



# Future of European Rail Freight

A compendium of our portfolio solutions and services

# We combine many years of experience with spirit of innovation

## Today's agenda



- 1** Our view of European rail freight

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- 2** Our offering for your freight business
  - A | Planning & Dispatching
  - B | Production
  - C | Maintenance & Diagnostics

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- 3** Conclusion

# The course in the European rail freight market is set. We continue to drive innovation closely to our customers

## The course for European rail freight market is set ...

### **Growth expected**

European land freight transport market is expected to grow by 30% by 2030 – and the rail freight segment to even double.

### **European strategy defined to reduce CO<sub>2</sub> emissions**

The European Commission has defined a sustainable, smart and resilient mobility strategy in order to “deliver a 90% reduction in the transport sector’s emissions by 2050”.

### **Need for significant capacity expansion**

Need for increased capacity, strengthened cross-border coordination and cooperation between infrastructure managers, better overall management of rail network, and the deployment of new technologies.

### **All stakeholders to contribute**

The transformation into a high-performing, efficient and sustainable transport system for a European multimodal logistic requires interaction of all major stakeholders on the industry.

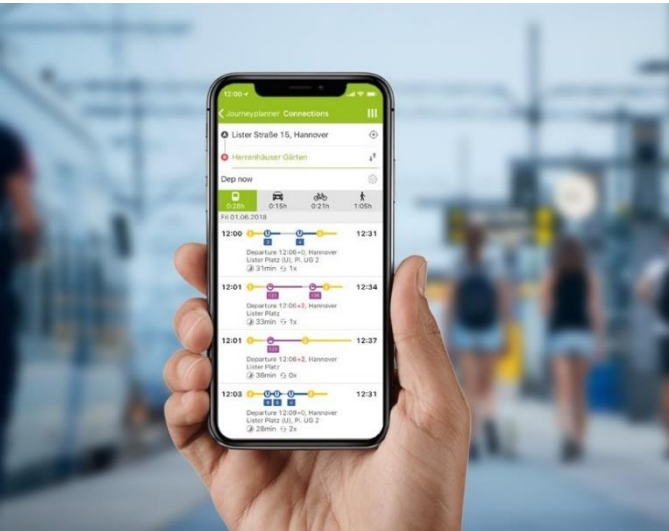
### **Digitalization is the key driver**

Digitalization is an indispensable driver for the modernization of the entire system, but also reliable rail industry know-how is essential.

- The **Digital Freight Train** enhances operational efficiency and safety of train operations
- Increased productivity by **Automated Shunting and Train Formation**
- **Automated Driving** for an optimized operation to save energy and lower maintenance efforts
- Increase infrastructure capacity by an **Effective Timetable & Network Capacity Management** for network providers and operators
- **Innovative Service Solutions** for high system availability and efficient and safe operations over the entire lifecycle

... we are ready to pave the way for freight of the future!

# We are the most diversified and vertically integrated mobility company – and a reliable partner in rail freight



## Intermodal Solutions

Apps and backend systems for passenger and freight information, booking, payment and management of data, infrastructure and fleets



## Rail Infrastructure

Products and solutions for rail automation and electrification



## Rolling Stock

Short-distance, regional and long-distance rolling stock, product and system solutions for passenger and freight transport



## Customer Services

Services for rolling stock and rail infrastructure, throughout the entire lifecycle

# Continued innovation leadership secured by growing R&D investment

**36,800**  
employees worldwide<sup>1)</sup>

**81%**  
Coworkers, that are proud to work  
for Siemens Mobility<sup>2)</sup>

**1,420**  
patent applications since 2015/2016<sup>3)</sup>

**17,200**  
employees for more than 10 years  
with Siemens Mobility



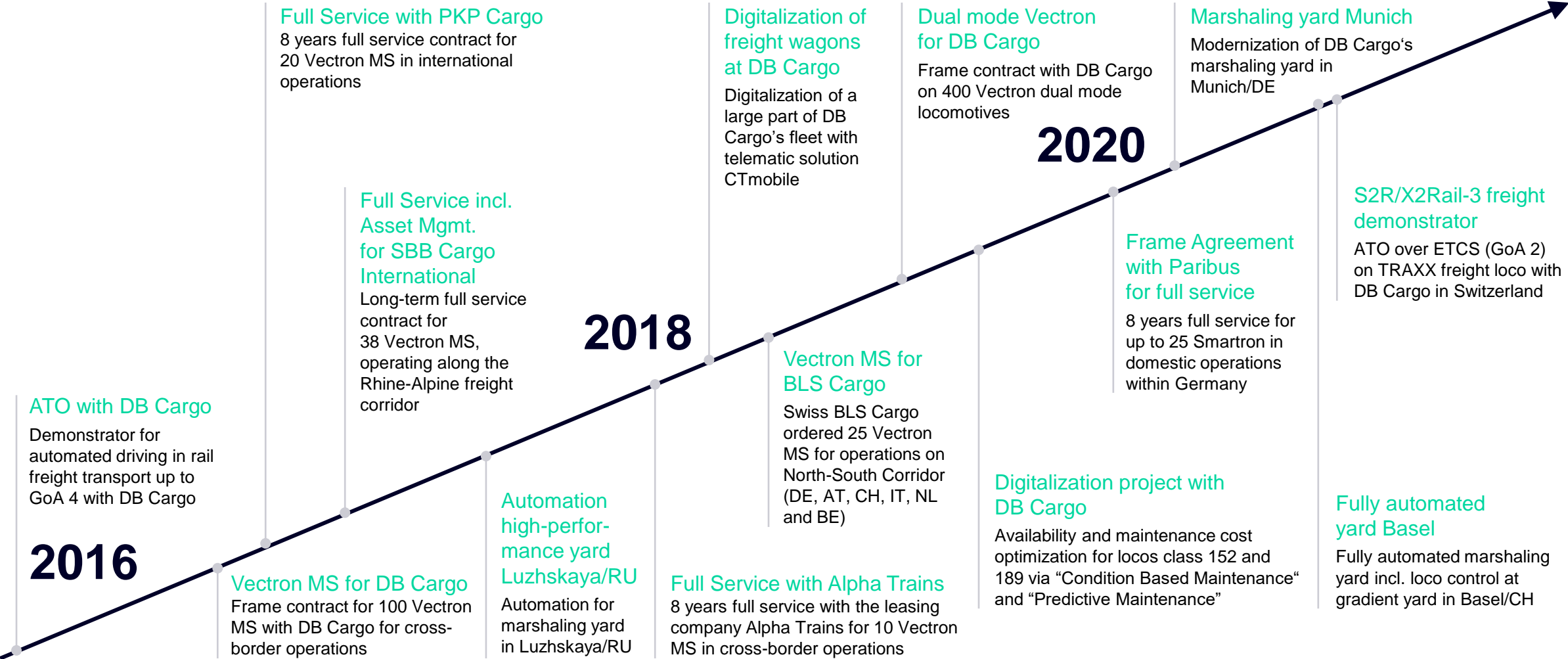
**2,600**  
R&D employees<sup>1)</sup>

**1,000**  
apprentices<sup>1)</sup>

**14**  
MindSphere application centers  
(MACs) worldwide

<sup>1</sup> As of 30.09.2020  
<sup>2</sup> Source: Siemens Global Employee Survey, June 2019  
<sup>3</sup> From 01.10.2016 to 30.9.2020

# Selected customer references in European rail freight



# We combine many years of experience with spirit of innovation

## Today's agenda



- 1 Our view of European rail freight:
- 2 Our offering for your freight business**
  - A | Planning & Dispatching
  - B | Production
  - C | Maintenance & Diagnostics
- 3 Conclusion

# Our offerings to enable an efficient and smooth freight transportation across the European network

## Planning & Dispatching



### Timetable Planning and Simulation

- 1 Train Planning and Path Request Management
- 2 Train Management Solution for Dispatching Locomotives, Wagons and Crew
- 3 ETA Calculation and Management Platform
- 4 Web Applications for Commercialization of Service Offers

## Production



### Operation in Shunting

- 5 Yard Automation: Hump Yards
- 6 Yard Automation: Flat Yards and Depots
- 7 Brake Monitoring System

### Operation in Driving

- 8 Reliable Locomotives: Vectron/Smarteron/Dual Mode
- 9 ETCS On-board Units
- 10 Automated Driving "ATO over ETCS"
- 11 Position Tracing and Cargo Monitoring

## Maintenance & Diagnostics



### Maintenance and Diagnostics

- 12 Maintenance & Technical support
- 13 Spare Parts & Repair
- 14 Lifetime Extension & Improvement
- 15 Digital Services





## Planning and Dispatching

1. Train Planning and Path Request Management
2. Train Management Solution for Dispatching Locos, Wagons and Crew
3. ETA Calculation and Management Platform
4. Web Applications for Commercialization of Service Offers

## Let TPS plan your trains and request path capacity for you in one go

### Train planning and path request management

Fully integrated track level train planning on eye-by-eye level with Infrastructure Managers reducing the processing times and risk of delays. Key features to optimize your planning activities:

- **Train planning:** Automated set up of train routes and train schedule times including required yard handling activities. Consideration of track maintenance and temporary speed restrictions providing realistic results
- **Resource planning:** Integrated rolling stock and crew rostering providing change impact information and decision support through all processes
- **Capacity requests:** Web/mobile based train path or track reservation requests integrated with the planning module minimizing overall processing times. Also useful for planning and managing yard or terminal capacity
- **Cloud capability:** The whole system is compatible with all major cloud environments

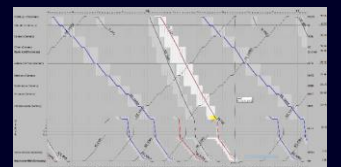
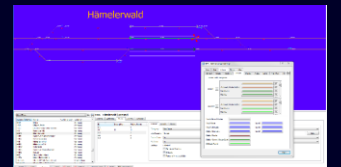


Planning solution for your freight services

### TPS.plan

### Market leading train planning solution in Europe

- Market leading train planning solution since 2010 at major European train operators and infrastructure managers
- Available technical integration framework fitting to your IT environment and regulations
- Mature and stable core components for highest system availability




## Knowing about upcoming issues in live operation allows to take pre-cautions

### Train management solution for supervision and dispatch of locos, wagons and crew

Early information about imminent resource conflicts or rule non-compliance predicted for live operating trains is key for enabling in-time services and efficient use of your resources. Key features to optimize your asset and crew dispatching:

- **Fleet supervision:** Monitor geo-position, fasten turnaround times of wagons, spot engine issues from integrated loco diagnosis modules, be informed by drivers via integrated driver app
- **Train dispatching:** Assess alternative train routes or changes to schedules of trains or yard handling activities when facing predicted conflicts. Consideration of planned or ad-hoc track maintenance and temporary speed restrictions providing realistic results. Integrated ad-hoc path request submission. Train incident management function
- **Resource dispatching:** Integrated rolling stock and crew re-planning providing change impact information and decision support



Train management solution for dispatching your services  
**TPS.live**

### Market lead in Europe

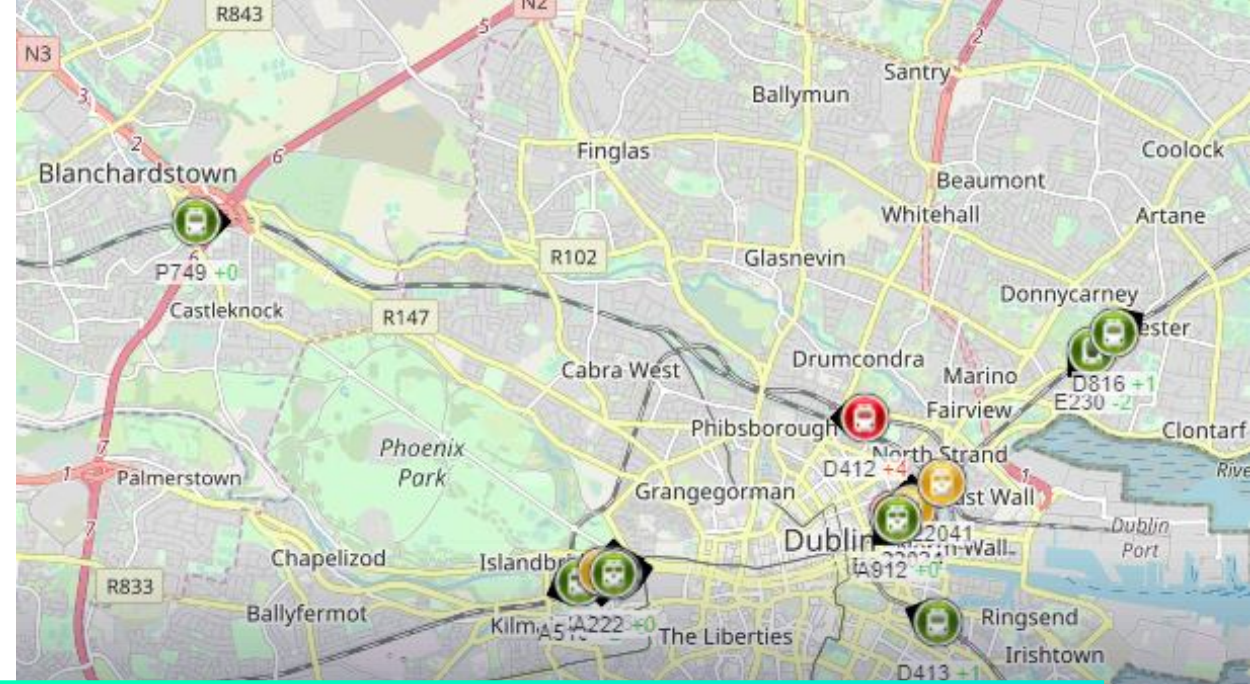
- Innovative dispatching solution based on market leading planning logic installed since 2010 at major European train operators and infrastructure managers
- Available technical integration framework fitting to your IT environment and regulations
- Mature and stable core components for highest system availability

## Improve your operations by predictions from various sources including AI

### SmartVMS based ETA management platform for international Train Monitoring, ETA calculation, comparison and evaluation

For use cases where predictions on real-time operations are not available, we provide predictions based on AI models and additional input from systems like strecken.info (HAFAS HIM) or via intelligent asset management Railigent. Improve your operations by three major levers:

- **Service supervision:** Monitor your trains and optimize your services by using accurate predictions for your relevant operational points. Provide your dispatchers with accurate and easy to use information for their daily work and use historic information to identify optimization potential
- **Stakeholder interaction:** Provide your cooperation partners with real-time updates via the control center, an interactive map or a standard interfaces. For operational staff incl. loco driver and truckers we provide a dedicated app
- **Neutral quality assessment:** Integrating planned and real-time information from various sources in a neutral system



Monitoring and prediction management for your services  
**SmartVMS**

### Market lead in Europe

- Based on experiences from the first international train monitoring system developed for CT operators in 2005 and since then in productive use at their dispatching centers
- Use to manage fleets of thousand buses and trains in various use cases
- Mature and stable core components allowing for highest system availability and compatibility

## Inform your customers about transport services easily and quickly

### HAFAS based freight service information and routing systems as basis for modern multimodal transport systems

Integrating services from various sources and providers in one coherent system, enabling real-time transport offers by using the highly efficient HAFAS algorithm. Key customer benefits:

- **Present and advertise your provider specific services:** Show all your direct or gateway services, including side information, in a modern HAFAS algorithm based company branded Web App to inform and attract your (potential) customers and to link them directly to your booking platform
- **Neutral multimodal freight transport planer/system:** Make freight transport as easy as passenger transport, by combining the various different services offers of numerous independent providers to a complete supply chain, including potential booking functions, transport companions and additional services
- **HAFAS algorithm as backbone of your booking platform:** If you have already a sales/marketing platform, just use HAFAS to ensure optimized routings with short request response times



Providing you customers with optimal routes for their cargo

### HAFAS Freight

#### Market lead in Europe

- HAFAS components and algorithms are the proven fundament of hundred journey planers and apps like DB Navigator or complete MaaS systems
- Used since many years by large CT operators for their “connection search” or for the worldwide offer process of large shipping lines
- Mature and stable core components for highest system availability and compatibility



## Production

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5. Yard Automation: Hump Yards
6. Yard Automation: Flat Yards and Depots
7. Brake Monitoring System
8. Reliable Locomotives: Vectron/Smartern/Dual Mode
9. ETCS On-board Units
10. Automated Driving  
“ATO over ETCS”
11. Geo-position and Cargo Monitoring

## Automation of marshaling yards for more efficiency and safety

### Fully automated classification process in marshaling yards

Modular and open automation system for all kind of marshaling yards and procedures which can be integrated in modern transportation chains. Key customer benefits:

- Control system *Trackguard Cargo MSR32* designed for **small yards and also high-end humping yards**
- Fully automated system for a **high marshaling quality and reduced shunting damage**
- This results in a **reduced shunting times and transfer cost** and enhance the **safety at work**
- Whispering brake segments *Trackguard Retarder* for a **significant noise reduction**
- Very fast-running point machines *Switchguard S700* for an **optimized throughput**
- Installation/commissioning possible under rolling wheel
- Full consideration of **Digital Automated Coupling** solutions



Solution for your marshaling yard

### Trackguard Cargo MSR32

#### Robust and proven solution

- Control system MSR32 is successfully implemented in high-performance marshaling yards throughout the world. Key references in Europe: Maschen/DE, Limmattal/CH and Luzhskaya/RU
- Available for all shunting techniques and procedures and adaptable to local climate and weather conditions
- Modular system fitting every individual yard and adaptable to upcoming innovations in the market

## Safety and automation in flat shunting areas and depots

### Shunting interlocking and Operation Management System

Cost-oriented interlocking for shunting operations for flat stations and depots. Modular system of *Trackguard Cargo MSR32* portfolio adaptable to your needs. Key customer benefits:

- Control system *Trackguard Cargo MSR32 RaStw* perfectly meets requirements of the **automated shunting in depots and flat yards**
- **SIL 2 system for safety-critical components** like controlling points, routes and light signals
- **Interface to adjacent interlocking systems** and modern transportation chains (cargo management system)
- Radio controlled **Decentralized point controller (DPC)** optimized for small yards
- **Combined with the Yard Management System** (OMS/BFR) the system controls maintenance center and surrounding tracks from a central point of operation and forms an **integrated solution for depots and workshops**



Solution for your shunting yards and depots

### Trackguard Cargo MSR32 RaStw and Controlguide Yard Management

#### Robust and proven solution

- Installed in many flat shunting areas like Berlin and Kornwestheim
- Together with OMS installed in many depots like Kinkempois/BE and Dortmund



## A smart innovation that makes the high efforts of manual brake tests go away

### Brake Monitoring System

Comprehensive solution to continuously collect all relevant wagon data to monitor wear, settings and load condition and make it available at your backend system. Key customer benefits:

- **Automated brake test for optimized train preparation** with reduced handling times and enhanced productivity and safety
- All relevant train handling data, events and wagon conditions are **displayed to the wagon inspector and train driver** and is **documented** in the **cloud**  
This increases **safety**, enables **paperless operation** and a seamless collaboration with other partners
- Continuous **monitoring of critical wagon components** in order to decrease downtimes of your fleet due to unexpected outages



Brake test and monitoring of critical wagon components  
**CTmobile Brake Monitoring System**

### Major step towards an intelligent freight train

- Essential building block to support an efficient train formation together with the Digital Automatic Coupler (DAC)
- Fit for retrofit installation as well as for new freight cars
- Successful field trials with major European train operators and wagon keepers

## Reliable locomotives: Vectron transforms borders into connections

### ONE locomotive evolving with your requirements

One locomotive platform consisting of complete family of AC, DC & MS and dual mode locomotives for all applications which can be adapted to new demands & innovations at any time.

Key customer benefits:

- **Maximum flexibility over** the entire locomotive **lifetime**
- **Higher flexibility in ordering process:** i.e. any quantity of an existing variant at any time
- **Easy modification & retrofitting**
- **Continuous evolution** to ensure **future-proof concept**
- Every customer can participate in further innovation and **benefits from the entire Vectron fleet**
- Participation in **periodic software and documentation updates**
- **Maximum amount of common parts** (also locomotive control software) across family resulting in life cycle cost benefit



As individual as your business

### Vectron locomotives

#### Vectron: Modular and flexible loco for EU cross-border traffic

- Robust and proven solution with 20 country authorizations
- >1,000 units sold to 55 customers
- Total fleet mileage > 400 mio. km



#### Smartron: "One country, one version, one contract"

- Fully pre-configured freight loco for selected countries
- >60 locos sold to 13 customers



#### Vectron Dual Mode: Flexible, cost effective, emission-lowering

- Significantly lower energy costs under overhead contact line
- Available for DE and AT, further roll-out planned for CZ and SK
- >110 locos/6 customers



## Smallest ETCS on-board unit with Baseline 3 implementation

### ETCS on-board unit: Compact and cost effective

The **ETCS on-board unit solution Trainguard 100/200** ensures safety-related interoperable train operation - providing control and monitoring functions towards highly automated operation.

Key features to optimize your freight operation:

- **Proven and highly reliable solution made in Germany** comprising various subsystems, such as EVC and DMI
- **Future-proof** with the latest ETCS Baseline 3.6 (BL3R2) and ATO over ETCS solution in operation
- **Maintenance free and smallest ETCS OBU** on the market
- **Optimized energy efficiency** for reduced operational costs over lifecycle
- **Scalable solution** for new vehicles and smart migration concepts for retrofit matching customer needs
- **Various national train control systems** can be integrated in Trainguard OBU (NTC/ Class B Systems)



Future with safety – powerful, flexible, expandable

### Trainguard 100/200 OBU

#### More than 420 Mio driven km in operation

- Worldwide proven ATP system with a total of more than 6,000 ETCS OBUs contracted for Siemens and 3rd party locomotives in both passenger and freight application
- Baseline 3 upgrade of 750 vehicles of the entire operational freight fleet in the UK
- With Thameslink Siemens Mobility has realized the world's first commercial ATO over ETCS application in mainline passenger rail services

## Solutions for automated driving with ATO over ETCS

### Automatic Train Operation for freight

Fully integrated and interoperable train operating system for optimized driving as a future proven ecological and sustainable technology. Key features to optimize your freight operation:

- **Energy savings:** Using time buffers, ATO adjusts the amount of coasting in the speed profile. The train will be driven to the next station or other location at exactly the required time and with the least energy possible
- **Reduced mechanical wear and tear:** By means of homogeneous driving with less braking efforts the mechanical wear and tear is reduced significantly. This result in optimized operational costs
- **Improved operational stability:** Smooth and homogeneous driving to avoid unnecessary stops enable potential additional energy savings



Automated driving for mainline freight operation

### ATO over ETCS

#### Pioneer in highly automatic freight operation

- ATO for freight transport:  
Demonstrator for automated driving in rail freight transport up to GoA 4 with DB Cargo in Wildenrath/DE (2016)
- S2R/X2Rail-3 freight demonstrator:  
ATO over ETCS (GoA 2) on TRAXX freight loco with DB Cargo in Switzerland (2020)

## Let your freight cars talk to you wherever they are

### Position tracing and quality monitoring of transported goods

Innovative and robust telematic devices and sensors are cableless mounted on freight car to capture, process and sent data to the customer's backend. Defined use cases with clear benefits:

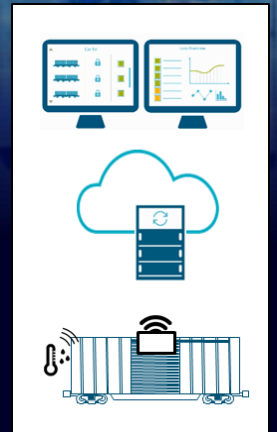
- **Tracking & tracing:** Relevant data of freight cars are transmitted real-time to fleet managers, train operators and maintenance staff for an efficient logistics and route planning
- **Mileage detection:** Accurate documentation of travelled distances per freight car for an efficient maintenance planning and a prolonged life span
- **Additional use cases with high customer benefit possible**



### Telematic solution for your freight fleet **Controlguide CTmobile**

#### Robust and proven solution

- Increase of efficiency, safety and transparency of freight transport
- Field experience since 2016 with major European train operators and wagon keepers
- More than 25,000 freight cars equipped in Europe





## Maintenance and Diagnostics

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- 12. Maintenance & Technical Support – Railcover®
- 13. Spare Parts & Repair
- 14. Lifetime Extension & Improvement
- 15. Digital services

## The right maintenance package to ensure maximum system availability and safety

### Maintenance & Technical Support – Railcover®

To ensure maximum availability and safety for locomotives and rail systems, our scope ranges from full service to tailored maintenance packages.

- **Lifecycle care:** Full service for rolling stock combined with further services such as asset management leading to the best performance
- **Full service:** Siemens as rail system maintenance expert committed to high availability of your assets
- **Technical Support & Spares Supply Agreement (TSSSA):** Strengthen your rolling stock maintenance organization with our expert support and spares supply capabilities
- **Technical support:** Professional on-site and remote assistance for any technical questions
- **System repair & overhaul:** Overhaul packages for rail infrastructure and rolling stock including vehicle accident repair to minimize your assets' downtimes
- **Workshop services:** Case by case vehicle maintenance activities performed in our Rail Service Centers



In order to ensure maximum system availability and safety

### Maintenance & Technical Support – Railcover®

#### Wide European workshop network

- No matter, if you are an operator, a leasing company or a financing institute, we have the right solution for you!
- 80+ workshops in 16 countries, thereof 50 ECM-approved
- Major hubs of the TEN-T corridors covered
- Continuously expanded network along new Vectron homologated countries
- 20+ mobile teams with Siemens specialists across Europe



## Fast and reliable spare parts and components services

### Spare Parts & Repair

Fast and reliable spare parts and components services

- **Easy spare parts supply:** Reliable part delivery and complete process handling for all needed spares
- **Easy Spares®:** Performance contracts for ensured availability and part delivery within 24 hours
- **Easy component and part repair and overhaul:** Getting your components and parts quickly back into operations
- **Easy obsolescence solutions:** Proactive and reactive measures to ensure a reliable spare parts supply over the entire lifecycle
- **Easy Sparovation Part®:** Improved 3D printed parts combining additive manufacturing and Siemens engineering know-how



High part availability and efficient material logistics

### Spare Parts & Repair

#### High part availability

- Order online in three minutes. Around the clock. From anywhere
- More than 800,000 parts available online in our online marketplace MoBase
- More than 800 parts available for print on demand in virtual stock





## Spare part service for optimized availability of the systems

### Spare Parts & Repair

Our ambition for spare parts & repair services: Identified in 10 seconds, ordered in 3 minutes and delivered in 24 hours. Key customer benefits:

- **Easy spare parts supply:** Complete process handling in framework agreements for a reliable spare part service
- **Easy spares® – Performance contracts for ensured availability:** Optimized delivery times within 24 hours “just-in-time” directly to the place where the part is needed
- **Easy components and parts repair and overhaul:** Repair and return service for parts and Siemens components at OEM quality
- **Easy obsolescence solutions:** Ensuring availability of spare parts over the entire lifecycle by monitoring product change and product discontinuation notices
- **Easy Sparovation Part® – Improved 3D printed parts:** Combining engineering know-how and additive manufacturing technologies for improving parts over the lifecycle

High part availability and efficient material logistics

### Spare Parts & Repair

#### High part availability

- More than 800,000 parts available online in our online marketplace MoBase
- Order online in three minutes. Around the clock. From anywhere
- All meaningful Vectron spares on stock
- E.g. complete bogies can be assembled and delivered within 30 days
- More than 800 parts available for print on demand in virtual stock

## Ensured and improved asset functionality, safety and value during the entire life cycle

### Lifetime Extension & Improvement

Protecting and increasing functionality, safety and asset value during an entire asset life – which might be even longer than initially planned.

- **Vehicle upgrades & lifetime extension:** Modernization solutions that make your fleet ready for the future and enhance attractiveness and usability
- **Component lifetime analysis & upgrades:** Technical improvement and lifetime extension of your rolling stock components, such as bogies, traction or pantographs
- **Upgrade solutions:** Comprehensive set of standard solutions to enhance vehicle availability and lifetime



High functionality, safety and asset value over entire lifetime

### Lifetime Extension & Improvement

#### Optimizing your life cycle cost

- ~15 years longer vehicle service life possible
- If timed right, costs for scheduled work can also be saved
- Your existing fleet can be upgraded to latest technology in terms of passenger comfort and operating characteristics; Cheaper than an investment in new vehicles

# Digital support for operations, maintenance and renewal planning of rail assets & systems

## Digital Services

Operating, maintaining and managing rolling stock and rail infrastructure assets smarter via advanced digital services and Artificial Intelligence for decision support.

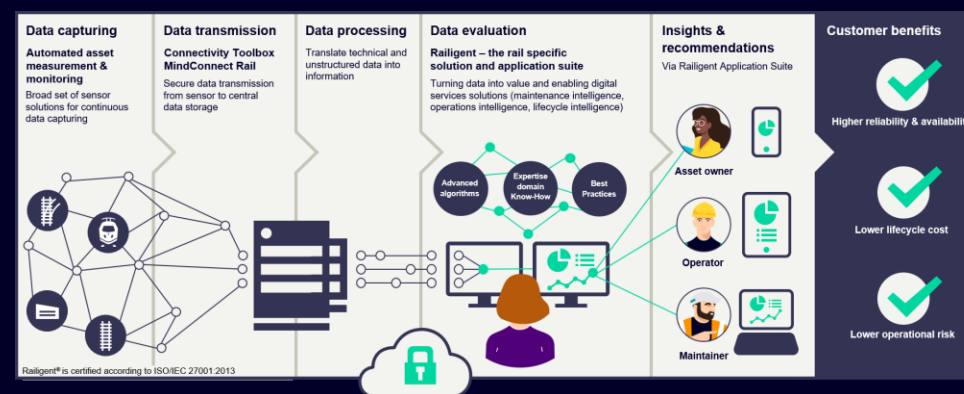
Taking care of train and wayside IT systems – including cyber security.

- **Connectivity & data transmission:** Comprehensive connectivity toolbox for secure and robust real-time transmission of system and diagnostic data
- **Measurement & monitoring:** Range of monitoring solutions to optimize maintenance, prevent derailments and minimize service interruptions
- **Data- and AI-driven decision support for optimization:**
  - **Digital asset management for rail systems** to maximize the value from rail assets over their whole lifecycle
  - **Maintenance intelligence** for high reliability & maintenance efficiency
  - **Operations intelligence** for high service availability and operational efficiency
  - **Lifecycle intelligence** for optimized renewal decisions
- **IT care:** Sustain and enhance Siemens's seamless IT solutions on-train and at the wayside, across the vehicle lifecycle
- **Cyber security services:** Protect vehicles and rail infrastructure from malicious attacks

Operating, maintaining and managing your assets smarter  
**Digital Services**

## Digital services enabled by Railigent® the IoT application suite for rail

- Ensure 100% system availability
- Improve maintenance efficiency and lifecycle costs
- Optimize service operations and throughput



# We combine many years of experience with spirit of innovation

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- 3 **Conclusion**

## We'd like to be your technology partner in the European Freight of the future

Siemens Mobility has the proven products the industry needs, but we also have a unique record of collaborating with infrastructure managers, transport operators & other technology providers

- Our solutions enable the **capacity increase** on European freight routes and yards needed to cope with the targeted modal shift and expected growth
- With pioneering products we help to **reduce emissions** and achieve the sustainability goals of the industry and the European Commission
- The combination of **more than 150 years experience** in global rail business with **pioneering innovations in digitalization** make us believe that we have a major part to play in leading the industry into freight of the future as your **technology partner**

Let us be your technology partner in European freight of the future.



