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)
WELCOME TO THE SFERA WEBINAR!

Foreword

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Deputy Director Rail System, UIC
Introduction
Agenda

I. Presentation of the project + the IRS

II. How the different parts of SFERA interact

III. Maintenance + next steps
I. Presentation of the project + the IRS

II. How the different parts of SFERA interact

III. Maintenance of the standard
Presentation of the team

**UIC SFERA Group**

- DB Netz  
- SNCF Réseau  
- ProRail  
- Trafikverket  
- Banenor  
- Infrabel  

- DB Cargo  
- SNCF Passengers  
- ÖBB  
- SNCB  
- NS  
- SBB

#Drivers  #DAS  #Traffic management  #Energy management
What is SFERA

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

Core document – 50 pages
- Requirements of the exchange protocol
- The Journey Profile Model
- Data Structure
- Communication Mechanisms
- Maintenance of SFERA

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?

Who?
Available to all
For free

[https://appendices.uic.org](https://appendices.uic.org)
I. Presentation of the project + the IRS

II. How the different parts of SFERA interact
   - 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.

FEEDBACKS
- Updated train characteristics
- Train position
- Status reports

TRAIN PATH ENVELOPES

TMS

OUTER LOOP

DAS
INNER LOOP

DAS
INNER LOOP

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

```xml
<SP_Characteristics>
  <LineAndTrackIdentifier>
    <lineIdentifierStart 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"/>
  </StaticSpeedProfile>

  <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>
  </PermittedSpeed>
</SP_Characteristics>
```
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:

<table>
<thead>
<tr>
<th>DAS capabilities</th>
<th>ATO GoA2, C-DAS-O, C-DAS-C, S-DAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAS behaviour</td>
<td>Standalone, Connected, C-DAS-C Only</td>
</tr>
<tr>
<td>DAS statuses</td>
<td>N/A (before connection, the DAS has no status)</td>
</tr>
</tbody>
</table>

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).
I. Presentation of the project + the IRS

II. How the different parts of SFERA interact

III. Maintenance of the standard

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

Chloé Lima-Vanzeler

Bart Van der Spiegel

Thomas Sutter
Reasons for Maintenance of SFERA

Railways start using SFERA and discover a need that cannot be fulfilled by the current version.

New legislation, rules and regulation demand adaptations.

Development in international standards (e.g. TAF/TAP, EULYNX...)

New versions of UNISIG Subset-126 are published.

Technological developments or threats (e.g. cyber security) demand adaptations.

Further needs for change...

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

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.
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

1. **June 4th, 2020**
   - Launch Webinar.

2. **Before June 15th, 2020**
   - Signal interest to join the SFERA Maintenance Group.
     - Via global process for the UIC opt-in program.

3. **September 30th, 2020**
   - Opt-in dead-line

4. **October 12th, 2020**
THANK YOU FOR YOUR ATTENTION

Q&A
Stay in touch with UIC!

www.uic.org

#UICrail

Thank you for your kind attention.