Trainguard Futur 2500
Level 2 ERTMS solution
Within the range of the Trainguard Futur family of train control systems made by Siemens, Trainguard Futur 2500 is the Level 2 solution which provides great performance for operation and enhanced maintenance features for railway operators around the world.

Harmonized community transport policies are essential throughout the European Union. The ability to circulate from one member state to another using interoperable driving systems is becoming a fundamental requirement.

Achieving a single automatic driving system is crucial for the optimization of rail transport efficiency not only on a European scale but also for other countries outside the European Union (i.e. Saudi Arabia, Kazakhstan, etc.) which are considering this standard as a basis for their railway operations.

In order to develop such a system, it is necessary to establish common standards for on-board systems, the connection / communication interfaces between modules and the development of common procedures. In order to fulfil these requirements, the European Rail Traffic Management System (ERTMS) has been developed and is now being deployed worldwide.

Siemens has developed a full range of safe and interoperable ERTMS equipment which is already being used successfully in various applications. Trainguard Futur 2500 is Siemens’ ERTMS Level 2 train control solution.

**Key features**

**Operability**
The entire functionality of Trainguard Futur 2500 has been tested in several projects with different railway operational concepts. Futur 2500 has been certified according to UNISIG 2.3.0d. Regarding upcoming specifications, Futur 2500’s updating path to UNISIG Baseline 3 has already been defined.

**Modularity**
Trainguard Futur 2500 has a modular structure. Each element executes a clear functionality. This facilitates maintenance and improves reliability by employing specialized hardware for the different functions. Moreover, it permits equipment evolution since each element may be modified independently without affecting others.

**Connectivity**
The system provides excellent connectivity with other systems through serial interfaces – established using the TCP/IP protocol. It facilitates access to different types of networks used in railway environments (i.e. GSM-R, TETRA).

**Reliability**
The components employed in the Trainguard Futur 2500 system have been selected because they comply with the highest levels of reliability. They include components that are widely available throughout industry in order to extend availability during the system’s lifetime and to facilitate updating to new versions.
Availability
All safety-related subsystems of Trainguard Futur 2500 have been developed as a two-out-of-three system (2oo3). Communication equipment offers the possibility of being deployed in a hot-standby configuration, thus ensuring high levels of availability.

Maintainability
Maintenance and diagnostic operations can be carried out either locally or from the central control system – granting real-time access to all parameters of the system.

Safety
The Trainguard Futur 2500 design methodology follows the European standards CENELEC EN 50126, EN 50128 and EN 50129.

High performance
The system employs already proven techniques in order to reduce both costs and the size of the hardware and also to increase process speed. Any later modifications to functionality and response time requirements of the chosen system are guaranteed by the selected platform.

Temporary speed restrictions (TSRs)
Trainguard Futur 2500 includes an advanced system to manage temporary speed restrictions (TSR) on the line. TSRs may be established and canceled in an operator-oriented, safe and simple manner. The proposed system allows the TSR to be chosen either within any kilometric range of the line or using track circuit allocation. Available speeds are set from 0 to 350 km/h in steps of 5 km/h.

Representative projects
Siemens has successfully implemented its ERTMS solution in several projects with different railway concepts:

- high-speed lines (i.e. Córdoba–Málaga, Madrid–Levante, Mecca–Medina, Ankara–Konya, etc.)
- metropolitan areas (i.e. Madrid commuter lines, Marmaray)
- metropolitan areas with ATO (i.e. Thameslink)

The Trainguard Futur 2500 system has been installed and put into service to provide the route with ETCS Level 2 in accordance with the Unisig 2.2.2 specifications. In addition to the usual control and monitoring functions for their respective areas, the two installed Trainguard Futur 2500 RBCs implement the complex functionality in relation to “train handover”.

System operation
The Trainguard Futur 2500 system is a complete train protection system based on the interchange of bi-directional continuous information with the train through the use of GSM-R Euroradio.

According to the infrastructure state and the situation of the trains on the line, the radio block center (RBC) calculates the movement authority (MA) and sends it along with the track data to each train. This information is generated by the RBC using each train’s localization as given by the relevant interlocking. The train’s position is given by the GSM-R/TETRA as well as through track occupancy.

The on-board equipment provides continuous supervision of the train’s speed in order to avoid overrunning the MA given by the RBC.

The Trainguard Futur 2500 ERTMS Level 2 equipment is applicable for several exploitation scenarios – from high-speed lines up to 500 km/h to commuter lines with high degrees of occupancy, all accompanied with all those particular requirements defined by railway operators.
Architecture
The Trainguard Futur 2500 system consists of the following basic elements:

**CEC – central ERTMS control**
This subsystem manages all functions included in ERMTS Levels 1 and 2 from a single control center.

Command and control of all RBCs on a line is the main function of the CEC. Temporary speed restrictions (TSRs) are set safely from the CEC and are then sent to the trains through the RBCs.

A CEC may work independently or be integrated into an operations control center (OCC). Any particular railway line may be split between several CECs, the transfer of command between them being another available functionality.

The CEC is designed as a modular architecture, in terms of both hardware and software, thus granting adaptability to future functional requirements.

**LEC – local ERTMS control**
The LEC is the subsystem allowing the operator a safe introduction of commands for the RBC, including temporary speed restrictions (TSR).

The operator has a mouse and keyboard interface to use the LEC. All commands are registered in the JRU and all relevant information is displayed to the operator.

**JRU – juridical recorder unit**
An accident-resistant "black box" unit is allocated to each RBC, permanently recording all messages from and to each RBC, including faults and incidents related to the RBC and its communications – LMAs, train positions, etc.

There is also a JRU associated with each LEC.

**MAS – maintenance assistance system**
Each RBC has equipment allocated for data storage and maintenance assistance, including fault location and communications health monitoring.

The MAS is common to both Level 1 and Level 2 systems, providing real-time communication with maintenance staff by SMS.

**ICE – interface control equipment**
An ICE machine is used to interconnect the RBCs with the CEC through the real-time operating network. This provides total isolation for the private signaling network to which the RBCs are connected.

A hot stand-by configuration is used to guarantee total communication availability.
Trainguard Futur 2500 includes a powerful tool for tests and simulations in the lab. This tool allows data validation for both Level 1 and Level 2. Tests in the field are then limited to correspondence tests between the data and the actual hardware.

Tests with this tool may be automated, thus saving engineering hours in the lab and testing times in the field. The system also proposes alternative solutions to the initial settings, thus enhancing final performance of the system and aiding exploitation management of the line.

The simulator is also capable of emulating several types of rolling stock with the correspondent dynamical behaviors. Application data of the ERTMS equipment may be therefore better adjusted.
The information in this document contains general descriptions of the technical options available. The required features should therefore be specified in each individual case at the time of closing the contract. For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action and integrate each component into a holistic, state-of-the-art security concept. Third-party products that may be in use should also be considered.