INTERNATIONAL UNION
OF RAILWAYS

WELCOME TO THE SFERA WEBINAR !

Starting in few minutes…

Please mute your microphone & camera if you're not talking

To ask questions, please use the Chat (top right)

4 June 2020

INTERNATIONAL UNION
OF RAILWAYS

WELCOME TO THE SFERA WEBINAR !

Foreword

Jean-Michel Evanghelou
Deputy Director Rail System, UIC

4 June 2020

Introduction

Agenda

I. Presentation of the project + the IRS

II. How the different parts of SFERA interact

III. Maintenance + next steps

Agenda

I. Presentation of the project + the IRS — Chloé Lima-Vanzeler

II. How the different parts of SFERA interact

III. Maintenance of the standard

Presentation of the team

UIC SFERA Group

DB Netz	DB Cargo
SNCF Réseau	SNCF Passengers
ProRail	ÖBB
Trafikverket	SNCB
Banenor	NS
Infrabel	SBB

#Drivers #DAS #Traffic management #Energy management

What is SFERA

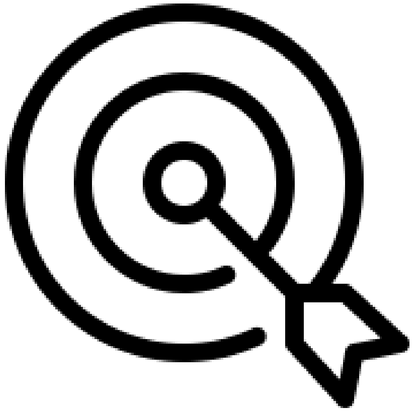
Smart communications
For
Efficient
Rail
Activities

Single messaging standard for data exchange between IMs, RUs and on-board devices

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

Targets

- **Interoperability** of DAS
- **Automate the information transmission between TMS and all trains**, by implementing the conditions for the development of "off the shelf" C-DAS products.
- **Help ATO over ERTMS implementation** through data flows preparation



A 4 years project

The IRS

AIM

Support the implementation of the **SFERA protocol** in DAS (Connected or Standalone), TMS and ATO.

CONTENT

It defines a standard for data exchange and includes:

- **content and format of data** exchanged between DAS and TMS,
- **use cases** for data exchange with DAS,
- **communication architectures**,
- basic **functional requirements** needed to ensure the compatibility of the systems.

USERS

Railway Undertakings / Infrastructure Managers / DAS suppliers / other IT systems & software suppliers.

The structure of the documents


INTERNATIONAL RAILWAY SOLUTION

IRS 90940

Draft 1.15 20 March 2020
For 1st edition: May 2020
Version: Original
Original version: English
Distribution format: .docx

Digitalisation, Data, Emerging Innovations

Exchange of Data

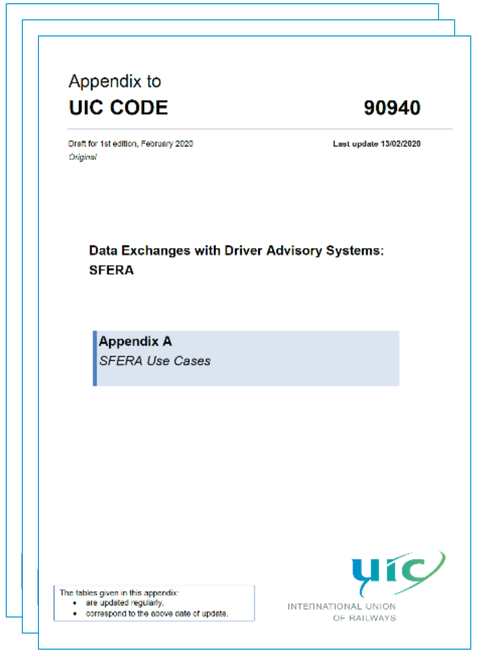
Data exchange with Driver Advisory Systems (DAS) following the SFERA protocol

IRS

Core document – 50 pages

- Requirements of the exchange protocol
- The Journey Profile Model
- Data Structure
- Communication Mechanisms
- Maintenance of SFERA

+


Appendix to
UIC CODE 90940

Draft for 1st edition, February 2020 Last update 13/02/2020
Original

Data Exchanges with Driver Advisory Systems: SFERA

Appendix A
SFERA Use Cases

The tables given in this appendix:
- are updated regularly,
- correspond to the above date of update.

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Appendices :

Appendix A – SFERA Use Cases
Appendix B – SFERA Communication Protocol
Appendix C – SFERA Implementation Cases
Appendix D – SFERA XML Schema Definition
Appendix E – SFERA Data Handbook
Appendix F – Sample SFERA XML Communications
Appendix G – Correspondence Table SUBSET-126/SFERA
Appendix H – Error codes in SFERA

Access conditions

When?
Publication closely following the webinar, June 2020

Where?
On the UIC ETF online shop:
https://www.shop-etf.com/en/leaflets-irs

https://appendices.uic.org

Who?
Available to all
For free

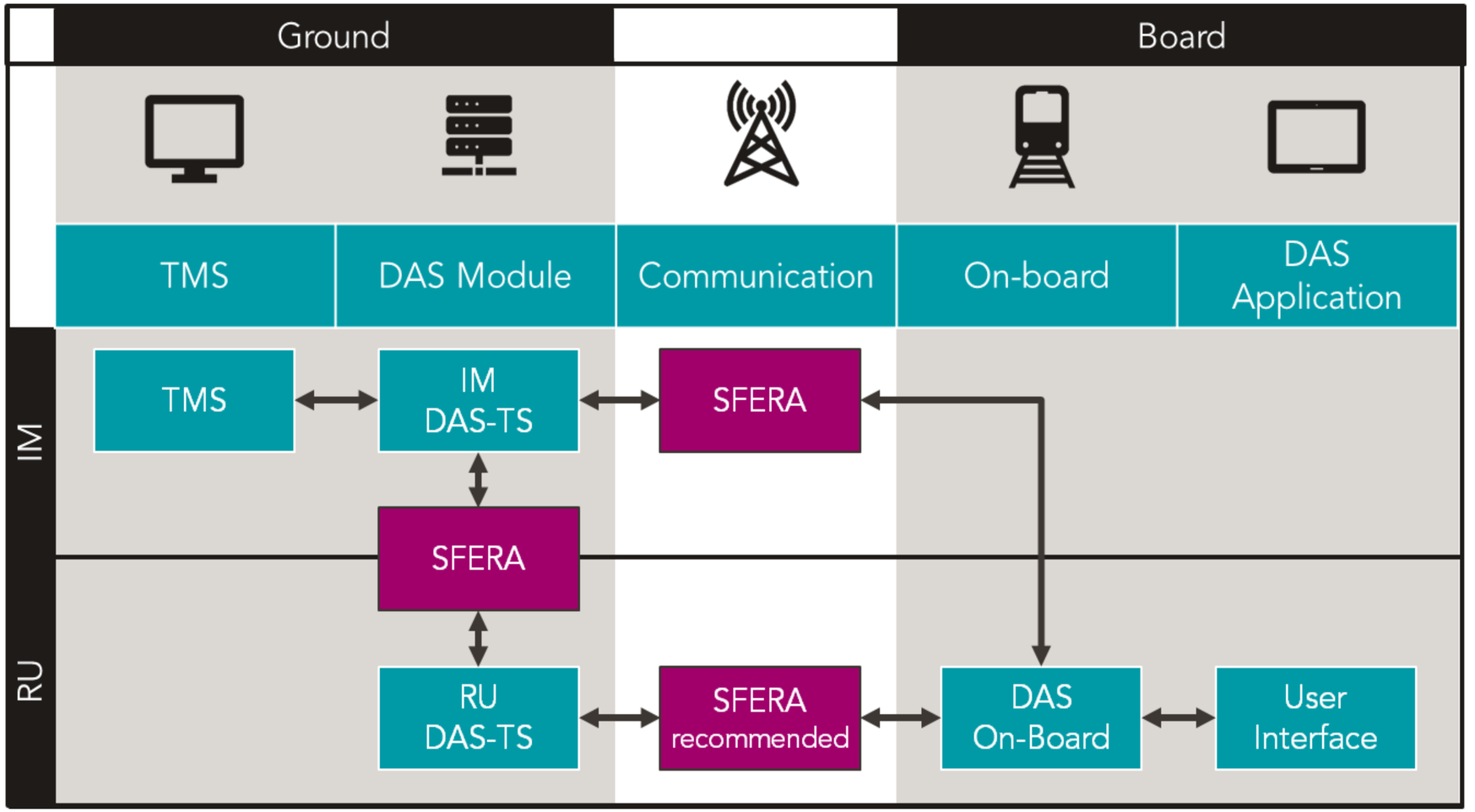
Agenda

I. Presentation of the project + the IRS — Chloé Lima-Vanzeler

II. How the different parts of SFERA interact — Bart Van der Spiegel
- High level system overview
- The Journey Profile Model
- Use Cases
- Communication Mechanisms

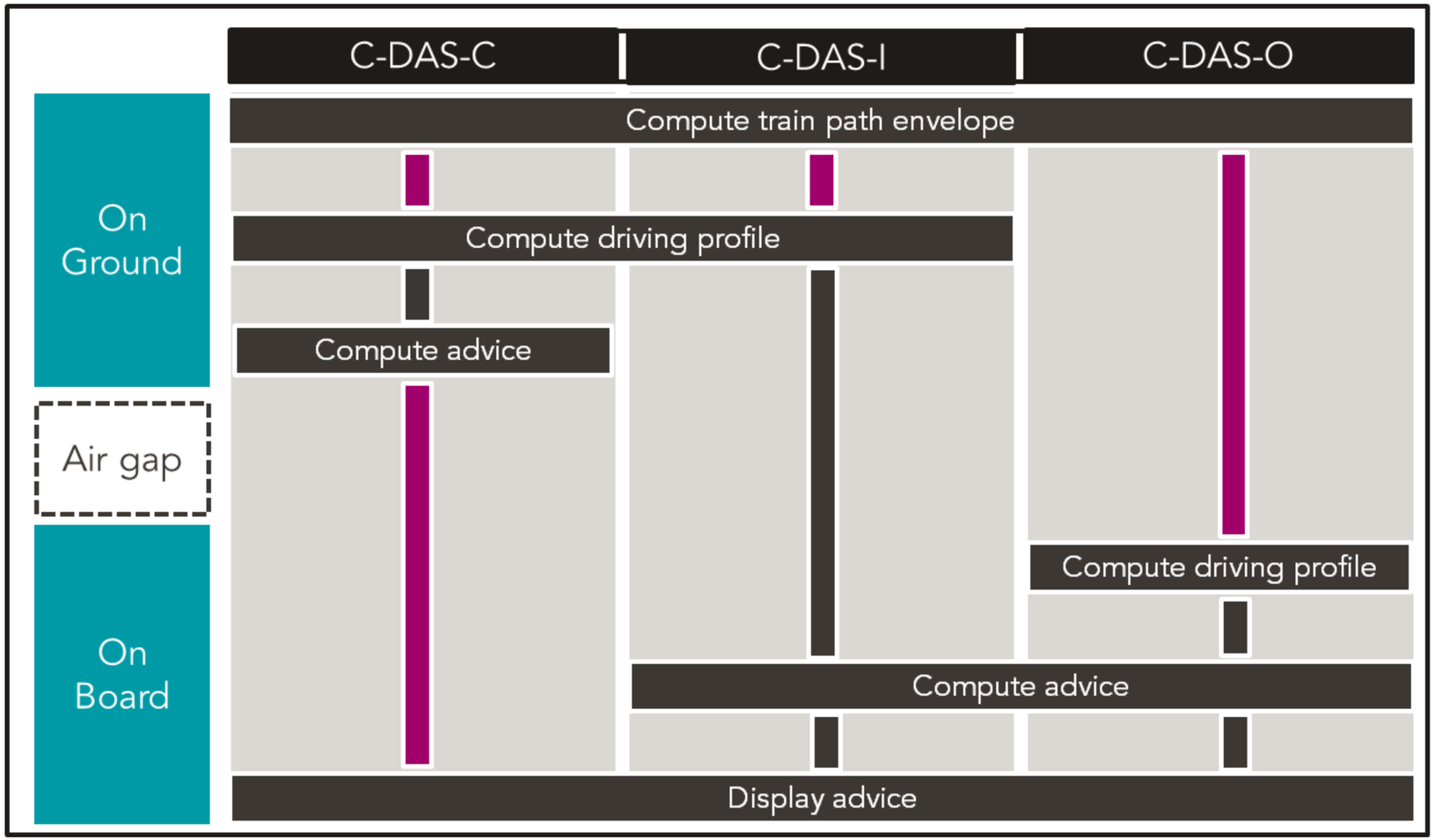
III. Maintenance of the standard

High-level system overview



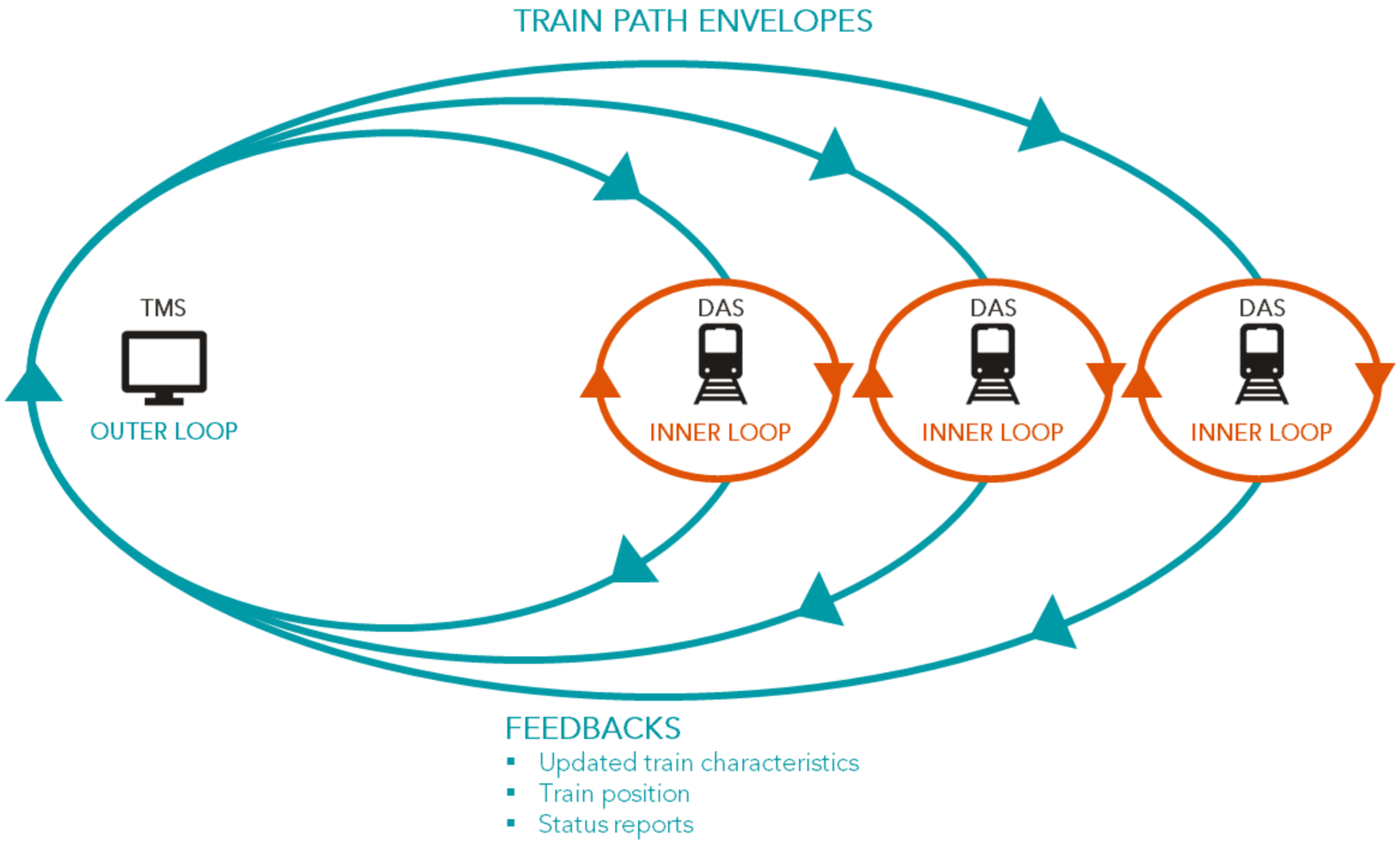
- Bidirectional communication between TMS and a DAS on-board
- Direct or via a ground server of the RU

High-level system overview



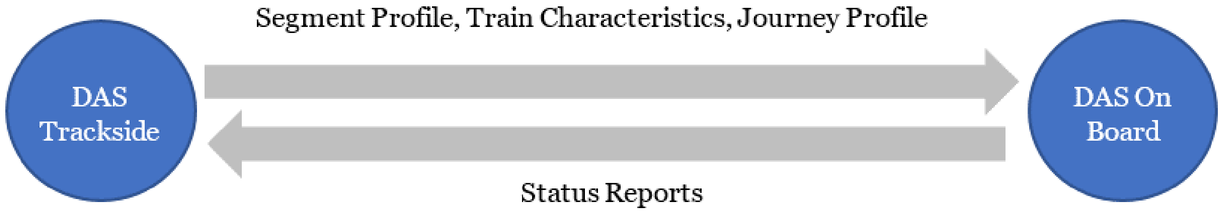
- SFERA focuses on C-DAS-O (TPE sent to On-Board where advice is computed)
- C-DAS-C (explicit advice sent to On-Board) supported for transition
- C-DAS-I not supported

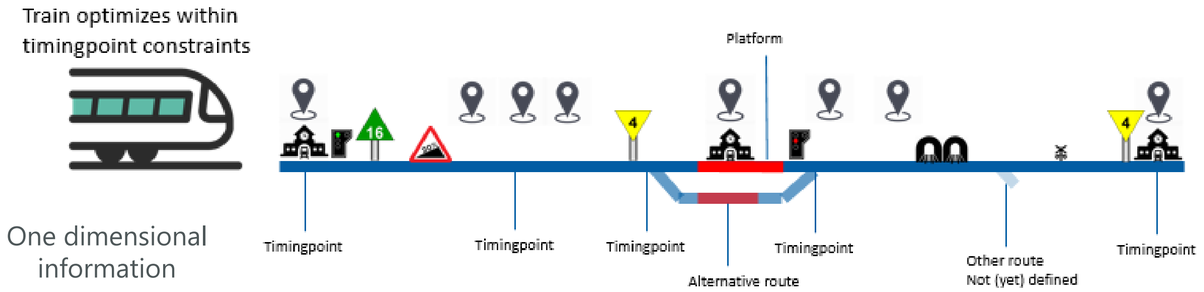
High-level system overview



- Each DAS has its own optimisation algorithm.
- Each DAS sends feedback to TMS.
- TMS detects conflicts, defines optimal solution and adjusts Train Path Envelopes.
- A Train Path Envelope contains the periods of time in which a train can pass each of the significant locations of its train-run.

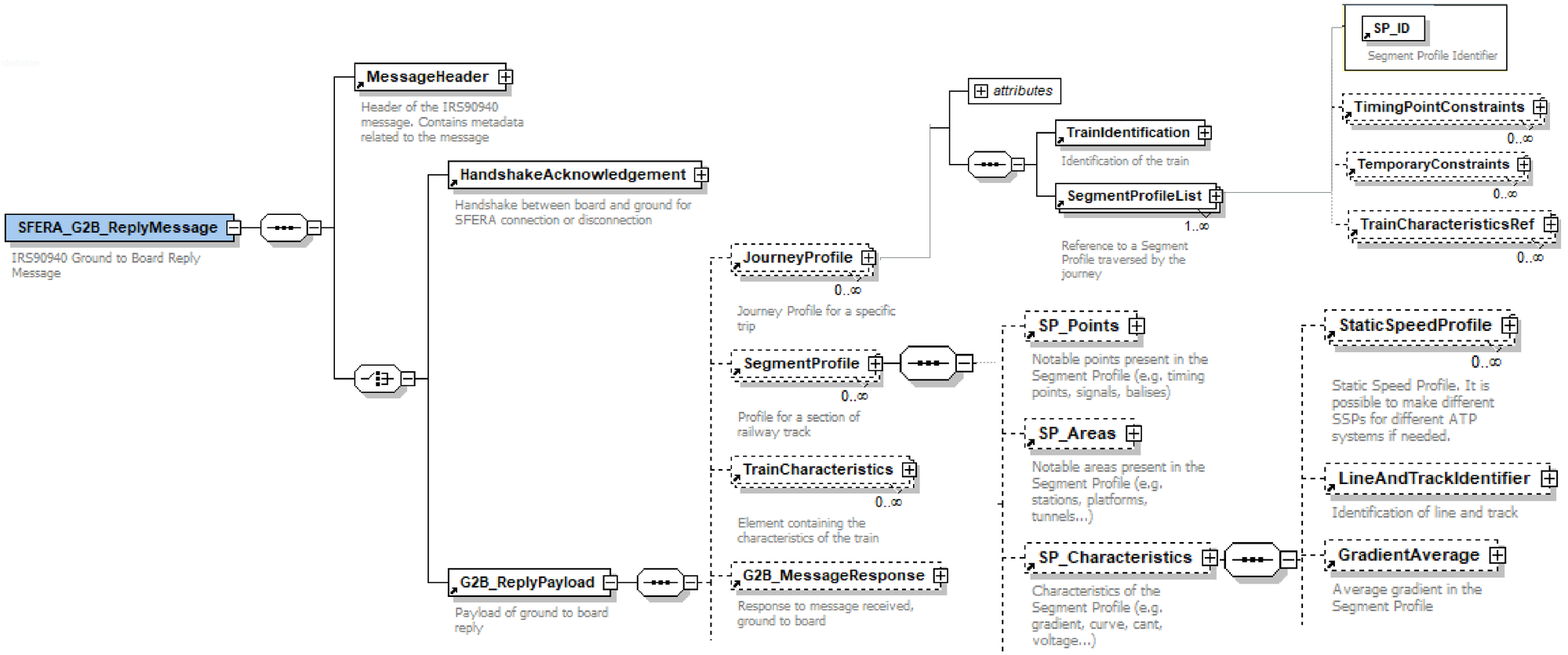
The Journey Profile Model
(inspired from SUBSET-126 of ATO over ETCS)



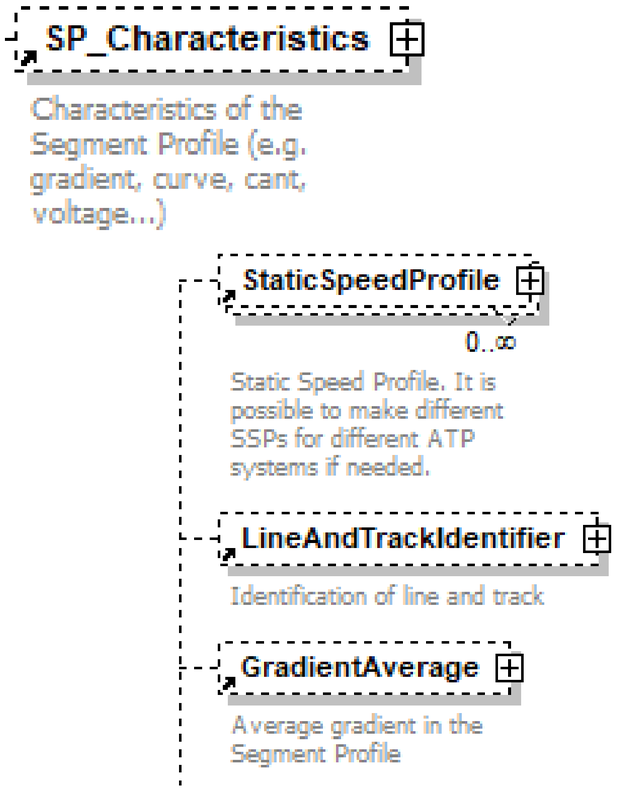


- Journey Profile (JP):
  - Unique train ID
  - Timing restrictions (incl. stopping points)
  - Dynamic data like temporary constraints
  - Link to SPs and TCs
- Segment Profile (SP):
  - Mostly static infrastructure data
  - Points (e.g. signals and balises)
  - Areas (e.g. platforms and powerless sections)
  - Characteristics (e.g. static speed profiles and gradients)
- Train Characteristics (TC):
  - Information about rolling stock type
  - Length and weight of train
  - ATP system supported by train
- Status Report (SR):
  - Position and speed of train
  - Times at recent and next timing points
  - Any changes of train characteristics or adhesion
  - Expected consumption and regeneration.

The Journey Profile Model
(inspired from SUBSET-126 of ATO over ETCS)



The Journey Profile Model
(inspired from SUBSET-126 of ATO over ETCS)



Translating a part of this XML structure into an XML file with some SP_Characteristics between Antwerpen-Luchtbal and Antwerpen-Centraal

```
<SP_Characteristics>
    <LineAndTrackIdentifier>
        <LineAndTrackIdentifierStart lineIdentifier="250" lineName="25" trackIdentifier="771-2"/>
    </LineAndTrackIdentifier>
    <StaticSpeedProfile>
        <StaticSpeedProfileStart speed="130"/>
        <StaticSpeedProfileChange location="1442" speed="60" beginEndTrain="Begin"/>
        <StaticSpeedProfileChange location="3073" speed="90" beginEndTrain="Begin"/>
    </PermittedSpeed>
    <GradientAverage>
        <GradientAverageStart gradientValue="18.74" gradientDirection="Uphill"/>
        <GradientAverageChange location="97" gradientValue="8.3" gradientDirection="Uphill"/>
        <GradientAverageChange location="297" gradientValue="8.5" gradientDirection="Uphill"/>
        <GradientAverageChange location="557" gradientValue="6.52" gradientDirection="Downhill"/>
        <GradientAverageChange location="672" gradientValue="6.44" gradientDirection="Downhill"/>
        <GradientAverageChange location="942" gradientValue="28.97" gradientDirection="Downhill"/>
        <GradientAverageChange location="1846" gradientValue="5.68" gradientDirection="Downhill"/>
        <GradientAverageChange location="2260" gradientValue="1.01" gradientDirection="Uphill"/>
        <GradientAverageChange location="2528" gradientValue="7.09" gradientDirection="Uphill"/>
        <GradientAverageChange location="2882" gradientValue="0.16" gradientDirection="Downhill"/>
        <GradientAverageChange location="3010" gradientValue="0.19" gradientDirection="Downhill"/>
        <GradientAverageChange location="3114" gradientValue="0.31" gradientDirection="Uphill"/>
    </GradientAverage>
```

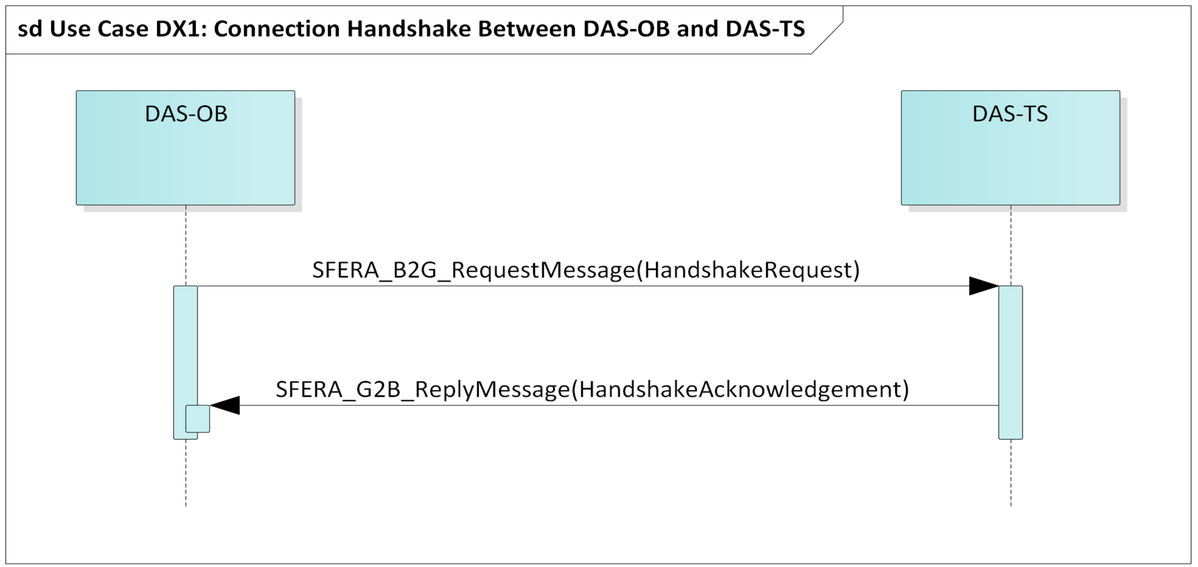
Use Cases: overview

- Data Exchange (DX):
  use cases related to the connection and disconnection process, and the transition between IM networks
- Journey Profile (JP):
  use cases related to the transmission of the elements necessary for a DAS to generate advice in a C-DAS-O configuration (JP and associated elements TC, SP)
- Train Characteristics (TC):
  use cases when a driver declares an error or a change in the Train Characteristics used at a given moment
- traction PoWer (PW):
  specific use cases related to the management of the power (positive or negative) used by trains on electrified routes, and the traction power infrastructure (substations, distribution grid)
- Status Report (SR):
  use cases related to the exchange of information initiated by the DAS, in majority for feedback purposes to the TMS
- DAS Status (DS):
  use cases related to the management of the status of different DAS devices
- C-DAS-C (CDC):
  use cases related to the transmission of the elements necessary for a DAS to present advice in a C-DAS-C configuration

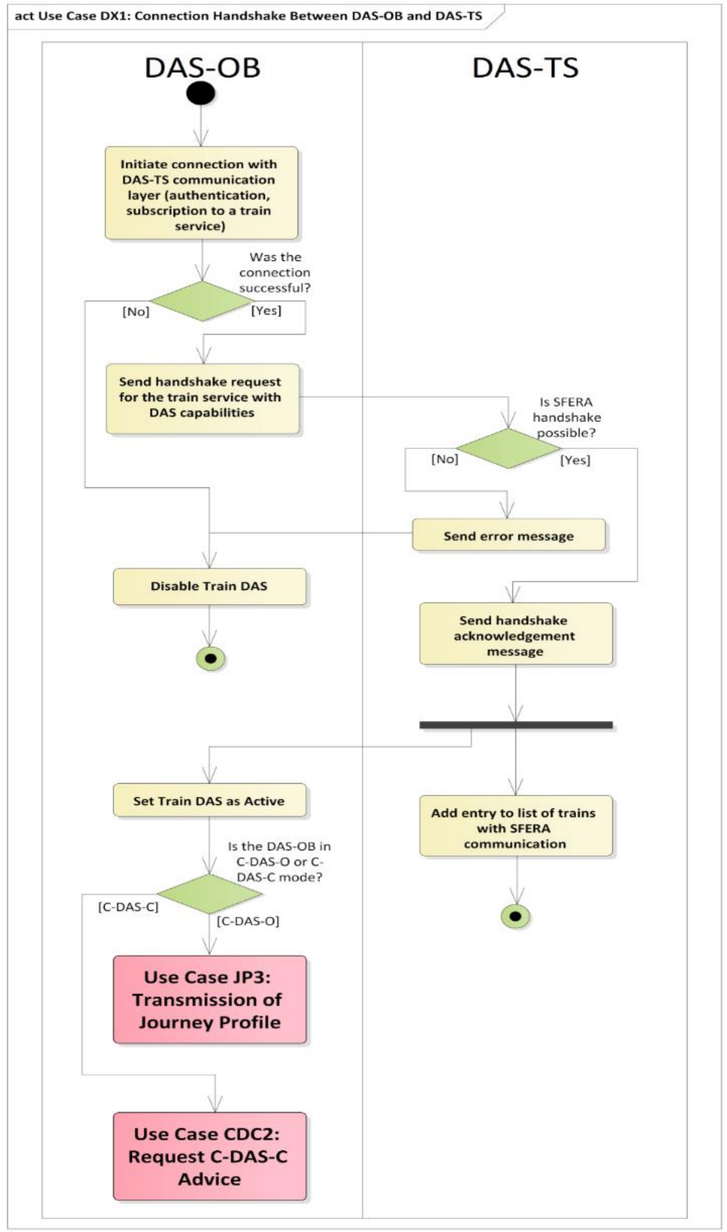
Use Cases: example

Each use case is described with an activity diagram.
While useful, also a sequence diagram is available.
A table represents the applicability:

DAS capabilities	ATO GoA2, C-DAS-O, C-DAS-C, S-DAS
DAS behaviour	Standalone, Connected, C-DAS-C_Only
DAS statuses	N/A (before connection, the DAS has no status)

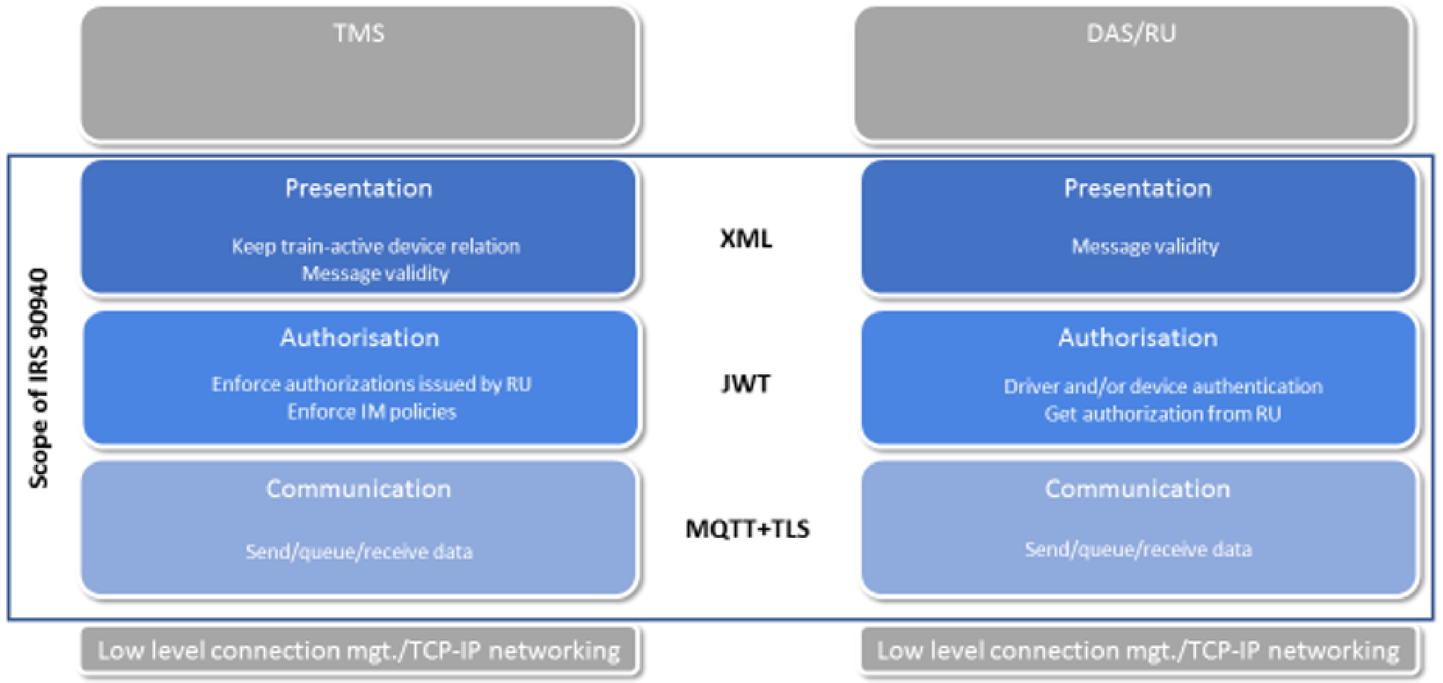


Sequence diagram DX1 – Connection Handshake



Activity diagram DX1 – Connection Handshake

Communication Mechanisms



- Presentation Layer:
  - Using XML structure of the Journey Profile Model
- Authorisation Layer:
  - Reflecting separation of responsibilities, e.g. RU is responsible for devices
  - protocol: signed JSON web tokens (IETF RFC7519 standard)
- Communication Layer:
  - Deals with reliable communication and the logic for distributing messages to the right DAS devices
  - Protocol: Message Queuing Telemetry Transport (MQTT) Version 5 over a secured web socket (TLS).

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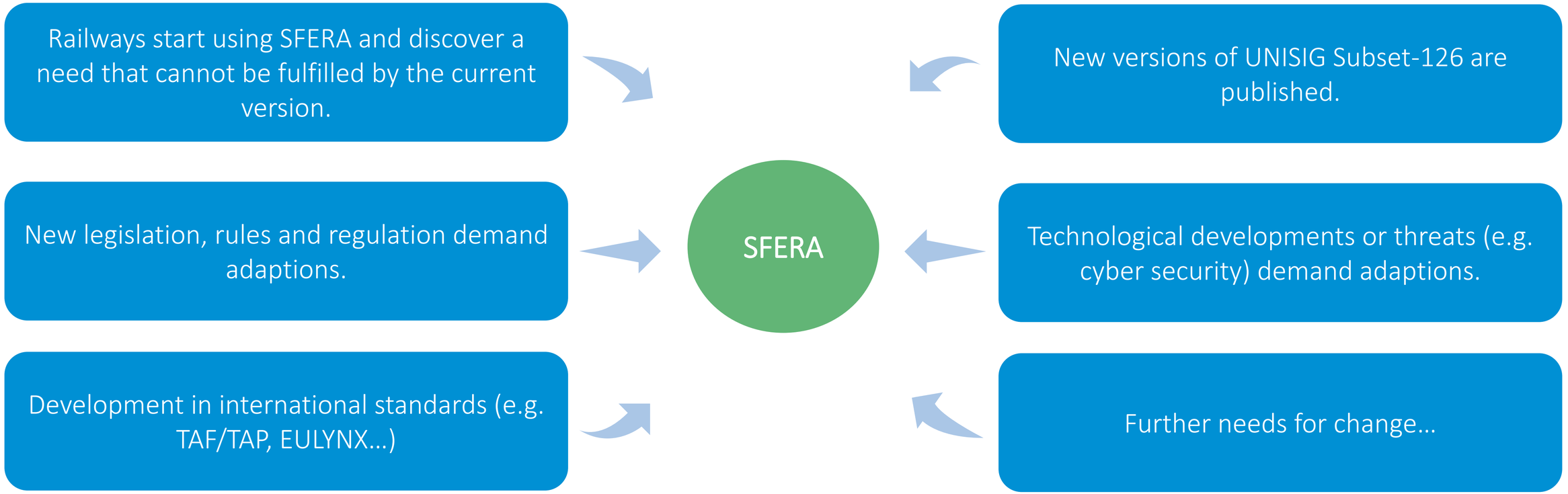
II. How the different parts of SFERA interact — Bart Van der Spiegel

III. Maintenance of the standard — Thomas Sutter

- Reasons for maintenance - WHY
- Maintenance procedure - HOW
- Participate in maintenance - WHO
- Next events - WHEN

Reasons for Maintenance of SFERA - WHY



➔ A procedure to cope with these new demands is needed.

Maintenance Procedure - HOW

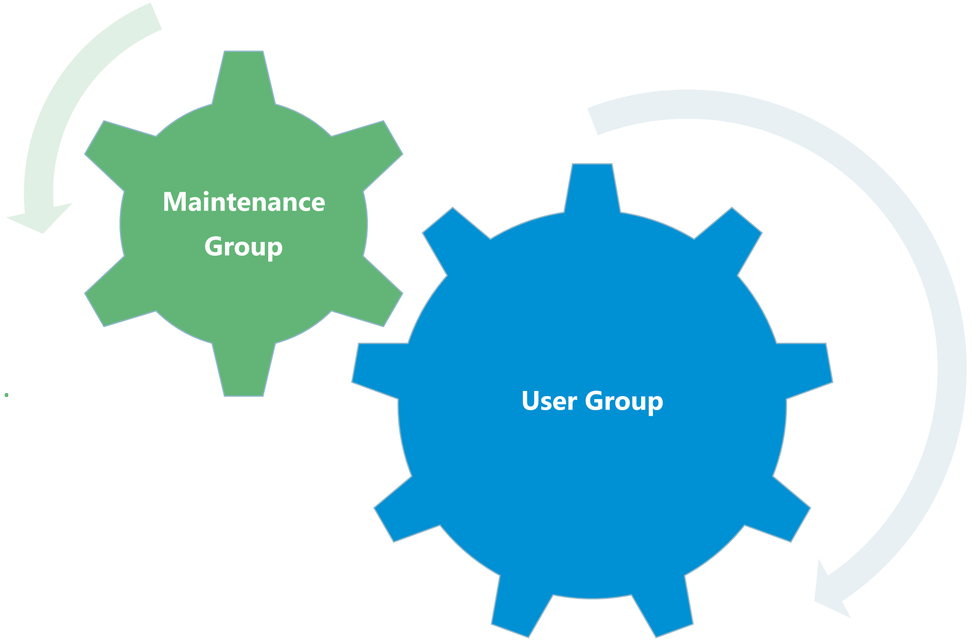
1. **Change Request:** UIC members can submit change requests to UIC by mail.
2. **First evaluation:** The UIC SFERA Secretary will make a first evaluation and determines the urgency (1/2 year or faster).
3. **Periodical Update:** The SFERA Maintenance Group meets twice per year to process the received change requests.
4. **Changes:** The SFERA Maintenance Group can publish small changes without consulting all UIC Members, large changes are subject to a formal publishing procedure.
5. **Publication:** All supported versions of SFERA and release notes will be published on the UIC website.

Participate in Maintenance - WHO

Maintenance Group:

Consists of UIC members.

- The Maintenance Group updates the SFERA protocol.
- UIC opt-in Project.
- Meets twice a year.
- Participants must be UIC members.
- Decides on change requests.
- Leads the User Group.



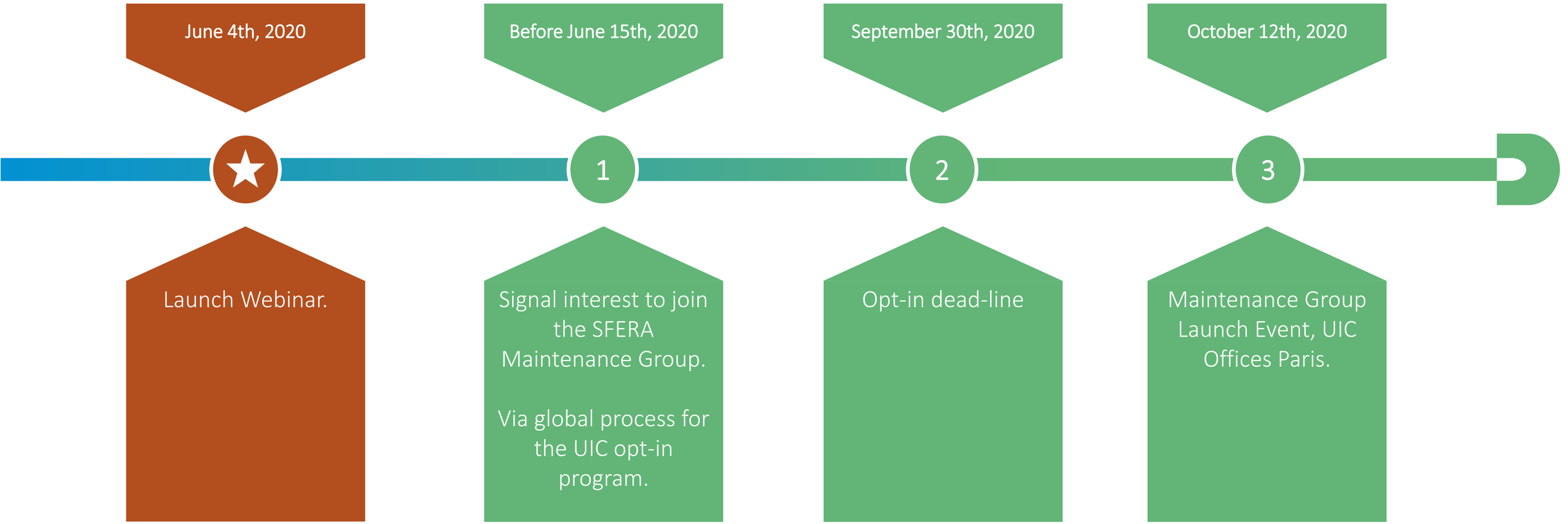
User Group:

Consists of companies that develop or use SFERA.

- The User Group is a platform for everybody that works with SFERA (Railways, Industry etc.).
- Organized by UIC and the Maintenance Group.
- Members discuss experiences with SFERA and help each other.
- Can draft change requests and submit them to the maintenance group.

We welcome new members! If your company is a UIC member and you are interested: Please signal interest via your UIC Representative.

Next Steps - WHEN



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THANK YOU FOR YOUR ATTENTION

Q&A

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Thank you for your kind attention.