Swiss Section

IRSE
Institution of Railway Signal Engineers
SWISS SECTION

ATO with Rail Systems Engineering (RSE) September 2020

Report by Patrick Sonderegger

After a long break where it was impossible to hold events, we were allowed in September 2020 to meet in bigger groups. That's why the IRSE Swiss Section took the opportunity to hold a very interesting event about Automatic Train Operation (ATO).

The event was organised as a trip from St Gallen to Winterthur on the Rail Systems Engineering (RSE) ATO test train, a two-coach self-propelled electric trainset, rented for the ATO tests by the Switzerland Southeast Railway SOB ("Südostbahn" – railway operator in Switzerland).

The RSE's ATO tests were performed southwest of St. Gallen (to Wattwil), but the IRSE Swiss section's journey took us to Winterthur. On the train, results of the tests and the technical integration of the ATO system in the train were presented.

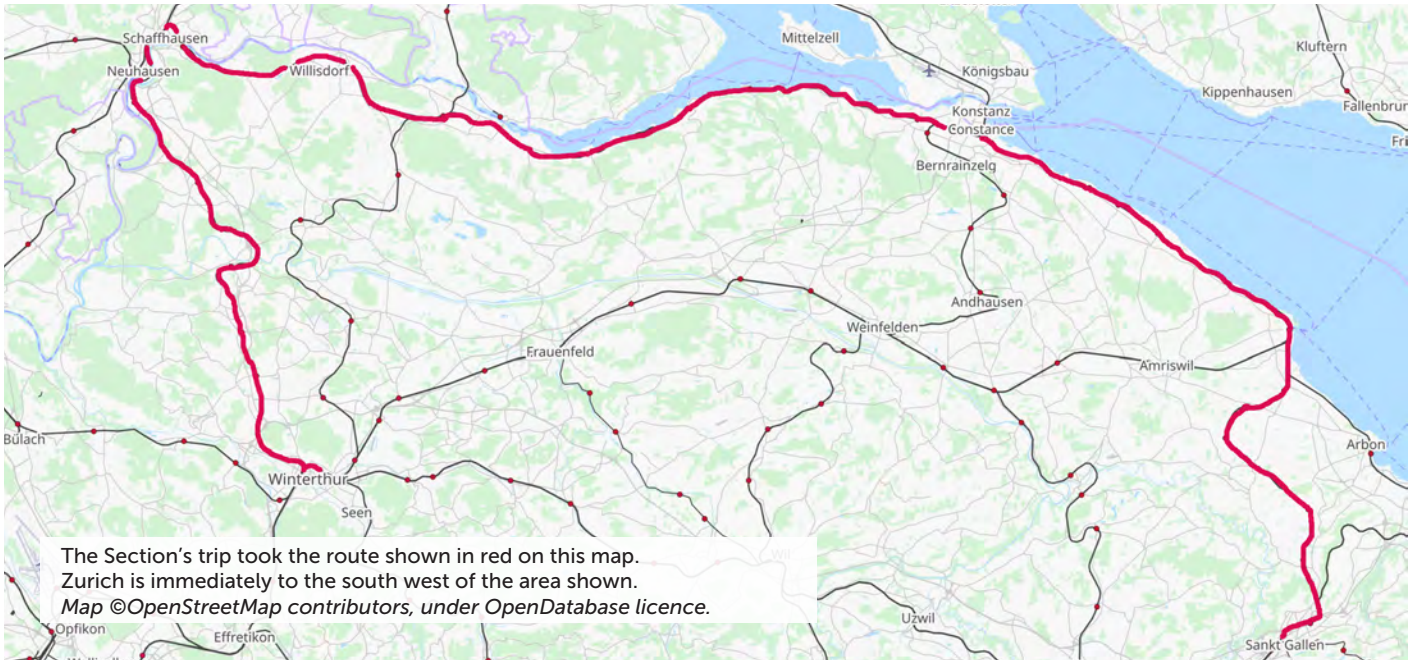
Daniel Pixley (IRSE Swiss Section President), Adrian Egloff (CEO of RSE Switzerland) and Philipp Goetz (CEO of RSE Malaysia) welcomed more than 20 members of the Section at St Gallen, the trip then started in the direction of Romanshorn.

There are always important points to experience at IRSE events. One of them is to have the possibility to talk to each other 'across the borders' of companies and roles, all with the same goal to share knowledge, to push and enrich the railway sector and to possibly instigate new projects. During the trip from St Gallen to Winterthur and also during the dinner, there were plenty of moments that were used for this purpose.

Another important point is to experience and enjoy the scenery, especially on trips with railways integrated into the event. On this trip, we could see the typical apple trees of eastern Switzerland that were ready to be harvested, and those in the driver's cab could see a lot of the railway and signalling specialities of the route, which Adrian Egloff had chosen for the trip.

In Switzerland and with lineside signalling, the knowledge of the driver is still mandatory and the driver was also able to inform the guests of many of the specialities between St Gallen and Schaffhausen. One of the scenery highlights was crossing the river Rhine. We were able to cross it twice. The first time was when heading towards Schaffhausen with a view of the bridges and city, and the second time after we had left Schaffhausen station and could look at the famous Rhine Falls.

The technical focus of the event was ATO. Adrian Egloff explained the project RSE is undertaking with SOB regarding ATO GOA2. RSE was selected at the end of 2018 as the supplier to



The Section's trip took the route shown in red on this map. Zurich is immediately to the south west of the area shown.
Map ©OpenStreetMap contributors, under OpenDatabase licence.

Above, part of the Rhine Falls.
Left, the RSE test train.
Photos Patrick Sonderegger.

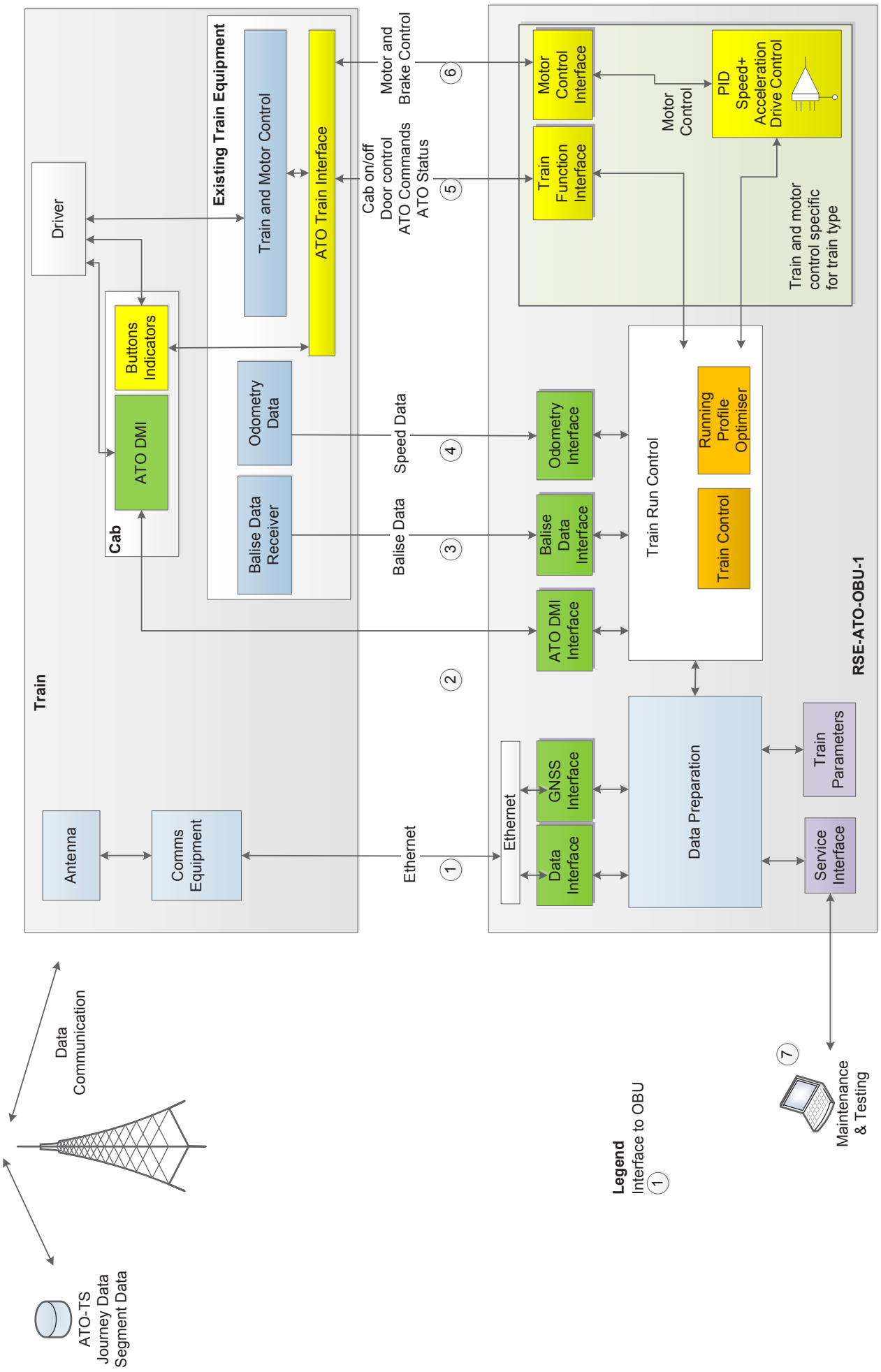
prepare and perform ATO tests on the railway infrastructure of SOB. After the successful preparation phase, ATO tests started at the end of 2019. To perform the tests, a test train provided by RSE was required (pictured above) and a lot of interfaces need to be integrated.

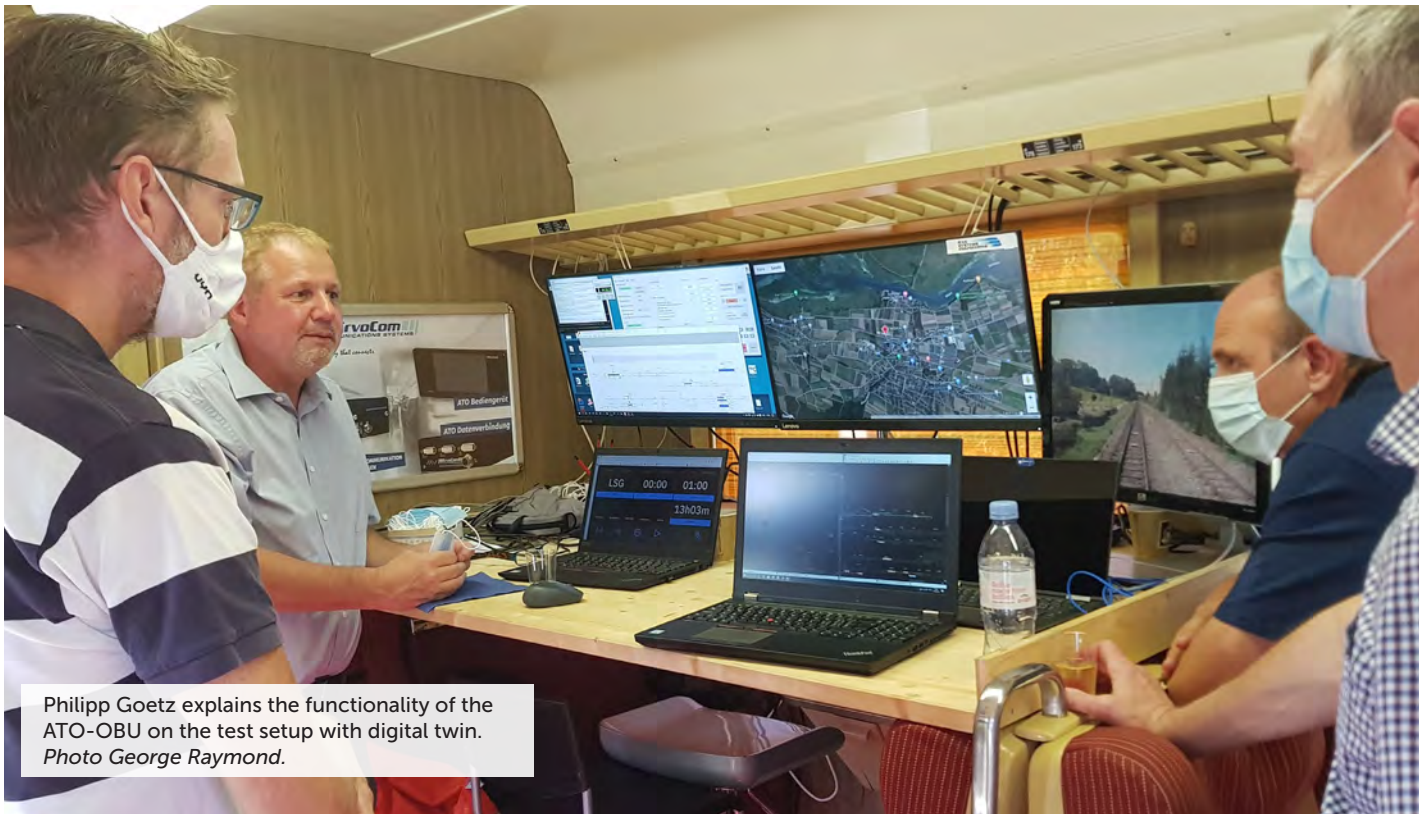
As shown in the system diagram overleaf, the heart of the system is the ATO OBU (On-Board Unit) which calculates the driving profile for the train and the target speed based on different inputs and actual conditions. Using this information, it tells the train to accelerate, coast or brake. The software for this application offers a smart interface between ATO OBU and the train controls. To depart, the driver must first give an order and driving is then done automatically. Door closing is not yet part of the testing.

At the time of the event in September 2020 the integration was already advanced enough to show the first results to the IRSE group. This was done in a practical segment where all the different systems on the train were explained to the group.

- Data preparation: the necessary data to perform the test on the tracks between Degersheim and Wattwil is prepared and transferred to the system in real time. Beside the geometric track layout (station stopping points, gradients) information about exact stopping positions for passengers was also necessary. The test line offers a number of trip profiles and many test cases.
- The train runs with ZUB supervision. The information the train receives from the balises is transferred to the system.
- The optimal running of the train is dependent on the timetable. The timetable and further information are transferred via a mobile data network to the train.

System diagram of the ATO solution, showing the RSE OBU and its interfaces.





Philipp Goetz explains the functionality of the ATO-OBU on the test setup with digital twin. *Photo George Raymond.*

- The ATO is not considered a safety (SIL 4) system and is completely separate from the signalling systems to assure safety. The 'master' of the train remains the driver and the responsibility for the train control is always the driver's duty. ATO (GOA2) only influences the train according to its optimal calculations if it is allowed by the driver. The driver can always turn the ATO off, and the ATO has no authority over the safety part of the train, So, if a received balise telegram requests a 'stop', the ATO cannot overrule this, even if the driver is inattentive.
- An SBB train driver was present who also serves as an ETCS consultant for the ATO project.

Information from the practical part of the event was supported by a theoretical presentation of the trial results. From January 2020 to September 2020 a lot of test runs were performed to show the integrity of the security and safety part of the system to the ATO system. This included gathering experience to 'tune' the interaction with the train control system and integrate the interfaces between ATO and trackside.

Automatic runs were performed according to schedule and different train characteristics, along with gaining the experience of drivers and optimising the operation of the ATO equipment accordingly.

A lot of tests have also been undertaken using a digital twin. The operations simulation system OpenTrack interfaces with the ATO OBU to give the same input to the OBU that the driver would receive from the train in live operation. The OBU does not know that it is getting data from OpenTrack instead of the train. An interface provides communication in real time between OpenTrack and the ATO OBU.

Similarly, the trackside server at Swiss Federal Railways (SBB) in Bern does not know it is not communicating with a train, but with its digital twin. When the ATO system gives orders to the train's traction motors, the orders instead go via a 'short circuit' to OpenTrack. This gives the ability to test and optimise ATO and its parameters without control of the train's traction motors. The digital twin also allows as much testing as possible while avoiding the cost of running a train with a driver.

The digital twin is merged into the OBU as an extra module and as a digital twin model of the Degersheim – Wattwil line. The simulation runs in real time and trains have been driven thousands of kilometres [virtually] to see what works and what doesn't work.

The progress of the tests has been very good and the project is on plan to reach its next milestone. It seemed that the chosen approach of implementing ATO step by step and doing early tests runs in the real world has helped, and this will assist with getting the ATO GOA2 technically mature. RSE has sought the advice of people involved in operations – including train drivers – in a phase where it is still easy to make changes.

RSE's ATO system will require approval of the Swiss FOT (Federal Office of Transport), and certification of the ATO system by the FOT will be easier because the driver and signalling system are still being used, unaltered.

Beside the technical issues, there are also the political and social issues. Is the driver still needed in the future? How does the profession of train driver change? Some of these questions were discussed. The feedbacks from the train drivers who performed the test runs was mainly positive, because they could see the additional help, they would benefit from with GoA2.

At the end of 2021 all the functions of the RSE ATO System from RSE were fully implemented on standardised hardware, that can also be used as a series of products. The actual tests have been focused on the driving according to timing and passing points, given by the traffic planning system. The accuracy to achieve the required arrival times has been an impressive +/- 5 seconds.

Finally, the IRSE group arrived in Winterthur. All the participants were impressed by the presentation and the progress of the project and were looking forward to an update on the project in the future.