UIC IRS 90940 – SFERA Project
Stakeholder Workshop, 05/11/2018

Poster Presentations:

- Overview of SFERA and relation with ATO
- Core Use Cases
- Advanced Use Cases:
  - Power Management
  - Degraded Adhesion
- Message structure
- Communications
- Proof of Concept

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OF RAILWAYS

Overview

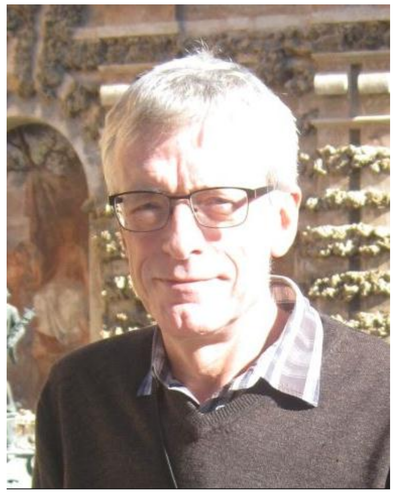
And Relation with ATO

Henk Tijssen - ProRail

Thomas Sutter – SBB Infrastructure

IRS 90940 (Project SFERA) Stakeholder Workshop, Paris 05/11/2018

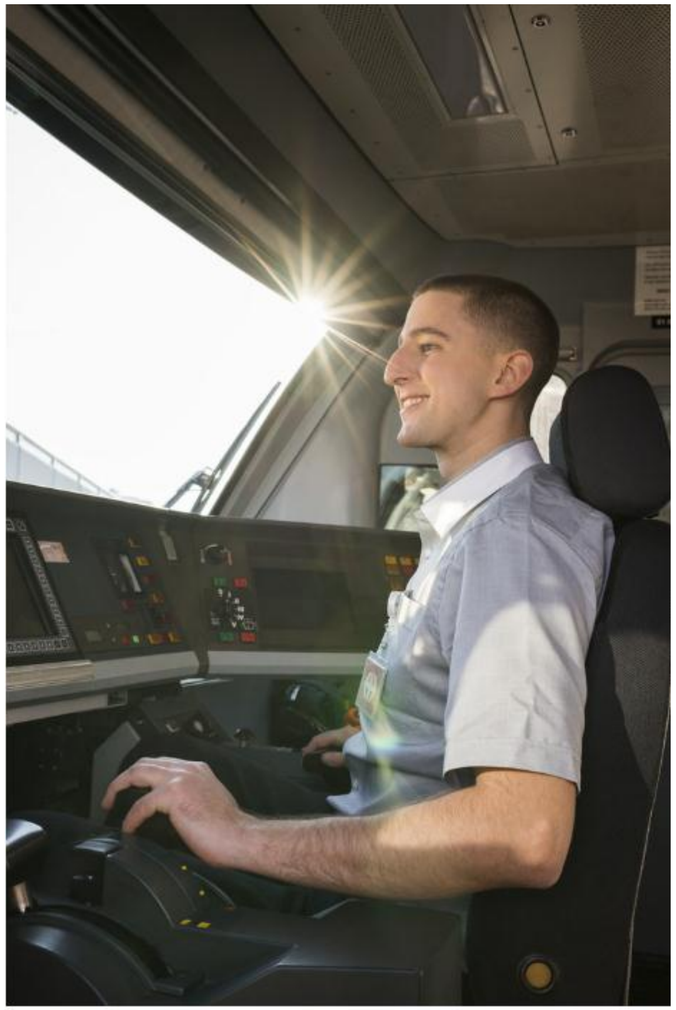
Who we are.



- **Henk Tijssen**
  ICT Architect, CIO Office
  ProRail

- **Thomas Sutter**
  Corporate Development Operations
  SBB Infrastructure

What is the SFERA Objective?



Standardize DAS data exchange between on-board and traffic management.

This means, the SFERA standard must be applicable:

✓In a multi RU environment.

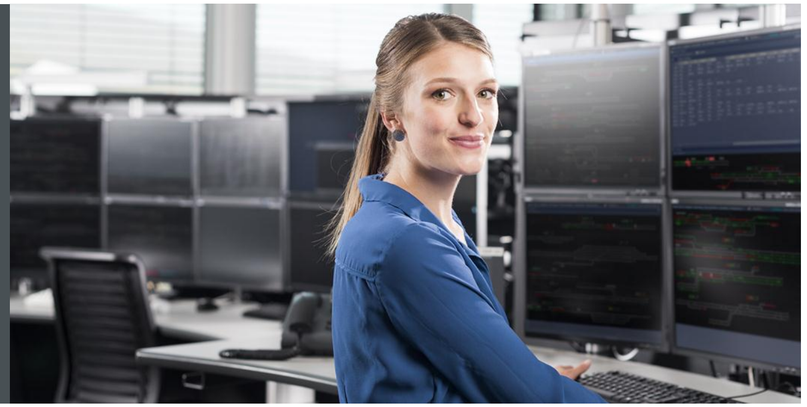
✓Cross IM border.

✓On ERTMS Lines.

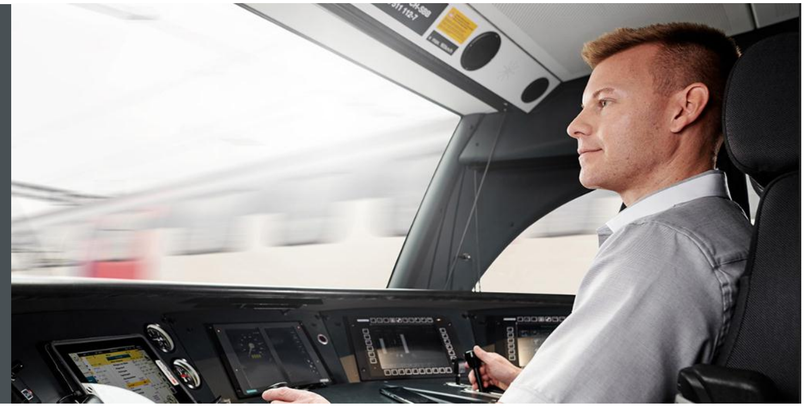
✓On Legacy Class B ATP lines.

We realised that data requirements for ATO and DAS are very similar.

IM



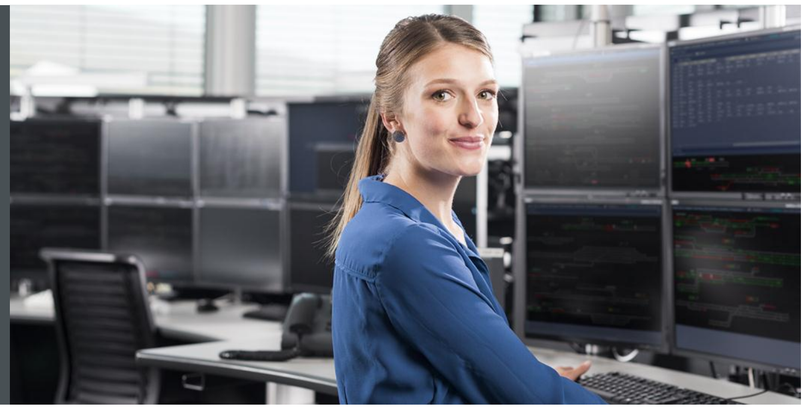
RU



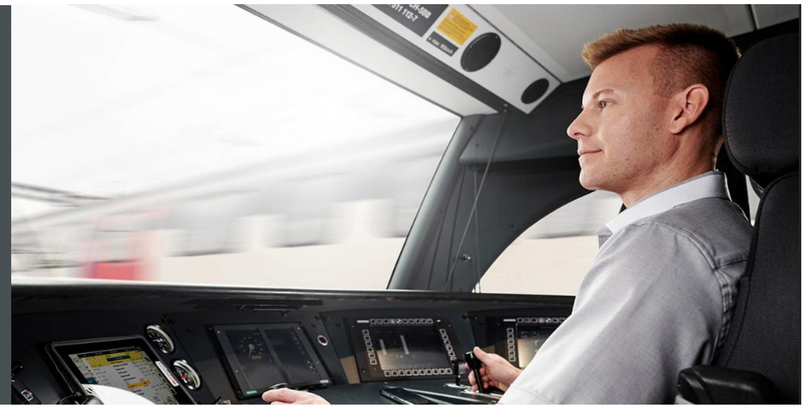
ATO over ETCS	Train Data Route Data Timetable Data	ATO	Automatic Driving
DAS	Train Data Route Data Timetable Data	C-DAS	Driving Advice

Why is this relevant for SFERA?

IM



RU



ATO over ETCS

SFERA / DAS

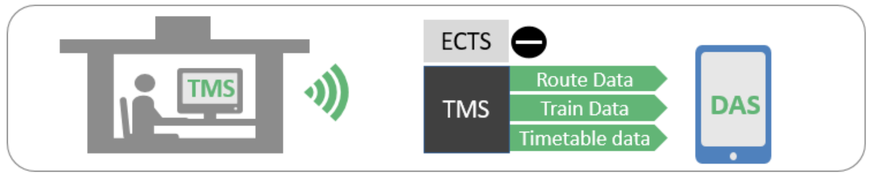
ETCS	Train Data	ETCS	Automatic Driving
TMS	Route Data	ATO	
	Timetable Data		
ETCS			
TMS	Train Data	C-DAS	Driving Advice
	Route Data		
	Timetable Data		

Introduction to the Poster.

In addition to the DAS-Concept, our poster covers:

Similarities between ATO o. ETCS and C-DAS.

Differences between ATO o. ETCS and C-DAS.

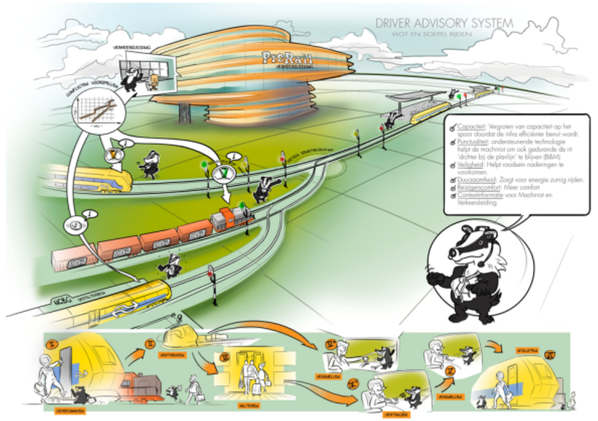


Data requirements for C-DAS.

Advantages our IRS 90940 approach brings.

Introduction to the Poster

IRS 90940 GENERAL OVERVIEW AND RELATION TO ATO OVER ETCS



IRS 90940 Objective :

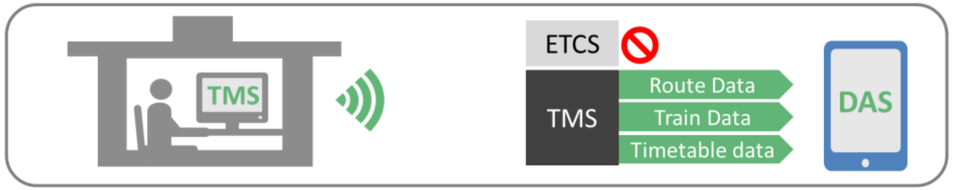
Standardize DAS data exchange between on-board and traffic management

This means:

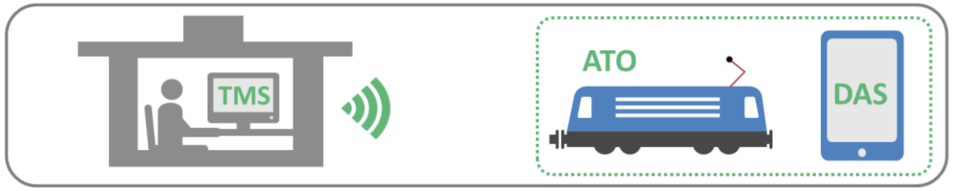
- In a multi-RU environment
- Cross IM boarder
- On ERTMS lines
- On Legacy Class B ATP lines

Data requirements for ATO and C-DAS are very similar

Standards for ATO over ETCS and C-DAS cannot be identical



For C-DAS, IM should deliver extra train, infra, timing and communication data



IRS 90940 ensures one single set of data to support ATO and DAS for all RU's

Key Takeaways: What You Really Need to Know.

- The data requirements for ATO and DAS are very similar and the respective standards should therefore be compatible.
- Because DAS does not have a connection to ETCS, Infrastructure Mangers must provide additional data from traffic management systems.
- The IRS 90940 ensures one single set of data to support ATO on Class B ATP lines and C-DAS for all Railway Undertakings.

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SFERA: Core Use Cases

Sébastien Dislaire – TMS Functional Specification, SNCF Réseau
Daniele Arena – Consultant, UIC
IRS 90940 (Project SFERA) Stakeholder Workshop, Paris 05/11/2018

Who we are

- Sébastien Dislaire
  - TMS Functional Specification, SNCF Réseau

- Daniele Arena
  - Consultant, UIC

S-DAS + C-DAS Initialization

Initial Setup

Driver Check:
Train Type

Driver Check:
Degraded Train Functions

DAS Operation

C-DAS operational use cases

DAS

TMS

Other IM systems

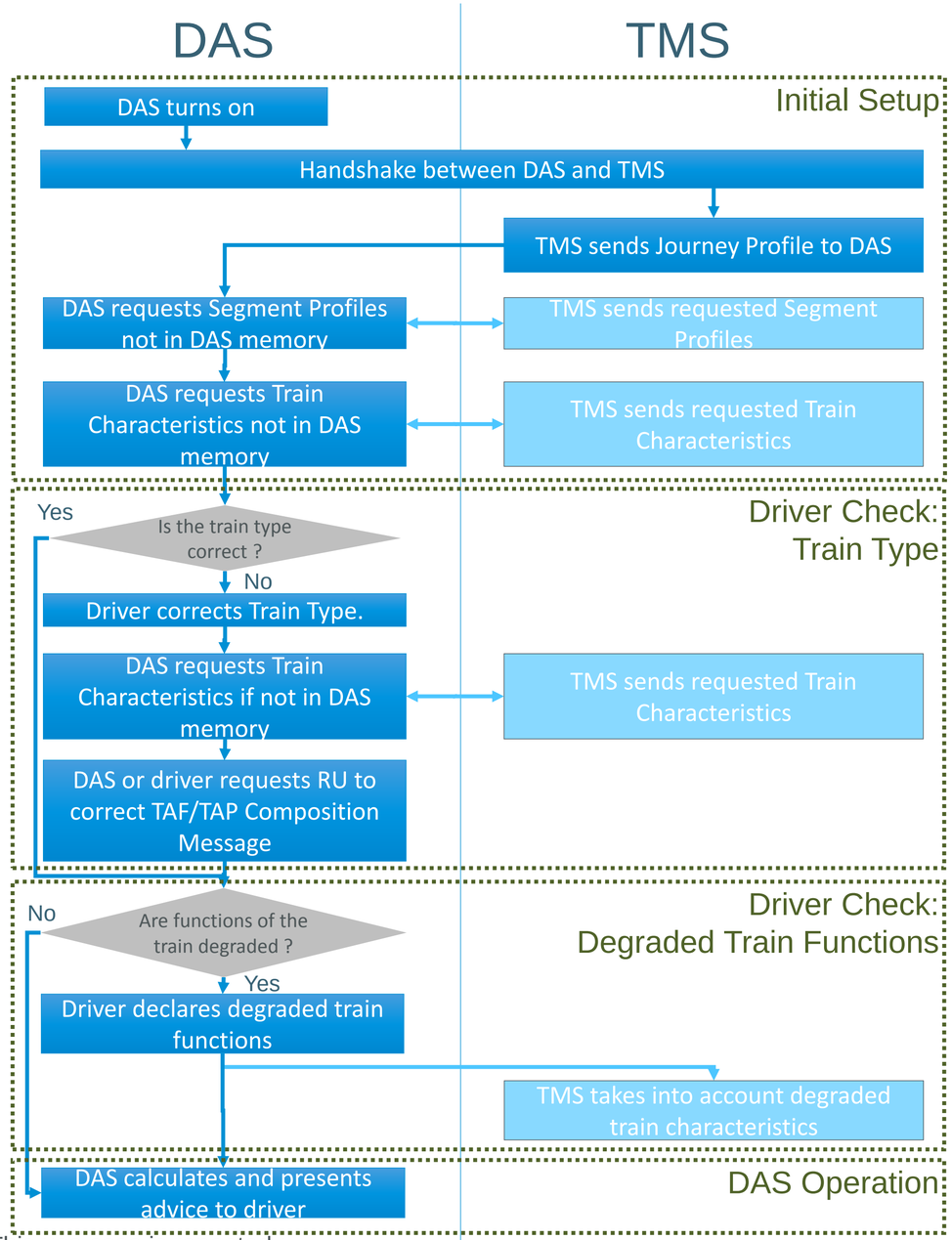
On-Board Triggers

Track-Side Triggers

DAS Initial Reaction

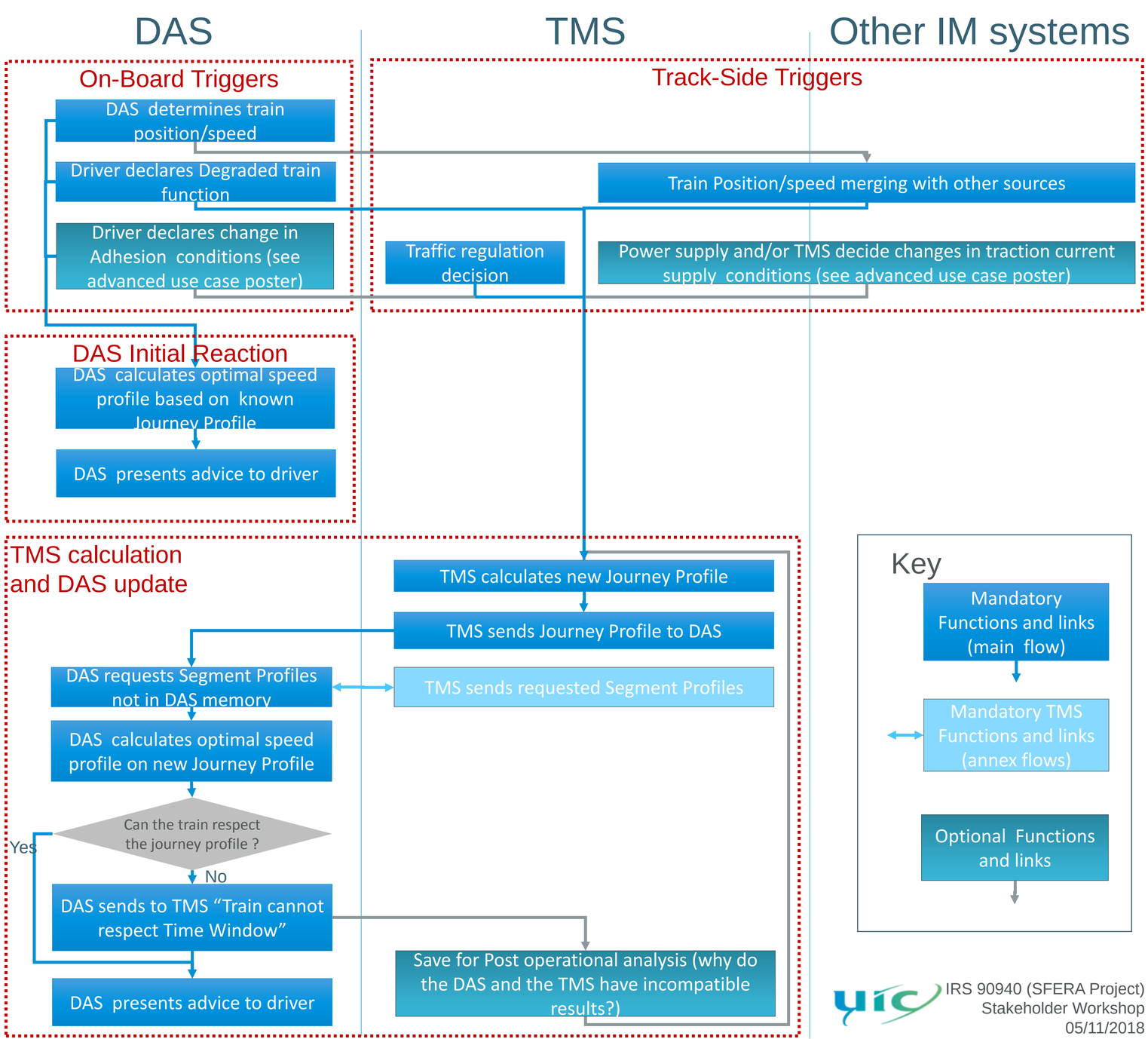
TMS calculation
and DAS update

S-DAS + C-DAS Initialization



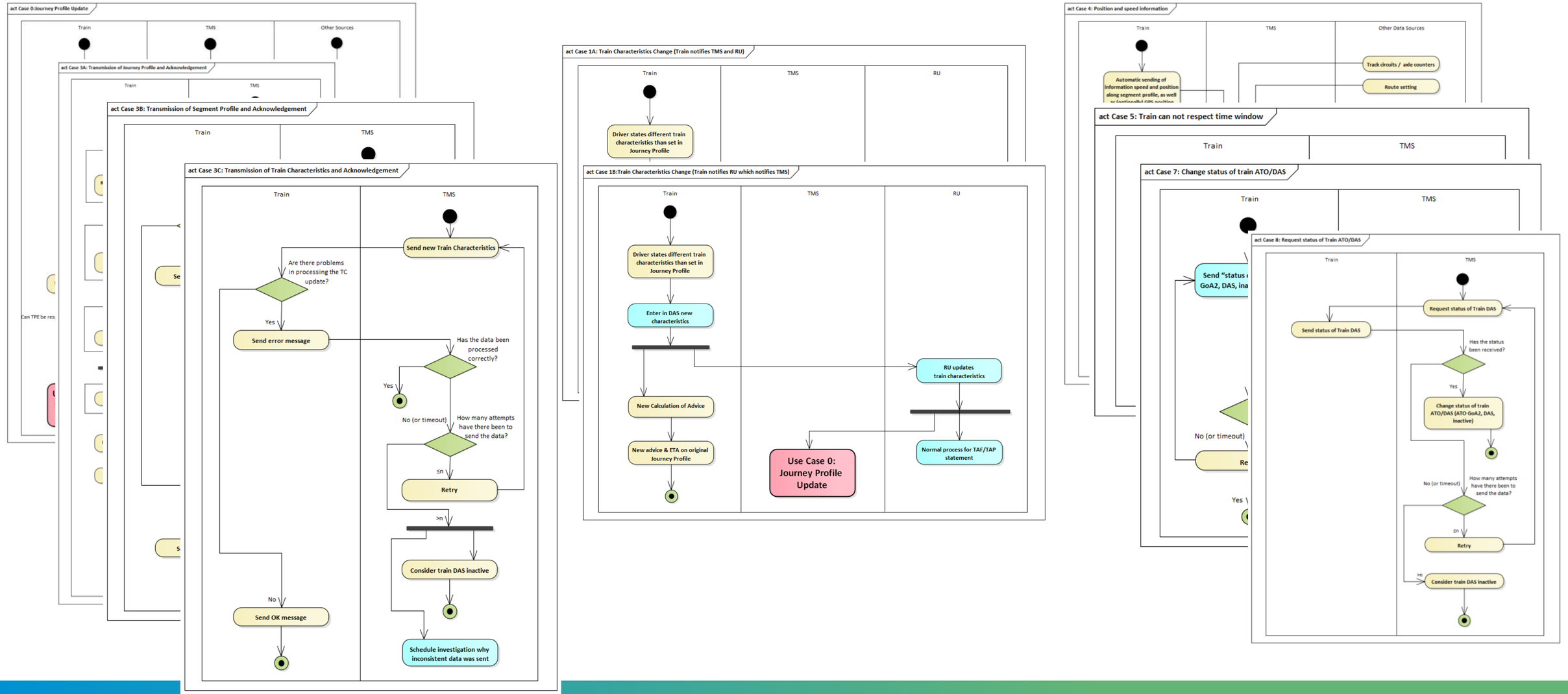
This use case is repeated :
- for all IM's on the train Journey when initializing in S-DAS mode ;
- When necessary in C-DAS mode (for example : at the last stopping point before a border).

C-DAS operational use cases



SFERA Core Use Cases – Detail

- Detailed use cases have been developed for each part of the process



Key Takeaways: What You Really Need to Know

- Initial setup
  - It is the same for S-DAS and C-DAS
    - DAS initiates handshake with TMS upon startup, which results in TMS sending the Journey Profile
    - DAS requests Train Characteristics and Segment Profiles not in memory
  - It is possible for the driver to change some parameters
    - Train type / composition
    - Declare that some train functions are degraded
- C-DAS operation
  - SFERA considers on-board and trackside triggers
    - On-board triggers can cause a direct reaction by the DAS
    - Trackside triggers can be from TMS or other systems
  - All triggers can generate
    - A recalculation of the Journey Profile
    - Communication between ground and board to transmit the journey profile
  - DAS can notify ground that it cannot respect the timing points

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Use Case Power Management

Markus Halder – SBB Energy
Bart Van der Spiegel – Infrabel
Niklas Biedermann - Trafikverket

IRS 90940 (Project SFERA) Stakeholder Workshop, Paris 05/11/2018

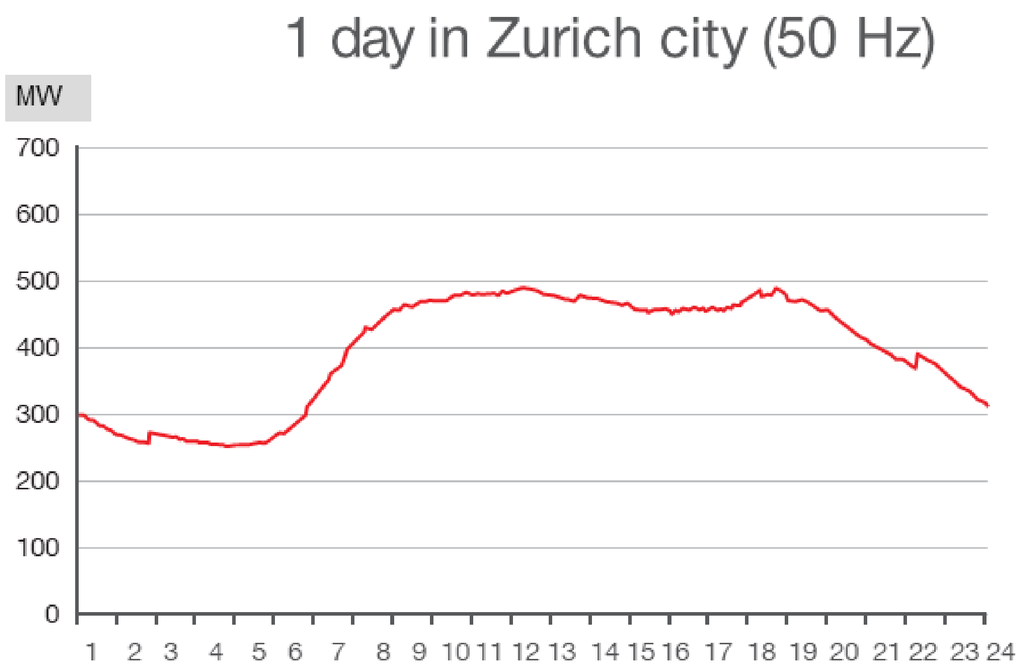
Who we are

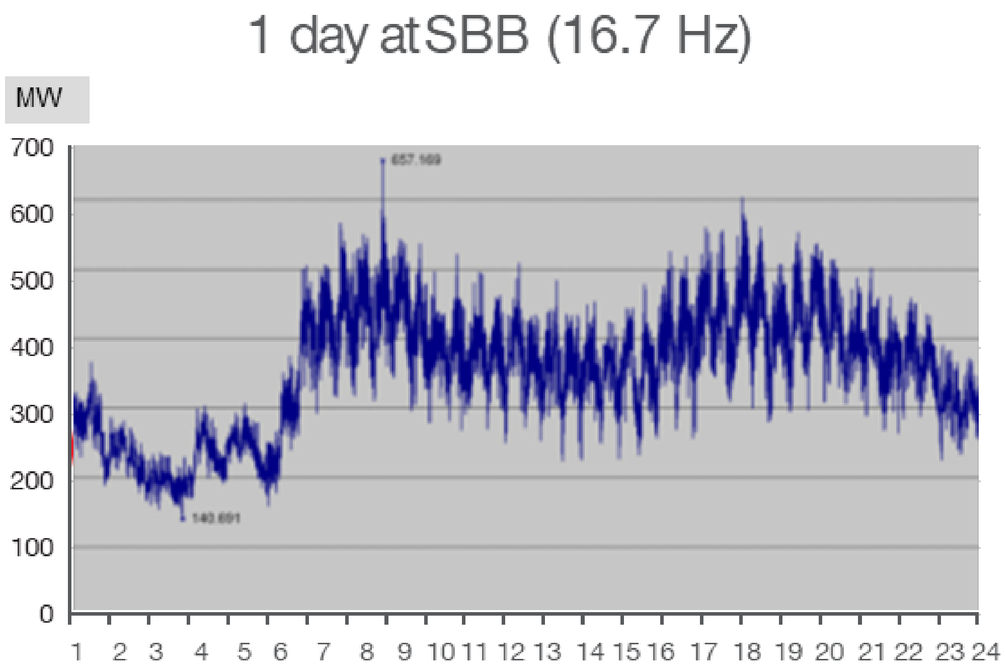
- Markus Halder
  - Swiss Federal Railways, SBB Energy
  - Head power demand management program

- Bart Van der Spiegel
  - Infrabel
  - Expert Energy Management

- Niklas Biedermann
  - Trafikverket
  - Expert Power System Design

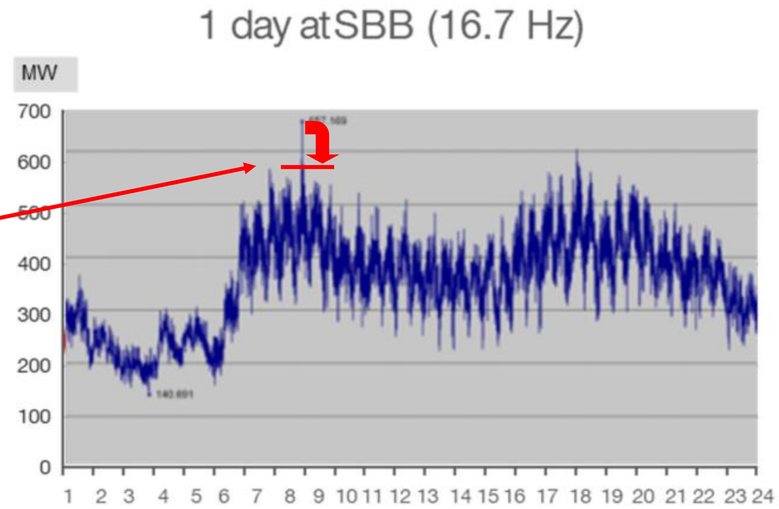
Why is this relevant for SFERA?





Why is this relevant for SFERA?

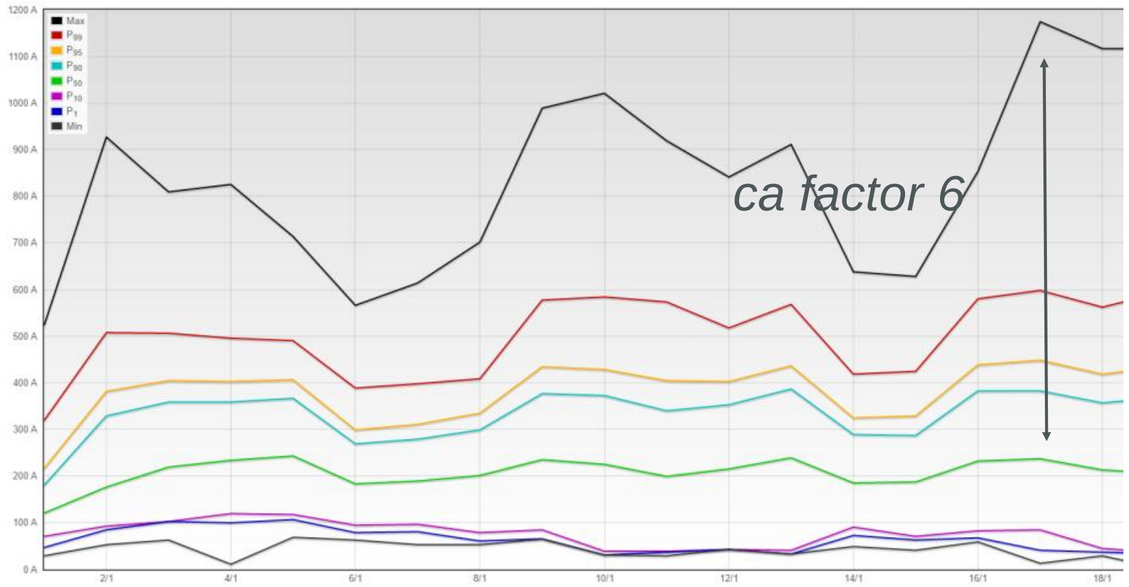
- Dynamic power profile of railways is challenging and expensive.
- Connection from ground to train offers opportunities to centrally influence power offtake.

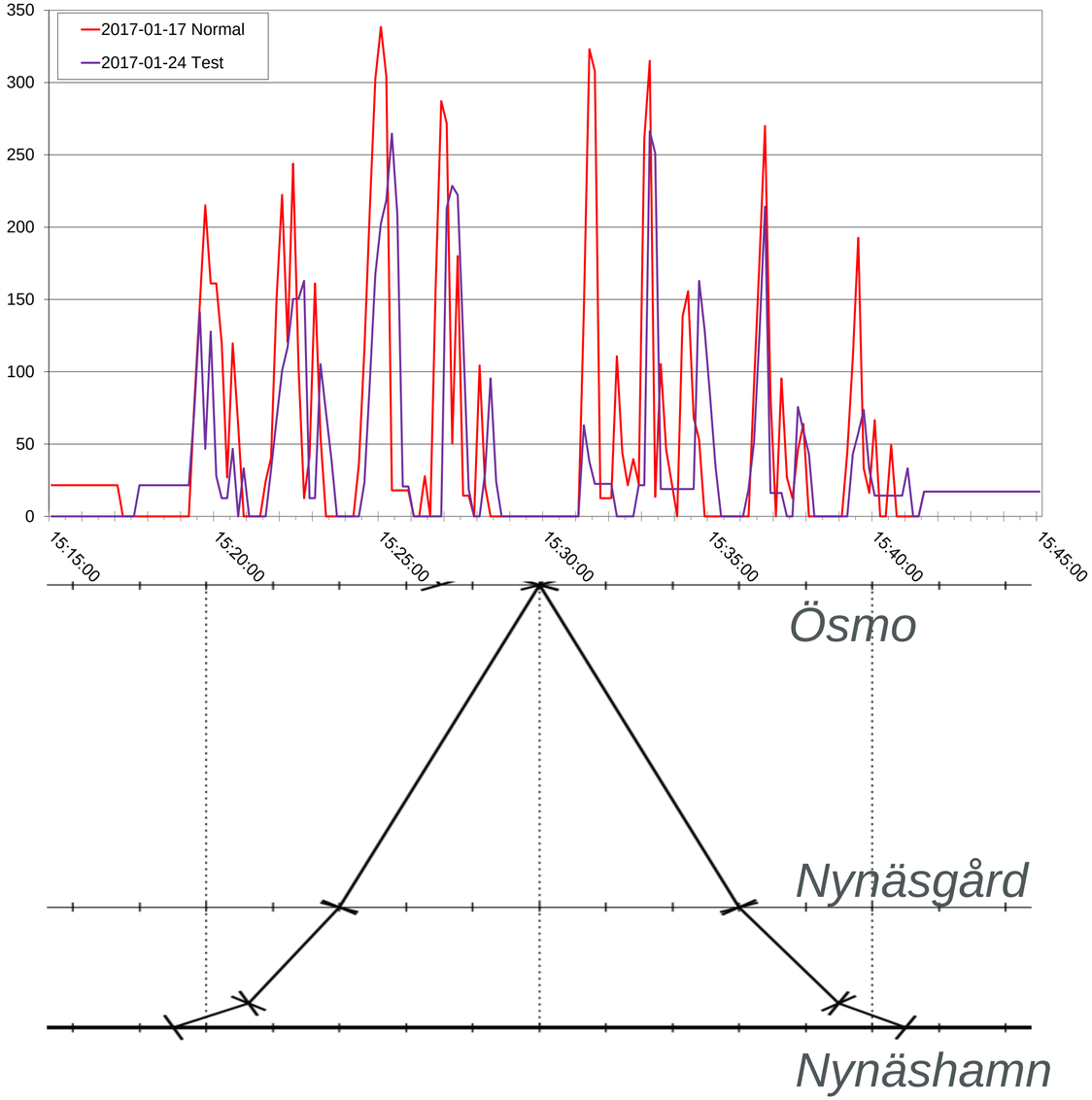


- Benefits:
  - Reduction of investment costs for new power supply
  - Additional options in critical grid situations (Business Continuity Management)
  - Less backup power to be provided

Why is this relevant for SFERA?

- Commuter train converter station:
  Factor 6 between median and peak value
- Info to the drivers – degraded power supply
- Comparison between two Tuesdays
- Train: Coradia Nordic, Pmax=5,6 MW
- Measurement right – line current for a single train
- Simulations show reduction of more than 50 %
  without affection to the timetable





Introduction to the Poster

WHY ?

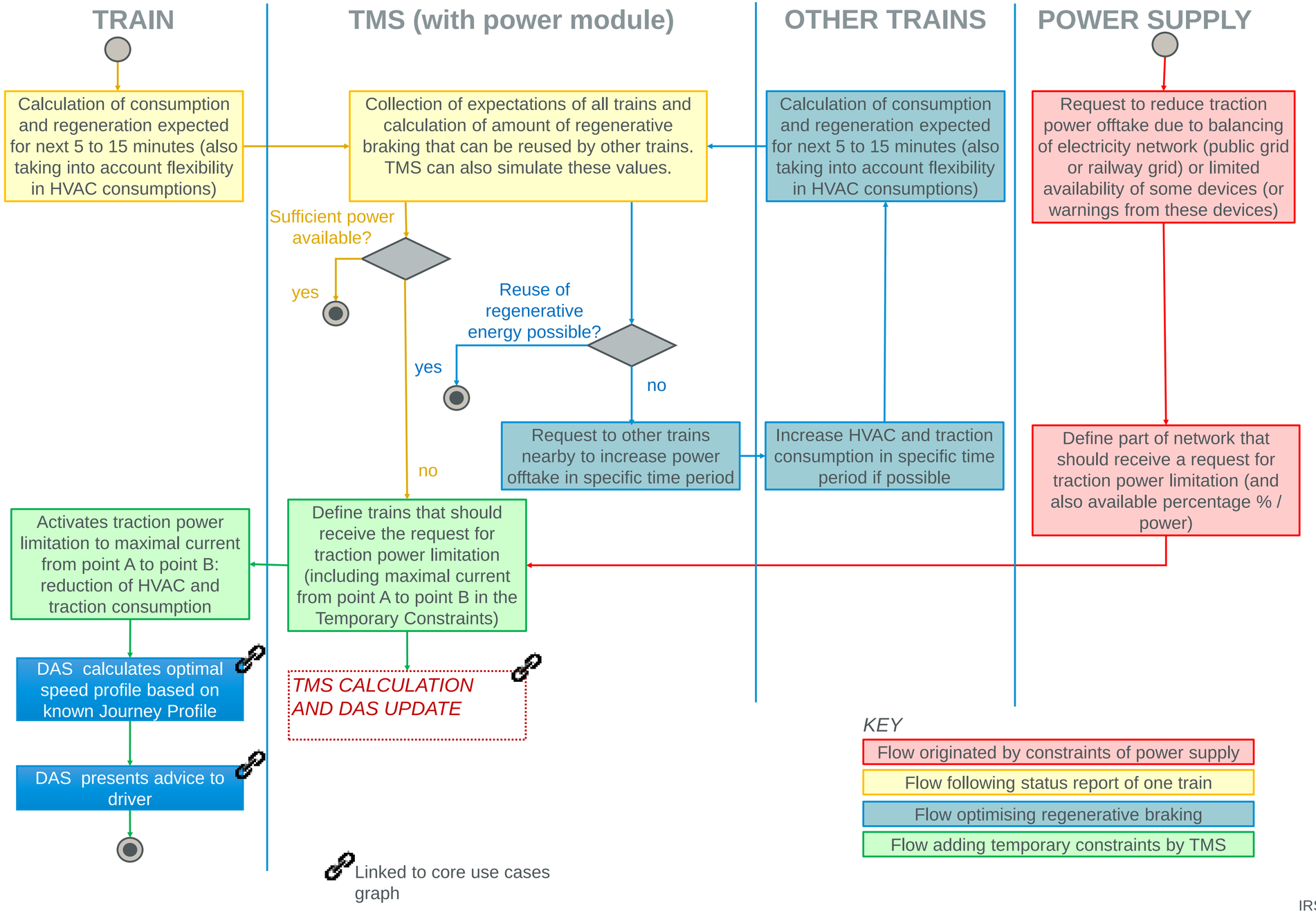
- Reducing costs for electricity production or purchase by reducing power peaks
- In case of failure of a critical component or thermal alarms, power offtake is limited
- Increase capacity of tracks by optimising the usage of available power
- Optimise exchange of regenerative energy
- Use thermal and kinetic inertia of railways to support stability in European electricity transmission grid

WHAT ?

- Adjust power consumption of trains to available power on location and time

REMARKS

- Reasons/benefits depend on railway power supply system
- It might be that part of regenerative energy is still lost in rheostats.


TRAIN
TMS (with power module)
OTHER TRAINS
POWER SUPPLY
Calculation of consumption and regeneration expected for next 5 to 15 minutes (also taking into account flexibility in HVAC consumptions)
Collection of expectations of all trains and calculation of amount of regenerative braking that can be reused by other trains. TMS can also simulate these values.
Calculation of consumption and regeneration expected for next 5 to 15 minutes (also taking into account flexibility in HVAC consumptions)
Request to reduce traction power offtake due to balancing of electricity network (public grid or railway grid) or limited availability of some devices (or warnings from these devices)
Sufficient power available?
yes
Reuse of regenerative energy possible?
yes
no
no
Request to other trains nearby to increase power offtake in specific time period
Increase HVAC and traction consumption in specific time period if possible
Define part of network that should receive a request for traction power limitation (and also available percentage % / power)
Activates traction power limitation to maximal current from point A to point B: reduction of HVAC and traction consumption
Define trains that should receive the request for traction power limitation (including maximal current from point A to point B in the Temporary Constraints)
DAS calculates optimal speed profile based on known Journey Profile
TMS CALCULATION AND DAS UPDATE
DAS presents advice to driver
Linked to core use cases graph
KEY
Flow originated by constraints of power supply
Flow following status report of one train
Flow optimising regenerative braking
Flow adding temporary constraints by TMS

Key Takeaways: What You Really Need to Know

- Continues availability of electric power is not for free. It influences railway production costs.

- The connection from ground to train offers opportunities for system optimisation
  - Cost savings on infrastructure side by influencing power offtake on trains.
  - Enhancement of the robustness / reliability of the railway power supply system and in consequence the railway system.

- SFERA defines the needed interfaces between ground and train enabling in the future profit from this opportunities.

- Challenges and opportunities vary dependent on railway power supply system (AC, DC, own production or purchase,…).

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Use Case
Degraded Adhesion

Didier Boulanger – SNCF Mobilités

Bart Van der Spiegel - INFRABEL

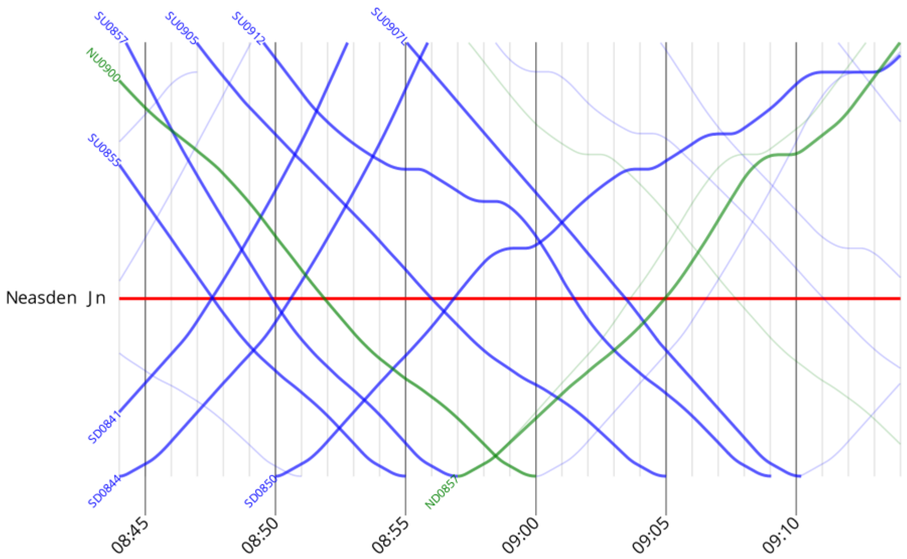
IRS 90940 (Project SFERA) Stakeholder Workshop, Paris 05/11/2018

Who we are

- Didier Boulanger
  - SNCF Mobilités
  - Head of DAS project & train driving expert

- Bart Van der Spiegel
  - Infrabel
  - Expert Energy Management

Why is this relevant for SFERA?



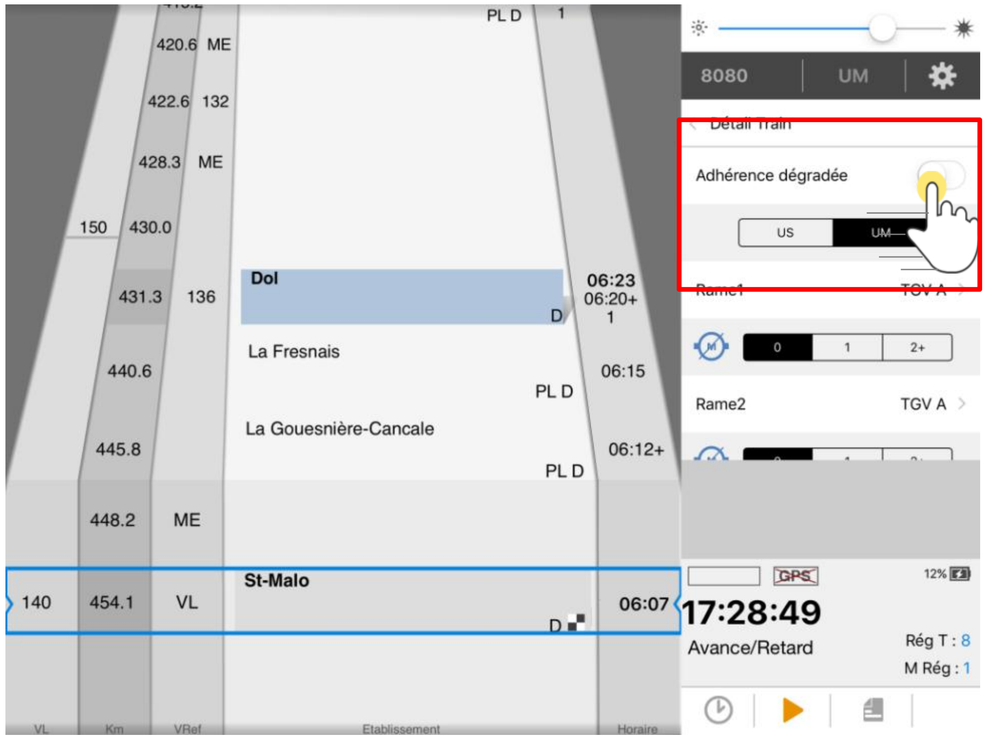
The degraded adhesion has a strong impact on the reliability of the train routing and scheduling.

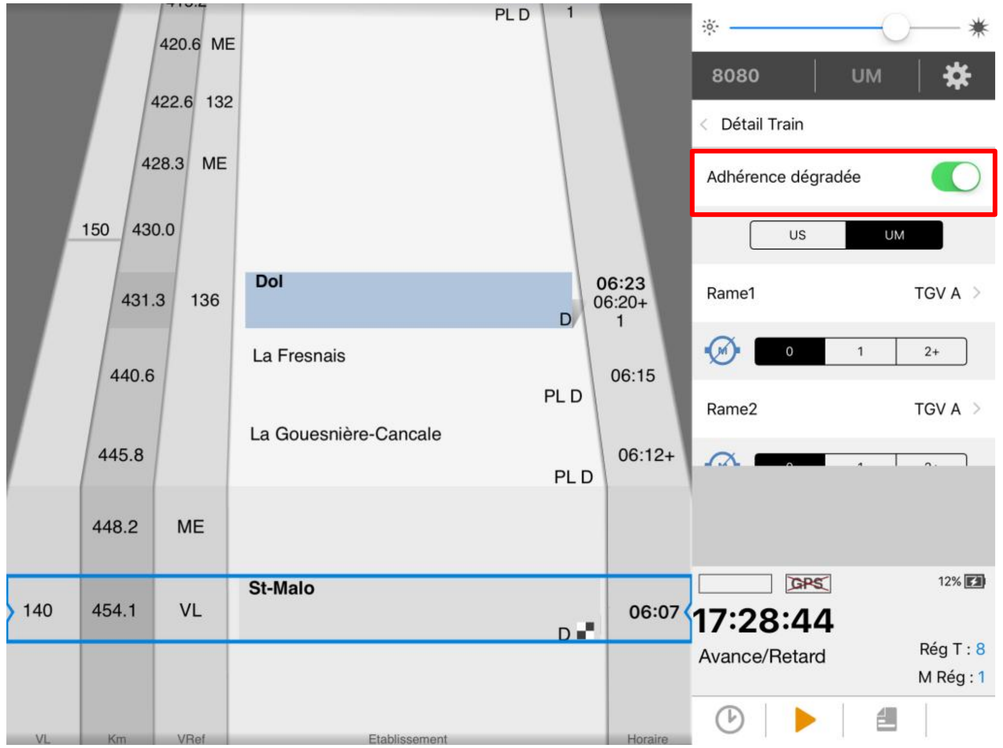
The drivers have a direct perception of the state of the rail.

A live information allows to recalculate for the train but also to anticipate the vehicule routing and scheduling.

Introduction to the Poster

The driver can indicate at any time during the driving a zone where the adhesion is particularly degraded





Introduction to the Poster

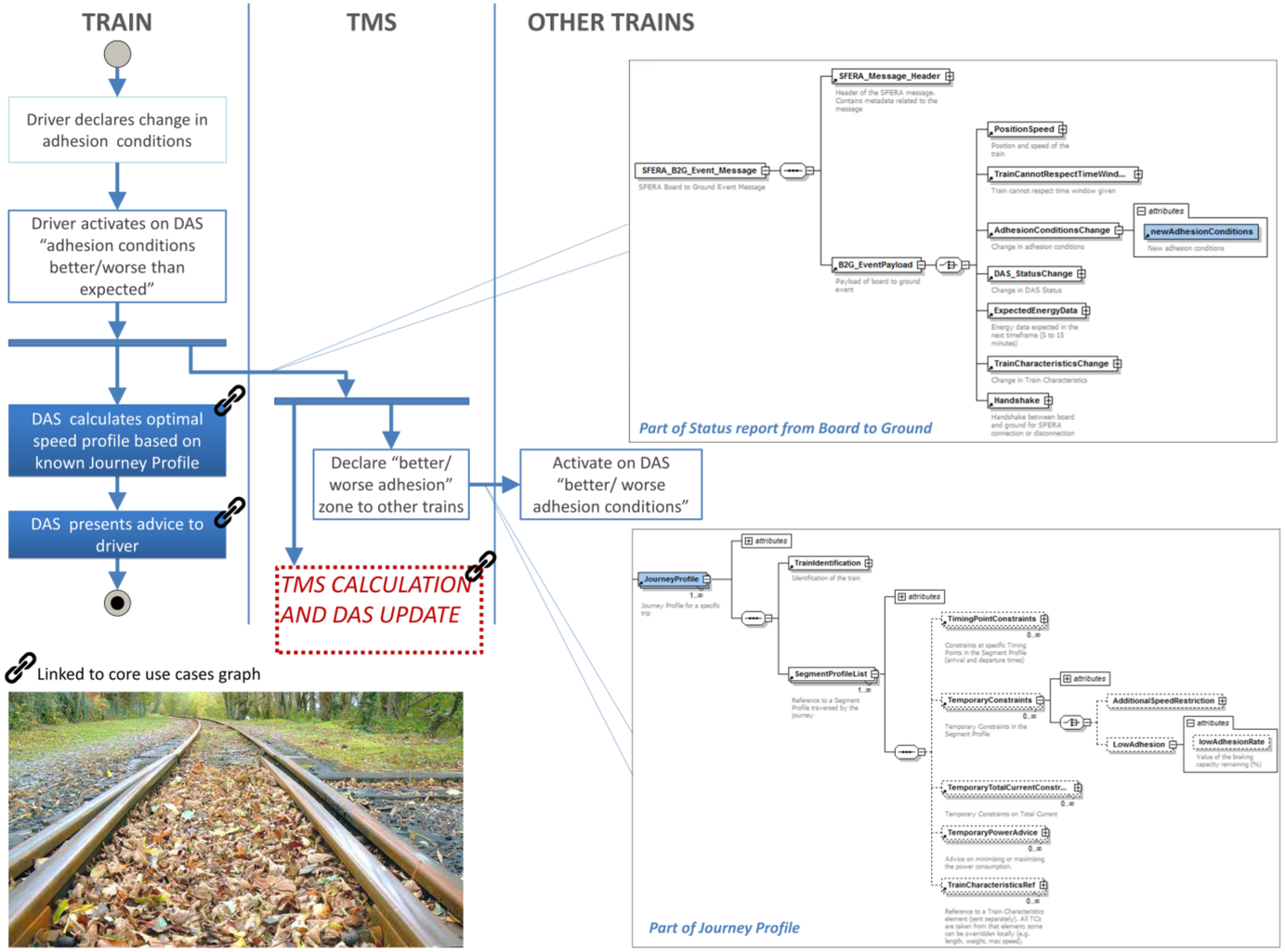
DEGRADED ADHESION USE CASE

WHY ?
- In case of low adhesion, trains will need more time to accelerate and to brake
- The theoretical schedule can not be respected
- DAS needs this information to calculate the optimal trajectory

WHAT ?
- Driver can indicate better or worse adhesion conditions
- Information is transmitted to Traffic Management (TMS)
- Traffic Management informs all trains on expected lower adhesion conditions on parts of the infrastructure

BENEFITS
- Anticipate the organization of the scheduling.
- Protect the rolling stock

REMARKS
- With built-in DAS the feedback can be given automatically from train towards DAS.



Key Takeaways: What You Really Need to Know

- Climate-related events often have an impact on the reliability of the vehicle routing and scheduling
- A consideration of the degraded adhesion allows to anticipate and to adapt the vehicle routing and scheduling
- An adapted vehicle routing and scheduling limits the degradation of the rolling stock and infrastructure
- The early information of the customers is always better perceived

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IRS 90940
Message Structure

Harm Jonker, Tibor Weidner, Alain Wenmaekers

IRS 90940 (Project SFERA) Stakeholder Workshop, Paris 05/11/2018

Who we are

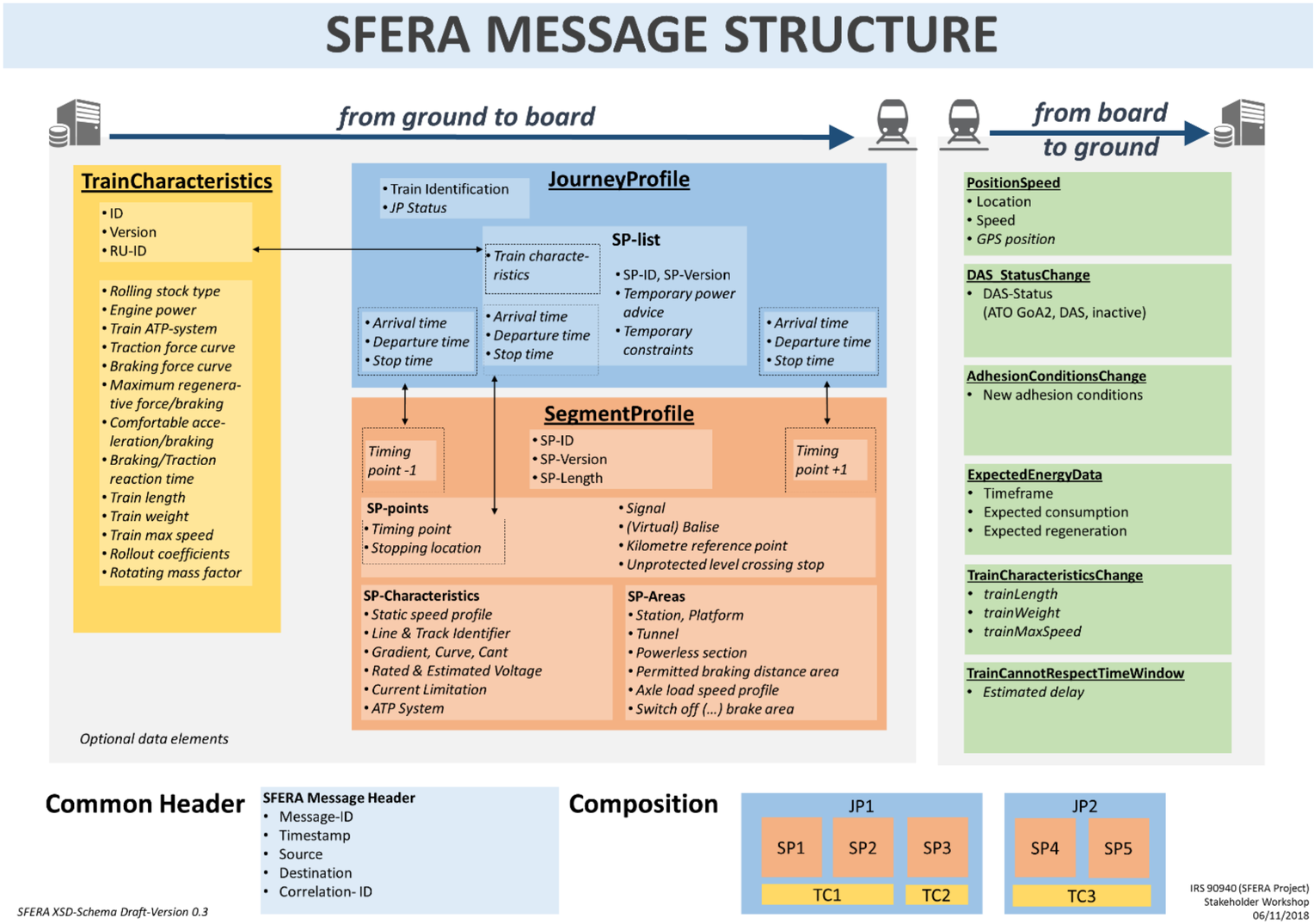
- **Harm Jonker**
  Nederlandse Spoorwegen
  IT department for supporting operations staff
  Solutions architect mobile

- **Tibor Weidner**
  DB Netz AG
  Algorithms specialist for traffic management and connected DAS

- **Alain Wenmaekers**
  Infrabel ICT
  Traffic Management
  Business analyst for the domains *Train planning*, *Simulation* and *Analytics*

The poster

Look for this poster to find us



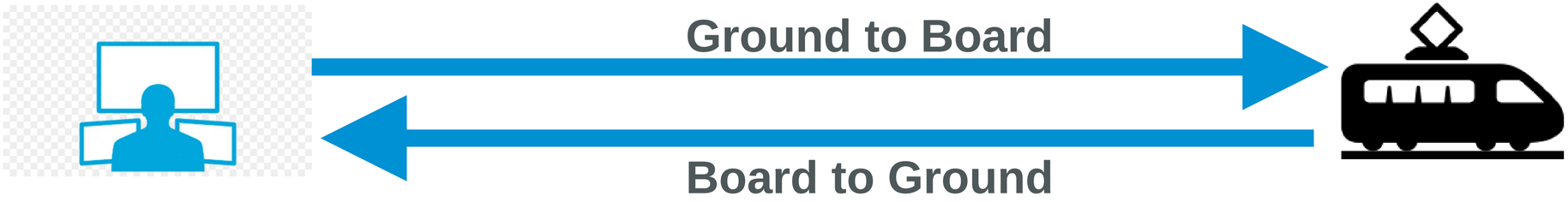
Purpose of the message structure

- The SFERA messages are
  - Flexible
  - Extensible
  - Interoperable

  Use of XML (instead of binary formats)
- Structure that is compatible with ATO Over ETCS Subset 126
  - Subset 126 messages can be expressed in SFERA
- Avoid using mandatory parts
  - Not all IMs and RUs are able to deliver full datasets
  - Target on the minimum what is needed to operate a (connected) DAS
- Train point of view
  - Concentrate on the events a train run will encounter

Message flows

- Two types of messages
  - Ground-to-Board: used to communicate data from the TMS to the onboard DAS
  - Board-to-Ground: used to communicate status and conditions information from the onboard DAS to the TMS
- Two communication patterns
  - Request/Response based: for data on demand use cases
  - Event based: actively publish changes to interested systems

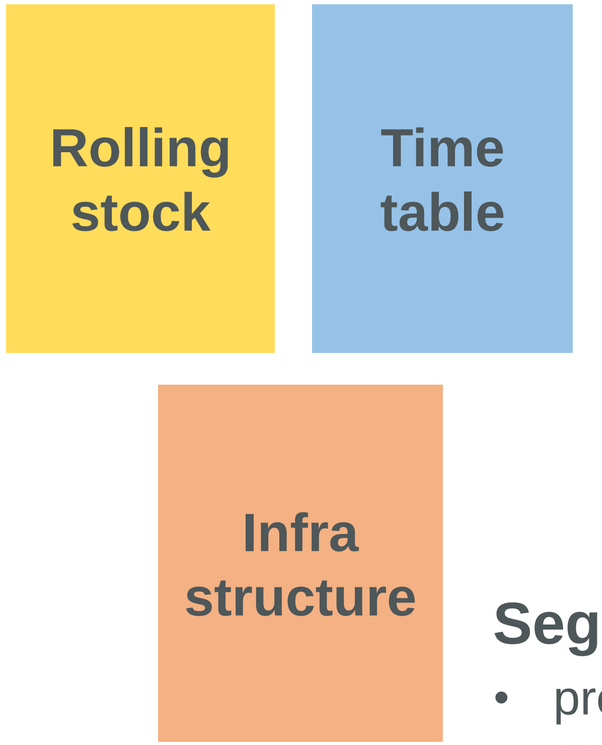


Ground-to-board structure

Ground-to-board messages are based on Subset 126 information structure

Train Characteristics

- mainly fixed by RU-planning
- changes sometimes
- train composition changes
- temporary rolling stock limitations



Journey Profile

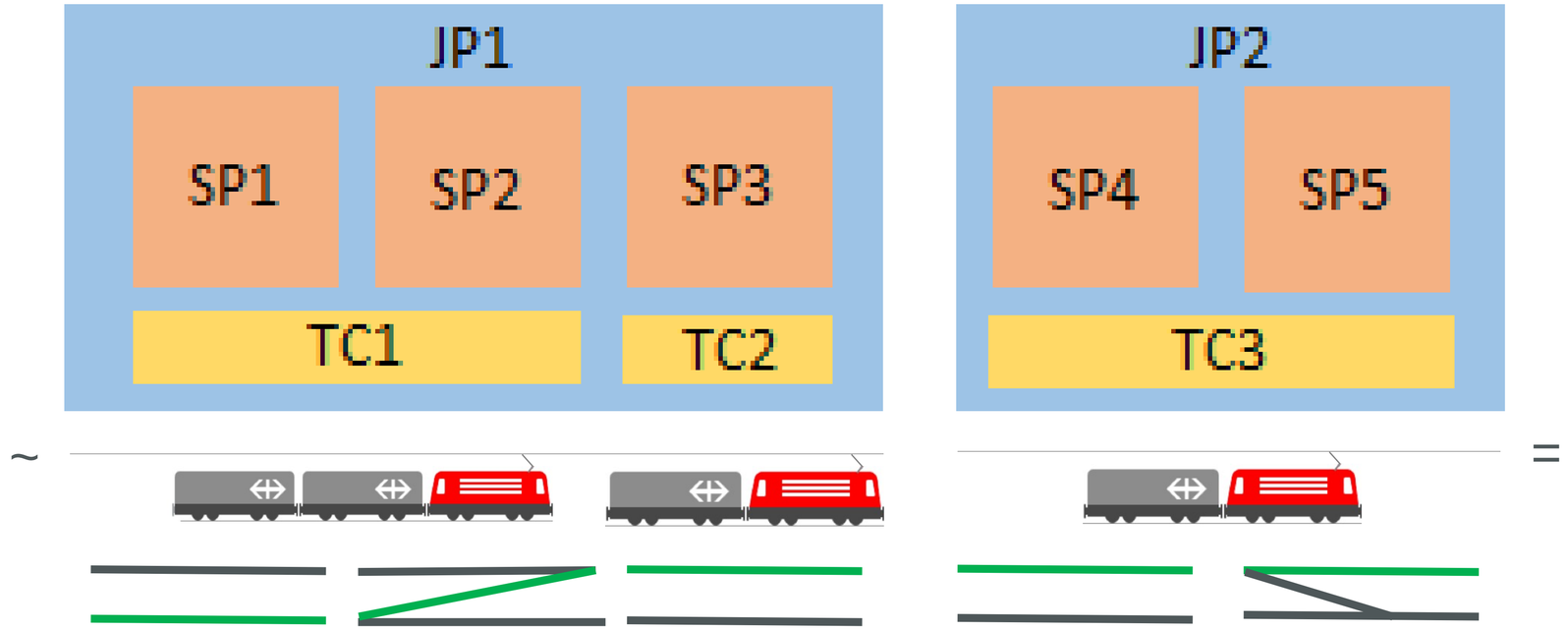
- highly variable
- many updates to adjust train movements to current traffic situation

Segment Profile

- pretty static structure
- same for many train journeys

Ground-to-board example

A complete journey for a trip from one country to the neighbouring country could look like this:



Board-to-ground messages

Board-to-ground messages serve to give status or feedback to TMS according to use cases defined in the working group

Currently foreseen:

- Position and speed
- DAS status change
- Change of adhesion conditions
- Expected energy consumption
- Train cannot respect time window

Progress of Message Structure definitions

- Ground-to-board messages: stable, nearly final
- Board-to-ground messages: need additional input and finalisation

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Communications

Challenges and Solutions

Bart van der Spiegel – Infrabel

Christophe Tassin – SNCB / NMBS

Jan Hoogenraad – NS /Spoorgloren

IRS 90940 (Project SFERA) Stakeholder Workshop, Paris 05/11/2018

Who we are

- **Jan Hoogenraad**
  Consultant
  NS /Spoorgloren

- **Christophe Tassin**
  Engineer Energy Efficiency and Innovation
  SNCB / NMBS

- **Bart Van der Spiegel**
  Expert Energy Management
  Infrabel

What is difficult on SFERA communication protocols ?

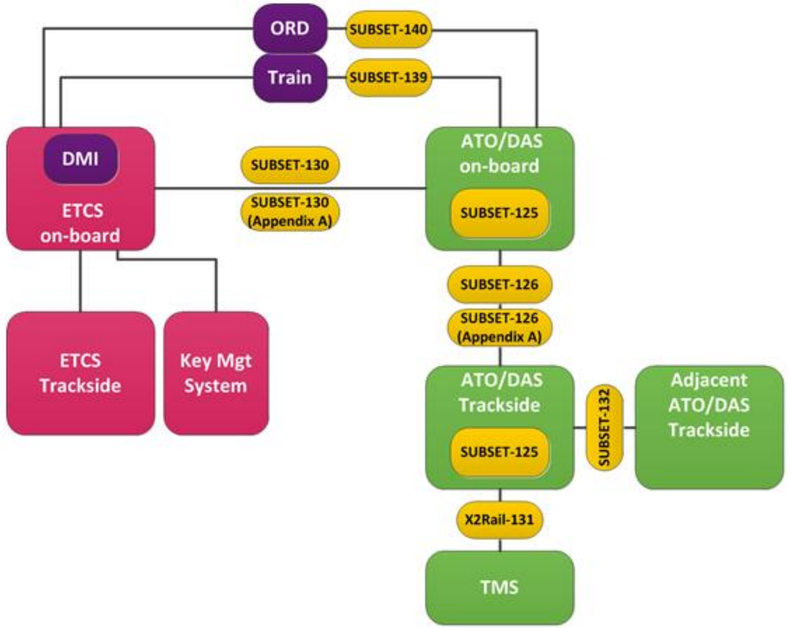
- We start with a working S-DAS SFERA protocol
  - Communication to train is easy: fire and forget
  - Communication IM-RU needs to be compatible as well

- For C-DAS, we need a compatible protocol which is:
  - Secure,
  - Reliable,
  - and Interoperable,

- Bidirectional communication.
- Compatible with DAS and ATO.

How did we implement SFERA communication protocols ?

- Data layer independent of content and S-DAS or C-DAS or ATO
- Three different supported communication architectures.
  - **BACK OFFICE TO BACK OFFICE**
  - **USING ATO OVER ETCS**
  - **DIRECT COMMUNICATION**
- Two architectures well defined, one under construction.



Introduction to the Poster.

- Our poster covers
  - The 3 architectures
  - The benefits of each architecture
- Come and discuss the different architectures with us

COMMUNICATION

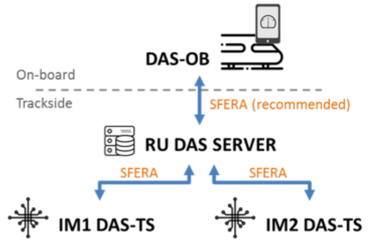
WHY ?
- Secure reliable and interoperable bidirectional communication.
- Compatible with DAS and ATO.

WHAT ?
- Data layer independent of content.
- Three different supported communication architectures.
- Two architectures well defined, one under construction.

BENEFITS
- SFERA extends ATO over ETCS beyond Baseline 3+ Full Supervision and remains compatible.
- Same IM server can be used for the three architectures.
- Architecture can be chosen based on preference of RU.

REMARKS
- All three communications can be used for DAS and ATO.

BACK OFFICE TO BACK OFFICE

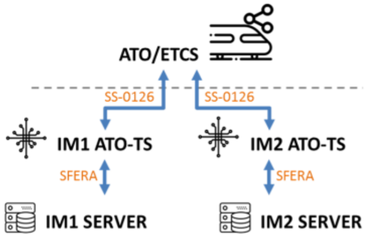


WHAT ?
- Back office communication between IM and RU.
- Communication with device on train guaranteed by RU.

BENEFITS ?
- Integrates with existing devices and data feeds of RU.
- On ground IM-RU link (with high reliability).
- Easy to reach good performance.
- Applicable to class B trains and lines.

REMARKS
- RU Server may be offered as a service by third party.

USING ATO OVER ETCS

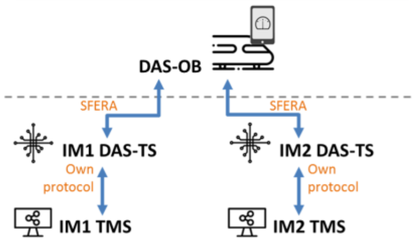


WHAT ?
- Communication via ATO-TS (according to ATO over ETCS standards).
- With trains and lines equipped with ETCS Baseline 3+ Full Supervision.

BENEFITS ?
- Performance guaranteed by ETCS.
- Same SFERA dataset usable for trackside data preparation.

REMARKS
- SFERA can be translated to the binary Subset 126.

DIRECT COMMUNICATION



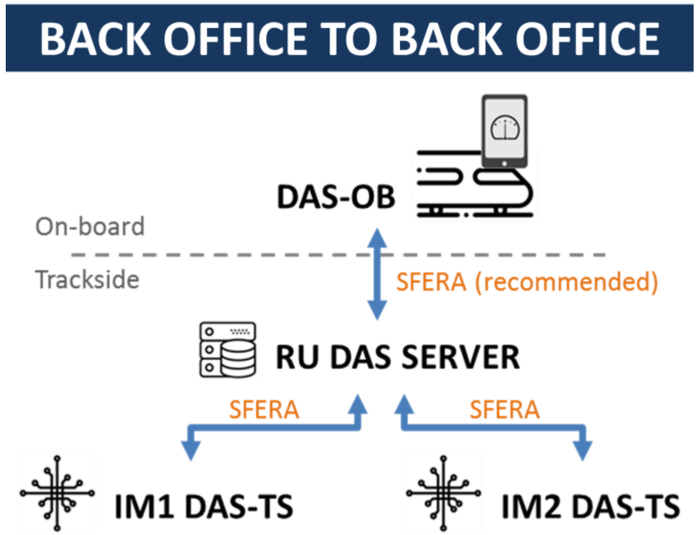
WHAT ?
- Device on train communicates with IM responsible for area where train is running.

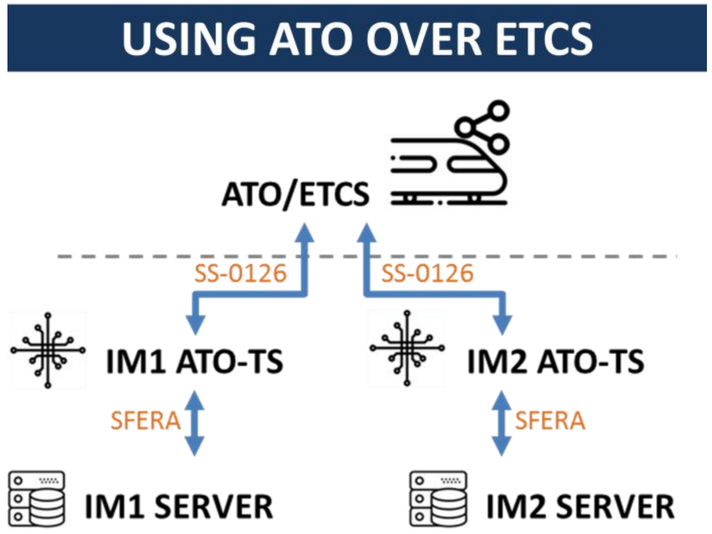
BENEFITS ?
- No ground RU-servers needed.
- Public communication infrastructure may be used.
- Applicable to class B trains and lines.

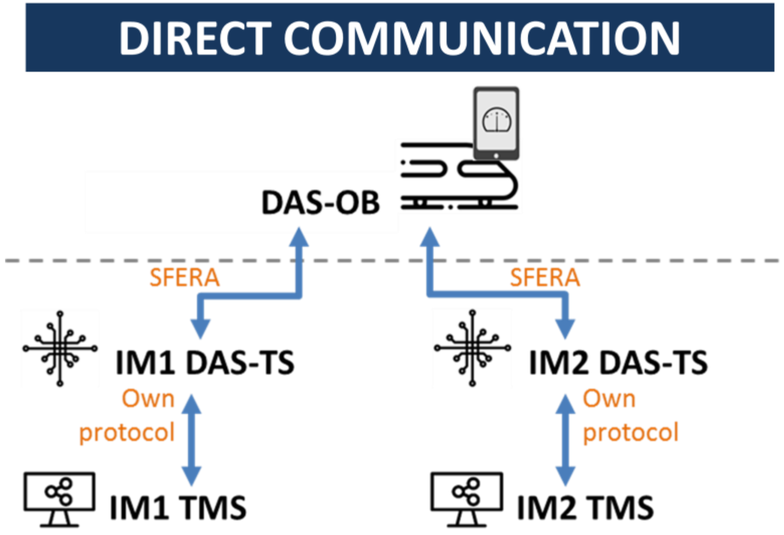
REMARKS
- Not identified yet.
- Challenging in keeping interoperability.
- Implementation can be different for handheld and built-in device.

Key Takeaways: What You Really Need to Know.

- By separating the data layer from the communications layer, IM and RU systems can be kept simple
- By supporting 3 architectures, SFERA has solutions for most IM-s and RU-s in Europe.
- 2 architectures are already in use







INTERNATIONAL UNION
OF RAILWAYS

PROOF OF CONCEPT

On Thalys runs

Theo Vis - NS

Chloé Lima-Vanzeler – SNCF Mobilités

IRS 90940 (Project SFERA) Stakeholder Workshop, Paris 05/11/2018

Who we are

- **Theo Vis**

  Requirements engineer

  NS

- **Chloé Lima-Vanzeler**

  Program manager in traction energy efficiency

  SNCF Mobilités

The goals of the POC

- ✓ Check the consistency of SFERA standard message
- ✓ Check that DAS can operate with SFERA data

PROOF OF CONCEPT

PROOF OF CONCEPT

		FR	BE	NL
1	Check data availability for every country	✓	✓	✓
2	Translate FR / BE / NL data > SFERA	✓	✓	✓
3	Bring the 3 countries' data together	✓	✓	✓
4	Integrate the data into Opti-conduite DAS (SNCF)	✓		
5	Integrate the data into TimTim DAS (NS)			✓

PROOF OF CONCEPT

DATA PREPARATION

TEST LIVE IN PASSENGER COACH

25/10/18

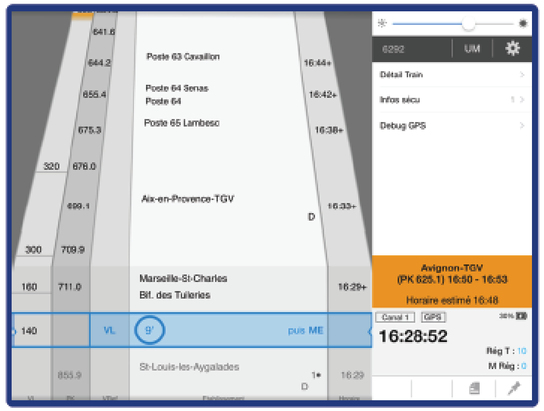
TEST LIVE IN DRIVER COACH

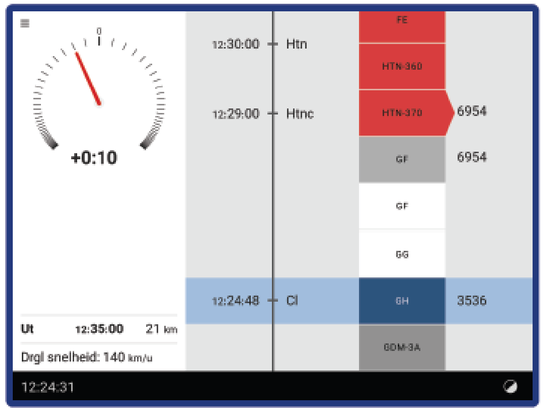
Coming soon

THALYS

Paris ← → Amsterdam

10 experts





2 DAS

10 devices

THE POSTER

THALYS TEST

Why / Waarom / Pourquoi

- Make sure the data of the 3 countries fit into the standard SFERA language
- Check the operation on S-DAS systems
- Make sure it works on the 3 networks (interoperable)
- Compare the native DAS systems

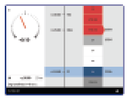
How / Hoe / Comment

	FR	BE	NL
1 Check data availability for every country	✓	✓	✓
2 Translate FR / BE / NL data > SFERA	✓	✓	✓
3 Bring the 3 countries' data together	✓	✓	✓
4 Integrate the data into Opti-conduite DAS (SNCF)	✓		
5 Integrate the data into TimTim DAS (NS)			✓

What / Wat / Quoi

2 Days Test

- 1 in passenger coach
- 1 with the driver

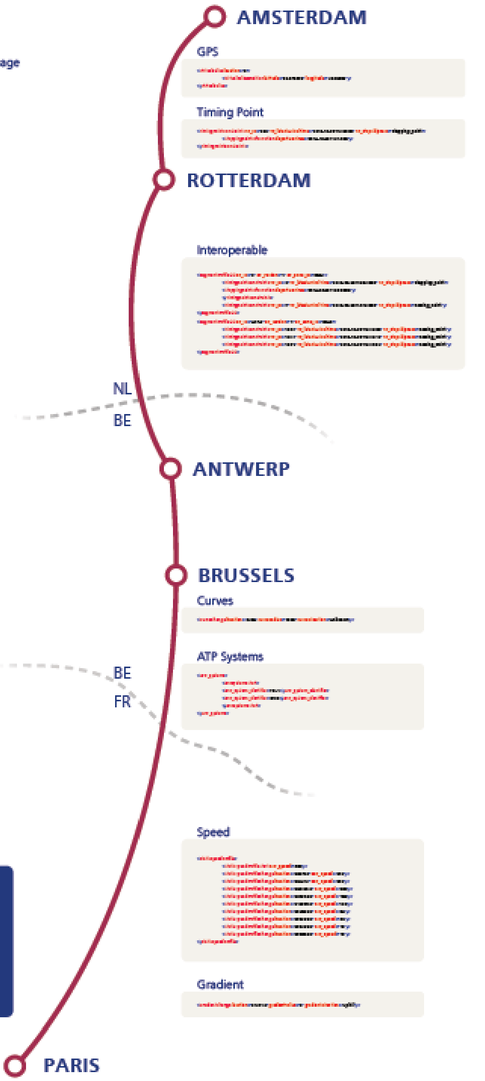


TimTim DAS (NS)

Opti-conduite DAS (SNCF)

Learnings

- Find small defects in the XML standard
- Difficult to collect all the (infra) data from infra managers (sources)
- Current DAS are working with different data



Key Takeaways: What You Really Need to Know

- A POC is being handled on an international Thalys trip with french and dutch existing DAS, integrating data from France + Belgium + Netherlands

- What has been done so far :
  - Data collection > translation into SFERA standard > integration in DAS
  - Run Paris → Amsterdam and back in passenger coach

  ➔ First results are ok : DAS operated well over the complete journey

- To be done :
  - Logs analysis
  - Run in driver cabin

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Thank you for your kind attention