ETCS – European Train Control System

With the testing and commissioning of the new Gotthard Base Tunnel upon us, Boyd Misstear takes a brief look into this often referred to, but little understood, important railway development being deployed as part of this 'Neue Eisenbahn-Alpentransversale' (NEAT)

Oft I have heard, usually passed in jest at model railway gatherings, when one modelling enthusiast quips his layout is equipped with ETCS, since he/she has not as yet installed any visible trackside signalling! As Wikipedia succinctly summarizes, the ETCS or to give it its full name European Train Control System is a signalling, control and train protection system designed to replace the many incompatible safety systems currently used by European railways. The need to develop such a system can be traced all the way back to the origins of the diverse and colourful history of each railway company, and the incompatible systems they severally established to control the safe and secure operating of their trains. Or to put it more succinctly, provide better shareholder returns by avoiding costly train crashes! While many of these companies became part of larger entities, which in turn eventually became national rail networks, through all these groupings each 'nation' developed their own best safety 'standardized' trackside signalling systems and associated operating procedures. Towards the end of the 1980s, there were no less than fourteen 'standardized' train control systems in the European Union!

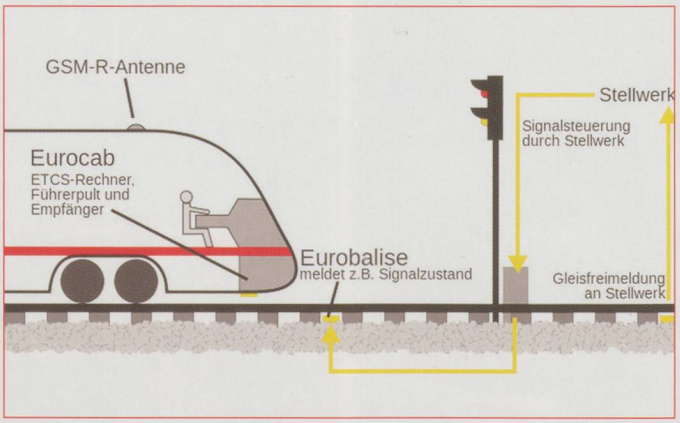
With the increasing speed of train travel in the latter half of the twentieth century and coupled with the need to reduce the cost and delay of cross-border working, it was obvious drivers needed to have the lineside information passed automatically into the cab, as they were no longer able to see and assimilate the information fast enough to offer safe operation. At a meeting of Transport Ministers and their working group advisers in late 1989, appeared the first suggestion of ETCS. A requirements list for interoperability was developed. By June 1991 the rail manufacturing industry and rail network operators had agreed on the creation of interoperability standards – 'Technical Specifications for Interoperability' or TSI standards. And in 1995 a plan to create a European Rail Traffic Management System (ERTMS) was first proposed, an initiative backed by the European Commission, with its two prime components being the ETCS, a standard for in-cab control, and the Global System for Second Generation (2-G) Mobile Communications standard, (originally Groupe Spécial Mobile) for railway operations or "GSM-R". The European Commission in 1996 under a directive called 96/48/EC set out the need for interoperability of high-speed trains in Europe. Then in 2001 a directive came about called 2001/16/EC on the interoperability of the trans-European conventional rail system and both have since been amended under directive 2004/50/EC. The key here is to note the word 'interoperability' - defined as 'the capability to operate on any stretch of the rail network without any difference'. In other words, the focus is on making the different technical systems on the EU's railways work together. No simple task! And this thrust is just part of a much larger set of European transport measures to develop a transport system capable of shifting the balance between modes of transport, revitalising the railways, promoting transport by sea and inland waterway and controlling the growth in air transport.

So what in a nutshell is ETCS?

This can be conveniently divided into two 'components': on-board and infrastructure equipment. And from the outset, trains equipped with on-board equipment manufactured by one company should be able to operate on lines where the infrastructure is provided by another. This has been one of the reasons why it has and continues to take so long to deploy, as the specifications and testing have had to be extensive. Even having said that, as the saying goes, the "devil is always in the detail" – there is more than one version of ETMS! The earlier specification contained a lot of options that limited interoperability. The 'final' ETCS (later called "Baseline2") specification as it is often referred to, is divided into four main equipment and functional levels. The definition of the levels depends on how the route is equipped and the way in which information is transmitted to the train. The movement authority ("permission to proceed") and the corresponding route information are transmitted to the train and displayed in the cab ("cab signalling"). I am led to understand a locomotive/train, equipped with what is now known as 'EuroCab' ETCS functionality, can operate on any ETCS route without any technical restrictions.

The detailed breakdown of the four levels and versions of ETCS are outside the remit of this brief introductory article, as is the development of a "Baseline 3" by the European Railway Agency (ERA) – an agency of the European Union. However, the following summary and illustrations (courtesy of Wikipedia), help to illustrate the four different levels (0 to 3) of ETCS.

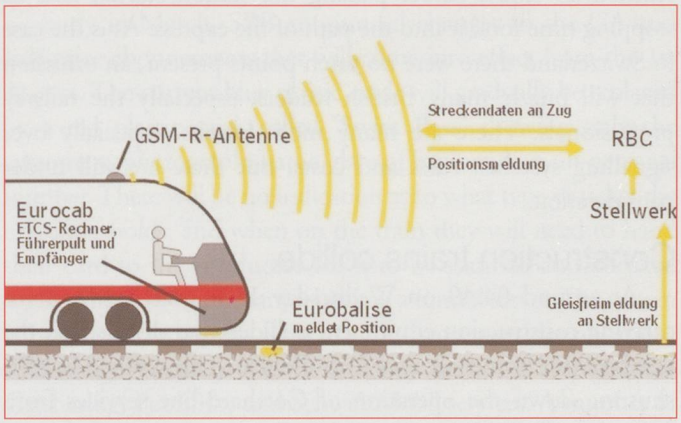
Level 0 – covers the situation where an ETCS-equipped train is travelling on an existing signalling system.



Level 1 – cab signalling superimposed on the existing signalling system (Stellwerk / Signal Box).

Information, in particular advanced information, to the train about the next signal, is transmitted between train and

infrastructure through devices called Eurobalises (devices positioned between the rails – see picture) and Euroloops (a system that consists of a radio leaky cable used as a transmission antenna positioned alongside the track).



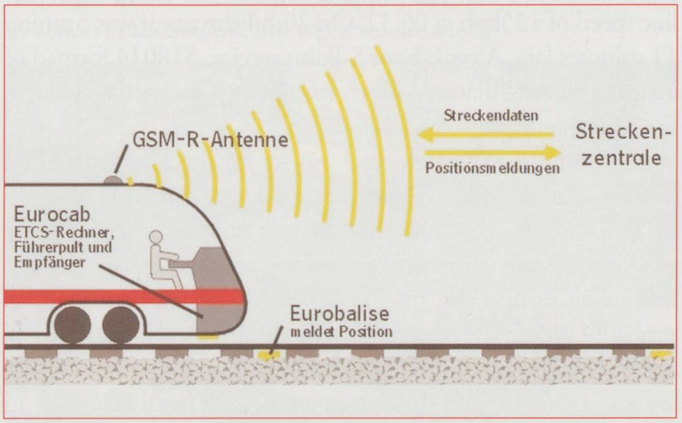
Level 2 – digital radio based system – all movement authority and signals are displayed in the cab.

All trains automatically report their exact position and direction of travel to the Radio Block Centre (RBC) at regular intervals. Train movements are monitored continually by the radio block centre. Unlike in Level 1, Eurobalises are only used to verify position.

In Switzerland, the pioneering of ETCS Level 2 installation was on the Mattstetten - Rothrist new line, a high-speed 45km double track line opened in 2004 between Bern and Olten for train speeds of 200kph (124mph). Technical problems caused ETCS operation to be the planned starting date and ETCS Level 2 operation was fully implemented in March 2007. ETCS Level 2 is now also in operation on the 35km single track Lötschberg base tunnel providing continuous speed supervision.

Based on the European Commission TEN-T Core Network Corridors (see "An integral transport 'Island' within Europe" and map SE 117 Pages 38-39), Switzerland is continuing to deploy ETCS Level 2 this year as part of the "Rhine-Alpine Corridor" connecting Rotterdam –Duisburg – Basel – Genoa.

In a presentation given by SBB back in 2012 on ETCS and anticipated utilization of the Gotthard Base Tunnels (57km of double track each in a single tube), SBB were planning for some 300 trains a day, with headway of some 180 seconds; with mixed traffic; with a maximum speed of 250kph. And by the end of 2017, it is anticipated around 3,000km of track across Switzerland will be fitted with ETCS L1, around 417km fitted with ETCS L2, 7 RBCs commissioned and around 850 vehicles equipped



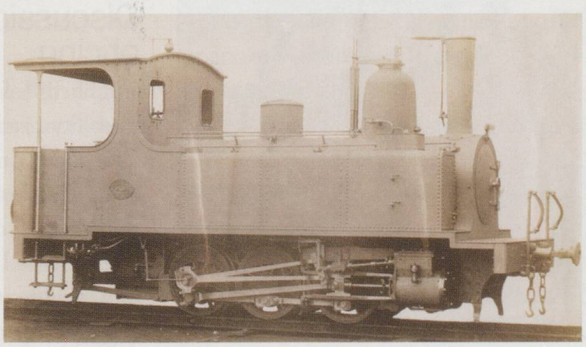
with ETCS on-board systems authorized for operation.

Level 3 – extends movement and signals to encompass full radio-based train spacing.

With Level 3, it works like Level 2 with an exception - one of the major differences over level 2 is the route is no longer cleared in fixed track sections. Trains find themselves by means of positioning beacons and departs from classic operation with fixed intervals to achieve continuous line clear authorization with the objective of maximizing route occupancy through "absolute braking distance" / "moving-block" operation. This requires a safe "end-of-train" detection, something which is normally only available now for Electrical Multiple Units (EMUs) and not locomotive hauled trains. As one can imagine, integrity supervision is necessarily complex.

For more information on ERTMS and ETCS rollout plans across Switzerland with charts and maps, please visit a presentation given by SBB Head of Business Unit Train Control Systems back in 2012. Visit **http://tinyurl.com/q7p39ks**. If any member has more updated information, I will be interested to receive it.

And for a final word! Even with all the above ERTMS/ETCS complexities of simplification (an oxymoron if ever there was!), non-European countries are already selectively deploying ERTMS / ETCS and these countries include Algeria, Australia, China, India to name just a few alphabetically!



FAR LEFT: LEB 5's boiler under repair 14.02.15.
Photo: Flückiger

LEFT: No 5 as original.

See article '**Story of a Survivor**', on page 37.