Swiss Section

Technical visit to the SBB operations centre for TMS

Report by Patrick Sonderegger

On 17 June 2022, SBB (Swiss Federal Railways) invited the Swiss Section to take an in-depth look at its Traffic Management System (TMS) and plans for the future operation of trains.

After a warm welcome by Peter Wohlhauser, Marc Reber presented today's operation and the future developments in an interactive speech to a very interested audience. He showed that, to develop a future that may be reality in 2050, SBB has to start work based on today's assumptions given by the government and on past experiences. The development of the strategy for TMS is similar to the daily planning and management of trains, but in a different time scale (i.e. with longer observation and feedback loops). In both cycles, task planning and task execution exist. The feedback loops are very important for both cycles. The second part of the event consisted of a demonstration of how signallers and dispatchers currently work, with deep discussions on current and future traffic management principles. The event demonstrated that SBB is on the way to digitalising its operation centres.

SBB has four operation centres for railway services. One is in the south, one in the east, one in the west and the one we were able to visit in the middle of Switzerland, BZ Mitte (BZ = Betriebszentrale/operations centre; Mitte = middle). The layout of the rooms and the organisation of the workstations in the four centres are similar. BZ Süd (south) and BZ Mitte are the most modern. For BZ Ost (west) a new building is planned where most things will be organised in the same way, but with small adaptations based on the experiences of the other operation centres.

Within each operation centre, sectors are built to control a certain region of responsibility. Two roles for train operation are permanently active:

- The **dispatcher** works on the dispatching level. Their tool today is the Rail Control System (RCS), which shows trains, foreseen routes, time forecast (with delays) and dependencies. The RCS also sends messages to the train driver to directly influence their driving (e.g. to let the train drive slower before reaching a signal to save energy or avoid a full stop). The dispatcher has the ability to change the sequence of trains at a station or on the lines between stations. They can also set dependencies between trains to delay departure of a second train when there should be a given time for passengers to change (e.g., if the first train is delayed). Usually, all dependencies are buffered in the system (current plan) and the dispatcher only has to act when something diverges from the current plan.
- The **signaller**, who works with the signalling control system (Siemens Controlguide Iltis is mostly used in Switzerland), is responsible for setting the routes. They operate the interlockings and, for some regions where ETCS L2 is used, also the radio block centre (RBC). Normally, they only have to observe the traffic, which is signalled automatically according to the planning on RCS. But the running operation is rarely "normal". The reality, or the "real normality", is that they must talk to train drivers about special situations (e.g. when the driver has a problem with their train), setting shunting routes, handling interdictions (track locks) or informing other train drivers about delays.

The communications between the signaller and the dispatcher are mostly verbal. They are supported by a 'chat system' which is part of RCS and with which further persons can also be informed or involved.

In case of a critical event or a severe disturbance, more complex actions need to be coordinated and undertaken. The so called Kümmerer (person who takes care of special situations) becomes active. When we were looking into the operations room, we could see that a Kümmerer had become active. Good for him, but not so for the visitors, as the problem was solved within one minute and he became inactive again.

SBB operation centres also control traffic from other railway operators, not just SBB traffic. The number of working dispatchers and signallers depends on the expected traffic. On weekends or night shifts when fewer trains are planned, these roles can control more sectors.

As stated, everything is planned. The planning is done in multiple time scales:

- The first is **strategic planning**: What traffic (or technology) is expected in the next 30 years? What impact will this have on operations? Of course, it is an aim to automate more and more. But with every step of automation, dependencies on techniques and data quality increase. So, decisions about automation need to be wise.
- The second is **conceptual planning**: What organisational structures, techniques and finance will be needed? Can the foreseen traffic actually be supported? How can the available funding be used in the best way for the end customers? How is an evolution from today's systems to future systems possible

without negative impact for the end customers? How can the enhancements and the interfaces be synchronised within Europe or built according to a standard? What needs to be done for security?

- Based on the results of these two tasks, **yearly timetables** are generated. These timetables must consider planned restrictions or network extensions. For example, due to some changes/enhancements in the rail network planned five years ahead, it may be necessary to cancel some trains for one year. That would then allow even more trains to run in year six. Everything that can be planned and then be communicated early enough is easier to handle.
- Based on the yearly timetable, the **daily timetables** are created. The daily timetables have to consider restrictions that weren't known when the yearly timetable was created or updated.

These four tasks are done for the whole of Switzerland in regular timeframes. Sometimes things other than train planning need to be done in short time frames. One example was the introduction of the mask obligation when the Covid-19 pandemic started. A pictogram to wear a mask had to be created and introduced so that it could be shown on train displays in stations. To perform this task, an update on different systems had to be planned and carried out in addition to the daily business. Thanks to SBB's flexibility, this was possible.

For daily operation in the operations centre, the daily timetable is the base. It is loaded onto RCS and shows graphically what is planned for the current day, or for the next 24 hours, since the operation is running 24/7. The timetable in the RCS is always the **current plan**. This plan can then be changed by the dispatcher, signaller or by other system inputs. After a change has been approved and accepted by the system – the system can reject a change requested by the dispatcher – the changed (new) plan is made the current plan. The timetable can also be changed by actions of the signaller. When a change has been done, new information from the interlocking is sent to RCS and RCS updates the plan.

Finally, the timetable can be changed by active feedback from trains and interlockings.

Figure 1 shows four levels (from top to bottom):

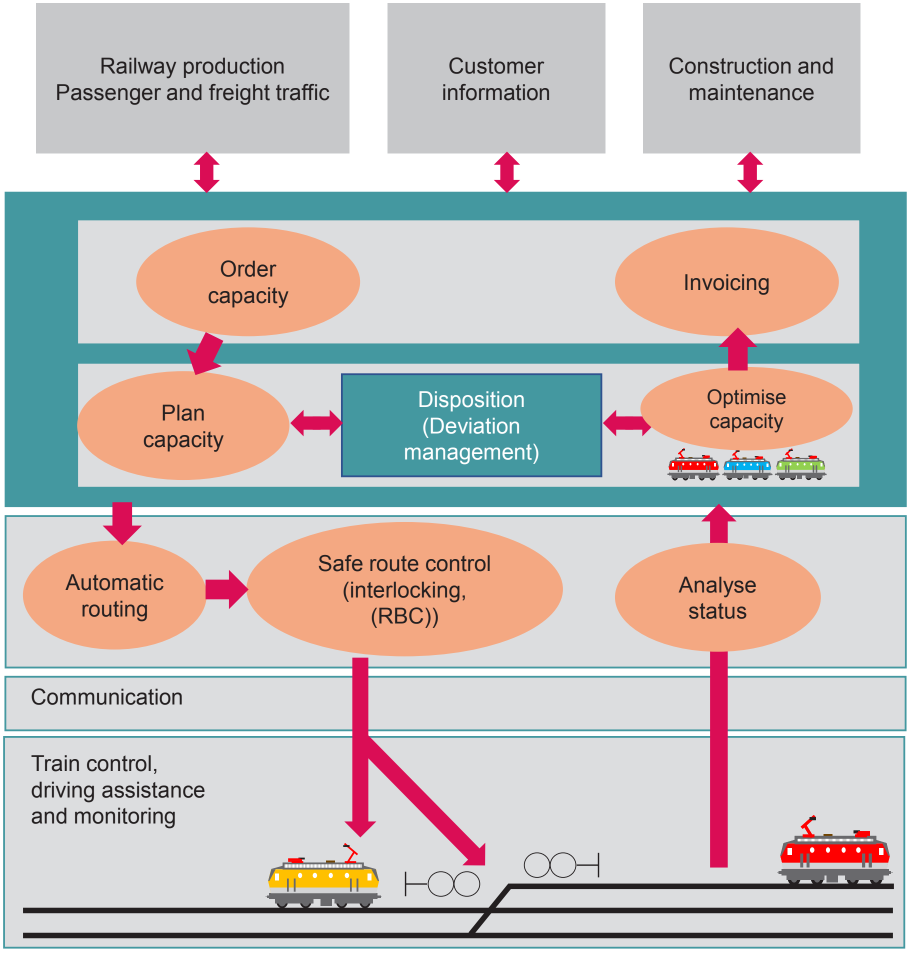

Figure 1 – The four levels of the system.

- First level: Train movements are ordered. Planned/actual train movements are notified to the requester ("Bestellung"/"Abrechnung"). The TMS also has interfaces to the customer information system and organisations that plan and execute maintenance works.
- Second level (dispatcher's tasks): The plan is made according to the orders (in principle, according to the daily schedule, but deviations are part of daily business). The system must also optimise the plan according to feedback and information on available tracks. The current plan is regularly updated based on the different inputs.
- Third level (signaller's tasks): The signalling control system receives the necessary information from RCS to control the interlockings. The routes are set and the trains are allowed to drive according to signals or ETCS movement authorities. If necessary, the signaller handles conflicts, special requests or unclear situations.
- Fourth level: The trains perform their journey. They may receive additional information to optimise for timing or energy efficiency purposes (from the signaller or automatically from the RCS). The interlockings and trains give feedback via Iltis to the RCS to update the current plan again.

So, in principle, the RCS always has the current plan, based on the current data. There are a lot of systems involved and every system needs some time to calculate its results based on the inputs and then provide the outputs for the next system. The aim is to handle feedback loops in a good way and optimising them in the right way is not an easy task. "You can never reach 100 per cent or be perfect, but the systems are steadily improving and today there is a good quality of service," Mark Reber said. For 2025, the focus is to further improve the robustness of the system.

One step in this direction is the enhancement with new functions. For some months, RCS has been enhanced to automatically execute some changes to provide optimisation (e.g. of capacity). With this task, RCS changes its current plan autonomously according to given rules. The RCS now also offers more possibilities to the dispatcher, so that

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many changes to the current plan are done on the dispatching level within seconds. More complicated tasks that take some ten seconds are no longer needed on Iltis by the signaller.

The recalculation of the current plan for the next 30 minutes is done within seconds after the accepted receipt of a change. Due to the large amount of data and dependencies, this calculation cannot be done for the whole of Switzerland, but only for a timetable region. Today, there are about 45 timetable regions in Switzerland. The results of one region must be communicated to the other regions which leads – as a further input – to recalculations in the affected regions. The recalculation in the affected region may again lead to an input to the region that originated the change. Mechanisms are needed to prevent endless loops.

For strategy and concepts, feedback from the operations team is very important (not daily, but on a yearly basis or with occasional intermediate summaries). So here a feedback loop is essential.

For the current plan, a feedback loop is also essential. The RCS always, and as quickly as possible, needs to know what any new plan is. It also needs to know what the trains or the interlocking are doing.

The operations centre uses the information it receives from the trains, the interlocking and the infrastructure data. An actual picture of the situation is also vital in emergency situations. The automation should not only be able to resolve 'normal' problems, but also many exceptional situations. Only then is automation a real help. For things to be automated, different aspects need to be considered: Which situations can be handled? What is the ratio of effort/win? How can the funds from the FOT (Federal Office of Transport) be used in the best and most effective way for the end customers?

The discussion in the audience showed again that operation can be more effective and consequently much cheaper if ETCS L2 is used on the network.

Two out of several reasons are:

- With ETCS L2, the position of the train is updated every 6 seconds. This leads to a more precise current plan and therefore to a better forecast and operation. A deviation from the plan is visible immediately and replanning can start in order to detect and resolve any conflicts earlier and in a better way.

  With optical lineside signalling, an update for the system can be delayed for more than 2 minutes (because a train running between two block signals with a distance of 3km needs 2 minutes to pass when driving 100km/h). During this time, no new information or update is available for RCS.
- With ETCS L2, the communication to the train driver is easier. If due to a suddenly encountered problem, a temporary speed restriction is necessary, the signaller submits the relevant data to the RBC. For the next train, the restriction will be active without any verbal communication with the train driver or the need to send someone to the track to install speed restriction signs.

Fast feedback from the train data about current status is one of the key factors for a well performing operation. Another important point is the quality of the infrastructure and train characteristics data. The more accurate the data is, the better the decisions for the current plan can be.

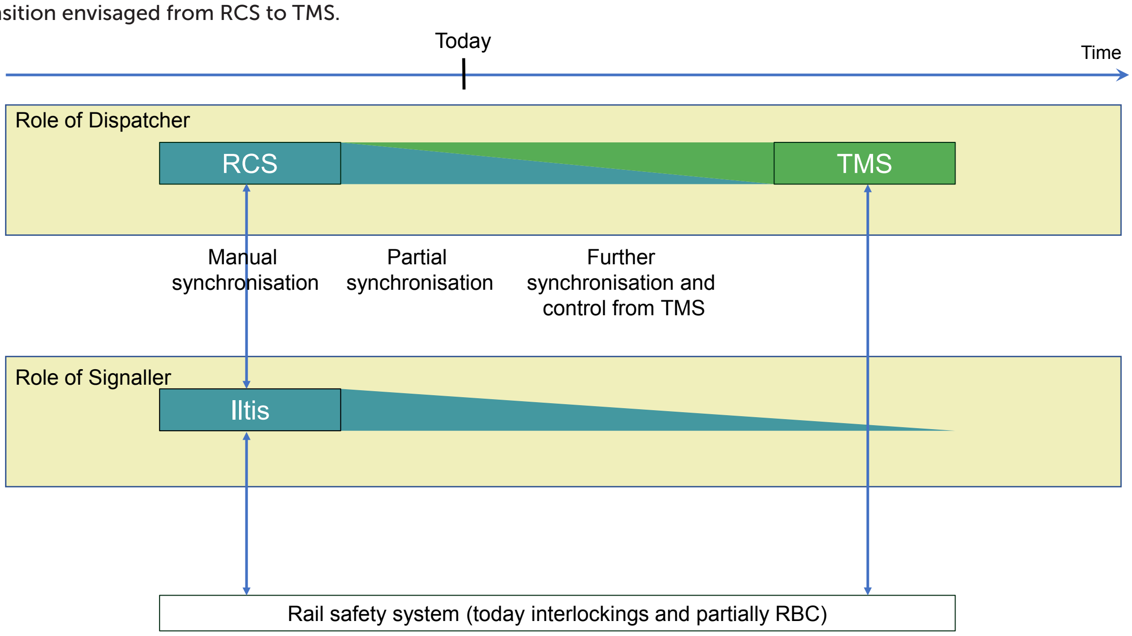
Two examples show that with the transformation from RCS (an "office system") to a TMS (a "basic safety system", formerly called SIL0), the requirements regarding safety increase.

- One example discussed was the usable length of a platform in a station. If a train of 420m usually stops on track 2, but now, due to a problem, needs to stop on track 1 (usable length of only 350m), the system needs to know this. Otherwise it will plan the train to an incompatible platform. If the system lets the train stop at an incompatible platform, this is considered dangerous.
- Another example for safety consideration is the profile of a train. The RCS needs to know both the infrastructure's capability regarding limited loading gauge and the train's characteristics to avoid trains passing locations or tunnels that are not wide enough.

These examples show that more automation requires more accurate data for systems and that safety considerations are key for the future TMS. In addition, it also needs to be shown that TMS can handle such situations with sufficient reliability.

The system can only perform well when the input data is accurate enough. The staff today know the usable length of

Figure 2 – The transition envisaged from RCS to TMS.



the platforms because they use this information daily. A big task for railway companies is to make sure all relevant information is entered into the systems reliably, accurately and on a timely basis. To do so, the processes to update the infrastructure database need to be improved and digitalised. Only with digital processes can changes to the infrastructure be updated immediately. Then the current plan will be even better and the system can be better at making the right decisions. SBB is working on the topic of timely and accurate data and information, not only for usable length of platforms, but also for other parameters such as signal positions, balise positions, clearance gauge, maintenance works, train weight, train length, and braking capacity.

In today's TMS architecture, the dispatching is done on RCS. Iltis is used for control and requesting routes in the interlocking. In recent years, the synchronisation between RCS and Iltis has been improved to better synchronise the timetable in RCS and the automatic route setting data. Improvement in the handling of dispatches has also been achieved recently.

With the next steps – the evolutionary move from RCS to TMS and improving the data quality – the TMS should also provide control information, hopefully with a standardised European interface, directly to the interlockings.

Possible changes to processes or the organisation will also influence the tasks of the dispatcher and the signaller.

The signaller will have fewer control tasks in the traditional way. Their main tasks will be performing safety critical tasks such as route revocation and setting/removing of interdictions (track locks). Today the signaller also sets shunting routes, but even for this task, improvements and more automation are foreseen in future TMS developments.

SBB has shown us how, using today's know-how and outlook, they are considering new types of inputs and feedback for their future TMS. This will ensure continued successful operation and help further digitalise areas where it makes sense.

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