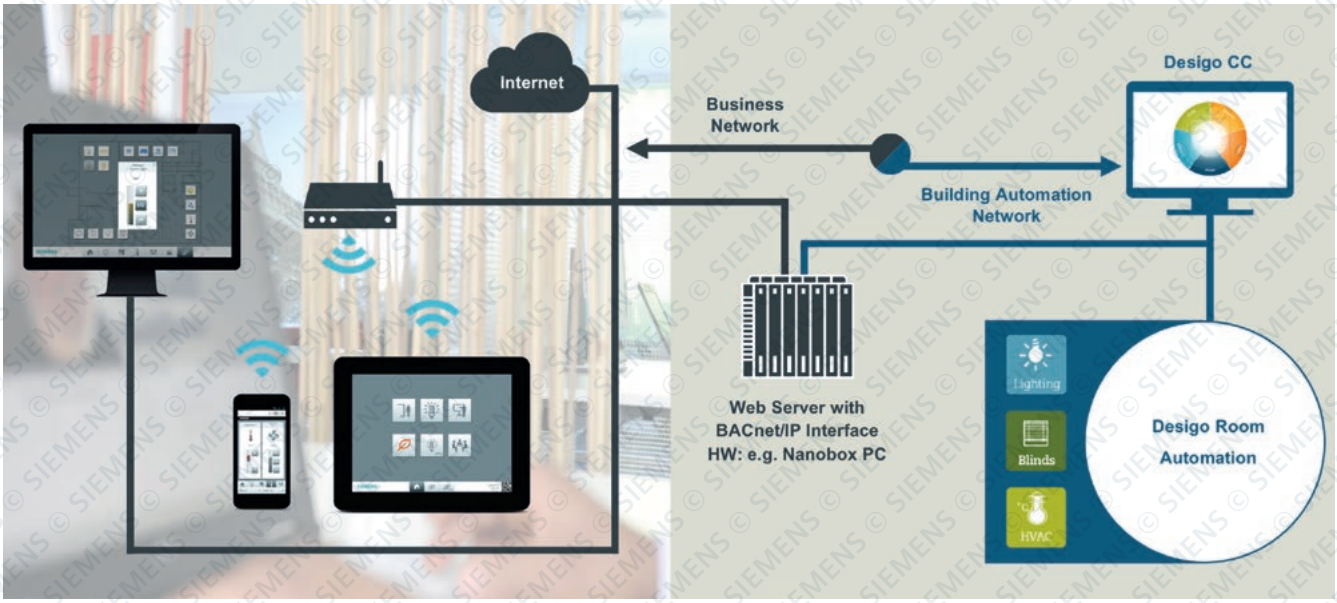
Lighting, shading and HVAC technology are operated via PC, smartphone and tablet in a convenient, intuitive and cost-effective solution. With Smart Room Operator it is easy to control each workplace individually, for example by making it brighter or darker, thereby increasing user satisfaction as well as productivity. The intuitive graphical user interface, clear labelling and operation from inside the workplace all combine to make the system even easier to use. There is no need to walk to the switch or the room unit. When rooms are rearranged, not so many new switches are needed, and less cabling needs to be changed.

The graphical user interface is elegant and timeless, and easy to adapt to customer requirements. The control philosophy is modern, intuitive and designed from the room user's point of view. The graphics can be positioned anywhere on the control page in order to optimize user interaction for each project.

This solution has been tested and optimized with Desigo on BACnet/IP.

Highlights

- Convenient control of room automation via PC, smartphone and tablet
- Cost-effective, individual workplace control without lots of switches
- Classic, elegant and timeless design
- Easy, intuitive and quick to use
- Flexibility to easily make customer-specific adaptations
- Control pages adjust automatically to the different web browser formats
- Scalable vector graphics guarantee a spectacular display in all resolutions
- Can be integrated with the company's intranet pages
- Latest web-based solution without the need for plug-ins
- One solution for room control via PC, smartphone, tablet and touchpanel
- One web server for up to 1,000 simultaneous users/sessions



Smart Room Operator does not require an Internet connection, but wifi access is recommended for other apps which do need the Internet.

Example of SRO scenes

Main features and functions

- Classic, elegant and timeless design: The graphical user interface is elegant and timeless, and easy to adapt to customer requirements.
- Easy, intuitive and quick to use: The control philosophy is modern, intuitive and designed from the room user's point of view. Active and pressed buttons appear darker. The detailed settings can be accessed from the toolbar.
- Scenes: With scenes, multiple settings can be changed from a single button.

Human Centric Lighting – putting humans at the centre of the lighting solution

People spend around 22 hours a day indoors – at home, at work or in public institutions. Many people even play sport indoors in a gym. That means it is particularly important to make the room climate and also the lighting as pleasant as possible, as a way of improving the sense of well-being. In room automation, there are numerous factors that play a part in well-being.

Human Centric Lighting (HCL) is a particularly important part of room automation, making it as pleasant as possible for people to spend time in rooms. Plants and animals including humans – in other words life in all its forms – depend on daylight. In the dark winter months, some individuals who are sensitive to light are badly affected when a lack of daylight depresses their mood. A biologically effective lighting control can significantly influence our well-being.

Influence of daylight

HCL takes account of invisible biological factors when a lighting solution is planned and implemented. In 2001[1], researchers found a previously undiscovered photoreceptor in the human eye. This proved that light also affects the physiology of humans. For example, light influences the hormone balance and is the main factor controlling the timing of the human body clock (circadian rhythm[2]). Daylight is particularly important here. Over the course of a day, daylight changes in intensity, direction and colour. In the morning and evening, daylight has a reddish tinge, with a lower colour temperature. In the middle of the day it is bluer and very intense, with a higher colour temperature. The human body responds to these changes in its hormone balance, which can dictate how active, awake or tired we feel. Because people these days spend up to 90% of their time in enclosed spaces mostly lit by artificial lighting, the synchronization of the body clock can suffer. HCL is concerned with how the correct colour temperature and light intensity at the right time can support people's health and well-being.

[1] See Brainard et al 2001: Action spectrum for melatonin regulation in humans: evidence for a novel circadian photoreceptor

[2] See «Description für eine biologische Dynamik, die durch endogene Oszillationen metabolischer oder physiologischer Aktivität oder des Verhaltens mit einer Periodizität von ungefähr 24 (20-28) Stunden verursacht» (in German, definition of circadian rhythm, source: http://www.spektrum.de/lexikon/neurowissenschaft/circadianer-rhythmus/2197)

Colour temperature changes from morning to evening (source: Zumtobel)

Individual solution

HCL solutions are used in various applications, from offices, to health centres, hospitals and care facilities. Each application is highly individual and therefore works differently. Desigo TRA supports all these different use cases: The colour and intensity are controlled in different ways depending on the application in order to meet the precise needs of the users. Biologically effective lighting has the potential to improve concentration, safety and efficiency in work and educational settings. It can support convalescence and guard against chronic diseases, for example in geriatric care.[3]

Applied correctly, the concept does more than improve the well-being of employees. Productivity can be increased by variable lighting too. This might be reflected in shorter unit processing times in assembly[4], or shorter hospital stays for patients[5] with a correspondingly improved treatment time per case flat rate.

[3] Source: A.T. Kearney Human Centric Lighting: Going Beyond Energy Efficiency Lighting, Europe German Electrical and Electronic Manufacturers' Association (ZVEI) July 2013

[4] Source: Wirkung von veränderlichem Raumlicht auf die Produktivität von permanenten MorgenschichtarbeiterInnen an einem Industriearbeitsplatz, Markus Canazei, Bartenbach Gmbh, Aldrans | AT Peter Dehoff, Zumtobel Lighting, Dornbirn | AT März 2013 ISBN 978-3-902940-17-9

[5] Source: A.T. Kearney Human Centric Lighting: Going Beyond Energy Efficiency Lighting, Europe German Electrical and Electronic Manufacturers' Association (ZVEI) July 2013

Emergency lighting with Desigo

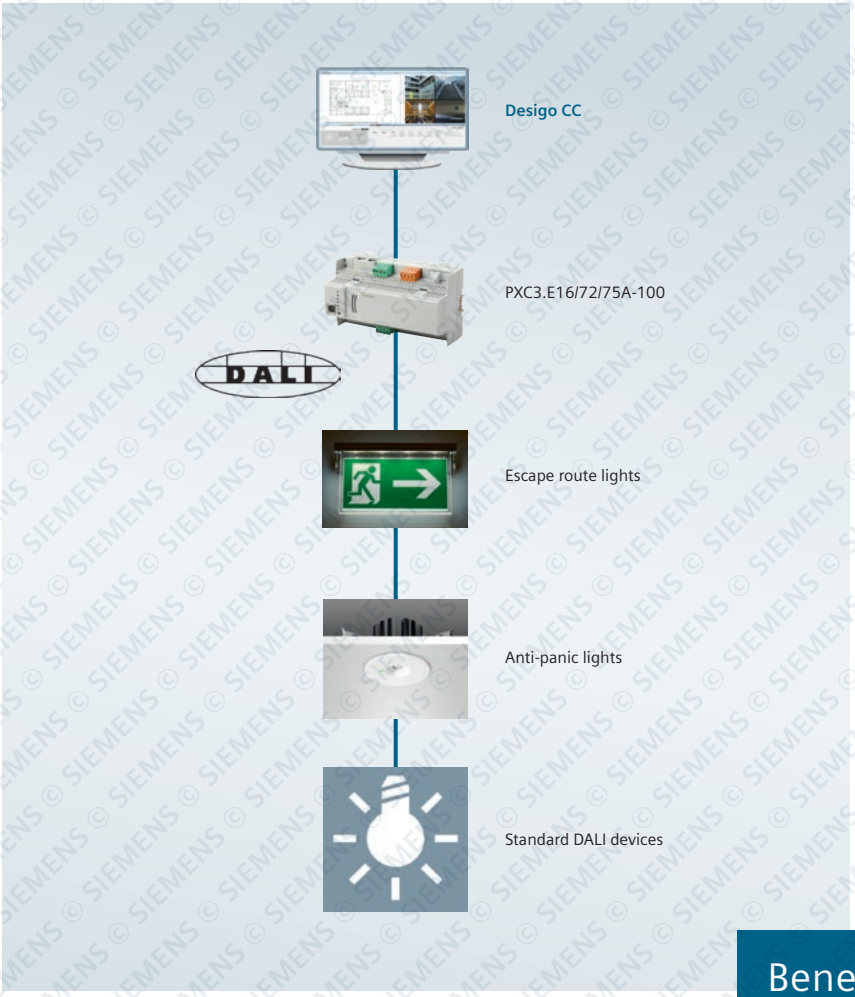
For safety reasons, maintenance and testing should be carried out in accordance with SN EN 50172

Desigo TRA – your solutions for decentralized emergency lighting

We encounter escape route lights just about everywhere in our daily lives. They have simple symbols so they are understood around the world, and they indicate the way out if an incident occurs. Escape route lights are installed at exits, in corridors or at crossing. Combined with emergency lights – this function is usually added to the room lighting – they are crucial in bringing people to safety if there is a power failure, a fire or other scenarios requiring evacuation.

DALI emergency lighting as part of the Desigo system solution

In Desigo room automation, the emergency light components are integrated in a monitored emergency light and general lighting system on the basis of the communication standard DALI. Desigo TRA complements the emergency light components and the general lighting in a standardized concept, with all the benefits that brings.



Safety lighting – automatic testing with Desigo according to SN EN 50172

The facility owners and/or operators are responsible for the commissioning, function testing, servicing and maintenance of escape route and emergency lighting. They must ensure that the safety lighting and safety-related power supplies are maintained correctly and are operational at all times.
This can be done with automatic equipment which must comply with SN EN 50172. Desigo room automation combined with the management platform Desigo CC meets this requirement. Desigo documents and stores the information in a fully automated process. Periodic test cycles can be created and modified quickly and easily in the Desigo CC management system.

Benefits

- Addressing and grouping of DALI lights
- Function and service life test
- Emergency lighting status requests
- Visualization
- Self test
- Capacity test
- Alarm if tests fail
- Automatic test report generation
- Reports are saved or printed automatically

Weather sensors and shading calculators

Late morning: the sun is almost at its highest point

Late afternoon: the sun is casting long shadows

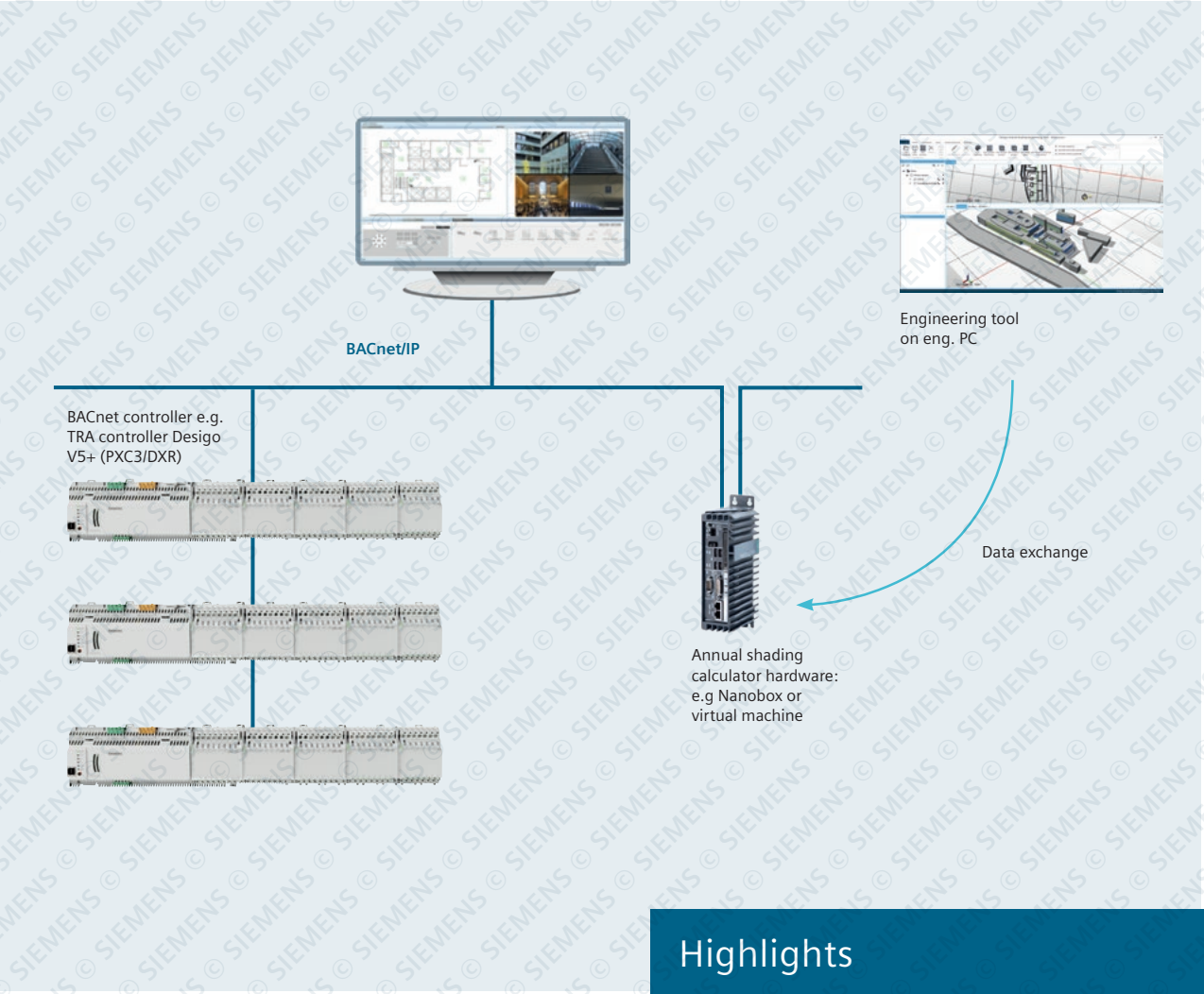
Shading calculator (Annual Shading)

Desigo Total Room Automation (TRA) from Siemens plays a crucial role in buildings, enhancing the well-being and comfort of the building's users and improving energy efficiency. To save energy and improve thermal comfort, shadow correction (Desigo Annual Shading) and slat tracking work together in an intelligent way. Automatically controlled sun shading systems have become an indispensable part of a building. They protect people from heat and glare while maintaining a comfortable working climate.

Calculating shadows

Desigo Annual Shading is an innovative solution which takes account of the shadows cast over the year. In this way, shadow correction can meet the contradictory requirements of glare-free working and maximum use of daylight. The buildings are captured in a 3D model and the shadows they cast are calculated. Working with annual shading, Desigo TRA only repositions those slats which are actually in the sun. Blinds which are in the shadow of neighbouring buildings are opened as far as possible.

To prepare, the data is captured in 3D and visualized as a 3D model. Any geometric shapes can be created, consisting of straight surfaces or sloping roofs, overhanging facades or canopies. 3D visualization is immediate, allowing the data to be validated. The shadows and reflections are calculated individually for each blind. To allow a number of blinds to be controlled at the same time, they can be grouped. Depending on how long the shadow will last, the slats can either be adjusted or the blind as a whole can be raised. Even temporary objects like deciduous trees or snow are included and activated/deactivated directly from the Desigo CC management station. The standardized BACnet/IP protocol is used to send the information to the relevant blind actuators.



Shading calculator (Desigo Annual Shading)

Highlights

- Takes account of shadows and reflections
- Precise calculation with fine granularity, e.g. 1 minute and subdivisions of the windows into grids. When a long-lasting shadow or reflection occurs, the blind responds immediately and not after a few minutes' delay.
- Calculation ahead of time, so depending on how long the shadow will last, either the slats are adjusted or the whole blind is fully opened
- Temporary objects like deciduous trees or snow can be activated/deactivated via BACnet, for example using the Desigo CC management station.
- Simply, intuitive input of the 3D data.
- 3D visualization allows the data to be validated instantly
- Shadows and reflections can be simulated for any date and time
- Simple fine adjustment of each blind with ± x min

PXC3 modular room automation stations

The modular and programmable room automation stations of the PXC3 series are able to perform a range of control functions for several rooms. They communicate with each other and with other system components over BACnet/IP. PXC3.E7.. room automation stations use integrated interfaces to communicate with KNX and, as an option, the DALI bus. TX-I/O modules are directly linked to the PXC3.E7.. in order to connect field devices. The PXC3. E7.. models include power supplies for TX-IO modules, KNX, and DALI bus. If necessary, separate power supplies can be added for the TX-IO modules and the KNX connection.

The PXC3.E16A* room automation station is designed for challenging lighting applications and has a dedicated DALI interface with power supply. The PXC3.E16A can be used for central lighting automation, possibly as part of a distributed HVAC installation. All lighting applications of the PXC3.E7.. can be used.

*Without TX-I/O modules

DXR2 compact room automation stations

The DXR2 compact room automation stations perform control tasks for up to two rooms. Depending on the implementation, they communicate with each other and with other system components over BACnet/IP (DX2.E...).
To connect field devices directly, the room automation stations have a fixed number of I/O data points and an integrated interface with KNX including power supply.

The DXR2 can be used with application software or in programmable mode as required.

Range	**Desigo TRA**		
Room automation station **Room controller**			
Typ	DXR2..	PXC3.E16A	PXC3.E7..
Applications			
Fan coil systems	■		■
Heated/chilled ceilings and heaters	■		■
VAV systems	■		■
Lighting basic applications	■	■	■
Lighting advanced applications	■	■	■
Shading basic applications	■		■
Shading advanced applications	■		■
Scene control	■ [1]	■	■
RoomOptiControl – Green Leaf	■	■	■
Functions/model			
Maximum number of rooms	1-2	Area	4-8
Fixed number of applications	■		
Programmable	■	■	■
Compact with fixed number of I/Os	■		
Modular with I/O modules			■
Communication			
BACnet/IP	■	■	■
Buses			
KNX PL-Link/KNX S-Mode	■ [2]		■
DALI		■	■
Power supply			
AC 230 V	■		
AC 24 V	■	■	■

[1] If using programmed applications (no fixed number of applications) with the scene editor of the ABT Programming Tool.
[2] All DXR2.E.. models support KNX PL-Link and KNX S-Mode.

DXR2.E09

Compact room automation station, BACnet/IP, 230 V, flat housing, 1 DI, 2 UI, 3 relays, 3 AO

Compact room automation stations for HVAC, lighting and shading:

- BACnet/IP communication
- KNX PL-Link to connect sensors, actuators, and operator units (including bus power)
- KNX S-Mode device integration
- 2-port Ethernet switch
- USB interface for tool access

Operating voltage	AC 230 V
Power consumption	24 VA
Frequency	50/60 Hz
Analogue outputs signal	DC 0... 10 V
Number of analogue outputs	3
Number of universal inputs	2
Number of relay outputs	3

DXR2.E09T

Compact room automation station, BACnet/IP, 230 V, flat housing, 1 DI, 2 UI, 1 relay, 1 AO, 4 triacs

Compact room automation stations for HVAC, lighting and shading:

- BACnet/IP communication
- KNX PL-Link to connect sensors, actuators, and operator units (including bus power)
- KNX S-Mode device integration
- 2-port Ethernet switch
- USB interface for tool access

Operating voltage	AC 230 V
Power consumption	24 VA
Frequency	50/60 Hz
Analogue outputs signal	DC 0... 10 V
Number of analogue outputs	1
Number of universal inputs	2
Number of relay outputs	1
Number of triac outputs	4

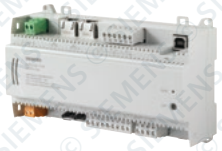
DXR2.E09

Compact room automation station, BACnet/IP, 230 V, flat housing, 1 DI, 2 UI, 3 relays, 4 triacs

Compact room automation stations for HVAC, lighting and shading:

- BACnet/IP communication
- KNX PL-Link to connect sensors, actuators, and operator units (including bus power)
- KNX S-Mode device integration
- 2-port Ethernet switch
- USB interface for tool access

Operating voltage	AC 230 V
Power consumption	24 VA
Frequency	50/60 Hz
Number of universal inputs	2
Number of relay outputs	3
Number of triac outputs	4



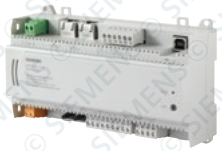
DXR2.E12P

Compact room automation station, BACnet/IP, 24 V, DIN housing, 1 DI, 2 UI, 2 AO, 6 triacs, pressure sensor

Compact room automation stations for HVAC, lighting and shading:

- BACnet/IP communication
- KNX PL-Link to connect sensors, actuators, and operator units (including bus power)
- KNX S-Mode device integration
- 2-port Ethernet switch
- USB interface for tool access

Operating voltage	AC 24 V
Power consumption	70 VA
Frequency	50/60 Hz
Analogue outputs signal	DC 0... 10 V
Number of analogue outputs	2
Number of universal inputs	2
Number of triac outputs	6



DXR2.E18

Compact room automation station, BACnet/IP, 24 V, DIN housing, 2 DI, 4 UI, 4 AO, 8 triacs

Compact room automation stations for HVAC, lighting and shading:

- BACnet/IP communication
- KNX PL-Link to connect sensors, actuators, and operator units (including bus power)
- KNX S-Mode device integration
- 2-port Ethernet switch
- USB interface for tool access

Operating voltage	AC 24 V
Power consumption	78 VA
Frequency	50/60 Hz
Analogue outputs signal	DC 0... 10 V
Number of analogue outputs	4
Number of universal inputs	4
Number of triac outputs	8

PXC3.E..

Room automation station

Modular, programmable room automation stations for HVAC, lighting, and shading (TRA Total Room Automation):

- BTL tested BACnet/IP communication, compli-antwith the BACnet standard (Rev. 1.13) including-BASC profile
- Island bus to connect TX-I/O modules with any data point mix (including bus supply) (not with PXC3.E16A)
- KNX bus for direct connection of peripheral devic-es using KNX PL-Link or KNX S-mode communica-tion (including bus supply) (not with PXC3.E16A)
- DALI-Bus zum Anschluss von Vorschaltgeräten (PXC3..A-Varianten)
- DALI bus to connect lighting controls (types PXC3..A)
- Integration of single KNX devices via PL-Link
- USB interface for tool connection
- Mounting on standard mounting rail
- 2-port Ethernet switch for low-cost cabling

Summary of TXM1.. I/O modules

Type	TXM1.8D	TXM1.16D	TXM1.8U	TXM1.6R	TXM1.6RL	TXM1.8RB	TXM1.8T
Total number of inputs/outputs	8	16	8	6	6	8	8
Functions							
Local override							
LCD display							
3-color I/O status LED	■						
Green I/O status LED		■	■	■	■	■	■
Digital inputs (DI)							
Signal (NO/NC)	■	■	■				
Pulse	■	■	■				
Counter 25 Hz (bounce-free)		■ [1]	■				
Analog inputs (AI)							
LG-Ni1000			■				
Pt1000 / 0...2500 Ohm			■				
T1			■				
DC 0...10V			■				
Analog outputs (AO)							
DC 0...10V			■				
Digital outputs (DO)							
Maintained contact on/off				■			■
Maintained contact 3-stage n				■			
3-point output				■			■
Pulse on/off				■			
Pulse				■			
Pulse (3-stage)				■			
Bistable contact					■		
Contact for blinds motor						■	
Pulse width modulated (PWM)							■

All I/O points of a module are configurable to any implemented function. To integrate Modbus, M-Bus etc. the PXC50/100/200..D has the TX1.OPEN module.

1 In TXM1.16D the counters are only implemented at inputs 1 to 8.

TX-I/O™ modules

Easy planning and implementation:

- Slim, manageable I/O range
- Maximum flexibility with I/O point mix

Efficient use of cabinet:

- Low space requirement with ultra-compact shape
- DIN form for easier cabinet installation using standard components
- Self-generating bus connection of TX-I/O modules, including power supply
- Direct wiring without transfer terminals

Fast commissioning and service:

- Straightforward addressing
- Fast servicing: plug-in is replaced without tools or rewiring
- Foolproof terminals

Operating voltage	DC 22.5...26 V
Dimensions (W x H x D)	64 x 77.5 x 98 mm

KNX room controller

Functions	AQR.... 2570.. & 253..	AQR.... 2570.. & 253..	P36	P30	P70	QMX3.. P34	QMX3.. P74	QMX3.. P02	QMX3.. P37
Display		■ [2]	■		■ [2]	■	■		■
Mode selection			■			■	■		■
Fan switch			■			■	■		■
Setpoint adjuster			■			■	■		■
Control of lighting and shading	■ [3]	■ [3]	■ [4]					■	■
Temperature sensor	■	■	■	■	■	■	■	■	■
Humidity sensor	■	■			■		■		
Air quality sensor		■			■		■		
Installation									
Flush-mounted	■	■	■						
On the wall				■	■	■	■	■	■
Control cabinet (door)									
Communication									
Wireless									
PPS2									
LonWorks									
KNX	■	■	■	■	■	■	■	■	■
Range									
Desigo TRA PXC3..[1]	■	■	■	■	■	■	■	■	■
Desigo TRA DXR2..	■	■	■	■	■	■	■	■	■

[1] Without PXC3.E16A
[2] LED for air quality indicator
[3] With two potential-free inputs
[4] Combined with button UP2..

AQR253..

Front modules for base modules

Color	Titanium white
Degree of protection	IP30

AQR2570..

Base module with KNX for temperature and/or humidity measurement

Voltage supply	KNX bus
Communication	KNX S-Mode KNX LTE-Mode KNX PL-Link
Analog inputs	Passive temperature sensor NTC 10k
Number of analog inputs	1
Digital inputs	Potential-free contacts
Number of digital inputs	2
Electrical connection	Bus connection: Spring terminals Sensor inputs: 4 Screw terminals

AQR2576..

Base module with KNX for CO_2 measurement

Voltage supply	KNX bus
Communication	KNX S-Mode KNX LTE-Mode KNX PL-Link
Analog inputs	Passive temperature sensor NTC 10k
Number of analog inputs	1
Digital inputs	Potential-free contacts
Number of digital inputs	2
Measuring range	CO_2: 0...5000 ppm
Electrical connection	Bus connection: Spring terminal Sensor inputs: 4 screw terminals

QMX3..

Room sensors and operator units for KNX PL-Link, freely configurable, flush-mounted

QMX3.. flush-mounted room units, consisting of:
- Operator unit
- Bezel, titanium white
- Base plate and KNX plug

Functions
- Freely configurable user interface (keys and visual items) as part of Total Room Automation
- RoomOptiControl energy efficiency function
- Room temperature measurement
- Display of room temperature, control mode, scenes etc. (dot matrix LCD)
- Backlit display, white or blue selection
- KNX PL-Link interface to the room automation station with plug & play functionality
- Can be combined with different standard and designer bezels

QMX3..

Wall-mounted room sensors and operator units for KNX

QMX3.. wall-mounted room units, consisting of:
- Base plate
- Sensor or room operator unit

The following functions are available (depending on type):
- Temperature or multisensor (temperature,
- relative humidity, CO_2)
- Backlit display or LED display
- Touchkeys
- Switching and control of lighting, shading and scenes

QMX3.P30

Room sensor with KNX for temperature

Functions
- Temperature sensor

QMX3.

Room sensor with KNX for temperature, humidity sensor

Functions
- Temperature sensor
- Humidity sensor

QMX3.P70

Room sensor with KNX for temperature, humidity, CO_2

Functions
- Multisensor (temperature, relative humidity, CO_2)
- Air quality display with

QMX3.P34

Room operator unit with KNX, sensors for temperature, segmented backlit display, touchkeys

Functions

- Temperature sensor
- Segmented backlit display and touchkeys
- «Green Leaf» LED

QMX3.P74

Room operator unit with KNX, sensors for temperature, humidity, CO_2, segmented backlit display, touchkeys

Functions

- Multisensor (temperature, relative humidity, CO_2)
- Segmented backlit display and touchkeys
- «Green Leaf» LED

QMX3.P02

Room operator unit with KNX, sensors for temperature, configurable touchkeys, LED display

Functions

- Temperature sensor
- Configurable touchkeys with LED display
- Switching and control of lighting, shading and scenes
- Window for labels

QMX3.P37

Room operator unit KNX with temperature sensor, segmented backlit display, configurable touchkeys, LED display

Functions

- Temperature sensor
- Segmented backlit display and touchkeys
- Configurable touchkeys with LED display
- Switching and control of lighting, shading and scenes
- Window for labels
- "Green Leaf" LED

Ethernet/IP room operator unit

Functions		QMX7.E38
Applications		
4,3" touch TFT displays		■
Lighting and shading operation		■
Scene selection		■
Energy-efficient operation (Green Leaf)		■
Setpoint adjustment		■
Mode selection		■
Fan switch		■
Installation		
Flush-mounted		1-2
Portrait or landscape orientation		■
Communication		
Ethernet/IP		■
Range		
Desigo TRA		■ [2]
DALI		
Range		
Desigo TRA	PXC3..	■
	DXR2..[1]	■

[1] Only DXR2.E.. (BACnet/IP)

RXM21.1

I/O block with KNX PL-Link block for use with a PXC3.E7.. series room automation station

The I/O block with KNX PL-Link, RXM21.1 contains the inputs and outputs required by a PXC3 series room automation station for a fan coil application.

- KNX PL-Link bus communication
- Fan control (3 potential-free relay contacts
- Thermal valve actuator control (AC 24 V)
- Motor-driven valve and damper actuators (AC 24 V, 2- or 3-point)
- Pluggable screw terminals

RXM39.1

I/O block with KNX PL-Link for use with a PXC3.E7.. series room automation station

The I/O block with KNX PL-Link, RXM39.1 contains the inputs and outputs required by a PXC3 series room automation station for a fan coil application.

- KNX PL-Link bus communication
- Fan control (ECM fan, DC 0...10 V)
- Actuator control DC 0...10 V
- Electric heating control DC 0...10 V
- Potential-free relay contacts to release fan and electric heating
- Pluggable screw terminals

UP 258D12

Presence detector with brightness sensor

- Detection range horizontal 360°, vertical approx. 105°
- Motion detected within an area of diameter 8 m (depending on mounting/room height)
- Flush mounted in the ceiling with spring clips or hollow wall box
- Programming button accessible from front

Switching actuators for lighting and shading

RL..

Type (ASN)	Description
RL512/23	1 x blind, 16 A, AC 230 V
RL521/23	2 x blinds, 6 A, AC 230 V

RS..

Type (ASN)	Description
RS510/13	2 x light, 10 A, AC 230 V
RS520/23	1 x blind, 6 A, AC 230 V
RS525/23	1 x light, universal dimmer

UP5../03

Type (ASN)	Description
UP510/03	2 x light, 10 A, AC 230 V
UP510/23	2 x blinds, 10 A, AC 230 V
UP520/03	1 x blind, 6 A, AC 230 V

UP5../13

Type (ASN)	Description
UP520/13	1 x Jalousie, 6 A, AC 230 V
UP525/13	1 x light, universal dimmer

AP118

Type (ASN)	Description
AP 118	Module box

AP641

Type (ASN)	Description
AP 641	Automation box

CET – Critical Environment Technology

Introduction

Lab

CET – Critical Environment Technology

Critical Environment Technology (CET) is a range of reliable volume flow controllers and additional components to measure, control and monitor volume flows and room pressures in buildings safely, precisely and quickly. CET can easily be integrated with building automation systems. This means the overall system delivers maximum **efficiency, cost-effectiveness and safety.**

CET was primarily developed for:

- Room pressure control and room air balancing
- Room air conditioning
- Lab fume hood control
- Control of extraction units

Clean rooms

is suitable for the following applications:

- Lab rooms
- Clean rooms
- Production rooms
- Storage rooms
- Operating theatres
- Isolation wards

Room pressure and fume hood control with Desigo room automation

VAV damper drive
Faster and more accurate actuator which continuously adjusts the damper position.

DXR2 controller
Controls the air volume flow in order to keep the room pressure precisely within the defined tolerances. The room pressure is monitored separately. Interacts with the lab fume hood controller and the building automation system.

Integrated lighting and blind functions.

Room pressure sensor
Senses the room pressure and transmits the information to the DXR2 controller for room pressure control.

Status monitoring
Indicates the room status, for example the differential pressure compared to adjacent rooms, and temperature and humidity values.

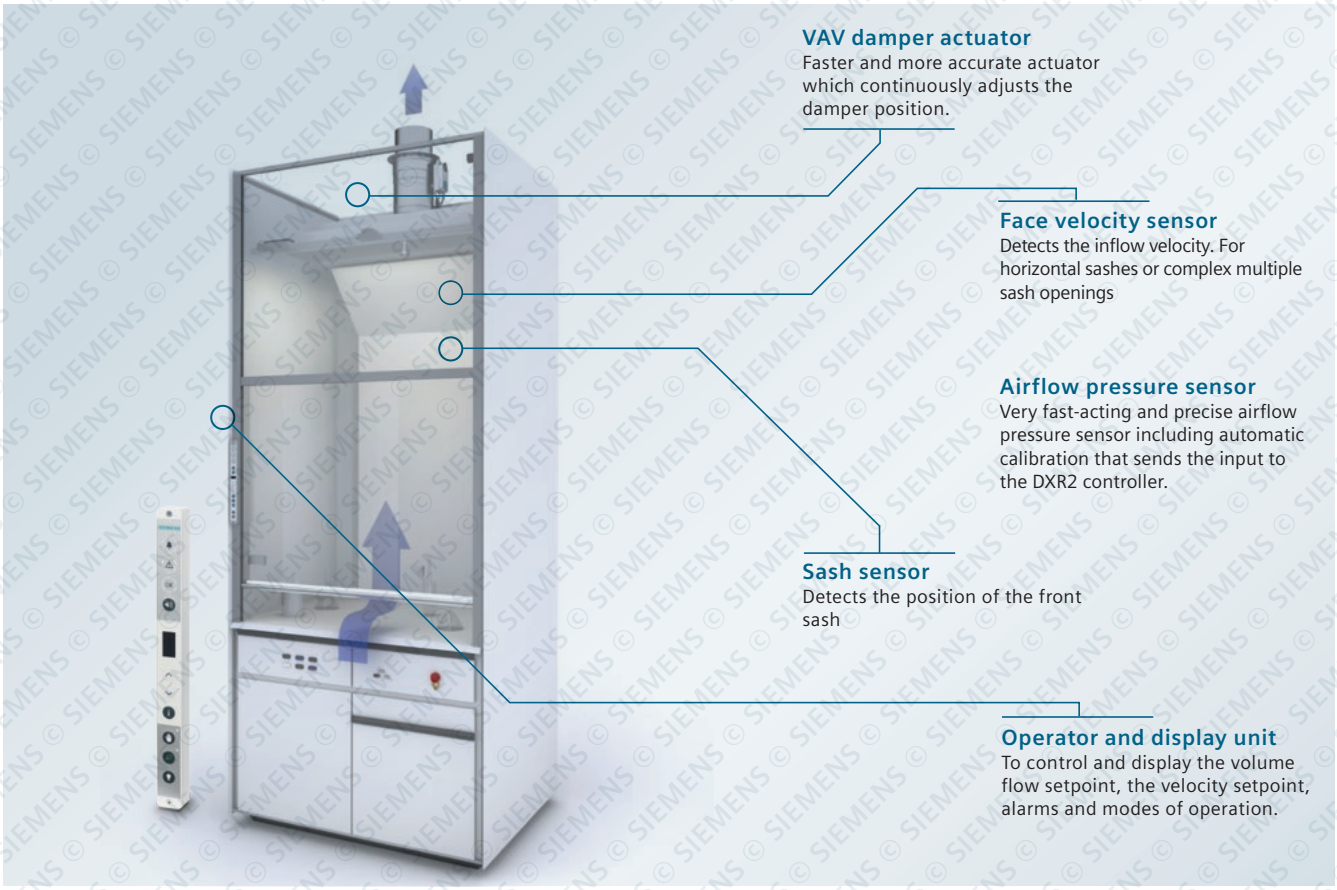
Air flow pressure sensor
Very fast-acting and precise air flow pressure sensor with automatic calibration, which transmits its signal to the DXR2 controller.

Operator and function display unit
To control and display the volume flow setpoint, the velocity setpoint, alarms and modes of operation.

The lab solution is based on the Desigo building automation system. This optimizes integration, establishes a standardized system architecture for controlling fume hoods, temperature and room pressure, improves safety and convenience and also makes the building more economical to run. It also guarantees continuity of data from the volume flow controller to the management system without additional interfaces (gateways). Data analyses and reporting tools are available in the management station. They provide a comprehensive overview and support end-to-end danger management with targeted, continuous system optimizations. The fume hood control has an intuitive operating concept.

CET is based on the TRA (Total Room Automation) room automation platform and also handles lighting and shading automation. The lab solution also includes other integrated systems such as fire protection, access control, video surveillance, gas detection and extinguishing. This minimizes risks, increases availability and protects your investment.

Fume hood control and fume hood monitoring according to EN 14175. B

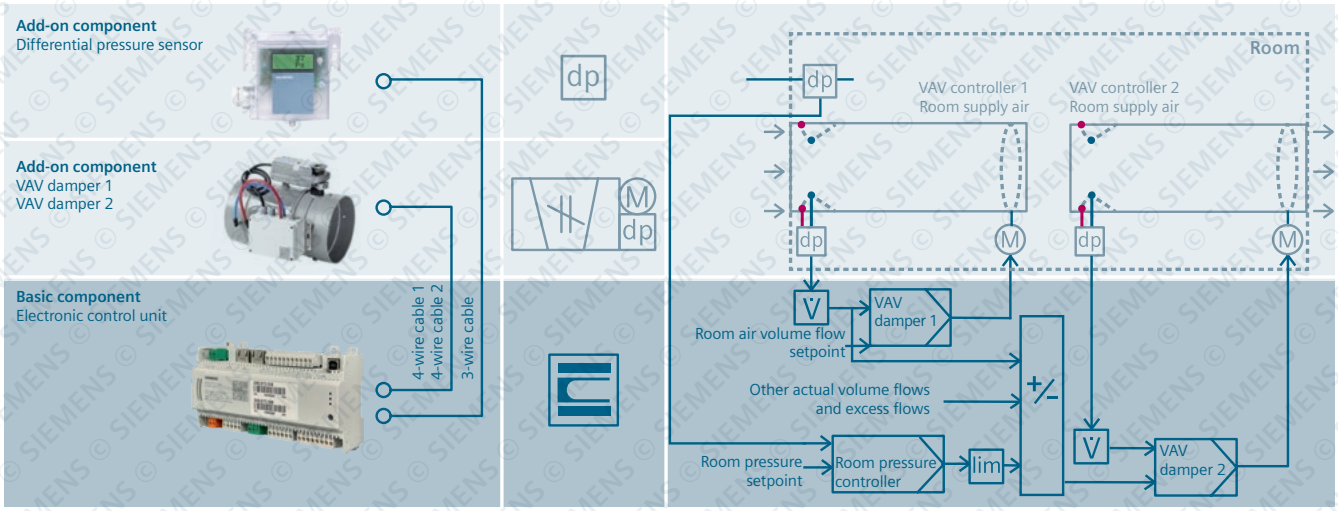


The fume hood controller is suitable for fume hoods with an air flow which is constant or variable or dependent on the front sash. The volume flow is controlled and also monitored. An alarm is triggered if there is a malfunction.

The fume hood controller can quickly adjust the volume flow according to the position of the front sash (EN14175-T6). The opening of the front sash can be detected directly with position sensors or indirectly via a flow sensor.

A large selection of additional functions can be configured in the fume hood, such as a simultaneity alarm, booster fan and fire functions.

Example of the room pressure control principle



The principle of room pressure control

The room pressure is measured with a static room pressure sensor. Room pressure is controlled in a cascade control system with supporting balancing. This type of control is very precise, fast and stable.

The principle of room pressure control involves balancing the volume flows in the room. Balancing narrows down the setpoint for VAV damper 2, which controls the room pressure.

The function of the room pressure controller is to correct this balancing within certain limits (lim). VAV damper 2 controls the setpoint volume flow in order to keep the room pressure constant. The setpoint of VAV damper 1 (the room air volume flow setpoint) can be changed independently of the room pressure setpoint. The actual value of VAV damper 1 forms the basis of room air balancing. The room exhaust air can also determine the room volume flow and the room supply air controls the room pressure.

Communicative controller

DXR2.E17C..

Compact room automation station, BACnet/IP, 24 V, DIN housing, 3 DI, 4 UI, 2 resistive inputs, 4 triacs, 4 AO

Compact room automation stations for room pressure or lab fume hood control, lighting and shading

- BACnet/IP communication
- KNX PL-Link to connect sensors, actuators, and operator units (including bus power)
- KNX S-Mode device integration
- 2-port Ethernet switch
- USB interface for tool access

Operating voltage	AC 24 V
Power consumption	66 VA
Frequency	50/60 Hz
Analogue outputs signal	0-10 V
Number of analogue outputs	4
Number of triac outputs	4
Number of universal inputs	4
Number of digital inputs	3

Operator and display unit

QMX3.P88

Universal operator and function display unit for lab fume hood and room automation

- OLED display for volume flow setpoint, face velocity setpoint and alarms
- Alarm and warning notifications
- Silence alarm button
- Multiple operator modes
- Scheduler override
- Control of fume hood light
- Energy Efficiency function «Green Leaf»
- Interface KNX PL-Link (for TRA, with plug & play functionality)
- Powered by KNX PL-Link
- Optional battery backup for power loss

QMX3.P87

- LCD display for volume flow setpoint, face velocity setpoint and alarms
- Alarm and warning notifications
- Silence alarm button
- Multiple operator modes
- Control of fume hood light
- Energy Efficiency function «Green Leaf»
- Interface KNX PL-Link (for TRA, with plug & play functionality)
- Powered by KNX PL-Link
- Auxiliary buttons (6 programmable)

Sensors

HLV20.1

Wire sensor

To detect the front sash position in a lab fume hood, a peripheral device for Siemens the lab fume hood controller

- Wire sensor for lab fume hood, measurement of sash position with universal mounting option.
- Suitable for any fume hood type from any manufacturer (2100 mm).
- Maintenance-free and easy to install

QVE300

Flow sensor

The flow sensor is suitable for the exact and permanently stable detection of the air inflow velocity in lab fume hoods with horizontal and vertical front sashes.

- Measuring range 0... 1,3 m/s
- Output signal DC 0... 10 V
- Reliable detection of the reversal of a flow direction
- Integrated filter element to prevent contamination of the sensor
- Maintenance-free
- Simple assembly
- Power supply AC 24V

VAV damper with actuator and air flow

HLBD...

HLBF...

For volume flow measurement, control and monitoring in general and specifically in the lab environment including the lab fume hood

- Nominal volume flow from 330 to 36000 m^3/h.
- Round or square construction
- Variants for aggressive and corrosive air volume flows
- Variants with sound insulation
- Variants with flanged or plug-in connection
- Robust measuring point
- Fast actuator, 2 sec 90°, 250 increments
- Flexible choice of components
- Largest range of VAV dampers
- High-quality components
- Returns to a safe position if there is a power failure

SIEMENS

Ingenuity for life

Protocols in building technology

buildingtechnologies.siemens.com

Standard protocols in building technology – Communication protocols for greater cost-effectiveness

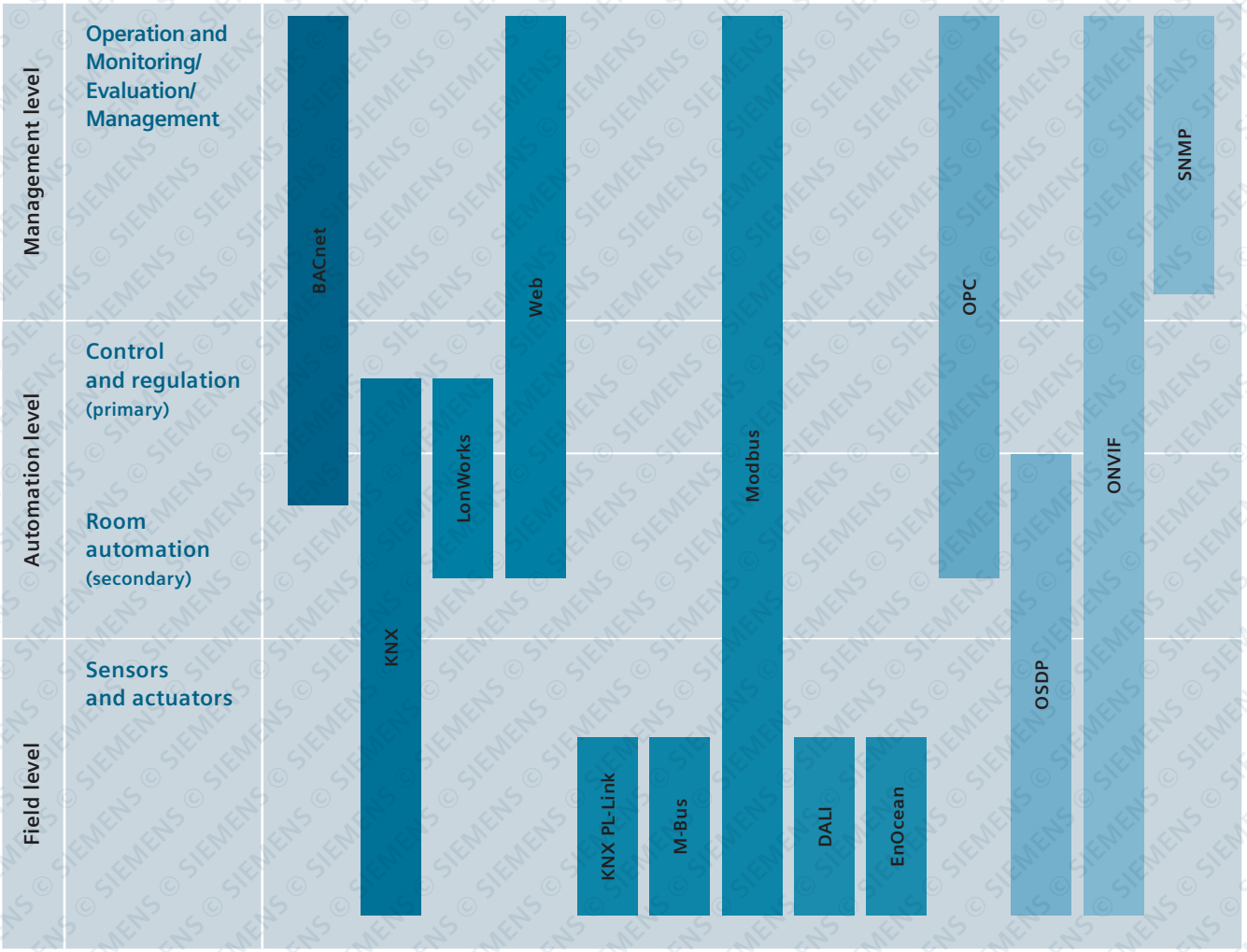
Open communication in building technology is important and enables simple, secure integration of third-party systems at all levels. In building automation, Siemens supports all the communication protocols listed here, not just established standards. These are communication standards for the successful creation and maintenance of projects. Proprietary communication protocols are employed in addition to the official market standards. These help secure communication, support efficient engineering and simplify maintenance and interoperability.

Building automation systems from Siemens and solutions based on these use the standards described here. The standardized and independent communication protocols are subject to ongoing development and ensure a consistent exchange of information between devices and systems. While BACnet, KNX and LonWorks are defined in international norms/standards, (e.g. EN/ISO), others such as EnOcean, DALI, etc. have become de-facto standards in the marketplace by virtue of their widespread use.

The Building Technologies Division of Siemens supplies complete building technology solutions and integrates heating, ventilation, air conditioning, lighting, shading, fire safety and security, lifts, power and energy distribution, etc.

Highlights

- Easy, secure integration
- Ease of data exchange between devices and systems
- Convenient, consistent operation
- Long-term investment protection thanks to the ongoing development of standards
- High level of flexibility thanks to extensive support for various standards



BACnet	**BACnet ™** **www.big-eu.org**	The BACnet communication protocol was developed specifically for requirements in and around buildings. It is suited for both the automation and the management level. The main focus is on HVAC plants and fire control panels. BACnet is continually being extended for other building-specific systems such as escalators and lifts. Around 500 manufacturers use BACnet in their products. The BACnet protocol has been adopted as an international standard in EN ISO 16484-5. It is a pure software implementation, with processor-independent and licence-free use of IP communication. For BACnet/IP, the standardized User Datagram Protocol (UDP) is used which supports the connectionless transport of data packets. UDP port number 47808 = 0xBAC0 is registered for BACnet.
KNX	**KNX®** **www.knx.org**	KNX technology allows flexible implementation of highly complex cross-discipline solutions as well as simple solutions in room and building automation to meet individual requirements. KNX products for the control of lighting systems, shading and room climate plus energy management and security functions excel in ease of installation and commissioning. A vendor-independent tool (ETS) is available for commissioning. KNX is an open, worldwide standard conforming to EN 50090 and ISO/IEC 14543, that is supported by more than 210 vendors. KNX can use twisted pair cables, wireless or data transmission networks with the Internet Protocol for communication between the devices. Coordinated room and building management often requires the integration of other technologies and systems. This requirement is met by providing KNX gateways and interfaces for Ethernet/IP, wireless, lighting control with DALI and building automation systems.
KNX PL-Link	**KNX PL-Link** **(Extension to the KNX communication standard)**	KNX PL-Link (PeripheraL-Link) is an extension to the KNX communication standard, optimized for communication between peripheral devices and TRA room automation stations handling HVAC, lighting and shading. Typical peripheral devices include switches/buttons, presence detectors, brightness sensors, other sensors, damper actuators, valve actuators and room controllers. The latter is based on standard KNX communication conforming to ISO/IEC14543 for maximum investment protection. In addition to KNX communication, addressing and configuration is done automatically for PL-Link enabled components (plug and play). This simplifies device replacement, which is possible without tools, promotes autonomy and saves time and money. Standard KNX components communicate on the same bus, but without the benefits of PL-Link.
LonMark International	**LonWorks®** **www.lonmark.org**	The LonWorks-based communication protocol is one of the most widely deployed technologies worldwide. This protocol can be used to create complete networks made up of interoperable products. More than 700 LonMark®-certified products from more than 400 vendors in building automation, traffic and energy supply are testimony to this. Given its widespread use worldwide and as an international standard, LonWorks is also very significant for Siemens, with the focus on HVAC functions in room automation and the field level. The protocol is standardized in ISO/IEC 14908 (worldwide), EN 14908 (Europe), ANSI/CEA-709/852 (USA) and also in China.

	DALI **www.dali-ag.org**	DALI (Digital Addressable Lighting Interface) is a standardized interface for lighting control. Electronic ballasts, transformers and sensors in a lighting system communicate with the building automation system via DALI.
	EnOcean® **www.enocean-alliance.org**	Leading global companies from the building sector formed the EnOcean Alliance to implement innovative wireless solutions for sustainable building projects. The core technology is EnOcean's battery-free wireless technology for maintenance-free sensor solutions that can be flexibly positioned. The EnOcean Alliance promotes further development of the interoperable standard as well as the future viability of innovative wireless sensor technology.
	M-Bus (Meter-Bus) **www.m-bus.com**	M-Bus is a European standard covering remote readout of meters and can be used for different types of consumption meters and various types of valves and actuators. Data (e.g. heat energy) can be read electronically. Transmission is serial via a 2-wire cable with reverse polarity protection, from the connected slaves (meters) to a master. M-bus meters are available for heat, water and electricity.
	Modbus **www.modbus.org** ***Modbus® is a registered trademark of Schneider Electric, licensed to the Modbus Organisation, Inc.**	Modbus is an open, very widely used de-facto standard applied in a large number of areas including industry, buildings, traffic and energy. The Modbus protocol is used to establish master-slave/client-server communication between intelligent devices. Using Modbus, a master (e.g. automation station) and several slaves (e.g. chillers) can be interconnected. Data transmission occurs in one of three modes'Modbus ASCII, RTU or TCP.
	OPC **www.opcfoundation.org**	OPC is a standardized software interface that enables the exchange of data between various devices, control systems and applications from different manufacturers. This interface is frequently used to collect process values from third-party devices in a neutral form for further processing in a management station or in a security management system.
	OSDP **www.siaonline.org**	The Open Supervised Device Protocol (OSDP) is a communication protocol that connects peripheral devices such as card readers or biometric readers for example, with access control systems or other security systems. The Security Industry Association developed this protocol to promote interoperability between different security devices.
	OnVif **www.onvif.org**	ONVIF is an open industry forum for the development of global standards for IP-based physical security products. This is done on an entirely product neutral and vendor neutral basis. ONVIF defines a common protocol for the exchange of information between network video cameras, videostreaming and intelligent metadata.

When building technology creates perfect places –
that's Ingenuity for life.

Never too cold. Never too warm.
Always safe. Always secure.

With our knowledge and technology, our products,
our solutions and our services, we turn places into
perfect places.

We create perfect places for their users' needs –
for every stage of life.

#CreatingPerfectPlaces
www.siemens.com/perfect-places

Siemens Building Technologies Europe
Freilagerstrasse 40
8047 Zürich
Switzerland

Siemens Building Technologies Northern Europe
Sir William Siemens Square
GU16 8QD Frimley, Camberley
United Kingdom

Siemens Building Technologies Southern Europe
Freilagerstrasse 40
8047 Zürich
Switzerland

Siemens Building Technologies Western Europe
BP 20
78531 Buc CEDEX
France

Siemens Building Technologies Eastern Europe
Postbox 83
1211 Vienna
Austria