Railway Gazette INTERNATIONAL

India: On the path to digital signalling

11 August 2021

The use of Digital ATC on the Mumbai – Ahmedabad high speed line promises a step change in safety technology.

Bharti Jain - SME, Signal & Telecoms - India

The 320 km/h high speed line between Mumbai and Ahmadabad will bring some significant technical advances for Indian Railways, notably the introduction of digital train control.

Backed by JICA, the line will use Japanese Shinkansen technology, including the Digital Communication & Control system, known as DS-ATC. This will ensure safe operation at high speed, including the prevention of overspeed derailments, enforcement of interlocking rules and work zone protection and broken rail detection.

IR has installed a range of train protection and warning systems in recent years, looking to improve safety and performance as both freight and passenger traffic have increased.

In the 1990s, an automatic warning system was provided for Mumbai suburban EMUs, on 289 route-km run by Central Railway and 124 km of Western Railway. This was followed by a TPWS based on the European Train Control System for Southern Railway's Chennai suburban network. ETCS Level 1 was initially provided on the 50 km Chennai Beach – Central – Gummidipoondi route and by October 2017 was operational on three sections totalling 342 route-km.

Meanwhile, the indigenous Train Collision Avoidance System was introduced in March 2019, providing automatic train protection on a 250 km section of South Central Railway between Aligarh and Kanpur. TCAS is also fitted to the 'Train 18' inter-city trainset which operates the Vande Bharat Express over the 760 km between New Delhi and Varanasi.

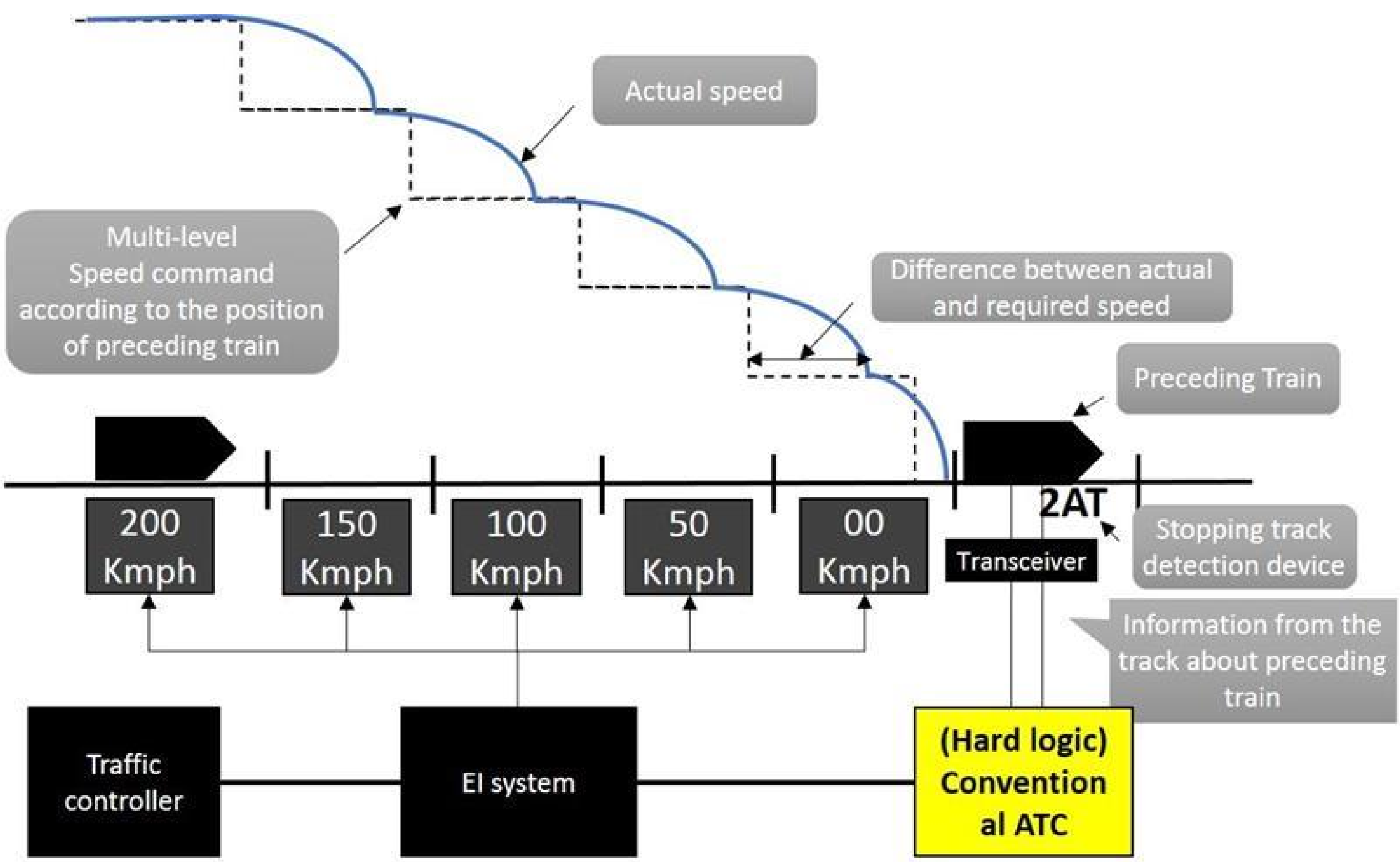

Fig 1. India's early ATP systems rely on a stepped speed profile for each block section.

From analogue to digital

India's early ATP systems provide speed oversight in conjunction with lineside signals. Based on track occupancy, the system transmits a permitted speed to the trains using an electromagnetic link. The onboard unit intervenes with a brake application if the actual speed exceeds the target by a predetermined amount. However, train operation is still the responsibility of the driver.

These intermittent ATP systems are based on fixed blocks, resulting in a stepped reduction in speed when approaching a train in front (**Fig 1**). By contrast, DS-ATC is designed to provide a much smoother braking curve (**Fig 2**). Using real-time train position information, the microcontroller-based ATC Logic Device prepares telegrams to be transmitted to the trains. The Transmission Control System communicates with lineside equipment using a modulation technique known as Minimum Shift Keying.

Data exchange between track and train uses transponders at roughly 3 km intervals. Based on the ATC telegrams, the onboard unit selects the most appropriate braking pattern stored in its database to match the current speed and desired stopping position. Rather than simply intervening with a brake application if the target speed is exceeded, the onboard unit will actively manage the speed of the train throughout the braking curve.

All coded telegrams and messages are verified at each stage of the process, to ensure safety and reliability. The smoother braking curves will improve ride comfort and reduce energy consumption, as a stepped curve results in trains spending more time travelling at lower speeds. They should also allow trains to run at closer headways.

The use of micro-controllers and digital electronics makes the equipment very compact, and should reduce costs. DS-ATC will allow a degree of scaleability, as future increases in train speeds can be accommodated through changes to the database, rather than by altering the hardware.

As well as future high speed lines, we expect DS-ATC to be rolled out on conventional lines as they are upgraded for semi-high speed operation. The technology offers IR the prospect of better punctuality, enhanced safety and increased line capacity.

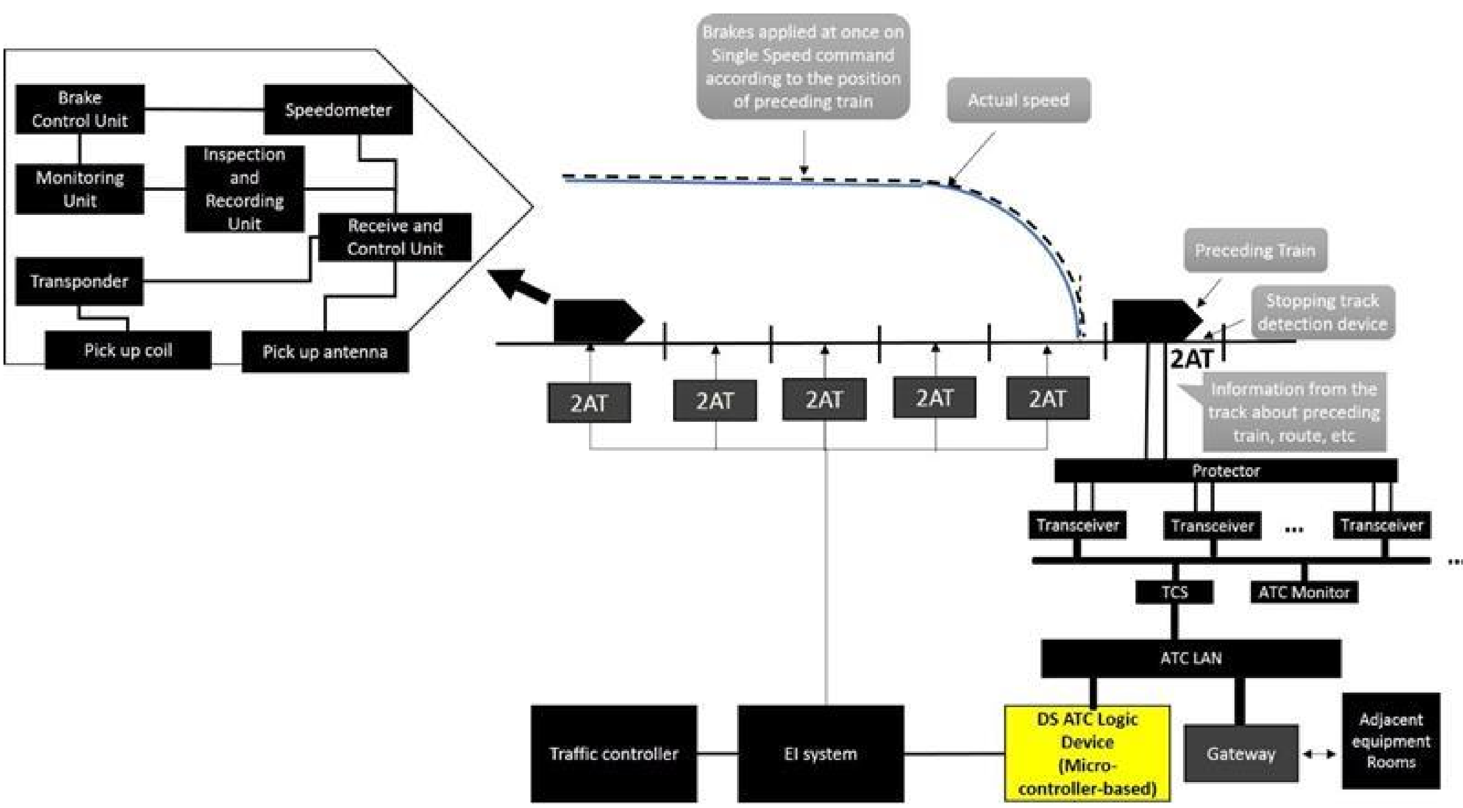

Fig 2. The DS-ATC architecture is designed to provide smoother braking curves, improving both performance and capacity.