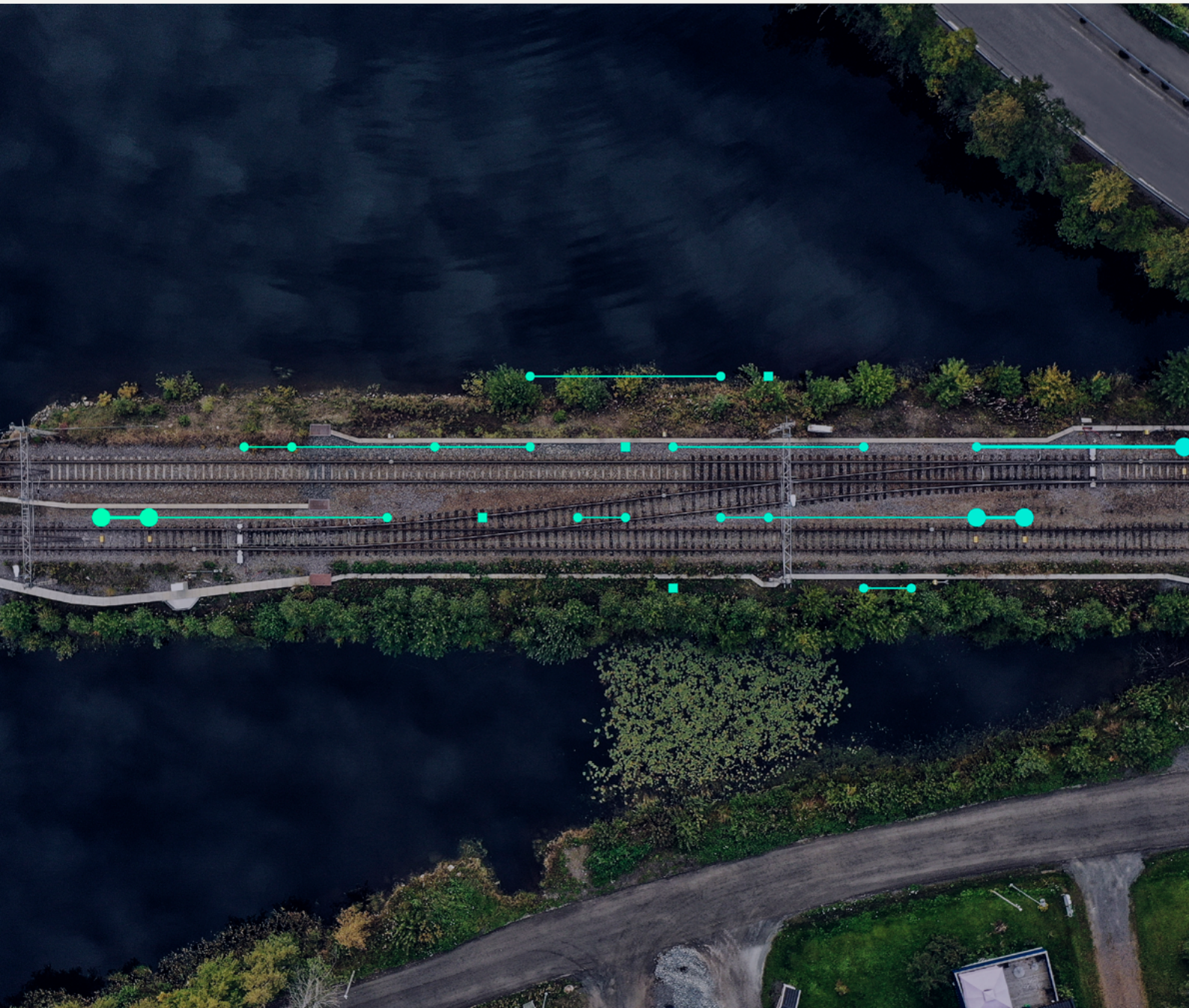
SIEMENS

MIGRATION SOLUTIONS FOR DIGITALIZED TRAIN PROTECTION

# **ETCS Retrofit – The future of rail transport available** for retrofitting



# On track
# **for the future**

Demand in passenger and freight traffic is growing faster than the capacity of our rail networks and significant performance gains will be necessary if rail as a mode of transport is to meet future requirements. Operating capacity and energy efficiency both need to be improved and further optimization is also required in the areas of interoperability, cost-effectiveness and reliability. Digitalizing the railway to enable Automatic Train Operation (ATO) is key to meeting these challenges. The basis for this next step, for track and vehicles alike, is the European Train Control System (ETCS). This standardized train control system monitors the speed of vehicles and ensures that appropriate train spacing is maintained.

There are many different national train control systems in use across Europe and it is now the aim at European level to replace them all with ETCS so that rail traffic can move across borders freely with no technical barriers. ETCS, which has become the standard modern solution for train control, in combination with ATO provides the basis for highly-automated, sustainable and energy-optimized rail transportation. We have already successfully paved the way for ATO over ETCS in commercial operation in accordance with the European standard.

**Performance optimized operation thanks to our APIs**

The advantages of a digital – and thus intelligent – infrastructure are enormous. Thanks to our APIs (Application Programming Interfaces), ATO over ETCS, TPS.live and Sidytrac, we are able to increase throughput by up to 30%, which makes it possible to run more trains on the same track safely. Smooth, reliable operation with our APIs improves traffic flow, increasing punctuality by as much as 15%. Optimized route-speed and velocity profiles also reduce energy consumption by up to 30%. This means better operation in all respects with significantly improved performance.


# **ETCS Retrofit**
# Retrofit and enjoy the benefits

As key to greater efficiency in rail transportation, ETCS enables smooth and sustainable operation across national frontiers in Europe and many other countries worldwide. The European standard can be fitted to existing fleets as well as new vehicles. Modernizing existing vehicles to protect current investments for the long term represents an economical alternative to procuring a new fleet. Retrofitting provides a way to bring your rail vehicles up to the latest standard with advanced signaling and safety technologies, enhancing the application options and extending the service life of your fleet. Retrofits are also usually significantly cheaper than purchasing replacement vehicles.

We use migration solutions that can be implemented with minimal intervention for our ETCS upgrades, which are intended to safeguard the viability of existing equipment and address the upgrading of vehicles and existing systems holistically. Our approach includes the integration of our ETCS on-board equipment with existing systems and the possible addition of other Class B systems. We are able to do all of this without significantly impacting existing maintenance workflows at vehicle level too, which also helps to save you time and expense.

## Save time and expense

Put the powerful ETCS on-board equipment to work for you and enjoy high reliability and availability coupled with consistently low operating costs. *Trainguard 100/200 OBU* helps you avoid resource-intensive maintenance and periodic checks. Investing in ETCS on-board equipment enables you to reduce your future material and labor outgoings with no hidden costs during operation.

**The right solution for every operational requirement**

Our ETCS on-board equipment is as multifaceted as your business – and we have the right solution for every ETCS level irrespective of vehicle manufacturer. You can be sure different systems will work together seamlessly even across national frontiers. *Trainguard 100/200 OBU* offers a high level of technical compatibility with numerous Class B systems. Tried, tested and approved for use with more than 15 different National Train Control Systems (NTC), it ensures your vehicles are ready for use on the conventional rail network as well. Extend the functional range of your vehicles whenever your business requires it.

# **Retrofit**
# **As individual** as your business

There are a number of factors to consider when retrofitting existing vehicles, not least the matter of how to upgrade rail vehicles during operation. Our tailored migration solutions keep downtime and any associated operating limitations to a minimum.

Another important factor to bear in mind is the great diversity of rail vehicles: There are an extraordinary number of different vehicle types and fleets on the tracks across Europe and every single vehicle has its own specific structures and characteristics. Our innovative 3D technologies enable us to establish the precise equipment installation positions and other parameters for any specific rail vehicle, which we then use to produce a vehicle-specific integration concept.


"Our tailored retrofit solutions make upgrading to the latest train control technology economical and trouble-free.

# **Everything from a single source**
# Concept and service portfolio

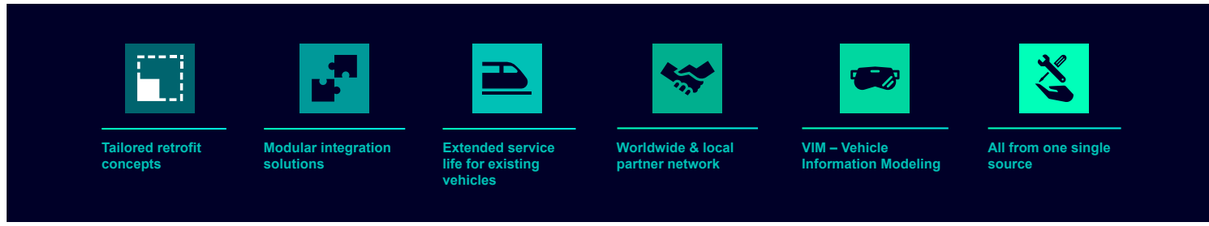

Fig. 1: Implementation concept for a retrofit project

**ATP:** Automatic Train Protection
**ETCS:** European Train Control System
**ATO:** Automatic Train Operation
**NTC:** National Train Control
**TCMS:** Train Control and Management System
**RAMSS:** Reliability, Availability, Maintainability, Safety and Security

**V&V:** Verification and Validation
**TSI CCS / LOC&PAS:** Technical Specification for Interoperability – Control, Command and Signaling / Locomotives and Passenger Rolling Stock

We support you in every project with a capable retrofit team that has many years of experience in signaling and safety systems. Whether we have overall responsibility for the realization of your retrofit project or just partial responsibility is up to you. Once we have gathered all the details required, we prepare an implementation concept matched to your particular needs (see Figure 1). This concept covers all the necessary aspects for a professional upgrade of existing vehicles. We have the flexibility to generate new alternatives for you even if the underlying conditions in your case are fluid, ensuring that you can still benefit from timely and efficient project implementation.

## We make your vehicles (retro)fit




Building on our implementation concept, we have developed a retrofit service portfolio (see Figure 2) that includes conversion on a turn-key basis. The process begins with a feasibility study on site to identify retrofitting potential. We then use the findings of this study to develop a suitable ETCS integration concept before going on to take care of vehicle configuration, the on-board equipment (prototypes and vehicle series, commissioning, trials) and the final re-authorization step.

We are closely involved in the national and European certification authorities and have both an extensive network of certification experts and long-standing relationships with certification and assessment bodies. Fleet management (equipping whole vehicle series) and training courses for our ETCS on-board equipment complete the service portfolio.

From defining retrofit concepts to achieving re-authorization for retrofitted vehicles, our team is at your disposal every step of the way – and not just for Siemens vehicles: We can upgrade other manufacturers' rail vehicles for you too.

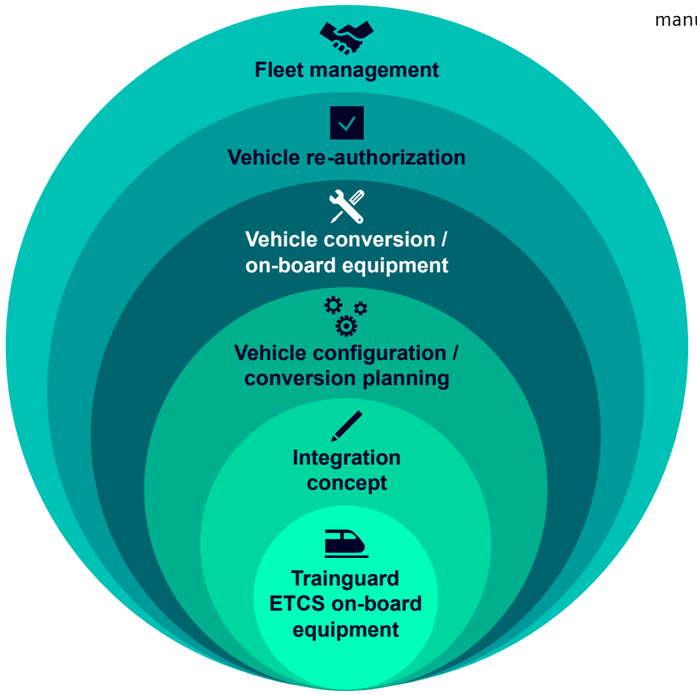
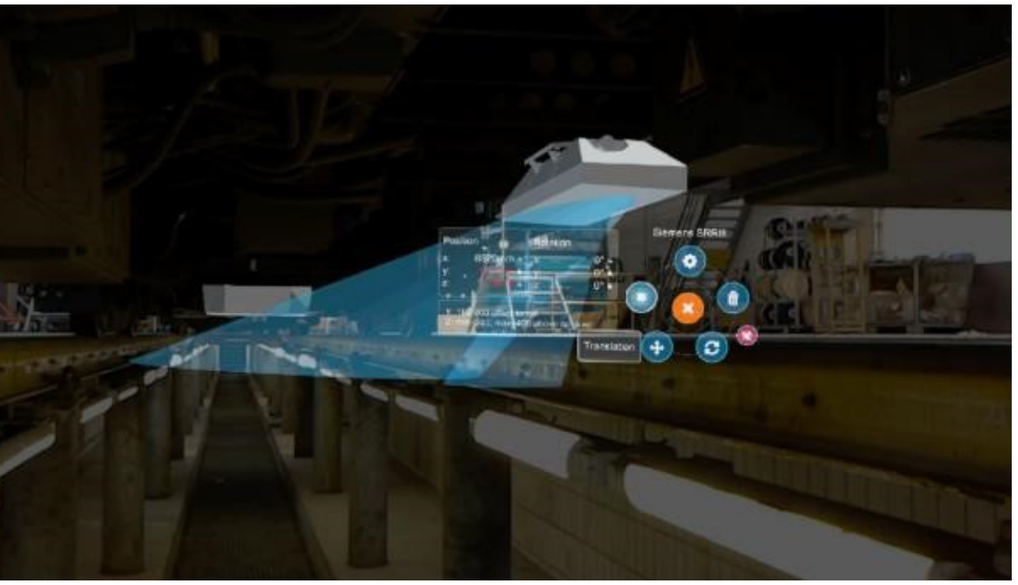



Fig. 2: Retrofit service portfolio

# Digital technologies **for vehicle analysis**




Digital technologies provide a platform for innovation, transparency and future-proof workflows. We use augmented reality to identify the different installation options for ETCS components and conduct feasibility analyses, projecting 3D models of our components onto the actual vehicle environment using HoloLens to reveal potential installation risks.

Innovative 3D laser technologies enable us to analyze rolling stock with great accuracy to obtain a model of the vehicle to be modernized. The laser scanner captures the vehicle in its entirety, including all associated components. These technologies also enable us to fill in any gaps in our knowledge due to incomplete or missing vehicle documentation, a common problem with older vehicles. The raw data acquired is combined to produce a 3D CAD model, which provides the basis for the subsequent preparation of a detailed ETCS integration concept.

The combination of sophisticated concepts and high-precision surface modeling significantly speeds up and simplifies the subsequent engineering activities. The ability to test retrofit concepts thoroughly in advance, moreover, helps to avoid unpleasant surprises later in the process (even in more challenging migration projects).



# **Plug-and-play** integration

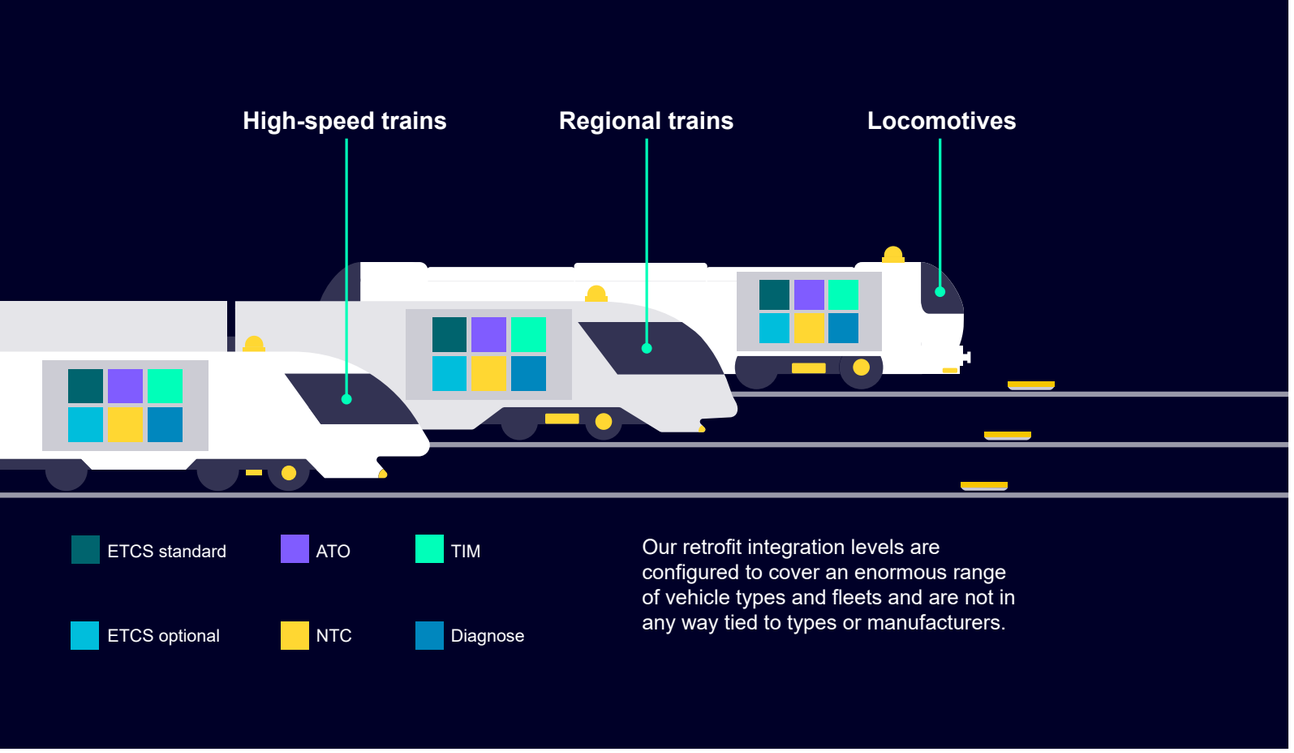
Functional integration is the first priority when retrofitting rail vehicles with ETCS. Key factors here include the interfaces to the vehicle itself and to the existing National Train Control Systems (NTC). Fire safety and electromagnetic compatibility (EMC) are also considered, as is the identification of suitable installation spaces for the components of the *Trainguard 100/200 OBU* ETCS on-board equipment. We distinguish between three different integration levels in retrofit projects:

**1. ETCS-based system**
**(partial vehicle integration)**
We provide a complete ETCS system that is integrated into the vehicle architecture with minimal intervention. We equip the ETCS installation with the necessary standard functions and can connect country-specific train protection systems with the ETCS on-board equipment if necessary.

**2. ETCS convenience system**
**(full vehicle integration)**
We supply you with a fully-integrated retrofit concept enhanced with optional ETCS functions, for example service brakes, Cold Movement Detection (CMD) and additional message displays.

We establish your specific requirements and integrate the new features into your vehicle so that they fit in optimally with the existing structure. The modular nature of our ETCS on-board equipment ensures space-optimized and technically seamless integration into the existing vehicle architecture.

**3. ETCS performance system**
Release additional potential and enhance your operating performance with advanced technologies such as Automatic Train Operation (ATO over ETCS), Train Length Detection and Train Integrity Monitoring (TIM). The advantages speak for themselves: Capacity gains of up to 30% and equally significant energy savings. Our core competence is the flexible upgrading of existing vehicles with solutions developed to meet specific customer requirements, from standardized vehicle classes to unique all-in-one solutions. We can provide custom ETCS complete solutions for all your vehicle models.




# System components **and installation variants**

The *Trainguard 100/200 OBU* essentially comprises the ETCS computer unit, sensor systems, control and display equipment and the associated peripheral equipment. Other components are the Juridical Recording Unit (JRU) and the Driver Machine Interface (DMI).

The central ETCS unit, which consists of the European Vital Computer (EVC), the Non Vital Computer (NVC) and the (optional) ATO, forms the heart of our system. Thanks to its compact design, it can be installed in vehicles in a number of different ways: in a 19" control cabinet inside the vehicle, for example, or even outside the vehicle. Whether ceiling container or underfloor option, every one of our ETCS mounting solutions is designed using a standardized installation structure. The height, width and depth dimensions are variable, however, so the actual installation options are virtually unlimited.

We can supply our components ex works in a variety of different design variants and ready-made to precise specifications too. The modular nature and compact form of these plug-and-play solutions provide great flexibility in train protection system integration, ensuring rapid implementation with no need for any major technical intervention in the existing vehicle structure.



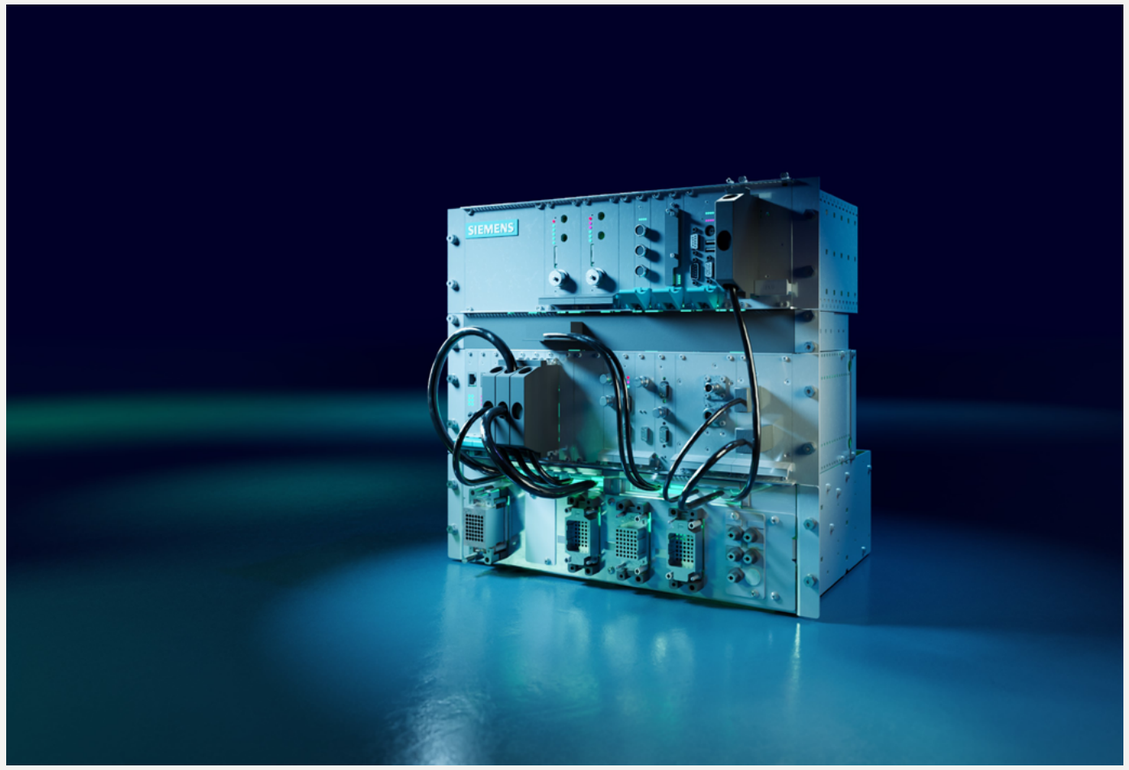
# At your service Europe-wide
## Service and consulting

Our extensive partner network means we can offer our retrofit expertise throughout Europe. Take advantage of this network and gain access to our many expert teams with a comprehensive knowledge of ETCS retrofitting. As pioneers in the field of ETCS automatic train control technology, we offer proven products for specific migration solutions and a scalable system of vehicle and communication equipment plus – of course – a full range of expert supporting services.

Seize the opportunity and tell us what you need to know: Our service staff will be sure to provide a quick and dependable response. You can rely on us for help with challenges unrelated to project implementation too.

We are developing constantly to stay ahead of the ever-tougher requirements regime and to ensure we can continue to finalize our projects successfully in the future. We want you to be completely satisfied, so we are very keen to hear your feedback.

# We make your **vehicles (retro)fit**

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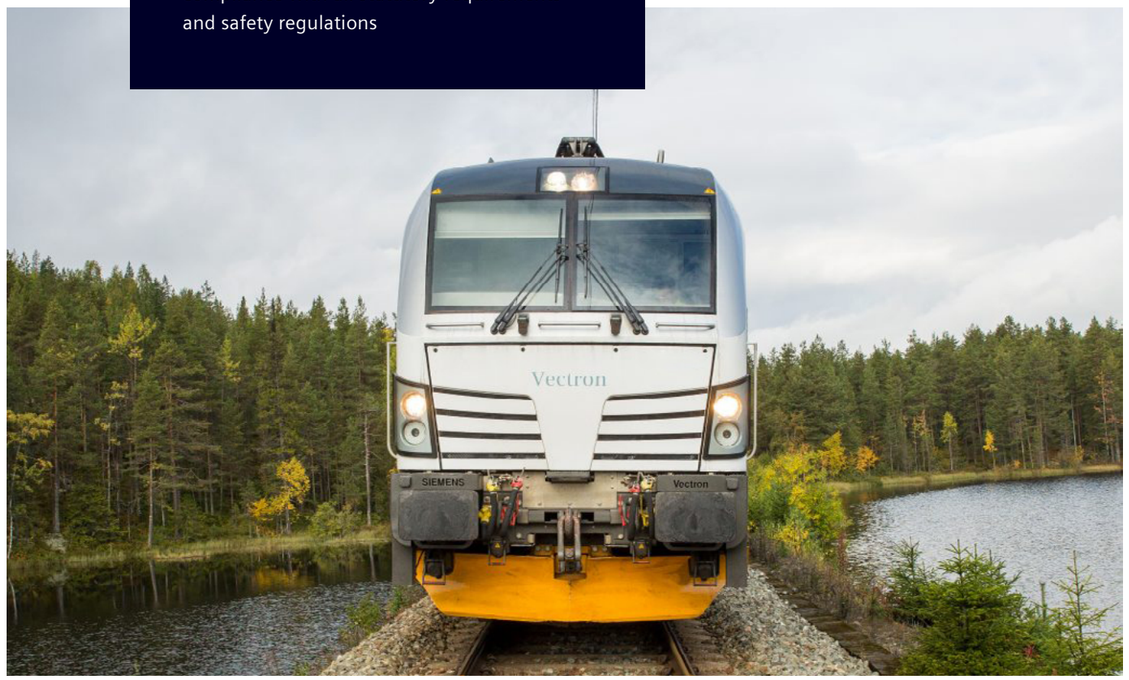
Digitalized, automated rail transportation will be a central pillar of future mobility. We provide tailored retrofit solutions to make this future a reality for existing vehicles – for operation across national frontiers with no technical barriers.

ETCS Retrofit from Siemens is all about intelligent migration solutions to help you meet your quality and performance targets and simultaneously protect your investments. The ETCS on-board equipment is sustainable and maintenance-free. This enables us to work together to create an ecosystem for an intelligent transformation in mobility while at the same time helping to protect the climate. Join us on the passing loop and break through into the future of automatic train operation.

## The benefits in brief:

- Interoperable and future-proof
- Increased profitability
- Extended service life for existing vehicles
- Tailored retrofit concepts
- Sophisticated, service-oriented diagnostics
- Fast and straightforward integration
- Compact design, modular and extensible
- Low operating costs throughout the life cycle
- High availability with zero maintenance
- Re-authorization of existing vehicles in compliance with all statutory requirements and safety regulations

You can count on Siemens Mobility to assist with other challenges in railway operations too. Whatever your mobility requirements, our trail-blazing technologies, vast experience and global network of experts can provide the technologically outstanding solutions you need. Siemens Mobility: Your dependable partner, always.



# Siemens is your trusted partner for railway retrofit projects worldwide

**LOC&PAS – SNCB, Belgium**

- Retrofit of 390 vehicles with ETCS Level 1 and Level 2 and TBL1+, LZB and ATB
- Equipment with Baseline 3R2
- Responsibility for the complete design, proto type conversion, material supply and approval of CCS and LOC&PAS

**ATO – Digital S-Bahn Hamburg, Germany**

- Retrofit of 21 vehicles with ETCS Level 1 and 2, ATO GoA 2 and PZB I60R
- Baseline 3R2
- Operation in Germany
- First-time application of „ATO over ETCS“ in Germany based on the European standard
- Implementation of energy saving management system controlled by ATO



**NTC – ČD CARGO and ZSSK, Czech Republic, Slovakia, Hungary and Poland**

- Retrofit for vehicles of class CDC 130, CDC 240, CDC 363.5, ZSSK 361, ZSSK EMU660/661 with ETCS Level 2
- Equipment with Baseline 3MR1
- Integration of NTC with ETCS



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Article No. MORI-B10019-00-7600