Energy efficient timetabling @ SBB

20th of February 2018, Brüssel
SBB infrastructure & vehicles.
The timetable as Link between infrastructure & vehicles.

Infrastructure:
- 31,266 signals
- 5,926 bridges
- 317 tunnels
- 3,230 km of track
- 12,997 sets of points
- 6 hydroelectric plants
- 7 frequency converters

multiple units:
- 16 international
- 118 long-distance
- 413 regional

locomotives & wagons:
- ≈ 450 locomotives
- ≈ 1,600 passenger carriages
Main traffic time in Switzerland.
Demand per hour in transport of people.
ADL as link between dispatchers and train drivers. Solving conflicts and saving energy with direct connection.
EcoDrive creates punctuality & energy efficiency
Example: ICN Bellinzona – Lugano

- Train 1 uses the travel time reserves and does not build up any further prematurity.
- Energy demand 311.8 kWh
- Train 2 builds up with taut driving over 200 seconds ago.
- Before Lugano, he is slowed down by a signal.
- Energy demand 342.4 kWh

Result
- Train 2 requires significantly more energy (+ 9.8%).
- Both trains arrive slightly ahead of schedule in Lugano.
Reduction of variation for more efficient production
Better predictability and greater energy efficiency

→ Today, the driving style differs both in terms of travel time and energy requirements. This complicates the planning of the operation and brings a higher energy demand.

→ One reason is the fact that the locomotive crew today, despite ADL, does not have all the necessary information to derive an ideal driving style (from the point of view of the overall system).

→ Thus, the train reaches the target relatively often before the actual target time.

→ A reduction of the scatter by means of improved information therefore improves the predictability of the railway operation and increases the energy efficiency.
Findings of the pilot of energy efficient timetable and DAS

Thomas Graffagnino, SBB I-FN-FPA
Pilot project of BLS with SBB infrastructure
Joint test of energy optimised timetable and DAS

BLS and SBB infrastructure tested in Spring 2017 an energy optimised timetable and two driving advisory systems. The aim was to save energy (at least 5%) with the same level of operational stability / punctuality.

- Q1/2017: Preparation of data (timetable, track journey, vehicle data)
- Q2/2017: Test on S44 in (Thun to Burgdorf), total 133 rides
- Q3/2017: Evaluation (energy savings, punctuality, variance, ergonomy)
Step 1: Determine the fixpoints
Fixpoints are critical places where time are advisory for a conflict free train path
Step 2: Extract the timetable for the fixpoints

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Step 3: Calculate $V_{ECO}$ speed profile in ZLR from RCS
Step 4: Translate the results to the driver
In case of delay MAX-Speed, if punctual $v_{ECO}$-Speed

$V_{ECO}$ speed profile
Savings of 10-15% of energy.
An energy optimized timetable with paper solution is equal to an electronic driving advisory system.

The energy consumption in suburban railway operation can be reduced by up to 10-15% if,

- the operational schedule is energy-optimized
- the driving recommendations are ergonomically displayed to the locomotive crew.

The effect of a driving recommendation system in practice depends less on the quality of the driving profile modeling, than on the way the information and recommendations are displayed and implemented.

The next steps to integrate "v_{ECO}" at SBB
Composition of the core group
Cross-divisional from planning to execution

Core group
I-EN-EFF: Matthias Tuchschmid, Philipp Keiser
P-OP-ZF Markus Kröpfli, Stephan Gut, Marcel Tonini
G-PN: Dominik Baumberger
I-B: Fabian Flück
I-FN: Thomas Graffagnino
IT: Martin Kyburz, Alexander Helm
SBB Innoteam: Charles von Grünigen
Five action fields at all levels
From timetable to education of driving personal

Energy-efficient railway production is based on interconnected solutions:
- The driver implements the optimum driving strategy based on the information displayed in the LEA.
- On the basis of the timetable, the most efficient operation is organized in the operation center.

Fields of action were identified in all levels, in some cases one field of action affects several levels:

- Education & further education
- Quickwin «Optimization LEA»
- ${v_{\text{ECO}}}$-column and und Eco-Trasse
- Dynamic transit times
- Indicator of punctuality
Benefits for the SBB
A higher accuracy of trains, lower energy costs.

The implementation of $v_{\text{ECO}}$ / EcoPath and the other improvements offers the following advantages:

- **Better information situation** for the locomotive staff in order to derive the ideal driving style from the point of view of the overall system.
- **Increase the acceptance of locomotive staff** by focusing on relevant information.
- **Better predictable journeys** for the train management and reduction of dispersion.
- **Energy savings** amounting to around 50 GWh, equivalent to railway costs of around CHF 5 million per year.
Thank you for your attention.
SBB’s overall strategy.
To reduce energy and power consumption by 20%.

Efficiency goal: 600 GWh/year from 2025

150,000 households = 600 GWh

Technology
Service planning
Railway production

Anchor energy efficiency in the company
Create transparency and manage energy consumption
SBB.
We keep Switzerland moving.

Infrastructure
3,230 km of network

Real estate
3,500 buildings

SBB Cargo
210,000 t of freight per day

Information technology

Passenger Division
1,21 million passengers per day
SBB Infrastructure.

3 Networks: Rail, Telecom, and Energy.

- **31,266** signals
- **12,997** sets of points
- **10,000** employees

- **5,926** bridges
- **3,230 km** of track
- **10,000 Trains each day for 20 RU**

- **317** tunnels
- **7** Frequency converters
- **6** hydroelectric plants

- **2** GSM-R operation centres
Rail Control System.

The RCS system.
Rail Control System.

The RCS system.