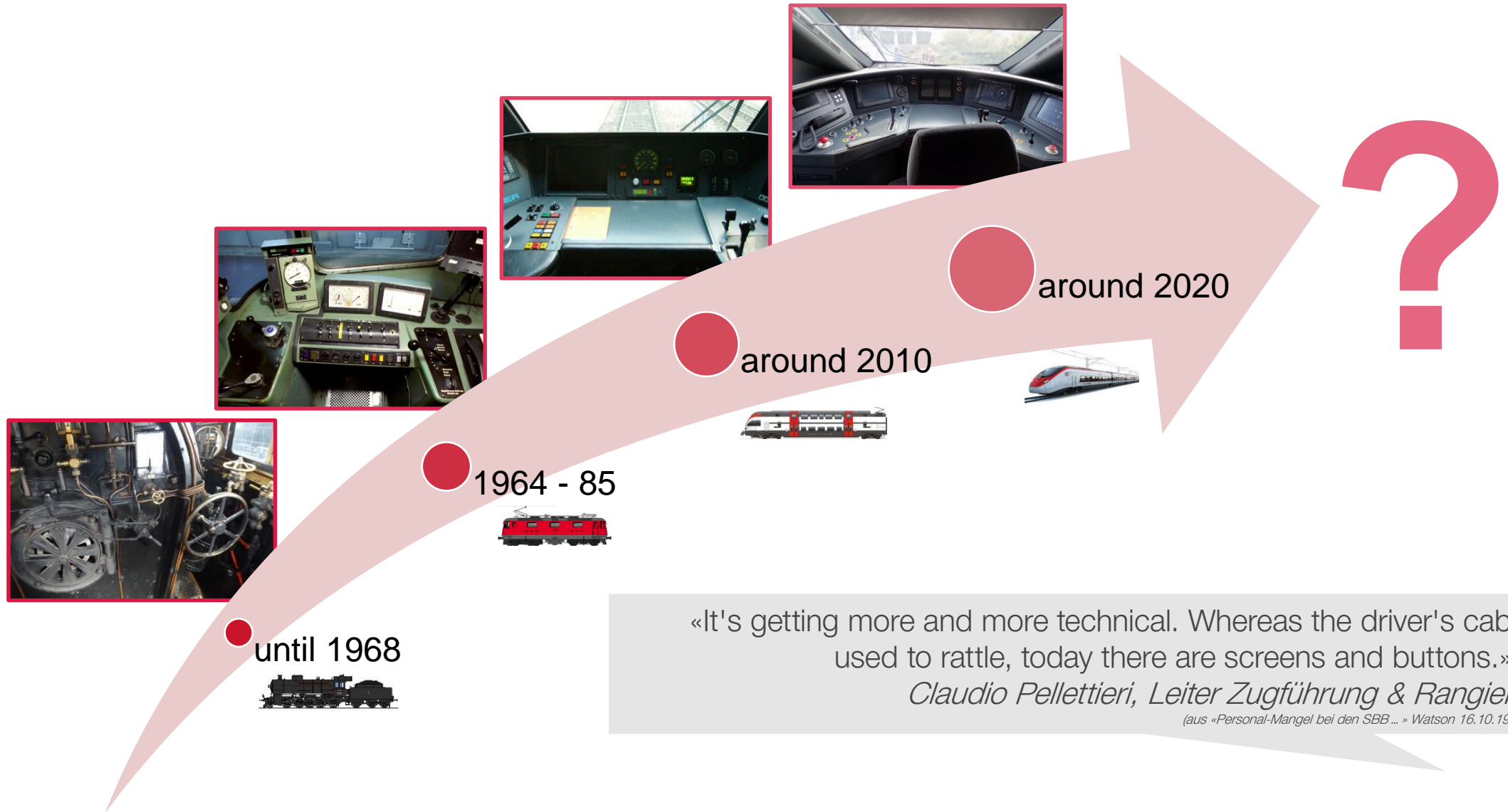


ATO – Technical Challenges from an Operator’s Perspective

CSFM Mini Conference Automatic Train Operation
Zürich, 12.12.2024



Development of Trains and Driver Cabs





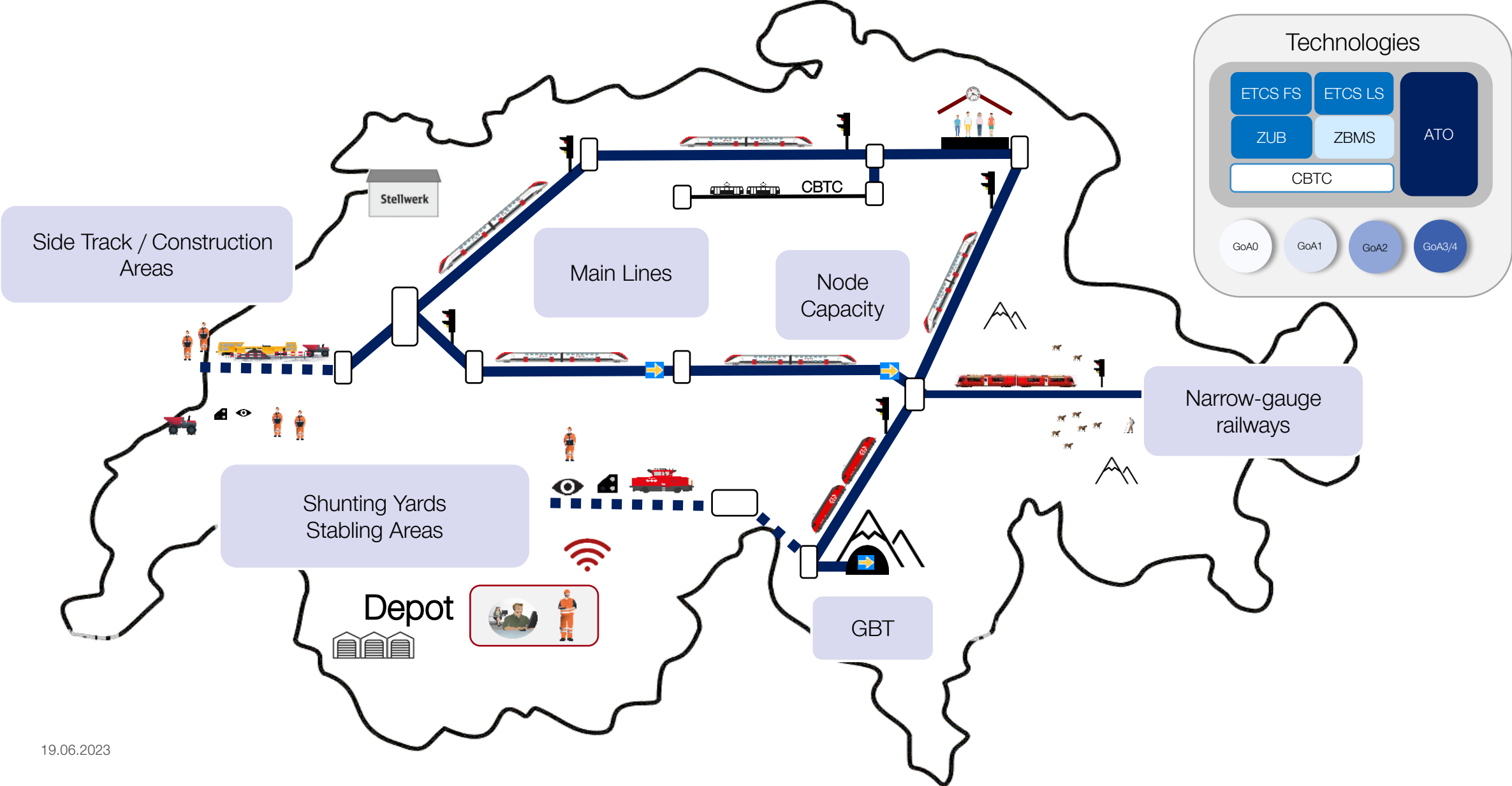
ATO potential Applications at SBB

Reasons for ATO in SBB: capacity, punctuality, energy consumption, stopping accuracy, possible lack of personnel

- GoA2 on high capacity lines e.g. Gotthard Base Tunnel (GBT)
- Automatic shunting in operation, construction and maintenance, especially in the GBT
- Automatic shunting/stabling
- ATO may optimize the three variables punctuality, stopping accuracy and energy consumption.



Possible ATO Applications at SBB





GoA 2

Braking Efficiency → Time Table Stability, Capacity Increase

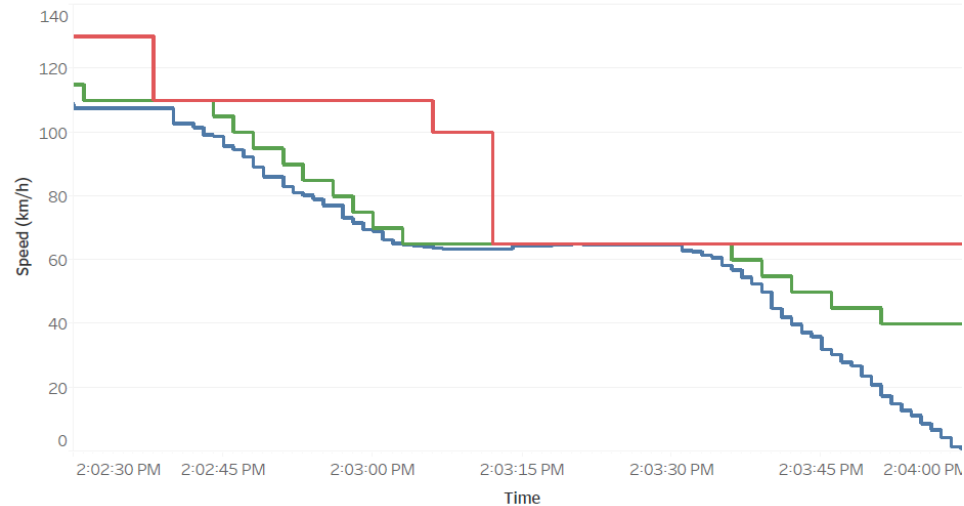
Comparison of ATO-braking vs. manual braking / ATO closer to ETCS permitted speed

ATO Braking

2020-07-25, Ride 5 Braking, Train 97171, ARD-SIE

Datenquelle: JRU data (TELOC data)

ATO Driving

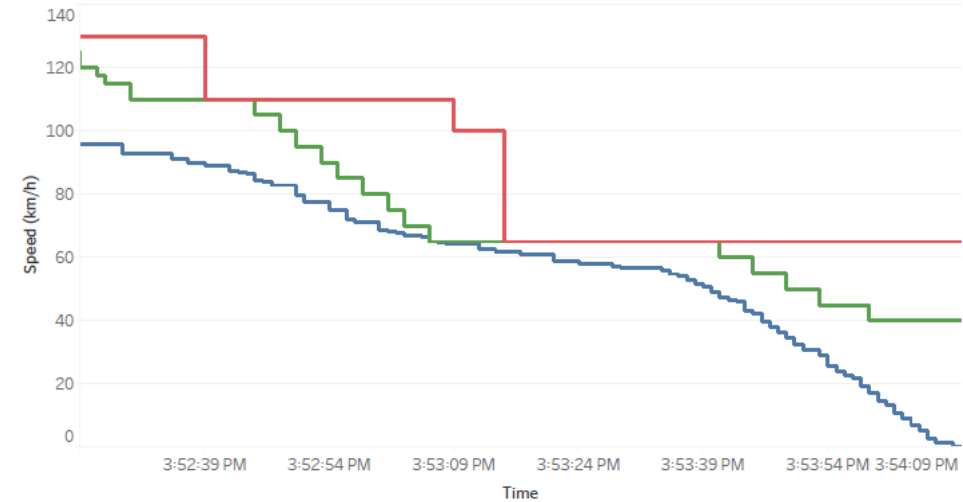


Manual Braking

2020-07-25, Ride 7 Braking, Train 97173, ARD-SIE

Datenquelle: JRU data (TELOC data)

Manual Driving



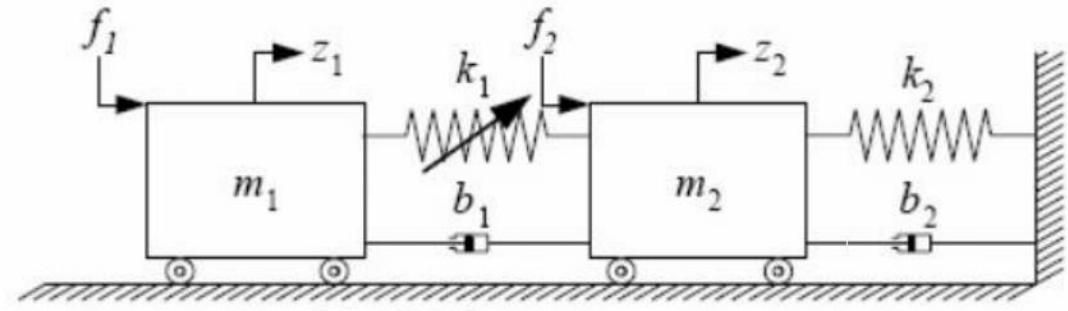
Red: Most Restrictive Speed Profile
Green: ETCS permitted Speed
Blue: Train Speed (ATO or manual)



Freight Trains

GoA2 according to TSI 2023 – Fit for Rollout?

- Problem: Cargo Trains



Source: DB Cargo report

- Tests EMU vs freight train
- Differences
 - No train communication bus
 - High brake latency
 - Coupled Spring/Damper system: special dynamics, especially with liquids
- Operational Driving rules to avoid accidents
- ATO has to apply these rules too

Driving Rules and Freight Dynamics Examples

Freight Train Specificities

Non-uniform composition: Containers, liquid wagons, empty wagons, heavy wagons, ...

Locomotive hauled train (S-Type train)

Towed loads exceeding 1600 tonnes

“Cargo” type brakes (G-Bremse)

Locomotive brakes are not enough to hold the train on steep incline

Driving over 40km/h switch and braking
Risk of derailment on “40 km/h” switch in deflecting position

- ATO Freight Train drives over a 40km/h switch in deflecting position
- ATO Freight Train must brake while driving over the switch (EoA after the switch)
- Main line pressure shall not be reduced by more than 0.5 bar (except when danger is imminent)

Downhill-Section

Brakes management (dynamic vs automatic) when strong braking efforts are needed, and dynamic brakes cannot be used for part of the braking distance

- ATO Freight Train drives toward EoA
- ATO Freight Train brakes with a “strong” effort to stop at EoA
- There is a section where dynamic brake cannot be used (for example a powerless section)
- ATO Freight Train must stop before EoA

No Power Section

EoA

Starting with relaxed couplers and accelerating the train until all couplers are “fully loaded”

- ATO Freight Train stops before EoA with “relaxed couplers” (compressed train)
- One or more wagons are detached
- ATO Freight Train receives a new MA and starts driving (acceleration until entire train is stretched)

Brakes and traction management when accelerating (train is not stopped)

- ATO Freight Train drives toward EoA (≥ 100 km/h)
- ATO Freight Train brakes with “strong” effort to stop before EoA
- Before the train is fully stopped (< 50 km/h), a new MA is received
- ATO Freight Train releases the brakes and accelerates

Braking (≥ 100 km/h)

< 50 km/h

Accelerating

EoA

New MA

New MA

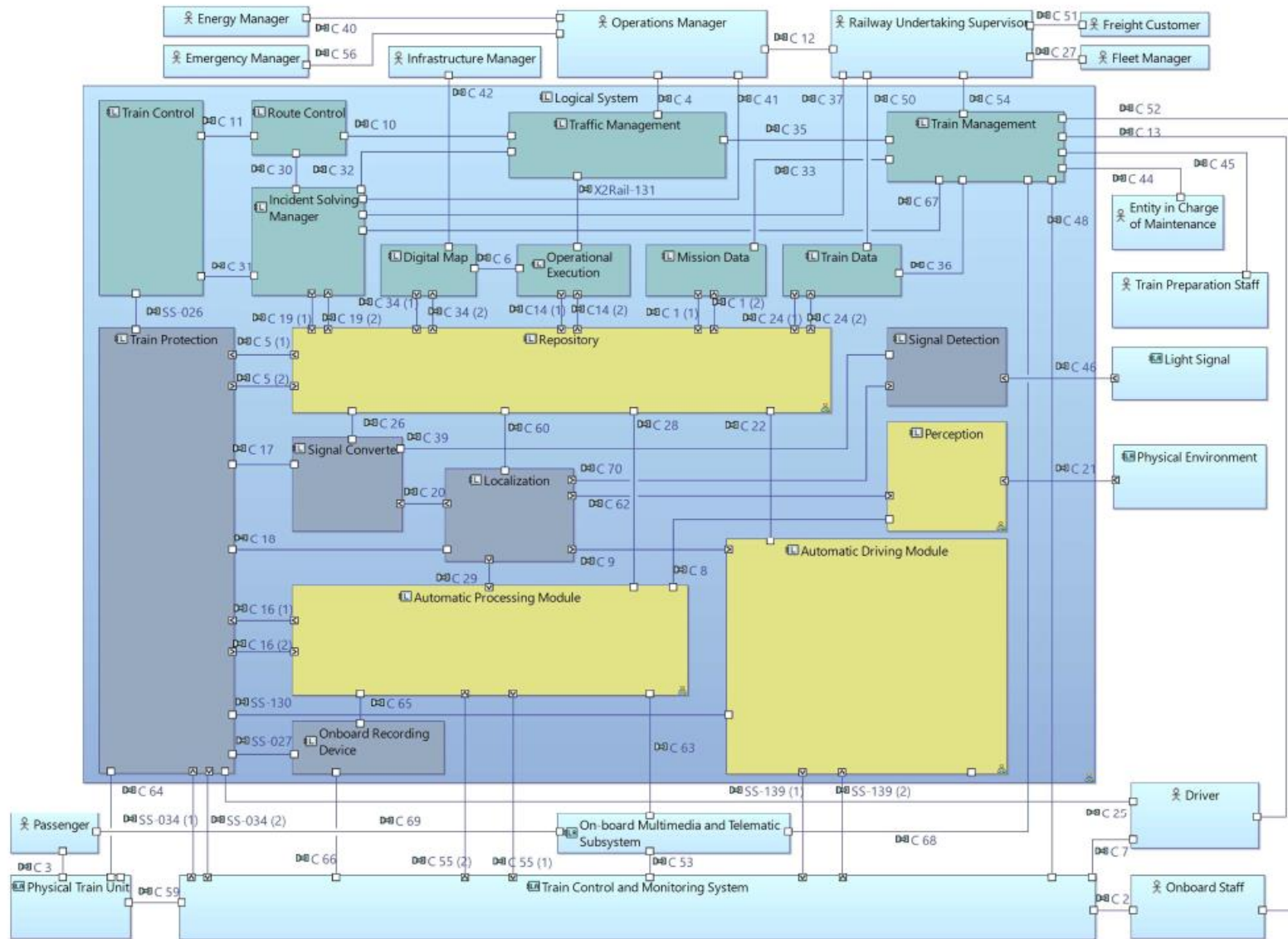


GoA3/4

Logical Architecture



Logical Architecture S2R for GoA 3/4



From: GoA3/4 Specification V1.0.0, X2Rail4 Shift2Rail, 2023



Automatic stabling

«Train driver enters train with passengers»

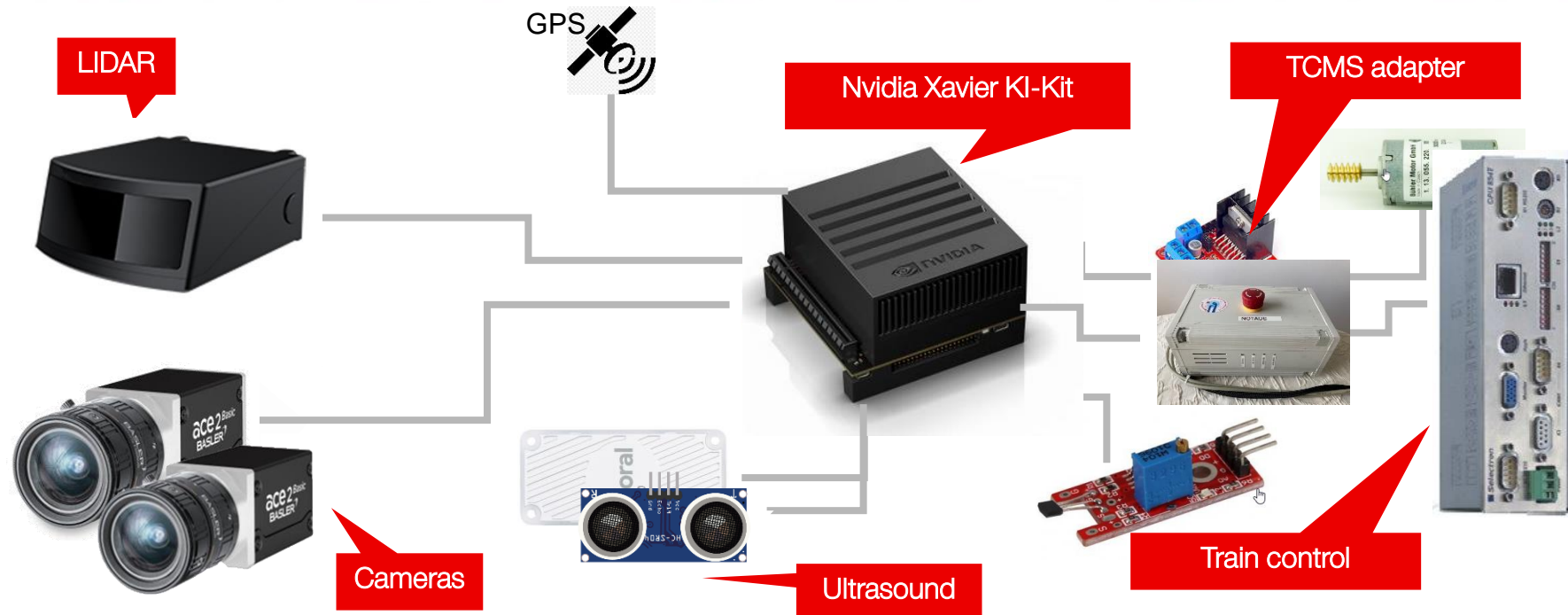
Idea born during ATO GoA2 Tests in Lausanne P12.

18 min walk from depot





Realisation from 2kg-model to 120t-Train



A photograph of a railway worker in an orange safety vest kneeling on a set of tracks, with a yellow figure placed on top of the rails. Another worker in an orange vest and mask stands on the platform to the left. A train with 'SBB CFF FFS' branding is visible on the right, and another train is approaching in the distance. The scene is set in a railway yard with gravel tracks and overhead power lines under a clear blue sky.

Thank you

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Link to video:
<https://www.youtube.com/watch?v=iTgaweQOOyl>

PoC

Automatisches Abstellen