

Passengers Railway Solutions



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“Connecting pieces of your world”



Hitachi Rail STS in brief

Complete Transportation Solutions - Passengers and Freight

All around the world, Hitachi Rail STS supports its clients to create and develop more reliable and sustainable networks that ease urban mobility and solve the challenges of today's population and cities rapid growth.

Hitachi Rail STS is a leader in rail transportation, with over 150 years of experience in pioneering safe and reliable railway signalling applications and transportation solutions. From turnkey contracts for mass transit, conventional and High Speed railway projects and single station signalling systems, to complete transportation solutions, Hitachi Rail STS is an undisputed global provider of innovative and integrated solutions.

In response to demand for interoperability and increasing speeds above 250 km/h, Hitachi Rail STS was one of the first involved with the development of ERTMS, the European Rail Traffic Management System, which is now the preferred solution for new High Speed lines in the world.

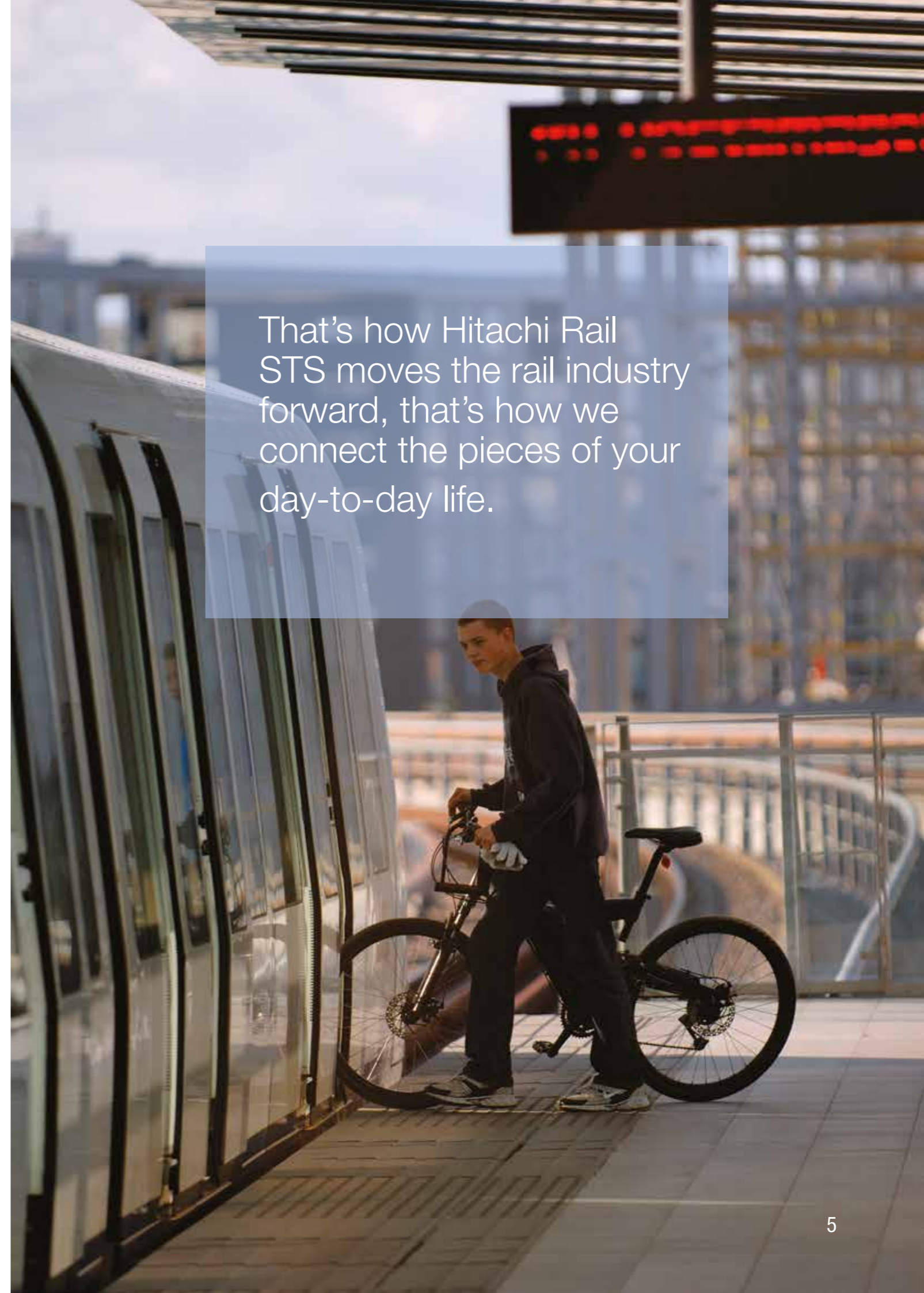
Hitachi Rail STS has over 30 years of lines around the world. This includes more than 10 years in the integration of railway systems for High Speed and the delivery of almost 5000 Km of lines and thousands of on-board systems in operations.

Hitachi Rail STS 's main capabilities encompass all phases of a rail project: from the design to the delivery, services and maintenance of signalling technologies, automation and control systems .

Hitachi Rail STS has a complete and innovative product portfolio that includes the most advanced technologies in:

- Operation and traffic Control
- ERTMS L1 and L2
- On-board signalling equipment
- Computer based Interlocking systems
- Wayside signalling systems and vital equipment
- Operation support systems
- Integrated security systems

Based on this complete product portfolio, Hitachi Rail STS has developed specific technical solutions suitable for all passenger railways.



That's how Hitachi Rail STS moves the rail industry forward, that's how we connect the pieces of your day-to-day life.

High Speed Lines (Mainly ERTMS)

Hitachi Rail STS technical solutions for High Speed lines are based on one of these architectures for the signalling system, that are applied on new lines with a top speed of at least 250 km/h and existing lines with a top speed of at least 300 km/h up to 320 Km/h, mainly based on ERTMS L2:

- IXL/ERTMS L2
- IXL/ERTMS L1+L2
- TVM based.

With Hitachi Rail STS's technical solution, the railway operators can take advantage of the new opportunities that ERTMS offers to create an Interoperable railway Automatic Train Control system, increasing the competitiveness of the railways in terms of:

- High Speed
- High Capacity
- Mixed traffic
- Coexistence with legacy system.



Why ERTMS?

Interoperability:

European Commission supports the development of **operational** and technical interoperability with unified signalling equipment in order to open railway markets to all train operators.

Safety:

ERTMS equipments are designed and produced in compliance with **CENELEC** standards.

Performance:

High speed can be reached using the lowest amount of time **distance** between trains.

Availability/reliability:

Due to the particular ERTMS architecture, there are less **equipment** along the lines, reducing fault probability and improving system reliability.

ERTMS Level 2 is a Train Control System based on continuous communication of variable data between the Radio Block Center (RBC) and the trains, via radio system.

The main principles of the ERTMS L2 are based on:

- Radio based Automatic Train Control system, which provides a continuous speed supervision
- Movement Authorities, track description data, temporary speed restriction and emergency messages are generated by Radio Block Center on the basis of information received from train itself, external interlocking system and Train detection
- Messages transmitted and received to/from the train via GSM-R system.
- Balises (Eurobalises) are used mainly for the positioning of the train and for specific situation
- ETCS on-board equipment calculates a dynamic speed profile taking into account the train braking characteristics and commands the brake if necessary
- Lineside signals are optional.

Eurobalises + Euroradio (GSM-R) + Radio Block Center

- No more trackside signals required
- Movement Authorities through GSM-R
- Train position via Eurobalises.

Main references:

• High Speed Line

- Italian HS Lines (ERTMS L2 only)
- Rome-Naples Line – length 200 km – in revenue service since December 2005
- Turin-Novara-Milan Line – Length 120 km – Turin-Novara in revenue service since February 2006; Novara-Milan in revenue service since September 2009
- Milan-Bologna Line – Length 185 km – in revenue service since December 2008
- Brescia-Treviglio Line – Length 60 km – ongoing
- Pioltello- Treviglio Line – Length 30 km – ongoing

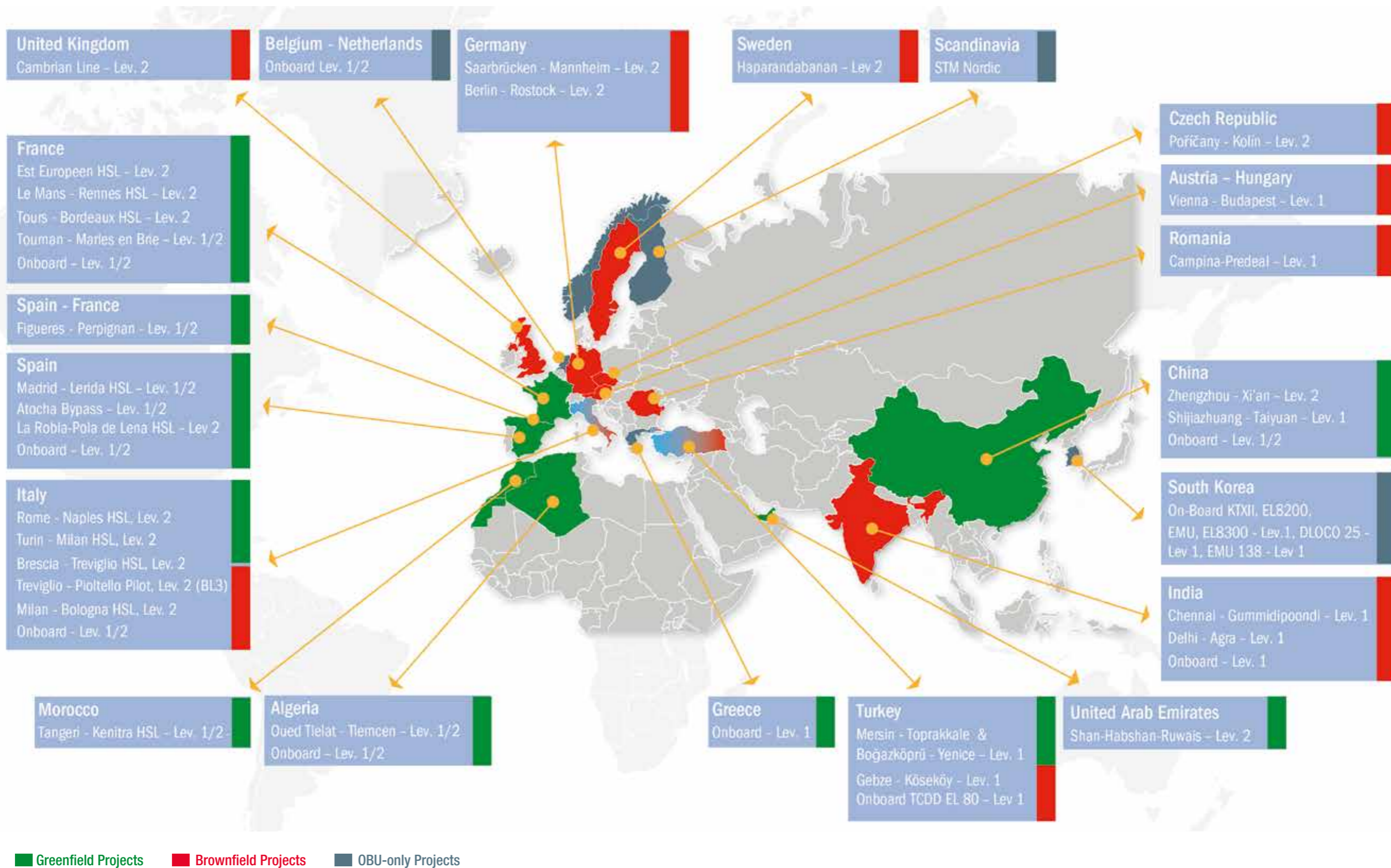
- French HS Lines (ERTMS L2 + National System)
- HSL Est Européenne Phase 1/2 – length 300+106 km - revenue service TVM: 2007; ERTMS (July 2016)
- HSL SEA (Tours -Bordeaux) – length 340 km - ongoing
- HSL BPL (Le Mans-Rennes) – length 182 km - ongoing

- Spanish HS Lines (ERTMS L1/L2 + National System)
- HSL Madrid-Llerida – Length 460 km - Revenue service with ASFA in 2004 and ERTMS Level 1 in 2006, Revenue service with ERTMS Level 2 in 2011
- HSL Perpignan-Figueras – 45 km (revenue services in December 2010)

- Chinese HS Lines (ERTMS L1 or L2 + National System)
- HSL Zhengzhou-Xi'an (ZhengXi) Line – Length 500 km - Revenue service with ERTMS in February 2010
- HSL Xi-Bao (Xian-BaoJi) Line – Length 138 km - Revenue service with ERTMS in December 2013

- North Africa HS Line (ERTMS L1/L2)
- Morocco - HSL Tangier-Kenitra 183 km - ongoing
- Algeria - HSL Oued Tlalat-Tlemcen Project – 180 km - ongoing.

ERTMS/ETCS L1/L2 Main References



Conventional Lines ERTMS Solution

Hitachi Rail STS technical solutions for Conventional lines are based on one of these architectures for the signalling system, depending on the request of the railway operator to revamp the existing interlocking (IXL) system or superimpose an ETCS system (L1 or L2) on new or existing lines with a max speed lower than 200 km/h:

- IXL/ERTMS L1 or L2/ National signalling system PTC system
- ERTMS Level 1 is a Train Control System based on intermitted track-to-train communication using Eurobalises and optional advances data Infill
- ERTMS level 1 is designed as an add-on to or overlay of a conventional line already equipped with lineside signals and train detection
- Communication between the tracks and the train is ensured by dedicated balises (Eurobalises) located on the trackside adjacent to the lineside signals at required intervals, and connected to the Train Control Center
- Receiving the movement authority through Eurobalises, the ETCS on-board equipment automatically calculates the maximum speed of the train and the next braking point if needed, taking into account the train braking characteristics and the track description data
- The speed of the train is continuously supervised by the ETCS on-board equipment

The main benefits of ERTMS Level 1 are interoperability (between projects and countries) and safety, since the train will automatically brake if it exceeds the maximum speed allowed under the movement authority.

Eurobalise without Infill:

- Overlay to Existing Signalling System
- Movement Authorities through Eurobalise
- Train Integrity & Position by Track Circuit.

To increase the capacity, additional Infill between the distant and the main signal are installed.

The new aspect status is updated more frequently via radio using GSM-R corresponding to a balise in advance of the train.

As a consequence, a train approaching the application zone of a more restrictive condition can revoke braking as soon as the signal clears without waiting to reach the balise itself.

Eurobalise + Infill:

- Overlay to Existing Signalling System
- Movement Authorities through Eurobalise
- Train Integrity & Position by Train detection.

Main references

L2 Brownfield projects – ETCS superimposed on National Signalling System

- Germany: Saarbrücken-Mannheim – Length 125 Km - ongoing
- Germany: Berlin-Rostock Lines – Length 176 km - ongoing
- Czech Republic: Poříčany-Kolín Pilot Line – Length 25 km

L2 Brownfield projects – IXL revamping and ETCS to be added

- United Kingdom: Cambrian Line - Length 218 km – Revenue service October 2010
- Sweden: Haparandabanan Line – Length 156 km – Revenue service December 2013

L1 and/or L2 Greenfield projects – new IXL and ERTMS L1 and/or L2

- Libyan HS Line (ERTMS L1/L2 only) – Length 1400 km - ongoing
- Turkey: Gebze-Köseköy Line (ERTMS L1) - Length 56 km - ongoing
- Abu Dhabi Line (ERTMS L2) - Length 370 km - ongoing
- L1 Brownfield projects – ETCS superimposed on National System (IXL, ATP)
- Italian Conventional Network
- India: Chennai-Gummidipoondi & Delhi-Agra Lines
- L1 Brownfield projects– IXL revamping and ETCS to be added
- Turkey: Mersin-Toprakkale & Boğazköprü-Yenice Lines – Length 430 Km - ongoing
- Romania: Campina-Predeal Line.

PTC Solution

A PTC system adds an overlay train control system to the existing infrastructure to enforce the following as its main functions:

- Wayside signal aspects
- Line speed restrictions
- Temporary speed restrictions
- Work zone protection.

Before the existence of Positive Train Control (PTC), railroads relied primarily on human, mainly train engineers and dispatchers trained to comply with all safety rules. Human errors were attributed to remarkable portion of train accidents that involve over-speed, another train, railroad workers, and road crossings.



A PTC system consists of four major parts: Carborne, Wayside, Office, and Communications. VEH manages the train and applies penalty brakes when detecting unsafe conditions related to over-speed or short stopping distances. Wayside relays interlocking status such as signal aspects and switch positions to VEH when interrogated by VEH. The Office contains workstations for dispatchers to add, modify, and delete TSR's and a Safety TSR Server that manages the TSR's. The TSR Server transfers an up-to-date TSR list to VEH when requested by it. The Communications bridges all the above parts together with a highly available network.

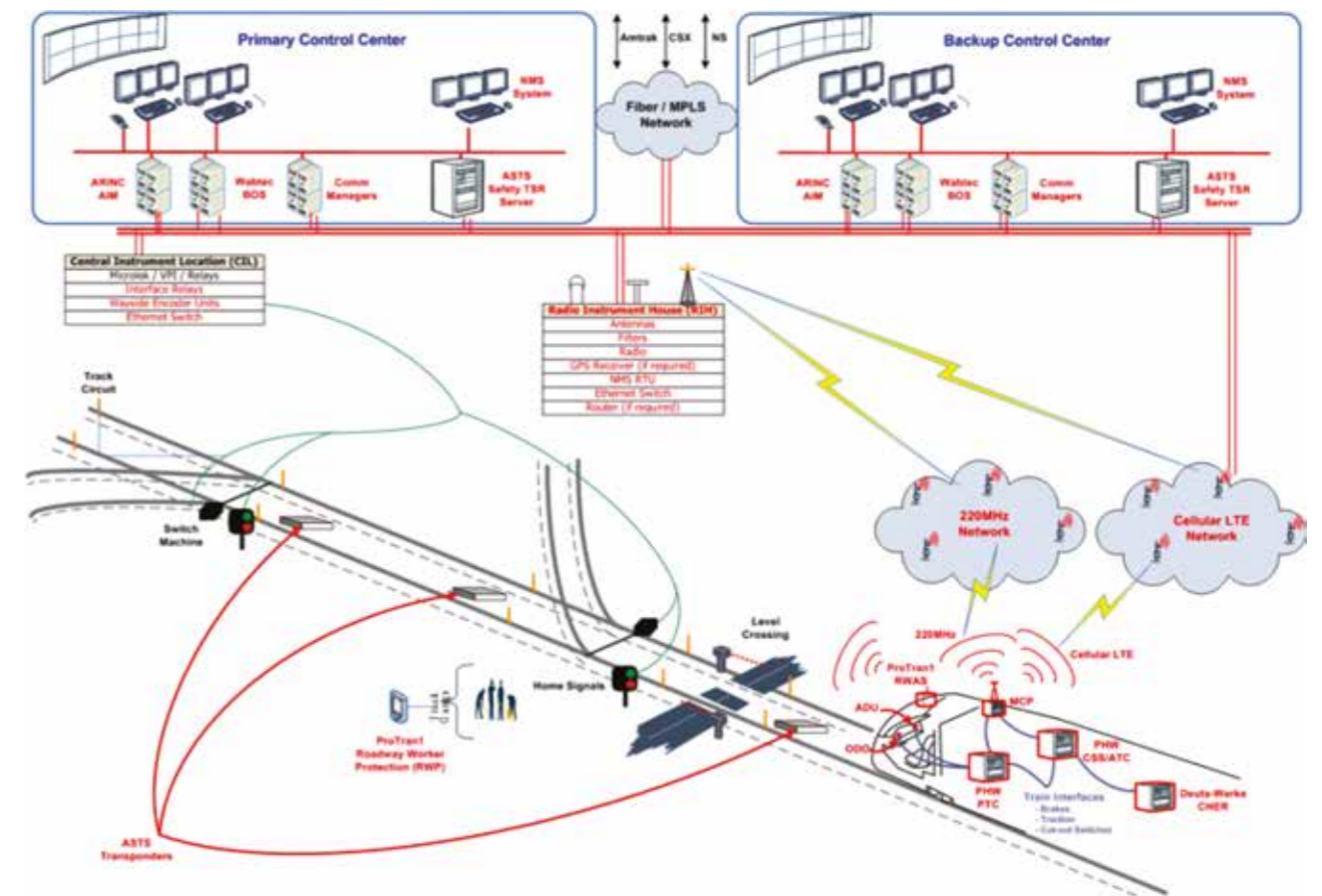
The PTC system protects security of itself with physical intrusion detection, network firewall, port activation/deactivation, account authentication, and data encryption. It provides high maintainability with monitoring and diagnostic functionalities.

Hitachi Rail STS integrates a full PTC system solution that implements both Advanced Civil Speed Enforcement System (ACSES) and Interoperable Electronic Train Management System (I-ETMS) technologies. This allows the system to interoperate with both passenger railroad networks and Class-I freight railroads that implement one of the above technologies.

The Hitachi Rail STS 's PTC solution increases system passenger, crew, and public safety while maximizing operational efficiency. It complies with the FRA Rule for PTC, particularly the PTC System Certification performance requirements in Part 236-i. The system implements PTC with a minimum disruption of daily passenger operations, and passenger and/or freight operations by tenant railroads on the property owner's territory. The technologies implemented improve the operational efficiency on tracks shared with tenant rail roads.

The system features user interfaces that improve train crew and dispatch personnel situational awareness of real-time railroad conditions and operations.

Within the Hitachi Rail STS technical solution, Hitachi Rail STS provides three major components, i.e. transponders, Wayside Interface Unit/ Wayside Encoder Unit (WIU/WEU) based on proven MicroLok II technology, and Safety TSR Server proven in Europe for its ERTMS applications. Hitachi Rail STS provides an end-to-end simulation environment for system integration, training, and trouble-shooting. In PTC applications, Hitachi Rail STS demonstrates strong capabilities in the design, installation, integration and commissioning of complex systems.



Suburban and Regional Railways

Why Hitachi Rail STS?



The basic aim of the ERTMS REGIONAL concept is to enable cost saving solutions for signalling on regional and local lines when upgrading or installing new signalling equipment on these lines.

The ERTMS REGIONAL concept is an idea that is a trackside development of specifications and systems based on the interoperable and standardised communication with the rolling stock over the air gap specified.

Interoperability and intraoperability with the ERTMS on-board equipment is thereby ensured.

Therefore the ERTMS REGIONAL is basically a trackside development managed by a centralised control through the use of the GSM-R system to operate the relevant objects (points, level crossings, key locks, shunting areas etc) in the infrastructure.

The center itself, called the TCC (Traffic Control Center), contains the integration of the RBC (Radio Block Center), CTC (Centralised Traffic Control) and the interlocking functions.

A typical example of an ERTMS REGIONAL application would be the need to upgrade old fashioned, even mechanical, interlockings where local dispatching is required, to an ERTMS REGIONAL system that facilitates the introduction of remote-controlled functionality based on one or two dispatchers per line.

The key features for ERTMS REGIONAL are as follows:

- On-board standard Eurocab
- Air Gap Eurobalise and GSM-R
- On-board permanent check train integrity

- Trackside train detection devices as an option
- No lineside signals.

ERTMS Regional is aimed to be an ETCS level 3 concept whereby the main characteristic aspect of level 3 is to use the on-board odometry for the train location.

The check of train completeness can be solved more easily on regional lines than on main lines. Level 3 allows significant cost reductions because traditional means for train localisation in the track are no longer necessary.

The introduction of the GSM-R or other network system communication with object controllers in the infrastructure (points, level crossing etc) can reduce the amount of cables. Power supply to point machines is still needed.

The key points for the cost savings are as follows:

- Staff reduction in stations
- Less trackside equipment (e.g. no complete radio coverage)
- No lineside signals
- No traditional interlocking, integrated Interlocking/RBC/TMS with one data model
- Minimising cables by controlling elements via radio
- Track circuits and axle counters only for special locations
- Fall-back by Rules and Regulations
- Safety approach by considering a tolerable hazard rate.

GSM-R Track side and ERTMS on-boards are not contained in the calculation as it is considered to be a prerequisite.

The Hitachi Rail STS's approach

The main objectives to be achieved by a Turnkey Contractor are:

- Ensure the compliance with the overall project schedule and budget through an integrated planning management and costs control
- Ensure the compliance of the transportation system with the general requirements, standards and regulations
- Ensure that each sub-system works accordingly to its functional specifications and to the overall system requirements
- Ensure the proper interface management across all the sub-systems and the external constraints
- Ensure the compliance of the complete transportation system with its overall performance requirements
- Ensure the safety of the system in any condition of operation
- Ensure the project delivery on time and on budget.

To successfully achieve the above mentioned objectives, over the past decades of experience in mass transit Turnkey projects, Hitachi Rail STS has improved its Turnkey "system thinking" up to the Full System Approach.

Through the Full System Approach it has been possible to integrate all our competencies in an optimized solution, managing all the interfaces among the sub-systems (civil and track works, system technologies and rolling stock), considering all the possible external constraints, needs and criticalities related to the operation and maintenance, all along

the project concept phase and life-cycle.

Hitachi Rail STS acts as lead contractor (or consortium partner) and system integrator for major projects around the world, under the following main contractual schemes:

- Contracting for Design & Build
- Build, Operate and Transfer (BOT)
- Project Financing
- Design, Build, Operate and Maintain (DBOM)
- Public Private Partnerships (PPP).

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