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FRMCS
FUTURE RAILWAY MOBILE COMMUNICATION SYSTEM
Introducing FRMCS in Sweden

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Agenda

10.00–10.15 Welcome, Trafikverket

10.15–10.45 FRMCS project in Sweden, Trafikverket

10.45–11.00 CEF Digital 5G4RailScand, Trafikverket

11.00–11.15 Break

11.15–11.30 FRMCS on-board introduction, Trafikverket

11.30–12.00 FRMCS on-board in France, SNCF

12.00–13.00 Lunch

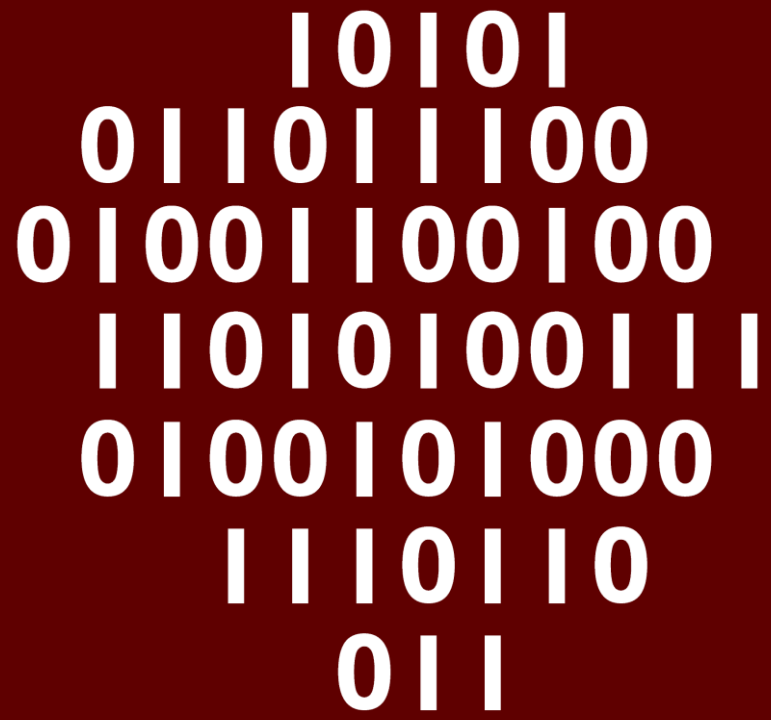
13.00–13.30 FRMCS on-board solutions, Funkwerk

13.30–14.00 FRMCS on-board solutions, Alstom

14.00–14.15 Break

14.15–14.40 FRMCS use cases, Trafikverket

14.40–15.00 Wrap up, Trafikverket



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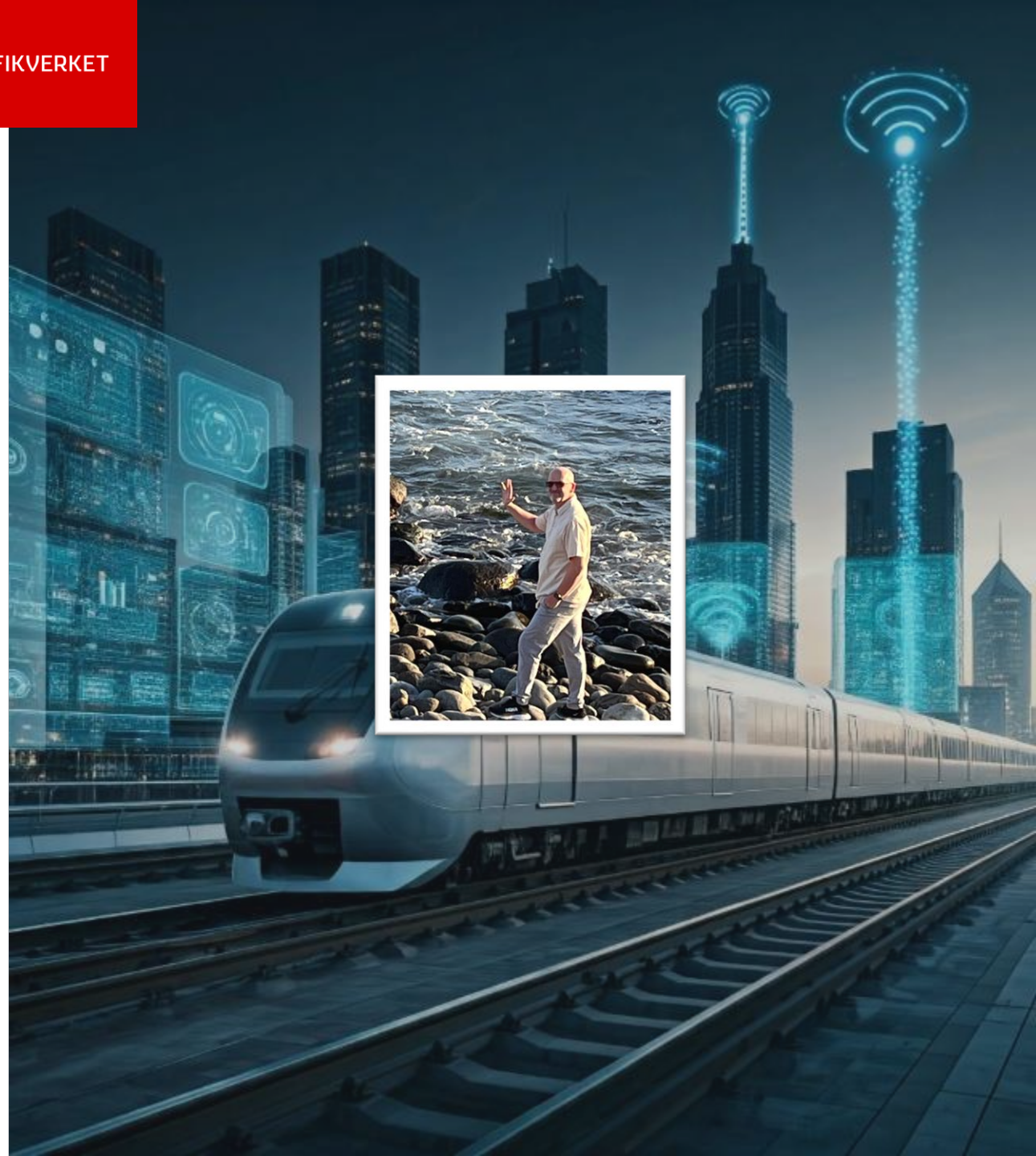
Welcome!

Magnus Dalersand

Deputy CIO, Trafikverket



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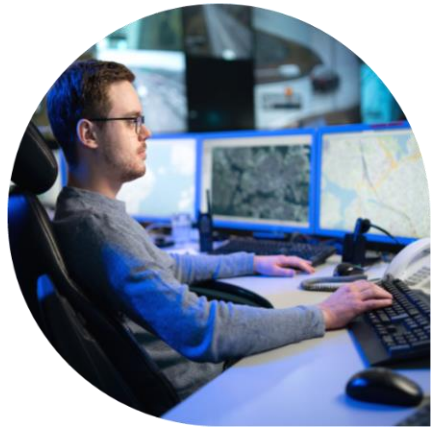
We thank GSM-R for its long and faithful service…

Railways in Europe are facing a major technological shift.

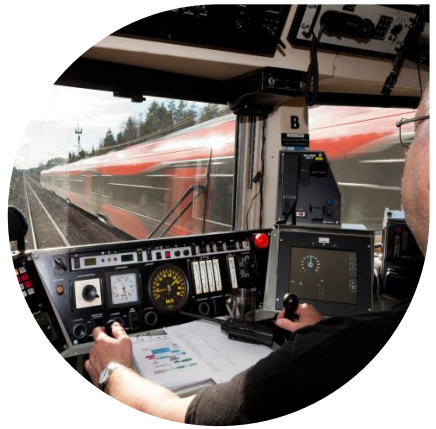
Today's mobile communication system for railways, based on 2G, GSM-R, is approaching the end of its service life and does not meet our increased communication needs.

The GSM-R system is essential for voice communication between control center, drivers and railway workers and for ETCS data communication.

In order to continue to operate safe and secure railway traffic in Sweden and Europe, we need to replace GSM-R with a new system.



GSM-R was put into operation in 2000 and today the system handles 350,000 calls per month.



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…and introduce FRMCS

FRMCS, a new and modern mobile communication system for railways

- Increased reliability and higher security compared to GSM-R.
- An enabler for the digitalization of the railway based on technical standardization and harmonization.
- A prerequisite for continued safe rail traffic in Sweden and Europe.
- A cornerstone for an interconnected European railway system – what we call interoperability.

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FRMCS project in Sweden

Pipsa Hallner

Project Sponsor, Trafikverket

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FRMCS project in Sweden

Mats Malmström

Project Manager, Trafikverket

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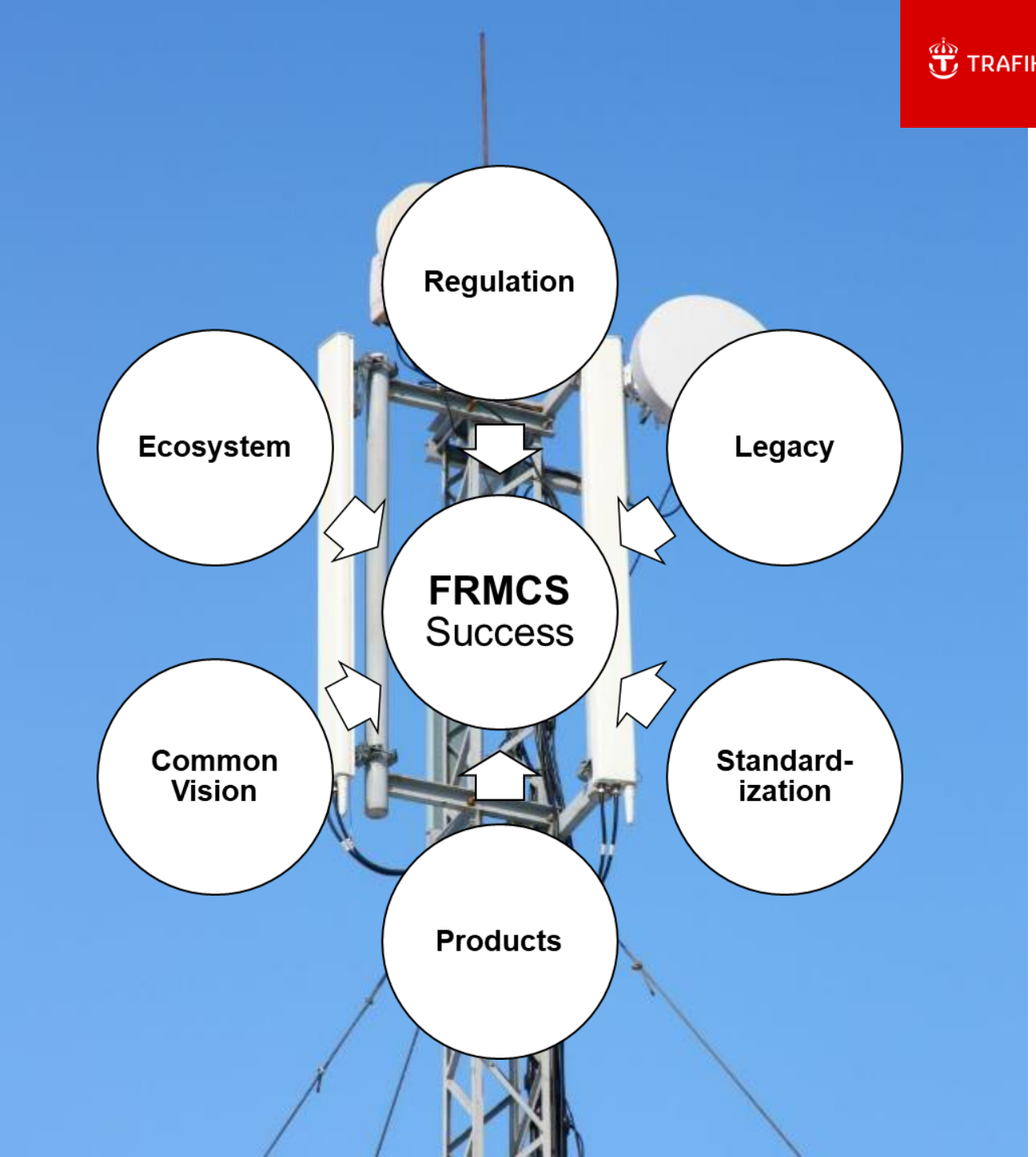
FRMCS – Flexible, efficient and secure

Independent of radio access technologies: Future-proof the system with high capacity. Intended to enable the use of satellite, WiFi and upcoming technologies.

Supports cybersecurity standards: Provides improved ability to detect and remediate cybersecurity threats.

Configurable and flexible: Modular architecture reduces the dependency between hardware, software and telecom. Intends to simplify implementation and upgrades, which can lead to lower investment and operating costs in the long term.



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How Trafikverket works with FRMCS

The implementation of FRMCS is a complex and challenging task that affects all railway users.

It requires careful and well-thought-out strategic planning in close collaboration with both internal and external stakeholders.

Two main activities are currently underway:

- Pre-study for the introduction of FRMCS in Sweden
- International work

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International work

Trafikverket is, to a large extent, involved in the development of FRMCS specifications and standards to ensure interoperability and efficient communication across the entire European rail network.

The first version of the FRMCS specifications, that can be implemented, is published in the TSI, Technical Specifications for Interoperability 2027 by ERA, the European Railway Agency.

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Pre-study for the introduction of FRMCS in Sweden

In the pre-study, we map user needs, identify requirements and risks for the implementation in Sweden and build knowledge for upcoming procurements.

The project also has several connections and dependencies to projects both within Trafikverket and internationally. Some examples are :

- Opto 2.0
- ERTMS
- Telecom systems
- CEF-Digital 5G4RailScand
- MORANE2

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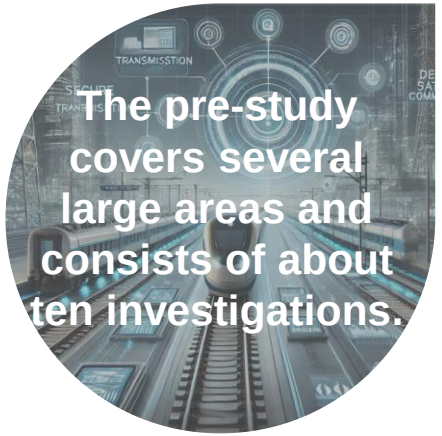
Scope of the pre-study



Use Cases
Needs today and tomorrow?

Expectations and requirements.

Socioeconomics
Scenario-based utility calculations.

Laws & regulations
Ensuring compliance and continuity

Supply chain
The role of Trafikverket and service delivery.

Processes and organization for asset management, operation and maintenance.

Implementation strategy and planning.

Technology
Establish test environment in facility and lab.

PoC – communication equipment on vehicles and in trackside infrastructure.

Build knowledge, investigate alternatives and prepare for upcoming procurement.

Test facility

The FRMCS project has invested in a test facility that is currently mainly used in the pre-study.

The goal is that the facility can also be used for evaluation and demonstration of products and new digital services, by several stakeholders, such as other projects within Trafikverket, industry and research institutes.

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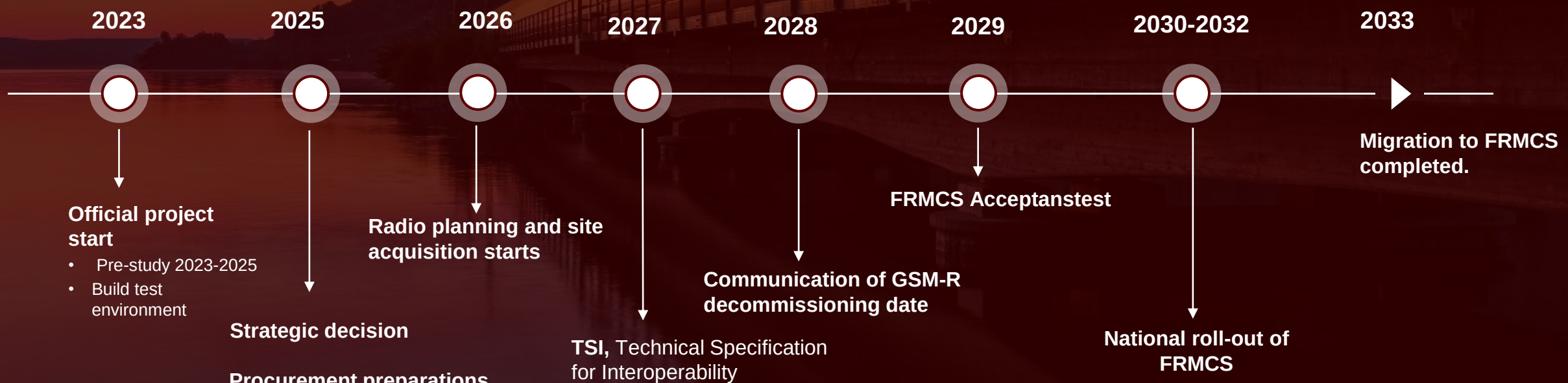
Time plan

For the introduction of Future Railway Mobile Communication System – FRMCS in Sweden



Current FRMCS planning

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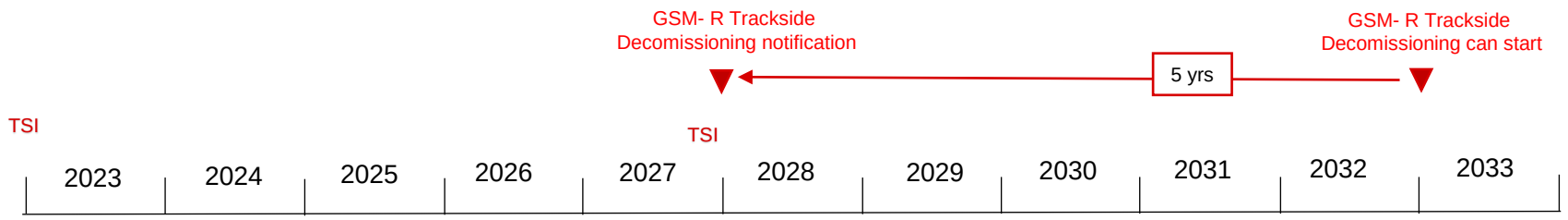

FRMCS Legal Framework

V2 Approved

Pre commercial FRMCS products

V3 Approved

FRMCS development and roll-out

ERJU MORANE 2

Pre-study

PoC

Procurement

Planning

First NW Deployment

Roll-out

Upgrade rolling stock

Preparation of Applications

GSM-R Dismounting

Build Radio infrastructure

Procurement

Build

EU CEF 5G4RailScand

SA

Related Projects

Optical Fiber

Tunnel radio preparation

IP Transport network

ETCS

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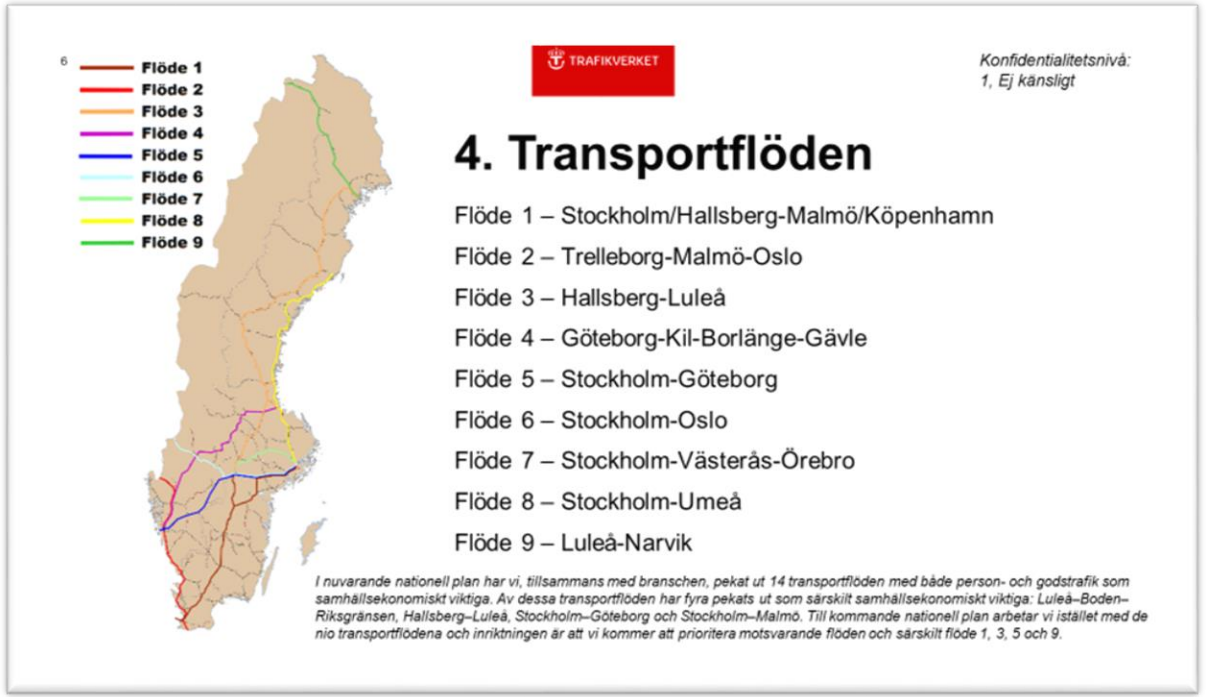
FRMCS implementation plan

- **Under development**
- **Principals:**
  - Entire lines completed
  - Based on prioritized transport flows

[FRMCS plan]



Test and Validation in Sweden

In collaboration with IM’s

Main objectives

- Carry out functional tests according to FRMCS V2 specification.
- Focus on existing functionalities in the railway such as Voice and ETCS.
- Functional test and transition between TRV 1900 MHz and Telia 700 MHz MOCN network.
- TRV test track is used for testing, validation and measurements.

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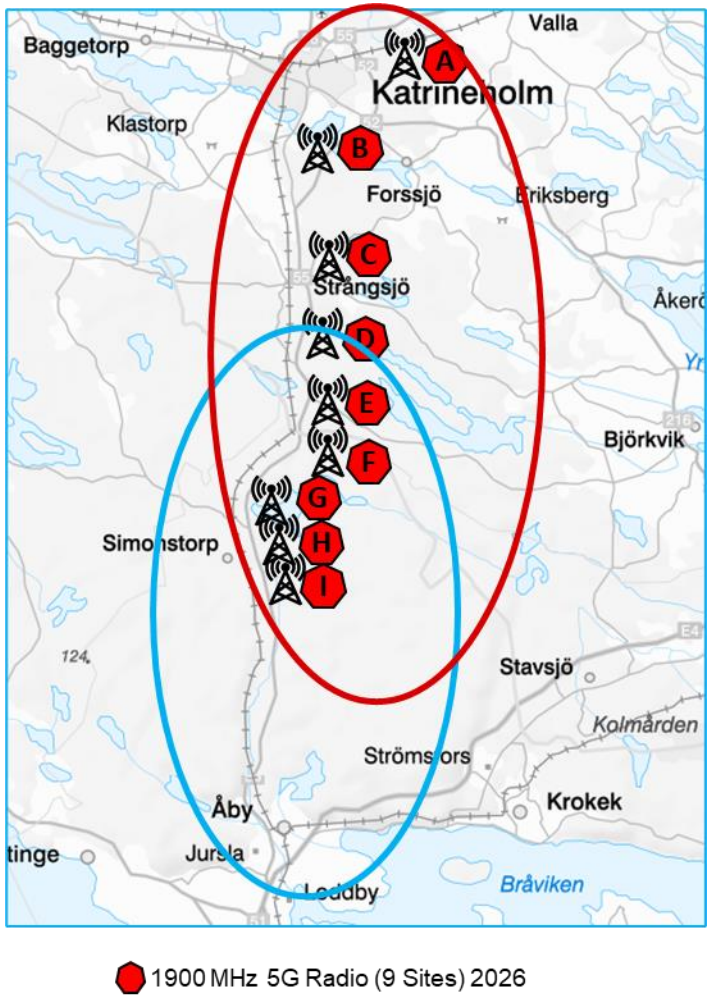
TRV Test track

- Operational line with various characteristics
- Track around 40 km
- Double track
- 1 test train
- Speed limit 200 km/h
- Masts 4 – 54 meters
- 9 TRV 1900 MHz + MNO 700 MHz radio sites
- Same track used for ETCS tests
- Possibility to integrate MNO network



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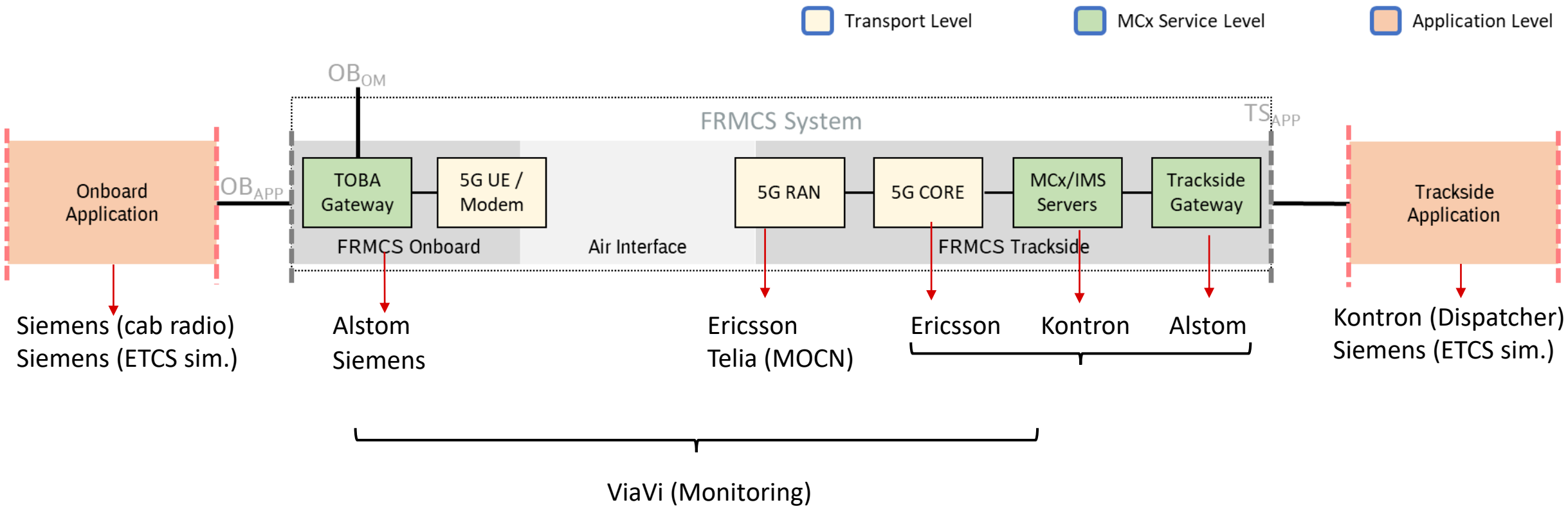
Vendors



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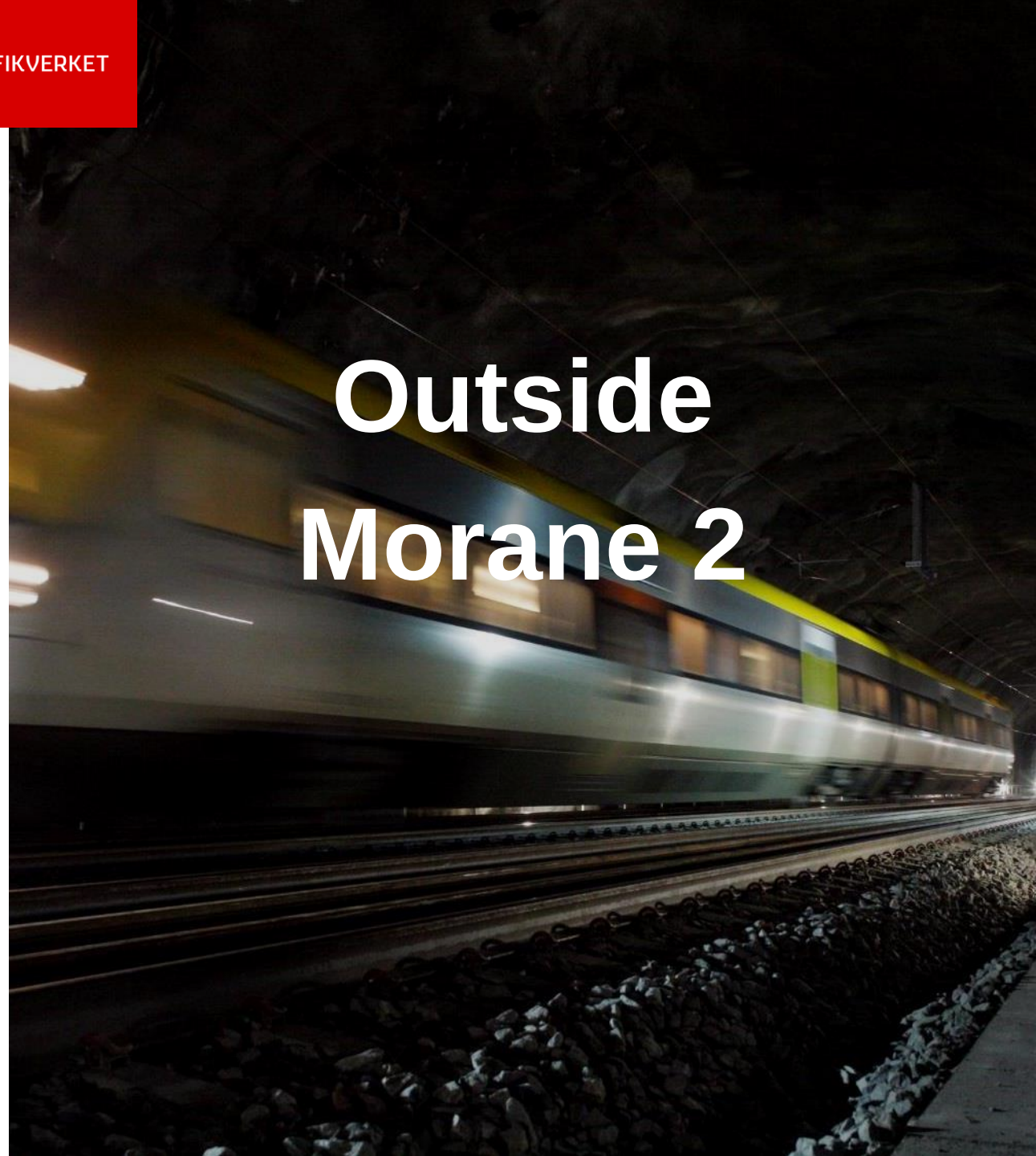
Test track Norrala Tunnel

- Test tunnel using radiation cables
- 3 macro radio sites
- Co-existence with GSM-R, public safety, FRMCS 1900 MHz TDD and mobile operators 4G/5G services
- Tunnel length 3,8 kilometers
- Speed limit 200 km/h
- Installation start planned for Q1 2025



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CEF Digital 5G4RailScand

Andreas Lingers

Project Manager, Trafikverket

5G4RailScand

5G4RailScand

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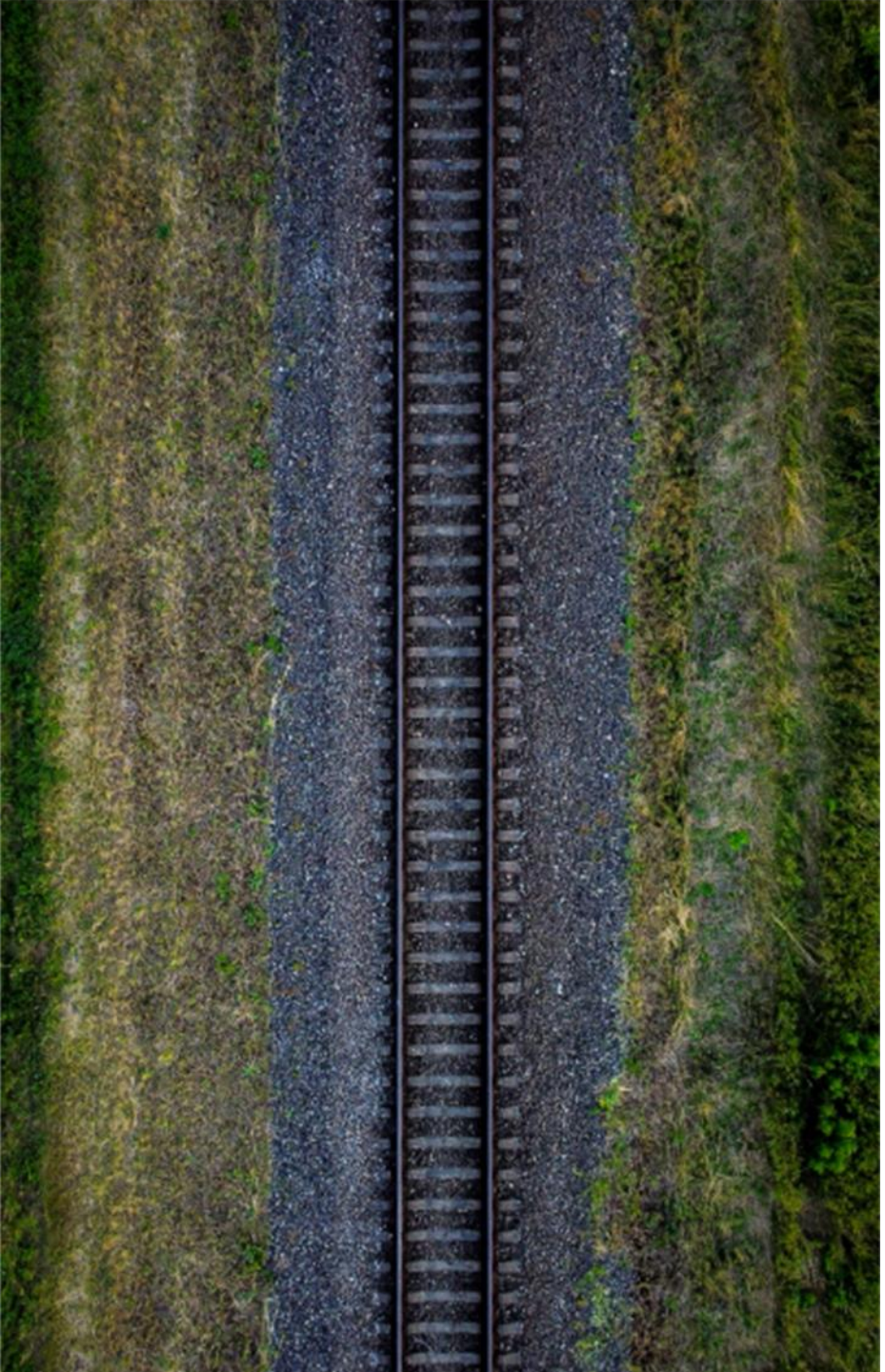
Co-funded by
the European Union

Scope

Along the 800 km Copenhagen Gothenburg–Oslo section of the TEN-T Scan-Med Corridor, the project will contribute to prepare the railway infrastructure, for implementing Future Rail Mobile Communication System (FRMCS).

Co-funded by the European Union



Objective

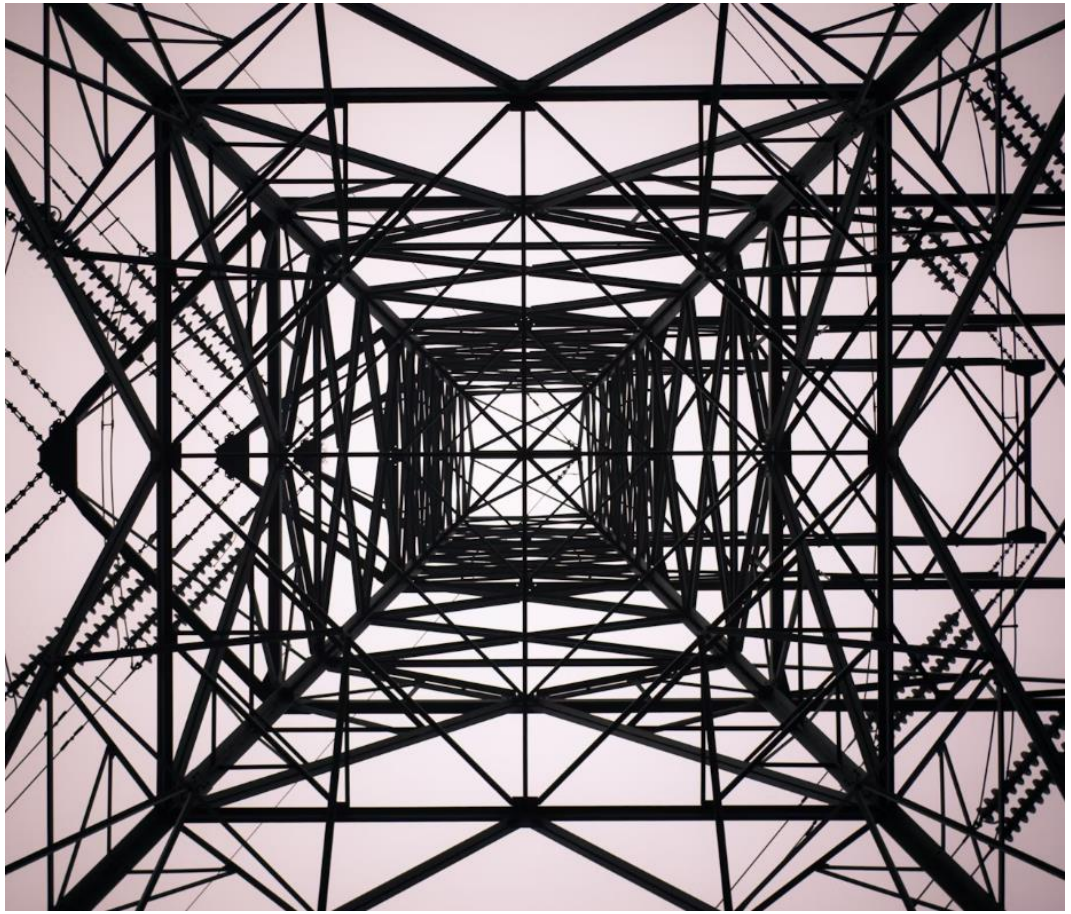
- To make preparatory cross border studies for the implementation of FRMCS in the railway corridor.
- To map for each country radio cell sites placement and configuration, optical fibre infrastructure and frequencies to be used.
- To install the needed passive infrastructure in the railway corridor.
- To prepare for active infrastructure deployment in the corridor.
- To establish cooperation between Sweden, Norway and Denmark for ensuring interoperable FRMCS systems in Scandinavia.

Co-funded by
the European Union

Co-funded by
the European Union

Expected outcomes

- Guidelines for the passive FRMCS infrastructure in each country
- Upgraded passive infrastructure in the corridor section to be ready for the deployment of active components and FRMCS network.
- Upgraded test track Åby-Katrineholm for piloting, testing of rolling stock and innovation of FRMCS services.
- Plans for deployment of active FRMCS network and piloting of rolling stock.
- Preparedness for the full-scale implementation of FRMCS, by streamlining processes and organisations.



Benefits

- First implementation of the (FRMCS) in the Scan-Med European transport corridor, section Copenhagen-Gothenburg-Oslo, by deployment of the needed passive digital infrastructure.
- Gain knowledge to establish purposely built processes for both building and deployment.
- Build even stronger connections and co-operation's between the Scandinavian infrastructure managers.

Co-funded by
the European Union

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FRMCS on-board introduction

Mats Malmström

Project Manager, Trafikverket

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On-Board FRMCS

- **On-Board FRMCS** is onboard equipment/functions for communication over FRMCS to/from ETCS, voice and other applications.
- First release of **On-Board FRMCS** is based on 5G and MCx (Mission Critical Communication.
- **On-Board FRMCS** is also called ”TOBA-BOX” (Telecom On-Board Architecture).
- **On-Board FRMCS** makes communication and applications separated from each other from a specification perspective. Makes it possible to upgrade to 6G, 7G…
- The **Coordination Function** enables parallel use of FRMCS and GSM-R.

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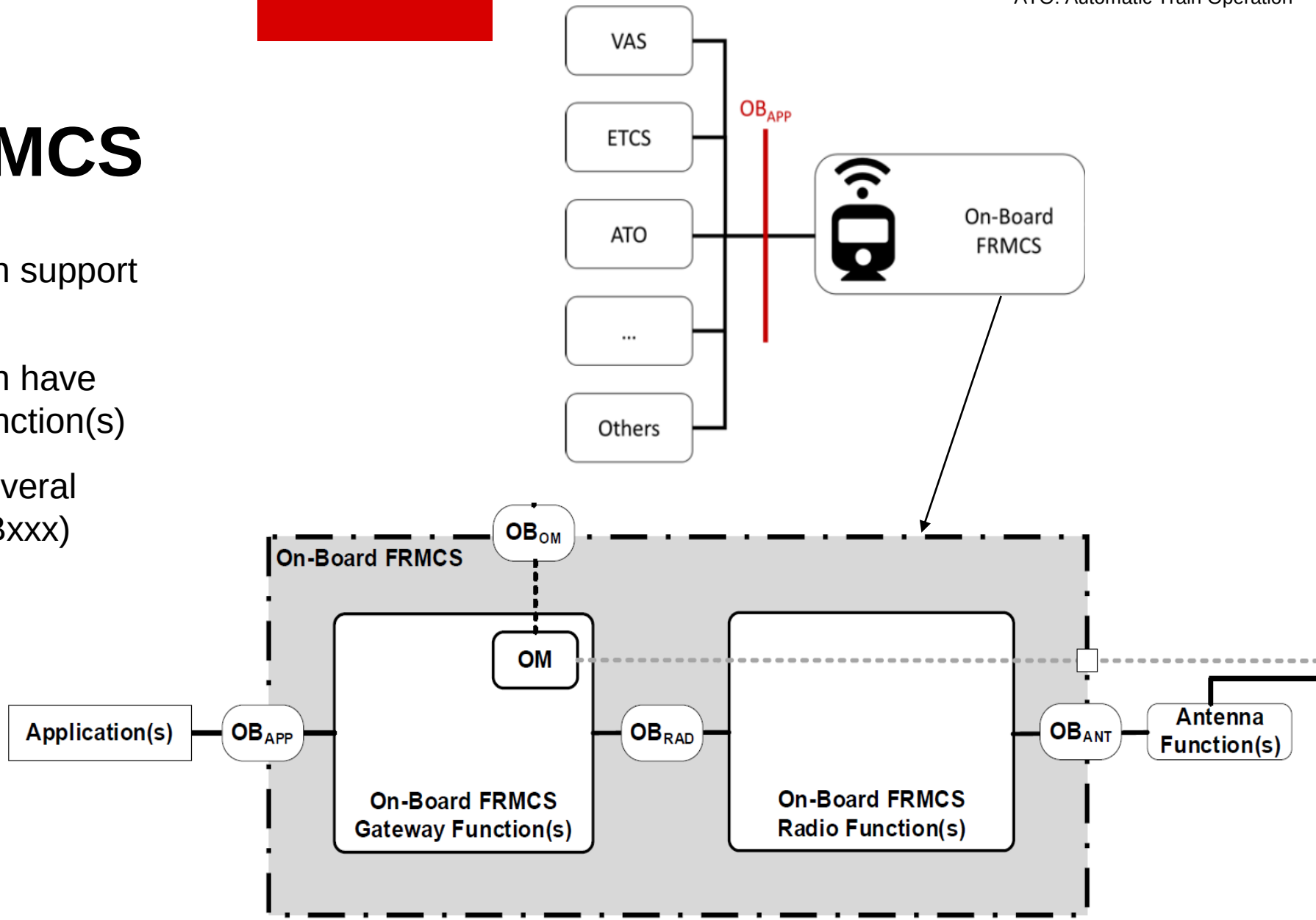
VAS: Voice Application Subsystem
ETCS: European Train Control System
ATO: Automatic Train Operation

On-Board FRMCS

One **On-Board FRMCS** can support multiple applications

One **On-Board FRMCS** can have several modems, Radio Function(s)

On-Board FRMCS have several standardized interfaces (OBxxx)



Source: FRMCS SRS v2.0.0

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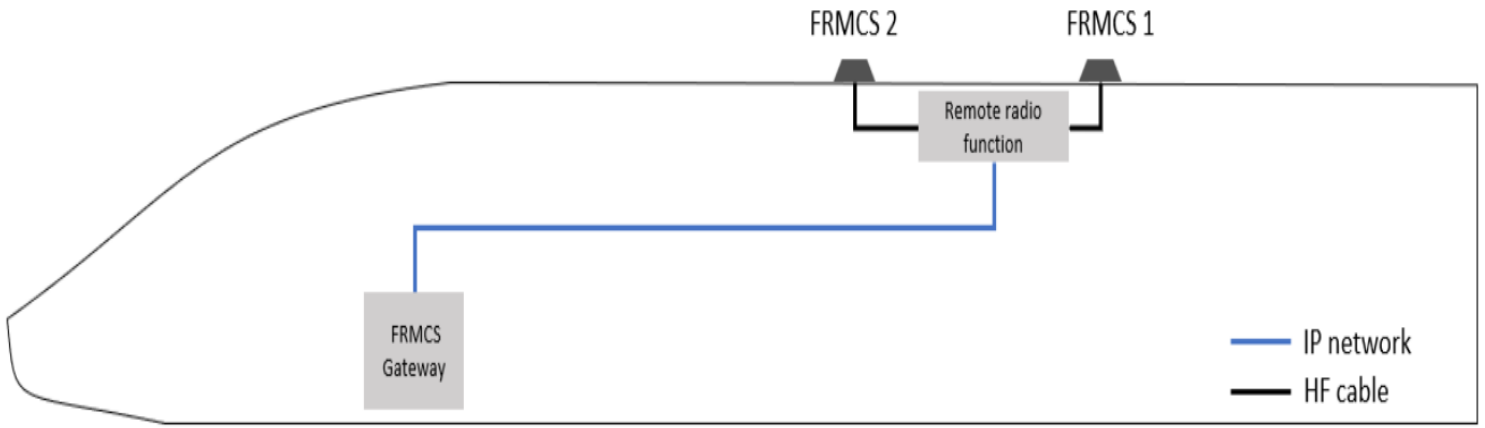
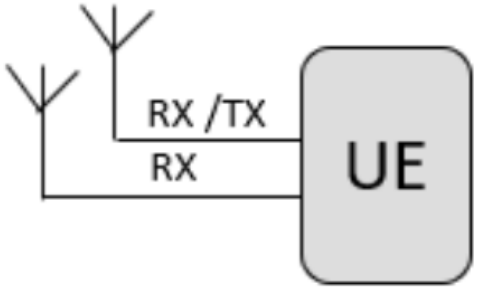
On-Board FRMCS

Since **On-Board FRMCS** support Radio MIMO (Multiple-Input Multiple-Output), antennas for multiple transmission and receiving must be used.

On-Board FRMCS support Remote Radio Function (modems).





To be in line with 3GPP specification 3GPP TS 38.101, the required minimal setup for FRMCS is 2 antennas (1 for Tx/Rx, 1 for Rx only).

Source: UGFA O-8868

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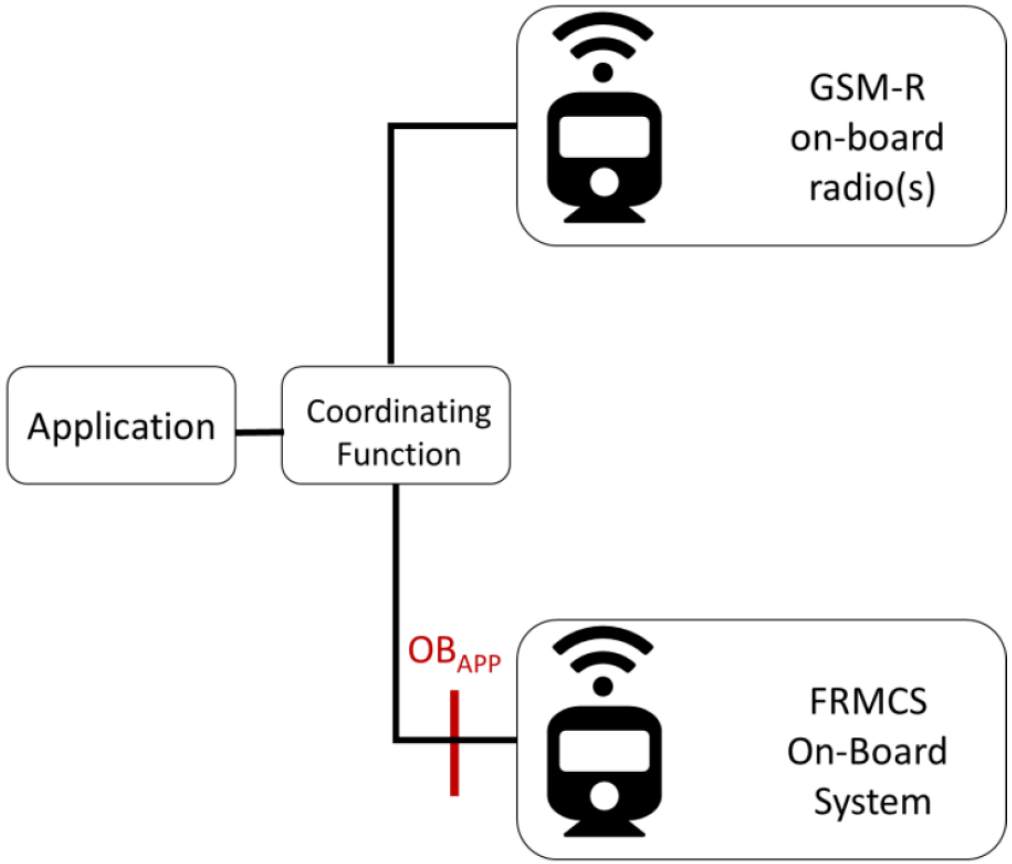
On-Board FRMCS

Migration from GSM-R to FRMCS will be done in steps.

On-Board FRMCS shall support **Coordinating Function** to allow parallel use of GSM-R and FRMCS.

GSM-R will be used as backup and for vehicles that are not yet equipped for FRMCS during rollout of FRMCS.

GSM-R will also be used on tracks not yet equipped with FRMCS.



Source: FRMCS SRS v2.0.0

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FRMCS on-board in France

Pascal Désaunay

Head of International Projects
for the Technology and Innovation
Department of SNCF Group

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Funkwerk Systems GmbH on-board solutions

Hendrik Holz

Head of sales new technologies

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Alstom Group on-board solutions

Pierre Cotelle

Networks & Connectivity
Solution Director

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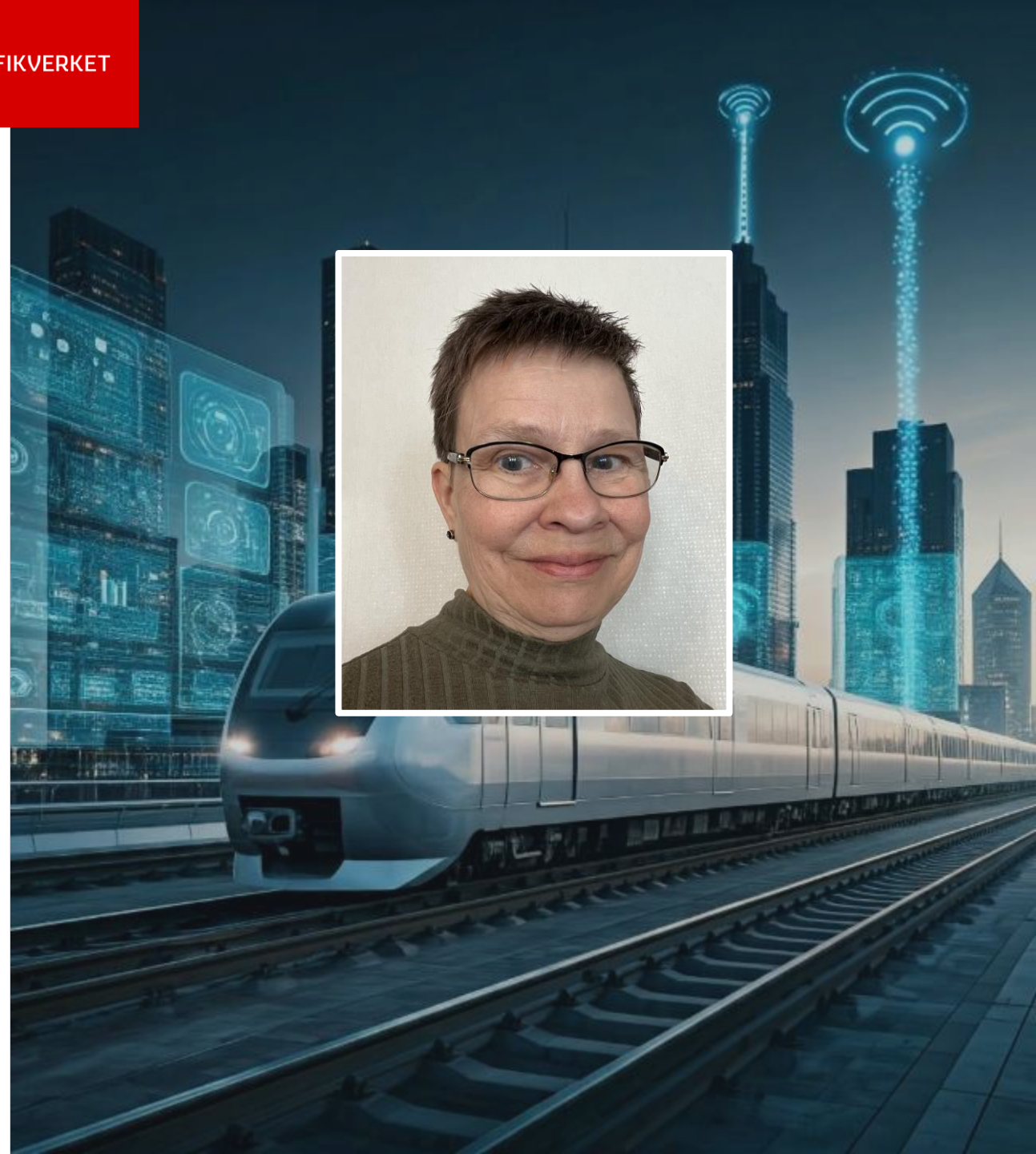
FRMCS Use Cases and Road Map

Ingela Isaksson

FRMCS Requirement analysis



What is a use case?

Humans, equipment or applications
using FRMCS communication services for:

- Voice
- Data
- Video

Business applications
General connectivity needs
Passenger connectivity

Performance applications
Cross industry needs
RU and IM needs

Critical applications
Essential for train movements
Voice and ETCS data

Use Case categories:

- **Critical** - Safety or legal obligation
- **Performance** - Improve the performance of the railway operation
- **Business** - Support the railway business operation in general

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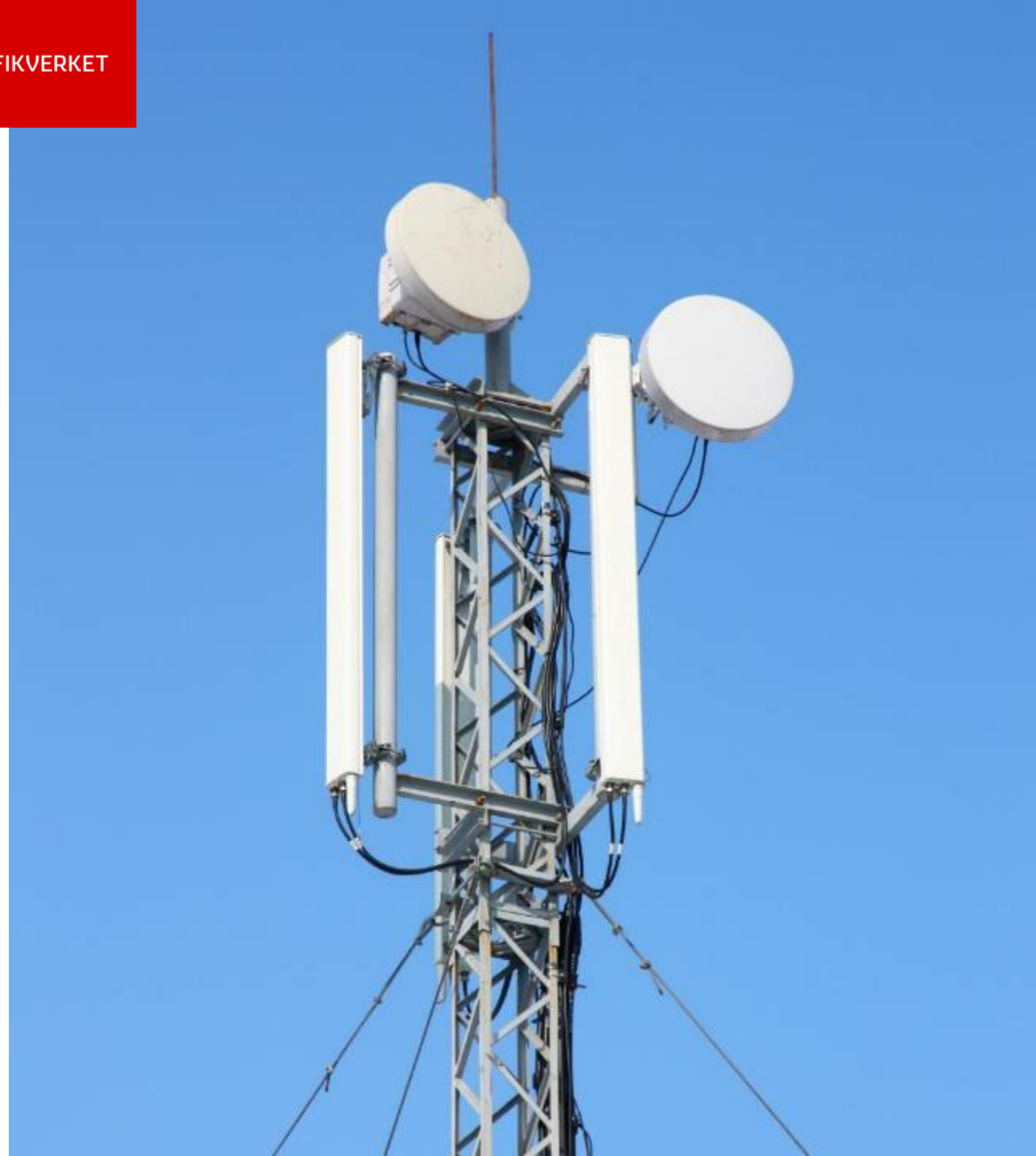
Road map starting point

From day one – Communication services for critical use cases:

- **Voice –** Traffic control/driver, REC, group calls
- **Data -** ETCS



Step-by-step approach

Starting with use cases benefiting the entire railway industry by:

- Improving capacity utilization
- Improving punctuality
- Preventing disruptions by:
  - Early problem detection
  - More predictive and proactive maintenance

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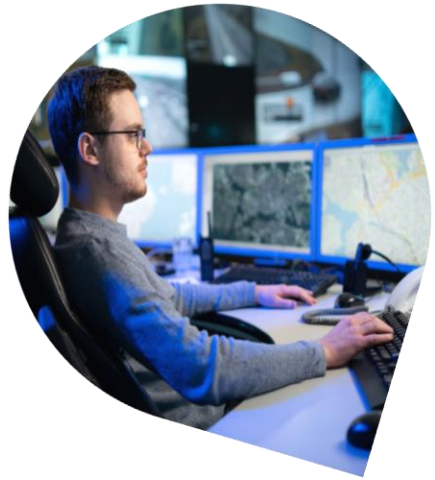
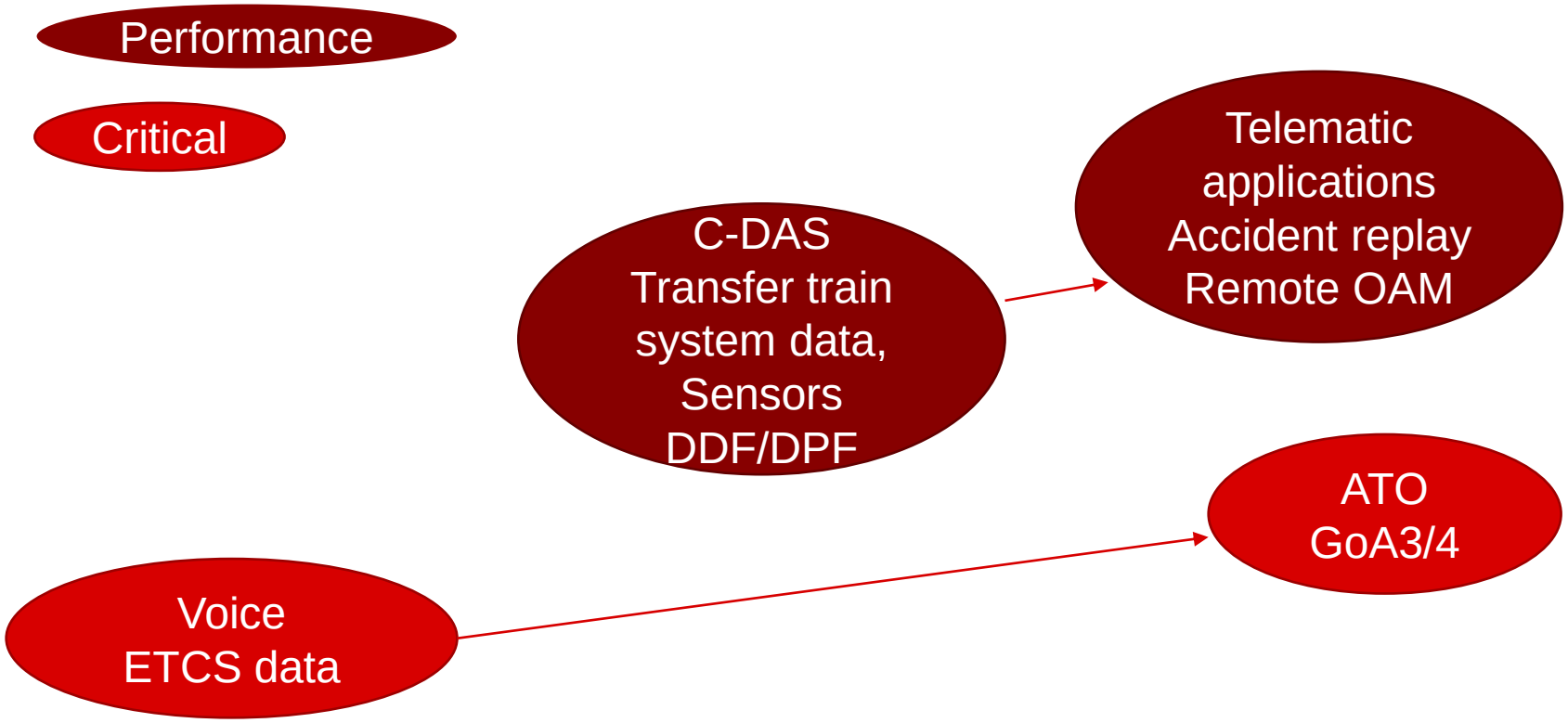
Selected use cases

- **C-DAS**. Facilitates a higher and smother traffic flow.
- **Train systems data transfer**. Facilitates early problem detection and more proactive maintenance of both trains and railway infrastructure.
- **Condition monitoring systems**. Sensors on trains. DDF/DPF Derailment Detection Function/Derailment Prevention Function.



Road map towards 2040



Dependencies:

- Infrastructure roll out and on-board migration
- Completion/development of FRMCS specifications/standards
- FRMCS compatible products
- Renewal of the train fleet
- Handheld units – tablets and the use of apps
- Innovation, research and development

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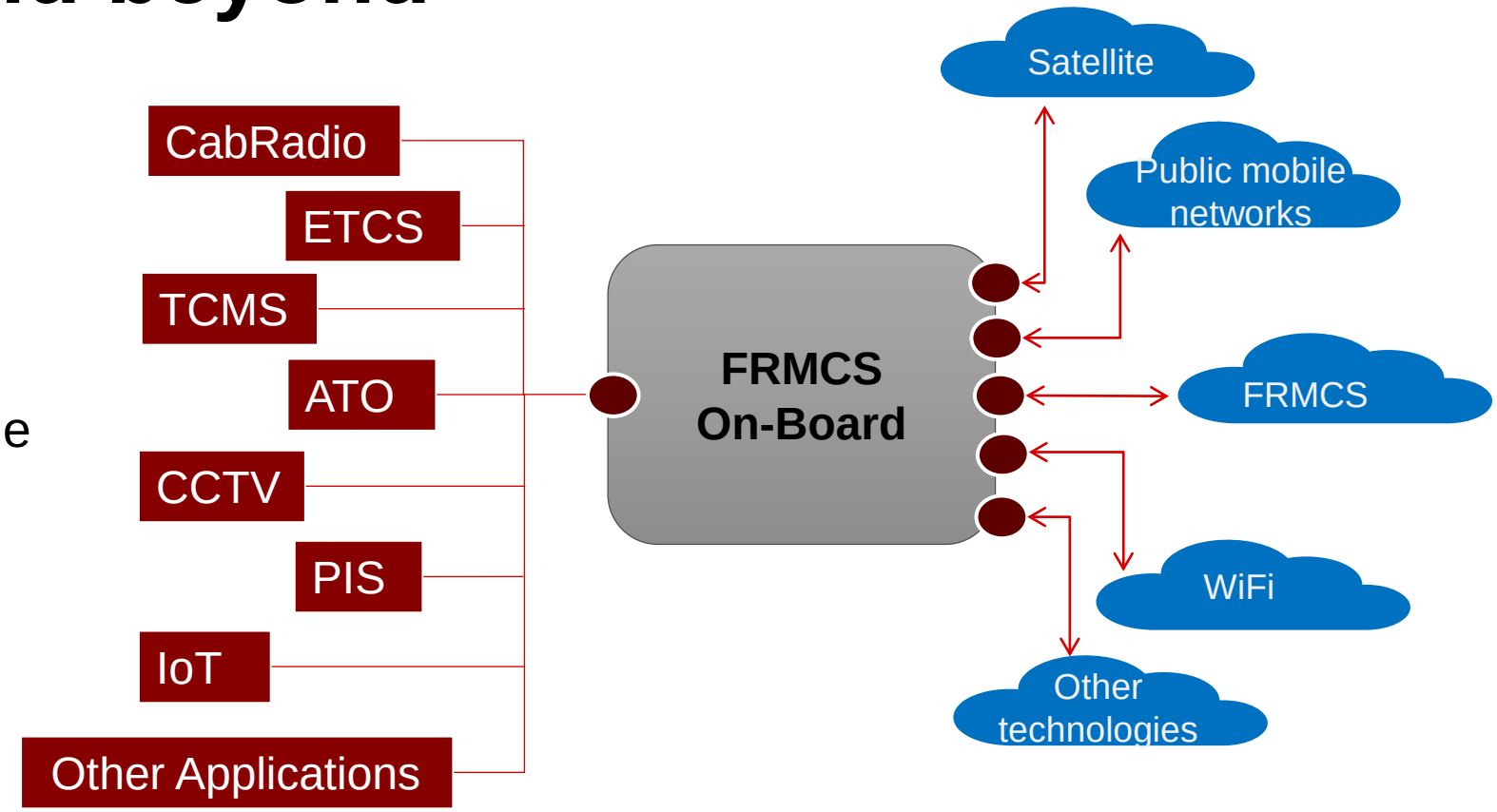
Towards 2040 and beyond

- Additional technologies
- Multi-connectivity function
- Public mobile operators - improved coverage along the railway

High Capacity
High Availability
High Reliability



End-to-End Responsibility

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FRMCS has the potential to be the catalyst for driving innovation and deployment of new services making the railway operation more efficient, reliable attracting more customers to select railway as their first choice of transportation.

A new mode of collaboration across the ecosystem will be necessary to capitalize on this huge potential.

Working together we make it happen !

We invite you to discuss FRMCS with us!

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CEF Digital 5G4RailScand
Project manager
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FRMCS Requirements analysis
ingela.isaksson@trafikverket.se

The presentations and video will shortly be available on-line

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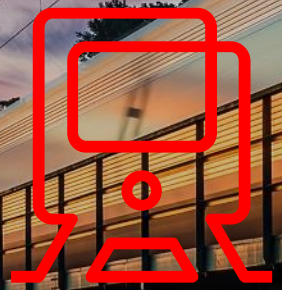

Sweden’s new railway

A shift towards a closer Sweden

Thank you !