

The status of Railway Cab Signalling in China



In the last two decades, the Ministry of Railways (MoR) offices of the Chinese Government have embarked on large scale expansion of the nation Chinese Railway network specifically to address the huge growth in passenger traffic demand from the ever expanding population and support the economic growth drive.

The main declared aims were:

- Improved economic productivity and competitiveness.
- Stimulating the economy by creating jobs and driving demand for construction.
- Facilitating cross-city economic integration.
- Supporting environmental sustainability and energy independence.
- Developing an indigenous HS rail equipment industry.

The growth of High Speed line mileage is evident from the following statistics:

- 2011 - 3,000km actual
- 2013 - 10,000km actual
- 2016 - 19,000km actual
- 2020 - 30,000km actual
- CR has expanded its network by 20.9% in the past five years, with the high-speed network alone doubling to 37,900km

To meet anticipated passenger demand, steps were determined by introducing leading edge technology initially satisfied by technology transfer from leading European suppliers. Adopting and adapting this technology through local production and self-sufficiency for both new Rolling Stock and particularly for the Signalling, Command and Control Systems where the highest levels of safety, availability and reliability were being expected and demanded.

The turning point for these determinations appeared to have been the timing of the 2002 UIC ERTMS World Conference held in Beijing where the development of the ERTMS/ETCS solution was presented by the UNISIG suppliers to a large audience of Chinese senior engineers and administrators. By 2003, the MoR had redefined the Chinese Train Control Systems (CTCS) describing Levels 0 to 4 combining, in Levels 1 – 4, the key attributes of the ERTMS solution but adopting the advanced track circuit technology (omni-present in the Chinese national rail network).

The earliest Cab signalling introduction project was realised on the Beijing to Tianjin (117km) line by a consortium of European and Chinese suppliers providing the capability of operation up to 350km/h where ETCS Level 1 is operational. This line opened just before the Beijing summer Olympic Games of 2008 and was equipped with both ERTMS Level 1 and CTCS Level 2. Following on rapidly was the Wuhan to Guangzhou HS line in 2009, the first CTCS Level 3 line, followed by the Zhengzhou to Xi'an HS line. Technical implementation was achieved by the Chinese signalling industry under a contract in which European suppliers committed to provide significant technology and engineering know-how and capability transfer of their ERTMS Safety Integrity Level (SIL) - 4 products to China.

Principal features of the CTCS grade levels

CTCS Level 0 is related to the legacy cab signalling warning system where CTCS Level 0 is supplemented by trackside balises and a Eurobalise reader attached to an LKJ on-board unit reading some trackside information from a Eurobalise via packet 44. The system is designed to support speeds up to 160 km/h.

CTCS Level 1 is a developing system, which want to plan update current CTCS Level 0 line. Based on current discussed solution, in the open line, it could be supplemented by trackside balises and a Eurobalise reader attached to an on-board unit reading trackside information from a Eurobalise via packet 44. In the station area, it will use radio to communicate with on-board for TSRS and side-line info, etc. It will be designed to achieve SIL- 4 products. Now, this system is not formal delivered.

CTCS Level 2 makes use of ERTMS type data packets such as for “gradient”, “linking” and “static speed profiles” but the significant difference is that the system does not read a Movement Authority (MA) from the Eurobalise as an ETCS Level 1 system would. The system is limited to a design speed of 300 Km/h. Currently, the CTCS level 2 line is designed for Max speed 250 Km/h. But, as a backup system, CTCS level 2 system can run max. speed in 300 Km/h in CTCS level 3 line.

CTCS Level 3 as the high end ATP capable of dealing with speeds up to 380 Km/h has a very similar ERTMS Level 2 type architecture and comprises Radio Block Centres (RBC) and a GSM-R radio communications infrastructure and on-board data radios. There are national adaptations with respect to functionality and dynamic transition between CTCS Level 2 and CTCS Level 3 and vice versa.

CTCS Level 4 is an option for future development of the Chinese train control standards toward a radio based moving block system comparable in some degree to the concept of ERTMS Level 3.

By the commencement of 2016, Chinese Railways had installed nearly 19,000 km of High Speed Lines operating at line speeds of 250 – 350 km/h. The CTCS Level 3 (C3) is similar to the European ERTMS Level 2 and is the leading ATP system on the High Speed Lines, overlaid on a CTCS Level 2 (C2) system, providing the trackside infrastructure for EMUs running 200 – 250 Km/h on Dedicated Passenger Lines (DPL).

The CTCS Level 2 together with the CTCS Level 0 traditional cab signalling system have been in operation for some time on approx. 10,000 track km of the existing railway network, providing an infrastructure dealing with both passenger and freight traffic. Although not developed along the CENELEC process CTCS Level 2 overlaid by CTCS Level 3 is very similar to an ETCS Level 2 SIL 4 based ATP.

Chinese Railway ERTMS development

In 2019 at the UITP Global Public Transport Summit in Stockholm, Zhuzhou CRRC Times Electric held the first global conference of the CRRC Group announcing their ETCS signalling systems, showing that CRRC can provide comprehensive signalling solutions for global customers. Based on the ETCS structure, the SigThemis signalling system is fully compliant with the latest ETCS Baseline 3 B3R2 standard and can fully support ETCS-NTC/0/1/2 level system applications. The SigThemis signal system is oriented to trunk railway and fully conforms to the latest standard of ETCS Baseline3 B3R2 (compatible with Baseline2 standard), which can fully support the system application of ETCS-NTC/0/1/2 level.

Chinese High Speed Passenger Line ambitions will continue to focus on the target of greater frequency, reliability and safety and improved capacity to provide services to a hugely demanding and growing travelling public at a domestic level. There are further indications of the Chinese Government’s intention to almost double the number of track kilometres for new dedicated passenger services in coming years, however, at this point in time further development isn’t being driven by passenger demand or climate goals.

Chinese Government achievements look modest next to what’s planned for the coming decades. China State Railway Group Co. recently put out a sequel to their 2004 plan promising a network 200,000 kilometers (125,000 miles) long by 2035, up from 141,000 kilometers now. High-speed tracks will comprise 70,000 kilometers of the total — roughly doubling their current length.

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