SIEMENS

Mobility Division

Background Information

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Automated driving by rail

The demand for automated solutions for rail systems is increasing. Rail has a great chance of becoming the most efficient means of transport in the future. However, this is only possible if it increases its competitiveness in comparison with other means of transport. This is achieved when trains arrive punctually and in quick succession. Siemens experts have therefore been working on autonomous operation of rail transport for several years. Significant progress has already been made with this automation of rail transport.

Pioneering the automation of rail services

As far back as 2002, Siemens, together with RWTH Aachen University, developed a fully automatically controlled powered freight car in the "Cargomover" project. Today, driverless train operation on metro lines has been a reality for some years. For example, Siemens delivered one of the world's first computer-controlled metro trains to the city of Nuremberg in 2008. In the meantime, automated Siemens trains are now also running in Barcelona, Paris and Budapest.

Target for 2030: Fully automated train operation, even for main-line traffic

Many years of experience in mass transit has made it possible to extend automated operation to regional and main-line traffic. This is achieved by linking the European Train Control System (ETCS) to the Automatic Train Operation (ATO) system which automatically accelerates and brakes the train and has proven itself in metro systems. Siemens is currently implementing such an "ATO over ETCS" system in London. This semi-automated train operation lays the foundation for further development, the target being to achieve fully automated train operation, even for main-line traffic, by 2030.

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The "ATO over ETCS" solution – how does it work?

Worldwide, Siemens has equipped over 300 kilometers of track for fully automated mass transit operation making Siemens the market leader in this technology. The benefits are clear: 99 percent punctuality, additional trains can be automatically deployed directly from the depot, capacity increased by up to 50 percent, and energy savings of 15 percent. These proven automation functions from the mass transit sphere can be adapted successfully for use in regional transportation and, in the medium term, for mainline services as well, in order to achieve significant increases in both efficiency and line capacity. But how exactly does "ATO over "ETCS" work?

- ETCS monitors whether train movements in regional and long-distance traffic observe the locally permissible speeds and the maximum permissible speed of the train. Both the train-track communication for the ETCS itself, as well as the communication between the trackside traffic management system (TMS) and ATO, are implemented for automated operation in Level 2 via GSM-R.
- While ETCS acts as the intermediary between the train and the trackside – in other words, the trackside transmits the safe movement authority to a train, thereby ensuring a safe train movement – ATO further optimizes the movement of the train.
- ATO can be used to automate normal operation, so that all trains move with exactly the same, optimized speed profiles (optimized headways). ATO is the automation module which partially or wholly takes over the train control from the trip computer. This ranges from brake and propulsion control for controlling speed, to propulsion control at the stopping point.
- The on-board ETCS and ATO equipment calls up information and precise positional data from the balises, and the radio communication is handled via GSM (Global System for Mobile Communication) according to ERTMS standards.
- ATO automatically translates the calculated energy-optimized trip profile into precise control commands to the train's propulsion and braking systems. This significantly improves not only the energy consumption but also the traffic flow.

- Technically, ATO is a control system and not a protection system. Like a train driver, ATO controls not only the propulsion and braking, but also other functions, such as door movements. The ETCS meanwhile handles the safety functions in terms of railway equipment safety.

The benefits are clear:

The advantages of the ETCS for regional and long-distance traffic have been known for a long time. For example, Level 2 not only substantially reduces infrastructure costs but also enables trains to travel at speeds in excess of 300 km/h. ETCS forms the basis for highly automated and, above all, interoperable, cross-border transportation, and assures rail operators of a secure future. However, ECTS becomes really interesting when it is combined with ATO. This mainly increases energy efficiency and line capacity.

- ATO **shortens headways** through time-optimized motoring, precise stopping, automatic door opening, stipulation of a precise dwell time for the driver, and precise travel along ETCS brake intervention curves.
- **Energy efficiency:** The ATO enables the train to follow the optimum speed profile based on the route data, timetable and real-time information from the infrastructure side. ATO saves up to **20 percent of energy costs**.

Interaction of mass transit and main-line traffic: Crossrail

The Crossrail project also uses a solution that facilitates an uninterrupted train journey from the mass transit network into the mainline network. In future, trains in the Crossrail Tunnel will be guided by wireless Communications-Based Train Control (CBTC). Level 2 ETCS is being installed on the west-bound long-distance line, whereas the eastbound line will have the local Train Protection Warning System (TPWS). A dynamic switchover between the three train control systems will ensure smooth integration of the different lines in future. To implement this solution, on the core section of the Crossrail Line, Siemens is installing the Trainguard MT radio-based train control system with ATO, the Vicos operations control system, and the Airlink radio transmission system.

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