Making progress towards standardised train control

HARMONISATION The introduction of ERTMS and ETCS is still largely driven by isolated national projects, with few railways committed to cross-border interoperability. Introduction of the Baseline 3 specifications later this year may bring new challenges as well as answers.

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Three years ago we looked at the state of development of the European Rail Traffic Management System, and considered how the challenges of introducing ETCS were being met in practice. We concluded that some progress had been made, albeit not much (RG 3.09 p33). So where are we now?

It is clear that large-scale projects in different countries should start to benefit from the lessons that have been learned. In terms of project organisation, studies for the European Commission and the European Railway Agency flagged up issues of system integration (or the lack of it), and the need for greater co-ordination between infrastructure managers, or more control for corridor management organisations.[1, 2]

ERA's review of system integration resulted in the so-called Common Safety Method for Risk Evaluation & Assessment. Under Regulation 352/2009, CSM-REA is now mandatory for the 'putting into service' of subsystems under Interoperability Directive 2008/57, and has to be applied to both trackside and onboard elements. We are starting to see railways using CSM-REA as a starting point for designing their project organisation, using a top-down approach.

Although ETCS has always been seen as a cornerstone for interoperability, there have been very few cross-border applications so far. And there are still technical borders within countries. Member states or NSAs require specific track-train integration tests, particularly to close open points in the European specifications.[3]

All too often, ETCS is seen as a toolbox from which every infrastructure manager takes those elements which meet its specific needs. But choosing different tools and applying national values without considering the overall consequences confronts international train operators with many different national implementations of

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Bombardier has been using this former postal EMU to test the ETCS Level 2 equipment on ProRail's Amsterdam – Utrecht route; one of five separate ERTMS installations in the Netherlands.

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the 'European standard'.

Although work is underway on several freight corridors, there is still only one genuine cross-border ETCS application, on the high speed line between Antwerpen and Rotterdam. Other projects can mostly be characterised as local applications or 'ETCS islands'. Worse, there seems to be no clear single driver; each project has a different objective (p37).

Thus infrastructure managers have not been challenged to make best use of the interoperability characteristics of ETCS. This does not mean that there is no international co-operation, but what does exist needs to be more focused. There is a need for stronger co-operation between infrastructure managers, and between their technical specialists and those of the train operators.

Operators affected

When converting to ETCS, one of the most important aspects to be considered is the quality of service and capacity offered to train operators. It is self-evident that line capacity should not be reduced, and should preferably be increased. However, this depends on the final design, and all too often neither the capacity nor the quality objectives have been defined.

In order to use ETCS-equipped tracks, the operators need onboard equipment, which adds cost. So in order to justify the investment they need stability, rather than facing the unknown cost of frequent migration to new standards.[4]

The certification and acceptance of rolling stock is a major obstacle, particularly where existing vehicles have to be modified. This should become easier, as TSI 2009/561 requires ETCS to be fitted in all new stock ordered after January 1 2012 or put into service after January 1 2015.

But gaining acceptance in every country is still a big issue, related to the retention of national rules and requirements. The problem is likely to last as long as the TSI still has open points, and this is still the case, even after the latest announcement by the European Commission on January 25.

Supporting organisations

In terms of international co-ordination, the work of the ERTMS Users Group and UNISIG from the supplier side is well known. Two other formal groups have been promoted by the European Railway Agency. One brings together the National Safety Authorities to co-ordinate the development of common safety standards. ERA is also working with the Notified Bodies through NB Rail to support the development of better certification methods and reduce the differences in approach. One of the tools being proposed is the use of peer reviews.[5]

To date, there has been no formal co-ordination of Independent Safety Assessors and Independent Assessors as defined under CSM-REA. Because many of them also act as NoBos there is some co-ordination via NB Rail, but this does not cover them all. Another challenge is that member states treat ISAs in different ways, from full formal accreditation in Sweden to no regulation at all in the Netherlands.

The Memoranda of Understanding between the European Commission and various rail industry associations signed in 2005 and 2008 commit their signatories to co-operate in the development and implementation of ERTMS. One initiative envisaged the creation of independent test laboratories, and although not much progress has been seen to date, that is set to change. The January 25 agreement makes laboratory testing a requirement for the onboard subsystem.

Moving to Baseline 3

Whilst much is being done behind the scenes, on the technical side many projects are awaiting the development of the Baseline 3 specifications. Due to be ready by the end of this year, Baseline 3 is intended to address problems encountered over the past decade, as well as the remaining open points in the current Version 2.3.0d. Important new functionalities are envisaged, including a better braking curve model, limited supervision mode, radio infill and the use of GPRS for data traffic.

Braking curves were not fully addressed in Baseline 2, leaving infrastructure managers and train operators to fill the gap; this has resulted in deviations from the TSI. Limited Supervision was initially requested by SBB as a cornerstone of the Swiss migration strategy, but other countries seem increasingly interested.

The idea of using GSM-R instead of balises to transmit infill information between the trackside and onboard units in Level 1 was initiated in Italy. One hurdle would be keeping track of the data keys assigned to trackside equipment and rolling stock.

Although GPRS is seen as essential for any ERTMS implementation in a large station area, it will not be ready

Don't confuse the driver. Retrofitting ETCS can result in a multiplicity of screens, as seen in the cab of a DB Schenker Class 189 electric loco.

in time for the first release of Baseline 3, and will follow in a later update. However, Banedanmark has already requested its suppliers to include GPRS in their bids (p41), and Infrabel may follow this route. It seems that the specification process is simply too slow to meet implementation requirements.

Recent experience can be summarised in the confusing sequence of local variations: 2.2.2, 2.2.2 Consolidated, 2.2.2+, 2.3.0, and finally 2.3.0d, where the d stands for 'debugged'. Nobody likes this degree of inconsistency, with the resulting need to repeat so many testing and development procedures. So great care is being taken in the preparation of the System Requirements Specification (Subset 026) and test specifications for Baseline 3. A programme to verify all the documents is now being organised by ERA in co-operation with UNISIG and the ERTMS Users Group.

Nevertheless, we should not ignore the probability that Baseline 3 will have its own bugs, particularly with the new functionality. Clearly, we will not be able to gain any

Test laboratories will play a significant role in ensuring interoperability; Alstom and SBB used this facility at Biel to prove the ETCS equipment used on the Mattstetten – Rothrist and Lötschberg Base Tunnel routes.

Current status of selected ETCS applications by country*

Switzerland

Although Switzerland is not an EU member it is a front-runner for migration to ERTMS, driven by the need to replace obsolete systems and equip new lines. The Swiss are also surrounded by EU member states which are expected to migrate in the longer term.

Given that many trains with onboard equipment from various suppliers use both the Mattstetten – Rothrist line and the Lötschberg Base Tunnel, which were themselves equipped by different suppliers, the Swiss were soon confronted with interoperability issues. These enabled SBB to gain considerable experience in track-train integration, from which other countries can benefit. Today the performance of ETCS Level 2 is so good that SBB has decided to remove the conventional signals that were provided as a fall-back on Mattstetten – Rothrist; ironically these decrease the availability of the system as a whole.

Although it seems hard to ensure full GSM-R coverage in mountainous areas, few problems have been reported. Switzerland also seems to be one of the few countries that has not suffered interference between GSM-R and public mobile communications networks, which may be due to local legislation on radiation levels and a well-designed GSM-R network structure.

Belgium/Netherlands/Luxembourg/France

To date, the high speed line between Antwerpen and Rotterdam is the only border crossing where two ETCS systems meet. As the Dutch and Belgian equipment were tendered separately to different suppliers, at a time when no harmonised interface specification was available, it is not surprising that serious problems had to be overcome to enable trains to cross the border at full speed.

The initial view of 'interoperability' focused on the track-train interface and forgot the system-level requirements. These were not just about defining the interface between two RBCs using different communication standards, but also about connecting two sections of track with different operating rules, modes of working and fallback systems.

Meanwhile, Belgium, Luxembourg and France are making steady progress on Freight Corridor C, where traffic was reportedly not hit by the financial downturn. Thanks to the addition of a link between Rotterdam and Antwerpen, Corridor C could handle traffic between Rotterdam and Basel, in competition with Corridor A and circumventing Germany. The Corridor C steering group has decided from the start to install ETCS Level 1 using Version 2.3.0d[6], which can be considered proven technology. At least the northern part of the route should be commissioned before 2015.

Denmark

As its conventional signalling reached life-expiry, Denmark opted for total renewal (p41), with the whole main line network to be fitted with ETCS Level 2 by 2021. This means that Banedanmark can move away from existing national rules. The ambitious strategy attracted much interest from suppliers, resulting in a competitive procurement. Denmark will be the front-runner in requiring GPRS communication for areas with high data traffic, which is not envisaged in the first release of Baseline 3. So Banedanmark will either deviate from the new European standard or end up setting it!

United Kingdom

Network Rail is looking to implement ETCS Level 2 as part of its £5bn Thameslink Programme, mainly on the basis of its assumed capacity benefits. The requirement is to provide a main line railway that can reliably handle a metro-like service with 24 trains/h through the central core of the route, with a very high degree of availability[7]. This means that the technical and business risks converge.

Learning from past attempts to introduce new technology, NR has opted for an incremental migration plan. To reduce operational risk, the line is initially being resignalled with colourlights and TPWS for a maximum of around 18 trains/h. Control would then migrate to ETCS Level 2 overlaid with Automatic Train Operation once the technology is ready to support the full service levels.

Belgium

Infrabel's domestic ERTMS strategy is specifically being driven by safety, following a number of serious accidents. These culminated with the collision at Buizingen on February 15 2010, which killed 19 people and injured many more (RG 3.11 p28). The resulting investigation concluded that ATP must be rolled out over the next decade.

Infrabel and SNCB already have ETCS Level 2 in operation on two of the country's four high speed lines, and are working to install Level 1 on a number of projects, including Corridor C (Antwerpen – Luxembourg – Lyon – Metz – Basel). Tenders are to be called for Level 2 on the main parts of the conventional network, combined with replacement of relay-based interlockings where necessary. However, the programme is still subject to approval and funding from the government.

Germany

In Germany, ERTMS has become a casualty of the government's austerity measures. Under current EU plans, four corridors should be equipped with ETCS by 2015, but the only route going ahead is the German part of Corridor A between Rotterdam and Genova, which is not now expected to be ready until some time after 2015, depending on future renewal plans. To guarantee interoperability, the Ministry of Transport announced in June 2011[8] that Germany would pay to have locomotives fitted with Specific Transmission Modules for LZB/PZB at a cost of €200m. However, this does not conform with the TSI requirements.

Although the government notes that LZB and PZB are not yet obsolete, this does not mean that ETCS has completely disappeared. Several routes are to be equipped in the coming years, such as Nürnberg – Ingolstadt, Nürnberg – Berlin and the POS corridor connecting to LGV Est (p51). But the federal government has also cited the small number of experts available compared with the large number of projects as a factor limiting the amount of work that can be undertaken by 2015.

Another argument is that costs are too high. This is because the initial plans focus on installing Level 2, with replacement of relay interlockings. Cheaper alternatives such as Level 1 Limited Supervision were proposed by DB, but were apparently not taken into account by the government.

** Note: This list is not intended to provide a complete overview of recent developments, but highlights selected countries to demonstrate some of the different objectives for adopting ETCS.*

Testing an unshielded balise. The Italians are now looking at radio infill as an alternative to balises for Level 1.

practical experience until after Baseline 3 applications have been implemented. And as well as the need to address any problems that emerge, there will be questions over the extent to which rolling stock will be accepted for cross-border operation without re-assessment.

With respect to version management, Version 2.3.0d has a problem with braking curves, where the default parameters provide inferior performance and reduce line capacity. Some infrastructure managers are reluctant to upgrade their existing installations to Baseline 3, but feel the need to address this specific problem. So the ERTMS community has invented a 'Version 1.1' for track-train communication.

If Version 1.0 is the Baseline 2 interface and Version 2.0 is the Baseline 3 interface, Version 1.1 envisages upgrading the Baseline 2 trackside equipment so that it could send a new message to a Baseline 3 train or an old message to a Baseline 2 train.

Given that the concept is complicated to explain, it might also be complicated to implement. We note that the transition in trackside implementation from Baseline 2 to Baseline 3 is already likely to be difficult. In Switzerland, SBB has concluded that there will have to be an intermediate section with Level 0 (Unfitted), so that trains will come out of ETCS mode in one version and return in the other.

The way ahead

The biggest obstacle to interoperability in the future seems to be the lack of uniformity in operating rules. Standardisation of these rules would help to smooth the introduction of ETCS. However, few countries are in the fortunate position of Denmark, where elimination of all legacy signalling will allow the whole rulebook to be re-written. Such a radical step may not be possible for railways that migrate gradually.

However, it might be feasible to start standardisation if the freight corridor groups concentrate on equipping cross-border sections with ETCS through joint projects. Managed by a central organisation, these could concentrate as far as possible on introducing uniform operating rules, which would comply with TSI-OPE from the outset. Only then would the specification, design and engineering rules and principles be agreed in detail. Proper co-operation between infrastructure managers is essential, but train operators need to be involved as well. It is their trains that cross the borders, and are hindered by the lack of harmonisation.

Whilst co-operation should start with an exchange of experience, the final goal should be to strengthen the position of the users with respect to the suppliers. Whereas the suppliers are already united through UNISIG, the users are fragmented between different organisations.

It would be helpful to repeat the ERA survey of ETCS implementation undertaken in 2007, in order to obtain a systematic overview of current applications and implementation plans. This study could focus on the main drivers for implementation and identify the hurdles to be addressed.

The European framework, and particularly CSM-REA, provides a powerful tool for system integration and defines the roles for all parties. But CSM-REA is limited to specific project initiatives, and there is a need for wider co-operation across projects. And here lies the biggest challenge for all the organisations involved: to act from a European perspective.

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