WHITEPAPER

The opportunities offered by digitally supported power distribution

How coordinated hardware and software can optimally exploit the digital opportunities in low-voltage power distribution

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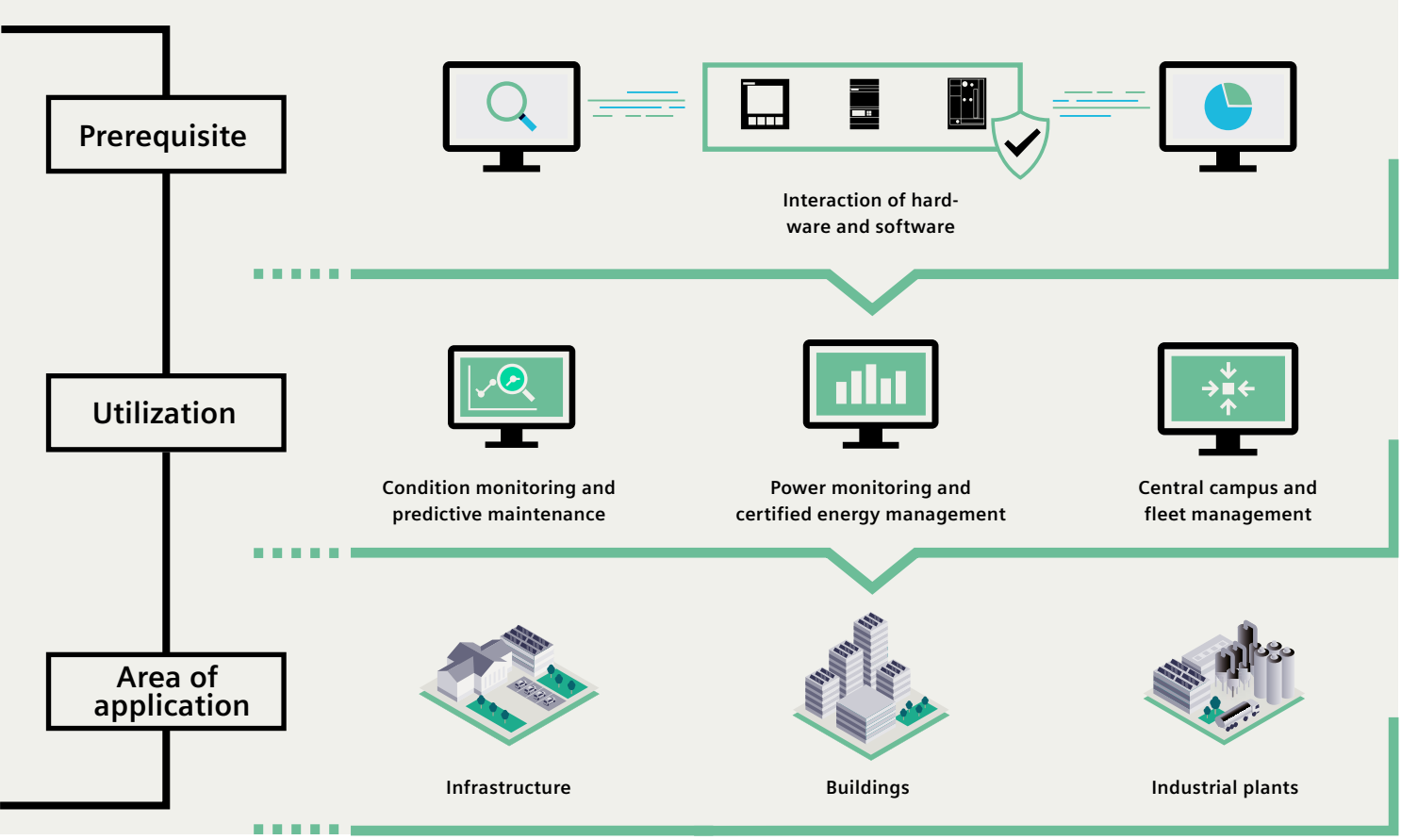


The energy industry has ambitious goals: climate neutrality, a reduced CO_2 footprint, and a distributed power supply. This also applies to low-voltage power distribution in buildings, critical Infrastructures, and production plants. One way to achieve these goals is through perfectly coordinated hardware and software, including the digitalization of the individual processes. This is the only way to confront the growing challenges of energy efficiency while also ensuring reliable power distribution.

The purpose of this paper is to show building operators, production plant operators, energy managers, and service providers – for example, for maintenance or facility management – how to unleash massive new potential using a hardware and software ecosystem. This potential extends from power monitoring, energy management, and continuous condition monitoring that significantly boosts maintenance efficiency and availability to comprehensive analyses of distributed campuses.

For example, they'll find out how they can make their power consumption transparent with the aid of power monitoring solutions – the starting point for identifying savings potential, complying with regulations, effectively reducing carbon emissions, and achieving decarbonization targets.

They'll also learn how data is acquired through plant monitoring and how this data can serve as the basis for condition-based predictive maintenance – easily and efficiently, thanks to coordinated interactions between hardware and software. This could be for an individual building, an entire campus, or for multiple properties in different locations. And of course maximum data security is guaranteed.

What's possible with digitalization in power distribution

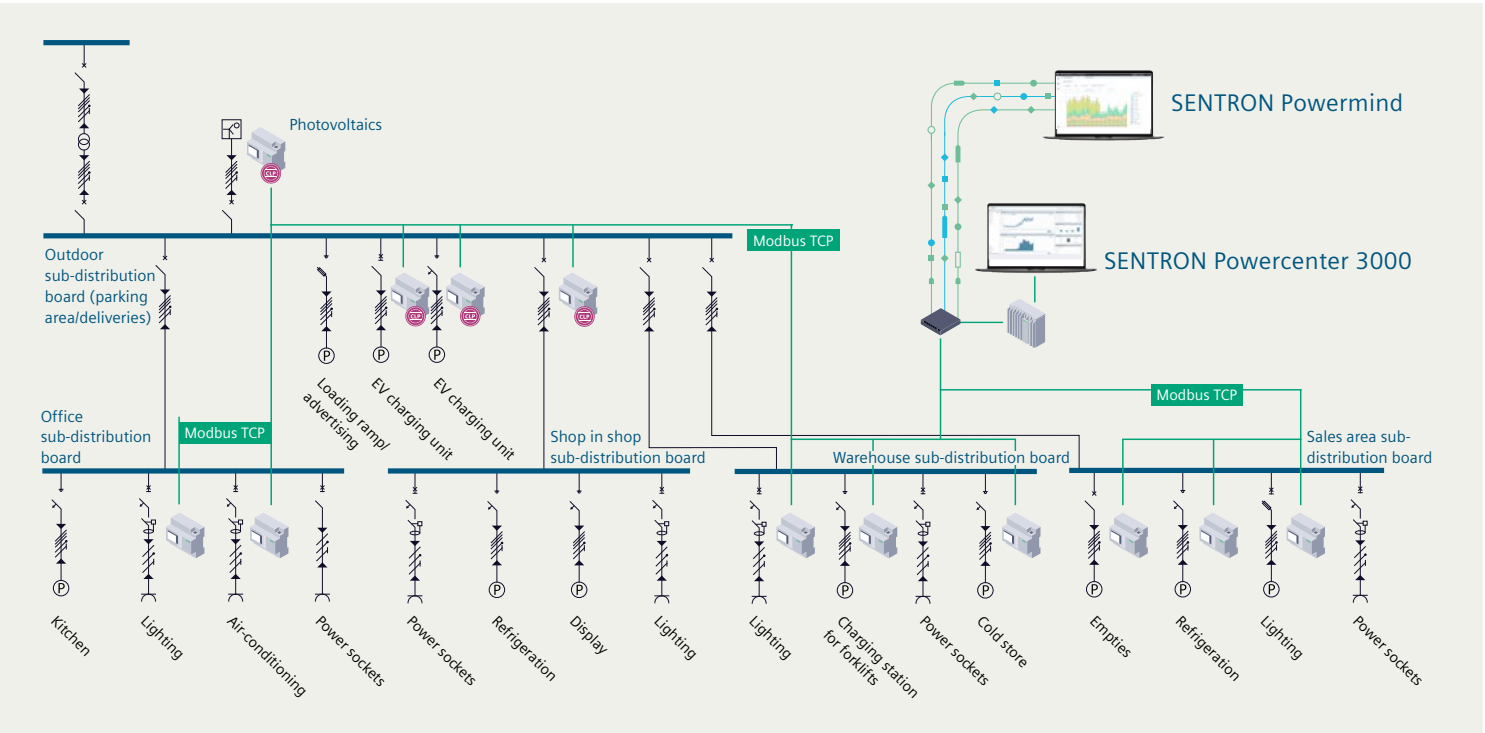
Digitalization makes it possible to increase efficiency, reliability, sustainability, and security in low-voltage power distribution. The electrical infrastructure can then be monitored and energy and condition data can be made transparent.
The energy values acquired are precisely analyzed and evaluated by smart software solutions. Power monitoring also lays the groundwork for operational energy management in accordance with legal requirements and standards like ISO 50001.

Power monitoring systems make energy data transparent

Energy efficiency in buildings and plants is subject to strict regulatory requirements and standards. Energy Efficiency Directive 2012/27/EU requires that all EU member states define indicative energy efficiency targets and apply measures that will contribute to a 32.5 percent reduction in the EU's overall primary energy consumption by 2030. With its European Green Deal, the EU has also set its sights on making Europe the first carbon-neutral continent by reducing emissions to zero by 2050. In an initial step, emissions will be lowered by at least 55 percent by 2030. To achieve this goal, individual EU member states will establish country-specific requirements, measures, and funding. For example, strict national regulations like Germany's energy passport for buildings will be implemented. But compliance with regulations means that the actual state of energy efficiency has to be determined. Power monitoring systems play a key role in analyzing and evaluating energy consumption. With the support of software, they then record all the energy flows within a company or across distributed properties. The data they collect can then be used to identify savings potential and implement improvements.

This data is also the basis for operational energy management according to ISO 50001 and its supplements, ISO 50003 and ISO 50006. These standards require that companies that want to be certified or are obligated to do so provide evidence that they're continuously improving their energy efficiency. The companies in turn benefit from long-lasting savings, funding, and competitive advantages. This makes the acquisition, evaluation, and documentation of energy data even more valuable.

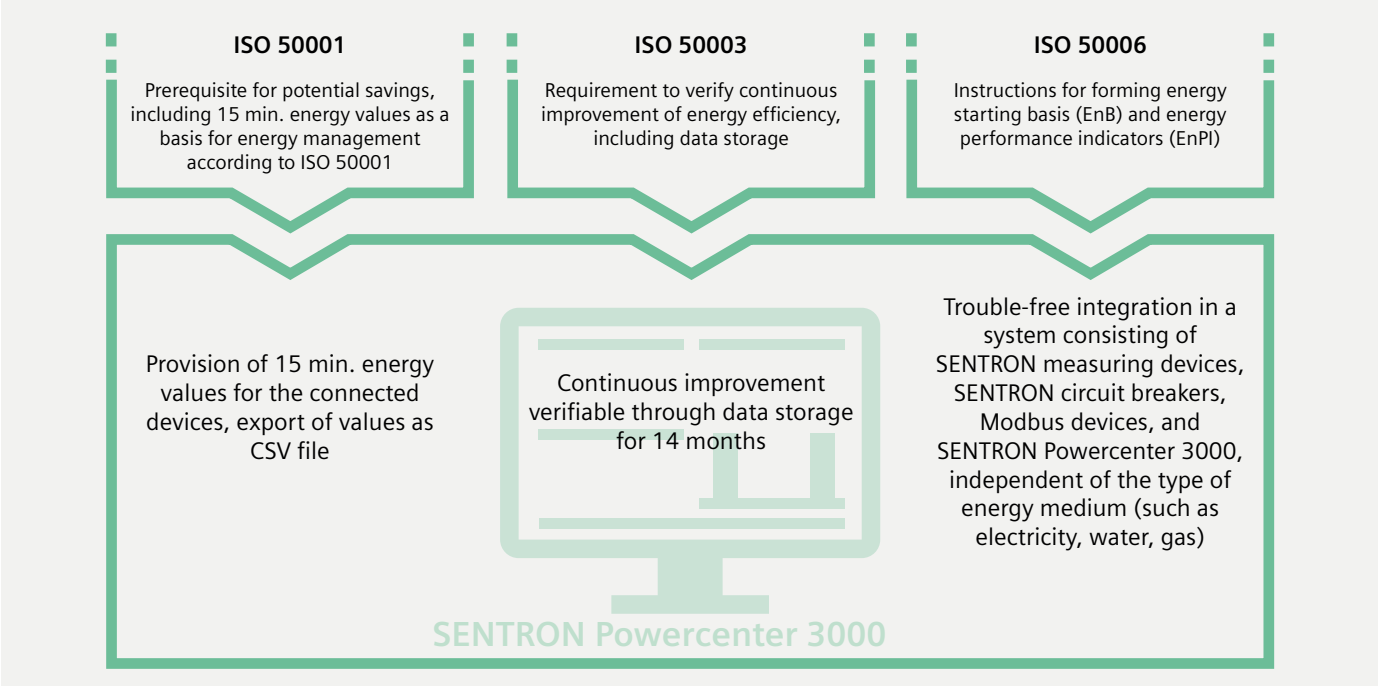
SENTRON Digital is a perfectly coordinated concept that includes hardware, software, and apps with a variety of uses, and it's an example of how digitalization can be implemented in low-voltage power distribution. It enables monitoring of the electrical infrastructure, makes energy data transparent, and is a prerequisite for effectively reducing energy consumption and energy costs.



Example of configuring the relevant measuring points in a supermarket, including measuring devices and data communication with SENTRON Powercenter 3000 or SENTRON Powermind

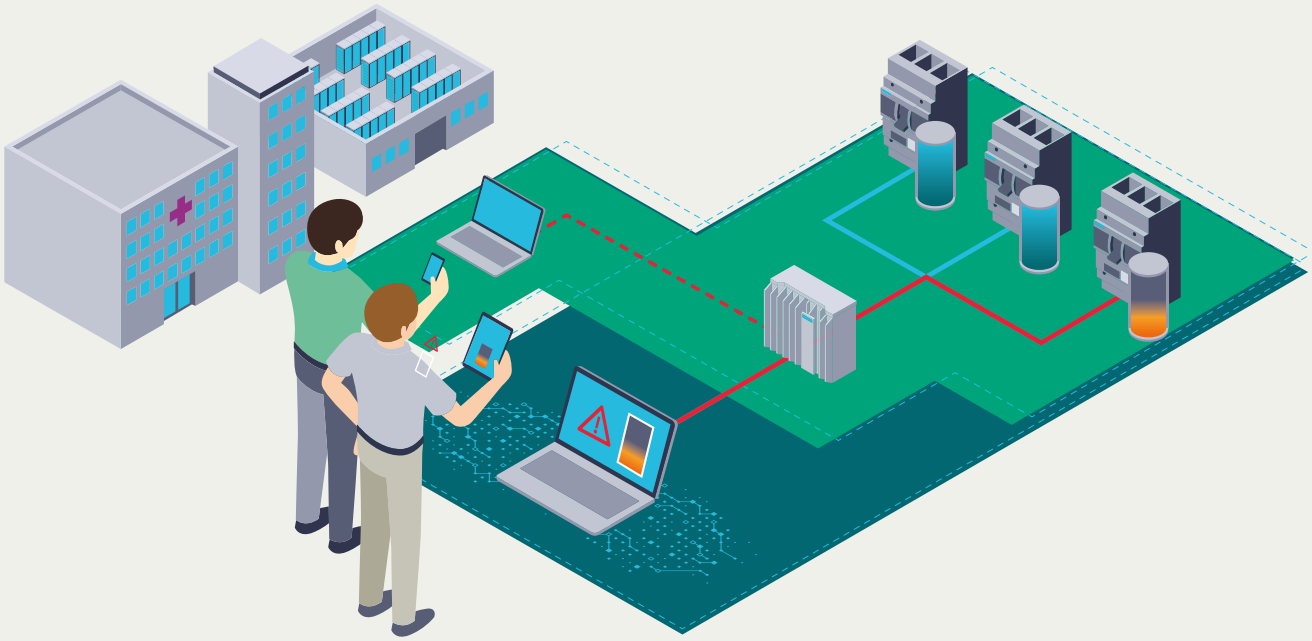
Siemens offers a high-performance power monitoring system certified according to ISO 50001. It consists of measurement- and communication-capable components from the SENTRON portfolio, the SENTRON Powercenter 3000 IoT data platform and software that provides an easy introduction to power and condition monitoring, the SENTRON Powermind cloud application for location-independent campus and fleet management, and the SENTRON Powermanager power and condition monitoring software for experts.

The compact SENTRON Powercenter 3000 can be easily integrated in the switchgear, where it functions as a central interface. It processes the data collected by communication-capable devices, including energy values, current, voltage, and output as well as component-specific data like switching states, number of operating cycles, trip causes, and the remaining service life of circuit breakers. This data can then be processed directly in an integrated web interface or even in cloud-based apps. With the simple press of a button, the data can be converted to CSV format and used for further analyses or for preparing reports. Faults in power distribution are also indicated or reported individually via e-mail in order to enable an immediate response.



SENTRON Powercenter 3000 IoT data platform as a prerequisite for an ISO-certified energy management system

All the data from communication-capable field devices – including measurement, switching, and protection devices – can be identified by SENTRON Powercenter 3000 and visualized in the integrated web interface in different customizable views.



Condition monitoring in low-voltage power distribution

The failure of individual components in low-voltage power distribution systems can lead to a total power outage. Not only does this create safety hazards for people and plants, it also results in high expenditures due to downtime, reactive maintenance, and implementation measures.

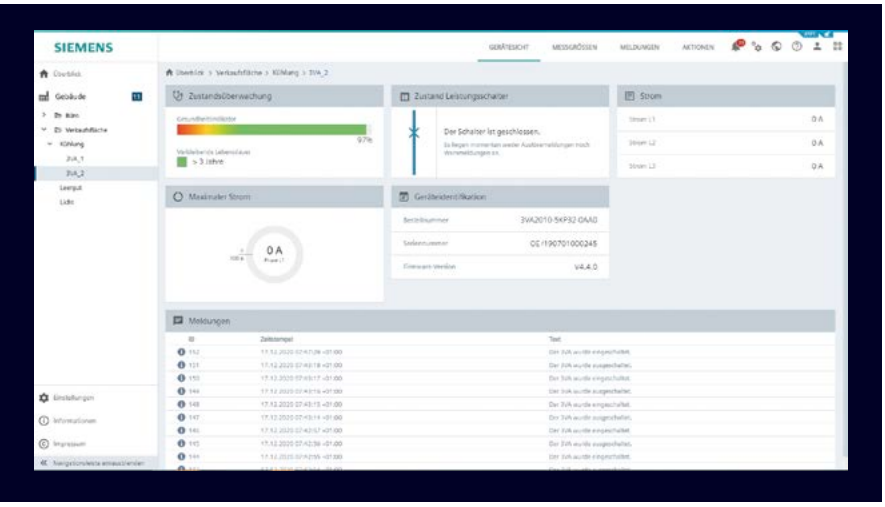
The best option for optimally planning and coordinating maintenance activities is a condition monitoring solution that continuously monitors component states.

Until now, inspections have usually been conducted at defined intervals, but today's maintenance management relies on maintenance concepts that are based on the actual state of each device. This makes maintenance planning much more efficient, saves time and money, and boosts plant availability.

A smart and communication-capable low-voltage power distribution system can supply the data necessary for a condition-based maintenance strategy. One example of a smart solution is the Siemens 3VA molded-case circuit breaker, which has the condition monitoring function integrated. By analyzing individual usage behavior and factoring in KPIs like operating cycles and operating hours, it's possible to draw precise conclusions about a device's current health status and remaining service life.

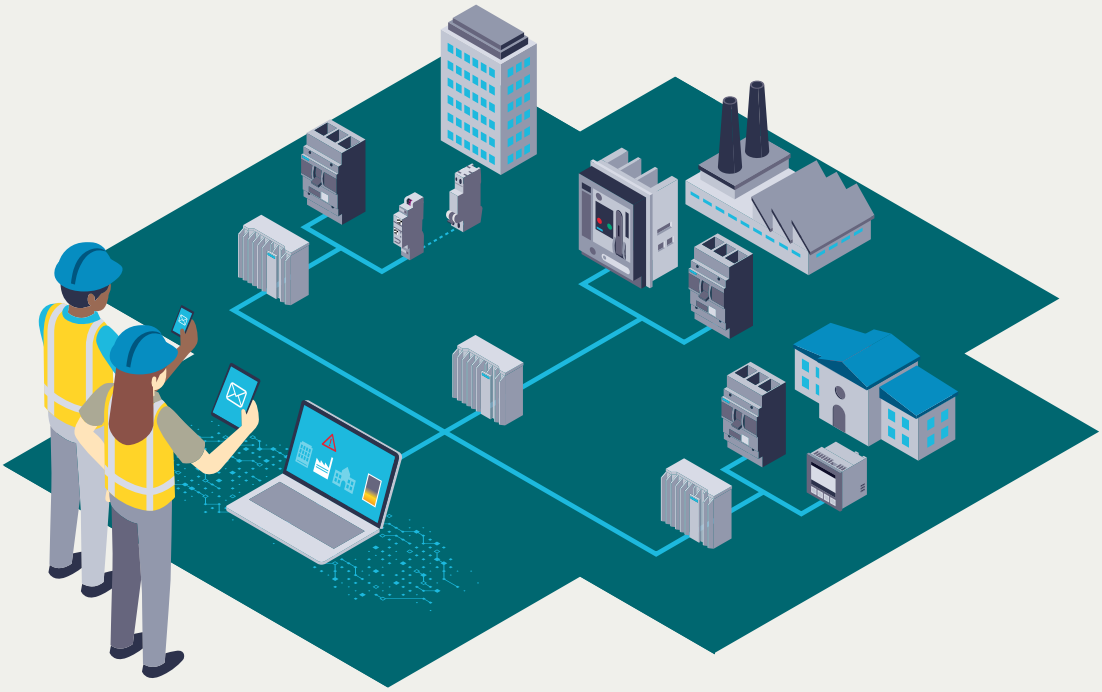
Using appropriate software tools and apps like SENTRON Powermanager or SENTRON Powermind, this data can be accessed at any time and used to schedule condition-based maintenance.

Naturally, many other SENTRON protection, switching, measuring, and monitoring devices and circuit breakers are already being deployed in many places. When combined with the Powercenter 3000 IoT data platform and software, as well as other SENTRON software solutions, condition monitoring can be easily retrofitted for predictive maintenance.



Condition monitoring of a protection device to optimize maintenance

Example: Condition monitoring with the SENTRON 3VA molded case circuit breaker		
Goal	**Sample solution**	**Functioning**
• Reliable, high-capacity electrical infrastructure for high and schedulable plant availability • Transparent device status and remaining service life • Avoid unplanned downtimes • Reduce planned break times • Optimally plan maintenance activities • More efficient work processes and cost structures	**Hardware solution** • SENTRON 3VA molded case circuit breaker for reporting status information • Basic data: operating cycles (electri-cal, mechanical), trips (including trip cause), and operating hours • Additional data: health indicator and remaining service life **Software solution** • SENTRON Powercenter 3000, SENTRON Powermind app or SENTRON Powermanager for visualizing the collected data in the web interface or in the app	• A circuit breaker's serviceability largely depends on the status of the main contacts. Different switching operations cause the contacts to wear out to varying degrees. • Without a diagnosis, it's difficult to determine the optimal maintenance time in advance. • That's why the status indicator continuously identifies the contact status based on the data collected right in the device. Data is collected, transmitted, evaluated, and compared with empirical values. • The more circuit breakers there are and the larger the campus, the more valuable central remote access and straightforward visualization become. This gives maintenance personal more time to concentrate on critical states.



Campus and fleet management for transparent low-voltage power distribution

The provision of data in the cloud is especially useful for distributed plants and for monitoring multiple properties. The acquired data is then available for campus and fleet management in real time and can be read and further processed independent of the location or device.

Thanks to software solutions, fast fault location is also possible in extensive campus structures – meaning widely distributed building complexes – via remote monitoring and remote access to all the data. The building managers in charge can access the necessary status messages relating to the electrical equipment at any time. Access that's location-independent but that's also absolutely secure is of special interest to service providers like system integrators, facility managers, and energy consultants.

In this way, SENTRON Powermind enables structured, resource-saving, and time-saving fleet management for operating multiple end users on one tenant, including the separation of data and analyses, thanks to Secure Data Sharing (SDS). Users are given an instant overview of multiple properties and can also access each one individually and retrieve power and status information.

Thanks to configurable alarm management, it's possible to receive a notification via a PC or any other mobile terminal device in the event of a fault or other predefined events. For example, SENTRON Powercenter 3000 collects and bundles data for energy-efficient and fail-safe operation. Users can view all the values and statistics at any time via remote access and, thanks to warning messages, can intervene in the event of a fault. This enables condition-based maintenance and ensures high plant availability.

Bundling individual status, statistical, and measured values to form compact data packets (smart data) reduces the volume of transmissions to higher-level evaluation systems. One example of an evaluation system is an integrated web interface with easy-to-read dashboards for visual-ization and an adaptive design that makes it usable on all terminal devices. Other systems range from full-featured, locally installed software solutions like SENTRON Powermanager to highly flexible apps like the SENTRON Powermind cloud app, which is based on Siemens' Insights Hub industrial IOT solution for improving operational decision making – the further evolution of MindSphere with Industrial Operations X. Depending on usage behavior, the data can be evaluated either on site or independent of location or device – for anything from individual plants to distributed properties, including for benchmark analyses.

Efficient communication between hardware and software

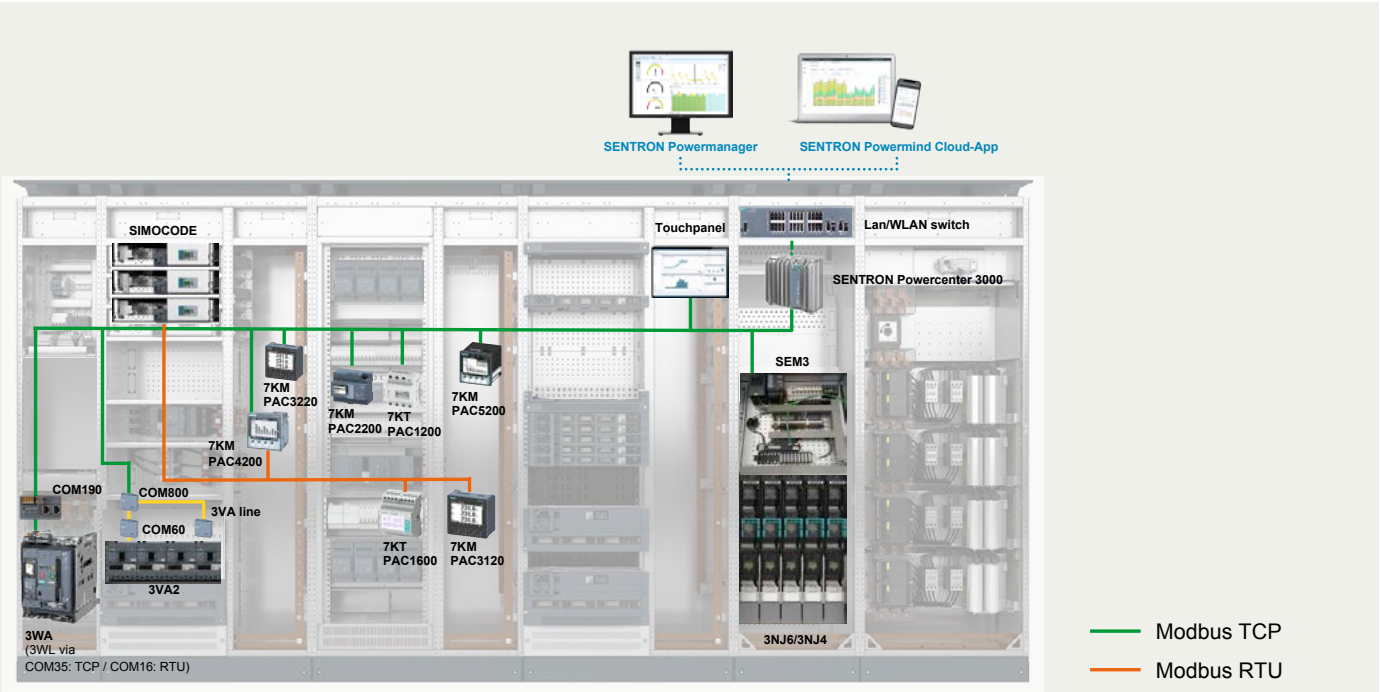
To take advantage of all the applications and the value they can add to low-voltage power distribution, efficient and coordinated communication between the components that collect the relevant data is absolutely essential. Other important factors include appropriate solutions for connectivity and on-site visualization as well as analysis and higher-level systems and applications: for example, in cloud environments.

The portfolio of communication-capable SENTRON protection, switching, measuring, and monitoring devices provides all the required communication interfaces while using common, application-specific communications protocols. This means that individual or bundled data packets containing energy, status, or device information from field devices can be easily and efficiently communicated to higher-level systems, platforms, software, or apps for purposes of visualization and analysis.

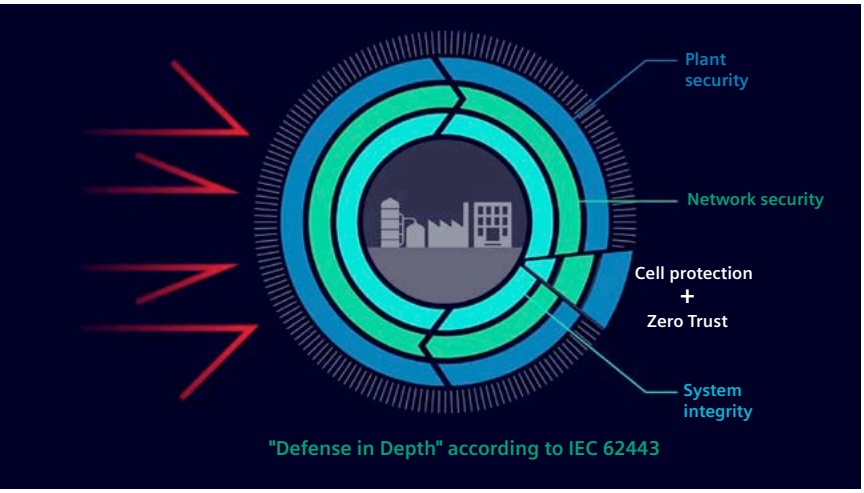
Communication between individual components in the field and the SENTRON Powercenter 3000 IoT data platform or the SENTRON Powermanager software is designed as native for Modbus TCP or Modbus RTU. This is the standard for instrumentation in power monitoring systems and communication in building technologies. As well as being highly efficient in terms of pricing, these open protocols allow users to integrate a variety of device types and easily implement projects.

Expansion options are also available for the application-specific PROFINET and PROFIBUS protocols. These protocols are standard in automation technology and make it possible to integrate the relevant devices in these communication environments for uniform and consistent operation.

The SENTRON Powercenter 3000 IoT data platform can be used right in the integrated web interface (browser-based, protected access to the IP address) as a standalone solution for power and condition monitoring. This also means that access to data can be provided from lower-level devices so it can be used and further processed in cloud-based applications. This can take place either in the SENTRON Powermind cloud app or, for example, in other cloud environments via the MQTT standard protocol.



Example of the configuration of a digitalized low-voltage switchgear



The defense-in-depth concept as deployed by Siemens ensures comprehensive protection from cyber threats. It's a multilayer defense strategy that makes hacker attacks more difficult, because both the hardware and software are fully protected.

Cybersecurity is guaranteed

In the context of digitalization, plant and data security are top priorities because cyberattacks can result in massive economic losses. According to the Center for Strategic and International Studies, cyberattacks were responsible for global damage costing more than €500 billion in 2018 alone. Many German companies are being targeted. According to a study by the Bitkom industry association, 70 percent of German companies suffered damage from digital attacks in 2018 and 2019. In Germany alone, total losses in 2019 are estimated at €100 billion. So it's not surprising that a survey by the Munich Reinsurance Company revealed that 20 percent of managers are concerned about the growing number of cyberattacks and believe that their companies aren't adequately protected.

It's very apparent that effective cybersecurity requires a defense-in-depth strategy that uses digital and systematic protection precautions. From firewalls and network security, signed firmware to prevent tampering, and verification of data integrity to regular behavioral analyses for ongoing cybersecurity updates, the use of digital functions to protect against cyberattacks is inevitable. That's why Siemens and various partners launched the first joint charter to increase cybersecurity in February 2018. The "Charter of Trust" initiated by Siemens promotes binding rules and standards that build trust in cybersecurity and advance digitalization. Cybersecurity is considered to be the key element in a successful digital economy.

In low-voltage power distribution, smart technology provides multilayer digital functions to protect against cyberattacks on both the local level and in the cloud. The SENTRON product portfolio's protective mechanisms are the foundation for the secure operation of communication-capable products. Only firmware signed by Siemens is used in these products, which ensures that only authentic software produced by Siemens can be installed and operated on the IoT device in question and prevents third parties from tampering with the firmware. In many devices, password protection can also be implemented to protect the device configuration from unauthorized write access. In addition, an IP address filter can be configured that only allows specific IP addresses approved by the user to communicate with the devices.

A write-protect switch can be used to block remote write access and protect the device's configuration. The SENTRON Powercenter 3000 data platform functions as a secure and universal communication interface. The protected gateway ensures a high level of data security between the platform and the cloud.

The example of the circuit breaker demonstrates that advanced low-voltage hardware can be realized by means of protective precautions implemented right in the devices. SENTRON circuit breakers have a variety of scalable and graded security functions for operation and data communication, including write-protection, remote switching protection, and protected Bluetooth connections. The availability of regular security updates ensures that devices will be protected throughout their service life. This is mainly the responsibility of Siemens' ProductCERT (Computer Emergency Response Team).

When protection is guaranteed, digitalization and the associated data exchange among networks and the cloud can offer significant benefits by increasing energy efficiency and availability.

Summary: The benefits of digitalization can be quantified

Increasing digitalization, data exchanges in local networks, and the IoT integration of smart devices and cloud-based services play a significant role in boosting energy efficiency and availability.

Optimal interactions between hardware and software lays the foundation for comprehensive power monitoring. Studies show that this can improve operational energy efficiency and increase the associated energy consumption savings by up to 30 percent. If the data acquired is also used for condition-based maintenance, productivity can be boosted by an average of 25 percent. The number of failures is reduced by up to 70 percent, and maintenance costs can be cut by as much as 25 percent. And there are more welcome benefits: Condition monitoring supplements the power monitoring functions of energy-efficiency management systems according to ISO 50001. Comprehensive digitalization of the entire low-voltage architecture reduces expenditures of time and money by up to 80 percent, from planning and engineering to installation and commissioning. In addition, the example of SENTRON demonstrates that the cybersecure use of communication-capable devices and cloud-based software instruments in low-voltage power distribution is a thoroughly reliable solution.

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