SPOTLIGHT Signalling

Testing, baselines and balises

A SIL0 test unit to monitor the quality and performance of lineside equipment will help to accelerate the deployment of ERTMS, and help to reduce the life-cycle cost of inspection and maintenance.

FRÉDÉRIC DU JARDIN
Chief Operations Officer
ERTMS Solutions

The European Rail Traffic Management System is incredibly complex. Railways across Europe have been calling for greater stability in the specifications, in order to facilitate a more rapid deployment of ETCS. But like any software-based system the baselines are inevitably going to evolve, despite the best efforts of the European Union Agency for Railways to standardise the functionality and reduce the frequency of maintenance releases.

Change requests, additional functionality and fine-tuning mean that it is difficult for manufacturers or infrastructure managers to predict how and when the system versions will change. But the timing of any changes can be critical, especially when it comes to the testing and commissioning of new equipment.

Even after the lineside equipment has been installed, it needs to be inspected on a regular basis to ensure that it is functioning correctly. Further testing will also be needed whenever any software updates are implemented, although of course the bulk of the testing should have been done 'off-line' ahead of deployment.

Test trains are scarce resources, and typically carry a wide variety of inspection and testing equipment, so they may not be available at short notice.

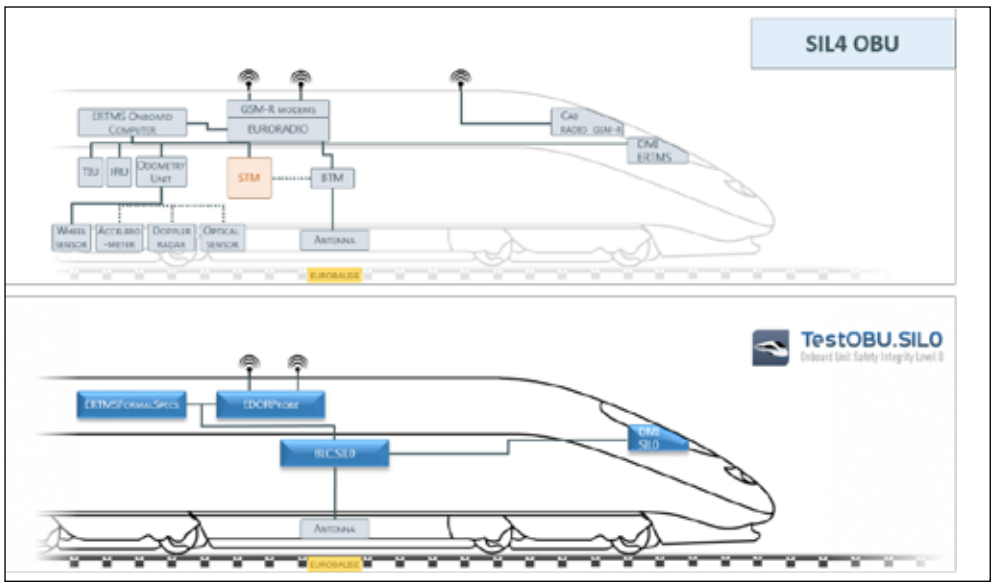

Fig 1. Because TestOBU.SIL0 does not have to be connected to the train's safety systems, it it is convenient to use.

It is not ideal to use a standard onboard unit of a normal service train for testing, as the user cannot know what is happening inside the box, or understand the reasons for any problem or failure just by looking at the DMI. The testing system needs to be transparent, so that root cause analysis can be undertaken immediately.

Ideally, too, the onboard and trackside units should also be using the same software version, although limited resources mean that this is not always the case, even when it comes to test trains.

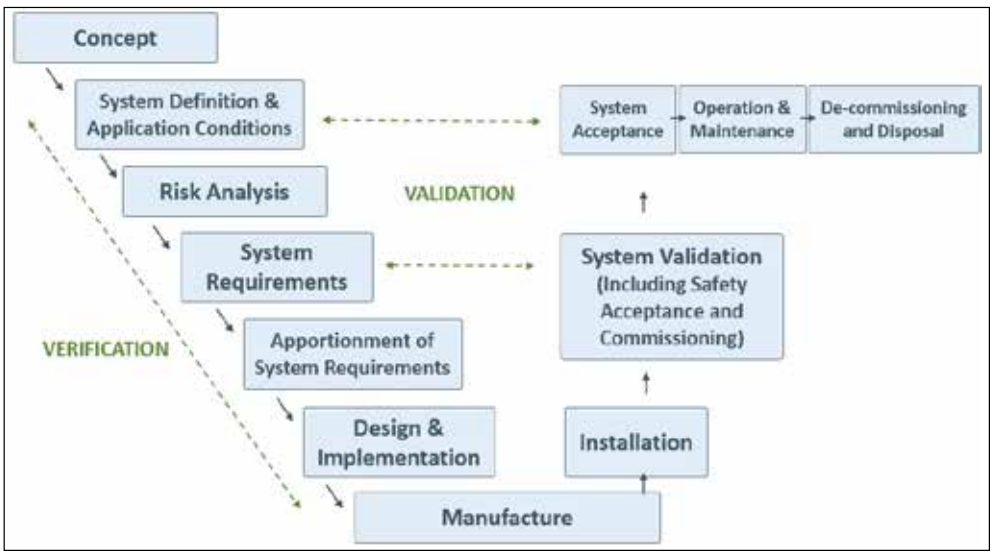

Fig 2. Making changes at a later stage in the V cycle can be very expensive.

Pre-testing models

As far as possible, any software upgrades should be tested in advance to identify any issues before the start of on-site testing; which should also reduce the time needed for the formal test and commissioning programme. It is well understood that the further a project progresses through the verification and validation process — the so called V Cycle (Fig 2) — the more expensive it is to make corrections. And the same applies to implementing change requests at an early stage in the development process. The sooner any issues can be identified, the easier and cheaper it becomes to solve them.

For the past few years, ERTMS Solutions has been developing an open source tool for modelling and testing ERTMS specifications in a 'white box' environment, known as ERTMSFormalSpecs. Coupled with a separate driver-machine interface and scenario editor visualisation tools, this forms the basis of an integrated suite to address tasks related to the European Vital Computer, such as the analysis of Change Requests, comparison against an independent test EVC and analysis of the Subset 076 test sequences (RG 9.15 p51).

All of the scenarios running on a model can be executed in a way that allows domain specialists to check quickly if there are any contradictions or ambiguities. The suite also enables change requests to be processed in an easy way to assess their potential impact on existing specifications.

The ERTMS Users Group is already

using the whole suite, while Thales is using the model to speed up the testing of the braking curves model in the development of its Baseline 3 Onboard Unit.

Development is continuing, and we are now close to having a complete model of a full EVC. The remaining work is being supported by a 50% grant from INEA under the Connecting Europe Facility, which provides a substantial allocation of EU funding to accelerate the deployment of ERTMS.

TestOBU.SIL0

Although ERTMS Solutions is not looking to become a manufacturer of SIL 4-compliant OBUs, in discussions with other parties we recognised the potential benefits of having the model mounted on a train to undertake live testing in a real environment. Another option would be to have a portable tool which is installed on trains in commercial operation without any interface issues.

Such a tool would be ideal for pre-testing, and help to save time during critical global test and commissioning programmes. While the ERTMSFormalSpecs model currently uses the Version 3.4.0 specifications, it can easily be upgraded to the later standards or even backdated to the earlier baselines if necessary. As the tool and model form a complete white box, the tool can be asked at any point to identify the origin of an observed failure.

At the suggestion of the European Commission's ERTMS Co-ordinator Karel Vinck, the concept was presented at the 2015 TEN-T days in Riga, as a form of 'Reference EVC'. However, ERA Executive Director Josef Doppelbauer pointed out that the tool was not meant to serve as a SIL4 OBU. So we have since adopted the more appropriate and self-explanatory name TestOBU.SIL0.

Throughout the development process, our main aim has been to keep the tool as simple as possible, while ensuring that it is both flexible and accurate. It can take information from other onboard equipment such as the odometry system, although a connection to the train's braking controls might raise questions about safety approval.

In fact, the tool does not need to be connected to the OBU. To avoid any problems, it can work with an independent balise reader such as BaliseLifeCheck, or use GPS location in conjunction with a database of balises along the track. This would avoid the need for any connection to the train systems, as the balise data would be read and supplied to the TestOBU.SIL0 without interfering with the onboard ATP.

BaliseLifeCheck

While BaliseLifeCheck can serve as a transmission module for the onboard testing system, it actually contains a host of other functionality. Our LifeCheck products (Fig 3) have been developed over several years as preventive maintenance tools, which are typically fitted to diagnostic trains but can also be mounted on trains in revenue service. They are now being used by a number of infrastructure managers across Europe.

They are effectively a form of moving laboratory, which automates the inspection of balises and/or track circuits during regular maintenance. Reading each balise as the train passes over it produces extremely detailed information about signal quality which was previously only available by sending the balise to a laboratory in a heavy and time-consuming process.

LifeCheck products are available for all manufacturers' Eurobalises as well as 'legacy' balises and coded track circuits for ETCS, TBL1+, SCMT, KER-KVB, Ebicab, RSDD or TVM. The core tool can be adapted to any train protection system where electromagnetic signals must be measured and assessed. Key metrics are then computed, such as geolocalisation and mapping of the balises, characterisation of analogue signals using either Amplitude or Frequency Shift Keying (such as carrier frequency, frequency deviation, or modulation index), the telegram bit rate and data-rate jitter. Measurements are also taken for the pulse envelope (ASK) and amplitude jitter (FSK).

As a side benefit, the LifeCheck products can also detect and quantify any big metal masses present on the tracks which may pose an EMC issue for infrastructure managers to consider.

GSM-R too

The latest addition to the TestOBU.SIL0 suite, which we presented at the UIC ERTMS World Conference in Brussels in March, is a function to test the quality of GSM-R communications links, which also play a critical role in ERTMS applications.

Many players across the industry need GSM-R information, so we have joined forces with French company Expandium, which specialises in communication tools. Expandium's Unattended Probe has been adapted as 'EDORProbe' for use with TestOBU.SIL0, as shown in Fig 1.

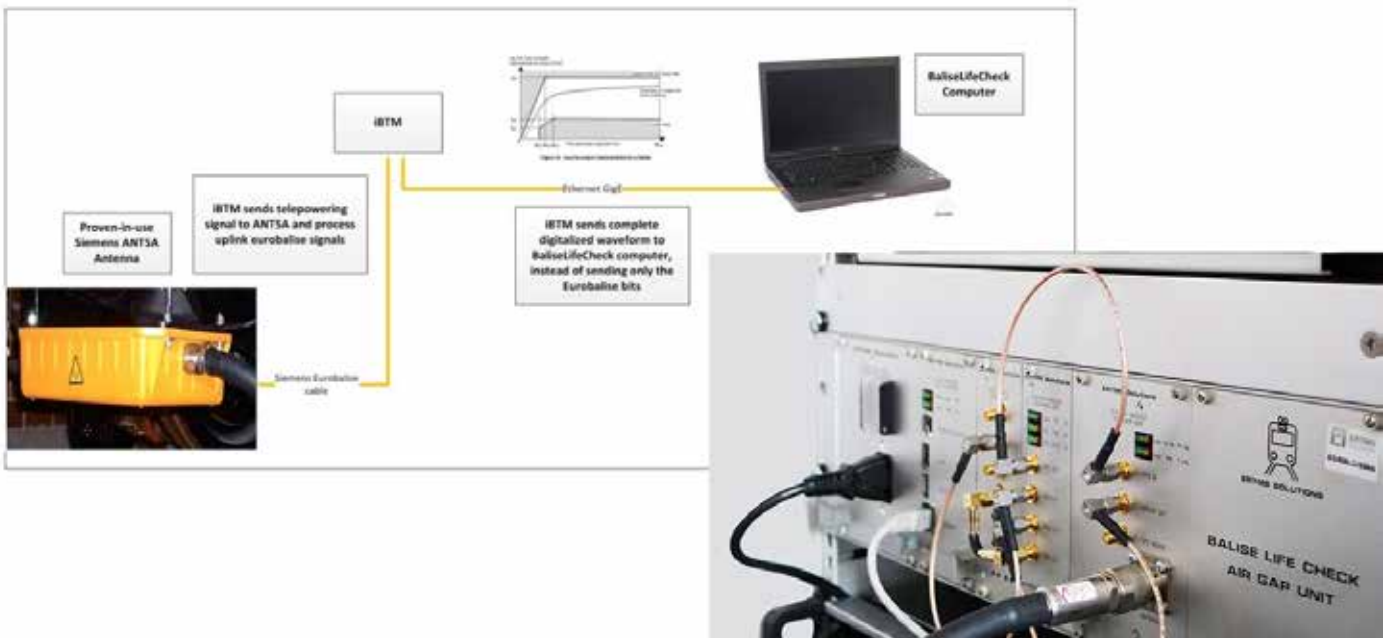

Fig 3. When assessing Eurobalises, the BaliseLifeCheck is connected to a standard balise antenna using an interface transmission module.

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