OpenTrack simulation of the Gotthard Corridor

To what extent do differences in the ETCS-braking curves (Level 2, Baseline 3 with and without service brake) lead to train delays along the north-south Gotthard railway line in Switzerland? To answer this question, EBP developed a microscopic simulation of railway operation.

To simulate railway operations, we used the OpenTrack software, developed at the Swiss Federal Institute of Technology (ETH) in Zurich. The Infrastructure projection for 2025 served as a basis for the microscopic simulation.

Realistic simulation of railway operations

With the aim of achieving an highly realistic simulation, we developed our infrastructure models in close collaboration with Swiss Federal Railways (SBB). In the process, we placed special emphasis on:

- Signaling, using both the L and N legacy signaling systems
- Cab signaling (ETCS Level 2)
- The applicable parameters relating to the different ETCS Level 2 models along the transalpine Gotthard corridor
- The baseline 3 braking curves (with and without service brake)
- The assumptions relating to buffer times and initial delays
- Dispatching rules along the route and at nodes

We based the train schedule used in our simulation on a Viriato export reflecting the current federal planning process for railway expansion up to 2025. The geographic boundaries of the simulation range from Arth-Goldau in the north to the

Client

Swiss Federal Office of Transport (FOT)

Facts

Period	2019 - 2020
Project Country	Switzerland
Simulated track length	890.3 km
Simulated train runs	1,000
Simulated routes	3,188
Simulated operation time	Approx. 600 h

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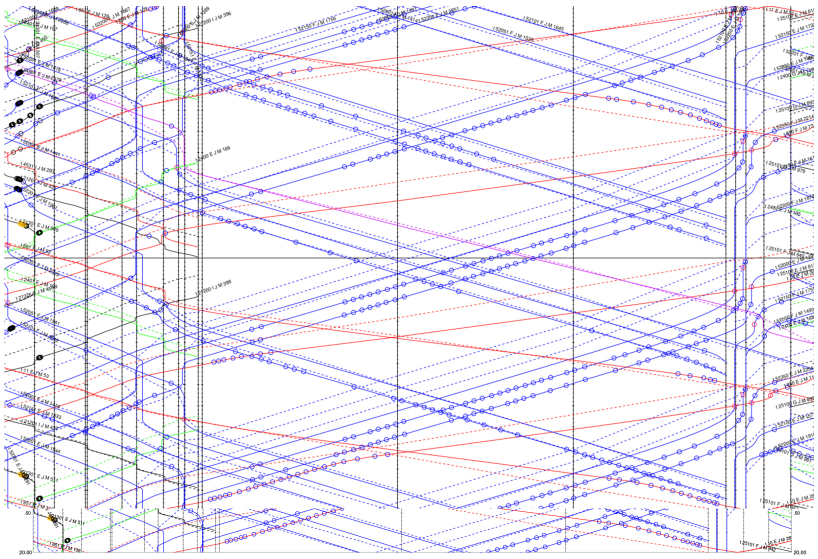
southern stations of Chiasso, Stabio, Luino and Locarno, and thereby includes both the mountain segments and the base tunnels of the Gotthard (GBT) and the Ceneri (CBT).

Simulated area. Picture Credits: maps.trafimage.ch

In developing our simulation, we didn't only emphasized the importance of accurately representing and parameterizing the two base tunnels, but also took the two ETCS level 2 projects referred to as "3rd track Bellinzona to Giubiasco" and "Vezia (near Lugano) to Capolago (near Mendrisio)" into account.

Delay development per train and train category

Our simulation captures all scheduled train services over a period of 12 hours. By chance, exactly 1,000 trains travel are captured in our study. All these services were provided with randomly distributed external delays. This allowed us to adequately represent operations outside the system boundaries. The distribution function for the external delays was based on the actual delays along the north-south Gotthard line from the most recent scheduling year. In order to determine the internal, or system-specific, operational delays, we evaluated 50 simulation runs using a specially developed script for each of the relevant stations.



Graphic timetable for a simulation for the Gotthard-base-tunnel segment. (For enlarged view, click on picture.)

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Our meticulous approach used for setting up our simulation enabled us to represent the delay development for each and every train and train category. It has allowed us to ascertain the impact that the application of the different braking curves of ETCS level 2, baseline 3 (with and without service brake) can have on timetable stability.
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