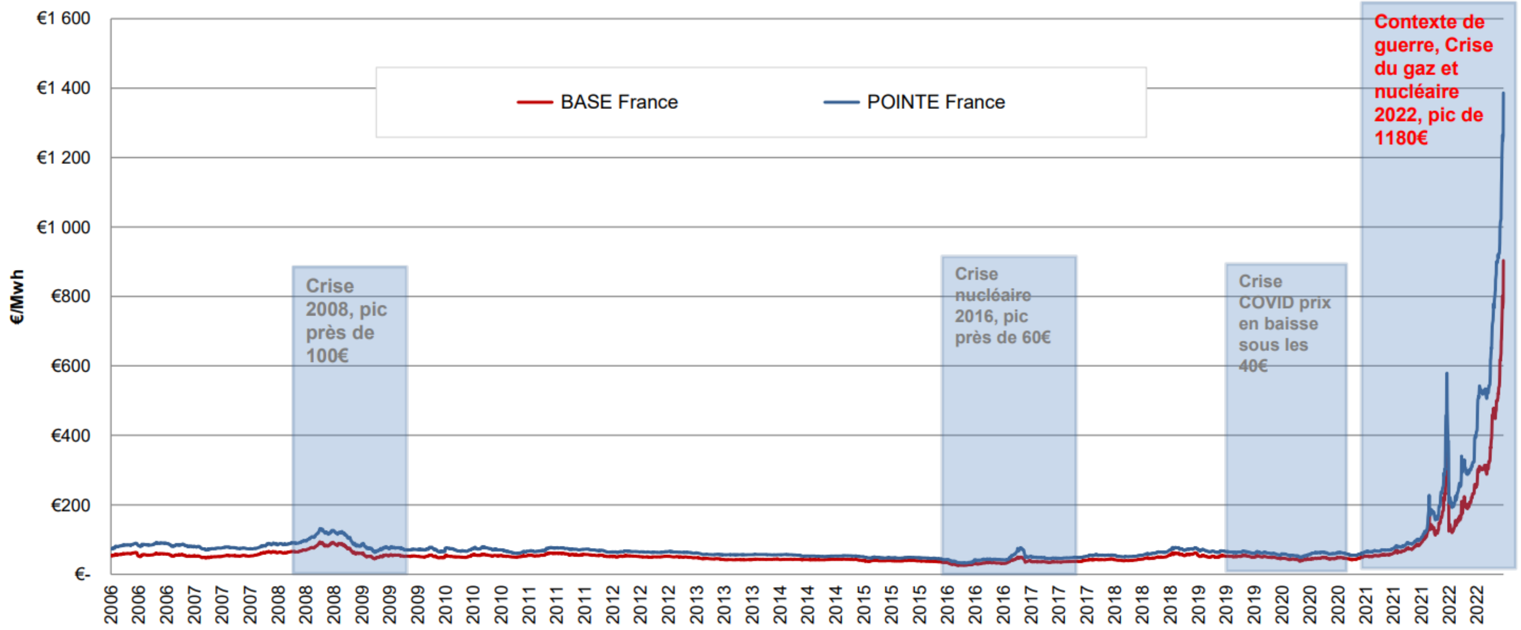
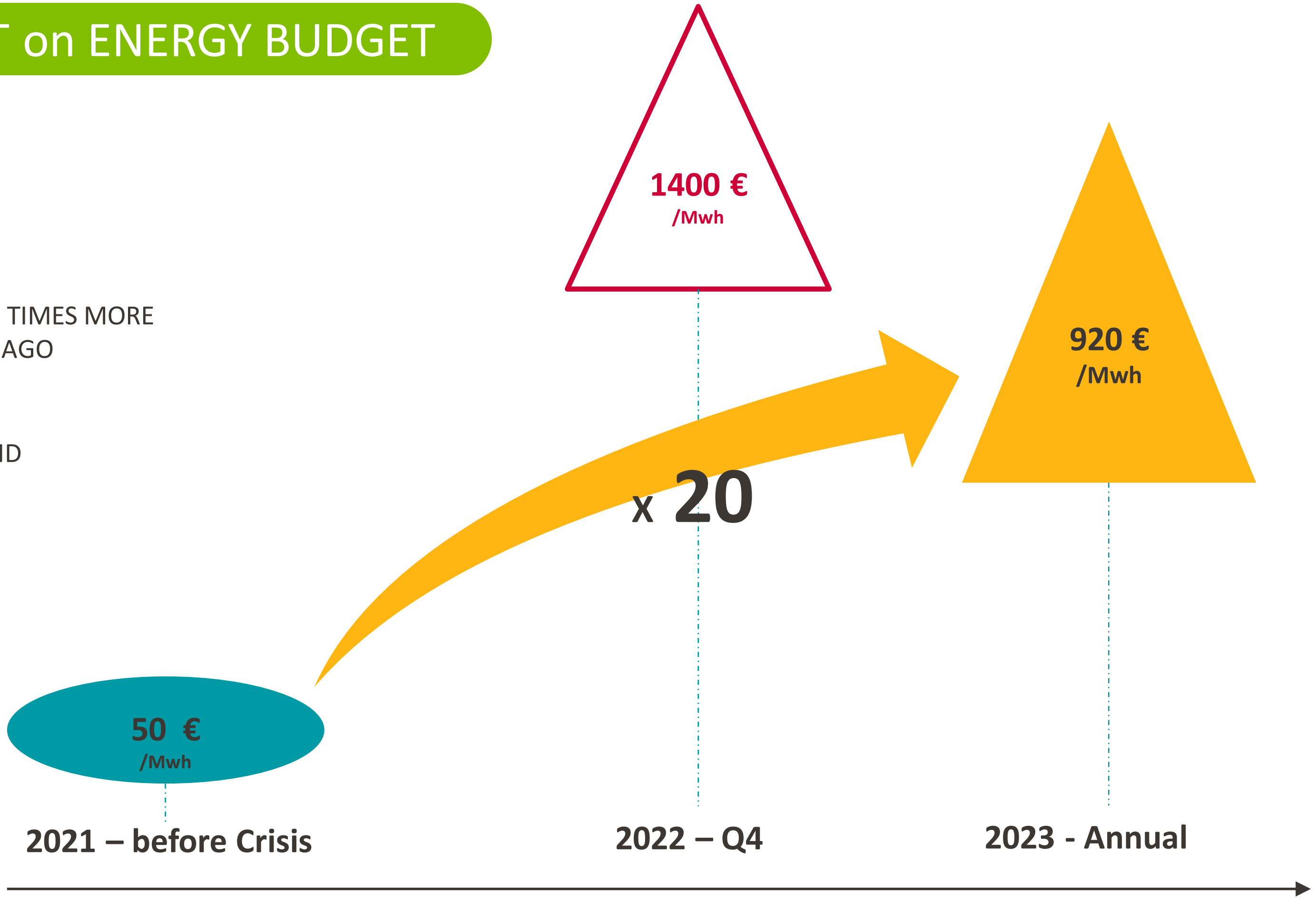
Facing an INCREDIBLE INCREASE in ELECTRICITY PRICES

THE CONTEXT OF WAR AND NUCLEAR UNAVAILABILITY GENERATES A PRICE SHOCK IN 2022



Billions € IMPACT on ENERGY BUDGET

- MARKET PRICE FOR 2023 IS 20 TIMES MORE EXPENSIVE THAN 18 MONTHS AGO
- EXTREME PRICE VOLATILITY AND LACK OF FORWARD LIQUIDITY



INCREASE the IMPACT of ENERGY SAVING PROGRAM

MOBILIZING the STAFF
Communication program

BOOST ENERGY SAVING on Trains

- Action 1
- ➢ Total use of S-DAS program on all trains
- Action 3
- Action 4
- Action 5
- ➢ C-DAS development
- Action 7
- Action 8
- …

ACCELERATE ENERGY SAVINGS on buildings

OVERVIEW OF ENHANCEMENTS

SFERA Edition 2

Tibor Weidner/Theo Vis/Sébastien Dislaire

Summary

The input of early adopters enhanced Edition 1 features.

New functions are included to:

- Improve the user experience
- Facilitate implementation
- Enhance performance

SFERA improves upon interoperability

The input of early adopters enhanced Edition 1 features.

User group

Early adopters of the SFERA protocol were able to detect bugs in Ed. 1

Modifications were proposed through Change Requests issued by the User Group.

Main subjects handled:

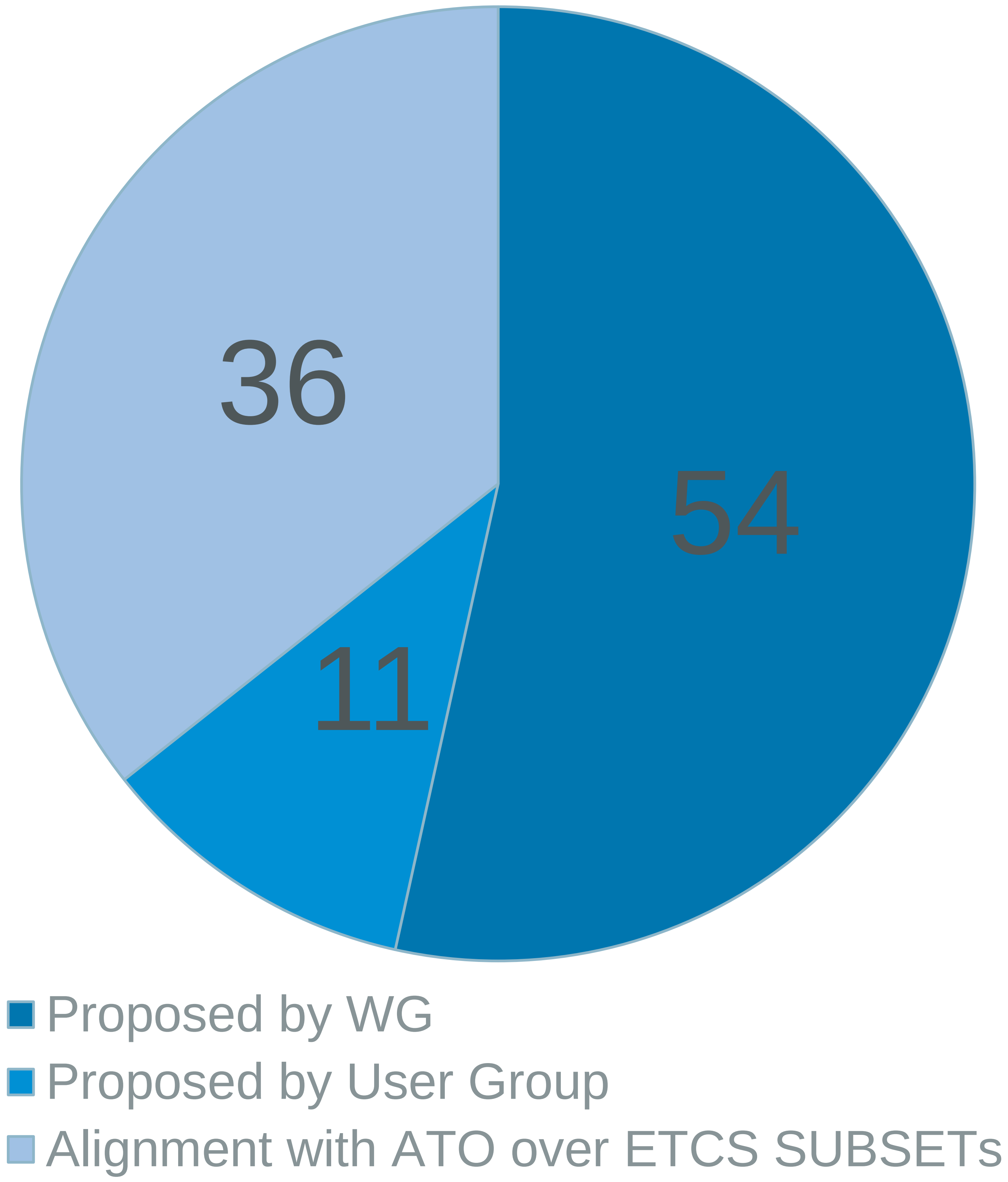
- Implementation of the MQTT/JWT protocol;
- Review of the handshake process;
- Alignment with ERTMS/ATO Stopping Points logic.

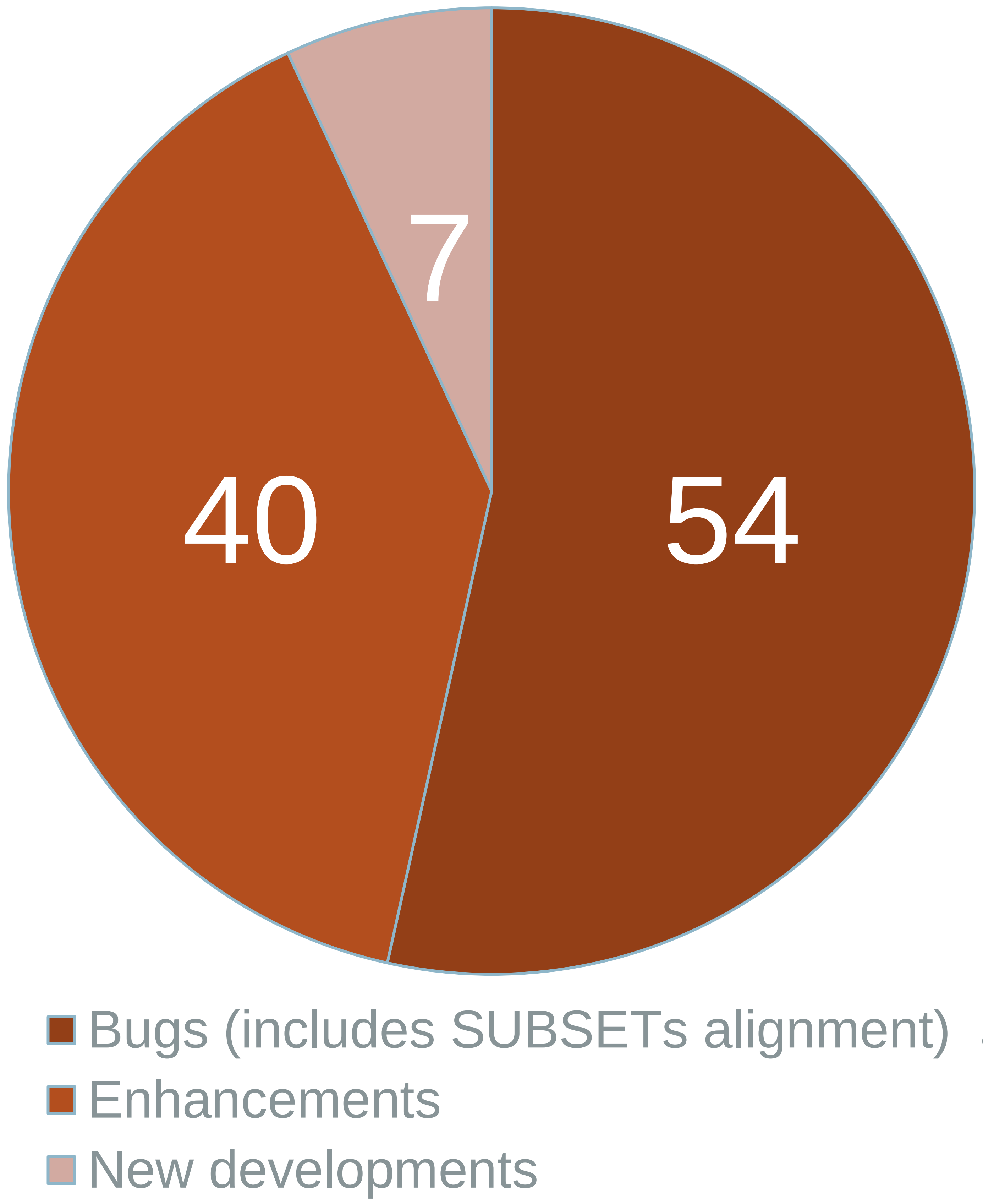
The draft IRS Edition 2 was also reviewed by the User Group.

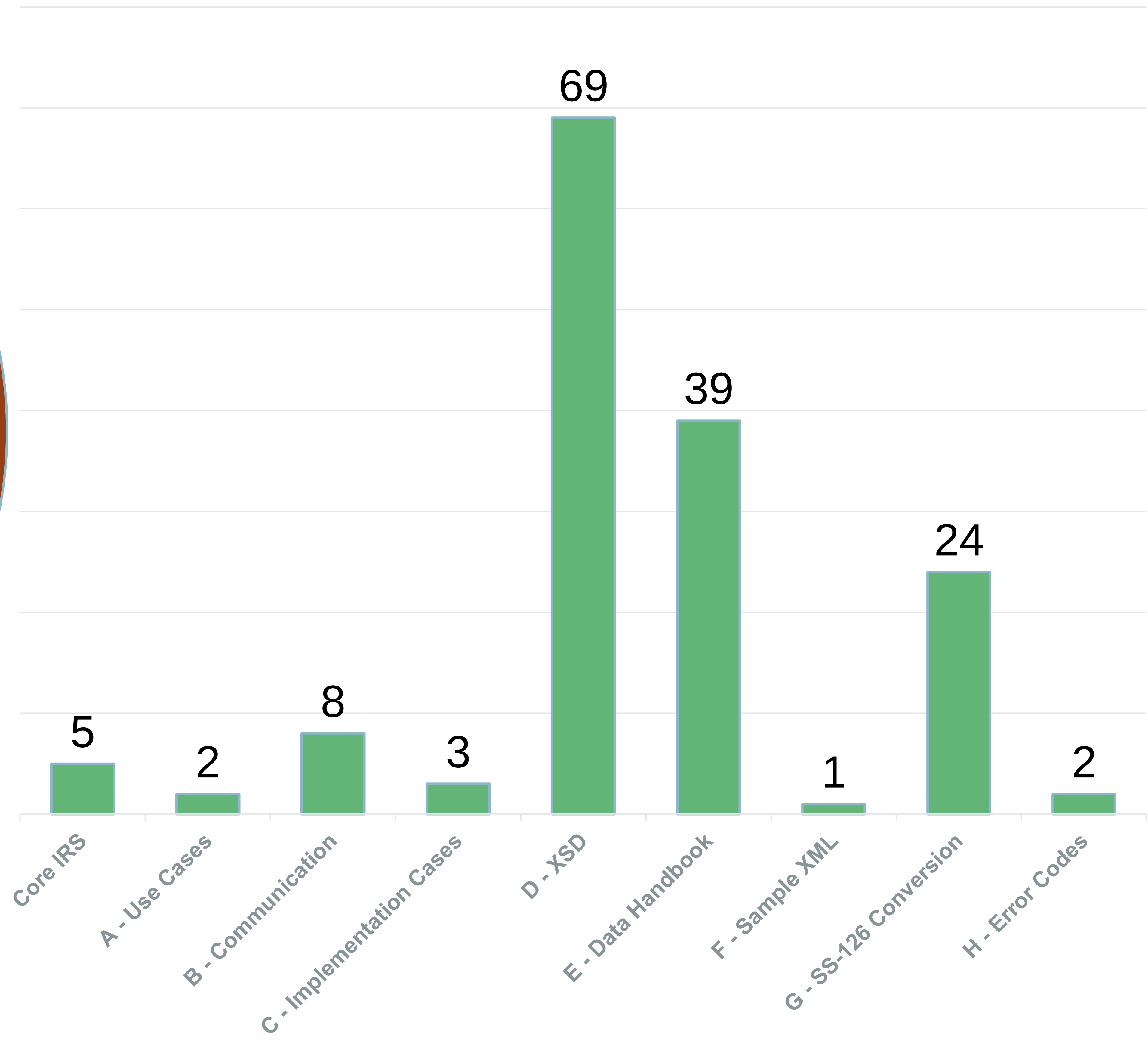
Thank you for your input !

Change requests after Edition 1

There were 101 change requests after the 1st edition

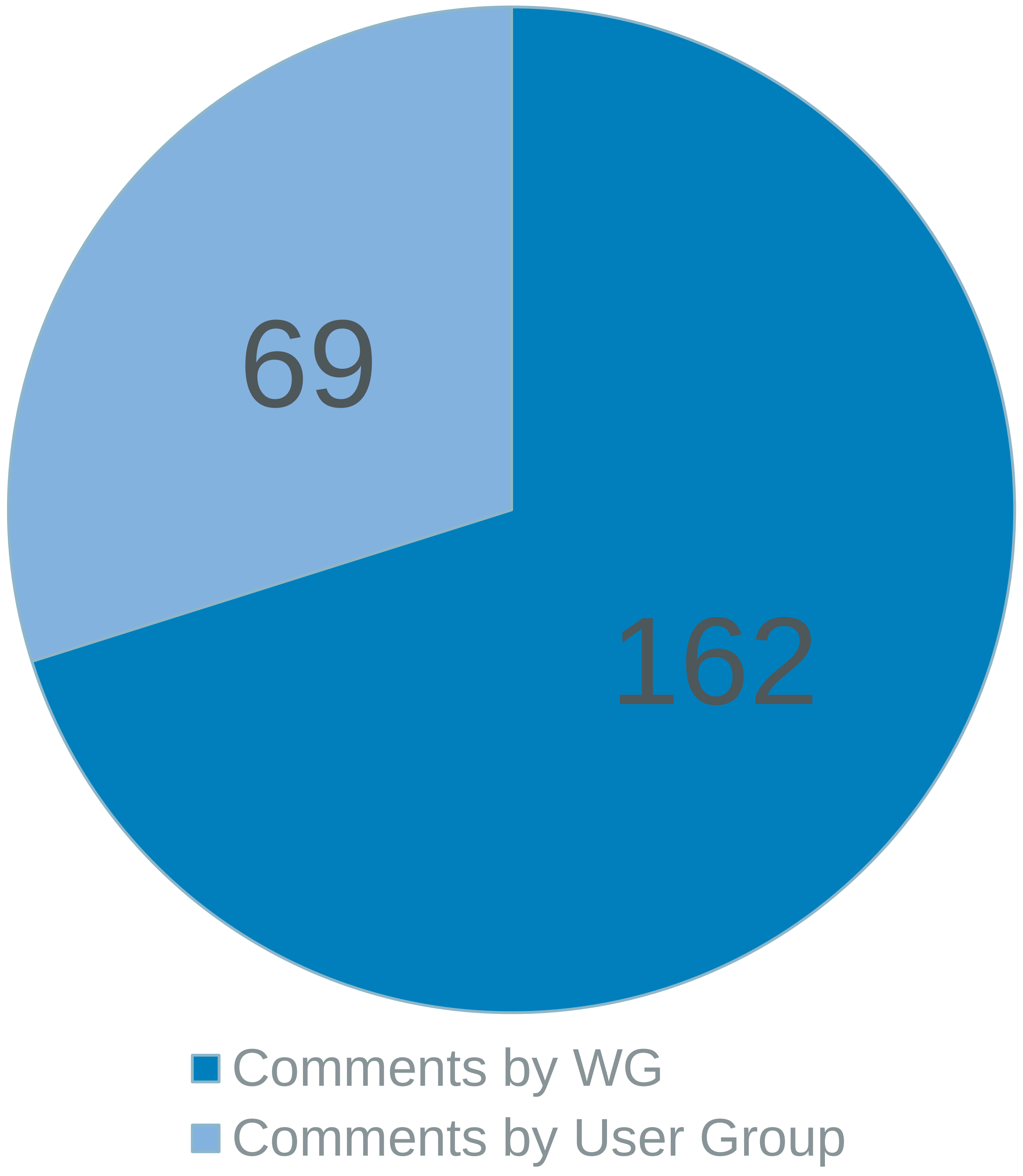


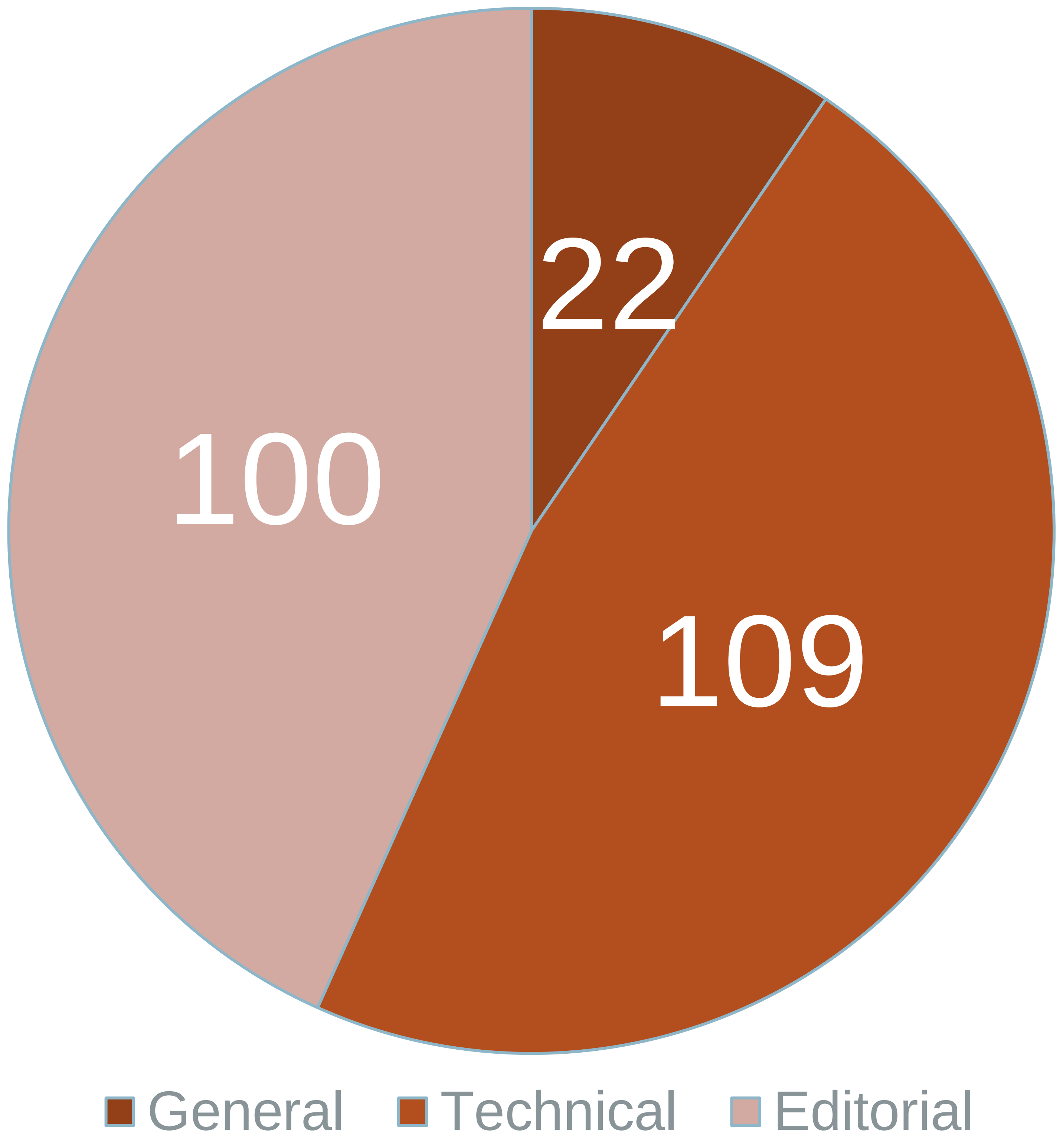


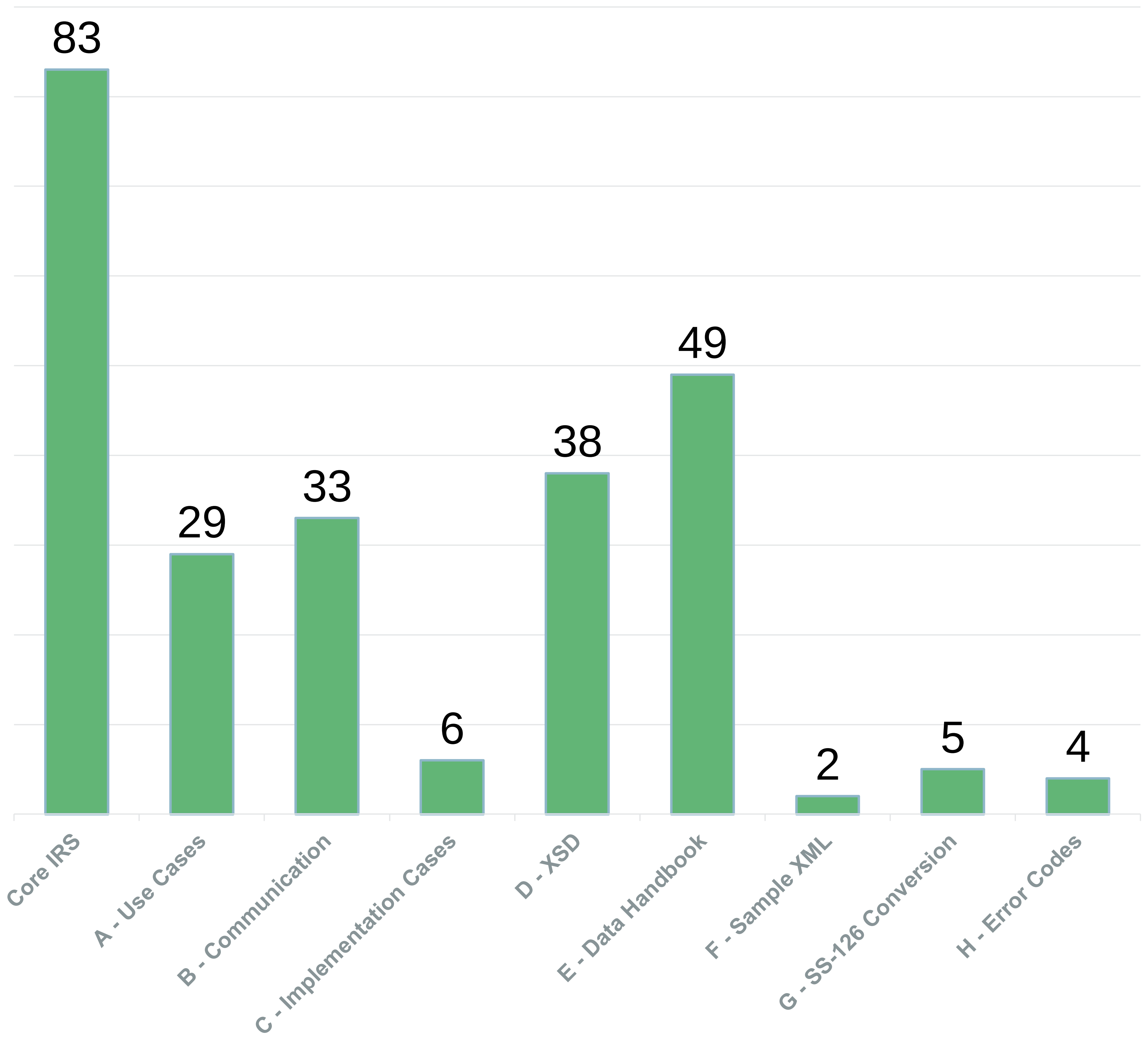


Comments during Draft review

231 comments received during the review of the draft IRS Edition 2







New functions are included to:
Improve the user experience
Facilitate implementation
Enhance performance

Occupation and status of other trains

The Related Train Information is the way to exchange information between trackside and onboard about the occupation and status of other trains which are on the path of the “own train” and which are driving in front or behind and are using the same tracks as the “own train”.

A DAS may use this information to update its driving advice, or drivers can use their expertise to interpret the displayed information and change their driving style.

The most important parts of the data concerning the related trains are:

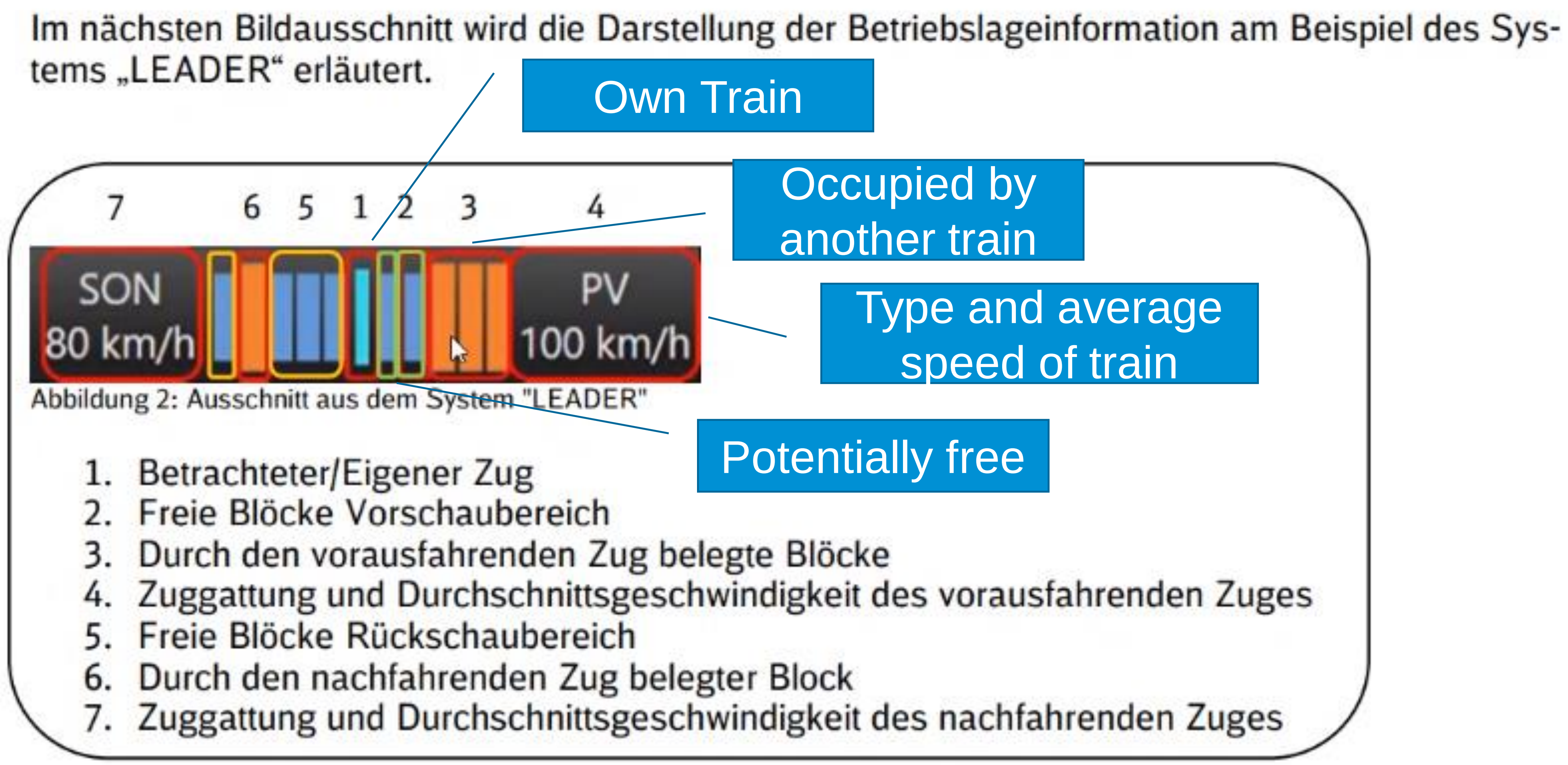
- Segment Claim: Gives the position of a train in terms of segment (SP_ID) and the position within this segment.

- Claim Type: Gives an indication of the status of route setting for this train on the given piece of the segment.

Highlights on SFERA Changes

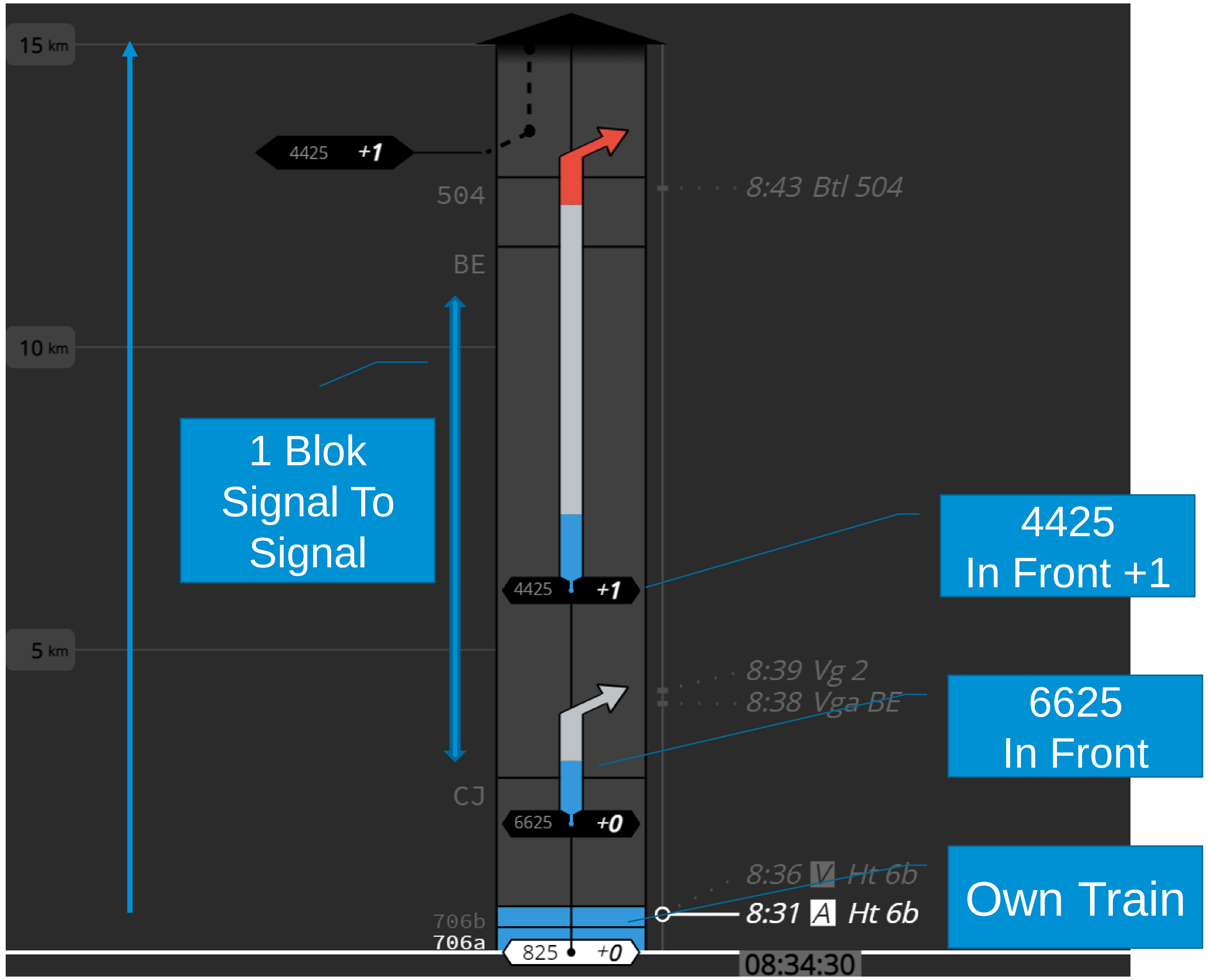
Addition of information on occupation and status of other trains (in front or behind)

Example of DB



Source: DB Cargo / Knorr-Bremse

Example of Routelint (ProRail)



Source: ProRail

Timetable mode

SFERA edition 2 introduces the “Driving Mode” parameter to inform trackside about the capability of the DAS or the mode currently used. Driving modes can be for example “Readonly”, “Inactive”, GoA1, GoA2, GoA3, etc.

In particular, the “Timetable” mode provides the timetable information that is historically provided "on paper" (time objectives in the different stations) and gives minimal information to the driver.

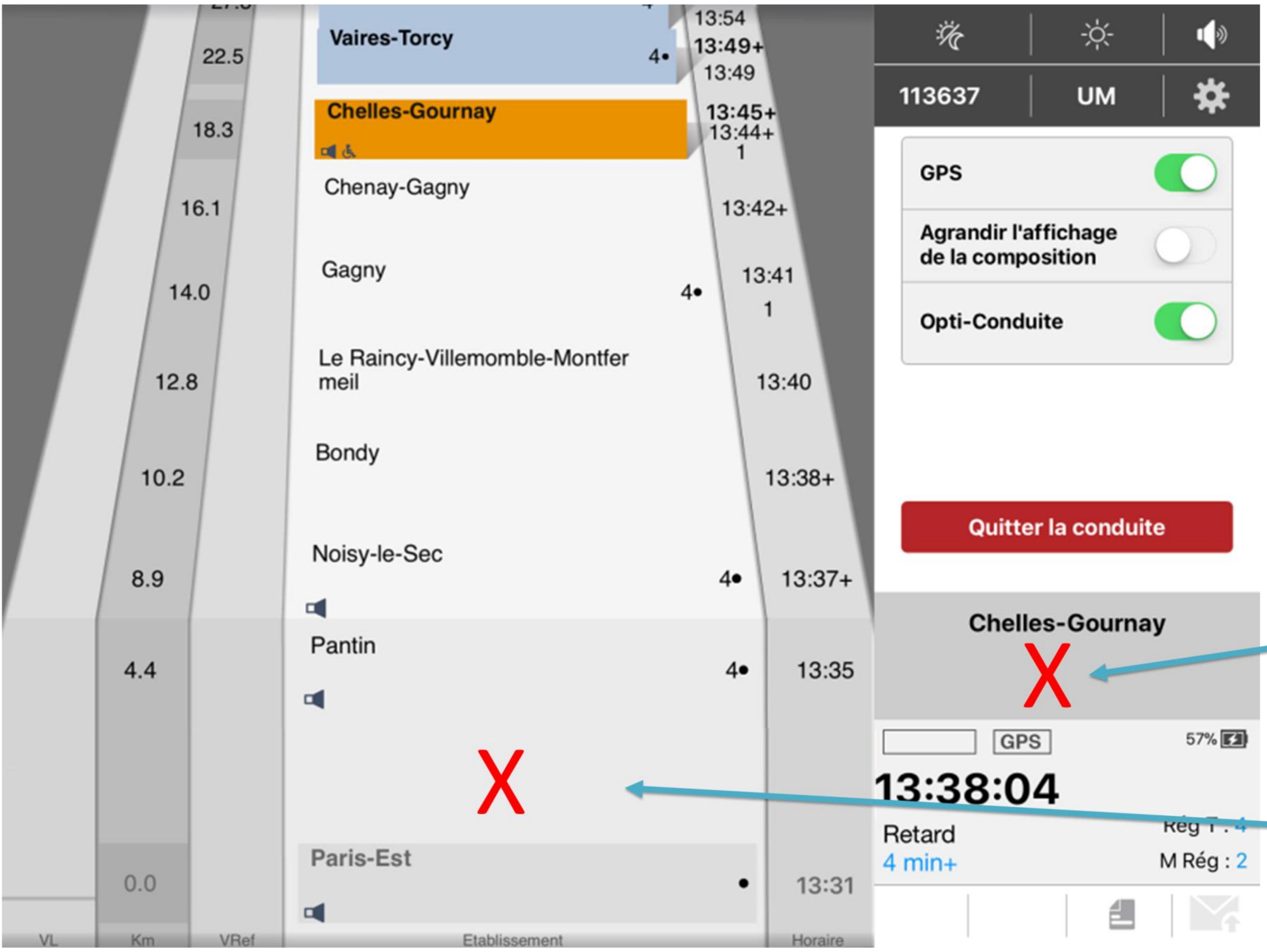
The “Timetable” mode would be used when the data source for driving advice calculation (accelerating, coasting, braking…) and ETA is unavailable or of insufficient quality.

Timetable mode

Timetable mode would be used when the data source for driving advice calculation (accelerating, coasting, braking…) and ETA is unavailable or of insufficient quality.

Examples of data :
- Gradients
- Speed limits and signals
- Traction power characteristics
- Fine geocoordinates of the track

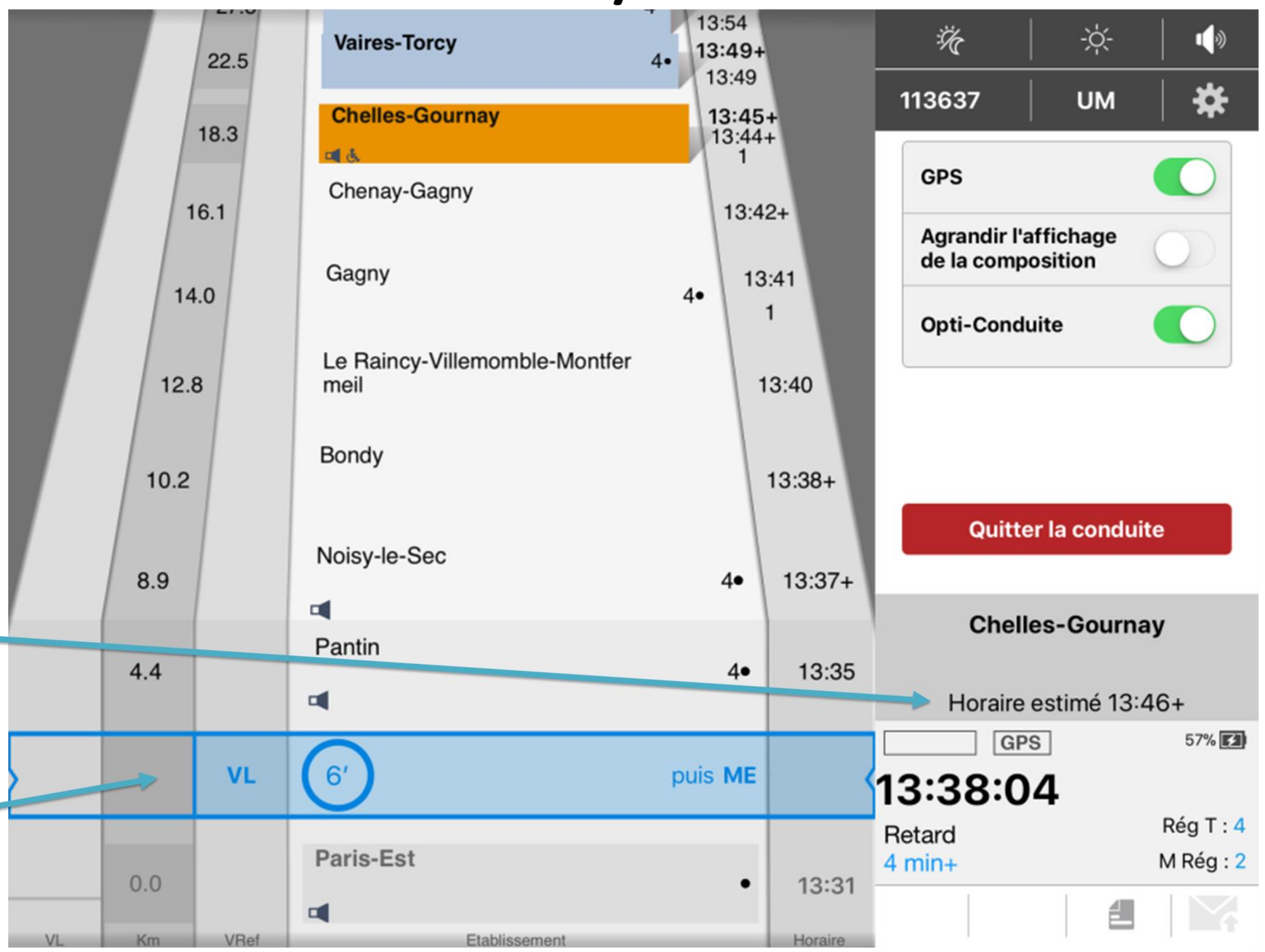
Timetable mode



ETA

Driving Advice

S-DAS / C-DAS



Advised speed in temporary constraints

In the edition 2 of SFERA advised speed over a certain area can be transmitted from ground to board as an "AdvisedSpeed" in a temporary constraint.

For example, to overtake a conflicting (slower) train that has (nearly) reached the location of overtaking.

This speed should be included in the driving profile and advice.

A range (min/max) or a speed can be sent together with a reason code.

New realtime data in the status report

In the edition 1 the status report includes few real-time information:

- Position
- Speed
- Adhesion conditions

In the edition 2 elements are added so a TMS and the IM energy management systems could benefit from.

Added are:

- Measured and current voltage: Voltage at the pantograph and current voltage taken from the overhead contact line or delivered (negative) when negative during regeneration
- Battery level: on battery powered trains, the available power is linked to the power available in the battery
- Maximal power that can be delivered form energy source available on-board (in kW)

Network specific parameters

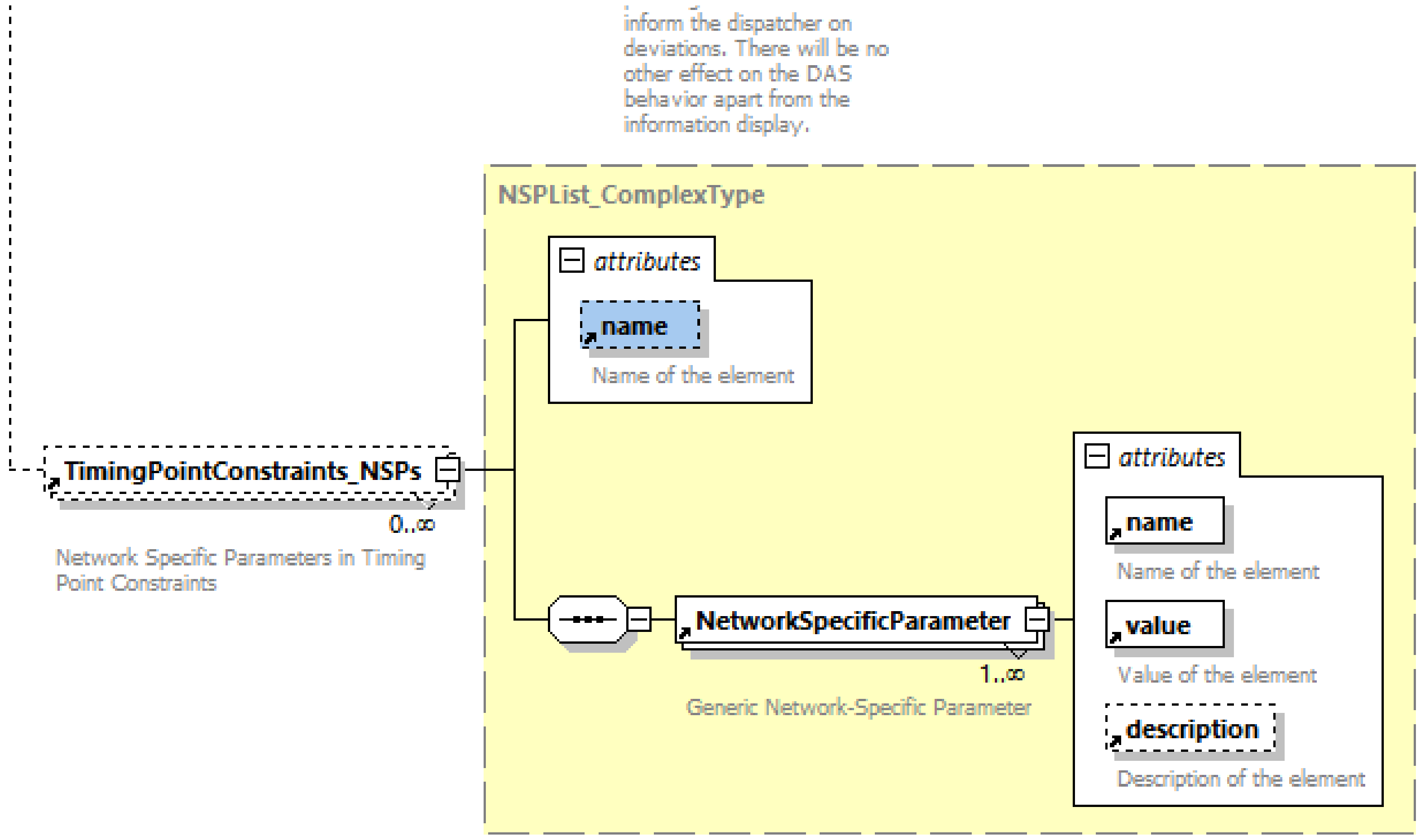
In several places of the data structure, it is possible to include so-called Network-Specific Parameters (NSPs).

Those are parameters that haven't been standardised for interoperable use in SFERA, but may be used in bilateral agreements between trackside and on-board DAS. They can include for instance some data that is only relevant in a specific IM area, or they can be used to test an additional function before submitting a Change Request to include the relevant data structure in SFERA.

Examples of places where NSPs have been added:

- Timing Points
- General JP Information
- Status Report
- Tracking and Braking Force Curve
- Signal and Physical Characteristics of signals
- Train Characteristics

Example




```xml
<TimingPointConstraints TP_latestArrivalTime="2023-09-04T12:17:00Z"
TP_StopSkipPass="Stopping_Point">
            <TimingPointReference>
                        <TP_ID_Reference TP_ID="Zandvoort"/>
            </TimingPointReference>
            <TimingPointConstraints_NSPs>
            <NetworkSpecificParameter name="crowdcontrol_message"
      value="Due to formula 1 grandprix crowd is expected,
            please inform driver on other side that departure is possible">
            </NetworkSpecificParameter>
            </TimingPointConstraints_NSPs>
</TimingPointConstraints>
```

SFERA improves upon interoperability

Interoperability

Two TSIs cover IT interoperability between the IMs TMS and the RU:

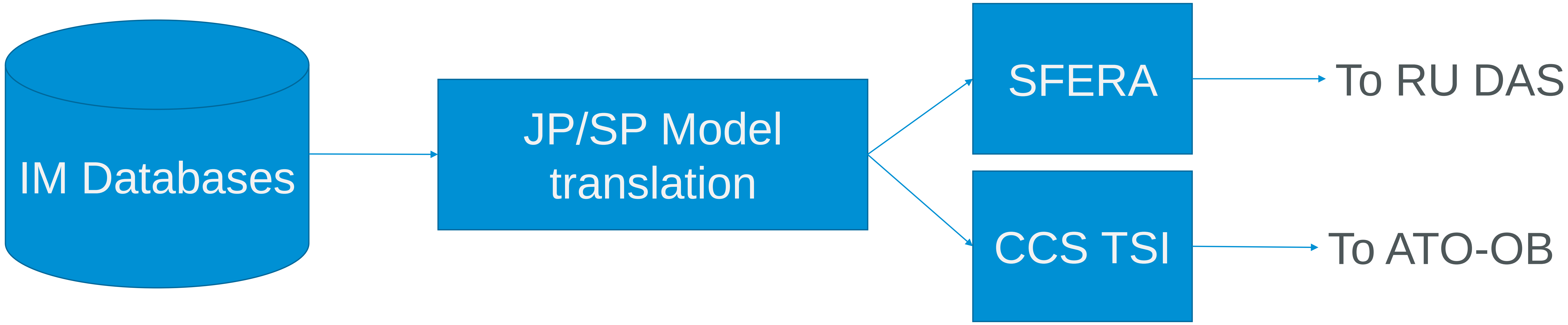
- CCS TSI for direct communication with the ATO-OB;
- TAF/TAP TSI for communication with the RU backoffice.

SFERA aims:	
Covering additional business cases	Providing an answer for short term needs of the sector regarding driver communication
Building upon existing TSI « Building blocks »	Mutualization potential for cost-conscious implementations
Aiming for integration of SFERA in future TSIs	Perpetuate innovations

SFERA improves upon interoperability: ERTMS/ATO

SFERA Ed. 1 included the entire ERTMS/ATO data model (CCS TSI Subset-126)

Main objective: mutualized data production for DAS and ATO

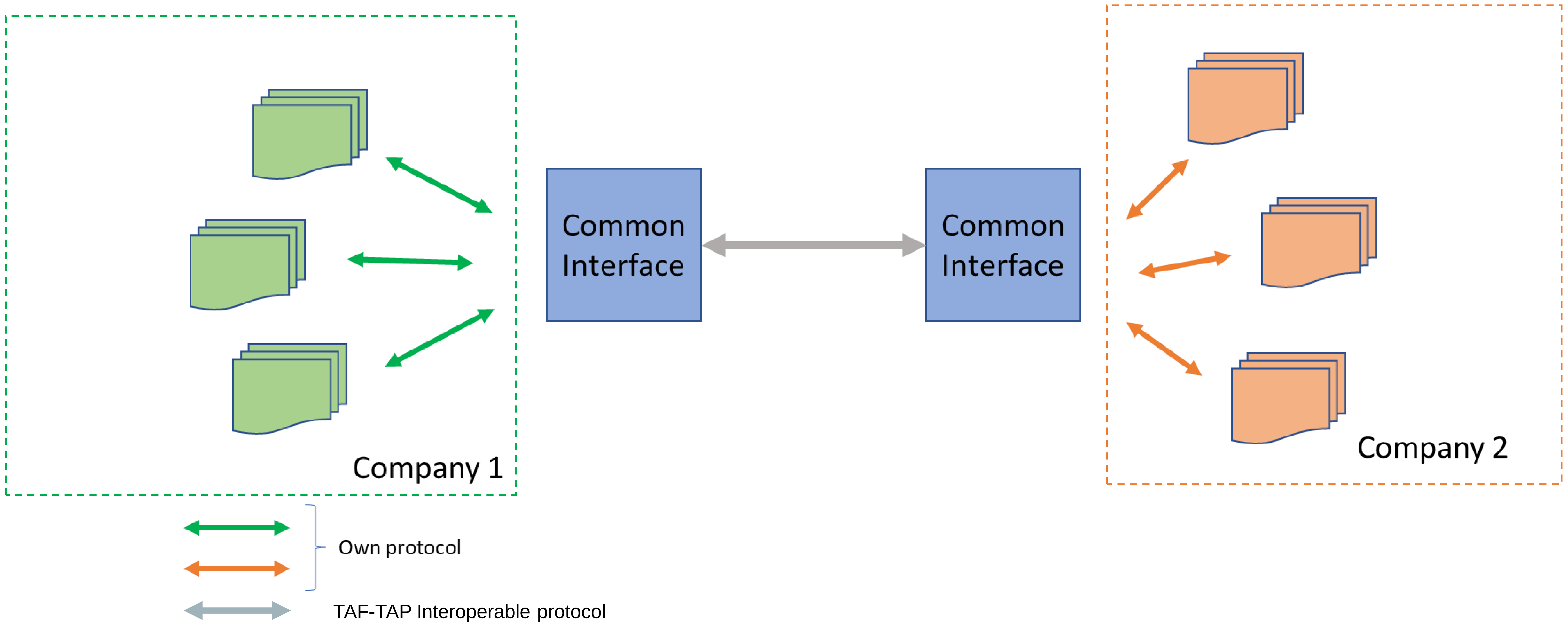


SFERA Ed. 2 was updated with current CCS TSI adaptations

SFERA improves upon interoperability: TAF/TAP TSI

TAF/TAP TSI covers interoperability between IM and RU IT systems

- Common Interface (CI) to establish technical links
- Exchange of standardized TAF/TAP xml messages
- Possible exchange of non-TAF/TAP messages



Scope of IM/RU TAF/TAP TSI messages:

- Path allocation and coordination
- Traffic management
- Train Performance Management

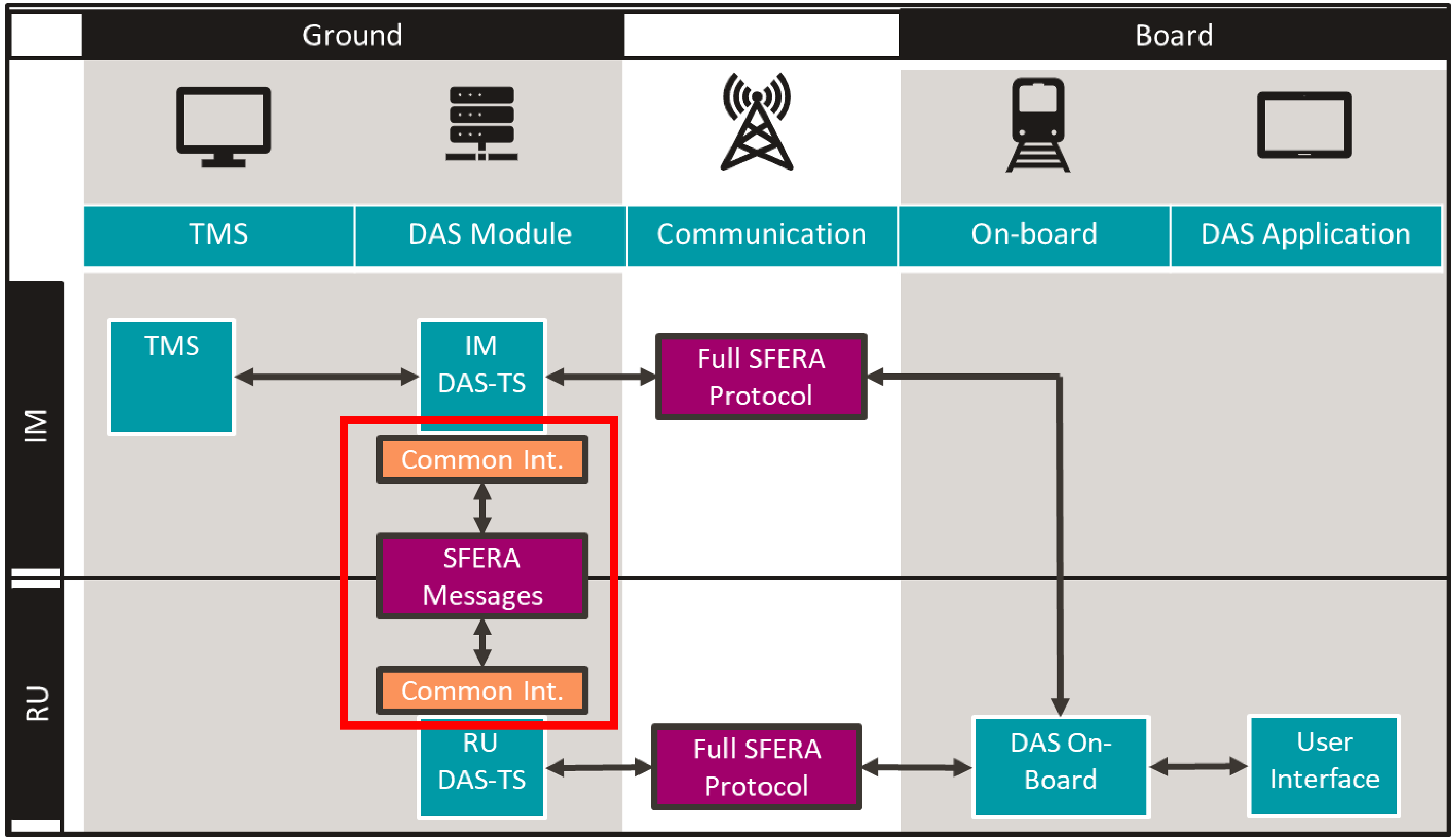
TAF/TAP TSI: Common Interface

The CI will be used by SFERA between the IM and RU Trackside servers.

Why?

- Deployed by all major Ims
- Deployed by many RUs
- « Off the shelf » CIs available
- Protocol appropriate for server to server communication

Impact on SFERA Ed.2: minor adaptation of message headers.



TAF/TAP TSI: Locations

TAF/TAP messages refer to primary and subsidiary locations (or PLC/SLC). For example:

« Train 12345 has been located at **Wien-Hbf** at 12h04 »

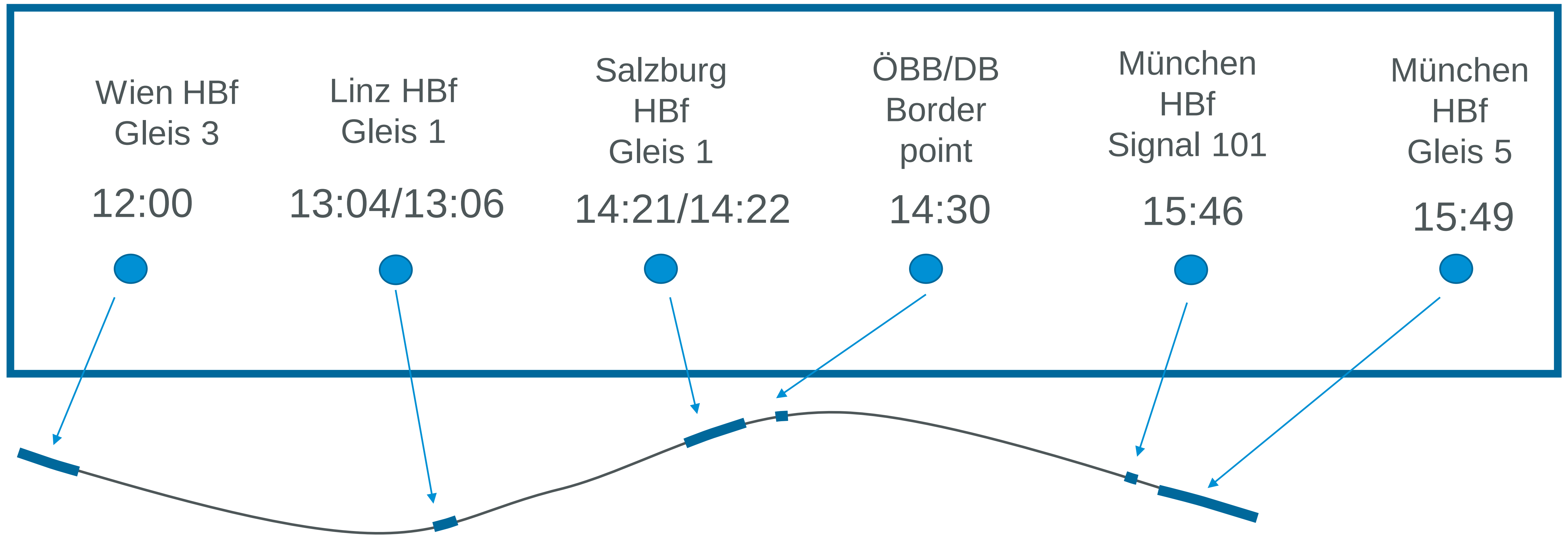
« Train 7891 is ready for departure from **Köln-Hbf/Signal101** at 12h04 »

RUs could be interested in linking TAF/TAP and SFERA data as they supplement each other:

- In the RU backoffice;
- In the DAS-OB.

TAF-TAP Path Details, based on locations

SFERA Journey Data based on distance



TAF/TAP TSI: Train Ready, Interruption, Delay Cause

TAF-TAP TSI defines standard messages between the RU backoffice and IM/TMS for incident management:

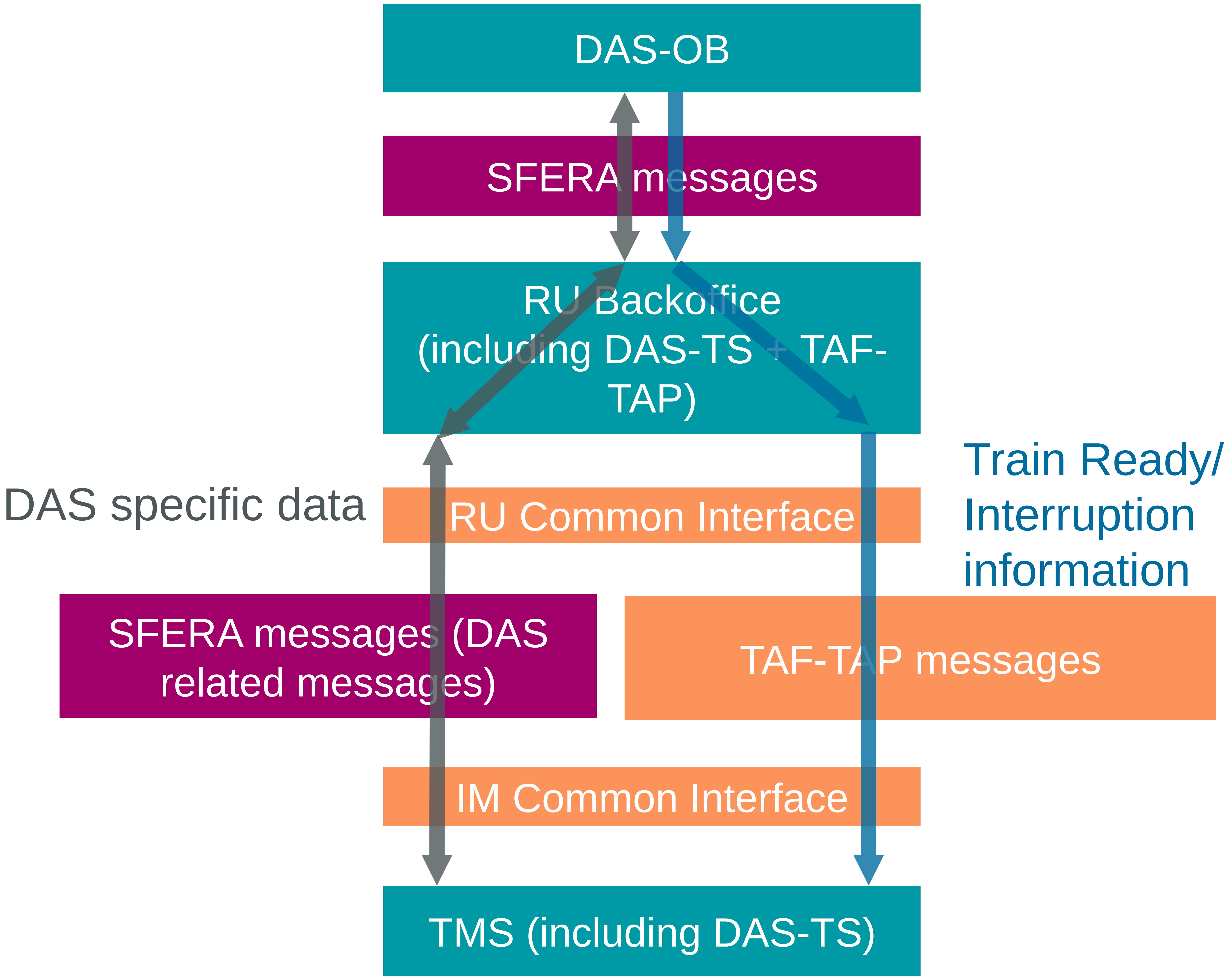
- Train Ready / Not Ready
- Train Running Interruption

On the RU side, one major obstacle is obtaining the information from the driver, which is not covered by the TAF-TAP TSI:

→ SFERA includes the payloads for transmission from DAS-OB to ground

→ The RU backoffice

SFERA includes the TAF-TAP XML payloads for the DAS-OB/RU DAS-TS link



100 YEARS ANNIVERSARY UIC INTERNATIONAL UNION OF RAILWAYS

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Thank you for your attention.

A connected Driver Advisory System for CFL

Amel SMAILJI
CFL Infrastructure

Mohammad SABBAGHIAN
Cubris

SFERA DAS Workshop
Paris
10/10/2022

Choice of the DAS solution/supplier

Focus on our strengths : CFL is only a small railway with limited resources but with relatively modern systems.

- **extension of our existing traffic management system**
  setting-up a track-side with close integration into our TMS
  seamless integration into our existing TMS ARAMIS

- **SFERA compliant solution**
  willingness to be innovative and first mover

- **from c-DAS to ATO**
  c-DAS as a steppingstone in our strategy towards ATO
  have the trackside evolve on the basis of the 2022 TSI
  → *ATO over ETCS (GoA 2) by 2025*

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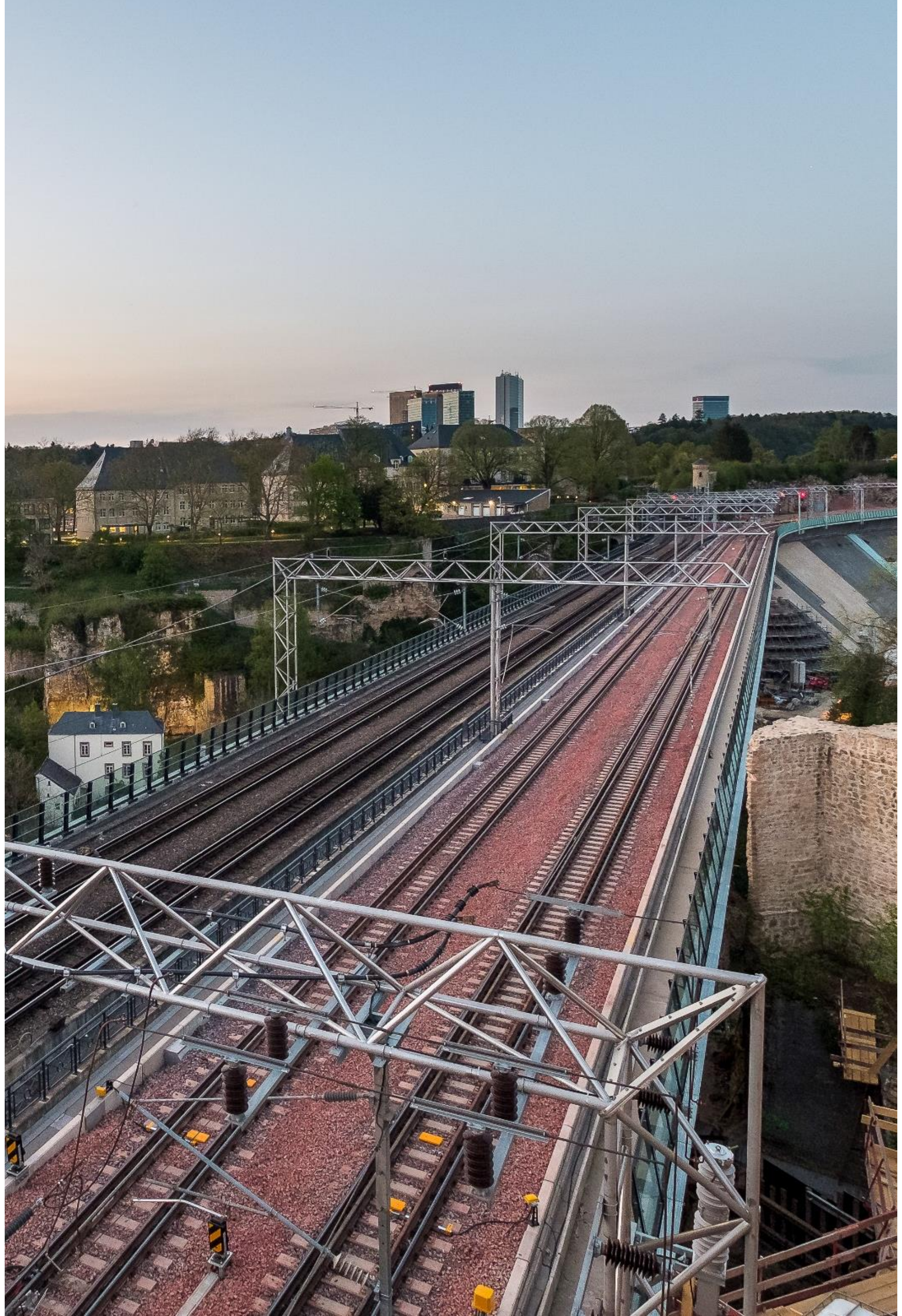

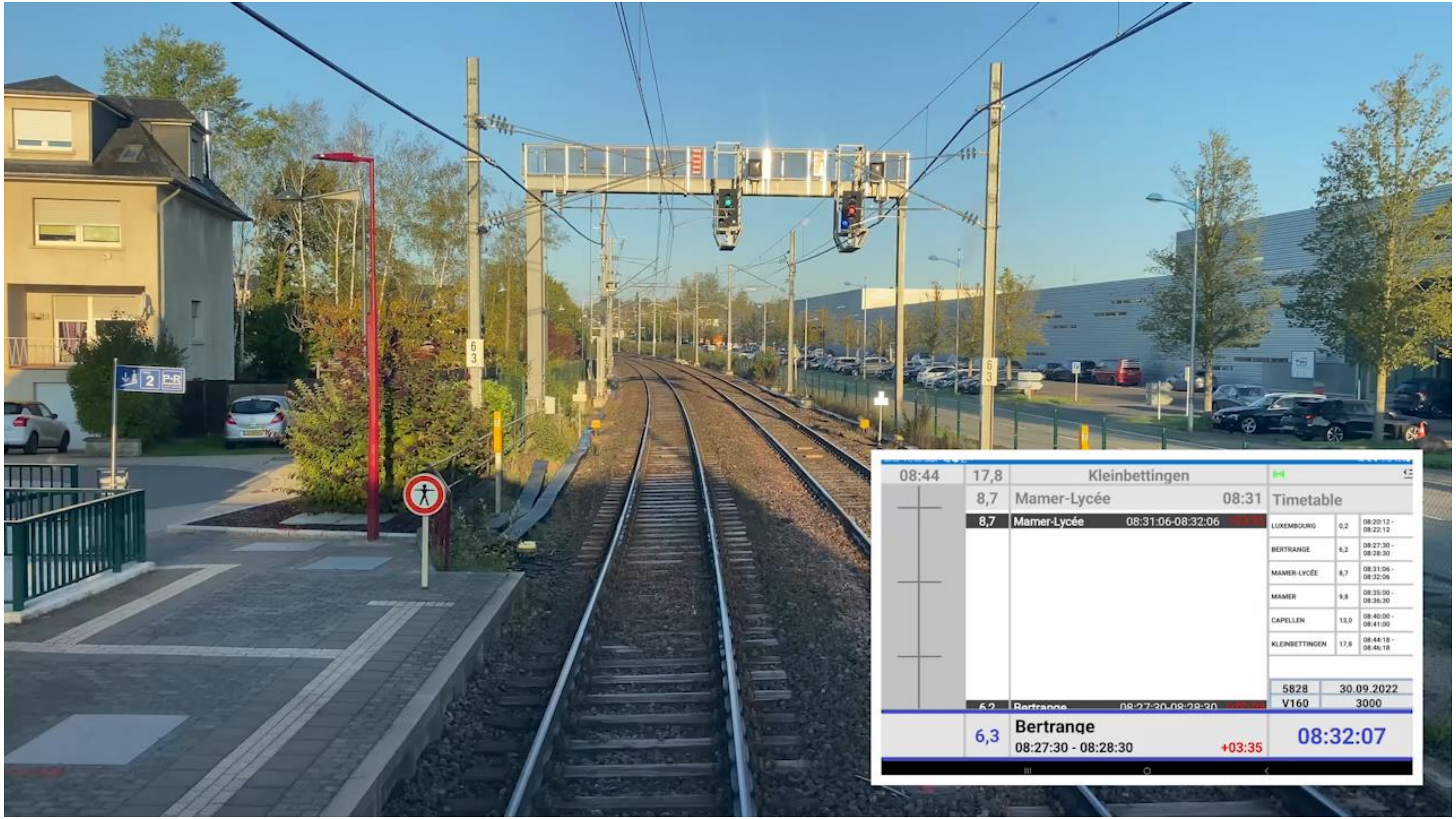

2 P+R
08:44
17,8
Kleinbettingen
8,7
Mamer-Lycée
08:31
Timetable
8,7
Mamer-Lycée
08:31:06-08:32:06
LUXEMBOURG 0,2 08:20:12 - 08:22:12
BERTRANGE 6,2 08:27:30 - 08:28:30
MAMER-LYCÉE 8,7 08:31:06 - 08:32:06
MAMER 9,8 08:35:00 - 08:36:30
CAPELLEN 13,0 08:40:00 - 08:41:00
KLEINBETTINGEN 17,8 08:44:18 - 08:46:18
5828
30.09.2022
V160
3000
6,3
Bertrange
08:27:30 - 08:28:30
+03:35
08:32:07

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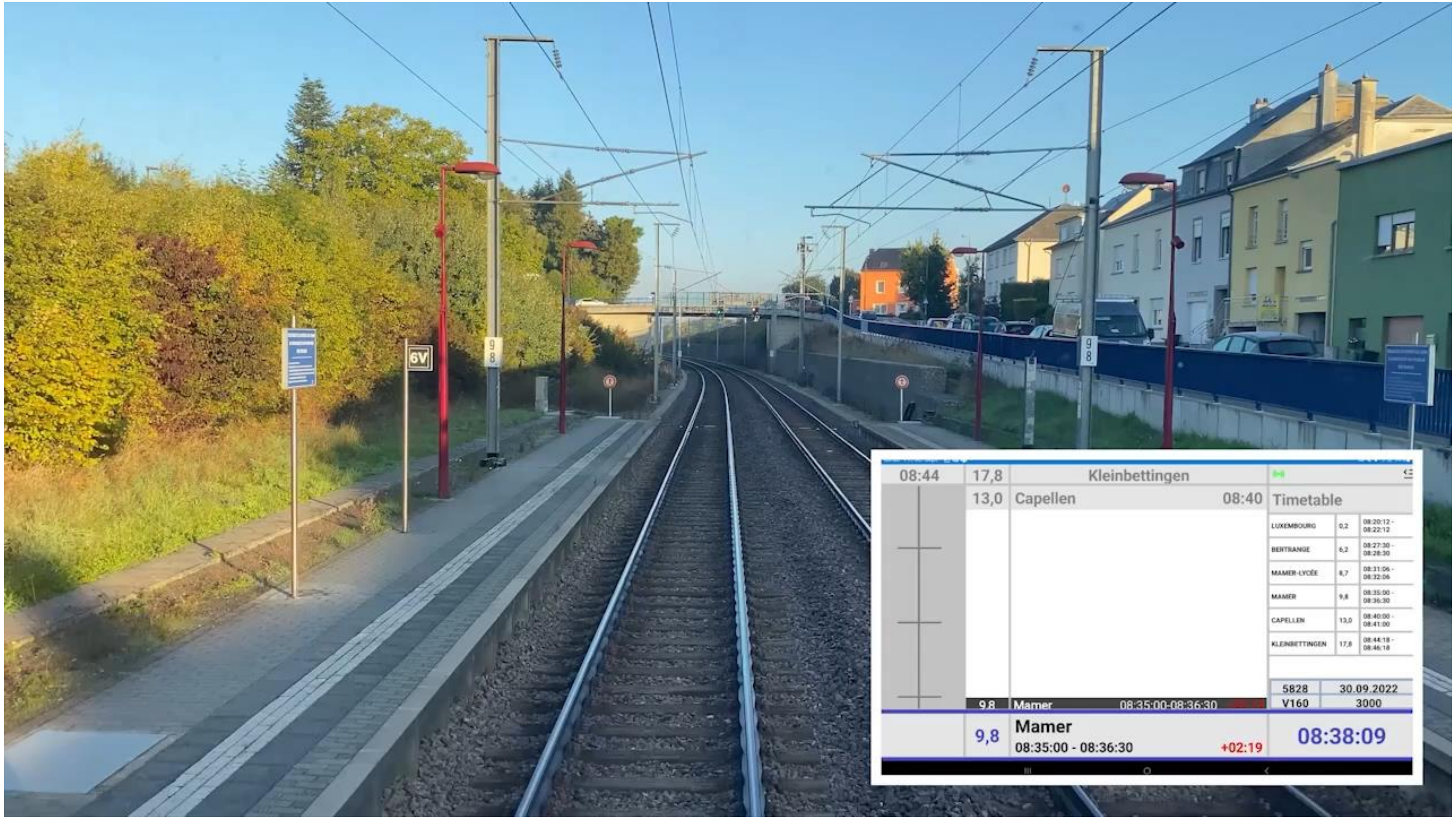

6V
08:44
17,8
Kleinbettingen
13,0
Capellen
08:40
Timetable
LUXEMBOURG 0,2 08:20:12 - 08:22:12
BERTRANGE 6,2 08:27:30 - 08:28:30
MAMER-LYCÉE 8,7 08:31:06 - 08:32:06
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5828
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08:35:00-08:36:30
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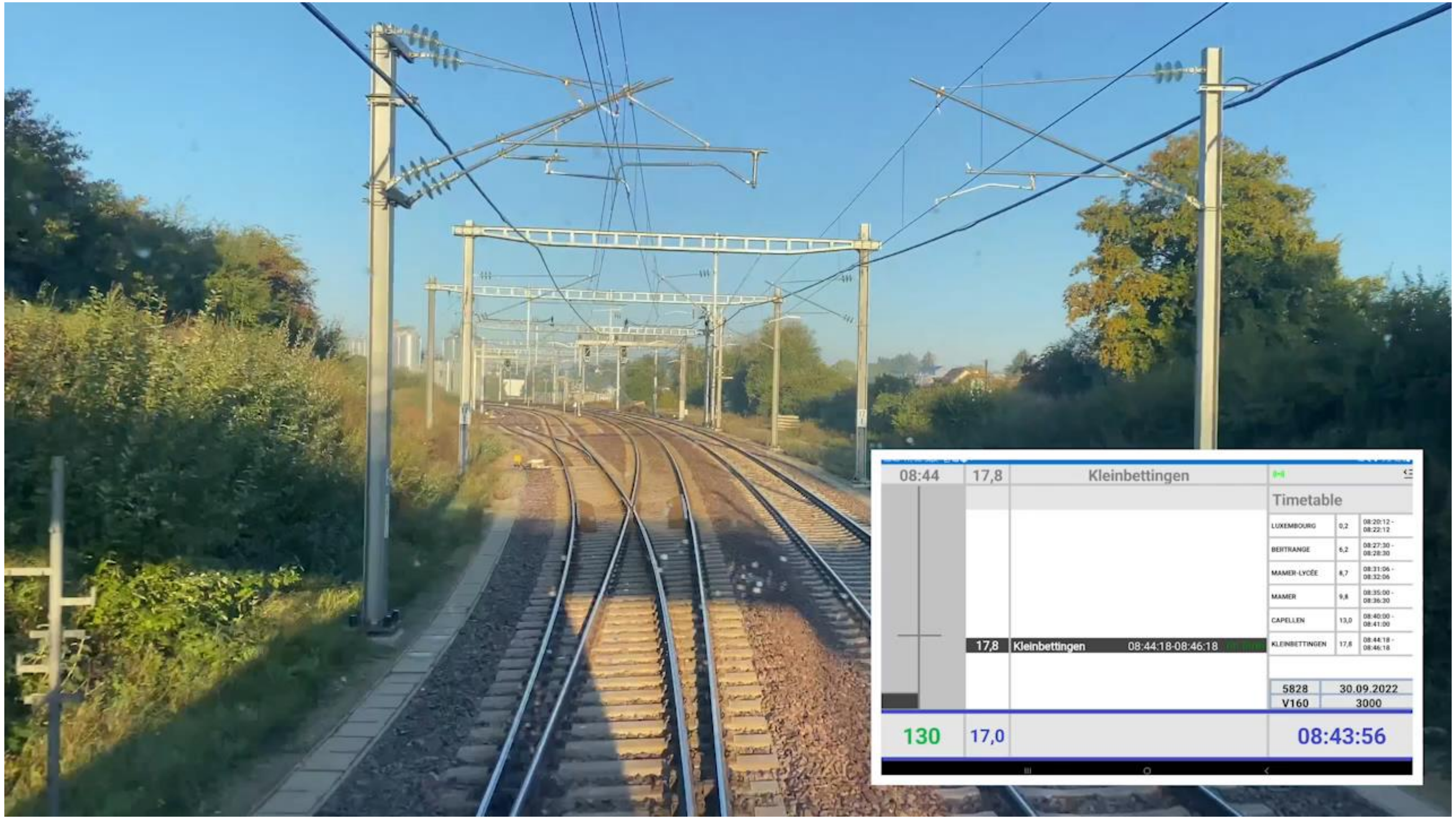
+02:19
08:38:09

CUBRIS

CFL


08:44
17,8
Kleinbettingen
Timetable
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KLEINBETTINGEN 17,8 08:44:18 - 08:46:18
17,8 Kleinbettingen 08:44:18-08:46:18
5828 30.09.2022
V160 3000
130
17,0
08:43:56

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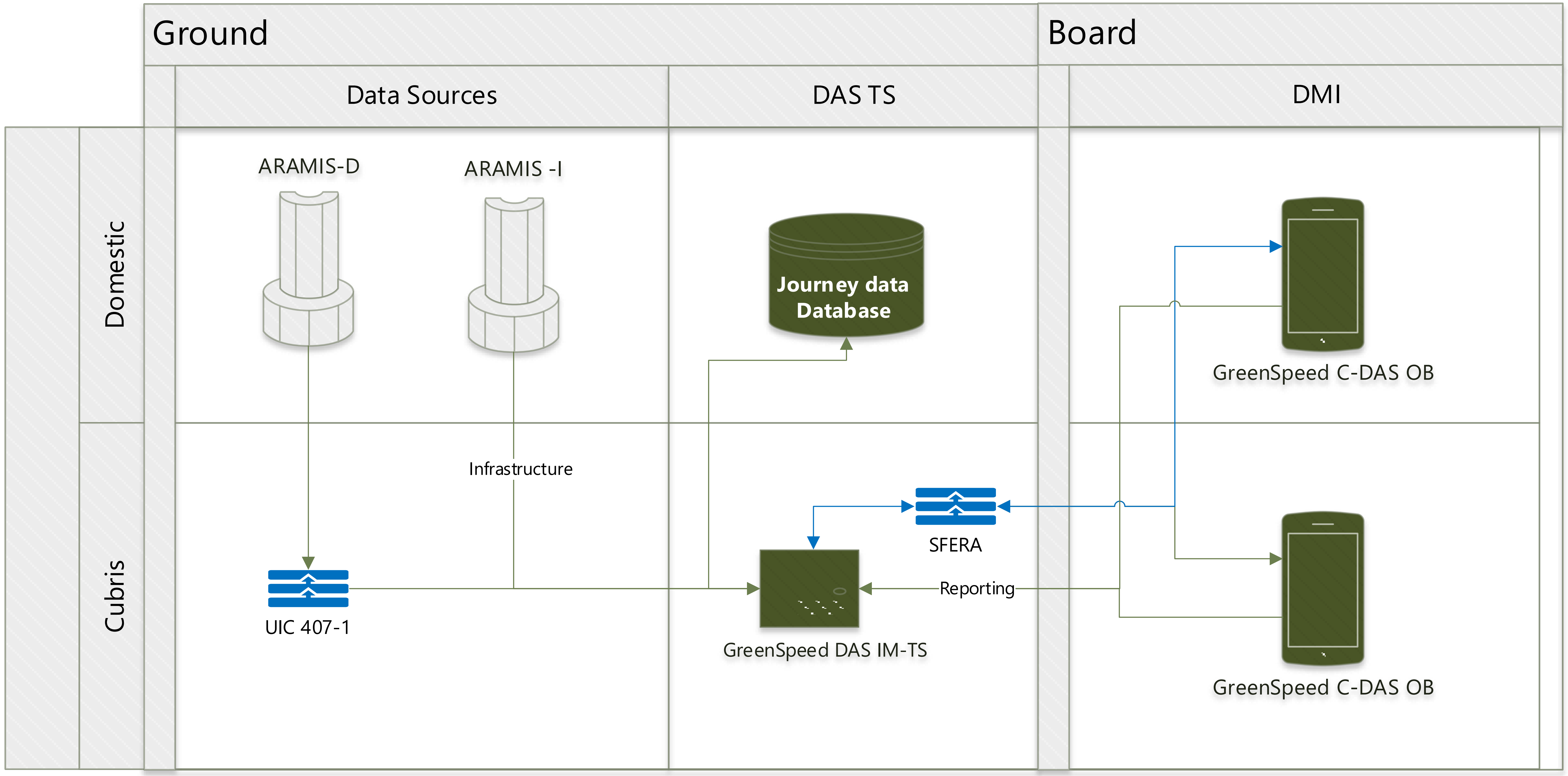
Ground
Board
Data Sources
DAS TS
DMI
Domestic
Cubris
ARAMIS-D
ARAMIS -I
Journey data Database
GreenSpeed C-DAS OB
Infrastructure
SFERA
UIC 407-1
Reporting
GreenSpeed DAS IM-TS
GreenSpeed C-DAS OB

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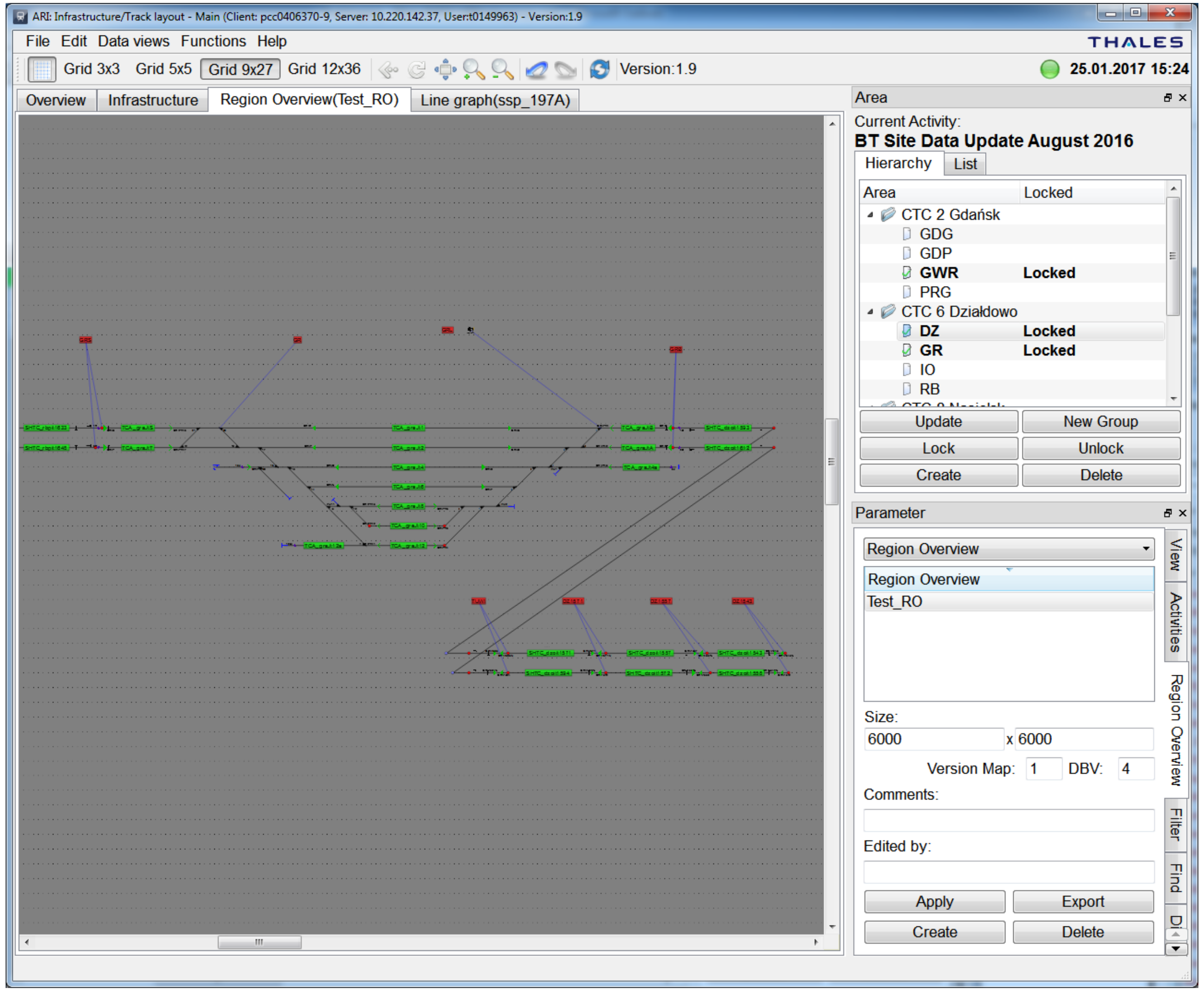
Data modelling not just for DAS



Also the way to ATO

RESTREINT

THANK YOU!

Amel SMAILJI
Project Engineer Digital Transformation
at CFL Infrastructure

E-Mail : amel.smailji@cfl.lu

Mohammad SABBAGHIAN
Software Engineer at Cubris

E-Mail: m.sabbaghian@cubris.dk

Quick overview on the Luxembourgish railways

628
km of tracks

70
train stations and stops

1.000
train-runs per day

49 %
cross-border traffic

free
of charge public transport

increase in passengers

Challenges of implementation

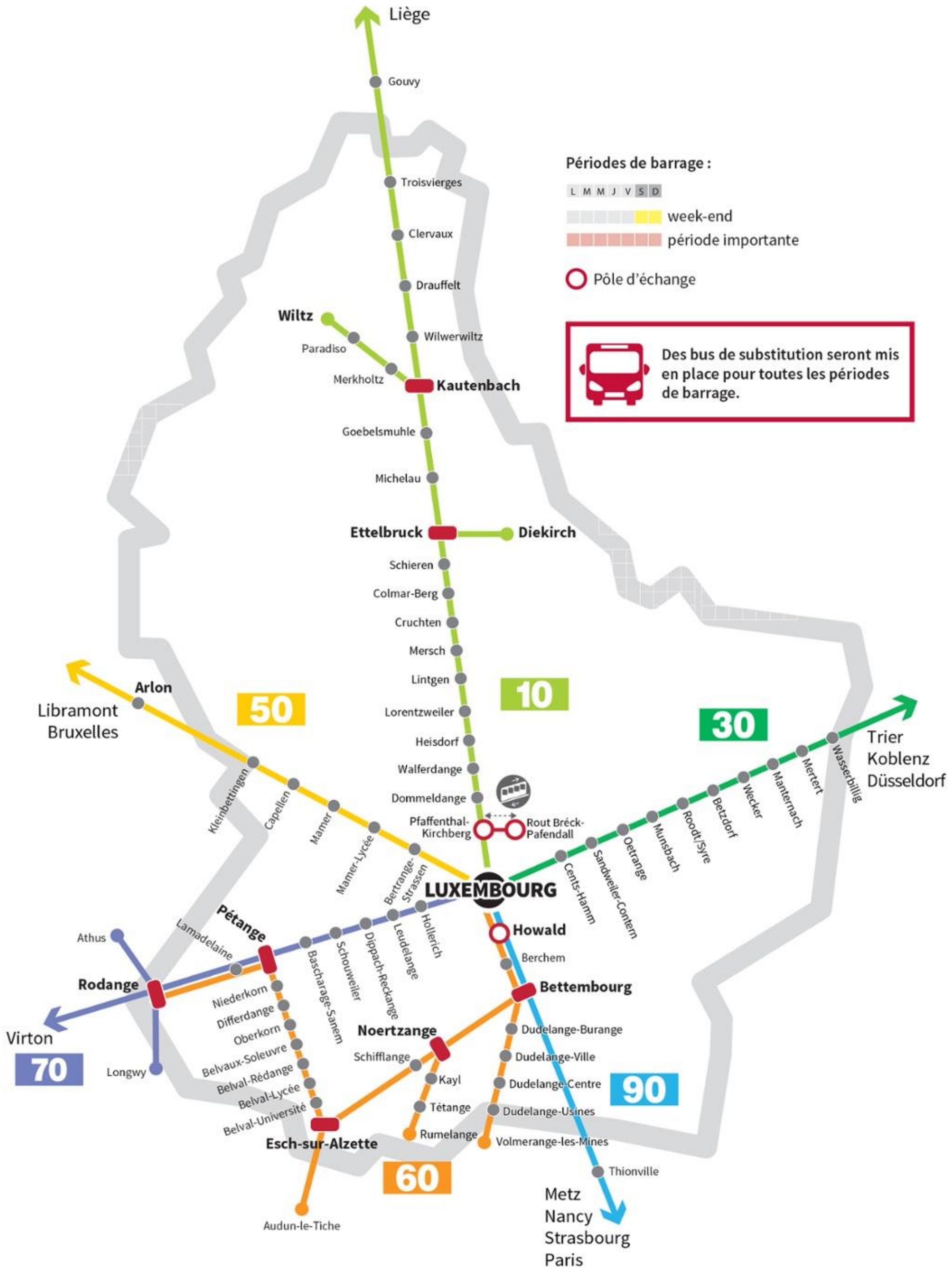
Infrastructure Data and Modelling

Infrastructure data is one of the three pillars of a c-DAS system

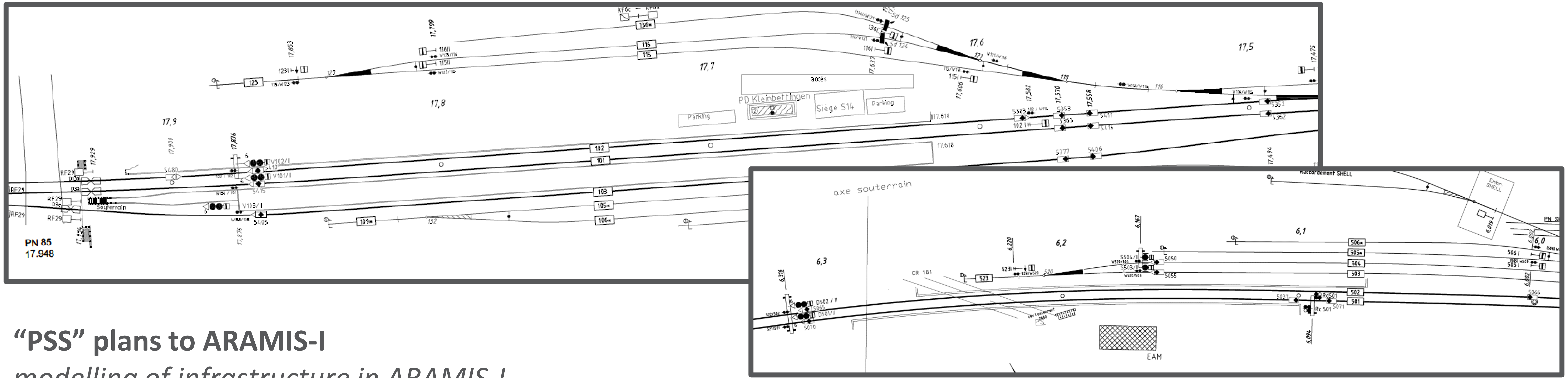
- **Additional acquisition of a central infrastructure database ARAMIS-I**
  modelling of infrastructure in ARAMIS-I
  generates RailML files for c-DAS TS (segment profiles)
  integration into our existing ARAMIS environment

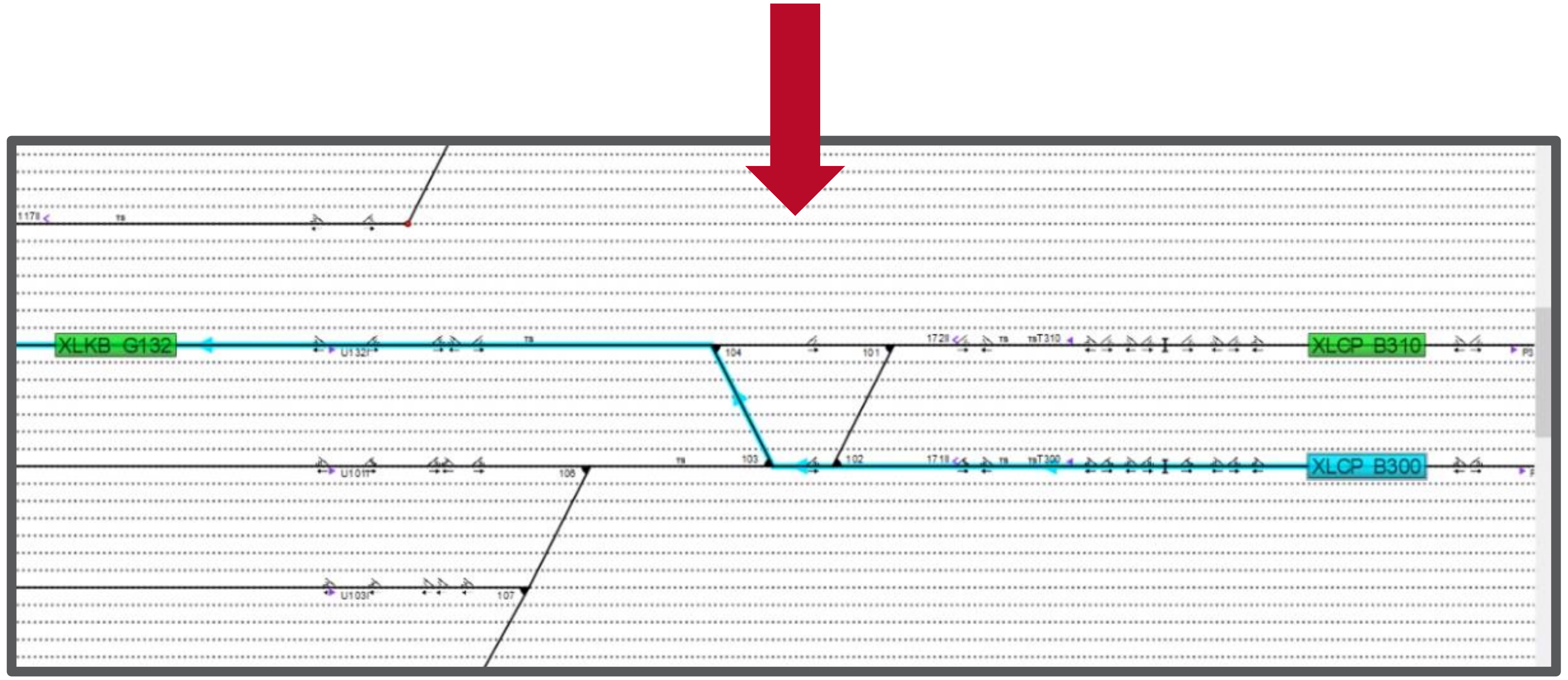
- **Different sources of data used for modelling in ARAMIS-I**
  *main data provided in "plans schématiques de signalisation" in pdf format (**PSS**)*
  other various sources (ETCS projecting data tables, ARAMIS data, CFL GIS platform, etc.)

- **Integrity and Validation of Infrastructure Data**
  c-DAS Signal and Switch positions, platform lengths
  reference kilometer points
  GPS coordinates



Infrastructure Data and Modelling

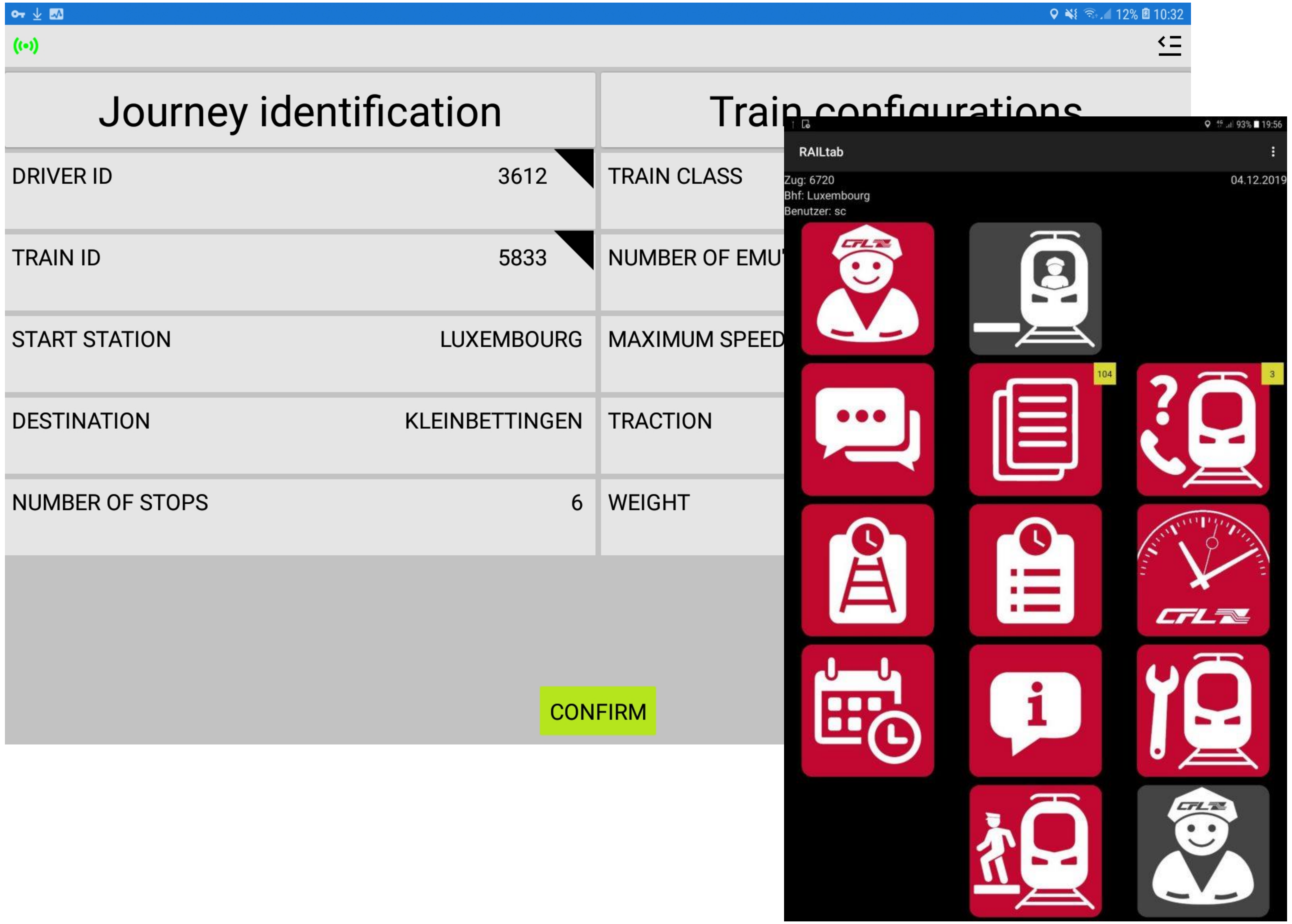




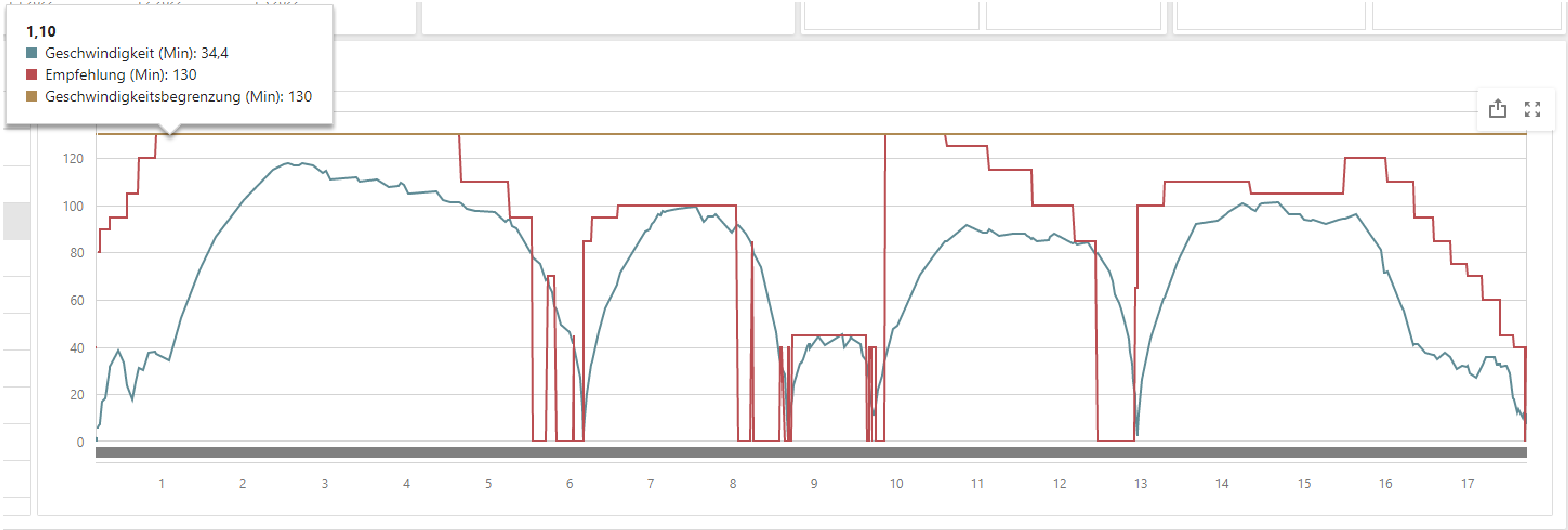
- **“PSS” plans to ARAMIS-I**
  modelling of infrastructure in ARAMIS-I
- **Different sources of data used for modelling in ARAMIS-I**
  main data provided in “plans schématiques de signalisation” in pdf format
  other various sources (ETCS projecting data, ARAMIS data, CFL GIS platform, etc.)
- **Establishing a work flow for data maintenance**

c-DAS CFL UI

- **Setup Screen**
  driver enters Driver ID and Train ID
  c-DAS OB automatically obtains data for generating a journey profile from ARAMIS (timetable, segment profiles)



Back Office View c-DAS train drive



CUBRIS

New insights into the applicability of SFERA for ATO over ETCS L1LS or Class B EuroZUB in Switzerland

SOB ATO pilot project

Markus Wachter

DAS Workshop presenting IRS 90940 Edition 2
UIC Headquarters Paris

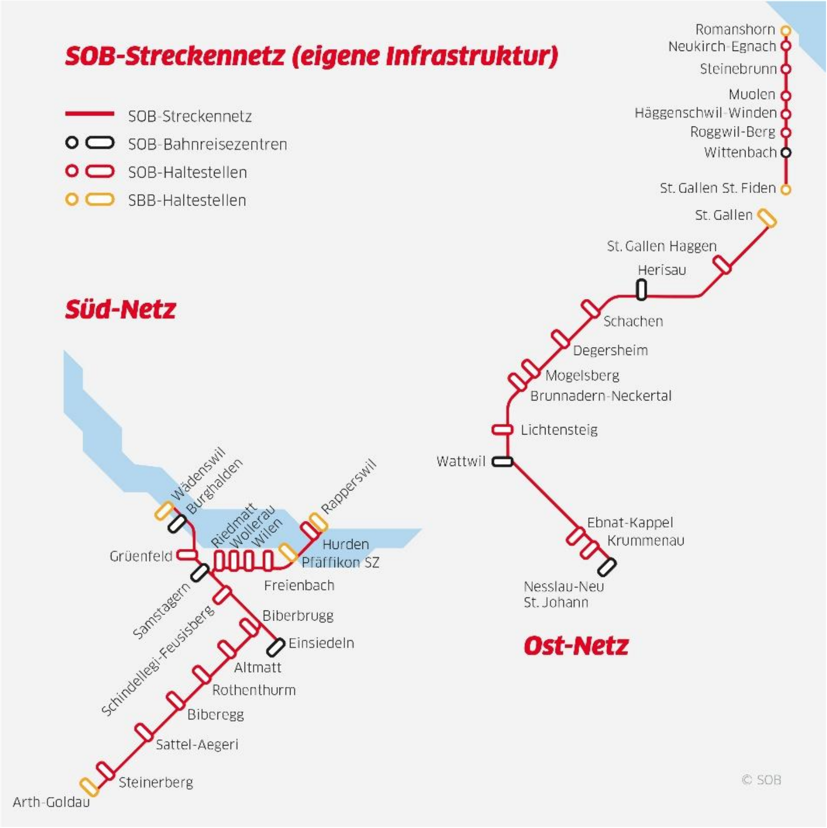
October 10, 2022

Agenda

- Introduction
- Current situation SOB ATO pilot project and potential SFERA
- SOB contribution for the IRS 90940 Edition 2
- New insights modelling of lineside signalling with SFERA
  - Example modeling the end of signalled speed restrictions with SFERA signal constraints according to Swiss national rules
  - Challenge dealing with expected signal aspects in SFERA for optimization versus current aspects in the real world
- Conclusion & outlook

Introduction

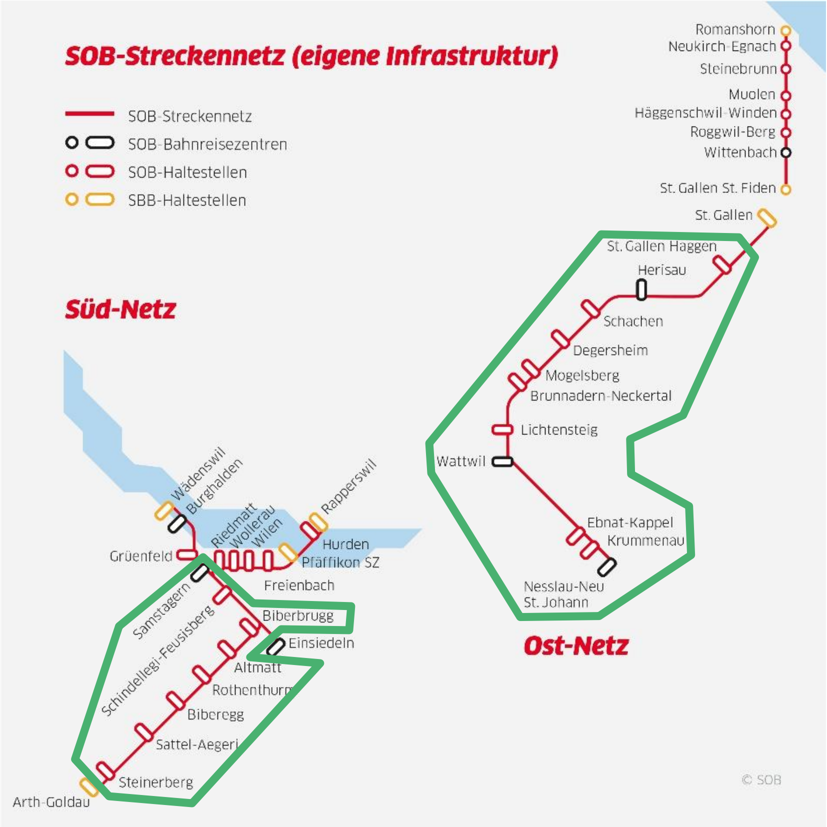
SOB (Schweizerische Südostbahn AG) is a private railway company (IM and RU).



SOB SÜDOSTBAHN
gerade unterwegs

Introduction

SOB (Schweizerische Südostbahn AG) is a private railway company (IM and RU).



ATO test areas:

Current lines with necessary infrastructure data for ATO-Trackside

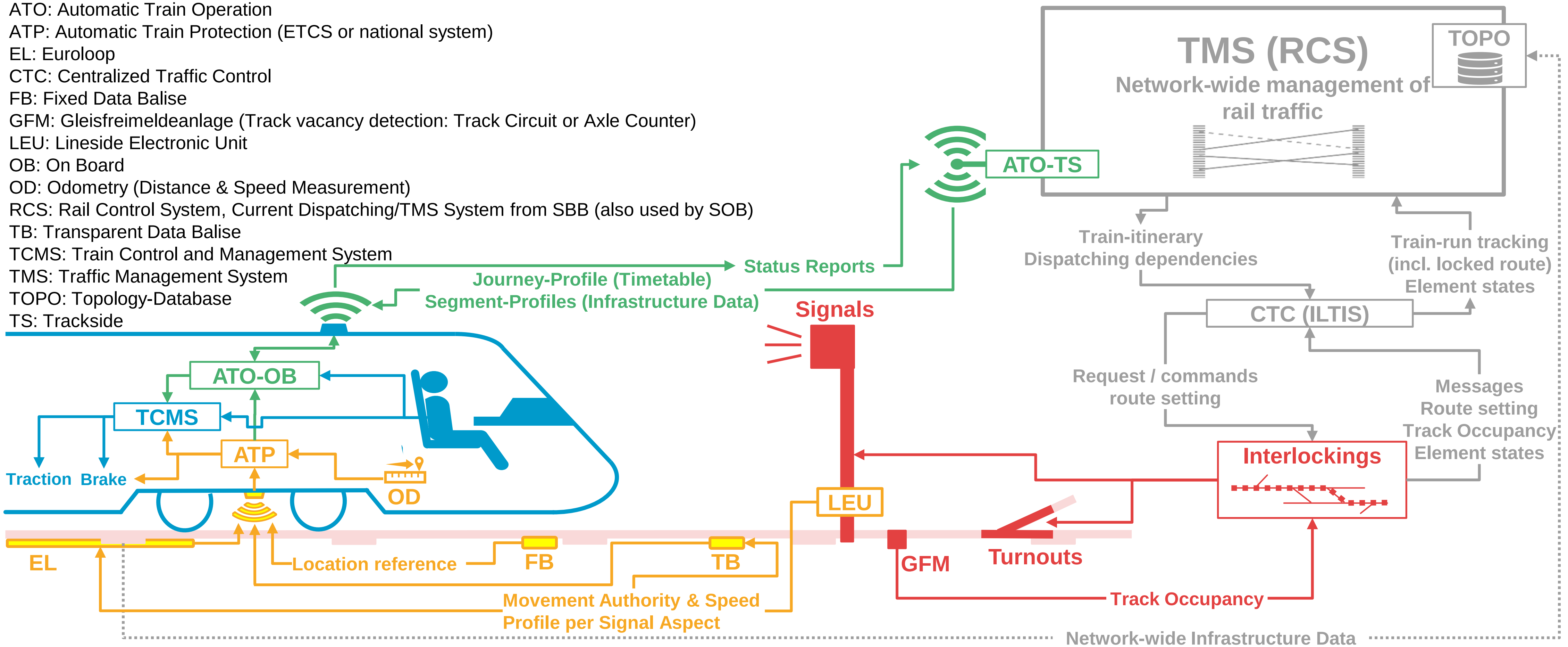
Introduction

- SOB is carrying out an ATO pilot project over ETCS L1 Limited Supervision, including ClassB EuroZUB.
- SOB sees potential in SFERA for transmitting correct signalling and line-speed data to ATO-OB according to swiss national operating rules.
- At the SFERA User Group Conference on September 2021, SOB presented its first findings on the applicability of SFERA, and submitted change requests for IRS 90940 Edition 2.
- In the meantime, the study for an ATO solution for swiss lines with lineside signalling has been completed.
- New insights have also been gained regarding SFERA. The study's findings and solution approaches, including SFERA application, could also be useful for an eventual extension of the TSI for ATO GoA2 for lines without ETCS Cab Signalling (after TSI 2022).

SOB SÜDOSTBAHN
gerade unterwegs

ATO GoA 2 over ETCS L1 LS System Overview

ATO: Automatic Train Operation
ATP: Automatic Train Protection (ETCS or national system)
EL: Euroloop
CTC: Centralized Traffic Control
FB: Fixed Data Balise
GFM: Gleisfreimeldeanlage (Track vacancy detection: Track Circuit or Axle Counter)
LEU: Lineside Electronic Unit
OB: On Board
OD: Odometry (Distance & Speed Measurement)
RCS: Rail Control System, Current Dispatching/TMS System from SBB (also used by SOB)
TB: Transparent Data Balise
TCMS: Train Control and Management System
TMS: Traffic Management System
TOPO: Topology-Database
TS: Trackside



ATO GoA 2 over ETCS L1 LS System Overview

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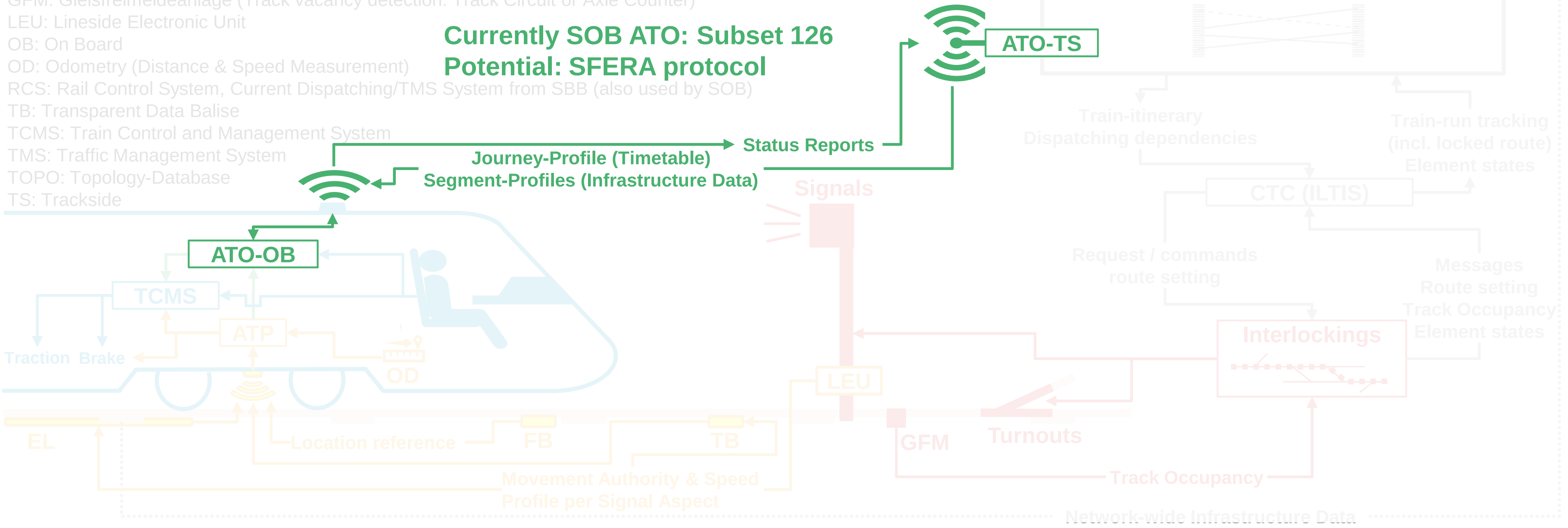
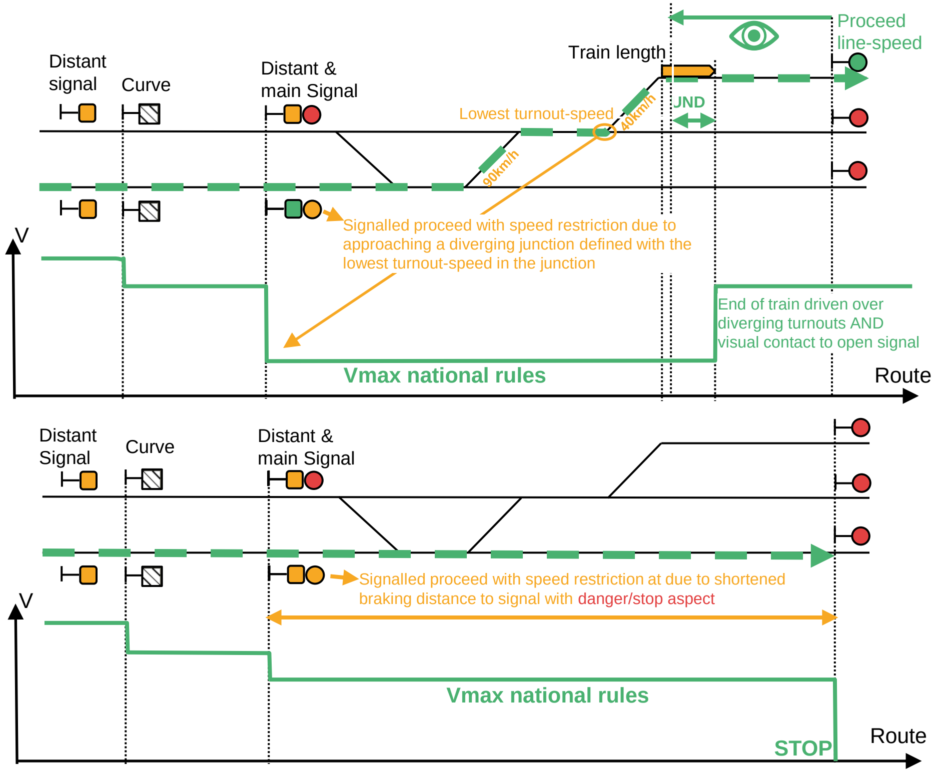
TOPO: Topology-Database
TS: Trackside



Allowed speed for a train depending on the signalling technology

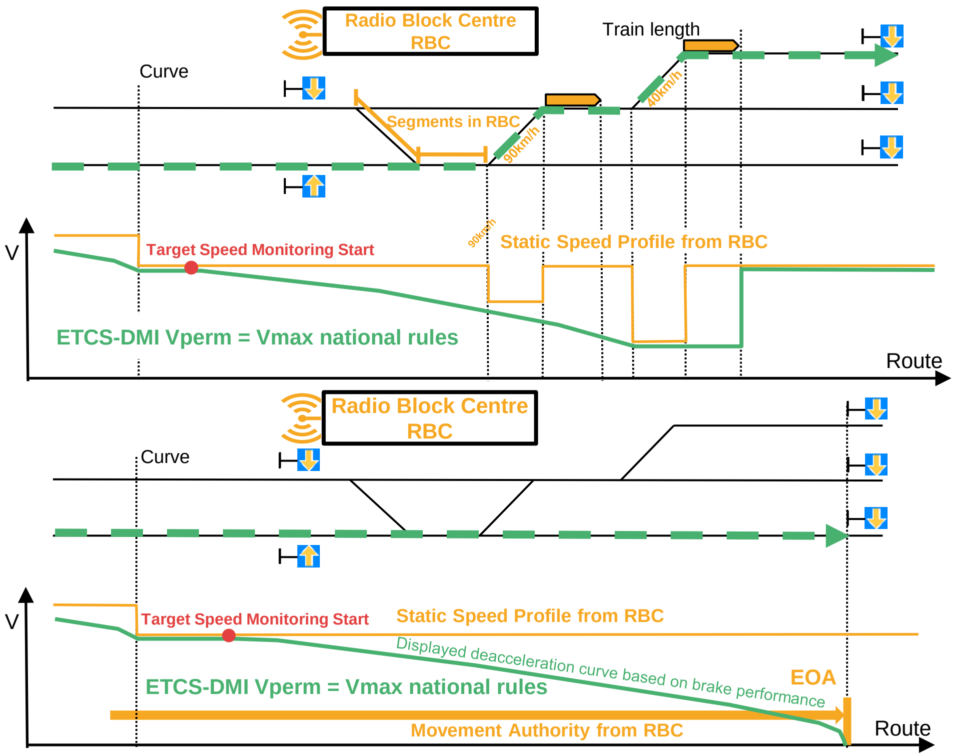
Lineside signalling Switzerland (ETCS L1 LS)

Close relationship between permitted line speeds, signalled speeds, signal positions and vehicle braking performance (brake percentage):



Cab signalling (ETCS L2 FS)

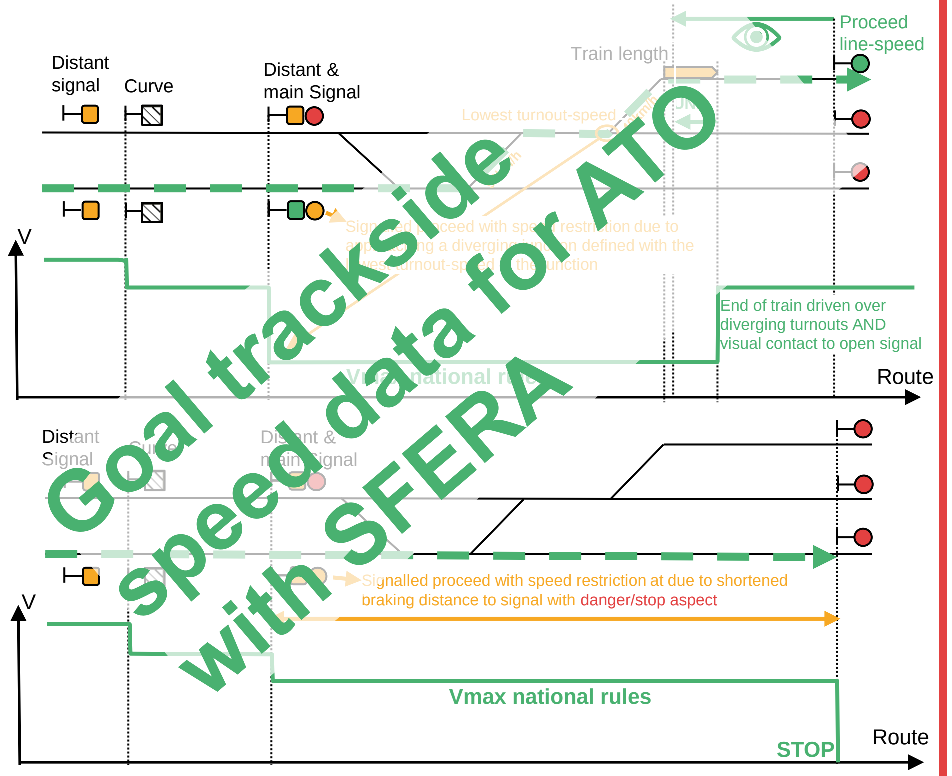
No relationship between projected static speeds, virtual positions signals (End of Movement Authority) and vehicle braking performance (brake percentage):



Allowed speed for a train depending on the signalling technology

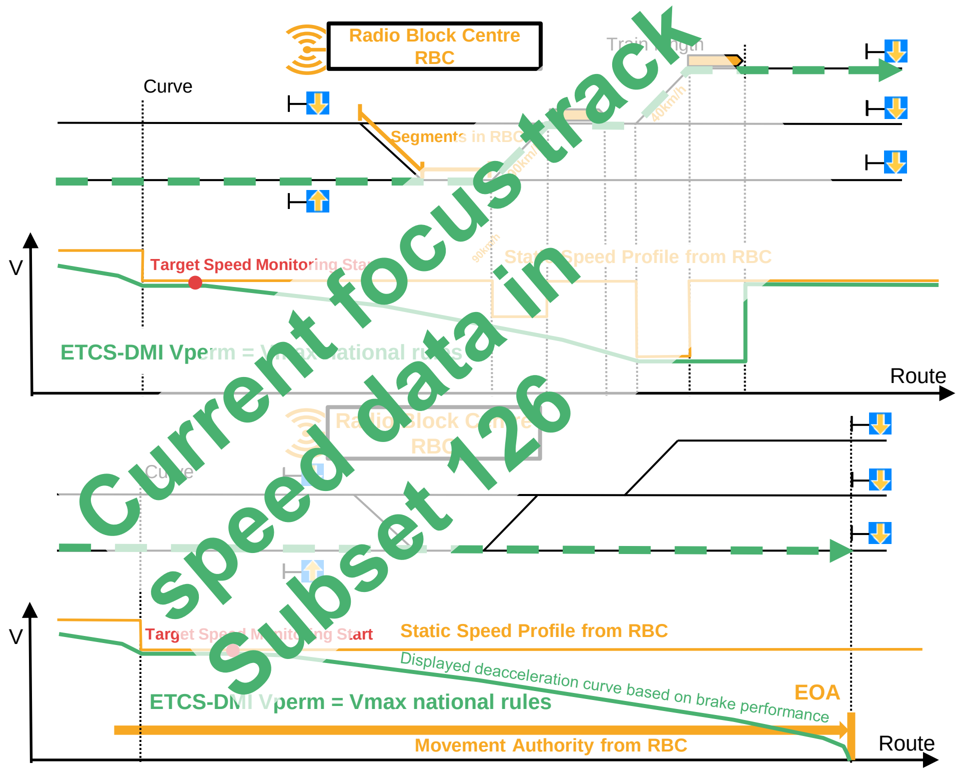
Lineside signalling Switzerland (ETCS L1 LS)

Close relationship between permitted line-speeds, signalled speeds, signal positions and vehicle braking performance (brake percentage):

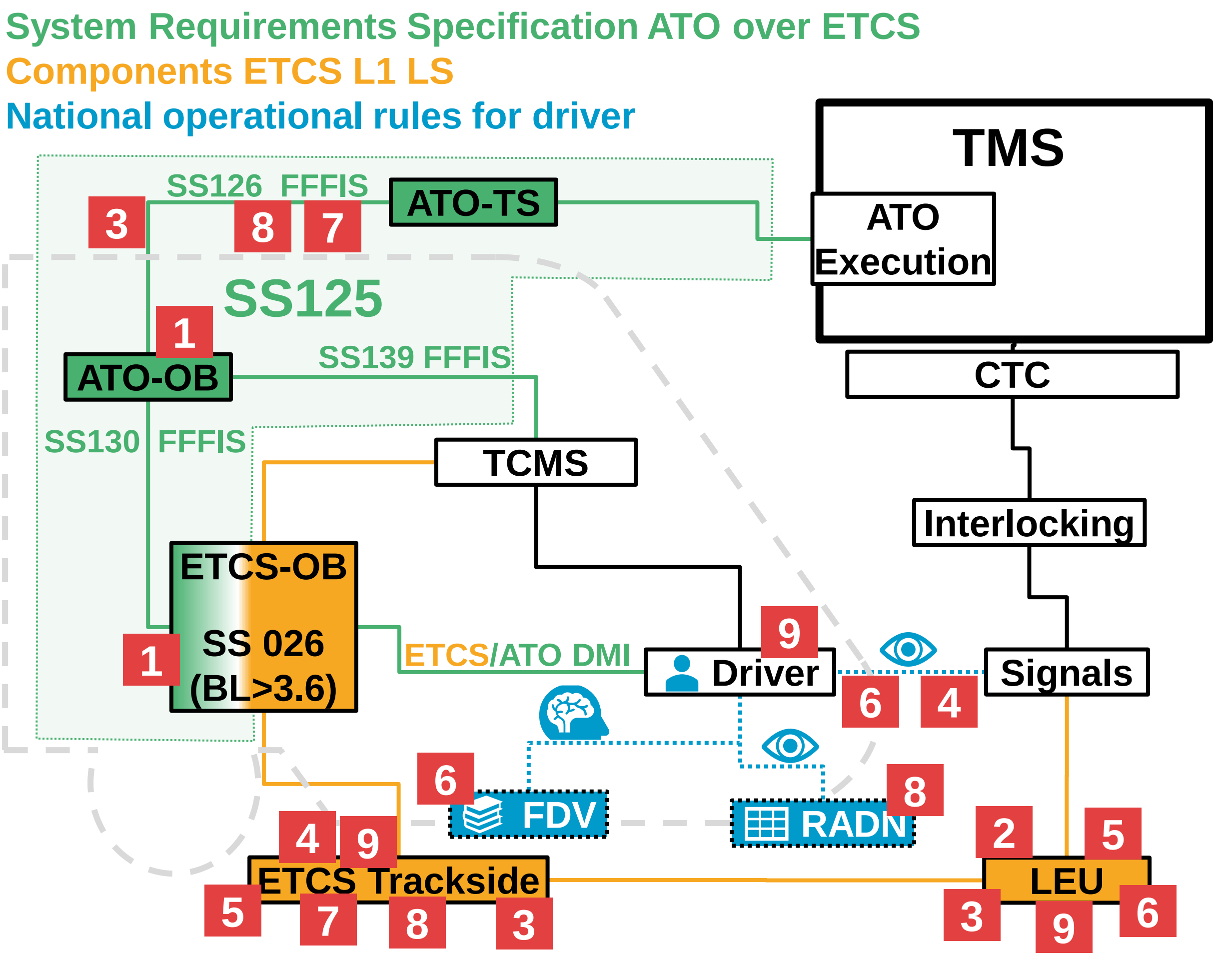


Cab signalling (ETCS L2 FS)

No relationship between projected static speeds, virtual positions signals (End of Movement Authority) and vehicle braking performance (brake percentage):



Conflicts ETCS L1LS with TSI drafts ATO over ETCS GoA2



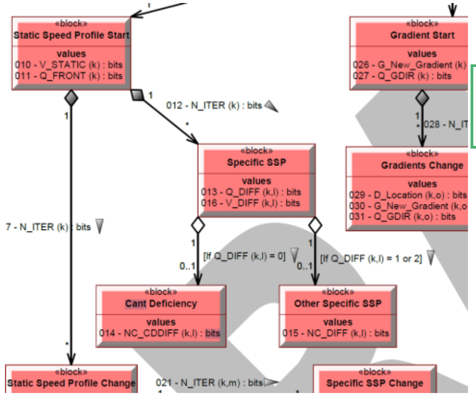
- One of the purposes of the SOB pilot project was to investigate the limits of the TSI drafts ERTMS/ATO on conventional lines with ETCS L1 LS.
- There are several conflicts.
- TSI 2022 with ATO only works on lines with ETCS Full Supervision and the not yet existing ETCS-OB Baseline >3.6 with ATO functions (AD-Mode, DMI, etc.)
- **SFERA can help to define a fast upward compatible solution for ATO as part of an efficient migration strategy to the target state full ERTMS-Rollout in Europe**

SS: Subset
FFFIS: Form Fit Function Interface Specification
FIS: Functional Interface Specification
RADN: route table with line speeds per train category
FDV: Fahrdienstvorschriften (national operational rules)

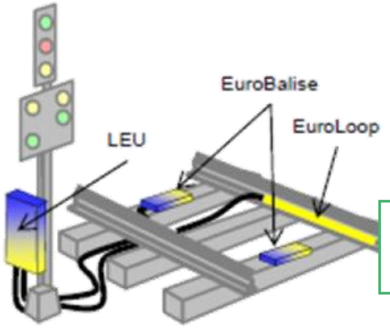
Current situation speed information for ATO and Potential SFERA

Current limits SOB ATO pilot project

Subset 126
Missing data elements for mapping signalling constraints and national train categories defining the line speeds



ETCS L1 LS (Subset 026 incl. Packet 44 EuroZUB)
Track inputs Static Speed Profile and Movement Authorities do not always the allowed speed according to national operating rules.
GoA1 task: background supervision danger points, no cab signalling



Possible ATO solution for lineside signalling

Replaced by

Still ATP for ATO

TMS

ATO-TS

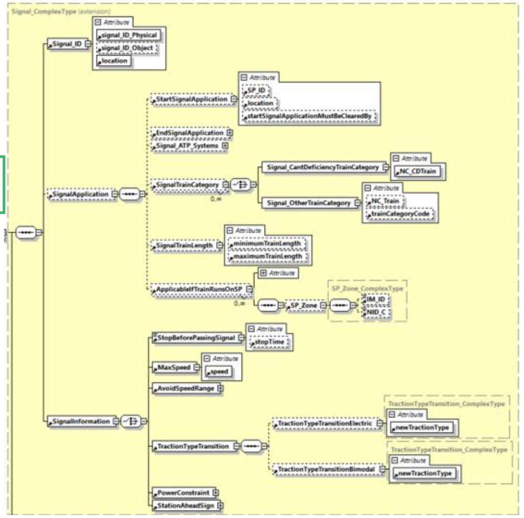
SFERA protocol

ATO-OB

Supervision & position data (read balises & odometry)

ETCS/ EuroZUB

SFERA
Transmission of correct line speed and signalled restrictions to ATO-OB according to swiss national rules. Based on real-time process data from the CTS/interlocking and topology data at level TMS

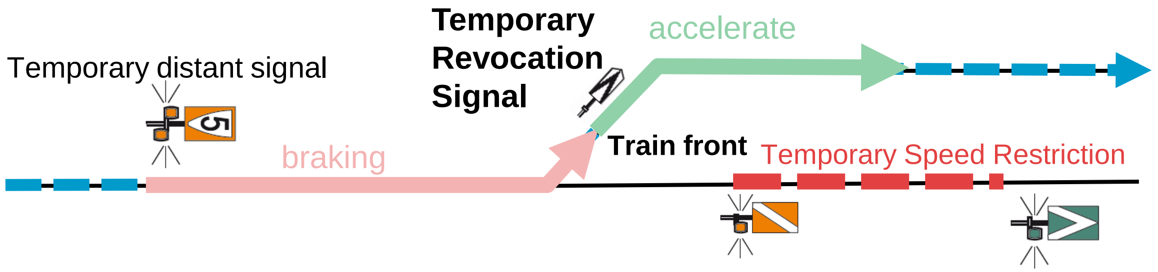


SOB contribution for the IRS 90940 Edition 2

Temporary slow-speed sections with logic lineside signals

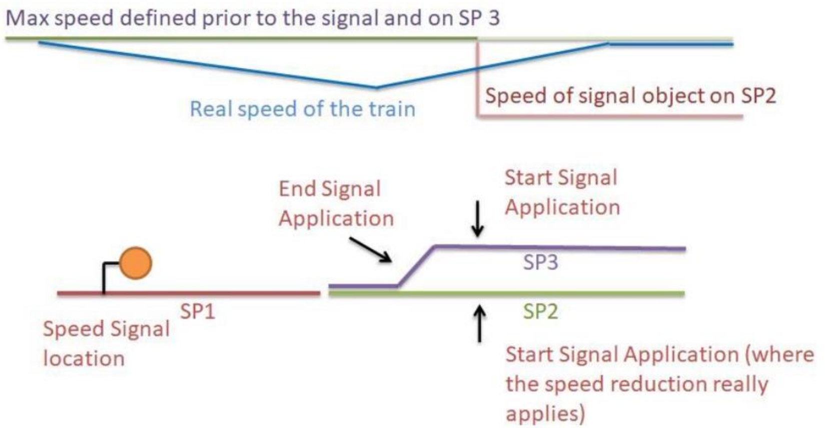
CR for modelling revocation signal at temporary speed restrictions (similar logic as Packet 66 from Subset 026 ERTMS/ETCS language):

Real world temporary signals and resulting operational rules or driver



SFERA-Handbook in Edition 2 extended the signal application rules for modelling the behaviour at revocation signal:

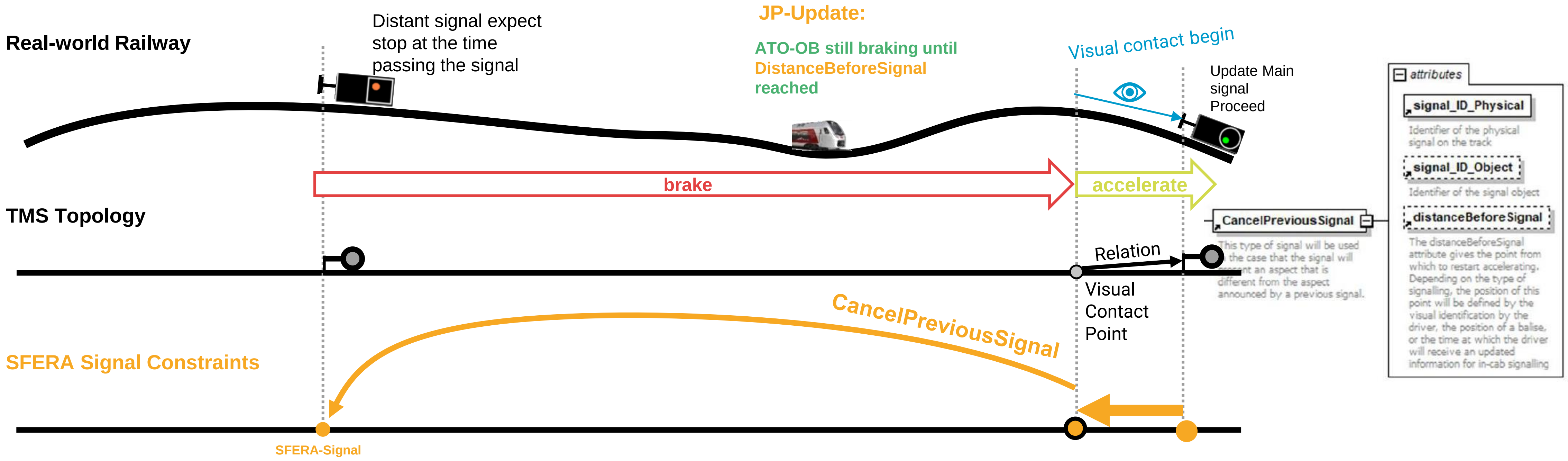
SRERA "digital world"



SOB contribution for the IRS 90940 Edition 2

Visual Contact Point

CR for modelling a signal update in relation to visual contact by the drive to the real-world signals. The proposed visual contact point is implemented in SFERA Edition 2 with "*CancelPreviousSignal*" under Signal Information, with a "*DistanceBeforeSignal*" attribute in meters (equals visual contact). Modelling in Switzerland is already possible at the TMS topology level



SOB SÜDOSTBAHN
gerade unterwegs

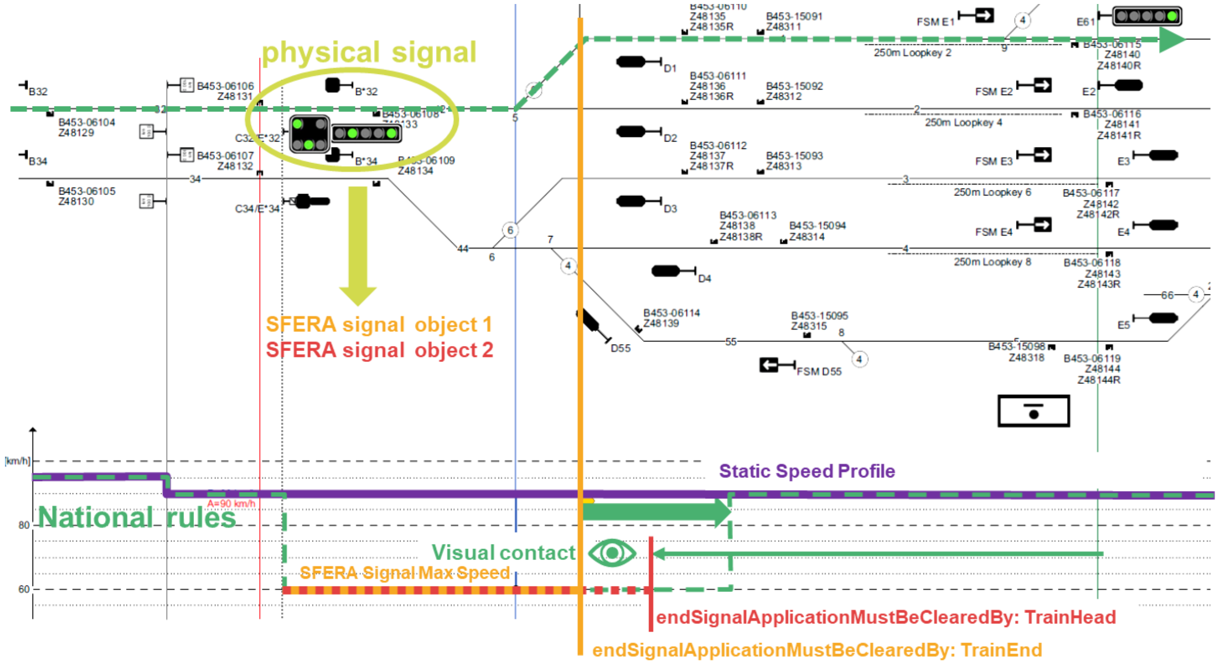
New insights the applicability of SFERA for ATO GoA2

Modeling the end of signaled speed restrictions with SFERA signal constraints according to Swiss national rules

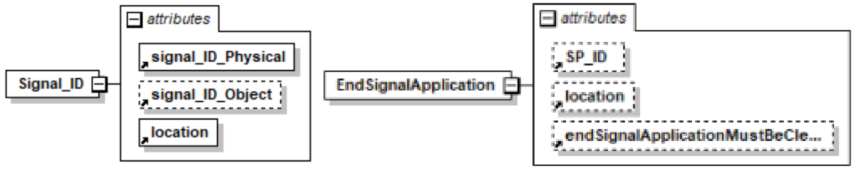
The determination of the end of a signalled speed limit has several criteria in Switzerland:

- length of the train
- switches in the route
- visual contact with the next signal

Specifying several SFERA signal objects per one physical signal makes modelling the individual conditions possible. The overlapping SFERA signal information complies with the swiss operating rules.



SFERA Elements:



New insights the applicability of SFERA for ATO GoA2

Challenge dealing with expected signal aspects in SFERA for optimization versus current aspects in the real world

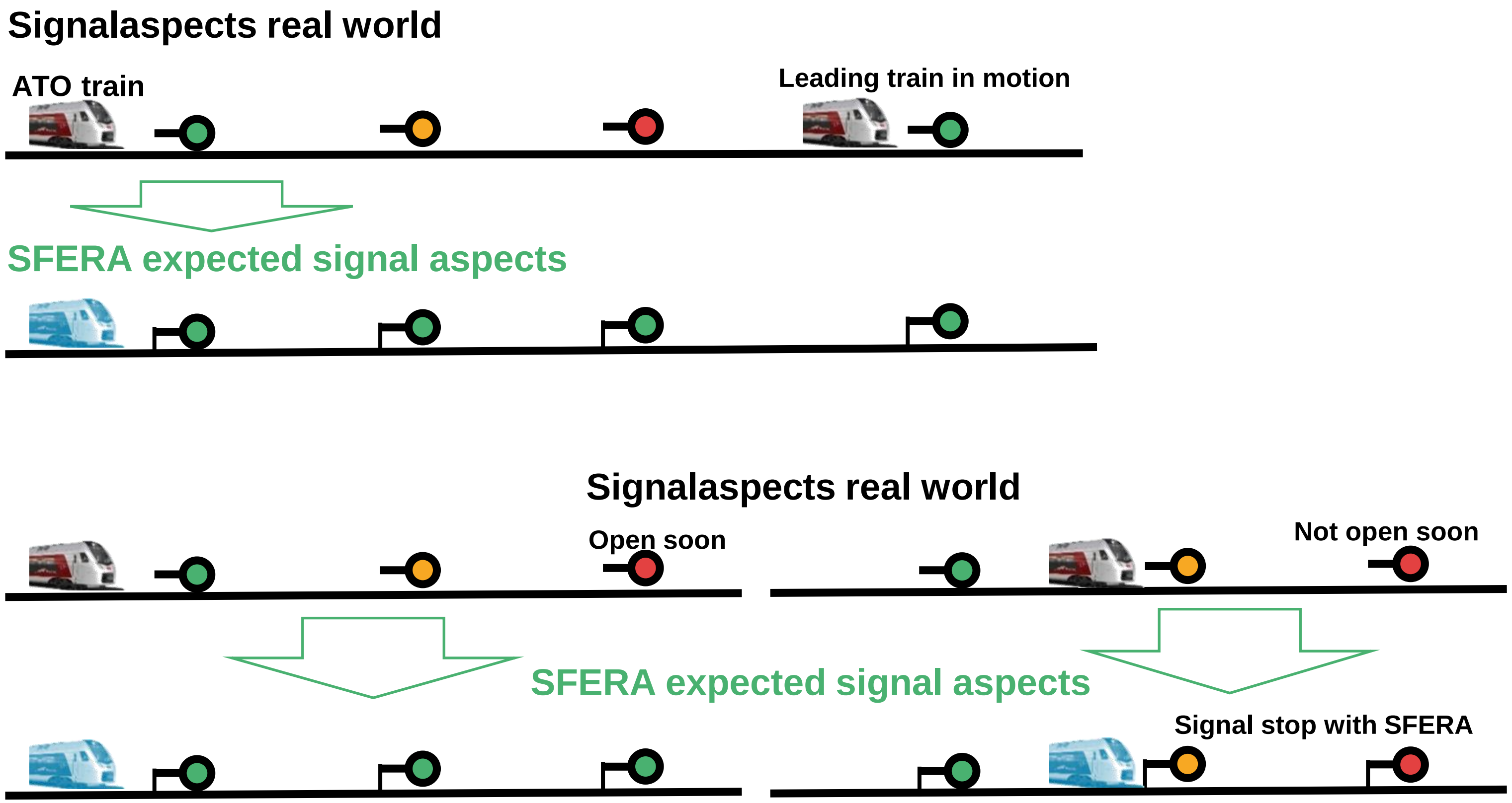
- The "Signal" elements in SFERA are meant to submit signal aspects that can be expected in the future . They are not used for submitting actual signal aspects to the train (can differ from the expected aspect). The purpose from SFERA is to deliver data for the optimization, not to be a cab signalling system.
- When running ATO GoA 2 with an ATP/ATC system with incomplete signalling information of the route (like ETCS L1 LS or Class B), the exact handling expected aspects in SFERA must be defined. At the latest, when passing the distant signal, the expected status must be the same as the actual status of the signal. Otherwise, this can lead to wrong behaviour of ATO or too fast speed advice in DAS-Mode.
- ATO should be able to stop with SFERA data before a red signal. However, SFERA is not a safety system; the driver must always observe the current lineside information (signals, speed boards etc.) and national operating rules. Perception technology for signal aspect detection could also help for more redundancy.
- An option would be to send the current states in addition to the expected ones (if TMS/ATO-TS has the information). A "status bit" open/closed would be sufficient for the current signal status. However, this would require an IRS 90940 change request. However, this is not absolutely necessary if TMS and ATO-TS handle SFERA correctly, especially with regard JP-Updates…

New insights the applicability of SFERA for ATO GoA2

Challenge dealing with expected signal aspects in SFERA for optimization versus current aspects in the real world

Possible handling of SFERA signal data (expected) so that optimization and real signal states for ATO are not in conflict:

The exact calculation of the expected state is a task of TMS using various data sources, including the control system interlocking real-time data, train position and forecast.



Conclusion & outlook

- SFERA Edition 2 already provides a good communication protocol for ATO GoA2 or C-DAS-O on Swiss lines with lineside signals. The “digital” modeling of analog lineside signals and resulting speed limits in compliance with operational rules is possible.
- SFERA allows upward compatibility to ERTMS/ATO once a rail line and running trains are equipped with ETCS Cab Signalling.
- SOB remains an active member of the SFERA User group and will continue to provide experiences, opinions and ideas for future releases.
- Joint between SFERA and X2Rail is good development in the standardization of communication protocols between trackside and onboard applications.
- Coordinated ATO GoA 2 and DAS solutions for legacy lines make sense. SOB can share experience for this task.

SÜDOSTBAHN
gerade unterwegs

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DAS / SFERA Ed.2
In-Person Workshop

Connected Driver Advice System [C-DAS]
Peak Power Demand [PPD]

Robert Yee

10th October 2022

UIC Paris

C-DAS

INTRO

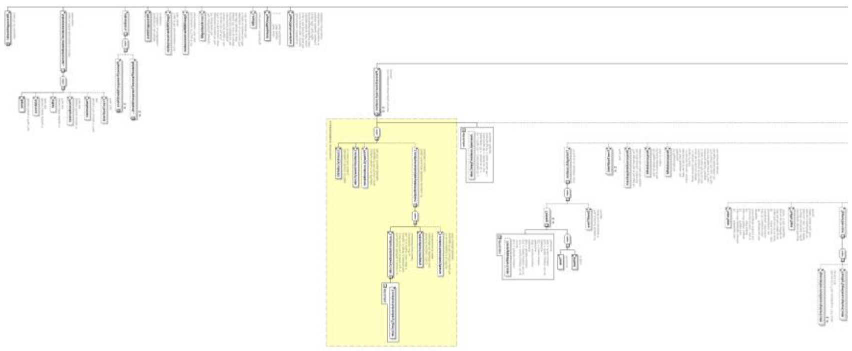
- TM [or information] the catalyst, DAS the enabler
- Ad-hoc timing changes can be efficiently communicated to the driver for execution (i.e. info. reach). The two-way flow of information, DAS to TM (i.e. info richness).
- Industry commissioned C-DAS PoC, S-DAS trains delayed on average 6%. After C-DAS advice “intervention” this dropped to 1.6%. Sample size 1300 trains, 4 weeks
- Realistically 30-50% of delays can be mitigated

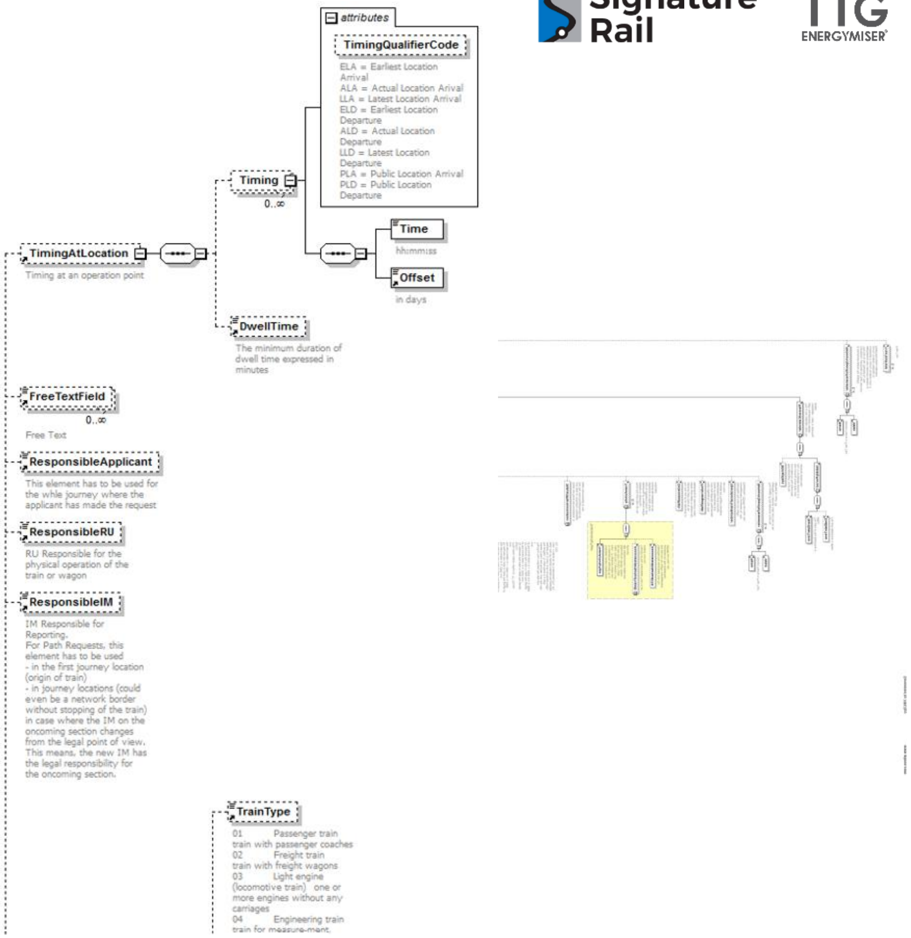
CDAS - Layered INformation eXchange [LINX]

- Infrastructure Manager’s [IM] unified message hub to enable data to be exchanged between various TMS and IM’s conventional systems + external systems [national timetables, stock & crew, PIS]
- Reliable, real-time data from 3rd party TM

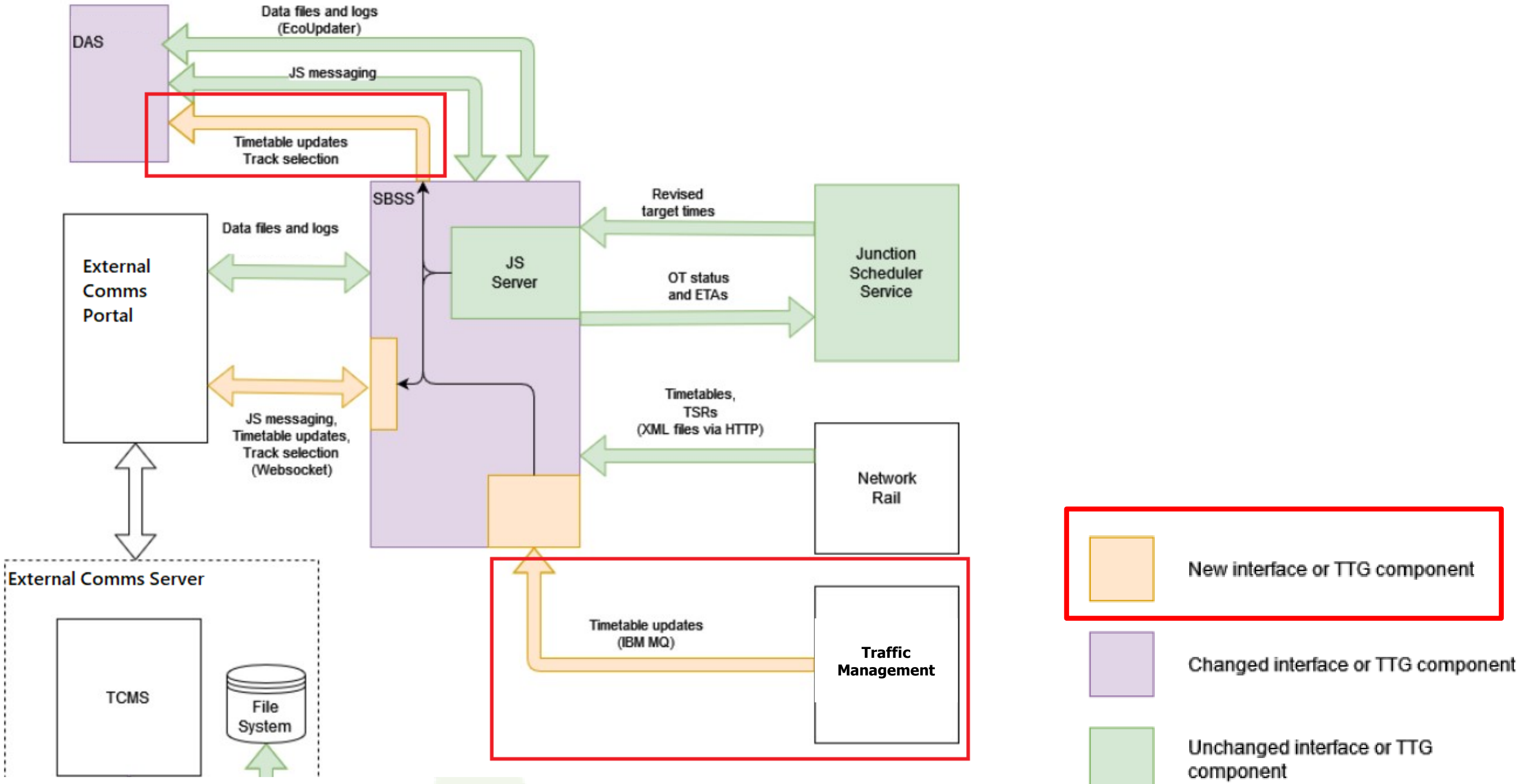
CDAS - Packet Structure

SAMPLE





CDAS - SCHEMATIC



CDAS - 5 LEVELS OF INTERVENTION

CURRENT VERSION

- Four TM real-time/operational
  1. Route Diversion
  2. Stopping Pattern change
  3. Scheduled Timing change
  4. Junction-Scheduler™ #3 timing change but not TM, fully automated
- One TM pre-trip
  - Very Short Term Plan changes. Timetables added < 48h

CDAS – PILOT

SUMMARY

- Proof of Technology Pilot of Connected DAS
- Operator is a long term TTG S-DAS/N-DAS partner
  - Inter-urban EMUs, Dedicated C-DAS test trains
  - Several days, multiple headcodes
- Next stage is cross platform s/w integration into TMS
- Following ex. is a Line Change

CDAS LINE CHANGE

ORIGINAL TIMETABLE & CDAS UPDATE

- Four tracks in the test section; UML, URL, DML, DRL
- Test train-section was booked on Up Main Line.

Cholsey	09:38:00	09:38:00	30	RL
Goring & Streatley	09:42:30	09:42:30	30	RL
Pangbourne	09:46:30	09:46:30	30	RL
Tilehurst	09:50:30	09:50:30	30	RL
Reading West Jn	09:53:30	09:53:30	0	FVL
Reading High Level Jn	09:55:00	09:55:00	0	FVL
Reading	10:06:00	10:06:00	720	DML
Kennet Bridge Jn	10:20:30	10:20:30	0	ML
Twyford West	10:23:30	10:23:30	0	RL
Twyford	10:24:30	10:24:30	0	RL
Ruscombe	10:25:30	10:25:30	0	ML
Maidenhead	10:29:00	10:29:00	0	ML
Slough	10:33:00	10:33:00	0	ML
West Drayton	10:38:00	10:38:00	30	ML
Stockley Junction	10:40:00	10:40:00	0	ML
Heathrow Airport Jn	10:40:30	10:40:30	0	ML

Raw timetable - in the CDAS until 09:47:33 [near Pangbourne]

CDAS LINE CHANGE

JOURNEY LOG EXTRACT

[TRC]	20220831 09:47:30	EcoDriver.	-1.100335	-1.10044										
[JRNYDAT/	20220831 09:47:31	18.798	20220831	201	31	76	33	1				1	51.48839	-1.10023
[TRC]	20220831 09:47:31	Approachi	09:47:31	18798.3	8.65038		Pangbourn	387 4 Car	09:48:40					
[TRC]	20220831 09:47:31	Approachi	09:47:31	18798.3	8.65038		Pangbourn	387 4 Car	09:48:40					
[TRC]	20220831 09:47:31	Approachi	09:47:31	18798.3	8.65038		Pangbourn	387 4 Car	09:48:40					
[TRC]	20220831 09:47:31	EcoDriver.	-1.100234	-1.10034										
[JRNYDAT/	20220831 09:47:32	18.813	20220831	201	31	76	37	1				1	51.48835	-1.10013
[TRC]	20220831 09:47:32	Approachi	09:47:32	18813.4	8.50222		Pangbourn	387 4 Car	09:48:40					
[TRC]	20220831 09:47:32	Approachi	09:47:32	18813.4	8.50222		Pangbourn	387 4 Car	09:48:40					
[TRC]	20220831 09:47:32	Approachi	09:47:32	18813.4	8.50222		Pangbourn	387 4 Car	09:48:40					
[TRC]	20220831 09:47:32	EcoDriver.	-1.100132	-1.10023										
[JRNYDAT/	20220831 09:47:33	18.822	20220831	201	31	76	39	1				1	51.48831	-1.10003
[TRC]	20220831 09:47:33	Approachi	09:47:33	18822.2	8.63443		Pangbourn	387 4 Car	09:48:40					
[TRC]	20220831 09:47:33	Approachi	09:47:33	18822.2	8.63443		Pangbourn	387 4 Car	09:48:40					
[TRC]	20220831 09:47:33	Approachi	09:47:33	18822.2	8.63443		Pangbourn	387 4 Car	09:48:40					
[MSG]	20220831 09:47:33	Application trigger update journey because of : Timetable update												
[TRC]	20220831 09:47:33	EcoDriver.	-1.100025	-1.10013										
[MSG]	20													
[ROUTEID]														
[ROUTESE	ZZ													
[INFO]	20220831 09:47:35	18.831	Overlapping speed limit 137 at 78.739 kms. Applying speed limit 161											
[INFO]	20220831 09:47:35	18.831	Overlapping speed limit 137 at 79.142 kms. Applying speed limit 161											
[TRC]	20220831 09:47:35	TSRs are same												
[ERROR]	20220831 09:47:35	18.831	-1	TT	Unable to find details of Didcot West End.Removing it from the timetable.									
[TTID]	1824743													
[TTMODE]	Timetable													

© ROUTE DIVERSION

CDAS LINE CHANGE

JOURNEY LOG EXTRACT – UPDATED PATH

TT before change

Cholsey	09:38:00	09:38:00	30	RL
Goring & Streatley	09:42:30	09:42:30	30	RL
Pangbourne	09:46:30	09:46:30	30	RL
Tilehurst	09:50:30	09:50:30	30	RL
Reading West Jn	09:53:30	09:53:30	0	FVL
Reading High Level Jr	09:55:00	09:55:00	0	FVL
Reading	10:06:00	10:06:00	720	DML
Kennet Bridge Jn	10:20:30	10:20:30	0	ML
Twyford West	10:23:30	10:23:30	0	RL
Twyford	10:24:30	10:24:30	0	RL
Ruscombe	10:25:30	10:25:30	0	ML
Maidenhead	10:29:00	10:29:00	0	ML
Slough	10:33:00	10:33:00	0	ML
West Drayton	10:38:00	10:38:00	30	ML
Stockley Junction	10:40:00	10:40:00	0	ML
Heathrow Airport Jn	10:40:30	10:40:30	0	ML

TT after change

Cholsey	09:38:00	09:38:00	30	
Goring & Streatley	09:42:30	09:42:30	30	RL
Pangbourne	09:46:30	09:46:30	30	
Tilehurst	09:50:30	09:50:30	30	RL
Reading West Jn	09:53:30	09:53:30	0	FVL
Reading High Level Jn	09:55:00	09:55:00	0	FVL
Reading	10:06:00	10:06:00	720	DML
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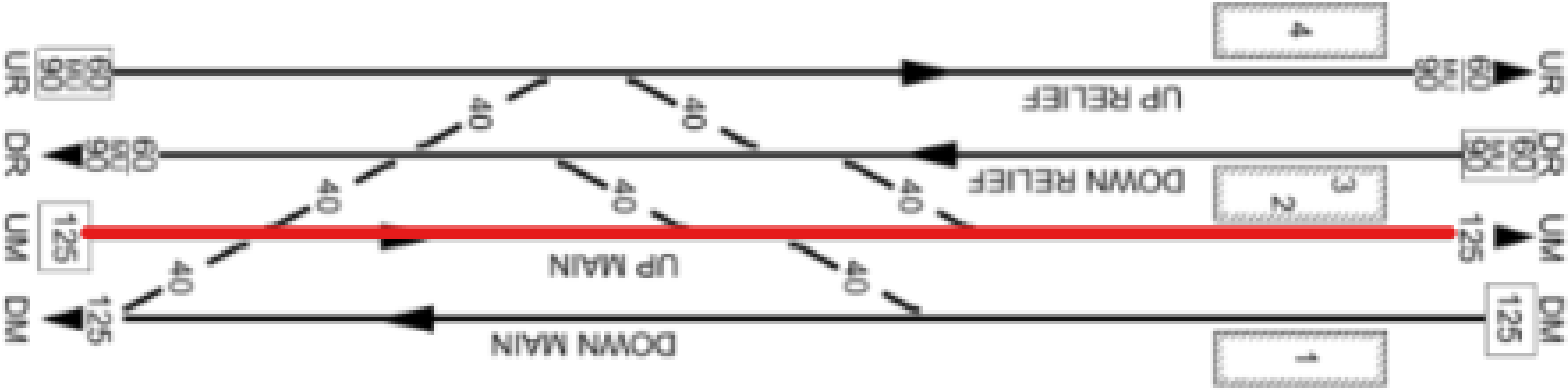
Twyford West	10:23:30	10:23:30	0	RL
Twyford	10:24:30	10:24:30	0	RL
Ruscombe	10:25:30	10:25:30	0	ML
Maidenhead	10:29:00	10:29:00	0	ML
Slough	10:33:00	10:33:00	30	ML
Dolphin Jn	10:34:00	10:34:00	0	RL
Langley	10:35:00	10:35:00	0	RL
Iver	10:36:30	10:36:30	0	RL
West Drayton	10:38:00	10:38:00	30	RL
Stockley Junction	10:40:00	10:40:00	0	ML
Heathrow Airport Jn	10:40:30	10:40:30	0	ML

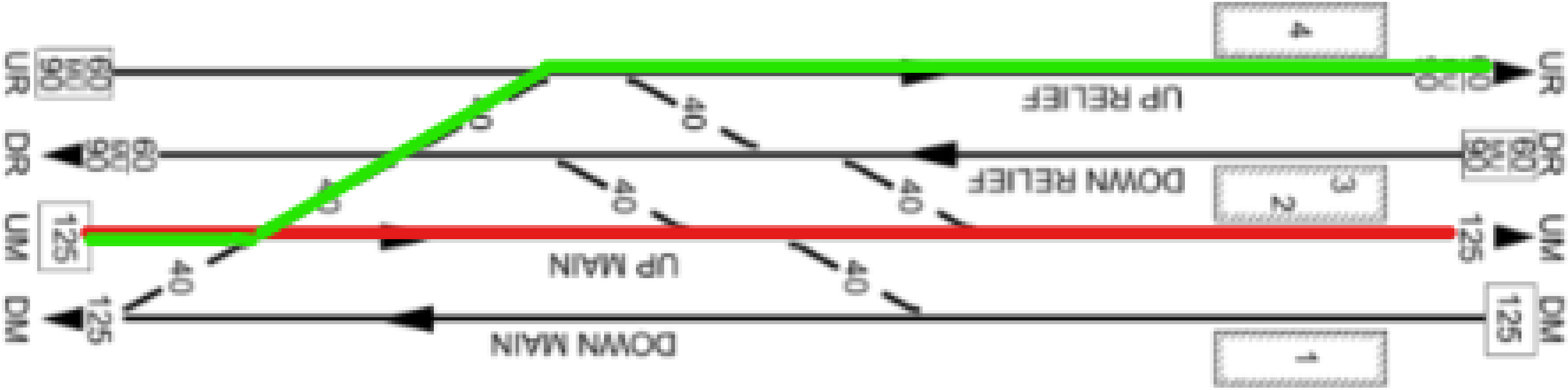
CDAS LINE CHANGE

PATH BEFORE CHANGE



CDAS LINE CHANGE

ACTUAL TEST TRAIN GPS PATH



CDAS PILOT

- We were also able to successfully;
  - Add and remove station stops during a trip
  - Adjust scheduled timings during a trip
  - Inject new short-term timetables
  - Cancel trains
- What next?
  - Peak Power Demand
  - Broadcast messages / Degraded running
  - Real-time feedback loop

PEAK POWER DEMAND

RESEARCH SUPPORT

- Purpose of this study to investigate **the use of DAS** to reduce TGV tractive power during known Peak Power Demand [PPD] periods.
- Peak production of power [intermittent] is both environmentally unfriendly and cost ineffective.
- These PPD periods only occur on certain days for limited times. During these balancing periods the power draw of the fleet can be reduced by a pre-defined target.

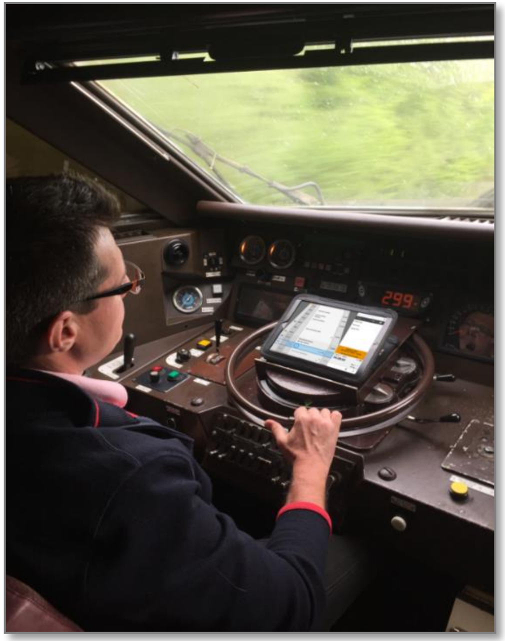
PEAK POWER DEMAND

CONTEXT OF STUDY

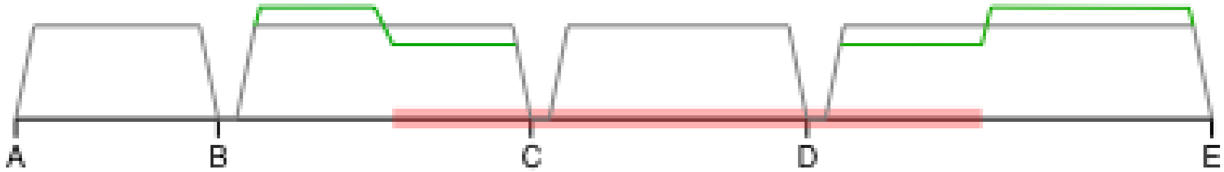
Three Phased Study

1. Feasibility & manual calculations
2. Optimisation algorithm developed

   Simulation 100+ headcodes
3. On-board trials, Enhanced Algorithm



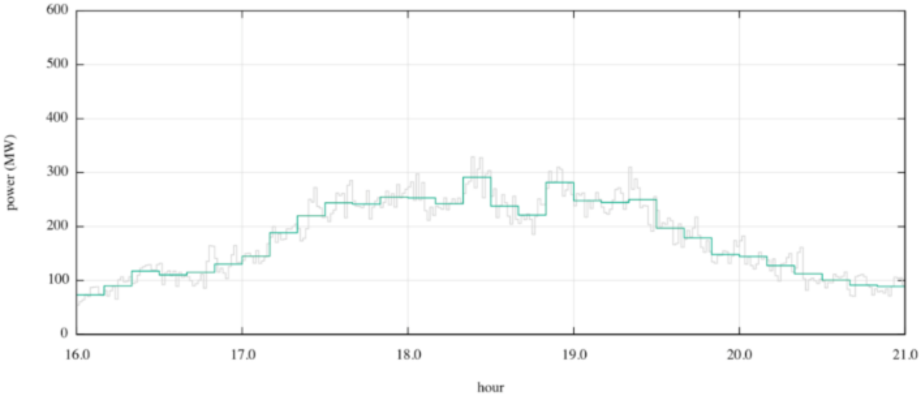
PPD 1. FEASIBILITY

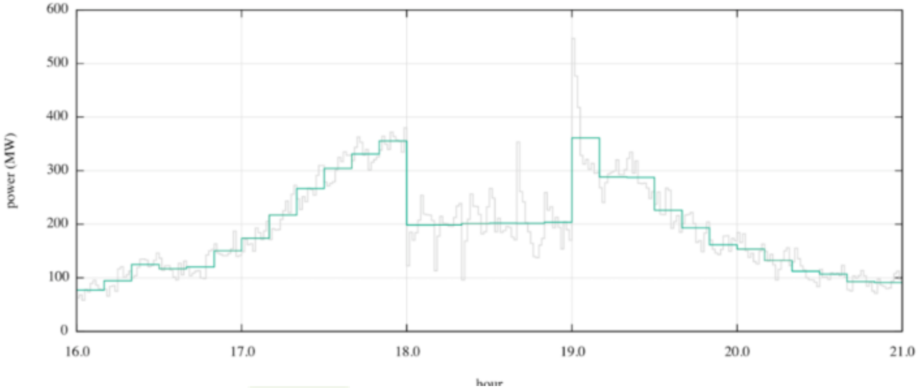


- Our approach doesn't require modification of the Energymiser/Opticonduite algorithm.
- Only the timings are modified - so this approach is easier to implement.

PPD 2. ALGORITHM & SIMULATIONS

BEFORE & AFTER PPD



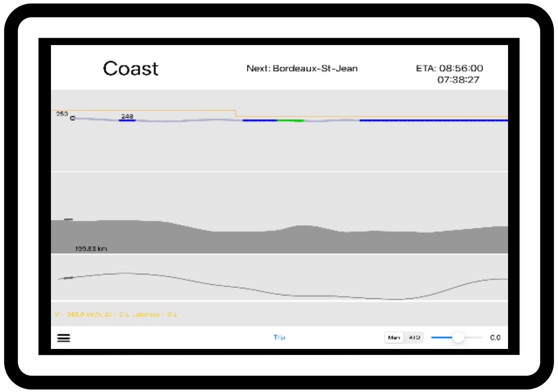


PPD 3. TRIALS w. ENHANCED ALGORITHM

S/W & H/W ONBOARD

Laptop mimicking PPD Server

DAS Tablet

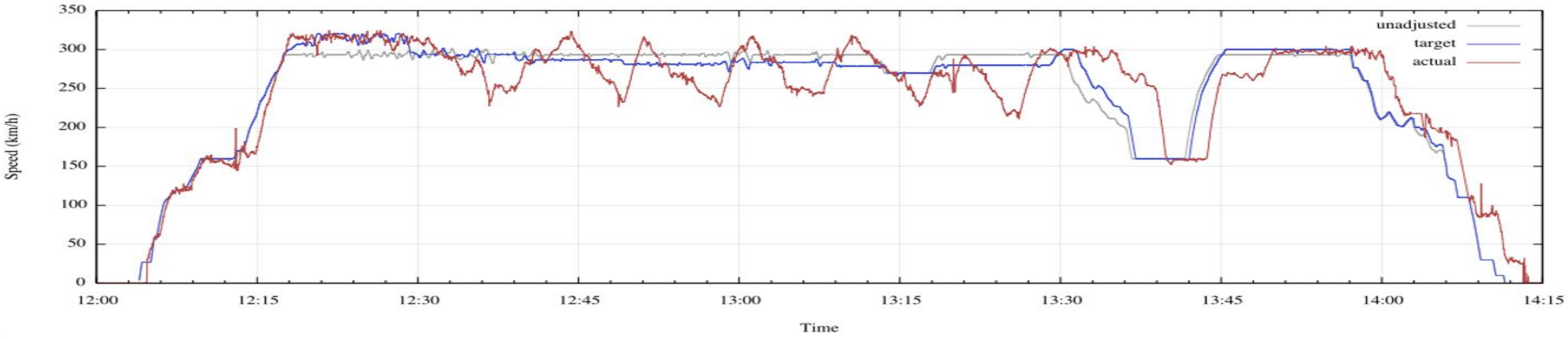


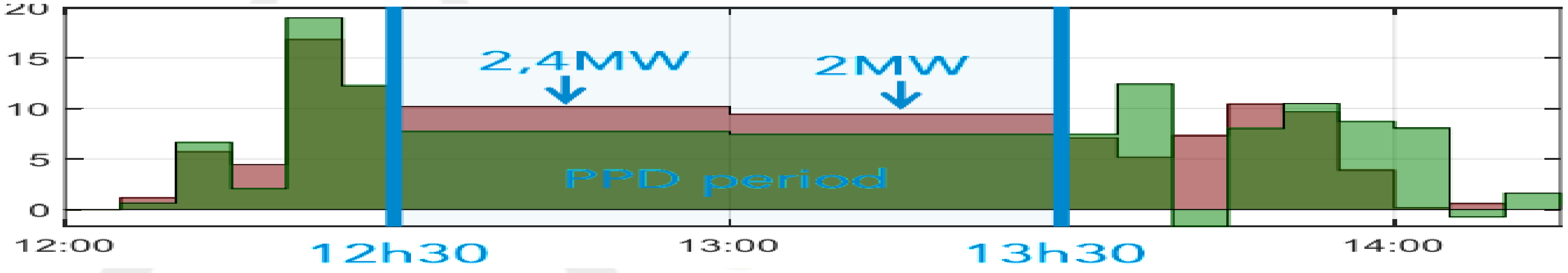
Ad-hoc WiFi network

- Feedback information on how to achieve peak power optimisation
- Re-calculate timing points

- Driver follows advice – injected with PPD timings, which are updated from the PPD Server

PPD TRIALS





~2.2 MWh energy saved during PPD

Thank You!

Signature Rail

TTG ENERGYMISER

SFERA IMPLEMENTATIONS:

PRORAIL/NS

Pim Sierhuis (Prorail – Pim.Sierhuis@proail.nl) / Theo Vis (NS - Theo.Vis@ns.nl)

Status

- Working SFERA service
    - Journey Profiles
    - Segment Profiles
    - Related Trains


```xml
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<SFERA_G2B_EventMessage>
    <MessageHeader SFERA_version="2.00" message_ID="6e76025b-6134-476f-b767-476d7271e9ff" timestamp="2022-10-09T09:18:54Z" sourceDevice='
        <Sender>0084</Sender>
        <Recipient>1084</Recipient>
    </MessageHeader>
    <G2B_EventPayload>
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                </SP_Zone>
                <TimingPointConstraints TP_StopSkipPass="Stopping_Point" TP_Information="None">
                    <TimingPointReference>
                        <StoppingZoneReference identifier="Ut_4_SINGLE"/>
                    </TimingPointReference>
                    <StoppingPointInformation departureTime="2022-10-09T05:50:00Z"/>
                </TimingPointConstraints>
            </SegmentProfileList>
            <SegmentProfileList SP_VersionMajor="1" SP_VersionMinor="1665152164" SP_Direction="Nominal" SP_ID="531_2575L_34.6_T">
                <SP_Zone>
                    <IM_ID>0084</IM_ID>
                </SP_Zone>
            </SegmentProfileList>
            <SegmentProfileList SP_VersionMajor="1" SP_VersionMinor="1665152164" SP_Direction="Nominal" SP_ID="531_2571P_34.6_T">
                <SP_Zone>
```
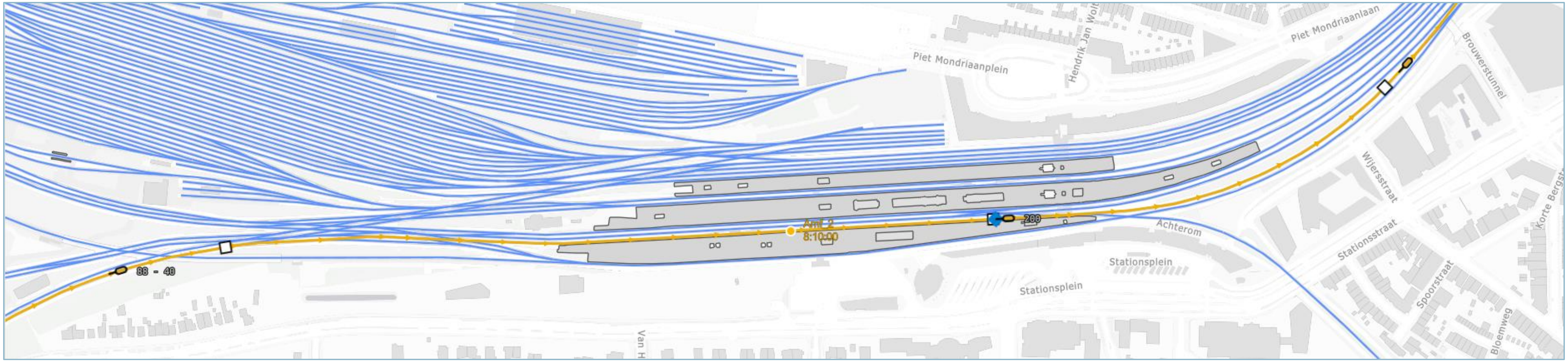




Dutch specifics and challenges

- Infra data: two models - schematic and geographic
    - Geographic data not always uptodate
    - Mitigated, but not perfect yet
    - Feedback loop by working system

- Simplified technical interface
    - Websockets for Journey Profiles and Related Trains
    - REST calls for Segment Profiles

- Some specials for the Netherlands
    - No real TMS that calculates conflict-free traffic plans
    - Algorithm for stopping point locations
    - ... see our documentation

Approach

- Incremental approach
- Work on problems that are actually there
- Together
- Open mentality

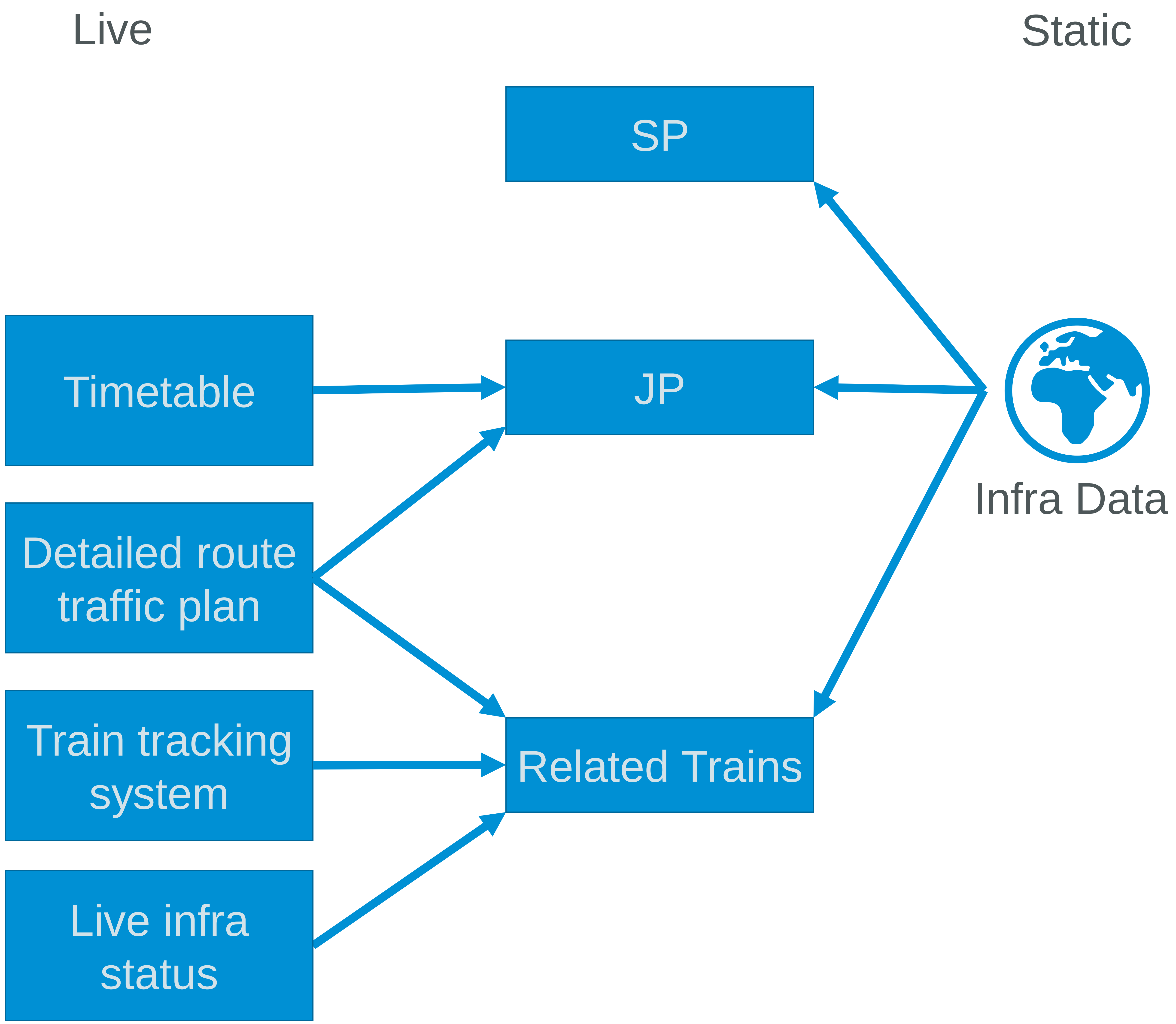
Working systems are the only real measure of progress

Call for participation

- So we'd like to develop our systems further in collaboration with you!
  - Are we on the right track?
  - What other data would you like?
  - We prepared sample data (JP's, SP's, RT's) from our systems: send me an e-mail at pim.sierhuis@prorail.nl

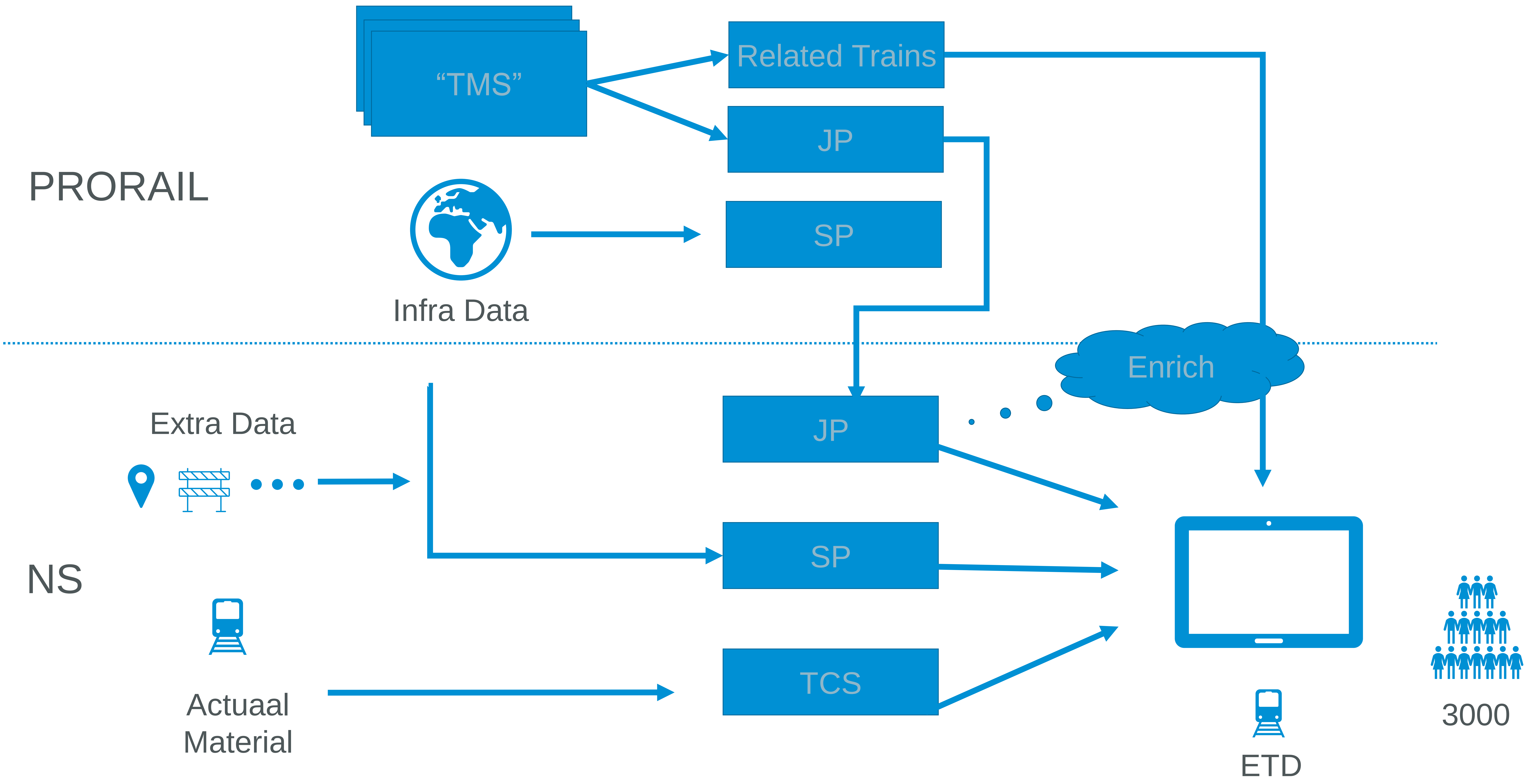
- Come visit our stand at the fair
  - Demo's with live data
  - Discuss details of data

Data sources

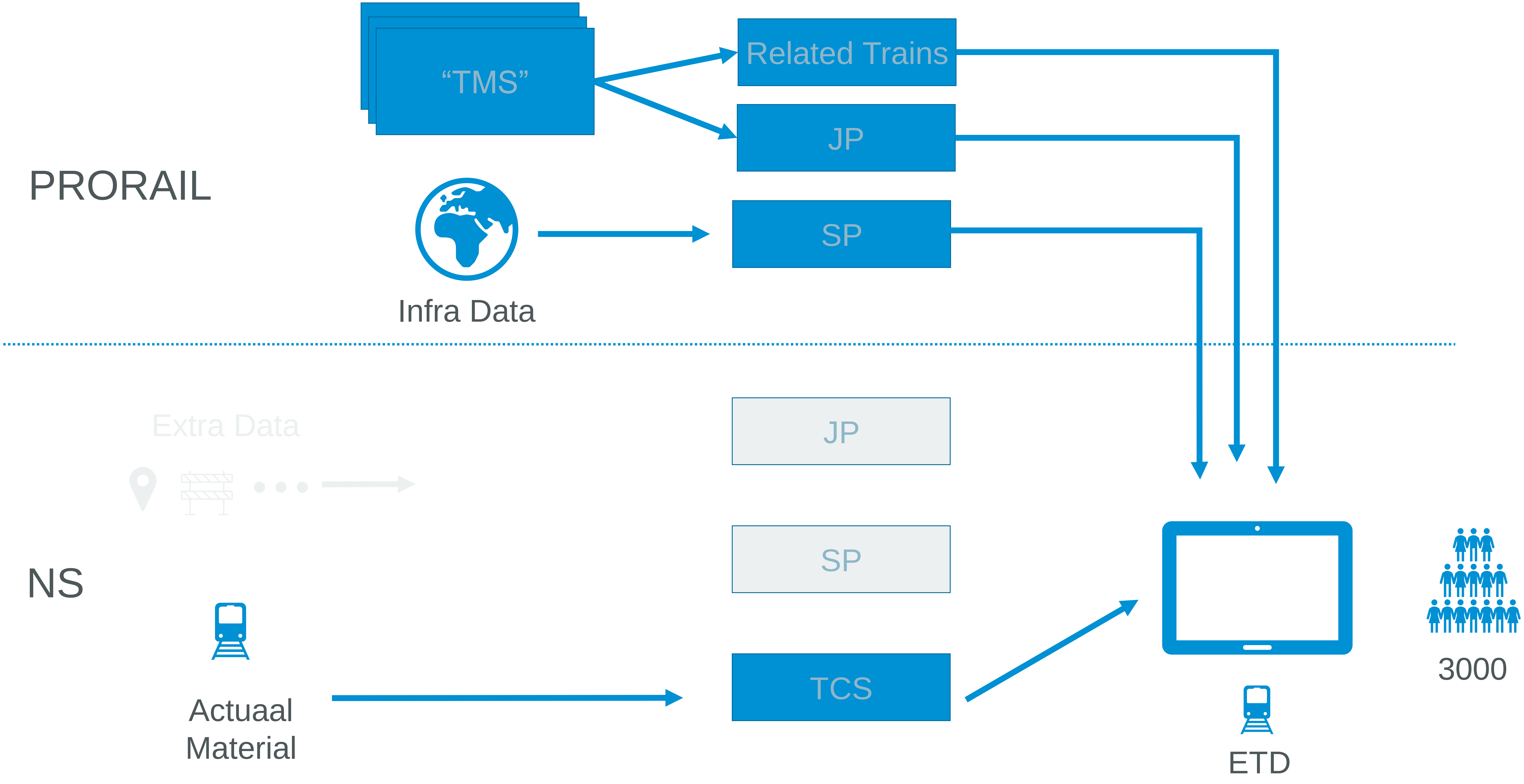


- JP's and RT's are live updated
- SP's are a static representation of the infrastructure
- Two levels of planning, with their own data services that need to be combined to a JP
- Only Related Trains use live train positions and infra status (switch positions etc)

CURRENT SFERA Implementation @ The Netherlands

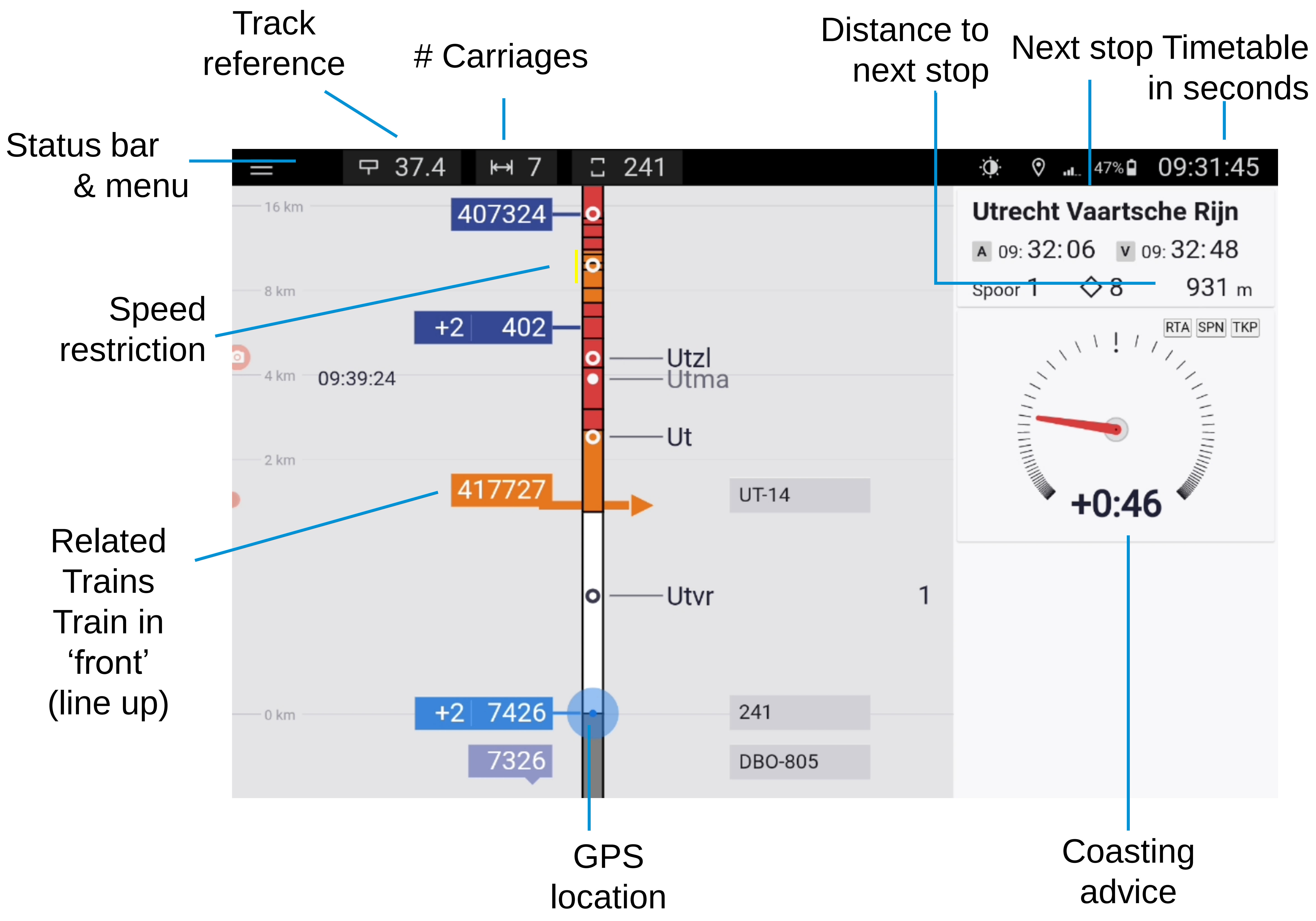


NEXT STEPS

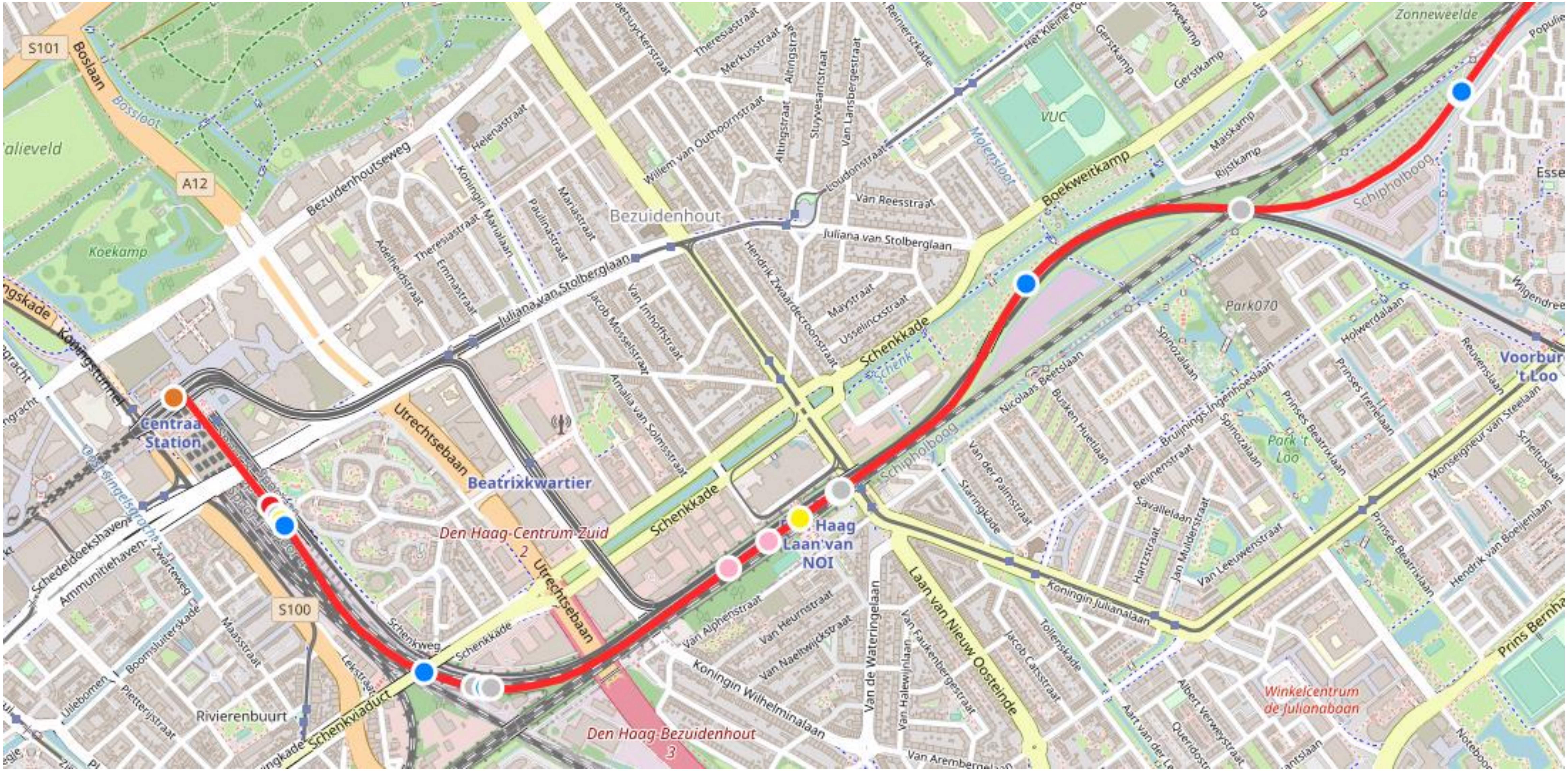


"TMS"
Related Trains
JP
SP
PRORAIL
Infra Data
Extra Data
JP
SP
NS
Actuaal
Material
TCS
ETD
3000

How does it look



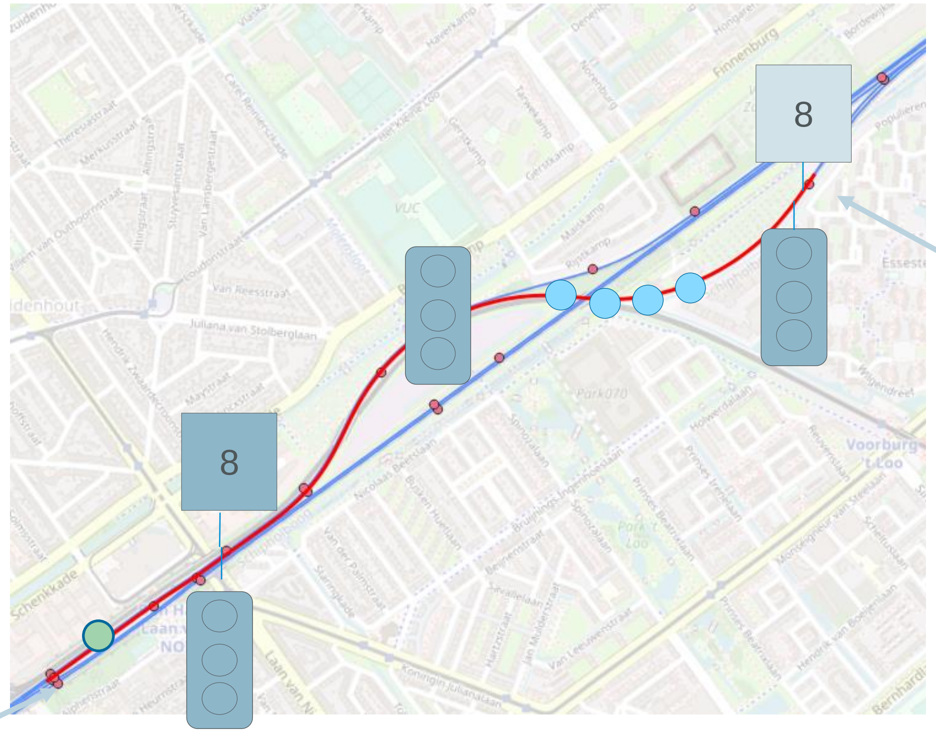
- Easier to interpret
- Information in the relevant position
- Better insight into actual situation
- Allows for additional future functionality, i.e. TSB, safety designations,
- Drivers can better anticipate upcoming situations and act accordingly
- Increased safety & punctuality, cost savings
- Android Tablet and Electronic Time Display (Build in)



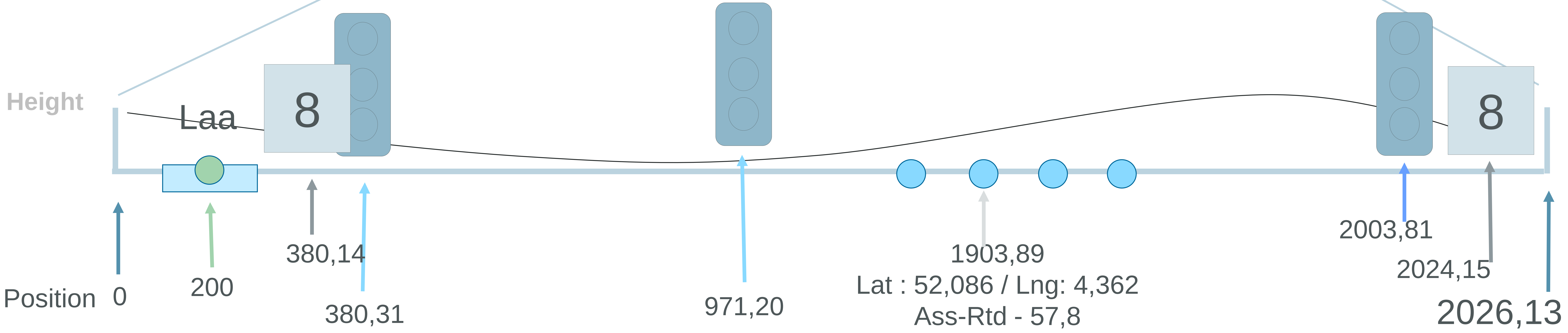
Centraal Station
Bezuidenhout
Beatrixkwartier
Den Haag Centrum-Zuid
Den Haag Laan van NOI
Den Haag Bezuidenhout
Park070
Voorburg 't Loo
Winkelcentrum de Julianaboan
Rivierenbuurt
Koekamp
Zonneweelde
VUC
Schenkkade
Boekweitkamp
Utrechtsebaan
Laan van Nieuw Oosteinde
Schenkviaduct
Juliana van Stolberglaan
Bezuidenhoutseweg
Koningin Julianalaan
Koningin Wilhelminalaan
A12
S100
S101

Example Segment Profile

Outside World



In data

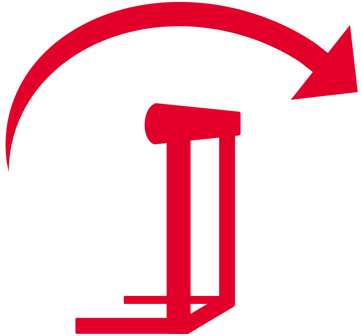


Status ÖBB SFERA implementation

ÖBB / UIC-SFERA Group

From Status Quo to AZL Next Level (AZL NL)

ÖBB INFRA



AZL NL – AZL Next Level

- Further development of the AZL contents as well as implementation of an independent driving time calculation

AZL – Adaptive Zuglenkung

- Development and implementation of a KE/KL, an extended forecast calculation, distribution logic / data transmission as well as visualization
- Connection of TRAKSYS with operation-optimized route construction

AZL preliminary stage – Driving recommendation with Text SMS

- First implementation of a driving recommendation with output via the train radio
Implementation and output of INFO - SMS via the train radio

Objective of today`s appointment:

To show the contents and effect of the SFERA interface, as well as KE/KL[1] planned in the TMS[2] including the extended forecast calculation (first step) as well as the independent travel time calculation (second step).

(1) Konflikterkennung/Konfliktlösung
(2) Traffic Management System

Agenda

Today`s Stand

Forecast in ARAMIS-ZWL based on reduction potential[1]	Manual conflict detection & resolution at the TMS	Text-SMS

Forcast based on reduction potential

The current forecast uses stored reduction potentials (travel and stop time reserves). It does not consider the infrastructure used and the actual vehicle characteristics.

(1) Taken from train planning tool

To achieve the goals AZL NL is a necessary intermediate step in AZL

Prospect

Driving recommendations to be displayed

KE /KL Phase 1

AZL

ANL

Sophisticated **implementation of the (fully) automatic KE/KL**

Extensive **implementation of the FZR[1] component** (including linear optimization)

(1) Driving time calculator

Intermediate step within the framework of the AZL

Adaptive Zuglenkung

ARAMIS-ZWL based on the extended forecast	Partially automated conflict detection & resolution at the TMS[1]	(Operation-optimized) driving recommendations[2]

Advanced forecasting at the TMS[3]

(1) KE/KL phase 1 if possible, incl. consideration of aS/ISBE
(2) Based on extended forecast calculation
(3) Based on program code that is not yet released in ÖBB-TMS

Advanced forecasting at the TMS

extended forecast calculation at the TMS

Infrastructure basis: Extended track plan node model at the TMS

(Vehicle) database: Rolling stock stored at the TMS (enriched with data from TRAKSYS and FZ-database)

Calculation basis: Specified constraint points must be "hit" by capping the maximum speed

The specific extension of the track plan node model as well as the aggregation of the rolling stock are also needed for the stand-alone FZR component.

Activation of the TMS internal "Advanced Forecasting".

Basic travel time calculation is fit, further fine tuning necessary.

The calculated speeds (in the train running profile) can be used for a driving recommendation calculation.

All dispositive measures with effect on the FZR must be considered.

- TMS-internal travel time calculation based on the stored infrastructure and vehicle data.
- Along a route different (passage) times have to be met.
- Determination of the "suitable" speed is done iteratively.

Not shown, but necessary for AZL NL:

- Consideration of influences from train protection systems
- Calculation of ATO Journey Profiles

Target image AZL NL

Expansion of operational management systems

Digitalisation & creation of driving recommendations

Adaptive Zuglenkung (Next Level)

Calculation at the TMS on the basis of an accurate FZR	Automated conflict detection & resolution at the TMS[1]	(Contents from the Departure Timetable project)	Operating and energy-optimised driving recommendations (FE)

Driving time calculation (FZR) on uniform data stock

Departure timetable is an independent project - content and elaborations are used at ANL

(1) Including interaction between journey and occupancy accounting at the TMS

Agenda

Possible calculation methods of the stand-alone FZR component

Method	How it works	Possible use
Technical / control driving time	Extending the restrictive speed profile taking into account infrastructure and vehicle characteristics	Determination of minimum travel time
Travel time with sectional surcharges	Travel time calculation taking into account sectional percentage travel time extensions.	Determination of approximate speed profile
Driving time with restricted maximum speed	Travel time calculation based on the extended forecast calculation, "hitting" predefined target travel times while capping the maximum speed (with/without coasting)	FZR for timetable construction / departure actual FPL
Travel time with minimum energy requirement	Running time calculation that provides the lowest energy consumption for a train path while complying with (sectional) target running times	FZR for FE and disposition / KL

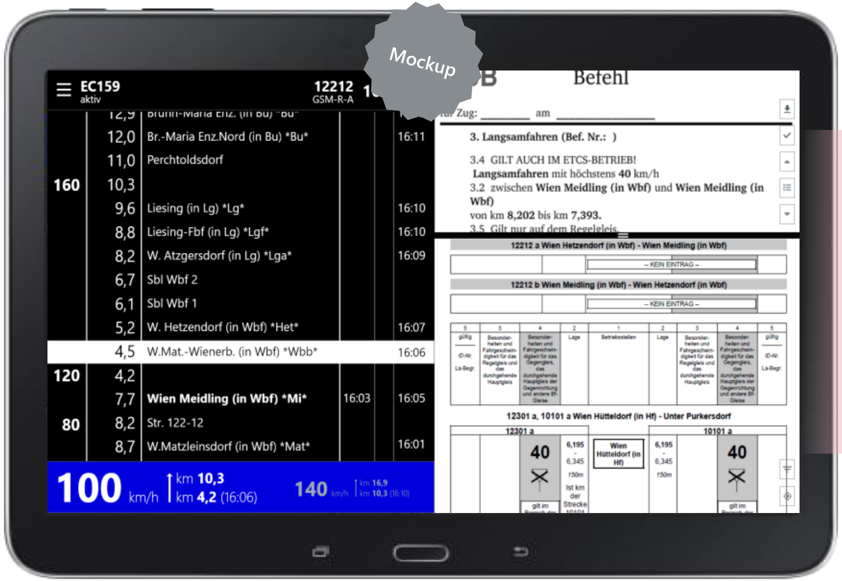
Agenda

Visual relief through intersected display

No more "transfer power" necessary: the driver sees directly the speed to be driven

ÖBB INFRA

infraDOAS



Separate display of static book timetable, driving recommendation, commands and la

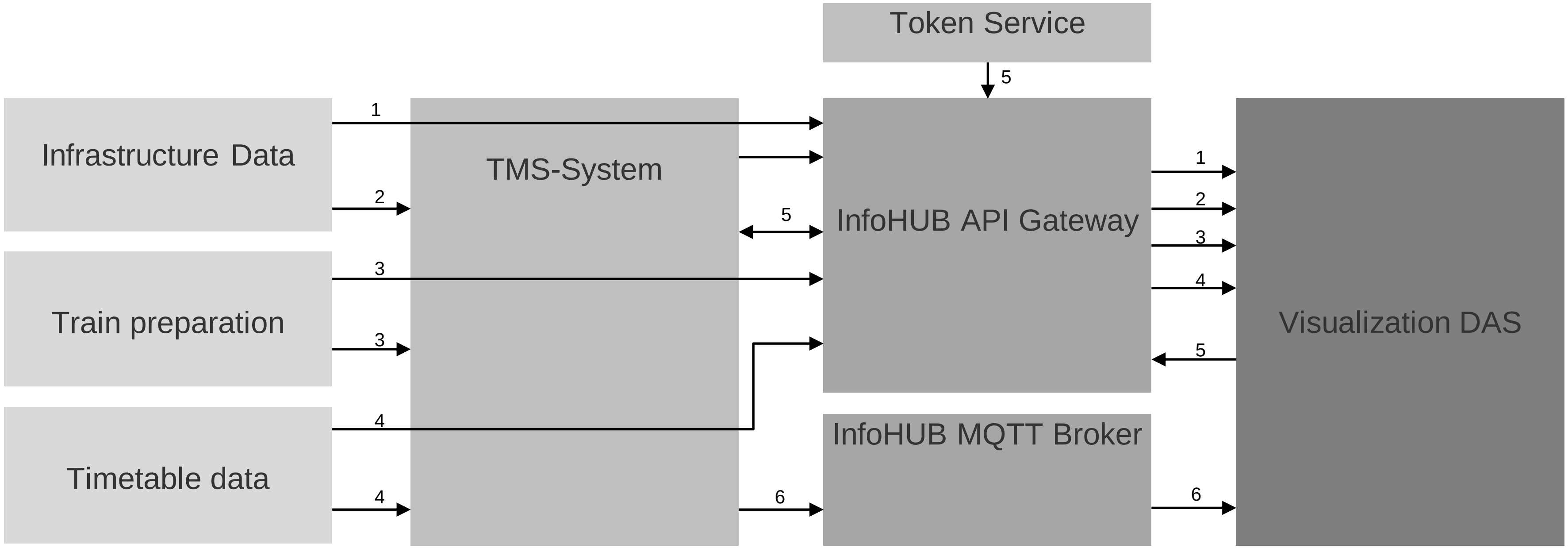
mixed timetable data (vision view)

There is only one source of information for the Tfzf with the current departure timetable.

Illustration on the right based on ADL 4.0 of the SBB

Agenda

AZL Architecture (Top-Level)



(1) slow speed points
(2) aS (exceptional broadcasts)
(3) train preparation

(4) timetable
(5) authentication/authorization
(6) driving recommendation

IMPLEMENTATION ROADMAP

SNCF Réseau

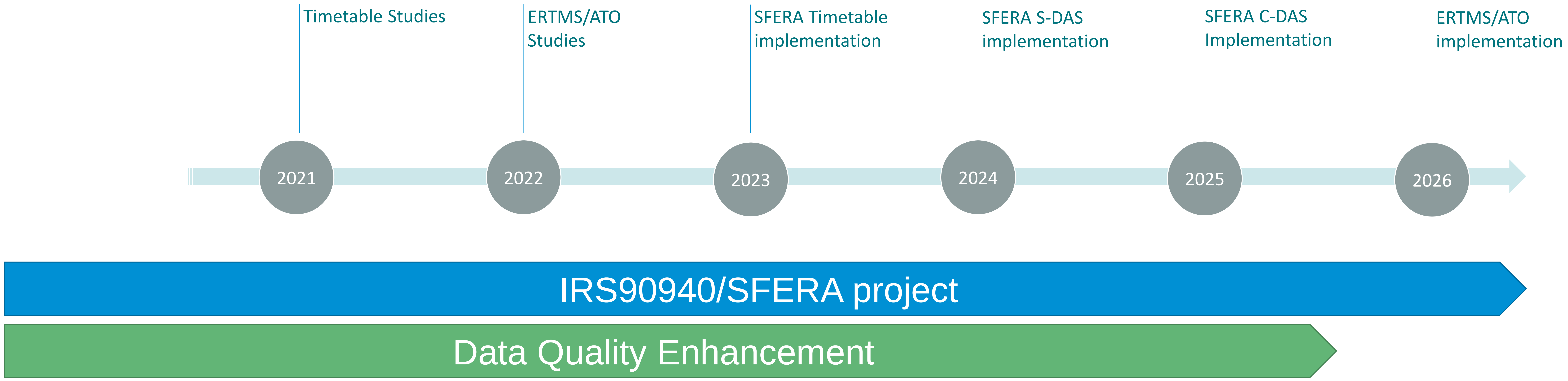
Sébastien DISLAIRE

Aims of SNCF Réseau implementation roadmap

Capture advantages of DAS : punctuality, capacity, safety, efficiency and quality of service

Establishing the trackside for 100% of trains to operate under DAS or ATO :
- Integrating with RU projects and DAS suppliers

Establishing the stepping stones towards ATO implementation

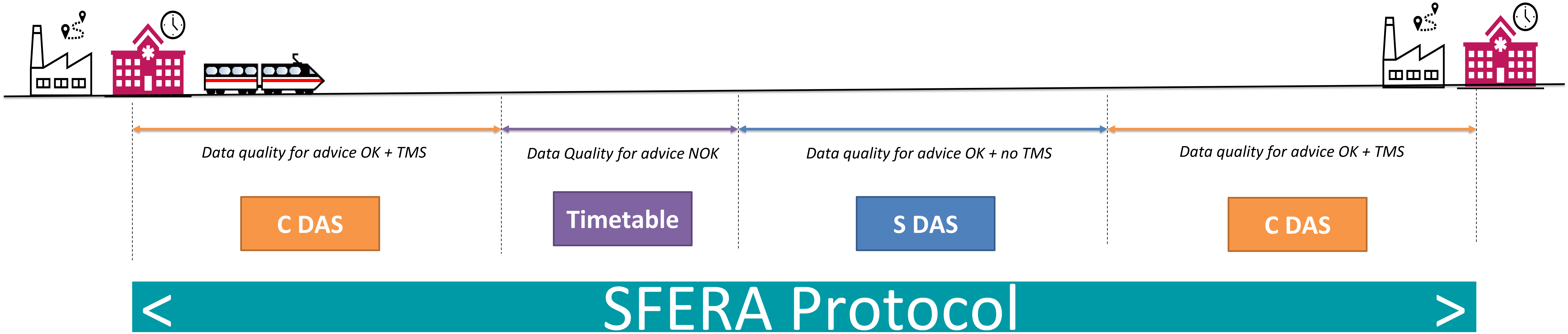


Constraints and Deployment strategy

We aim to offer end-to-end journey description to drivers

We will rely on the different operating modes SFERA provides to overcome two major constraints :

- A significant part of the network is not supervised by traffic managers (low traffic lines)
- Sufficient data for DAS is not currently available on the whole network

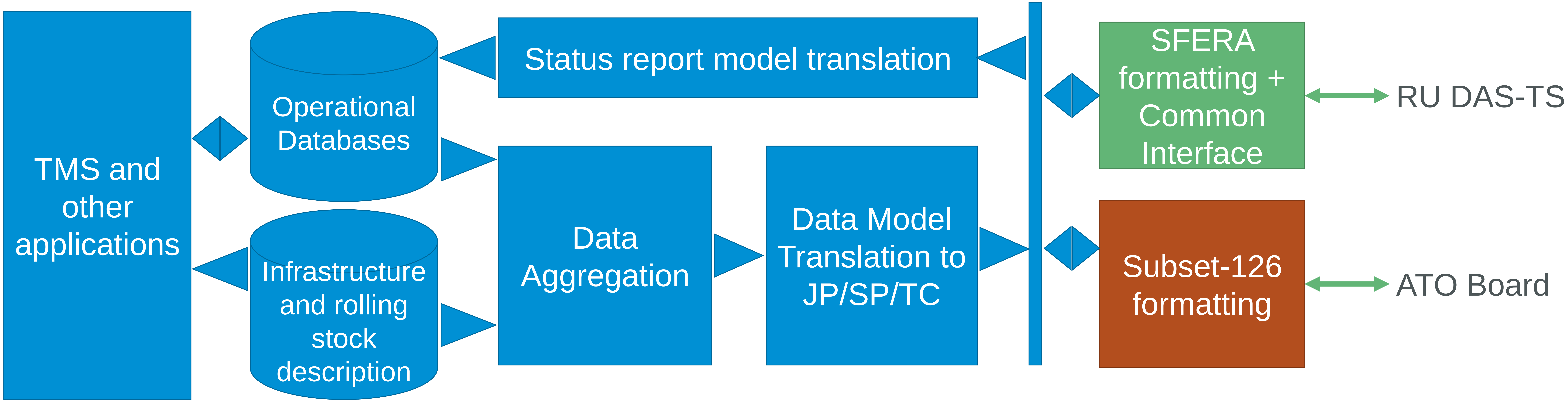


IT Implementation strategy

Aim: maximizing common components for Timetable, ATO and DAS data.

2 protocols for output to the RUs :

- SFERA for Timetable and then DAS
- CCS TSI for ERTMS/ATO



Architecture Concept (studies ongoing)

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#UICrail

Thank you for your attention.

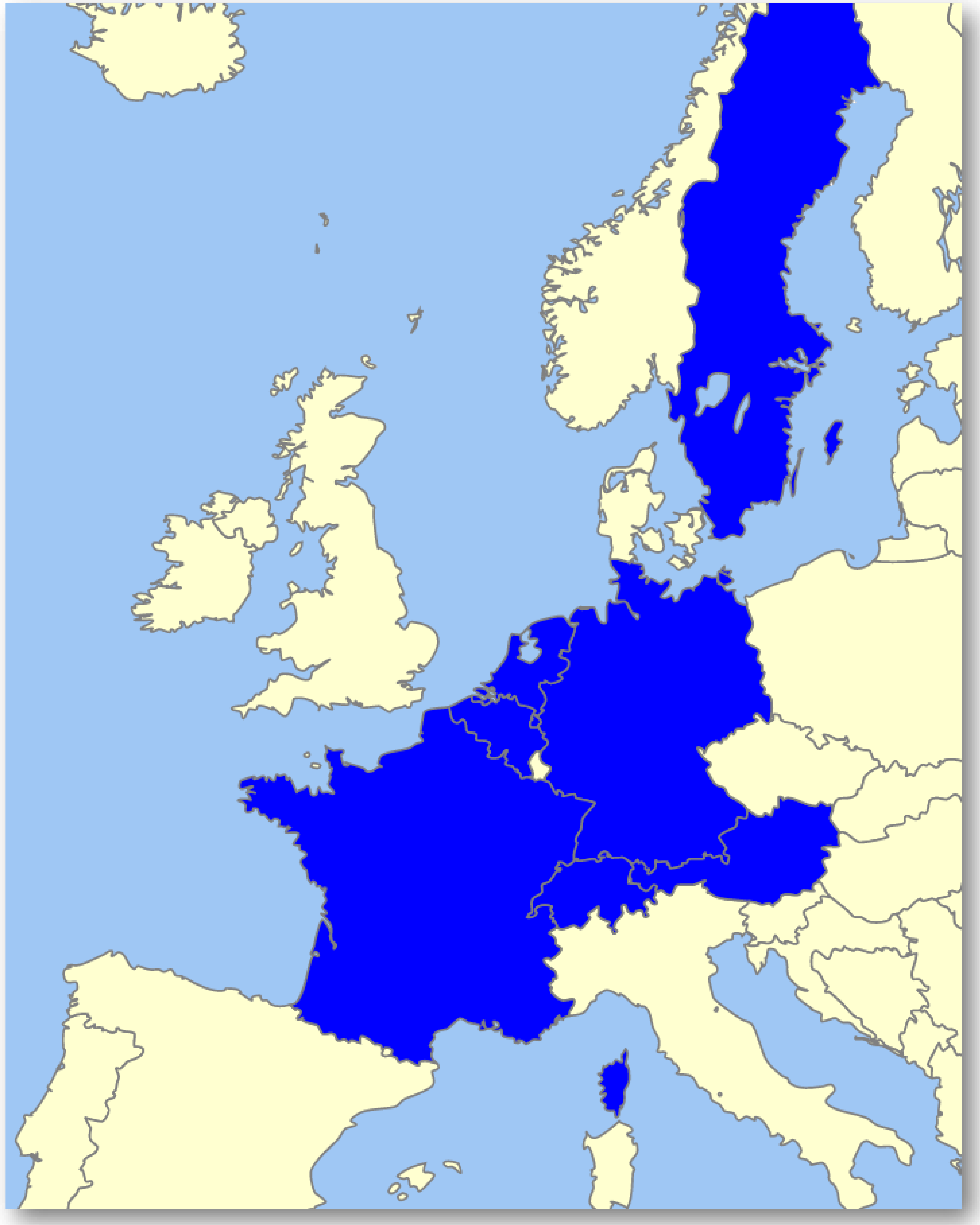
STATUS OF SFERA MEMBERS

DAS and SFERA Implementation

The SFERA Working Group

UIC Project

DB	Infrabel
NMBS/SNCB	NS
ÖBB	ProRail
SBB	SNCF
Trafikverket	



DB Netz

DB Netz Update

DB Netz prepares to send SFERA messages in the next years:

1. C-DAS-C for existing use cases (“Green Functions” of DB Netz) and Related Train Information (Farsight/Rearview) coming in 2023/2024
2. C-DAS-O based on dispatching decisions and location/speed messages coming after 2025
3. continuous C-DAS-O messages and energy messages not yet decided

Infrabel

Infrabel

- We have upgraded our TMS (based on SBB RCS): live since April 2022:
    - This is the technical back-bone/pre-requisite for DAS
- DAS-planning & implementation update:
    - Delivering data for trials with S-DAS
    - C-DAS-C implementation on schedule:
        a) Use out of the box RCS-ADL (which calculates C-DAS-C messages) as base
        b) Develop simple web-app to receive C-DAS-C messages using SFERA over MQTT
        c) Ensure sufficient data quality to start live test runs in 2023
    - Starting discussions with RUs and DAS-suppliers on how to implement C-DAS-O:
        a) Investigate possibilities to use RCS to output train path envelope/journey profile
        b) Directly to device on-board in IM-train setup (via MQTT).
        c) Delivering data using SFERA-format by our Data Exchange to the RUs.
        NOTE 1 - This can be by Common Interface (if requested).
        NOTE 2 - Data can also be handled using a server offered by a DAS-supplier as SaaS to some RUs.

Planning DAS (TMS-ADL) 2022-2023

SBB

SBB Plan for 2023

SBB plans to develop a C-DAS O solution in 2023

SFERA ed 2.0 fits to the whole set of SBB's requirements

A first set of functionalities has been determined for the first version

- Some requirements are not yet available automatically on the TMS side, they are left aside)

Thanks to the AdvisedSpeed structure (new in ed. 2), SBB can go straight to C-DAS O mode with its existing solution, without investing too much ressource on the tablet.

SNCF Voyageurs

1. FUTURE DAS PRESENTATION FOR DRIVERS

Drivers instructions : updating in real time and containing the current time, the radio chanel, etc.

A representating view from the journey to be able to anticipate further speed sequences :

- Driver's advices,
- Maximum speed,
- Journey view (stopping / passing point, KP and track information),
- Working zone.

Necessary informations for the driver (documentation access point and train composition) **and other usefull informations** (notes, global informations of the journey and settings).

Informations for the next stopping point (name, planned and estimated schedules, conventionnal signs).

2. SNCF specific aspects IN THE SFERA FORMAT

SFERA format for SNCF

SNCF wishes to implement the SFERA format to be able to interact with others as soon as possible.

At the end of the year 2022, SNCF will be able to recreate data for the DAS that will be clean enough to have the DAS module working properly. In the same time, SNCF benefits from this change to implement the SFERA format.

SNCF will not use the entire perimeter of the norm at the beginning because the communication between the IM and the RU is not ready yet. Moreover, SNCF add some tags needed by the DAS module which are specific for the French Railway Network. These tags are presented on the right side of the presentation.

Object OTN_ID	*Attribute* SNCF_DisplayName	*SIV (traveller information system) train code*
Object Temporary Constraints	*Attribute* SNCF_IdCIC	*CIC Id for the working zone*
Object Timing Point	*Attribute* SNCF_SignesConventionnels	*Conventional signs for timing points*
Object Timing Point	*Attribute* SNCF_TPVirtualBalisePosition	*GPS coordinate for timing points*
Object G2B_ ReplyPayload	*Attribute* SNCF_DEFIT	*Id for the DEFIT pdf (compulsory form for public works)*

Specific tags for SNCF

Trafikverket

Trafikverket – IM in Sweden

Ongoing pilot with C-DAS in cooperation with a few different RUs

- Not using SFERA at this point
- Both passenger and freight trains
- Established for a few stretches where a RTTP (Real Time Traffic Plan)/”Journey Profile” is delivered 24/7 from a digitalized time-distance graph

This autumn the first steps towards the SFERA standard have been taken

- The messages Journey Profile (JP) and Segment Profile (SP) will be used to replace the format of the existing messages in the pilot
- JP and SP will at the beginning contain the data to achieve a similar functionality as of today
- More data in the JP and SP will be added as the work continues
- Will in the beginning use the integration platform already established
- Using the Common Interface will be a later step

From the result of the work done during this autumn Trafikverket will in the beginning of next year establish a more specific plan for the work 2023

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Thank you for your attention.

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OF RAILWAYS

SFERA and X2Rail4

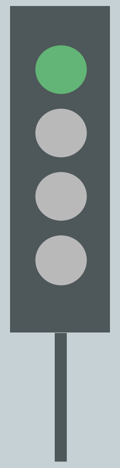
Joint work towards TSI 2026

DAS SFERA Workshop
10/10/2022

TSI 2022 situation

SFERA complementary to ATO over ETCS for covering all train operating use cases

Class B ATP Systems

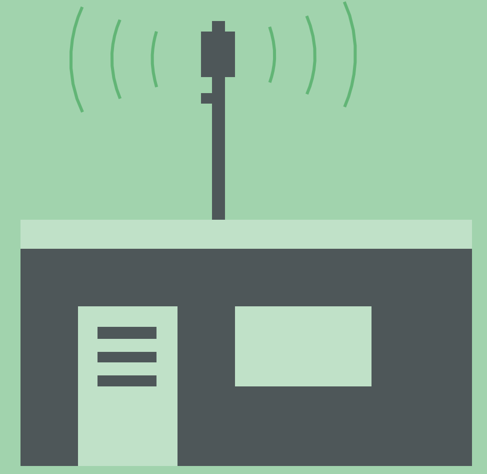


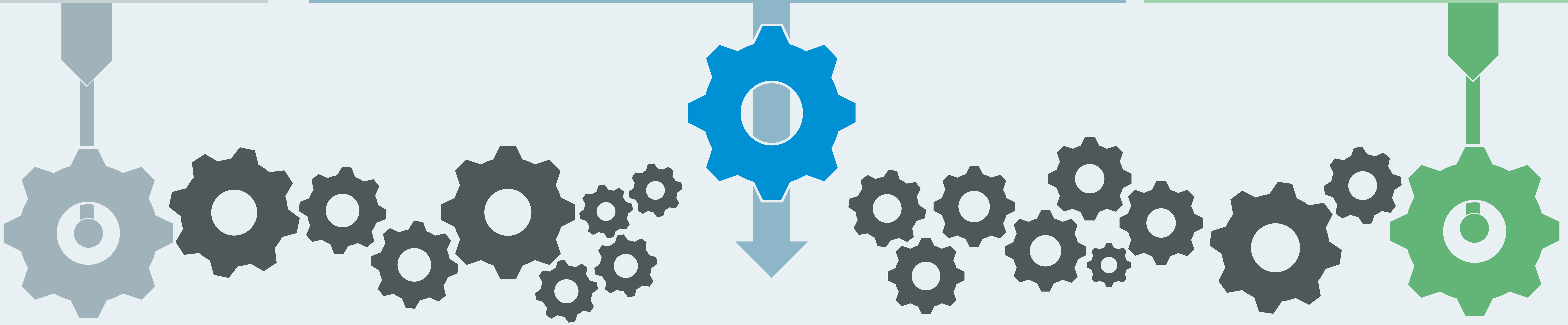
SFERA

- Enhance C-DAS and GoA1 operations
- Provide the driver with additional information in GoA1/2
- Usable on all ATP Systems (incl. ETCS L1LS)
- Simple, scalable, moderate investments
- Promotes precative preparation of data and systems for ATO

ETCS & ATO over ETCS

- Subset 125
- Subset 126
- Subset 148





SFERA roadmap vision update

One standard for ATO and C-DAS in Europe.

Parallel standard phase

SFERA and SS126 are maintained in parallel.

Changes in SS126 are integrated into SFERA.

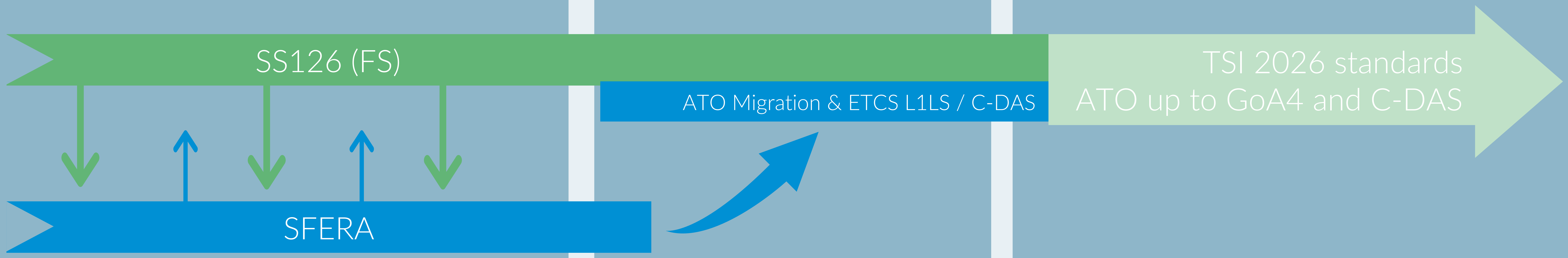
Smaller change requests for SS126 proposed by the SFERA WG.

Merging

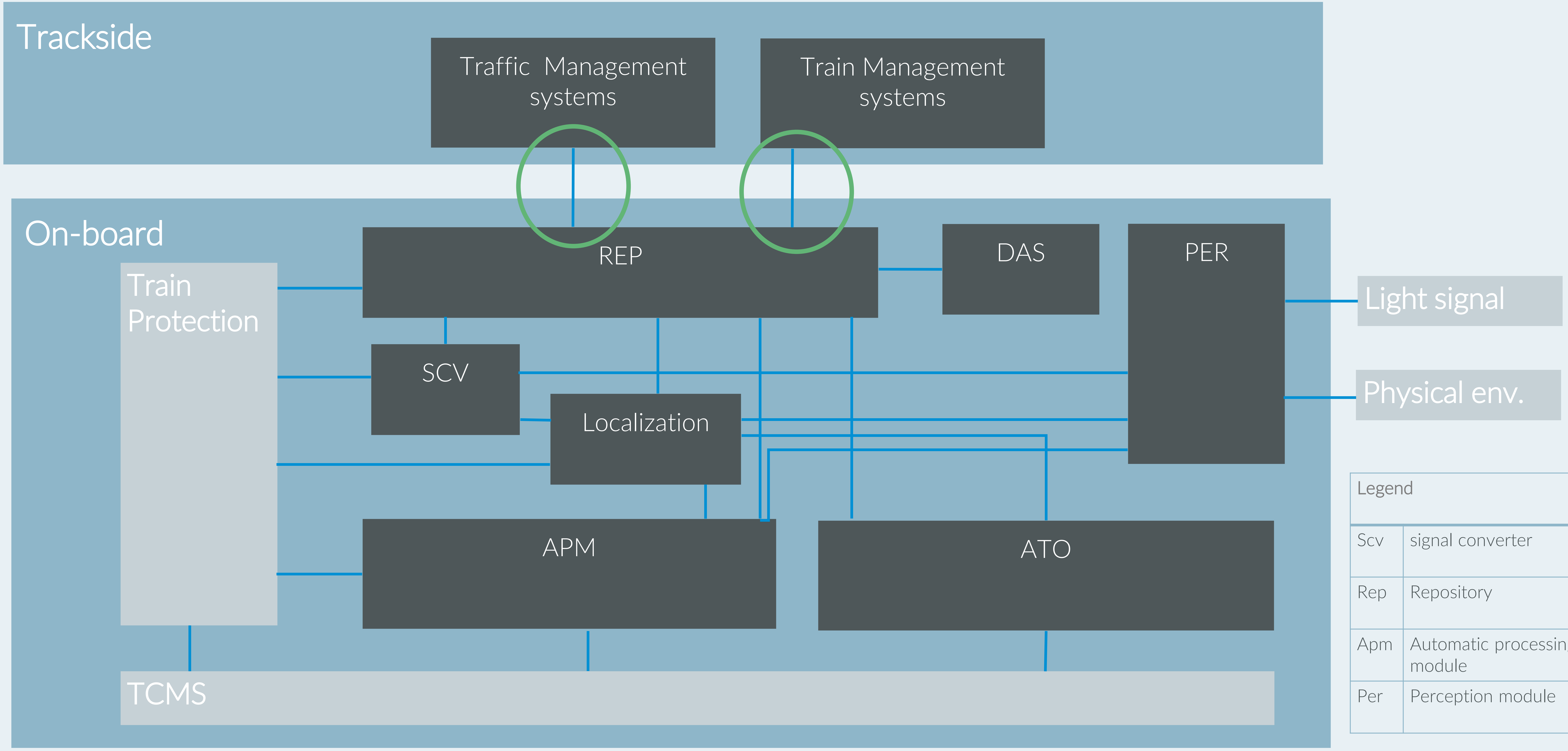
The standards are merged into one norm.

Single standard phase

One single standard ensures interoperable DAS and ATO operations on all lines in Europe and all usage scenarios



Provisioned architecture GoA1-4, including DAS



Legend	
Scv	signal converter
Rep	Repository
Apm	Automatic processing module
Per	Perception module

Joint work SFERA – Shift2Rail

One standard for ATO and C-DAS in Europe.

Application data

- Alignment on the data content
    - Mission Profile
    - Train data sets
    - Journey Profiles
    - Segment Profiles
        - Static layers
        - Dynamic layers
- Alignment on common Use Cases
- Alignment on the data format
    - binary
    - XML
    - Other

Communication Session Management principles

- Alignment on common Use Cases
    - Normal operation in fitted area
    - Crossing borders
    - Coupling and uncoupling
    - Change of CAB
    - …
- Support of specific Use Cases (e.g.)
    - Application installed on tablets associated to a driver
    - Automatic powering on and off.

Lower Layers of communication

- Alignment on common Use Cases
- Full compliance with FRMCS set of documents
- Introduction of layers currently used in SFERA (e.g. MQTT)

Target date: 12/2023

Questions ?

Thank you !