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Implementation of ETCS Packet 44 for platform screen door management

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This article describes the operation of Platform Screen Doors (PSDs) and train doors by using Packet 44 within the ETCS specification

India's National Capital Region Transport Corporation (NCRTC) is undergoing a transformative journey in regional connectivity with the advent of the Regional Rapid Transport System (RRTS).

This visionary government initiative aims to redefine public transportation in the NCR by providing a fast, high-frequency, reliable, and safe mode of transportation for commuters.

Addressing critical issues such as air pollution, severe congestion, and unmanageable urban sprawl stands as a primary objective of the RRTS. With a design speed of 180km/h and operational speed of 160km/h, RRTS offers a swift, safe, and efficient mobility solution, aiming to sustainably alleviate transportation challenges. The system not only promotes balanced and sustainable urban development but also promises substantial economic benefits to the region.

Safety and reliability are at the forefront of NCRTC's priorities, ensuring a secure and dependable transportation experience for passengers. To achieve this, the RRTS incorporates state-of-the-art signalling and communication technologies.

The NCRTC is setting new benchmarks in India's rail transportation with its implementation of the ETCS hybrid Level 3 using Long Term Evolution (LTE) as its communication backbone. ETCS integration with PSDs has also been successfully deployed in the RRTS. This is first implementation of its kind globally.

The primary purpose of PSDs is to enhance safety by creating a barrier between the platform and the tracks.

The platform screen door system in use on NCRTC infrastructure.

Their main function is to prevent falls, whether intentional or unintentional, onto the tracks. This reduces the risk of accidents and enhances passenger safety. This safety barrier is particularly important in high-speed railway environments like RRTS, which operates at a run-through speed of 100km/h on the tracks adjacent to the platform. At such high speeds, the air drag of a moving train has a high potential to pull passengers onto the track.

ETCS has established rules to transmit information in predefined packets via radio and/or balise, using variables, packets, messages, and telegrams interfacing between different signalling systems and subsystems. However, there is currently no predefined packet available for PSD control and management.

Therefore, specific communication rules were required to be developed for the control of PSDs within the ETCS framework, enabling the exchange of information between the train and the PSD control unit. These commands encompass both vital and non-vital information, ensuring the secure operation of PSDs and train doors. NCRTC has achieved this functionality by utilising the customisable packet (Packet 44) defined within the ETCS specifications.

Recognising the importance of PSDs, NCRTC is installing these at all 25 stations of the Delhi-Meerut Corridor, including full-height PSDs at underground stations. Full-height PSDs also offer the added advantage of controlling temperature by preventing the entry of external air into the station. This helps in saving air conditioning power and results in cost savings.

What is Packet 44?

ETCS establishes communication channels between trackside and onboard equipment, aligning with the interoperability directives of the European Union Agency for Railways (ERA). It is recognised that some features other than standard ETCS functions may be required by individual countries.

To accommodate such requirements, Packet 44 within the framework of ETCS is specifically intended for transmitting nation specific data between the train and trackside system. The packet structure can be designed to handle the communication requirement by assigning certain values of packet variables to cater for the indented functional requirement.

In ETCS, there are well-defined packets for ATP implementation, but there is no specific packet defined for PSD interface management. Packet 44 was therefore chosen to achieve the desired functionality of PSD interface. Configuring Packet 44 by individual nations also allows it to be used for other purposes such as ASDO (Automatic Selective Door Operation), and speedometer unit change.

Using Packet 44

NCRTC has utilised Packet 44 to exchange information/commands between the PSD system and the signalling system including:

- Information to onboard regarding the upcoming side of next platform (right/left/both).
- Door authorisation window information to ETCS onboard for proper door alignment of the train and PSDs.
- PSD inhibition to keep doors closed in the event of a fault.
- Commands from onboard to open and close the PSDs.
- PSD closed and locked status to ETCS onboard.
- Normal stopping point for different configuration of train (three cars, six cars, nine cars) since NCRTC shall be running mixed configuration of rolling stock.

To achieve the PSD control and management functionality in ETCS, various data packets for communication between Onboard (OB) and Trackside (TRK) system are required. This also requires interface between various systems and subsystems, such as:

- ETCS onboard (European Vital Computer).
- ETCS-TRK (ETCS trackside).
- PSD-SIG (interlocking and TMS).
- Rolling stock (RS) – ETCS onboard.

This architecture is shown in Figure 2.

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Figure 2 – Overall PSD interface with other systems.

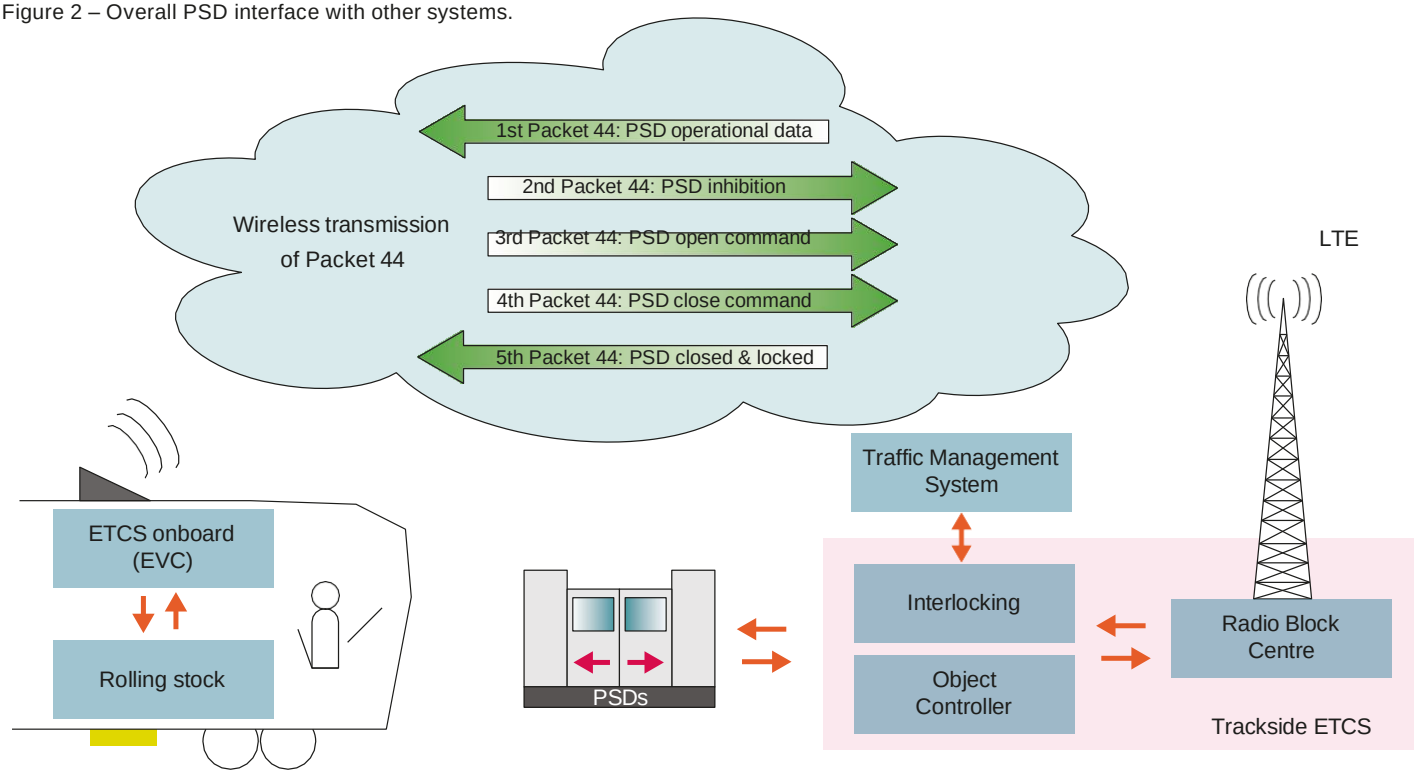
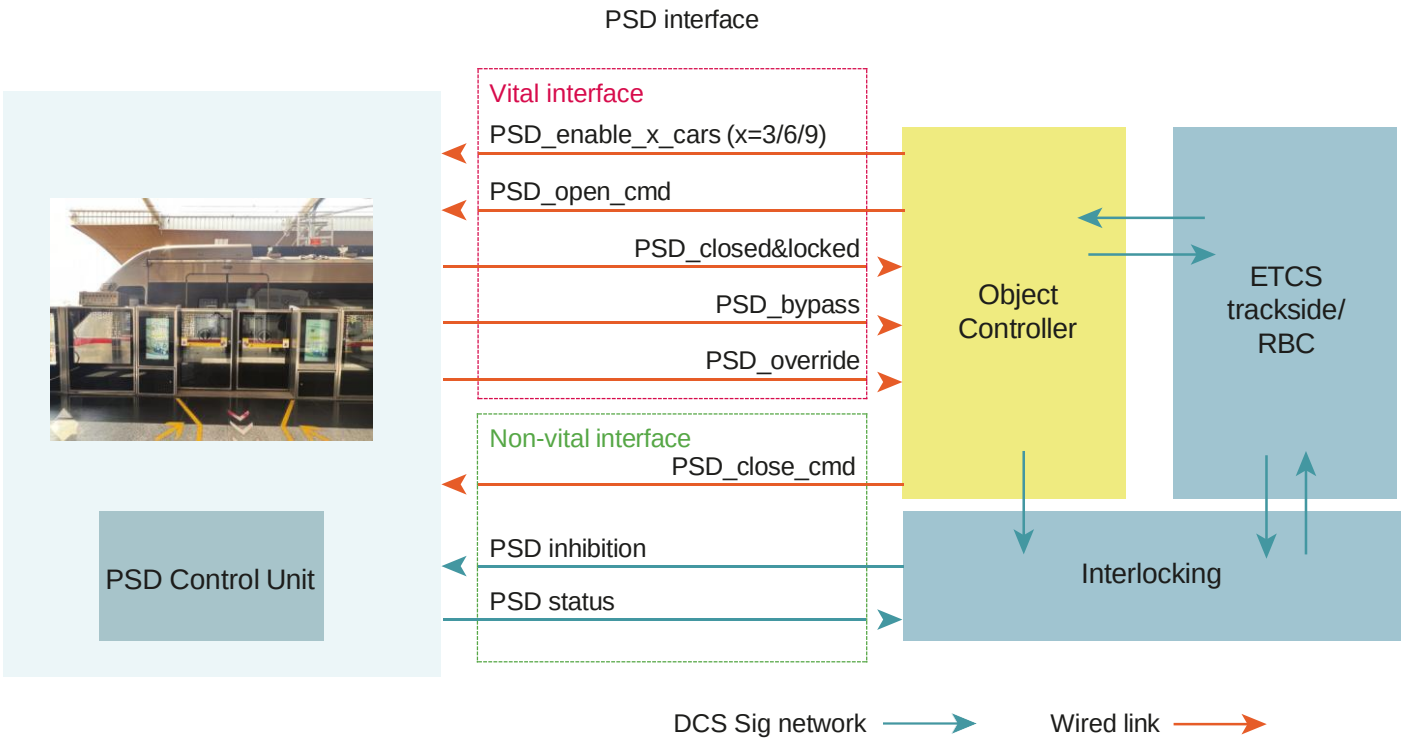


Figure 3 – PSD interface with RBC and interlocking.



Exploring further into some of these interfaces can throw some light on how sequentially a packet exchange takes place between subsystems to enable automatic PSD operations in ETCS.

Exchanging information between train and trackside

To control and manage the PSDs, five data packets, configured within the Packet 44 format, contain information/ commands which are communicated between ETCS onboard (EVC) and trackside ETCS (RBC and interlocking) in a sequential manner.

As soon as the next platform is assigned to a train, ETCS TRK sends to ETCS OB a Packet 44 containing operational data containing information about the stopping point location, PSD side, and PSD status to the managed doors.

After receiving this packet containing platform data, based on the current status of train doors ETCS, OB sends back to ETCS Track (RBC) a Packet 44 containing the PSD inhibition command.

When the train reaches the platform, standstill at the correct position is detected, and traction cut-off and service brake are commanded by ETCS OB to rolling stock. ETCS OB sends to ETCS TRK a Packet 44 with PSD open command, to open the PSD.

Similarly, when a 'close' request is received from RS, ETCS OB sends to ETCS TRK a Packet 44 with PSD close command, to close the PSD.

Following a close command, when the PSD is closed and locked, the status of the PSD changes from 'not closed and locked' to 'closed and locked', ETCS TRK sends to ETCS OB a Packet 44 confirming the closed and locked status. Receiving this status, traction cut-off and service brake is removed, confirming that train can safely proceed.

Vital and non-vital interface between interlocking and PSD

The vital interface between interlocking and the PSDs involves several commands for the control and management of PSDs. These include PSD enable commands for three, six or nine cars, enabling the opening of PSD to suit the respective train lengths. PSD enable for nine cars is for future provision and is not currently implemented in any station.

The 'PSD open' command requests the opening of the PSDs. The 'PSD closed and locked command' signals that all monitored doors of the PSD system are closed and mechanically locked. 'PSD bypass' communicates that a door is under maintenance, allowing trains to enter the platform with a speed limit.

The interlocking override is activated when internal monitoring of PSD locked status fails, permitting entry in case of faulty ‘PSD closed and locked’ control.

The non-vital interface includes commands such as the PSD close command, PSD status, and PSD inhibition command.

The PSD inhibition command is essential to handle a faulty train door/ PSD situation so that corresponding doors do not open.

For this, each PSD control unit cyclically sends the status of all PSDs to the interlocking, indicating the door numbers of operational and non-operational doors. The train, upon receiving the individual door status of the PSD and based on its own train door status, sends back the inhibition command to the PSD to synchronize the opening of all individual train doors with the PSD.

Thus, in case of any faulty PSD door, the corresponding train doors are not allowed to open. Similarly, faulty train door status is conveyed to the station PSD system.

Conclusion

As per ETCS specifications, Packet 44 is the free packet available for customisation. For any functionality which can't be met with other defined packets, they may be achieved through this packet.

Packet 44 is used to convey the information regarding the side of next platform, normal stopping point, door authorisation window, inhibition synchronisation of train door with PSD, PSD open, close command, and PSD closed and locked status. Its length is similar to all other packets defined in ETCS specifications. With the customisation of Packet 44, the challenge arises of interoperability. To deal with this, the same Packet 44 structure needs to be used everywhere to ensure the system remains interoperable.

As PSD door and train door open commands occur at different time intervals, it has to be ensured that proper time delay is introduced so that both train door and PSD are synchronised while opening and closing.

Packet 44 has been used for the first time in ETCS L2 (Hybrid L3) to control the PSDs. As ETCS specifications are continuously evolving, in the near future we may see standardised Packet 44 structure to make it interoperable for SIG-PSD interface.

About the author

Navneet Kaushik is working as director, systems and operations, in the National Capital Region Transport Corporation, New Delhi, which is the first project in India where ETCS Hybrid Level 3 integrated with PSD is implemented over an LTE communication backbone.

He is an engineering graduate with more than 35 years of railway industry experience in main line and metro dealing particularly with signalling, telecoms, platform screen doors, automatic fare collection, and operations. He has commissioned multiple CBTC projects across India including Driverless Train Operation (DTO)/Unattended Train Operation (UTO) as well as ETCS Hybrid Level 3.

What do you think?

Do you think we use enough imagination and innovation in using channels such as the 'Packet 44' message in the ETCS protocol? Do you have experience of doing something similar on your railway or project, or have you taken a different approach.

We'd love to hear from you, email editor@irsenews.org