World-first deployment of ETCS Hybrid Level 3

The new commuter and metro network serving India's National Capital Region is pioneering innovations such as virtual block, ATO and platform screen doors, as Navneet Kaushik* explains.

Photo: Shutterstock/PradeepGaurs

An RRTS train passes a conventional signal at Sahibabad station.

PUBLIC transport in the National Capital Region (NCR) around Delhi is currently undergoing a major transformation with the phased introduction of India's first Regional Rapid Transit System (RRTS).

Delhi will eventually be connected to neighbouring cities by eight new arterial RRTS lines, and work is now underway on Phase 1 of the programme, comprising the priority corridors from Delhi to Meerut (82km) and Panipat (103km), and from the capital to Shahjahanpur-Neemrana-Behror (SNB), which is 107km in length. The first section of the Delhi - Meerut corridor, running for 17km from Sahibabad to Duhai, was officially opened on October 20 2023, followed by a further 17km from Duhai to Modi Nagar North on March 6 2024.

With the aim of offering commuters seamless travel, all three Phase 1 corridors converge at Sarai Kale Khan station in New Delhi, meaning that trains arriving from Meerut can proceed directly to Panipat or SNB, saving time and avoiding the inconvenience of changing trains but also providing a true network to bind the NCR closer together. In addition, RRTS infrastructure will also be used for Metro Rail Transit System (MRTS) services within Meerut city, serving densely-populated areas, with 13 stations on the final 21km section of the line from Delhi. Loop lines are provided at MRTS stations for MRTS trains and allow RRTS trains to pass through at speed. This has enabled project authority National Capital Region Transport Corporation (NCRTC) to substantially optimise capital expenditure.

ETCS Hybrid Level 3

For signalling and train control on RRTS, NCRTC is truly breaking new ground by implementing the world-first deployment of ETCS Hybrid Level 3 on an LTE (4G) radio communications network. Following extensive consultation and technical analysis, this solution was chosen as the most suitable option for an urban transport system such as RRTS. 4G was preferred due to the obsolescence of the GSM-R radio communications system that is currently the backbone of ETCS in Europe, where it is due to be replaced by the Future Railway Mobile Communication System (FRMCS) that is now under development (p26). NCRTC has adopted the 3GPP Rel 15 specification which will pave the way for FRMCS.

ETCS is a proven interoperable system designed to ensure safe and efficient train operations. Hybrid Level 3 over ETCS Level 2 enables train headways to be reduced and system capacity to be increased by dividing block sections, whose boundaries are determined by physical axle-counters for train detection, into smaller virtual blocks without the need to install additional physical devices or section markers. NCRTC is also deploying ETCS Level 1. This is intended to provide a back-up in the event of an LTE communications system failure, with trains operating in fixed block sections. The movement authority is updated as the train passes over the balise group at the signal, marking the start of the next block. Under Level 2, the train continuously receives the movement authority at all locations via the LTE network up to the axle-counter boundary.

Hybrid Level 3 offers optimal flexibility, enabling continuous transmission of the movement authority

up to the end of the virtual/physical boundary. Train detection is still performed using axle-counters in Level 2, with virtual sections within the axle-counter sections programmed into the radio block centre (RBC). The RBC receives location information from the train by means of continuous two-way communication using the LTE network. Onboard systems determine train location using information from balises and the train's odometer. Based on this information, the RBC maps the train location corresponding to a virtual block and protects the boundary of this virtual block.

Train integrity is required for ETCS Hybrid Level 3. Onboard and trackside equipment work in tandem to confirm the train is complete, providing a function that has not been implemented on Indian Railways (IR) and on many European networks.

RRTS services operate at speeds of up to 160km/h in block sections, or 100km/h when passing station platforms. These speeds will enable passengers to travel between Delhi and other cities in the NCR within 1 hour, while ETCS also delivers important capacity benefits by shortening headways.

The same infrastructure will be used by both RRTS and MRTS services operated with different types of rolling stock, running at short intervals. Installing Hybrid Level 3 and creating additional virtual blocks has helped in achieving a headway of 3 minutes, bringing ETCS closer to CBTC. With distances between stations ranging from 5km to 10km, it ensures a fast and convenient train service for passengers.

The three converging RRTS corridors create an interoperable network, which from a technical perspective means that a train equipped with an ETCS onboard unit from one supplier can run on lines with trackside equipment from another supplier.

To ensure interoperability, ETCS is based on standardised specifications that each supplier must comply with. NCRTC is implementing ETCS Level 2 Baseline 3 Release 2 (Version 3.6.0).

Platform screen doors

In another global first, NCRTC has successfully integrated platform screen door functionality in ETCS using a spare packet (Packet 44) used for communications as per the ETCS specifications.

Platform screen doors are being installed at all 25 stations on the Delhi - Meerut corridor. Their primary purpose is to improve safety by creating a physical barrier between the platform and the track, preventing passengers from being pulled onto the track as trains pass through at 100km/h.

In underground stations, full-height platform screen doors help to maintain the desired temperature, reducing power consumption for air-conditioning, as well as cost.

To install platform screen doors with ETCS, NCRTC is using Packet 44 tailored to meet specific customer requirements. Testing to validate the functionality of Packet 44 has been completed and it was implemented successfully at stations currently open to traffic.

In order to ensure the alignment of train doors with platform screen doors, automatic train operation (ATO) is planned to be commissioned. The ATO specification for ETCS released in July 2023 is being followed. This will also help to maintain punctuality, accommodate shorter headways and enhance energy efficiency.

Hybrid Level 3 easily fills the gap between ETCS Level 2 and CBTC by enabling trains to operate at higher speeds and with shorter headways within a system that is supplier agnostic. As well as being a first for India, NCRTC's successful deployment of ETCS Hybrid Level 3 over LTE, combined with our philosophy of continuous knowledge exchange, has set the stage for the widespread adoption of this transformative technology for similar projects worldwide. **IRJ**

** Navneet Kaushik is director of systems and operations at the National Capital Region Transport Corporation (NCRTC), where he is overseeing the roll-out of ETCS Hybrid Level 3 and other systems on India's first Regional Rapid Transit System.*

Diagram showing the capacity benefits of ETCS Hybrid Level 3 versus ETCS levels 1 and 2.