Trainguard
Full interoperability for rail traffic
Siemens – we offer our customers optimized ETCS solutions

One of the major challenges faced by society is to ensure mobility. To remain mobile in future, we need networked traffic and information systems. It is only when all modes of transport are suitably harmonized and perfectly interact that our mobility requirements can be handled. That is why Siemens is creating integrated transport solutions – for safe, cost-effective and environmentally friendly passenger and freight transport.

Europe is growing together and the world is opening up
With its decision to opt for the European Train Control System (ETCS), Europe has paved the way for a future of cross-border rail traffic. Promoted by politicians and driven by railway operators and leading suppliers such as Siemens, a network of ETCS-equipped lines will be bringing Europe’s conurbations and key logistics centers closer together.

ETCS is successively replacing Europe’s different national train protection and control systems and has evolved into a worldwide standard. Standardized interfaces between vehicles and lines enable operational and technical interoperability. As a result, cost-intensive multiple on-board equipment and the inefficient change of locomotives at national boundaries will soon become a thing of the past.

As one of the pioneers of ETCS, Siemens’ Trainguard solution is providing sophisticated, field-proven systems and products for individual applications. Like no other supplier, this means that Siemens has a scalable system of lineside, on-board and communication equipment for all ETCS applications.

Trainguard is the name of the solution for the standard European Train Control System.
Success starts during the planning phase
As system provider with a firm worldwide customer base, Siemens has unique planning and implementation competence in the international rail automation market. Based on this experience, Siemens can provide operators with specific advice already during the planning phase and mutually define suitable, futureproof solutions.

Optimum migration and overall operating concepts
As partner for infrastructure and vehicle operators, Siemens offers customer-oriented solutions which can be used to equip both existing and new lines as well as vehicles with ETCS step by step. This creates the basis for successful migration to ETCS and serves as protection against investment losses. Leading rail companies have already been putting their trust in this competence worldwide for years.

Competent, reliable implementation
Siemens manages projects from the very beginning all the way through to final completion. Our services range from specification and project management through to implementation, approval and maintenance. Siemens has proved itself as a competent, reliable partner for the entire lifecycle in numerous rail automation projects.

Economic success
With Siemens as a partner, operators enjoy economic success thanks to high-level operating performance and low lifecycle costs. Siemens offers its customers scalable implementation. State-of-the-art systems engineering, tailor-made installation solutions and customized migration concepts for both lines and vehicles make customers’ operations futureproof. Automatic operating programs boost capacity and optimize energy in operations.
ERTMS from a single source
In addition to its Trainguard product portfolio for ETCS, Siemens also offers GSM-R and TETRA radio systems for rail projects worldwide. As an integrated-package supplier for ERTMS (European Rail Traffic Management System), Siemens has unique competence in the rail sector on a global scale.

Centers of competence
From its ETCS centers of competence in Madrid, Berlin, Chippenham and Braunschweig, Siemens controls the entire range of its ETCS activities. This is where its experts implement Trainguard for customers throughout the world.

Test and training centers
At Siemens’ test centers, the systems to be delivered are subjected to testing before being put into use. These tests which are run under live conditions considerably reduce both project durations and commissioning times.

Lineside and on-board components can be either simulated or actually integrated. Siemens’ engineers also have the possibility of accessing the real line configuration data of other ETCS suppliers and joining up with other manufacturers’ ETCS laboratories to demonstrate interoperability in IOP tests. In this way, an on-board computer can cost-effectively run along different lines in the laboratory before starting tests on the real system. To this effect, a unique infrastructure is available, enabling train runs to be shown under real-life conditions. This emulator is also used for training our customers.
Trainguard – futureproof solutions for safety and interoperability

Interoperability
ETCS is the basis for interoperability between the on-board and lineside equipment of different rail operators. The Trainguard product family ensures unrestricted interoperability across national borders. Siemens has already impressively demonstrated the real-life interoperability of its on-board equipment with other manufacturers’ lineside equipment in different combinations. Trainguard is based on a high-performance platform which also provides an excellent basis for future applications.

High safety standard
The Trainguard system meets topmost safety requirements and complies with the Technical Specifications for Interoperability (TSI). Trainguard has successfully proved itself in day-to-day practice.

Benefits

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Trainguard – solutions for ETCS Level 1
Modular and universal

The Trainguard train control system can be used on lines
• which are to be equipped with intermittent train control for operational reasons
• where cross-border or interoperable traffic is to be enabled
• where the safety level has to be increased
• where legacy systems are to be gradually phased out
• where intervention in existing signaling systems is to be minimized

Infills permit semi-continuous train control so that the currently indicated signal aspect becomes effective before the train passes the signal involved. This is done either intermittently by means of Eurobalises or continuously with the Euroloop.

The cab display (DMI) continuously shows the driver the permitted speed and the line profile ahead. The driver is provided not only with graphic information on the driving strategy for the line section ahead but also with information about speed restrictions and other operational and ETCS-specific data.

When exceeding the maximum permitted speed, the driver is initially warned both visually and audibly. If he or she fails to respond, the train is braked to the permitted speed.

Prior to reaching any hazard points, the Trainguard system causes graded braking (service braking, emergency braking) when the braking curve is exceeded.
Trainguard – solutions for ETCS Level 1 Limited Supervision

Fast, cost-effective migration

With Baseline 3 coming into effect, the new Limited Supervision (LS) mode was introduced which, as ETCS Level 1 LS, enables cost-effective migration to ETCS.

ETCS Level 1 LS can be used
- on lines where intermittent train control equipment is sufficient
- on lines where interoperable traffic must be made possible (each Baseline 3 vehicle can operate here)
- on lines where the safety level has to be increased
- on lines where the existing Class B system is to be discontinued

ETCS Level 1 LS is a new mode in vehicles which is commanded by the line. In this mode, there is no cab signaling on the on-board DMI. The driver has to observe the trackside signals and drive the train in accordance with the operating rules. The specifications transmitted by the line are monitored in the background.

Which specifications are transmitted by the line are defined on the basis of infrastructure managers’ risk evaluation. The possible range extends from purely stop monitoring at the signal to full braking curve monitoring, functionally comparable with ETCS Level 1 Full Supervision mode.

Current implementations of ETCS Level 1 LS are based on the functionality of the Class B systems used in the respective area, such as PZB in Germany and Integra/Signum/Zub in Switzerland.

Another benefit of this functionality is that drivers only need to be briefly trained since they continue to drive in accordance with fixed signals. This also means that the existing operating rules need to be adapted only slightly.

From a technical point of view, ETCS Level 1 LS offers the possibility of equipping the line cost-effectively. Optimized components and processes can be used by scaling the monitoring functions in line with operational and safety-related requirements.
Trainguard – solutions for ETCS Level 2
High-performing, efficient and futureproof

As the governing feature of ETCS Level 2, all information which is required for safe running on a certain line section is transmitted by radio from a radio block center (RBC) and displayed on the DMI. The GSM-R digital mobile radio system for railways (optionally TETRA) is used for this purpose. Eurobalises serve as reference points to determine the position of the vehicle. Trainguard uses the information provided by the route elements of connected interlockings. Signals can continue to be used for mixed operation or as a fall-back level, although they are no longer required for purely Level 2 operation. Information about signal aspects and point positions is sent from the associated interlocking to the RBC which uses this information to generate the movement authority and forward it via DMI to the driver.

Line throughput is considerably boosted. Running “on electronic sight” over several section blocks enables trains to operate at maximum speed and headway. Considerable savings in infrastructure can be obtained due to the fact that wayside signals can be optionally dispensed with.

The technical compatibility of Trainguard systems for Level 1 and Level 2 ensures interoperability beyond system boundaries and national borders.
The prime feature of ETCS Level 3 is operation without any trackside track vacancy detection components, resulting in major cost benefits, both for initial investment and throughout the entire lifecycle.

Irrespective of the Technical Specifications for Interoperability (TSI), capacity can be increased in the form of short headways by virtual fixed-block operation or moving-block operation.

In ETCS Level 3 which is currently not yet standardized in further detail, Siemens can offer the entire range of system competence since on-board equipment, vehicles and trackside solutions are developed from a single source. This results in consulting competence which can be applied in dialog with the respective line operators to the specific operational design. For example, depending on the objectives involved, it may be beneficial to apply ETCS Level 3 to individual selected areas and line sections and to certain vehicle types.

Suitable fall-back levels and scenarios can be offered on a customer-specific basis.

In contrast to other ETCS levels, in ETCS Level 3 the vehicles are integrated into route protection even more actively. They have to indicate their integrity to the RBC both safely and permanently. The RBC is thus capable of optimizing route utilization.
The "green and efficient" railway of the future is about much more than optimizing individual parts of the mainline system. Siemens can help design architecture, technology and solutions for environmental compatibility. Our products and systems incorporate ecological concerns – featuring both environmental advantages during their lifecycle with low resource consumption and effects on efficient rail operation. In numerous projects around the world, we have proven not only the excellent technical performance of our solutions, but also high integrability as well as efficient, solution-oriented project management.

We have listed a selection of references containing some of our most important customers.

**Trainguard references**

Middle East/Africa

- Algeria
  Société Nationale des Transports (SNTF) Ferroviaires
- Morocco
  Office National des Chemins de Fer (ONCF)
- Tunisia
  Réseau Ferroviaire Rapide (RFR)
- Saudi Arabia
  Saudi Railway Organization (SRO)
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