Automatic Train Operation with smartrail 4.0 – Status of work and pilots for assistance systems November 2018

This document describes the current status of work on the Automatic Train Operation (ATO) sub-programme within the industry programme smartrail 4.0. The basis of this document is the information from the document “ATO Basic Information”.

Current situation

One of the six sub-programmes within smartrail 4.0 deals with the subject of Automatic Train Operation. In this context, pilots are being carried out to determine the potential of automation approaches to support the locomotive driver. The aim of automation is to increase the consolidation of train journeys, thus maximising capacity with the existing infrastructure. ATO is divided into different grades of automation (GoA). This refers to the extent to which the train performs the journey independently and which tasks are taken on by the staff on the train.

Which ATO activities does smartrail 4.0 perform?

Activities at level GoA1

Today, systems that already support the locomotive driver on journeys include adaptive control (ADL), the European Train Control System (ETCS) up to level 2 and the locomotive crew electronic assistant (LEA). The functions of these systems are to be extended by 2023 during the first stage of smartrail 4.0. In a new line within the LEA, Eco2.0 proposes an environmentally sound speed in order to save energy while keeping journeys on time. With ADL 4.0, locomotive drivers receive additional information and more accurate driving instructions compared to today, meaning they can drive with foresight and thus increase capacity.

Activities at level GoA2

As train journeys are further consolidated, culminating in a moving block, it makes sense to automate the train journey itself. Smartrail 4.0 involves the testing and evaluation of automation grade GoA2, which is the equivalent of autopilot in aviation. The locomotive driver hands over control of the actual driving and intervenes if necessary, especially in the event of disruptions. This means that the speed of the train can be optimised at all times depending on the overall system, thus increasing capacity and punctuality and saving energy.

Activities at level GoA 3/4

GoA3/4 journeys are currently not addressed in smartrail 4.0, as further technical developments are required in order to ensure smooth, economical and safe operation. For smartrail4.0, GoA2 autopilot and moving block are sufficient to achieve the desired increase in capacity. However, fully automated shunting and stabling solutions are also being considered by other European railways, and this development is being monitored.

About the current tests

Projects at SBB

- In December 2017, SBB tested a self-driving train with an assistance system. On the Bern–Olten route, Stadler Rail’s double-decker train travelled at up to 160 kilometres per hour – and was able to brake and accelerate within the ETCS speed profile.

- On the weekend of 24 – 27 August 2018, and in the week from 3 – 7 September 2018, SBB carried out pilot test journeys with GoA2 on the ETCS Level 2 route from Lausanne to Villeneuve, during which the locomotive driver handed over control of the journey to the autopilot. The pilot will continue in 2019 with further test journeys.
The current tests on the Lausanne – Villeneuve route are investigating the applicability of some of the currently planned TSI (Technical Specifications for Interoperability) standards on the Swiss railway network. As a first step, the draft standards for communication between the vehicle and the trackside ATO equipment were tested for functionality at SBB on ETCS Level 2 routes. Later, the pilot will be extended to tests relating to further draft standards for the on-board equipment. A proof of concept (POC) will thus be performed. Commercial operations (passenger operations) are not currently envisaged.

This assistance system consists of a Siemens hardware module which can be temporarily installed in the test train (FLIRT from Stadler Rail). In addition to ATO-TS (ATO Trackside), a future component of the TMS (Traffic Management System), it uses information from the ETCS data such as the maximum speed and the distance to the destination and thus calculates the acceleration and braking curves. The test train was able to start automatically at the station after being handed over by the locomotive driver, then travelled along the route in accordance with the calculated driving profile and automatically braked to a defined point at the next station. The technology does not yet allow the train to stop with pinpoint accuracy without further adjustments, for example to the infrastructure.

This pilot constitutes a further step in automation; additional tests are necessary in order to reach automated railway operations. And, in addition to technical issues, there are also regulatory issues that need to be clarified.

**PROJECTS AT SOB**

- As part of the smartrail 4.0 programme, Schweizerische Südostbahn (SOB) is testing automated driving with GoA2 on routes with conventional trackside signalling and the ETCS Level 1 Limited Supervision train protection system. To this end, pilot testing with up to three different system suppliers is planned. The test journeys will take place between December 2019 and December 2020 on the Degersheim–Wattwil and Wädenswil–Einsiedeln routes. Between December 2020 and December 2021, circuits of the S13 (Wädenswil–Einsiedeln) will be tested with automation for commercial operations.

- A competition (based on architectural competitions in accordance with SIA142) is currently running to select three suitable system suppliers to participate in the SOB pilot programme. A decision is expected by the end of 2018.

**PROJECTS WITHIN THE UPT ATO METRE-GAUGE, SPECIAL-GAUGE/TRAM WORKING GROUP**

With the goal of further utilising the various existing systems, the metre-gauge railways are developing a common ATO standard based on the metre-gauge standard train control (ZBMS). This reduces the cost of implementing ATO.

Following on from discussions with potential suppliers and an internal discussion in the working group, the following routes are being considered for possible pilots:

- RBS: Worblaufen – Bern
- RhB: Klosters – Malans
- zb: Lucerne – Horw

Technical workshops are currently being held with the potential suppliers. During these workshops, the catalogue of requirements will be refined, taking into account the objectives of the pilot operations. The providers will submit an offer based on this information. Initial night-time tests are planned for 2019. A pilot operation for commercial operations is not possible until 2020 at the earliest.

**HOW AUTOMATED TRAIN TRAVEL WITH THE ASSISTANCE SYSTEM WORKS**

- The SBB tests involve an assistance or support system for locomotive drivers: the train driver sits in the driver’s cab monitoring the systems and intervening if necessary. ATO dispenses with
manual acceleration and braking. The link to adaptive control allows an energy-optimised driving profile to be realised automatically, as well as a smoother driving style that passengers will appreciate. This corresponds with the second automation level GoA2.

- The assistance system is based on the European train control standard ETCS. The RBC sends the train the ETCS data with the permitted maximum speed via SBB’s own mobile network (GSM-R). In addition, the train receives the production specifications from the train-control centre via the planning system of the traffic management system (TMS-PAS). When creating the timetable, TMS-PAS ensures that all train journeys – i.e. the overall operations – are planned as optimally as possible (in terms of energy and/or capacity and/or safety). The production specification, which contains a feasible timetable free of any conflicts, as well as the route data, is transmitted via the mobile network (GSM-P) to the vehicle on ATO on-board units (ATO-OBU) and carried out by the vehicle.

What this means for the locomotive crew

- Automated does not mean trains without personnel. The industry is convinced that it will continue to require specialists to ensure the safe and punctual handling of train operations on the train in the future.

- As railway technology advances, the job description for the locomotive crew changes. Staff knowledge is still vital for installing and using the new technology in a targeted manner. We are therefore working within the transformation sub-programme to be able to continue to offer an attractive profession and to clarify responsibilities.