How ERTMS has become the "de facto" worldwide standard for railway traffic management and safety

In the early 1990s, the European Rail Industry, with the backing of the EU Institutions, embarked on an initiative to design and create a common, single railway signaling system that would make rail transportation in Europe the safest, most competitive, efficient, and, as a world premiere, interoperable mode of transport. Factors which prompted this idea of a single, harmonized and interoperable system was the existence of more than 20 national train control systems that made cross-border train movements extremely technically complex, administratively very time consuming and consequently non-competitive against other modes of transport, particularly road transport.

Some national legacy rail control systems were only supported by a single and incumbent supplier whilst others were very expensive to maintain and support due to obsolescence issues. The situation was even further exaggerated by differences in track gauges, national electrification and traction power schemes. Environmentally, however, rail transportation emerged not only as "the" efficient alternative to road and air transport but also as the lowest CO_2-emission mode of transport contributor.

Background behind ERTMS

As a unique signalling system developed from a vision, ERTMS has been designed to be fully interoperable. The intention is to facilitate any train equipped with ERTMS to be able to operate on any line fitted with ERTMS, irrespective of the supplier, and be safe – the interoperability being geographical – across country borders and interoperable between different suppliers, either through the on-board fitment or the infrastructure fitment. This produces an open supply market, increase competition across the rail market and benefit the Infrastructure Managers and the Railway Undertakings and ultimately and especially the services for passengers and freight operators.

System architecture of ERTMS

A top-level point of view of ERTMS shows three different sub-systems:

1. an interoperable safety and control system (ETCS)
2. a radio system supporting cab signalling for driving without line side signals (GSM-R up to now and FRMCS in the next future)
3. an international traffic management system (ETML).

ERTMS offers various functional configuration options in line with the different ETCS levels as described.

ERTMS Level 1: the information required on board trains is provided via the on-board balise antenna from track mounted balises linked through an LEU linked to the lineside signals. In Level 1, movement authorities can also be issued over several sections, safely enabling operational speeds of up to 350 km/h.

ERTMS Level 2: The key feature of ERTMS Level 2 is that information is transmitted by radio to the train from an RBC (Radio Block Centre). Fixed balises are needed to determine the train's position and to forward non-variable track data. Signals can continue to be used for mixed operation although they are no longer required for pure Level 2 operations. Track vacancy detection information and information about point positions are transmitted from the associated interlocking to the RBC which generates the train's movement authority and sends it to the ETCS on-board computer unit. Line throughput is considerably increased and driving "on electronic sight" through section blocks enables short headways at maximum speed.

ERTMS Level 3: The main infrastructure elements of Level 2 are retained - however, track vacancy detection components are no longer needed. Moving-block operations are possible. In Level 3, trains actively participate in route protection and have to reliably indicate their integrity to the RBC. The RBC is thus capable of optimizing train traffic. Level 3 is currently not standardized but work is actively progressing and advancing for this solution.

Cross-border Operations

The European Commission is directly supporting and promoting cross-border connections coordinated with the ERTMS corridors vision. Cross-border examples already in service include the pioneering Vienna-Budapest line in 2003. 2009 saw the opening of the first High Speed cross border line linking Belgium to Germany, followed by the Amsterdam - Antwerp HS line. France and Spain are also now connected through a tunnel under the Pyrenees equipped with an ERTMS system.

The European ERTMS Deployment Plan, adopted in 2017, will add several new cross-border connections in the next few years. It sets targets dates until 2023 by which about 30-40% of the Core Network Corridors shall be equipped. In 2023, the ERTMS Deployment Plan will be updated again setting out the precise implementation dates for the remaining part of the Corridors between 2024 and 2030.

The European standard expands internationally

The substantial benefits achievable by the application of ERTMS have not passed unobserved by countries outside Europe, as the standard has already been implemented on every single continent. Infrastructure Managers have adopted the European model to revamp their old railway networks as they strive to increase traffic efficiency and raise safety standards to cope with rising populations and passenger numbers and their demands especially as environmental concerns take a rising importance. One of the most important and substantial benefits enjoyed by IMs and RUs is achieving the economies of scale as procurement for compliant solutions from several suppliers in open competition is possible.

ERTMS open the window to more benefits using disruptive technology

The implementation of ERTMS uses digital technologies. ETCS systems: RBC, Onboard Equipment and IXL are digitally connected and the technology used to develop these systems is able to send diagnostic information to the Train Control Centre. Using Artificial Intelligence algorithms, over the diagnostic information stored in the Train Control Centre, it is possible to find new maintenance rules (predictive maintenance) in order to reduce the maintenance budget. Statistics reveal that predictive maintenance can help to save till 30% of the maintenance budget over the equipment when intelligent maintenance systems are applied. Plus intelligent maintenance systems can be installed over "the CLOUD" allowing the user to pay only for the effective computational potency.

ERTMS on track

Currently, 50% of the global signalling market share is based on ERTMS technology with more than 50 countries deciding to deploy or already committed to ERTMS. Investments outside Europe represent over 50% of the global share spanning all continents. Among other key benefits of ERTMS, it is the only rail control system able to raise a complete railway network to another level as a continuous communication based solution. Advantages include:

- Increased capacity on existing railway lines: ERTMS reduces headway between trains enabling up to 40% more capacity on currently existing infrastructure. This leads to savings in terms of new infrastructures required (the need of new infrastructures is drastically reduced) and, consequently, to benefits to the environment (less interference with nature)

- Greater ability to respond to and satisfy the growing passenger and freight transport demands

- Higher speeds: ERTMS allows for a maximum speed of up to 500 km/h and is now considered in several countries as the system of choice for the construction of new High Speed lines

- Higher reliability rates: ERTMS helps to significantly improve reliability and punctuality, which are crucial for both passenger and freight transport

- Reduced maintenance costs where trackside signaling equipment is no longer required (from ERTMS L2 and further) and therefore with reduced Capital expenditure

- An open supply market: trackside and onboard equipment may be supplied by any of the ERTMS suppliers as all equipment is fully interoperable, making the supply market more flexible, independent and competitive

- Having a worldwide accepted and maintained series of technical standards brings significant economies of scale and competitive whole lifecycle costs

- Improved safety for passengers, employees and freight transport, which may be an issue in certain parts of the world

- Full network interoperability nationally and internationally.

All of the above mentioned benefits indicate that ERTMS is becoming the standard of choice for railway companies worldwide.

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