SIEMENS

Background information

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European Train Control System ETCS: safe and fast international travel

A key component in the integration of rail transport in Europe is the ETCS (European Train Control System), which is intended to replace the more than 20 national railway control and safety systems currently being used on the European continent. ETCS has since developed into a global standard and is being used in countries like China and Australia. The European goal behind ETCS is to enable an interoperable and thus competitive rail transport system. ETCS lays the foundation for highly automated transportation and secures operator investments for the future. Siemens has been heavily involved in the specification of the system, and has equipped and commissioned numerous rail lines and trains worldwide for ETCS service since 2005.

ETCS monitors the movement of trains with regard to observing local speed limits and the train's maximum authorized speed. It also monitors, for example, adherence to the route approved for the train, the direction of travel and compliance with operating procedures (e.g. line-of-sight driving, shunting etc.). The system requires trainborne equipment and various elements along the line, as well as a radio system (GSM-R or IP-based telecommunication). Various ETCS configuration levels (Levels 1 to 3) have been defined to serve different rail line and operator requirements as well as different user profiles. These differences in the levels apply to both trackside and onboard equipment.

ETCS levels are downward compatible; that is, a train equipped with ETCS Level 2 may also operate on Level 1 lines, whereas a train equipped with ETCS Level 1 cannot run on Level 2 lines.

ETCS Level 1 is based on the principle of intermittent train control system, with the advantage that additional information about the status of the line ahead is transmitted to the train and monitored. In Level 1, the signal locations are confirmed by Eurobalises. The balises can be provided with a fixed dataset, such as the

gradient and maximum speed of the line, or operate as switchable balises for transmitting variable information. Balises can be compared to the transponders we know from smart cards and RFID tags. As the train passes over them, they are energized by a high-frequency electromagnetic field from the onboard balise antenna and then transmit a dataset to the ETCS onboard computer. Switchable balises are connected to a so-called Lineside Electronic Unit (LEU) or a central LEU. The LEU picks up the valid signal aspect, transmitted from the interlocking to the signal, directly in the signal and thus enables the relay of the valid movement authority (MA), that is, permission for the train to proceed. ETCS Level 1 is especially suited for installing an ETCS system without having a major impact on all operating personnel on the trains and at trackside.

For **ETCS Level 2,** a continuous link between train and track is established via GSM-R or IP-based radio communication, making fixed-location signals unnecessary. Compared with Level 1, the movement authority currently valid at any time is received via radio link and displayed on the locomotive driver's driver-machine-interface (DMI).

For this, a Level 2 line requires a radio block center (RBC) in order to transmit the movement authority from the interlocking to the train via radio. The radio block centers are linked to the interlockings and receive information such as the setting of the points and signals as well as track vacancy detection data.

When a train reaches a Level 2 section, it logs on to the RBC with the appropriate command as soon as it has passed a balise. This communication with the RBC is authenticated and encrypted. This process checks whether the train is actually planned and authorized for the line, and places the train on the traffic controller's display screen. The benefits of Level 2 include reduced infrastructure costs, higher system availability and capacity increases made possible by driving with a continuous electronic look-ahead – all while maintaining the highest safety standards.

ETCS Level 3 functions similarly to Level 2, but is not dependant on the installation of track vacancy detection (TVD) devices. At this level, the RBC also takes over the function of TVD. At Level 3, a so-called "moving block" or "virtual block" is possible, which further increases line capacity and saves additional infrastructure costs. In the

classical “fixed block” system, the rail line is divided into fixed sections. When train 1 enters such a section, the section is automatically blocked for following trains with a stop signal. Only when train 1 has left the section may the following train enter it. In the more modern moving or virtual block system, the train’s actual position is transmitted rather than the section’s occupation – from the train itself to receivers along the line. If the length of the train (Train Integrity) is known, the expected braking distance and thus actually required space between the trains can be precisely determined. As a result, a following train need not stop at the beginning of each blocked section, but can proceed at a safe distance behind the first train. Trackside signals are no longer needed in this system.

With Level 3, network planning can be more flexible, since the positioning of signals and track vacancy detectors doesn’t have to be considered. Railway lines can be divided into moving or virtual blocks at a later time. If all trains are not equipped with Train Integrity capability, track vacancy detection data from the line can support mixed traffic operation.

Siemens is a pioneer of ETCS technology:

- Siemens has demonstrated the technical interoperability of its systems internationally
- Interoperability with respect to systems of other suppliers has been proven through numerous trackside and trainborne projects
- ETCS is licensed for commercial operation in many countries, including Austria, Belgium, China, Germany, Greece, Hungary, the Netherlands, Saudi Arabia, Spain and Switzerland
- Siemens has references based on ETCS specifications from Baseline 2 and 3, for example the new sprint line from Erfurt to Leipzig/Halle as part of Germany’s VDE8 transportation project and UK’s Thameslink north-south commuter route through London, connecting Bedford, located to the north east of the capital, with Brighton, on the south coast.

Economic success thanks to high operating performance and low lifecycle costs:

- Investment costs can be reduced by up to one-third
- Increased system availability as a result of fewer infrastructure elements
- Installation and maintenance are minimized

- Significantly lower energy consumption
- Investment protection for existing systems through the integration capability of Siemens solutions
- Ability to migrate allows the serial installation of trainborne and track equipment

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