



**Welcome to the FP2-
Morane-2 Mid-Term
Conference!**

**We will begin approx.
9.30am – check in and have
a coffee!**



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This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101196125.



Opening Address

Jean-Michel Evanghelou, UIC



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Opening Address

Michael Mikulandra, UNITEL



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Europe's Rail Joint Undertaking

Work Plan

Léa Paties, Europe's Rail Joint Undertaking



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FP2-MORANE-2

Context and Scope
Project Technical Coordinator – Dan Mandoc



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FRMCS

FRMCS is the successor of GSM-R - which will reach its end-of-life soon. It is also an opportunity – to enable digitalization, will provide capabilities to enhance the signalling systems, to make real-time telemetry as the norm, to enable the intelligent train.

FRMCS is a 3GPP 5G Mission Critical System. This enable standardized products, which can be further-on customized. The Mission Critical Service layer allows the needed voice features (PTT) and strong QoS.

In Europe we have obtained dedicated frequencies both in 900 and 1900 MHz, additional to GSM-R (ECC (20) 02).

These frequency bands are now 3GPP standardized (5G N100 and n101, PC3 (23 dB) and PC1 (31 dB)).

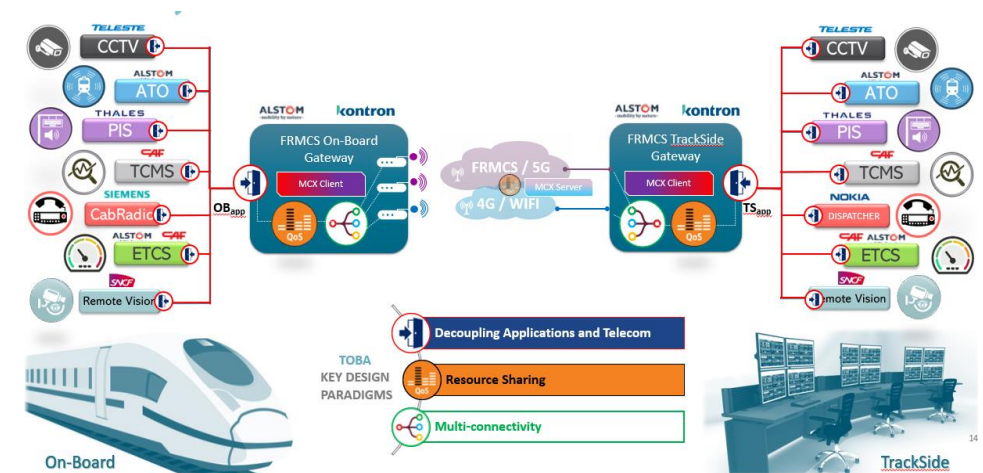
5GRAIL

We have delivered FRMCS V1 Specifications, which have been added in 2023 CCS TSI, as part of ERTMS .

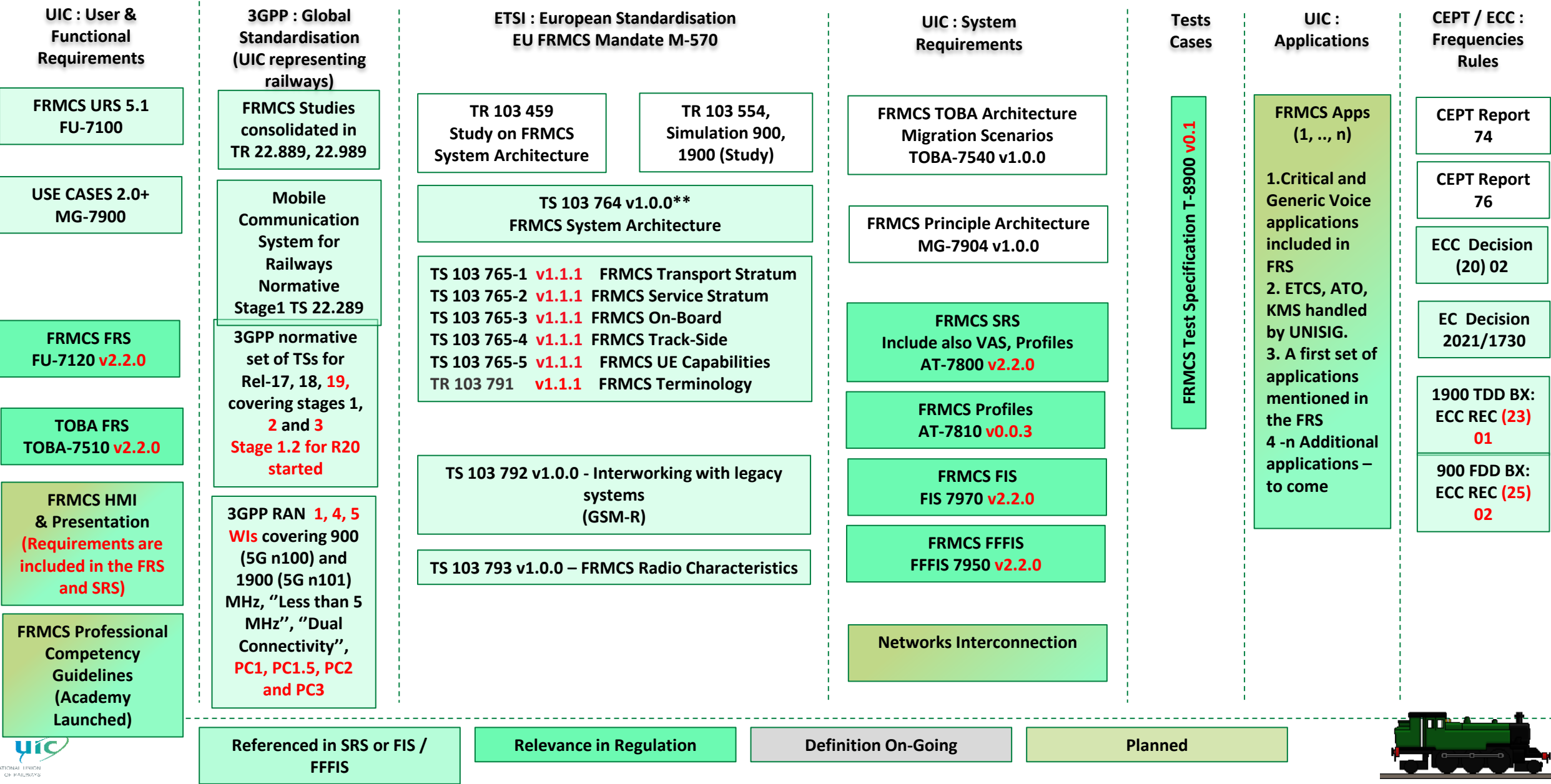
Following that, we have performed the first FRMCS tests, within the DG Connect co-financed 5GRail Project, which has been an important step towards FRMCS 1st Edition:

- Developing and testing the first FRMCS prototypes;
 - Confirming that 3GPP Mission Critical 5G Stand Alone is the right way forward;
 - Testing (Train Driver-to-Controller) Voice, REC, ETCS, but also TCMS and Remote Vision;
 - Testing a first set of 1900 MHz pre-n101 PC3 FRMCS chipsets
 - First FRMCS Border Crossing tests
 - Valuable lessons learnt
- ❑ 5GRail has proven FRMCS principles, have built and tested the first FRMCS prototypes.

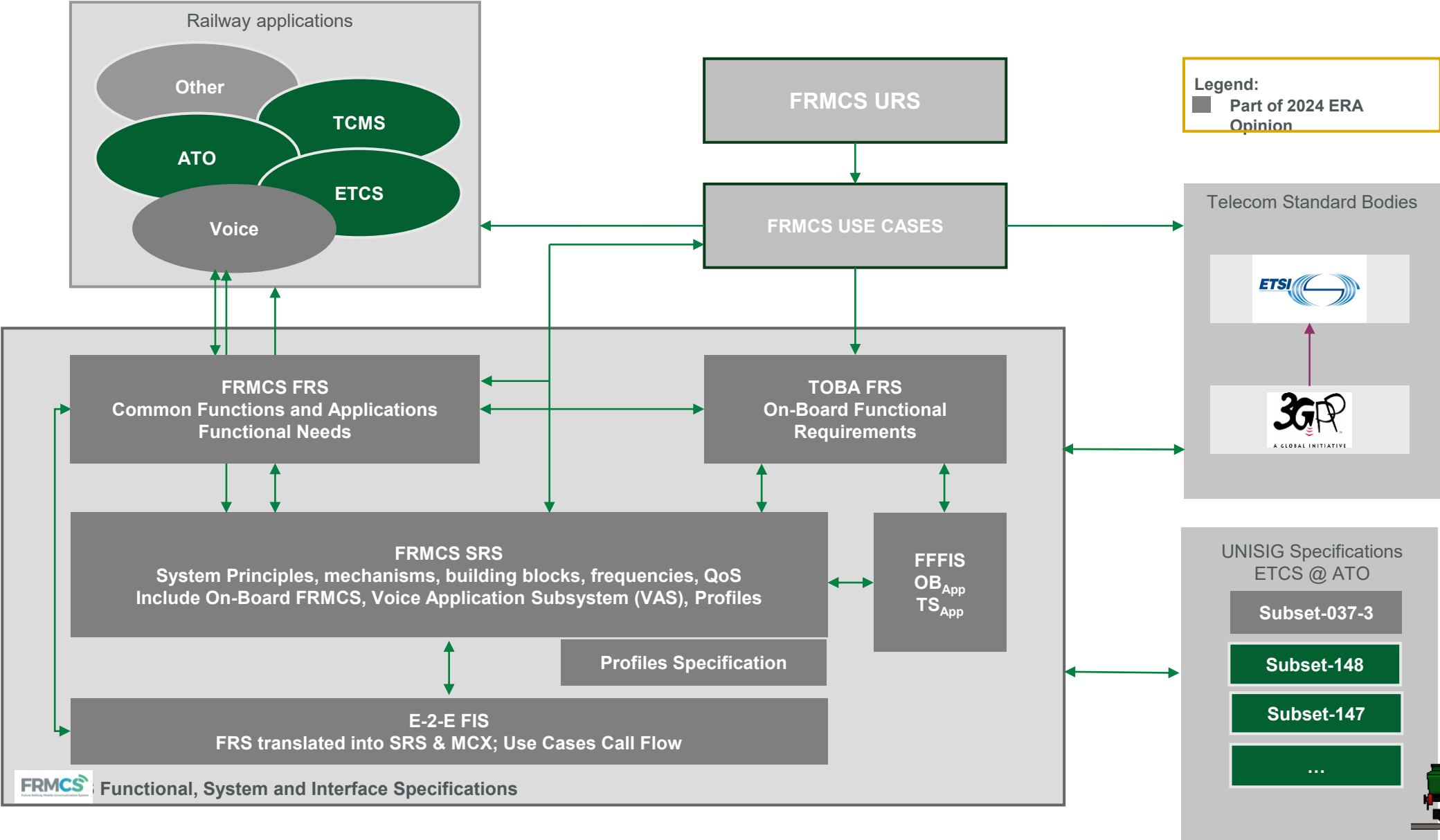
Voice applications	WP3 Lab Nokia Hungary	WP4 Lab Kontron France	WP5 Field DB Germany	WP5 Field SNCF France
On-train outgoing voice communication from the train driver towards the controller(s) of the train	X	O	X	
On-train incoming voice communication from the controller towards a train driver	X	O	X	
Multi-Train voice communication for drivers including ground user(s)	X	O	X	
Railway Emergency Communication (voice and data application)	X	O	X	
Data applications				
Automatic Train Protection communication	X	X	X	X
Automatic Train Operation communication (limited to GoA2 ATO)		X		X
TCMS (Train Control and Management System): ☐ On-Train Telemetry communications ☐ On-Train remote Equipment control	X		X	
Non-critical real time video	X		X	
Transfer of CCTV archives	X		X	
PIS (Passenger Information System)		X		
Remote control of engines (Remote vision application)		O		X

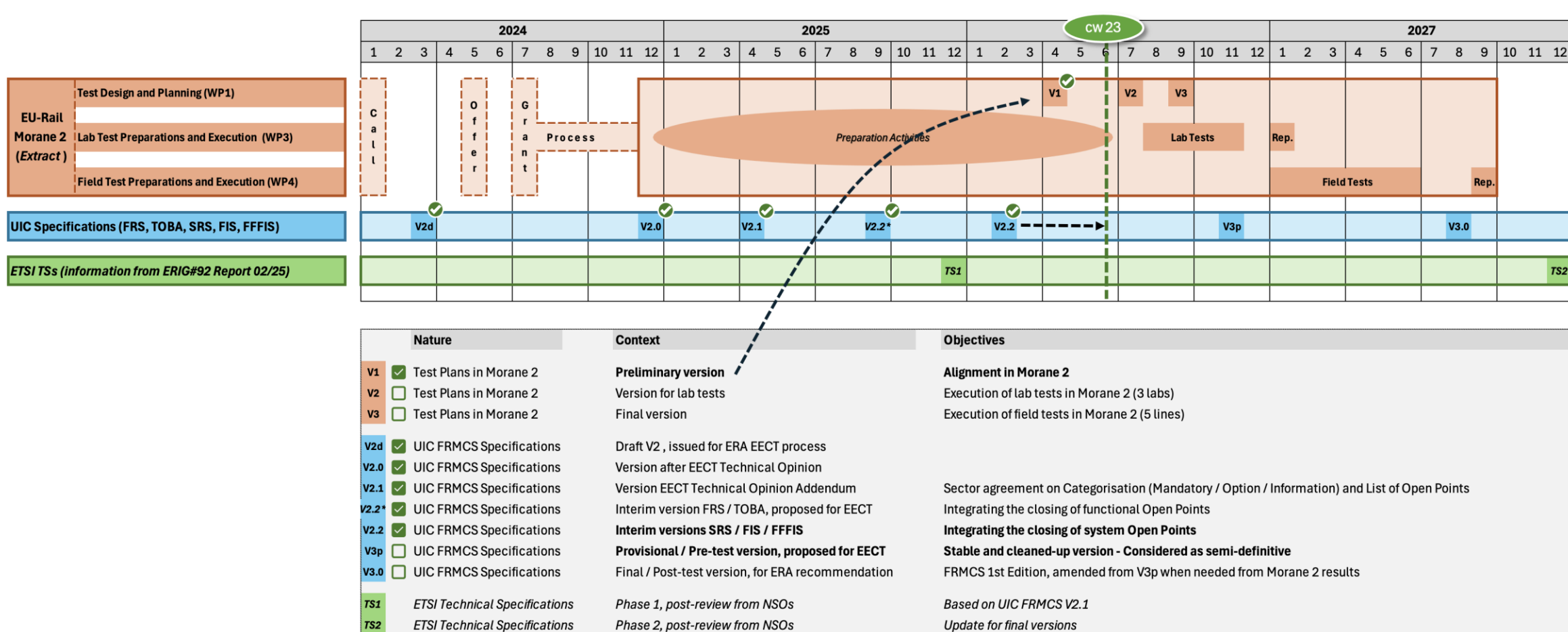


FRMCS Global Map for Specifications & Standardization Items (May 2026)



FRMCS V2 Hierarchy & Dependencies





FP2- MORANE-2



**Project name: Flagship Project 2 - MOBILE radio for RAILway
Networks in Europe 2**

Project acronym: FP2-MORANE-2

Call: HORIZON-ER-JU-2024-01

Topic: HORIZON-ER-JU-2024-FA2-SNS

Type of action: HORIZON JU Innovation Actions

Granting authority: Europe's Rail Joint Undertaking

Project starting date: 1 December 2024

Project end date: 30 September 2027

Project duration: 34 months

FP2-MORANE-2 Main Goals

MORANE-2 is a critical step in UIC's Plan to deliver FRMCS V3 Specifications, by the end of 2027, to be included in TSI.

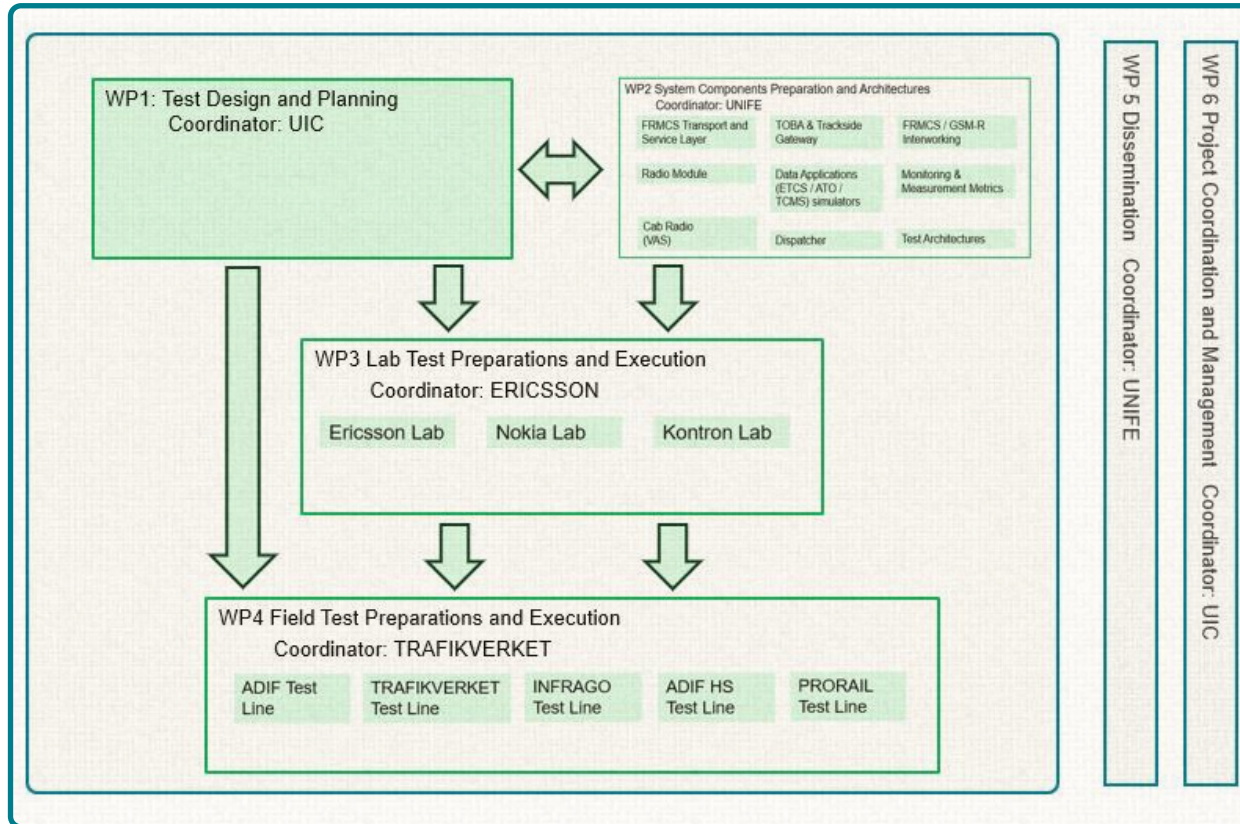
MORANE-2 is the FRMCS European Demonstrator. Its scope is to test the FRMCS V2 Specifications – real products in real trains:

- In three Labs, hosted by Ericsson, Nokia and Kontron
- In five Field Test beds, two of them including MNO operators, and one being a High-Speed Line. These Field Tests are hosted by Germany, Sweden, Netherlands, and Spain – two lines.

MORANE-2 Testing Results will then contribute to the finalisation of the FRMCS V3 specifications that will define the FRMCS 1st Edition, by validating architecture and functionalities solutions, quality of service parameters; therefore, an essential step to make FRMCS reality.

* - (*MO*bile radio for *RA*ilway Networks in *EU*rope)

Project Structure and Partners



FP-2 MORANE-2 Consortium, Coordinated by UIC include relevant Railways, Railway Telecom Suppliers, and UNIFE.

Questions?

Thank You!

mandoc@uic.org



uic.org



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6G SNS



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Coffee Break 15 Minutes



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Work Package 1

Test Design and Planning (M1- M32)



30/06/2026 – V. Nikolopoulou – Mid-Term conference



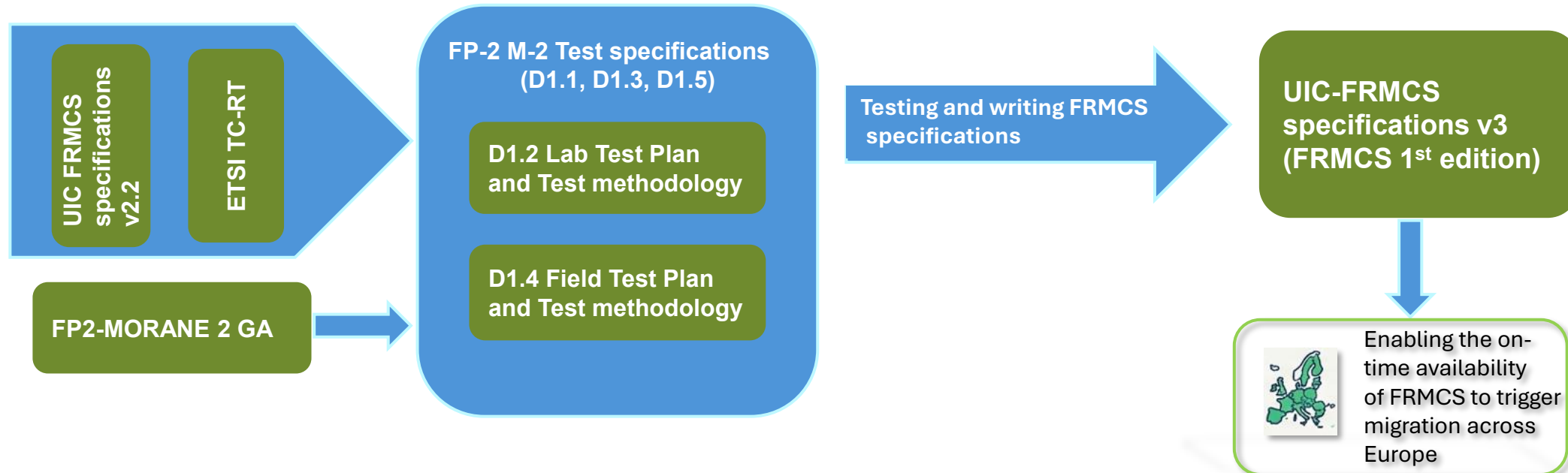
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WP1 Objectives

- ❖ **Task 1.1:** Define **functional, system, measurements and performance test cases** allowing to validate UIC FRMCS v2.2 specifications, considering mandatory requirements (M) and candidate mandatory for V3 requirements (M-V3), both including functions mandatory for interoperability in Europe (MI or MI-V3) respectively
- ❖ **Task 1.2:** Describe **lab test cases** in close collaboration with industry partners to avoid potential implementation issues but also preparing in confidence field testing activities
- ❖ **Task 1.3:** Describe **field test cases** that fulfil field testbed specificities of the IM^(*) partners, as expressed in the FP2-MORANE 2 GA
- ❖ **WP1 ↔ Specs WGs:** Ensure **regular exchange with the UIC FRMCS Specifications and other Standardisations groups (e.g. ETSI TC-RT, 3GPP)**, to update accordingly the test cases description and later, as a loopback, to provide observations/issues during the testing that may result to FRMCS specifications amendments

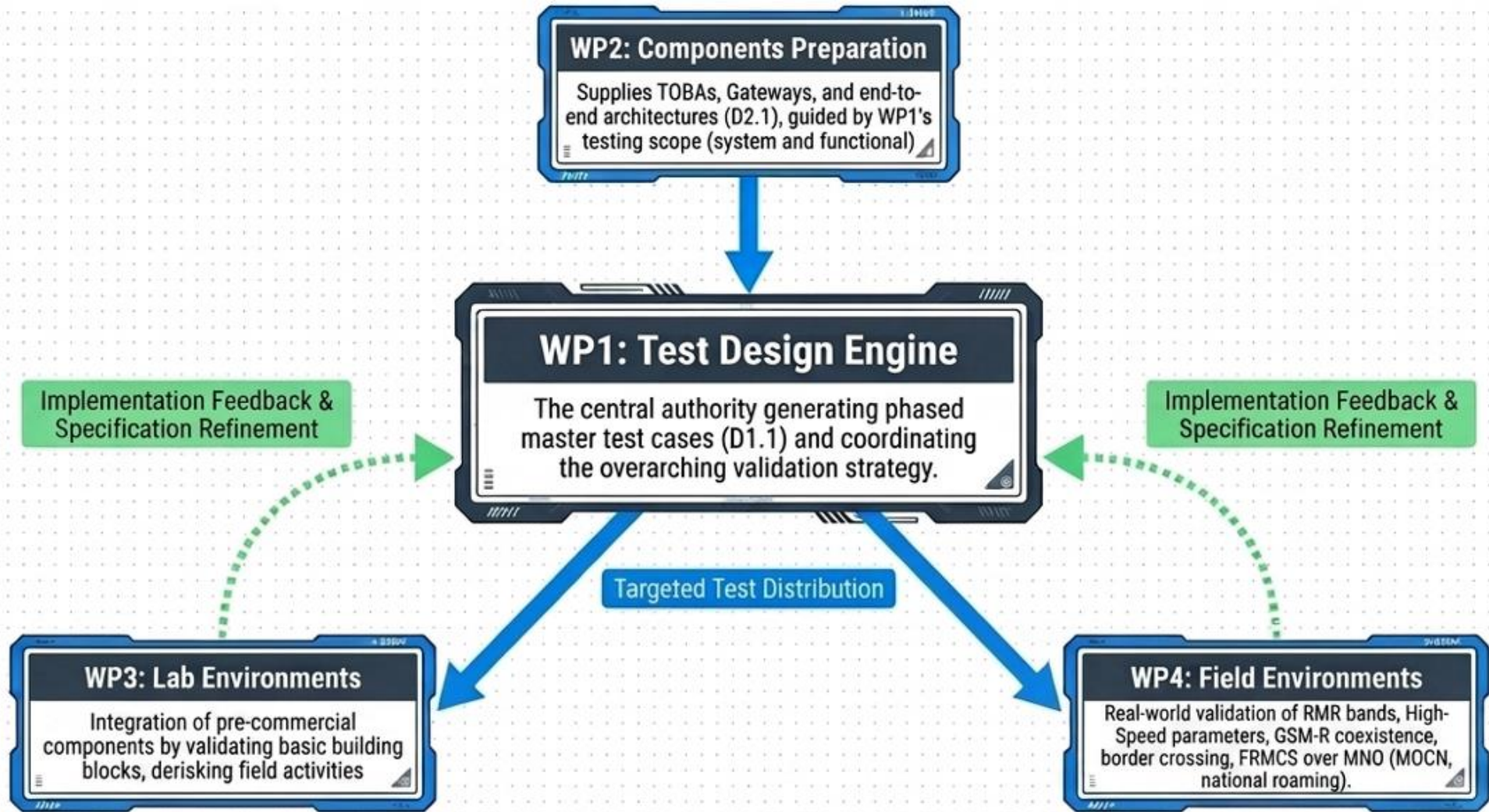
(*):Infrastructure Managers



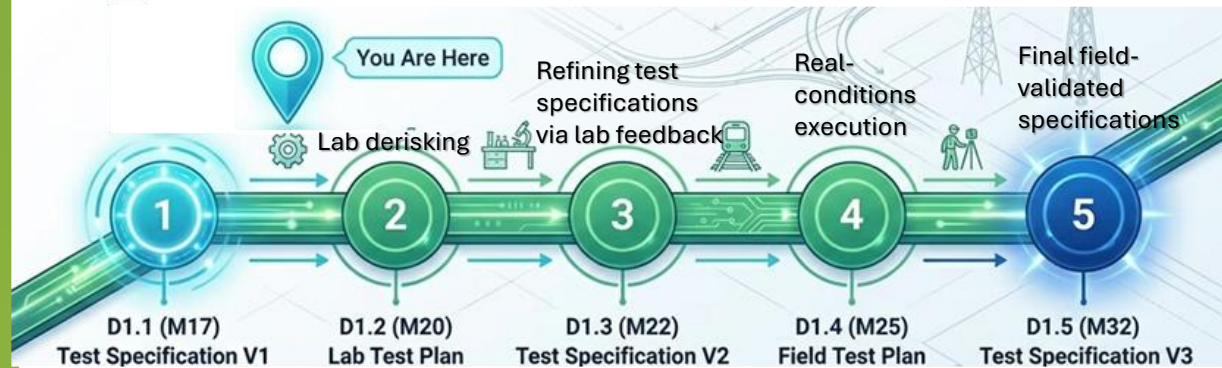
Our Partners:



WP1 interacting with the other WPs



WP1 timeline



D1.1 delivered

				Dec	Jan	Feb	Mars	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mars	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mars	Apr	May	June	July	Aug	Sept												
				2024	2025												2026												2027																				
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34												
WP1	Test Design and Plan	1	32																																														
Task 1.1	FRMCS Test Specifications	1	32																																														
Task 1.2	Test Plan and Test Methodology for Lab	1	20																																														
Task 1.3	Test Plan and Test Methodology for Field	1	25																																														
	Deliverables																																																
D1.1	FP2-MORANE-2 Test Specification V1		17															D1.1																															
D1.2	Lab Test Plan and Test Methodology		20															D1.2																															
D1.3	FP2-MORANE-2 Test Specification V2		22																D1.3																														
D1.4	Field Test Plan and Test Methodology		25																	D1.4																													
D1.5	FP2-MORANE-2 Test Specification V3		32																				D1.5																										
	Milestones																																																
MS5	Lab Test Specification Ready (D1.1)		17														MS5																																
MS6	MCP Element 1		18															MS6																															
MS9	Field Test Specification Ready (D1.3)		22																MS22																														
MS10	MCP Element 2		23																	MS23																													
MS18	Final Test Specification Ready (D1.5)		32																					MS32																									
MS19	MCP Element 4		33																								MS33																						

Legend	Deliverables
	WP1 Milestones

We are here

- Structure of D1.2 provided
- On-going work of review comments on D1.1, to prepare content of D1.2

Task 1.1. FRMCS Test Specifications (M1-M32) (1/2)

Methodology to prepare D1.1 (M17)



65% Task Completion

~200 (*) Test cases listed in D1.1

Testing scope agreed

Definition of high-level testing scope based on:

- selection of system and functional requirements to validate
- GA expectations

Nomination of industry partners, as primes for test case description under the coordination, and for some test cases contribution of UIC

- Distribution of test cases in field testbeds, considering their specific interests
- Distribution of test cases in lab testbeds, considering the supporting field testbed

D1.1 in 3 parts:

- Part 1: Overview of lab and field testbeds and definition of testing scope, presentation of success testing criteria
- Part 2: Applications, Performances and measurements
- Part 3: System and Functional

Applications to be tested



6ESNS



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Deliverable D 1.1
FP2-MORANE-2 Test Specification V1
Part 1/3:
Overview of lab and field testbeds and definition of the testing scope

Document Title	FP2-MORANE-2 Test Specification V1 - Part 1/3
Author	Author: Vassiliki Nikolopoulou, UIC Contributors: ADP, DB-InfraG, TRV, PROSA, ATSA, CAF, SMO, ERICSSON, NOKIA, KONTRON, HROTS, VIAVI, FUNKWERK, FREQUENTIS, ROT, TELTRONIC, EVIDEN, TEUSA
Document Version	V 1.0
Work Package	WP1
Document status	Final
Dissemination level	PU

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Deliverable D 1.1
FP2-MORANE-2 Test Specification V1
Part 2/3:
System & Functions

Document Title	FP2-MORANE-2 Test Specification V1 - Part 2/3
Author	Author: Vassiliki Nikolopoulou, UIC Contributors: ADP, DB-InfraG, TRV, PROSA, ATSA, CAF, SMO, ERICSSON, NOKIA, KONTRON, HROTS, VIAVI, FUNKWERK, FREQUENTIS, ROT, TELTRONIC, EVIDEN, TEUSA
Document Version	V 1.0
Work Package	WP1
Document status	Final
Dissemination level	PU

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Deliverable D 1.1
FP2-MORANE-2 Test Specification V1
Part 3/3:
Applications, Performance & Measurements

Document Title	FP2-MORANE-2 Test Specification V1 - Part 3/3
Author	Author: Vassiliki Nikolopoulou, UIC Contributors: ADP, DB-InfraG, TRV, PROSA, ATSA, CAF, SMO, ERICSSON, NOKIA, KONTRON, HROTS, VIAVI, FUNKWERK, FREQUENTIS, ROT, TELTRONIC, EVIDEN, TEUSA
Document Version	V 1.0
Work Package	WP1
Document status	Final
Dissemination level	PU

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(*): Some of them still placeholders in D1.1 to be addressed in further deliverables of WP1

Task 1.1. FRMCS Test Specifications (M1-M32) (2/2)

Testing scope covered in D1.1 and assigned partners primes:

System principles	Primes
Interfaces (OBapp/TSapp)	Alstom
IP routing (TC, LC)	Alstom
Inter-band HO (HO between n100/n101 RMR bands)	Kontron
OBnsm	UIC
OBo&m	Siemens (UK) and Trafikverket
VAS provisionning	Siemens (UK)
FSomr and Profiles provisionning	Siemens (UK)
Profiles	UIC

Specific testing architectures	Primes
Border crossing	UIC
HSL (Connectivity loss)	Kontron, Alstom
GSM-R/FRMCS transition (Coordinating function, NSM), BC conditions have also been added	Funkwerk, Siemens (DE)
MC domain interconnection	Eviden, supported by Kontron and Nokia, DB
IWF	Eviden
FRMCS over MNO: MOCN	Ericsson, Trafikverket
FRMCS over MNO: Multi-Path Function	ProRail, Ericsson, Alstom

Common functions	Primes
Role MGT	UIC and Frequentis
Location	Funkwerk
Authorisation (MC Service Profile/RBAC)	Eviden, Nokia, UIC
Talker Control	MCX Server and dispatcher providers contribution is still requested
Arbitration	Siemens
Time Services	Hitachi

Measurements and performances	Primes
	Viavi/Nokia, Voice & Data Application providers

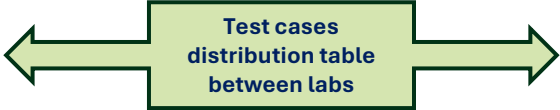
Applications	Primes
Voice (nominal conditions)	Funkwerk
REC (nominal conditions)	Funkwerk
Voice - First to answer (Shared FA for dispatchers)	Frequentis
ATP (nominal conditions)	CAF
ATO (nominal conditions)	CAF
TCMS (nominal conditions)	CAF
Messaging, DSD Alarm, PA	Not assigned yet

Task 1.2. Test Plan and Test Methodology for Lab Preparation of D1.2 (M20)

Test cases		Laboratories				Remarks
Number	ID	Ericsson	Nokia	Kontron	TC leader	
APM 001	VOIC_001	N	N	Y	FWK	
APM 002	VOIC_002	N	N	Y	FWK	
APM 003	VOIC_003	N	N	Y	FWK	
APM 004	VOIC_004	N	N	Y	FWK	
APM 005	VOIC_005	N	N	Y	FWK	
APM 006	VOIC_006	N	N	Y	FWK	
APM 043	MEAS_HSL_REC_KPI1_KPI2_KPI4	Y supporting lab	N	Y supporting lab	FWK	



85% Task Completion



Ericsson
(Düsseldorf, Germany)

Focus: Complementary VAS and REC basic tests, TSctrl, OBo&m, FSomr, VAS provisioning, Location, Arbitration, Profiles, FRMCS over MNO support for MOCN and Multipath function

Nokia
(Budapest, Hungary)

Focus: Authorisation in interconnected domains, intersystem authorisation, IWF, GSM-R/FRMCS transition, MC interconnection and migration, Border crossing support

Kontron
(Montigny, France / Vienna, Austria)

Focus: Basic FRMCS Building Blocks, VAS, REC, ATP/ATO/TCMS applications, KPI measurements, High-Speed Line Support



Deliverable D 1.2

Lab Test Plan and Test Methodology
Part (1/3)

FP2-MORANE-2	
Document Title	FP2-MORANE-2 Lab Test Plan and Test Methodology
Editor	Author: Vassiliki Nikolopoulos, UIC Contributors: ADF, DE-APRAGO, TRV, PROAIL, AT&A, CAF, I NOKIA, KONTRON, HROT, VAVI, FUNKWERK, FREQUENTS, R EVIDEN, TELIA
Document Version	V 0.0.1
Work Package	WP1
Document status	First draft
Dissemination level	PU

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FP2-MORANE-2 - GA 101180120



Deliverable D 1.2

Lab Test Plan and Test Methodology
Part (2/3)
Applications, Performance & Measurements

FP2-MORANE-2	
Document Title	FP2-MORANE-2 Lab Test Plan and Test Methodology
Editor	Author: Vassiliki Nikolopoulos, UIC Contributors: ADF, DE-APRAGO, TRV, PROAIL, AT&A, CAF, ERO, ERICSSON, NOKIA, KONTRON, HROT, VAVI, FUNKWERK, FREQUENTS, ROT, TELSONIC, EVIDEN, TELIA
Document Version	V 0.0.1
Work Package	WP1
Document status	First draft
Dissemination level	PU



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FP2-MORANE-2 - GA 101180120



Deliverable D 1.2

Lab Test Plan and Test Methodology
Part (3/3)
System & Functions

FP2-MORANE-2	
Document Title	FP2-MORANE-2 Lab Test Plan and Test Methodology
Editor	Author: Vassiliki Nikolopoulos, UIC Contributors: ADF, DE-APRAGO, TRV, PROAIL, AT&A, CAF, ERO, ERICSSON, NOKIA, KONTRON, HROT, VAVI, FUNKWERK, FREQUENTS, ROT, TELSONIC, EVIDEN, TELIA
Document Version	V 0.0.1
Work Package	WP1
Document status	First draft
Dissemination level	PU



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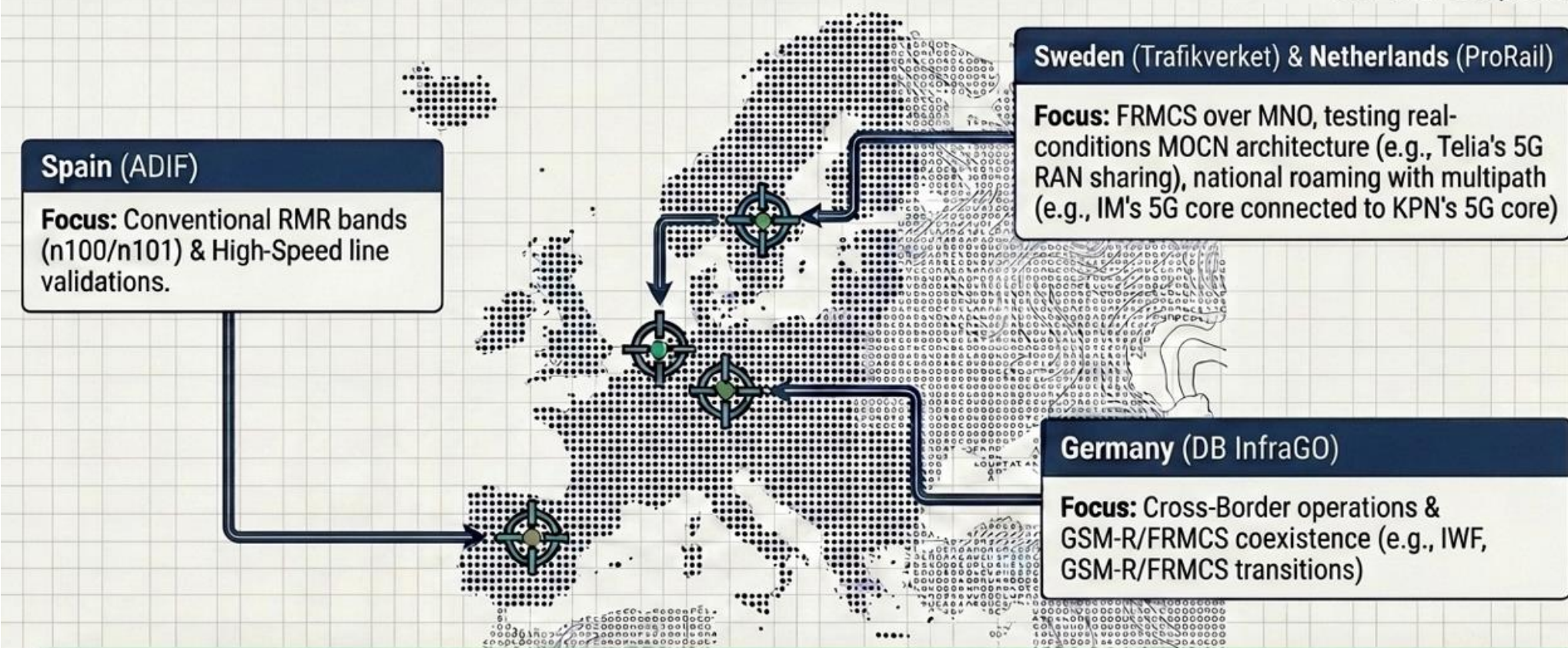
FP2-MORANE-2 - GA 101180120

120

Task 1.3. Test Plan and Test Methodology for Field

Field Test Planning: Validating across European test-tracks

60% Task Completion



Key Insight: Field test case distribution, complementary to Lab testbeds capabilities, directly aligning D1.4 Field Test Plan with real-world infrastructure constraints.

Conclusion & Next Steps

- ❖ **Industry partners:** High level of cooperation between network, MC servers, GWs and application providers cab radio, data applications to achieve a successful integration phase, ensure interoperability and lab readiness, involving WP1 for potential amendment of test cases description.
- ❖ **D1.2 Finalization:** Provide D1.2 on time to start Lab testing in August
- ❖ **Fill the Gaps of D1.1&D1.2:** Use the lab experience to improve test cases description.
- ❖ **Test cases traceability** to specifications requirements, instead of chapter level starting from D1.3
- ❖ **Closing the Gap:** WP1 is expected to feed implementation issues back to specification WGs to refine the FRMCS 1st Edition.



Questions?

Thank You!

nikolopoulou@uic.org

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Work Package 2 - System Component Preparation and Architectures

Mid-Term Conference

30 June 2026 | WP Lead: UNIFE | J. Bertolin



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WP2 – System Component Preparation and Architectures

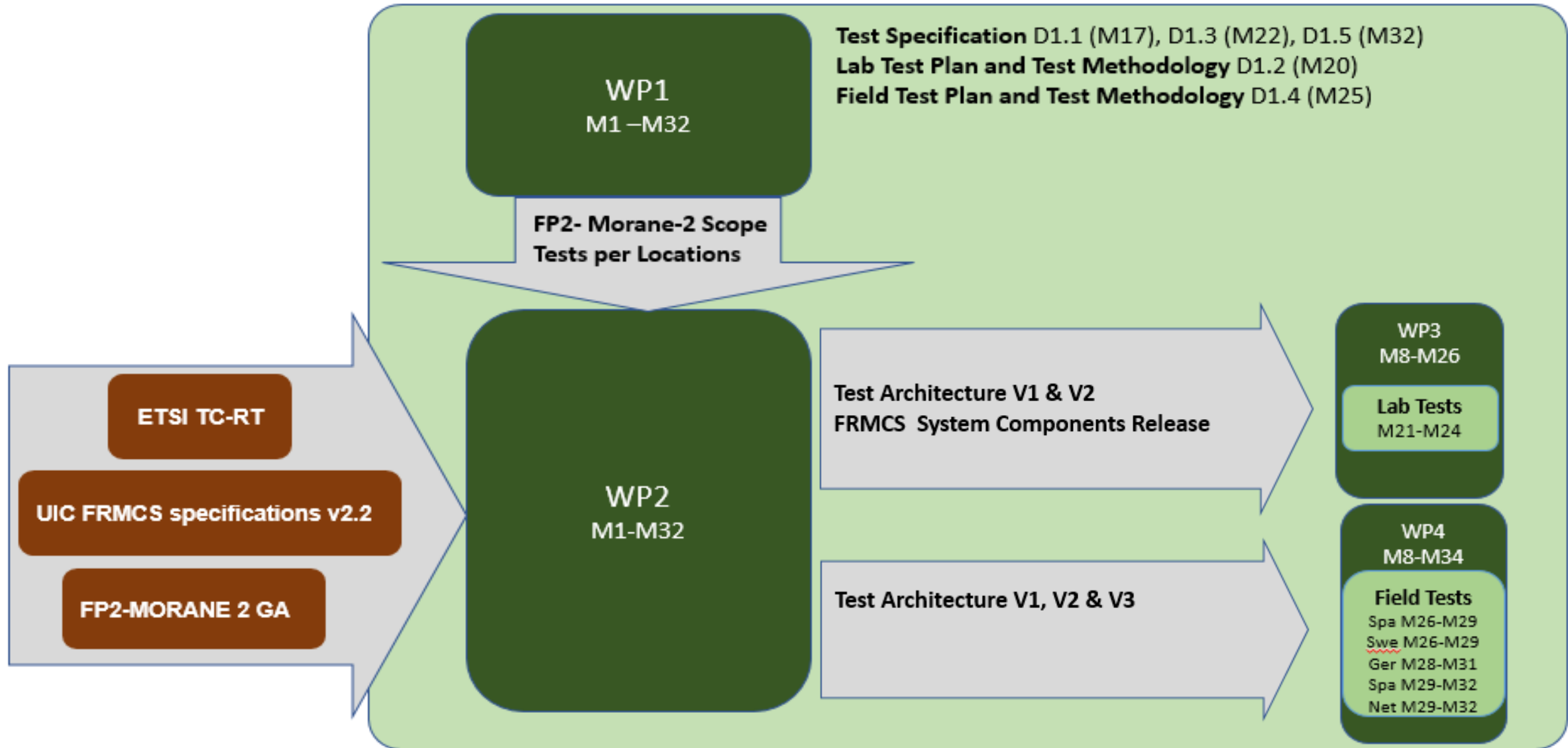
Duration: Dec 2024 - July 2027 (32 Months)

Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep				
2024	1Q2025			2Q2025			3Q2025			4Q2025			1Q2026			2Q2026			3Q2026			4Q2026			1Q2027			2Q2027			3Q2027						
System Components Preparation and Architectures																																					
T2.1		FRMCS Transport and Service Layer																			D2.2a D2.2b D2.2c																
T2.2		TOBA & Trackside Gateway																																			
T2.3		Cab Radio																																			
T2.4		Dispatcher																																			
T2.5		Monitoring & Measurement Metrics																																			
T2.6		Data applications (ETCS/ATO/TCMS Simulators)																																			
T2.7		Radio Module																																			
T2.8		FRMCS/GSM-R Interworking																																			
T2.9		Test Architectures																			D2.1					D2.3					D2.4						

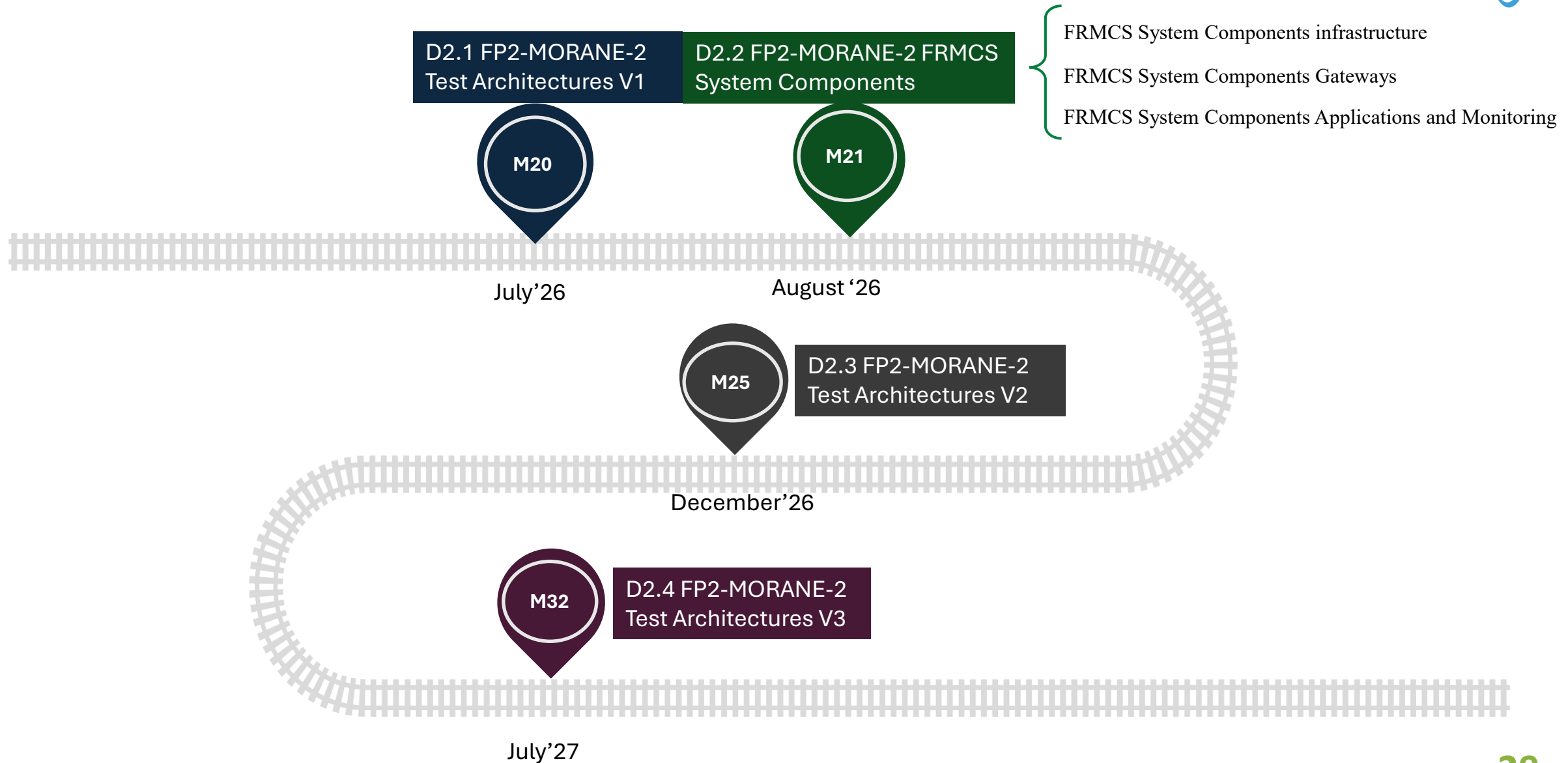
The main objectives of WP2

- Preparation of the necessary FRMCS system components according to FRMCS V2 Specifications & V3 target requirements (**August 2026**)
- Creation of a generic FMRCs architecture for the test activities in WP3 and WP4 (**July 2027**)

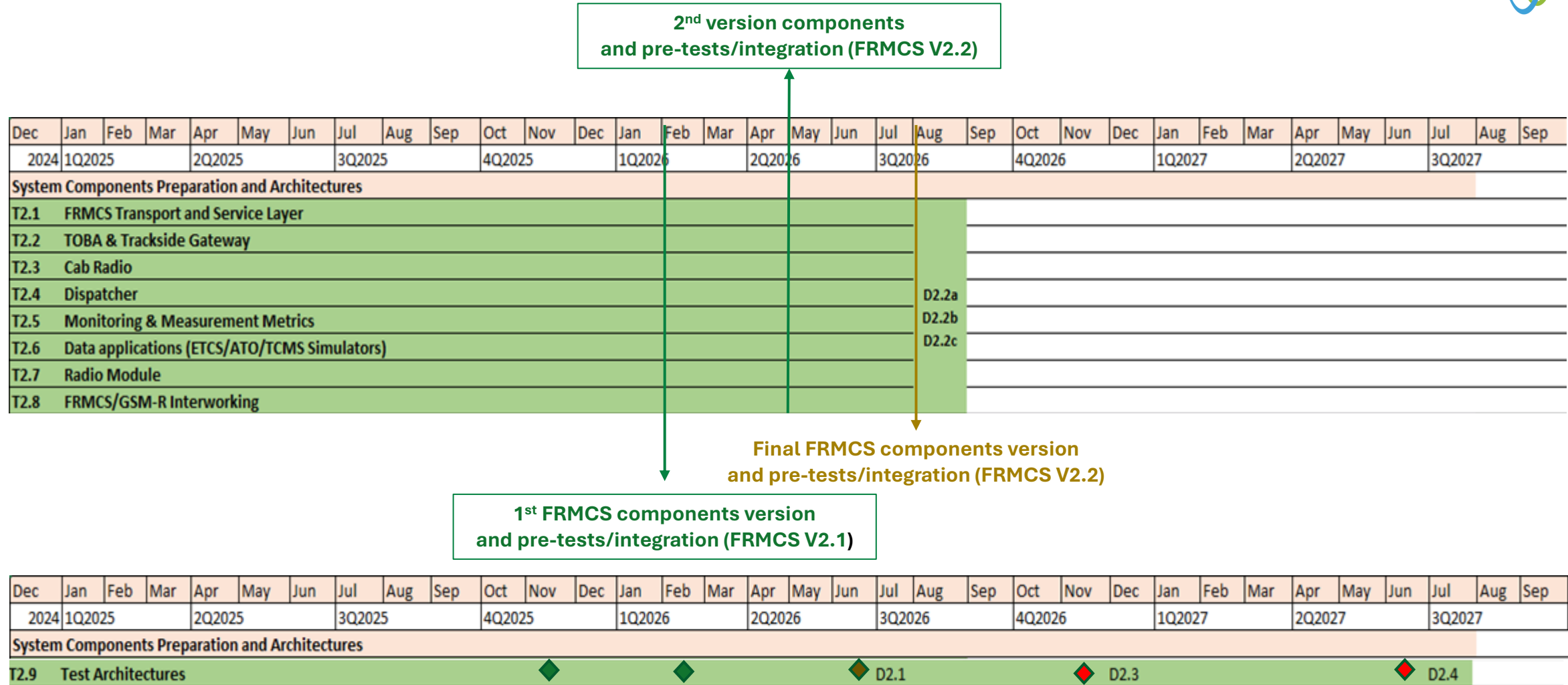
WP2 – WORKFLOW



Timeline and deliverables



WP2 – Planning



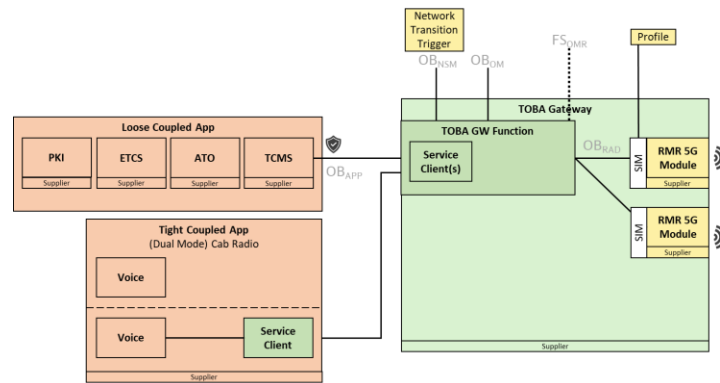
Early delivery of D2.1 and D2.3 draft to support early laboratory and field installation

Objectives

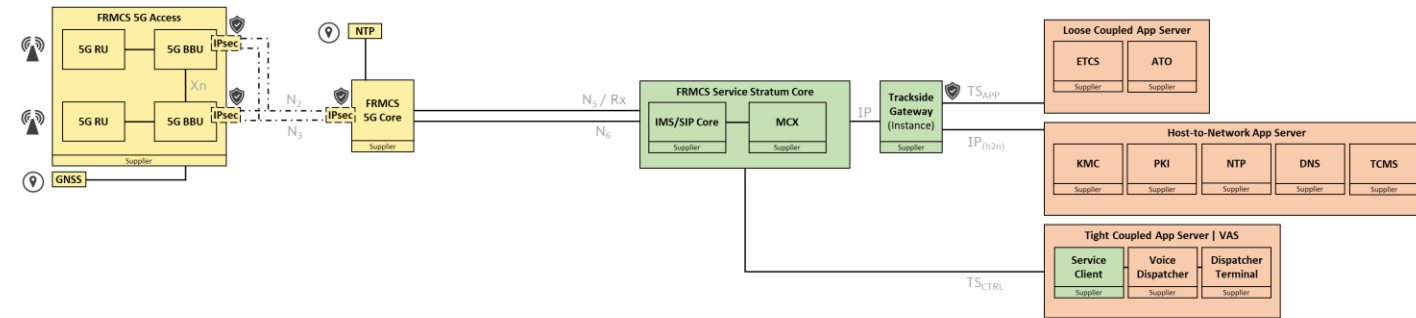
- Provide a **functional end-to-end reference architecture** (high-level design), considering all FRMCS and application system components as well as interfaces from T2.1-T2.8
- Consolidate **basic monitoring metrics** for the assessment of the test architectures and for WP1 test cases
- Use the functional architecture to describe test cases and achieve **comparable test installations** with consistent outcomes
- Develop **sub-system architectures** to verify operational scenarios:
 - Inter-FRMCS domain transition (IFDT) in border-crossing scenarios,
 - Interworking with GSM-R,
 - FRMCS Multipath,
 - FRMCS high speed functionality

Reference Architecture & Functional Layers

- FRMCS Transport Stratum
- FRMCS Service Stratum
- Application



Onboard

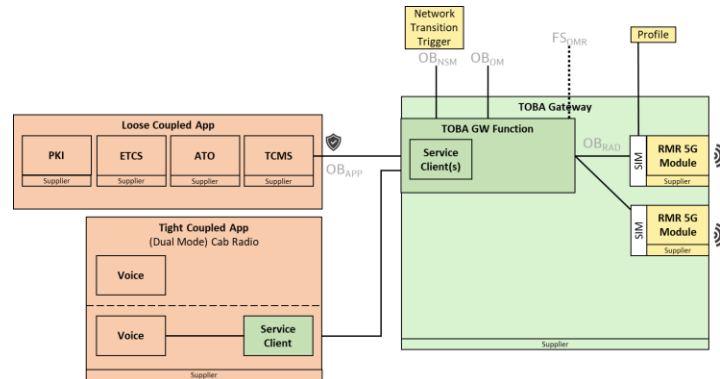


Trackside

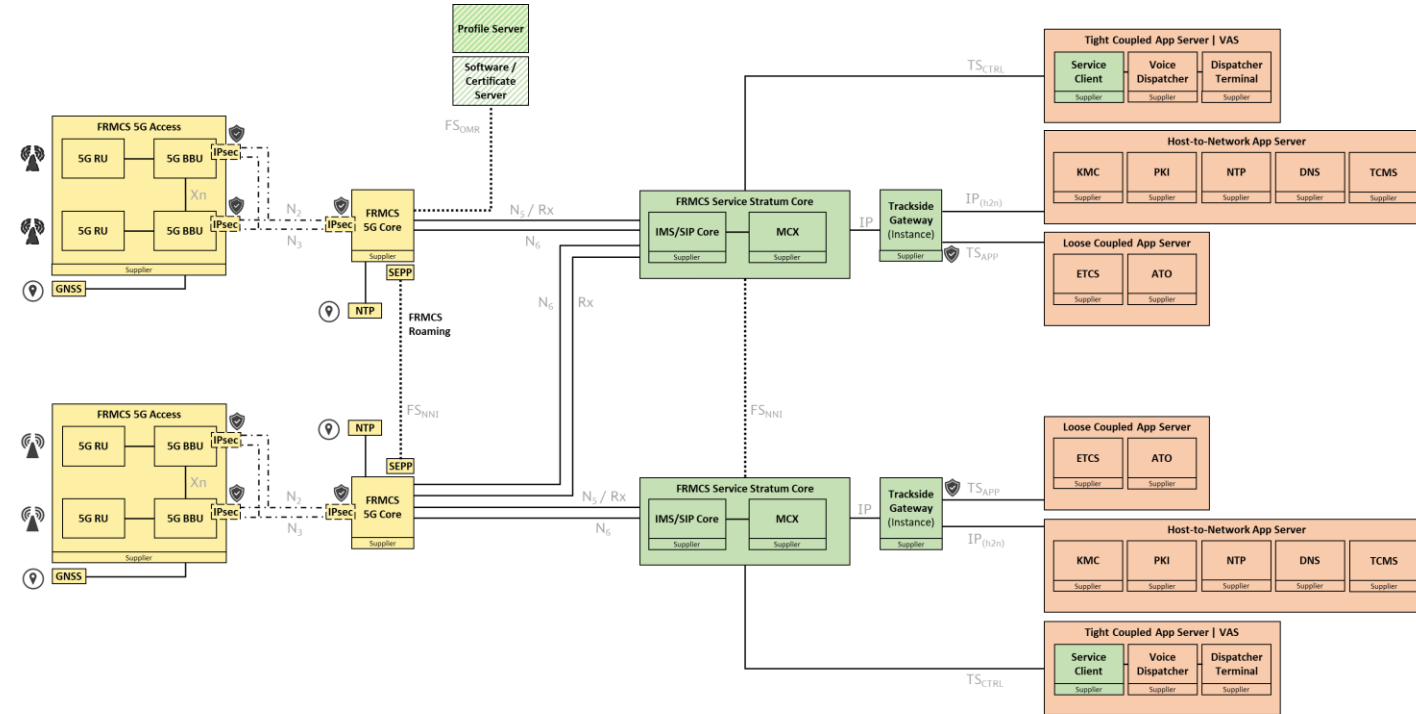


Reference Architecture & Functional Layers

-  **FRMCS Transport Stratum**
-  **FRMCS Service Stratum**
-  **Application**
- External Networks
-  **FRMCS Transport & Service**



Onboard



Trackside



Reference Architecture & Functional Layers

 **FRMCS Transport Stratum**

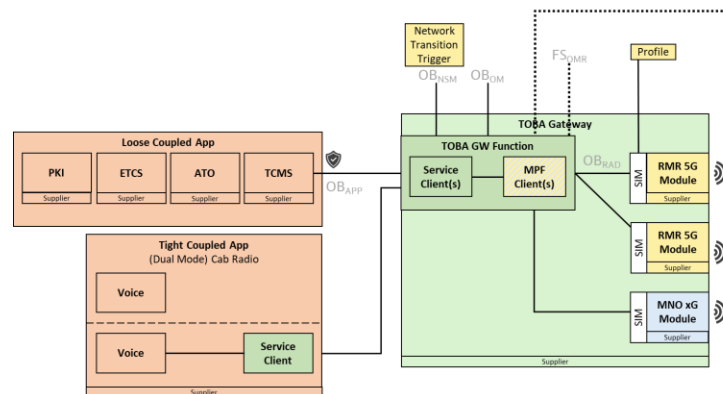
 **FRMCS Service Stratum**

Application

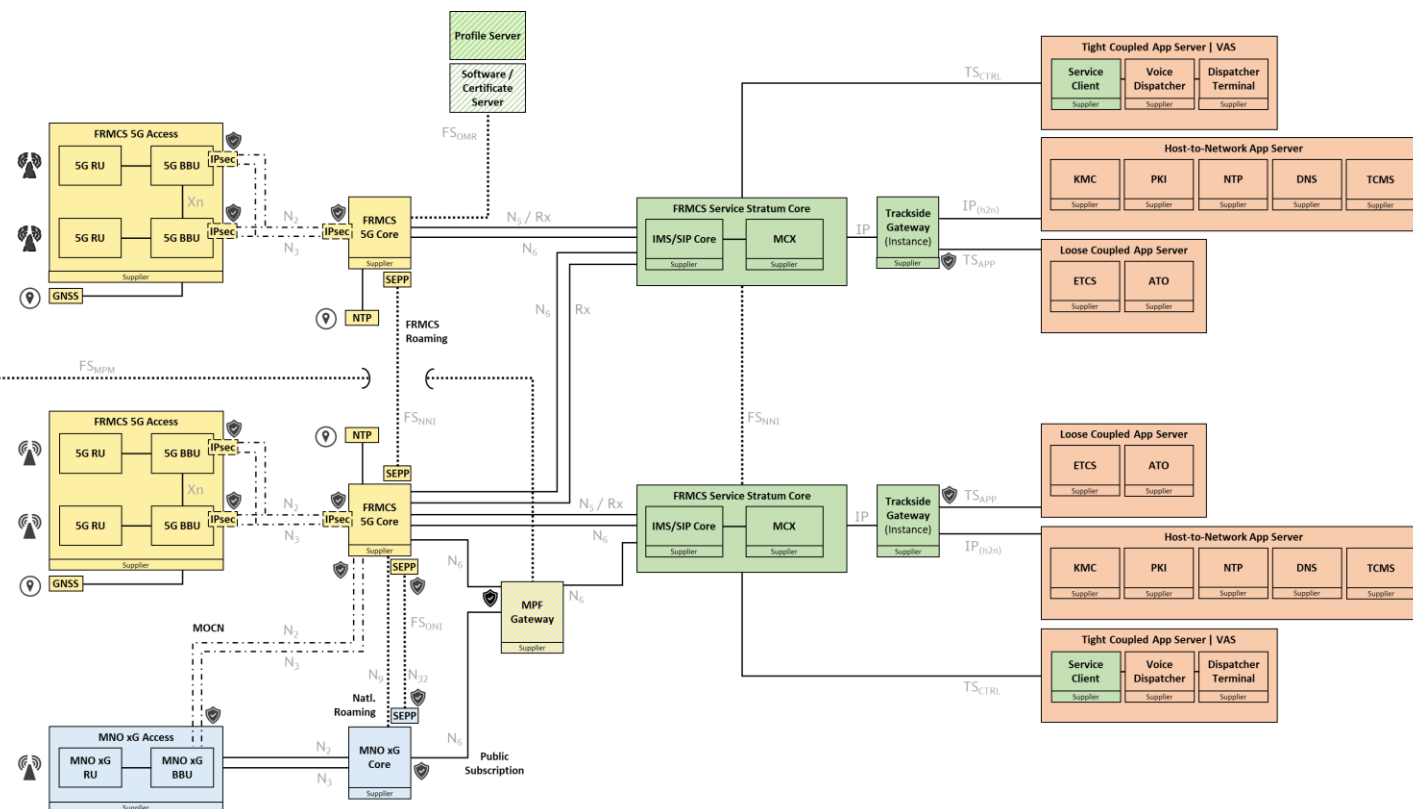
External Networks

 FRMCS Transport & Service

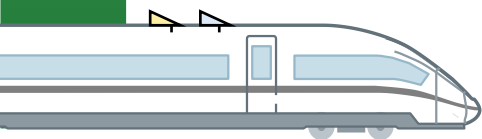
 **MNO Transport**



Onboard



Trackside



Reference Architecture & Functional Layers

 FRMCS Transport Stratum

 FRMCS Service Stratum

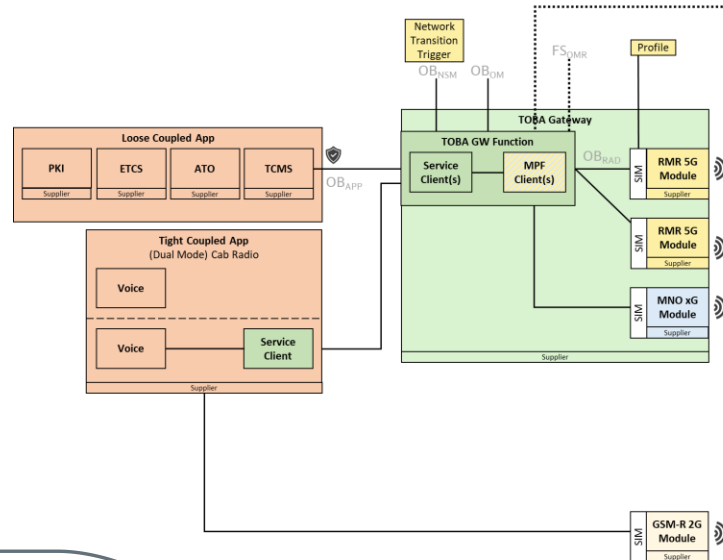
 Application

External Networks

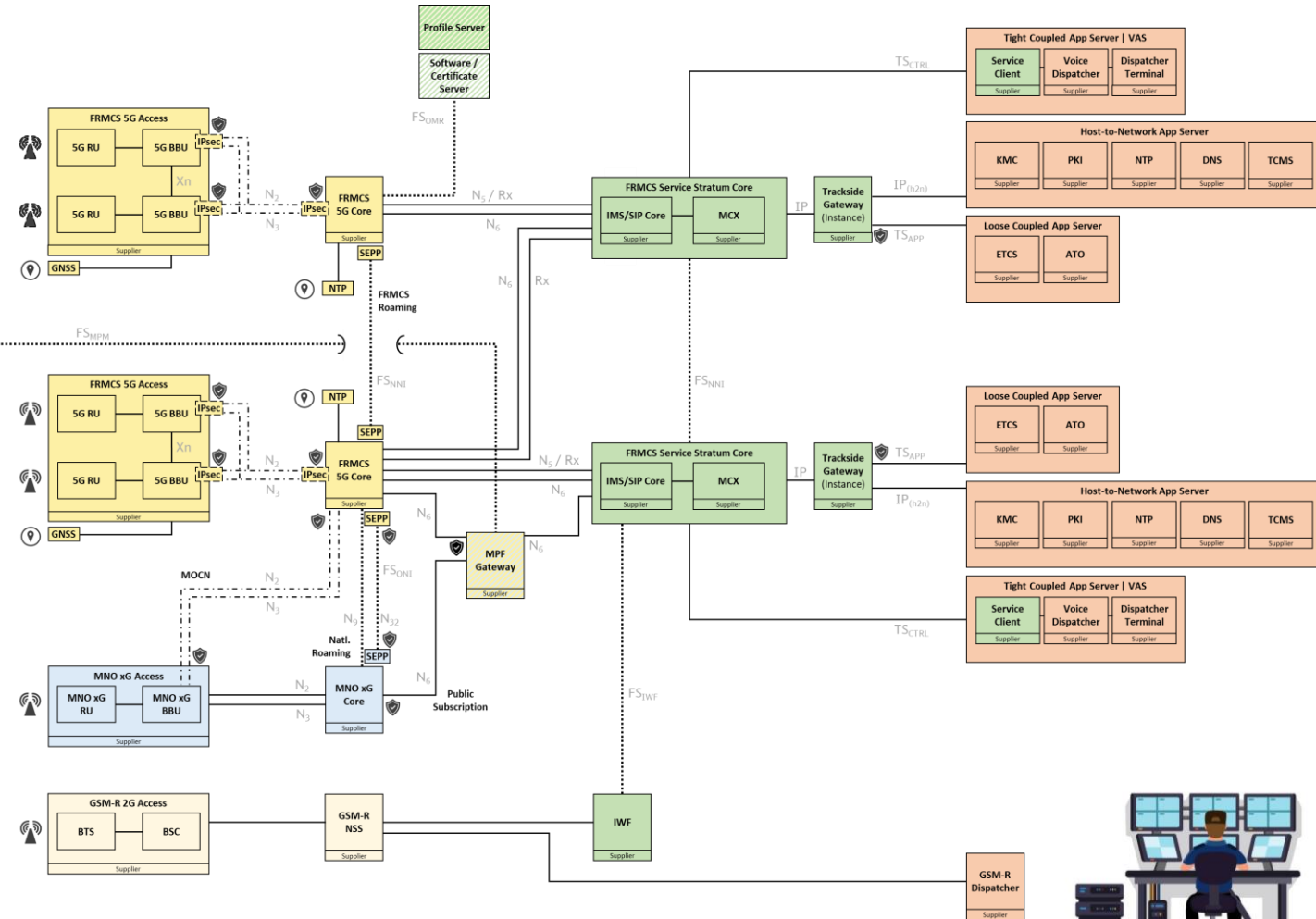
 FRMCS Transport & Service

 MNO Transport

 GSM-R Transport



Onboard



Trackside



Reference Architecture & Functional Layers

 FRMCS Transport Stratum

 FRMCS Service Stratum

 Application

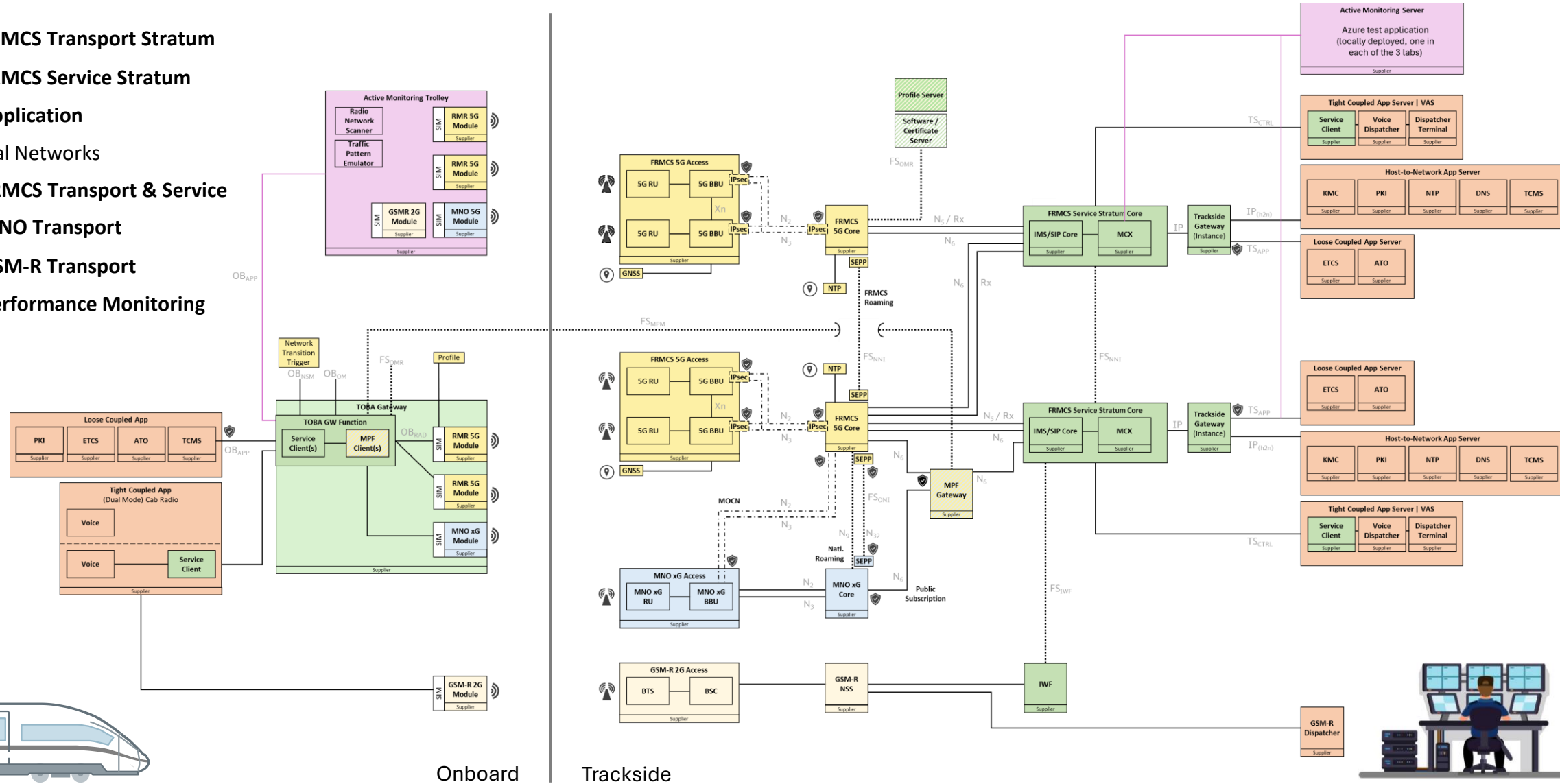
External Networks

 FRMCS Transport & Service

 MNO Transport

 GSM-R Transport

 Performance Monitoring



Deliverables

- description of architecture design will be provided in incremental releases
- **D2.1 : M20 (07/2026)**
- D2.3 : M25 (12/2026) – lab test feedback
- D2.5 : M32 (09/2026) – field test feedback



**FP2-MORANE** 2

Deliverable D 2.1
Test Architectures V1

FP2 MORANE2	
Document Title	Test Architectures V1
Editor	All
Document Version	V 0.0.2
Work Package	WP2
Document status	Draft
Dissemination level:	PU

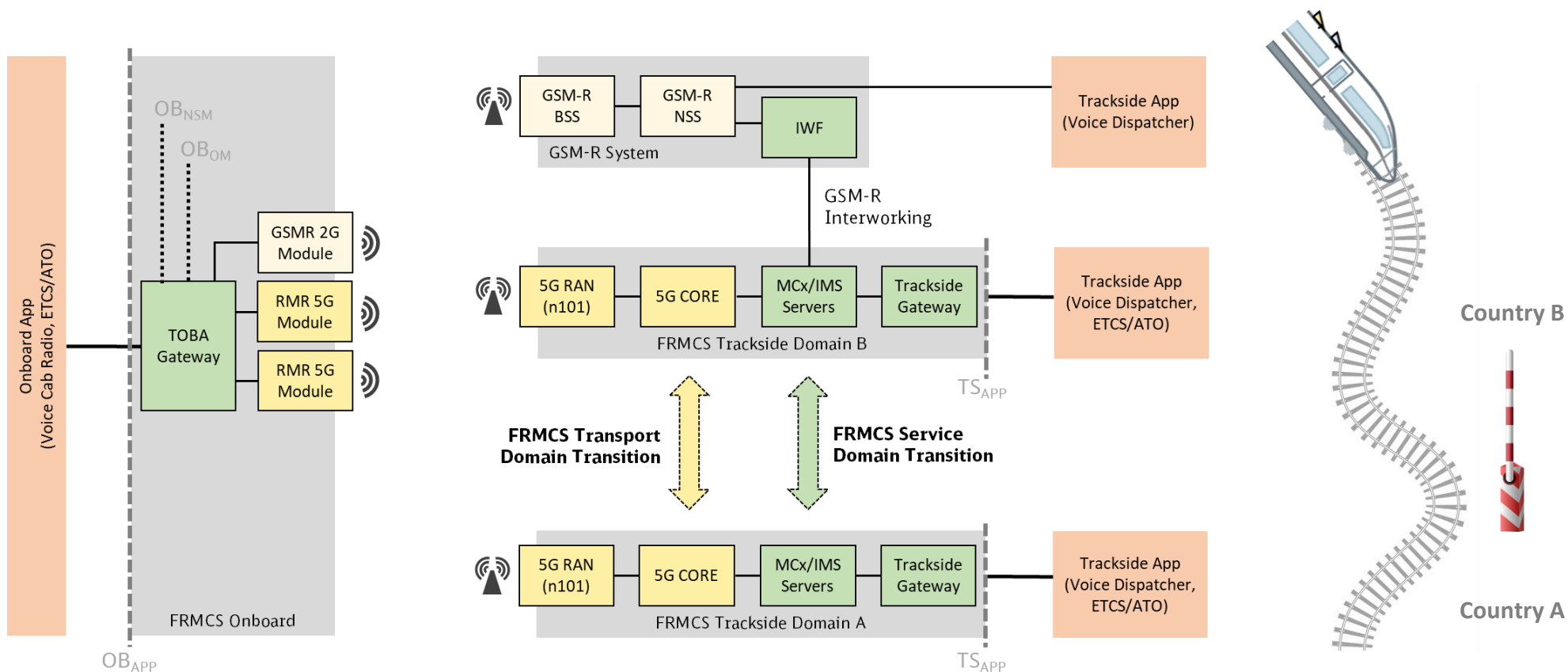
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FP2-MORANE-2 - GA 1011981251|48

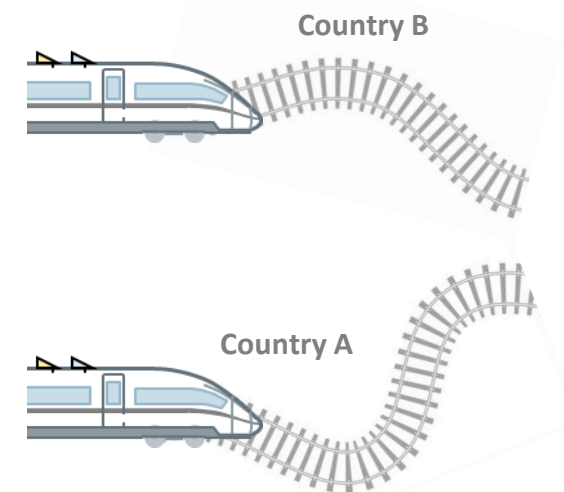
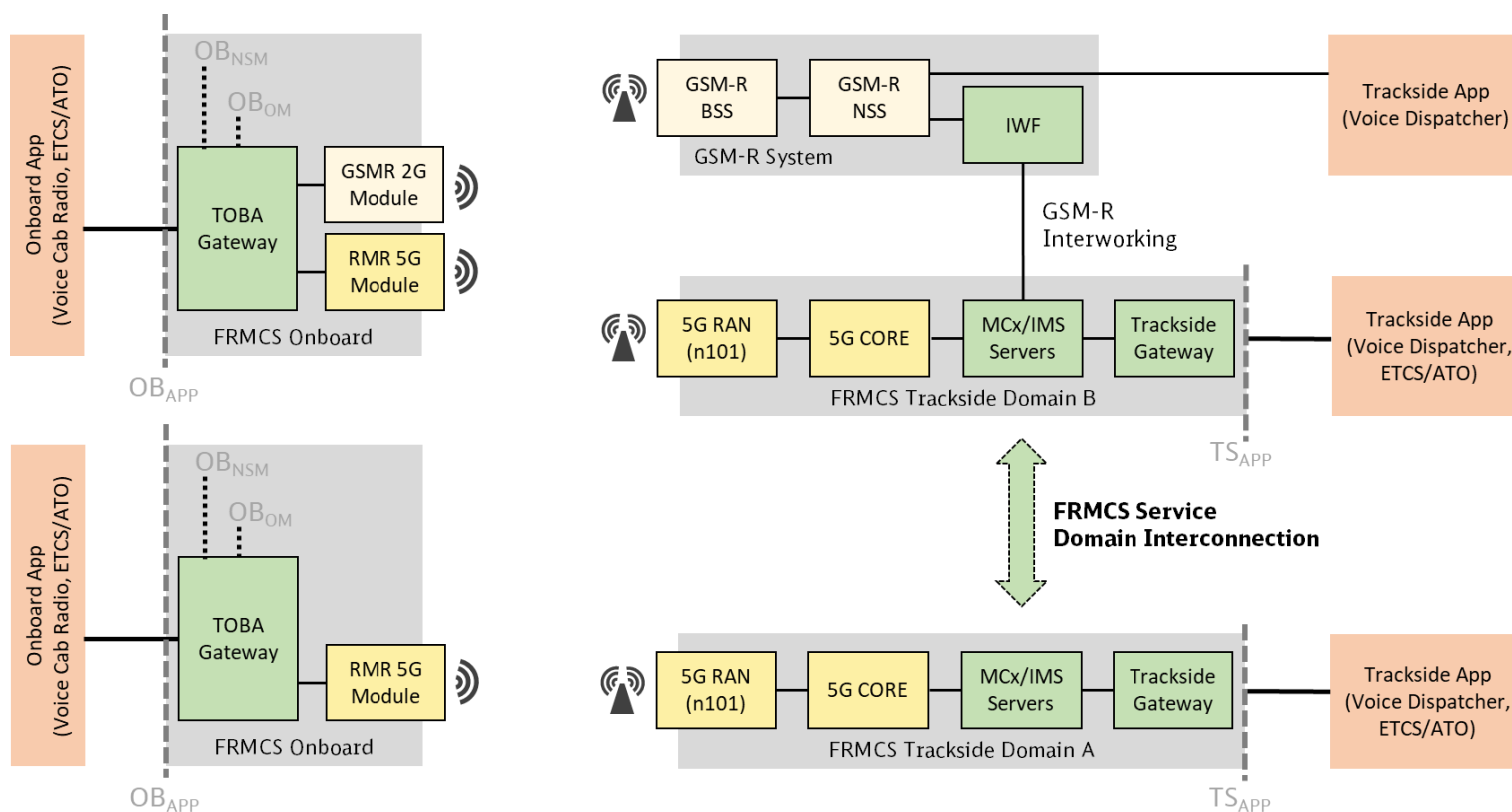
Border-Crossing (BX) Scenarios

- **FRMCS Domain Transition** via 5G Home-Routed Roaming (Transport) and MC Migration (Service) – 2 UE for ETCS/ATO vs. 1 UE for Voice



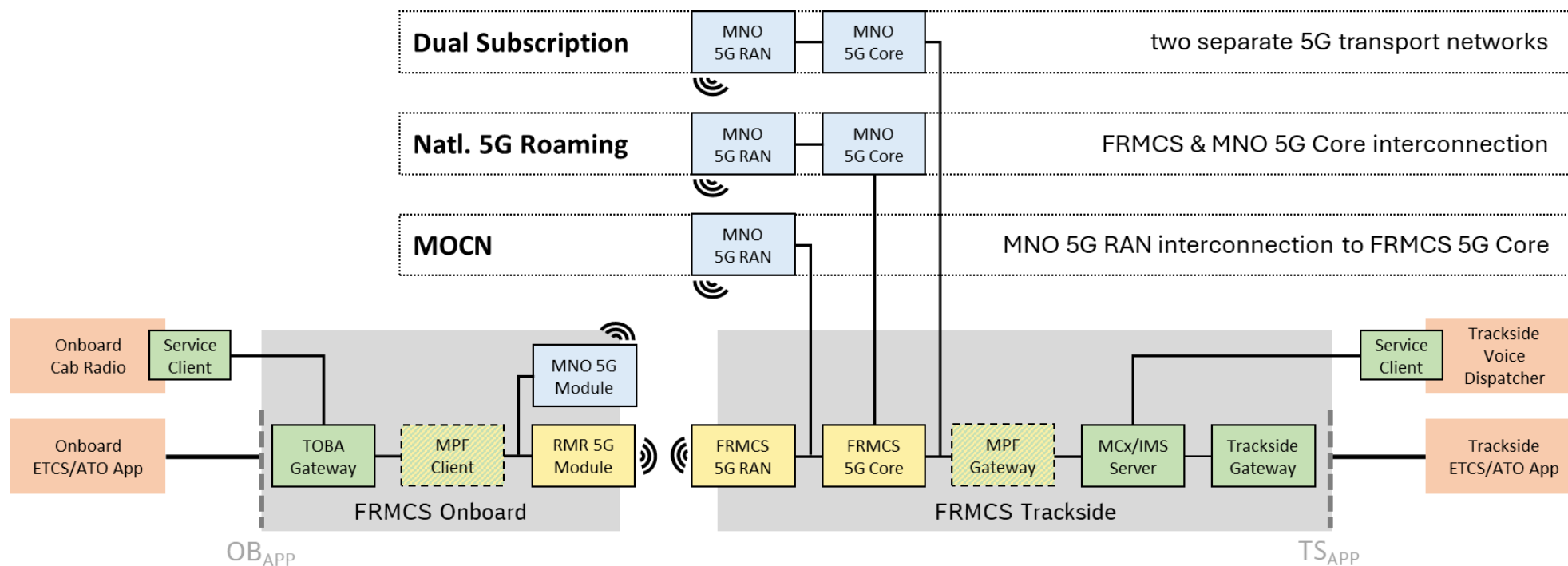
Border-Crossing (BX) Scenarios

- MC Domain Interconnection**



MNO and Multipath Scenarios

- **FRMCS MOCN** with focus on trackside implementation
- **FRMCS National Roaming** with and w/o Multipath Function (MPF)
- **FRMCS Dual Subscription** with MPF





FRMCS Transport and Service Layer

Mid-term Conference

30 June 2026 | Task Lead: Kontron | A. Hinterberger



Co-funded by
the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101196125.

Objectives

Technical Architecture and Partner Interconnection for Labs and Fields

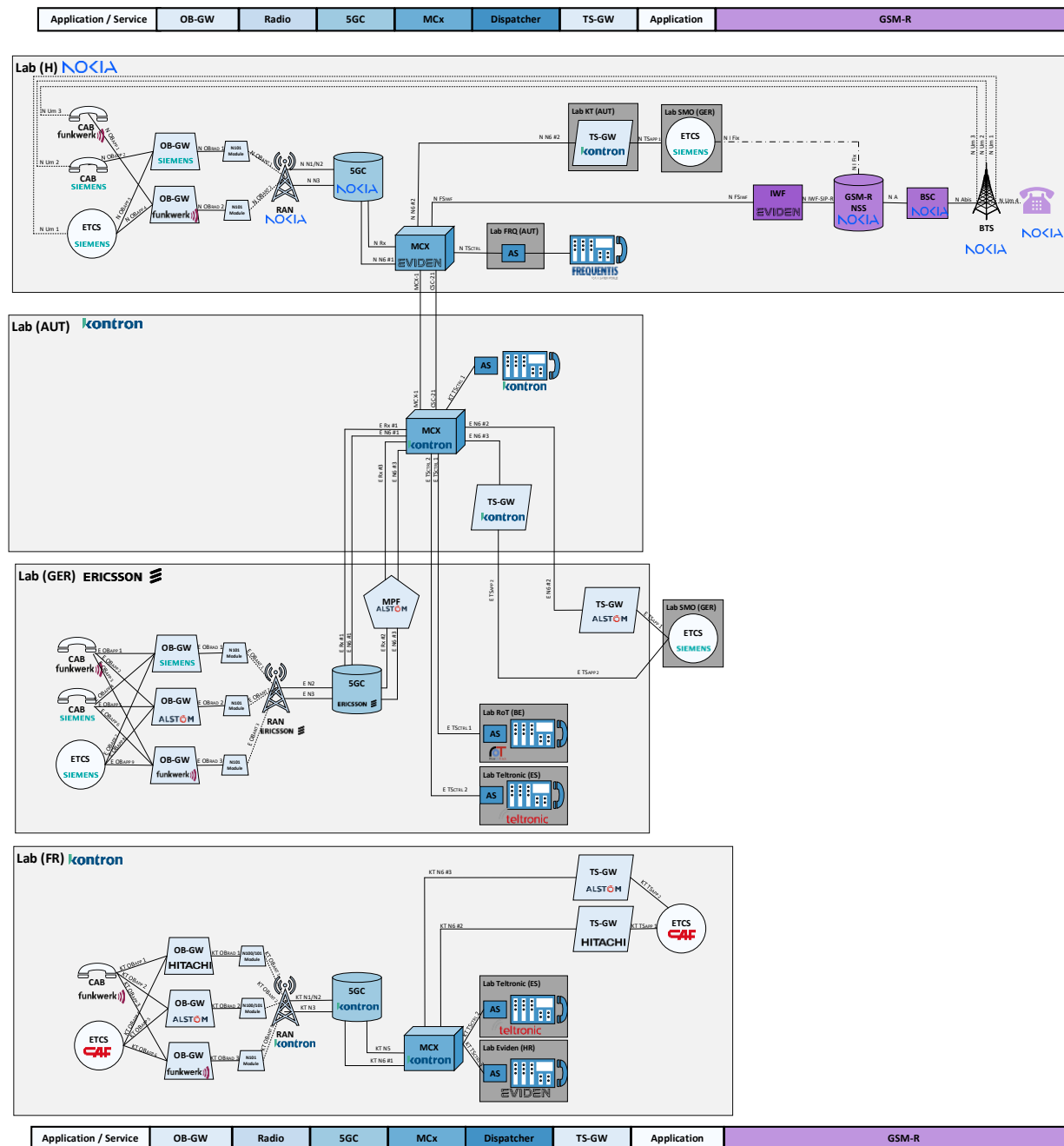
- **Component Mapping:** Define all physical components and local interfaces within the project ecosystem
- **System Architecture:** Deliver a unified architecture for WP3 and WP4 considering all partner contributions to represent the full project scope

Partner Alignment & Validation

- **Strategic Communication:** Maintain high-level alignment and proactive communication across all partners
- **Testing Orchestration:** Coordinate lab and field activities to ensure integrated testing and validation

Lab Interconnection & Techn. Architecture

- **Streamlined Lab Architecture:** Provides a simplified overview of partner distribution across interconnected lab facilities
- **E2E Component Lifecycle Alignment:** Validates that lab testing utilizes the same end-to-end components designated for field.
- **Standardized Interface Nomenclature:** Ensures unique naming conventions and identification across all system interfaces.



- 





FRMCS/GSM-R Interworking

Mid-term Conference



30 June 2026 | Task Lead: Nokia | C. Lindner / T. Tenyi



Co-funded by
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This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101196125.

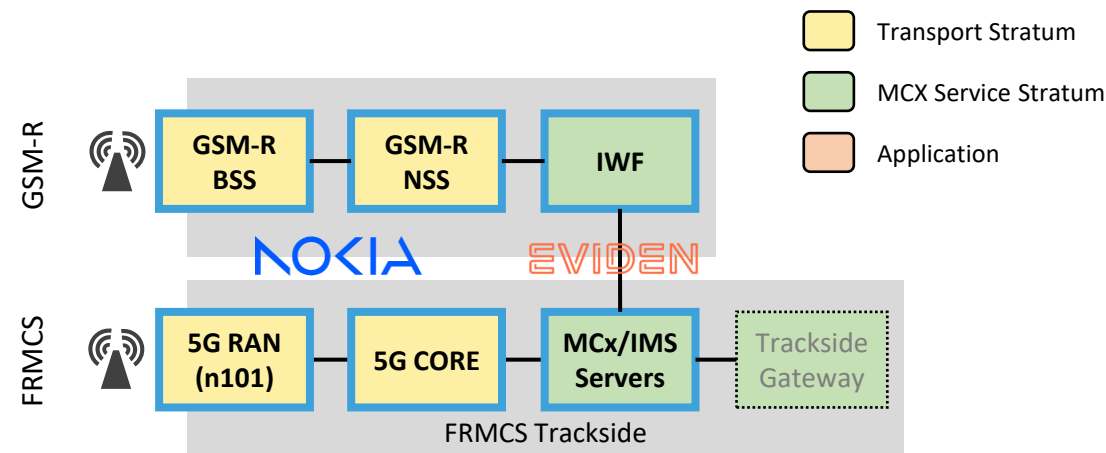
Objectives

Partners:      

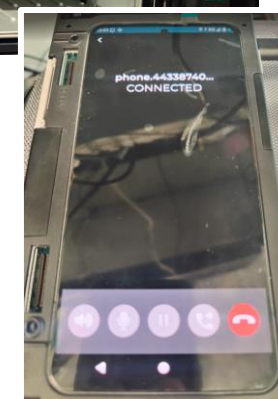
- Support of **interworking tests between GSM-R (2G) and FRMCS (5G) MC systems** according to WP1 and based on ETSI TS 103 792 specification
- Interworking Function (IWF) is realized to enable **operational continuity for voice services**, such as group calls, point-to-point calls, and the Railway Emergency Call (REC)
- IWF will support **identity mapping** between GSM-R and FRMCS domains
- Integration involves Nokia's Morane-2 lab, where a GSM-R system (core MSC, radio) is made available to interconnect with the 5G based MCX

Status completed

- Integration of Eviden MCX & IWF with Nokia GSM-R core/radio and Nokia FRMCS core/radio in Budapest lab
- Pre-testing scope agreed, targeting June/July 2026
- Private calls GSM-R <--> FRMCS are working with real phones (on intermediate MCX SW stack)



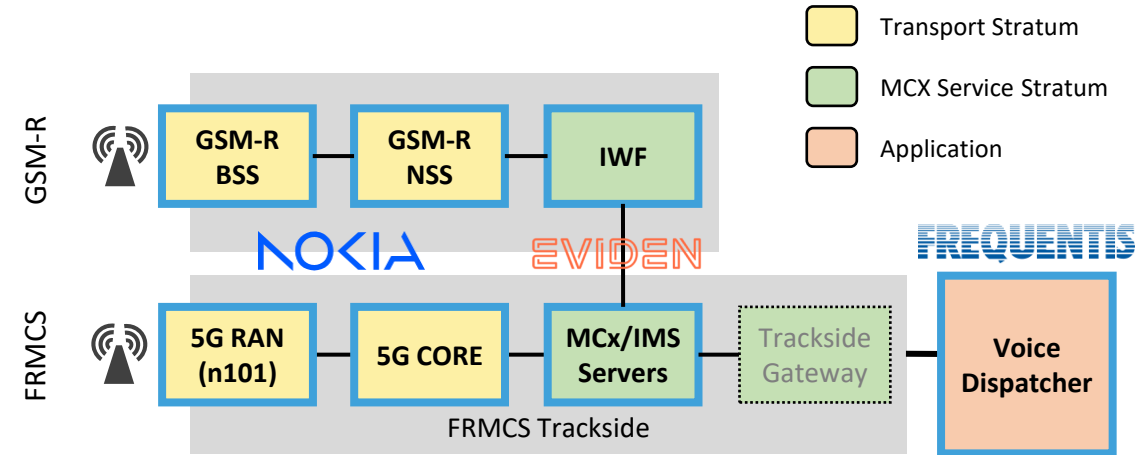
GSM-R
phone



FRMCS device
(n101)

Status ongoing

- Integration of Frequentis voice dispatcher (via interconnection to Vienna lab)
- Update of Eviden SW stack for
 - Adhoc group calls (AHGC)
 - Railway emergency calls (REC)
 - identity mapping
- *Next steps:*
 - Execution of the pre-test scenarios
 - Integration of Funkwerk and Siemens onboard devices (TOBA GW, CabRadio)





Gateways

Mid-Term Conference

30 June 2026 | Task Lead: Alstom | P. Molin



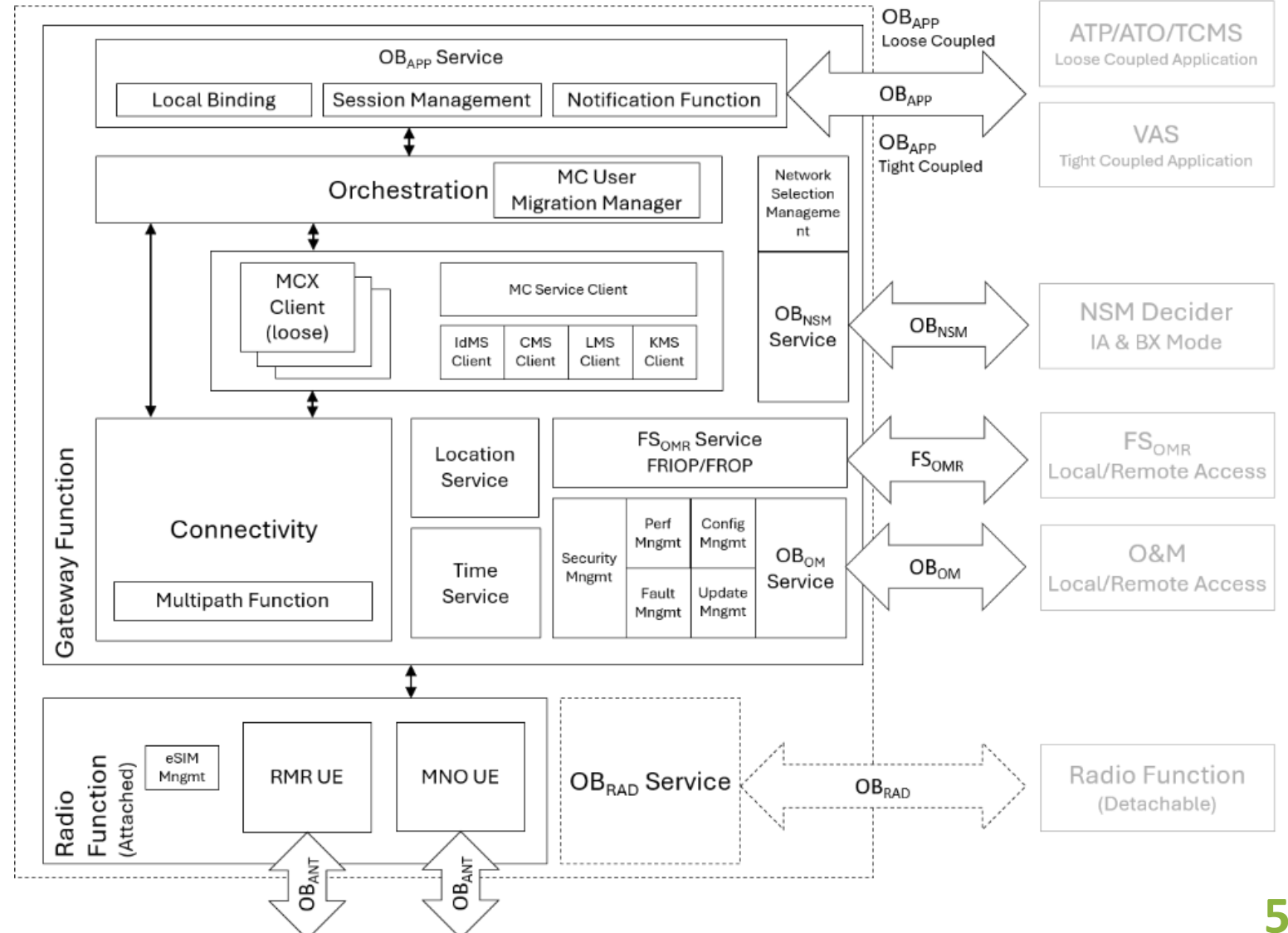
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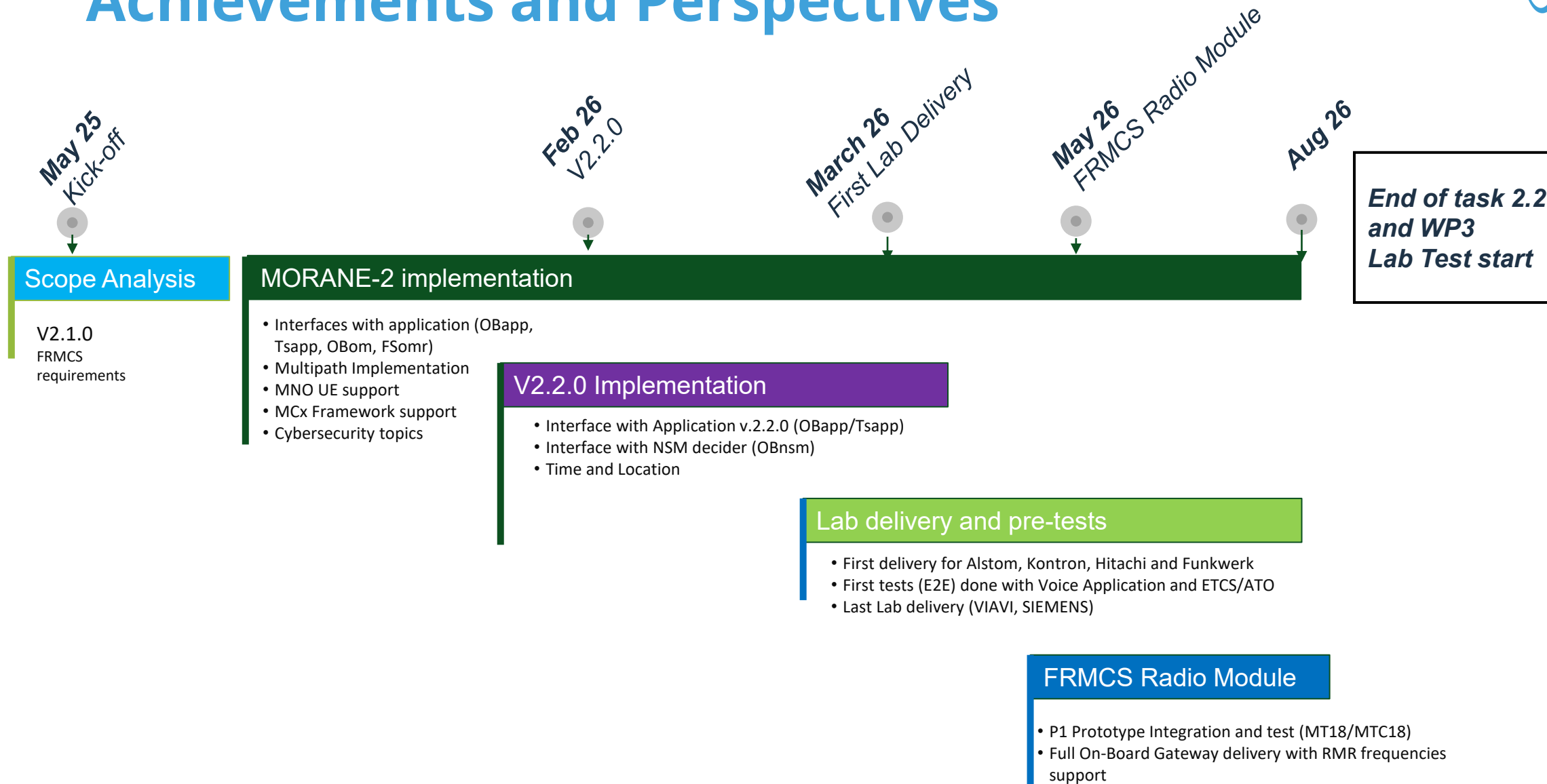
Objectives

Objective is to prepare On-Board and Trackside gateways for lab test and field support.

- ✓ FRMCS interfaces with Applications (Voice, Data, Maintenance)
- ✓ MCx client implementation to support Mission Critical services,
- ✓ The integration of FRMCS Radio Modules and MNO radio modules to support operation with FRMCS and MNO frequencies.
- ✓ The support of UE orchestration and flexibility for multipath communication and border crossing scenario.



Achievements and Perspectives



A Look at the Hardware



HITACHI



ALSTOM



SIEMENS

MORANE-2 On-Board Gateways

- Railway standards products
- Integrating commercial MNO UE
- FRMCS UE (Integrated and/or Remote)



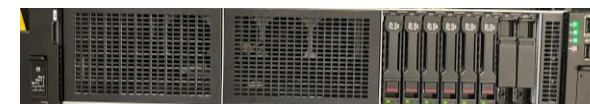
funkwerk

MORANE-2 Trackside Gateways

- Embedded in rackable server



HITACHI



kontron



ALSTOM



Cab Radio

Mid-Term Conference



30 June 2026 | Task Lead: Siemens | A. Skilton



Co-funded by
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This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101196125.

Objectives

- Develop, build and supply operational dual mode cab radios with enabled FRMCS (test) voice application and GSM-R connectivity, including required software and physical interfaces.
- Validate the Cab Radio for use on railway vehicles, to the applicable version of FRMCS Specifications and/or other relevant technical specifications.
- Provide and integrate with required interfaces (TOBA, GNSS, Digital I/O, Driver HMI)

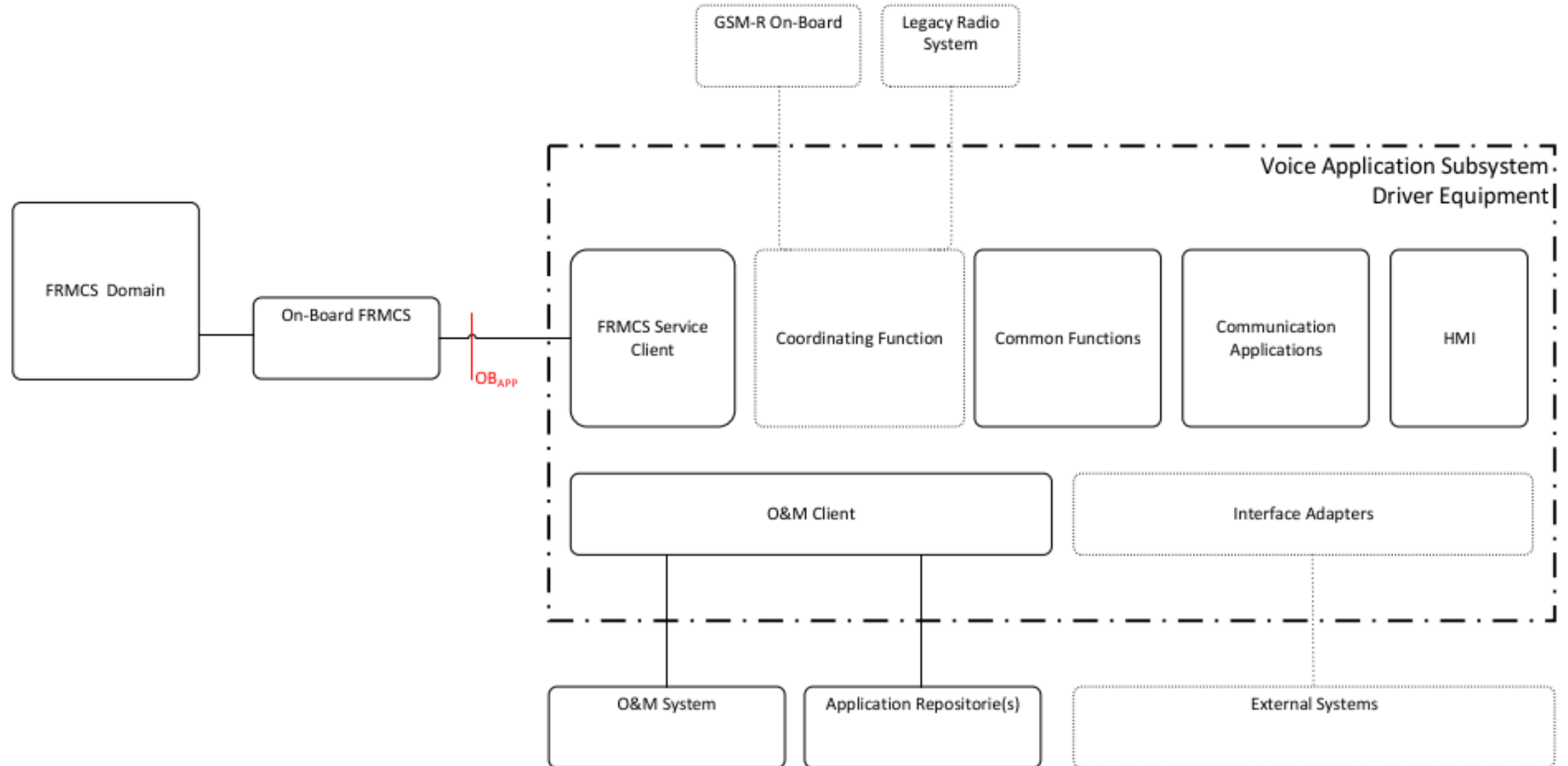
SIEMENS



funkwerk 



VAS Functional Architecture



Progress

PHASE 1: FOUNDATION & DESIGN

Requirements

Stabilized: Functionality, operations, and dependencies defined.



Hardware Design: VAS hardware design finalised and manufacturing successfully completed.

PHASE 2: TECHNICAL READINESS



VPN Established: Remote connection configured and operational.



Hardware Logistics: Remaining hardware on target for Lab testing delivery.

PHASE 3: INTEGRATION & TESTING



Pre-integration: Test activities underway in Labs and at supplier locations.



Software Development: VAS-specific feature development is progressing in parallel.

Next Steps

LOGISTICS & DEPLOYMENT

-  **Equipment**
Despatch: Move all remaining hardware to Lab and Field test locations.
-  **Resource**
Allocation: Ensure personnel availability for upcoming intensive test periods.

INTEGRATION & READINESS

-  **Integration**
Testing: Complete all required test activities to ensure system harmony.
-  **WP3:** Support Lab setup to ensure readiness for commencement early August.

SOFTWARE & UPDATES

-  **Software**
Progress: Continue development and deploy updates to Lab equipment.
-  **Remote**
Deployment: Utilize remote or direct access for effective delivery of software updates



Radio Module

Mid-Term Conference



30 June 2026 | Task Lead: Funkwerk | **D. Schattschneider**



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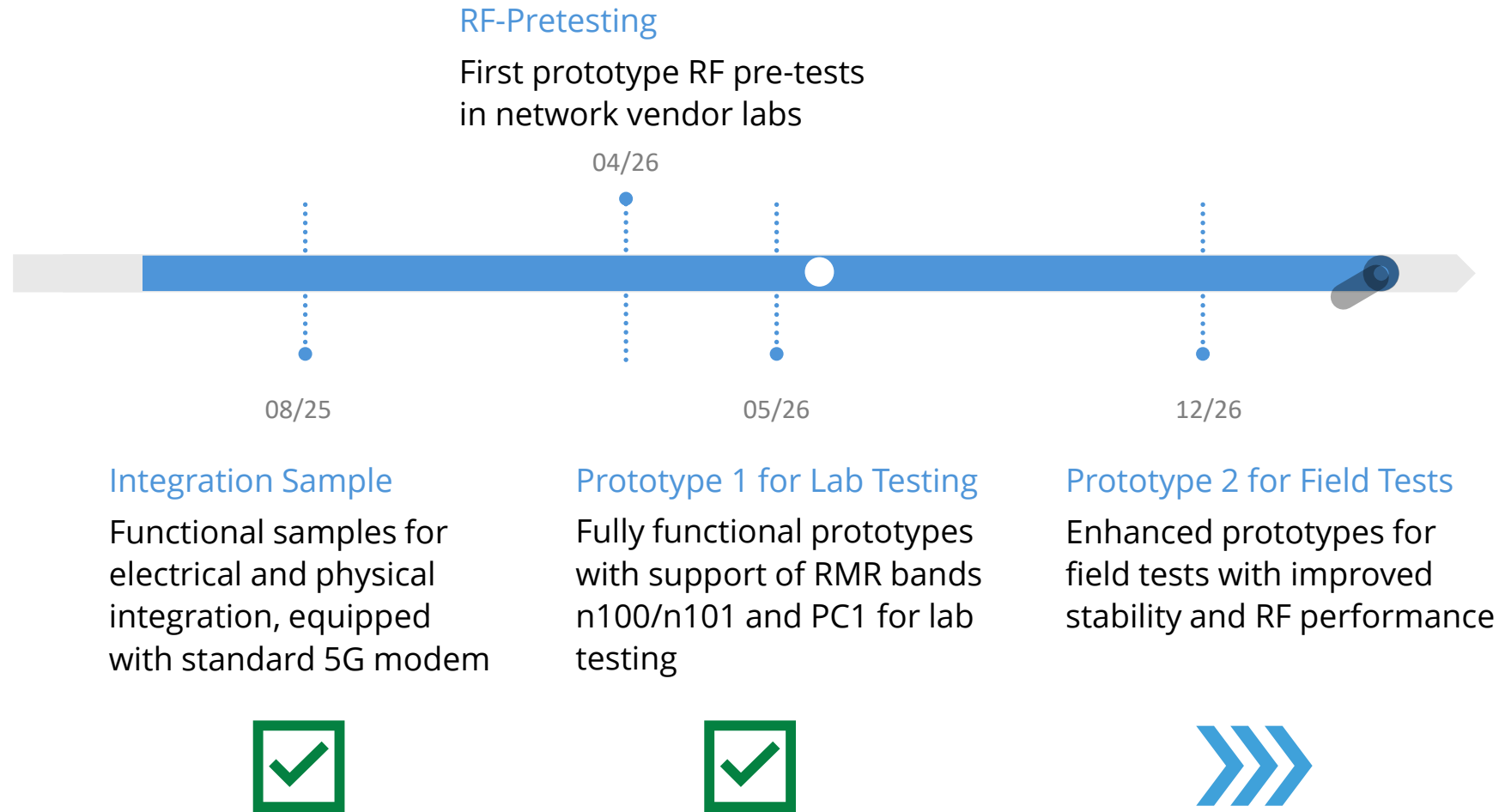
Objectives

Objective is to prepare and provide RMR Radio Modules for MORANE-2 lab and field tests

- ✓ Two different variants developed
 - ✓ MT18 (backplane version)
 - ✓ MTC18 (frontside version) with integrated PS and CPU
- ✓ Both support band n100 in 900 MHz and Band n101 in 1900 MHz with Power Class 1 (31 dBm)
- ✓ Integrated eUICC (eSIM) and support of physical SIM
- ✓ RX-Filtering designed to comply with ECC/EC spectrum regulation



Progress



Achievements

- ✓ Integration tests of Prototype 1 RMR Radio Modules have been successfully performed in all three MORANE-2 labs (n100 and n101)
- ✓ End of April 2026 two days static and dynamic tests with the RMR Radio Module at Deutsche Bahn test site in the Ore Mountains in band n101 infrastructure
- ✓ Integration of MT18 and MTC18 into different FRMCS On-Board Gateways is ongoing
- ✓ Centralised ticket system for issue reporting launched





Dispatcher

Mid-Term Conference



30 June 2026 | Task Lead: Rideon Track | **B. Cuypers**



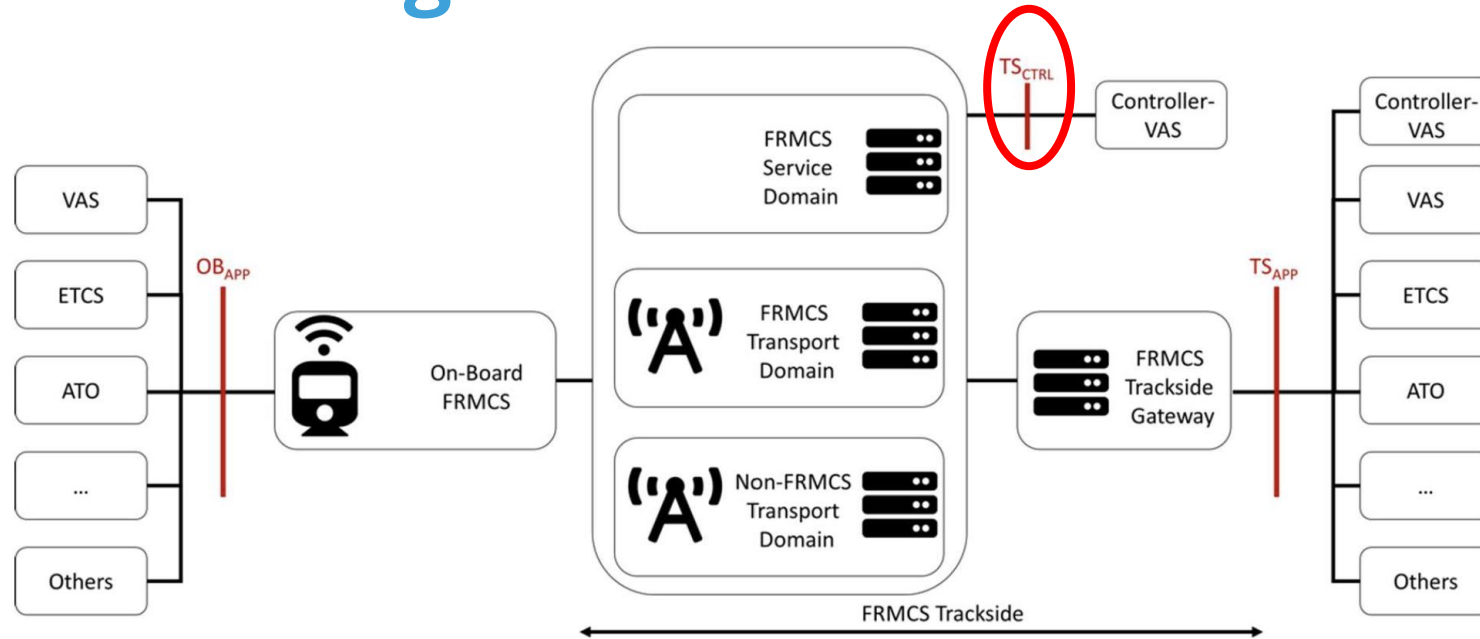
Co-funded by
the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101196125.

Objectives

- Application development according to MCX/FRMCS specifications (up to now, according to plain MCX and FRMCS v2.2 specifications)
- Follow-up on open topics and decisions which are made (i.e. joint point of view on IPv4 vs IPv6)
- Provide input and feedback for WP1
- Performing pre-integration tests ahead of lab tests to verify basic MCX interoperability between the different vendors

Status and Progress



Vendor DISP	Vendor FRMCS
RideOnTrack (T2.4 Task Leader)	Kontron
Frequentis	Eviden
Kontron	Kontron
Eviden	Kontron
Teltronic	Kontron

Status
1. Software Modifications FRMCS v2.2
2. VPN Connection for pre-integration tests
3. Pre-integration with MCX server
4. VPN Connection for lab tests



Finished



In Progress



Not Started

Next Steps

Mid July-2026

- Finalize development of FRMCS/MC-X dispatcher solution based on FRMCS v2.2

End July-2026

- Successful Connection to Lab System
- Successful pre-integration testing with relevant FRMCS server supplier
- Prepared and ready for Lab Tests (WP3)



Monitoring & Measurement Metrics

Mid-term Conference

30 June 2026 | Task Lead: Viavi | J. Somerfield



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This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101196125.

Objectives

The objective is to adapt the existing VIAVI MCX Monitoring solution to perform FRMCS FP2 MORANE-2 lab and field tests accordingly to WP1 test plan definition and Railway environment.

The activity is broken into two parts, onboard active monitoring and trackside passive monitoring of the FRMCS network. The current status is:

- An active monitoring solution for FRMCS has been developed:
 - **The lab test version will be available by end June;**
 - **The field test version will be delivered by end of November 2026.**
- A passive trackside monitoring solution is in development:
 - **Passive monitoring of raw traffic will be delivered mid-July for the Lab test;**
 - **A full solution with the associated dashboards etc will be delivered end Q3/early Q4 2026.**

Onboard Active Monitoring

- VIAVI are delivering 3 FRMCS enabled trolleys to cover the three lab tests and five field tests.
- Each trolley will contain 2 FRMCS modems and either standard 5G MNO modem or a GSM-R modem.
- This trolley will be capable of making measurements in both conventional and high-speed environments, and also private and public FRMCS networks.
- In addition to standard OTA measurements, the trolley also has a built-in OBapp interface, enabling it to connect to the onboard gateway and perform measurements via the gateway.
- As well as standard radio and MCX measurements, the trolley will also be able to simulate ETCS and ATO traffic patterns during the field tests.

Trackside Passive Monitoring

- In order to support the FRMCS V2 Specifications & V3 target requirements as defined by WP 1, it has been necessary to find ways to resolve the challenges presented by the encryption which is part of all FRMCS networks.
- Despite extensive discussions with other partners, identifying a means to achieve this was much harder than foreseen, causing significant delays to product delivery.
- A passive monitoring solution covering the 5G RAN and MC traffic will be delivered in two parts:
 - **Part 1, including data capture and processing will be delivered during July, in time for the start of Lab Tests.**
 - **Part 2, including data analysis and KPI presentation dashboards, will be delivered during end Q3/early Q4 26 in time for the 1st field tests in Sweden and Spain.**

Next Steps

LOGISTICS & DEPLOYMENT

-  **Equipment**
Despatch: Move 3 Trolleys to Lab by End Of July.
-  **Resource**
Allocation: Ensure personnel availability for upcoming intensive test periods.

INTEGRATION & READINESS

-  **Integration Testing:**
 - MT18 Integration
 - OBapp Integration Testing
 - Passive Monitoring Devs
-  **WP3:** Support Lab setup to ensure readiness for commencement early August.
-  **WP4:** Discussions started with IMs re active monitoring deployment.

SOFTWARE & UPDATES

-  **Software**
Progress: Continue development and deploy updates to Lab equipment.
-  **Remote**
Deployment: Utilize remote or direct access for effective delivery of software updates



Data Applications: ETCS/ATO/TCMS Simulators

Mid-term Conference

30 June 2026 | Task Lead: CAF | J. Arrieta

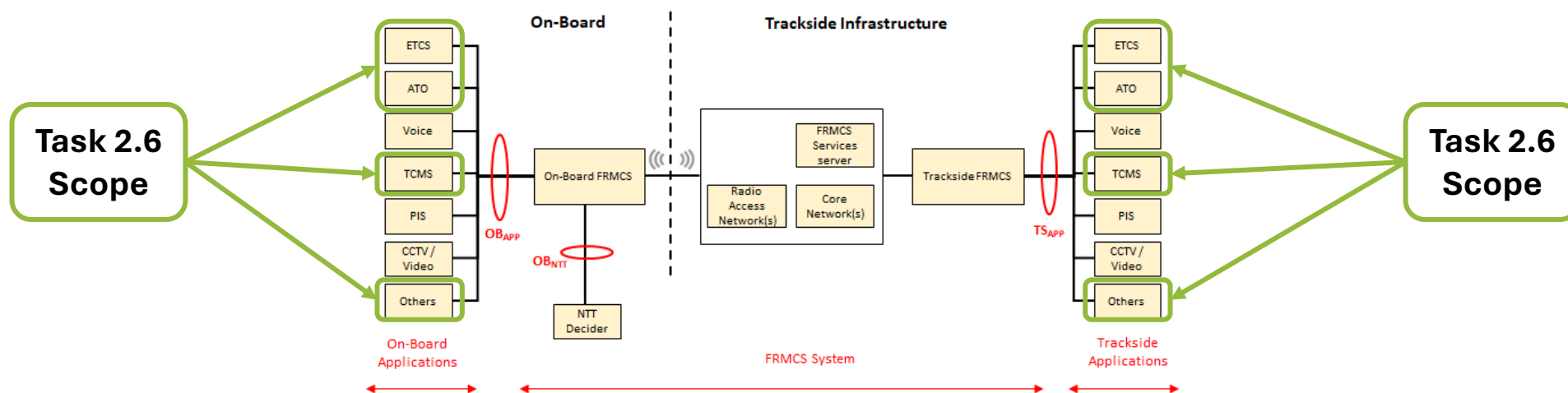


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This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101196125.

Objectives

- Development of ETCS, ATO, TCMS And KMS application prototypes for Lab and Field test activities
- Provide application data to stimulate the FRMCS system
- Check the QoS fulfilment for applications (RTT, packet losses, etc.)
- Cross-check and validate FRMCS specifications for data applications
- Extract key learnings for application specification updates (ETCS/ATO/TCMS/KMS)



Progress

- Prototypes **development completed** for ETCS, ATO, TCMS and KMS applications.
- Definition of **application test cases** included in D1.1 (WP1)
- Remote connectivity (VPN) for remote test execution **ready**.
- Prototypes **in process** of integration with FRMCS GWs
 - **Validate the OApp/TSApp messaging**
 - **Validate TLS certificate and protocol compatibility**
 - **Validate E2E connectivity**

Integration Status

		OB GW				TS GW		
		HITACHI	ALSTOM	funkwerk	SIEMENS	HITACHI	kontron	ALSTOM
ETCS (H2H)	CAF	Partial (OBApp 2.2.0 compatible, pending E2E)	Successful	Partial (OBApp 2.0.0 compatible, pending 2.2.0)	N/A	Partial (TSApp 2.2.0 compatible, pending E2E)	N/A	Successful
	SIEMENS	N/A	Ongoing	Partial (OBApp 2.1.0 integrated 2.2.0 pending)	Partial (OBApp 2.1.0 integrated 2.2.0 pending)	N/A	Partial (TSApp 2.1.0 integrated 2.2.0 pending)	Ongoing
ATO (H2H)	CAF	Pending	Successful	Partial (OBApp 2.0.0 compatible, pending 2.2.0)	N/A	Pending	N/A	Successful
	SIEMENS	N/A	Pending	Pending	Pending	N/A	Pending	Pending
TCMS (H2N)	CAF	Pending	Ongoing	Pending	N/A	Pending	N/A	Ongoing
KMS (H2N)	SIEMENS	N/A	Pending	Pending	Pending	N/A	Pending	Pending

Next Steps

- Finalize lab pre-integration tests with all applications
- Coordination with WP1
 - **Provide details on QoS monitoring mechanism**
 - **Finalize testcase definitions for applications**
- Coordination with WP3 and WP4
 - **Provide HW details**
 - **Define integration dependencies**
 - **Define a testing execution plan**

Thank you.

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Lunch Break
We will resume in 60
minutes!



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WP3 – Lab test



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WP3 - Lab Test Preparations and Execution

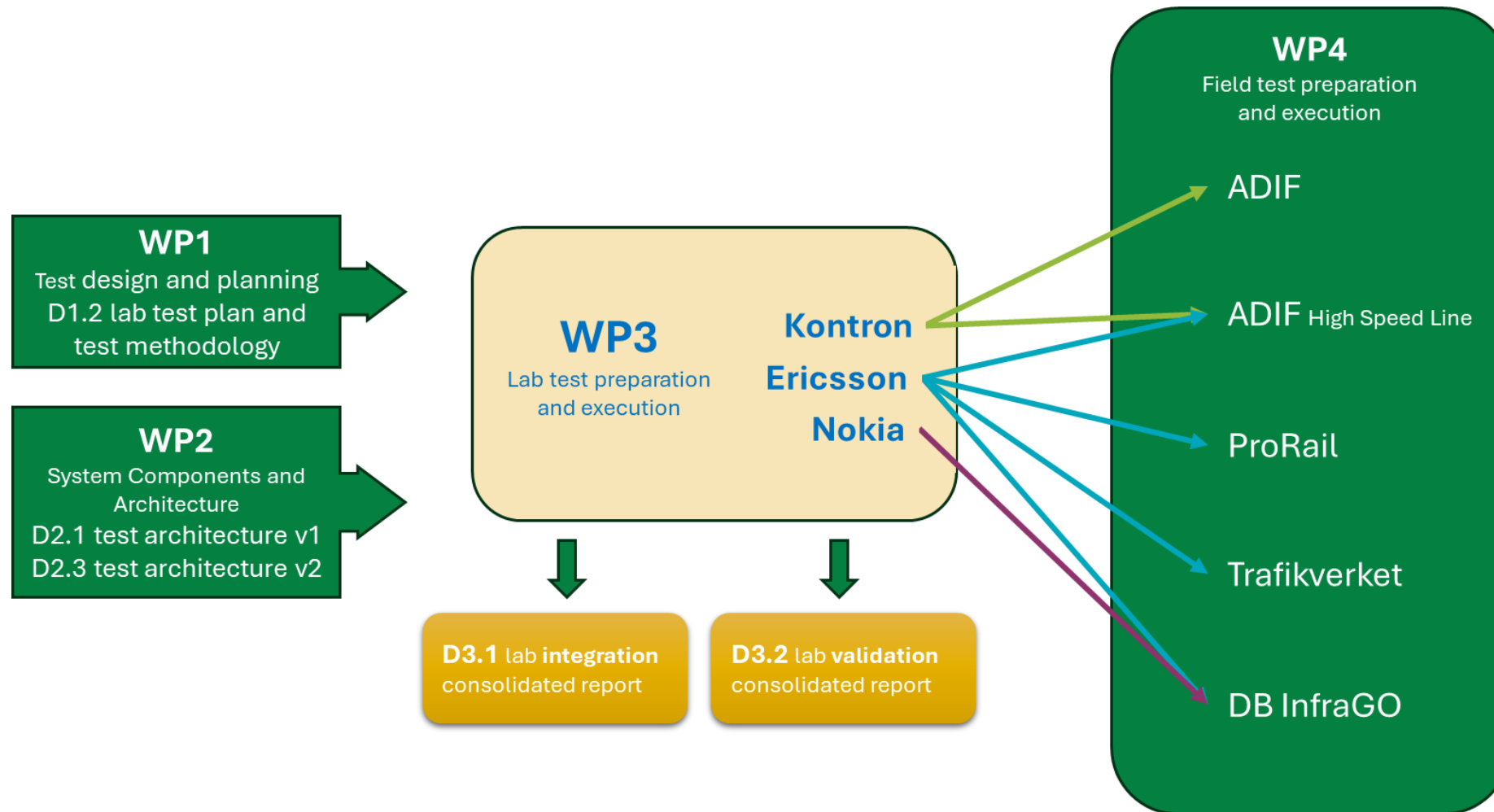
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				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33		
WP 3	Lab Test Preparations and Execution	ERI	C										Lab Test Preparations and Execution																									
Task 3.1	Staging of Lab Environment Ericsson	ERI																																				
Task 3.2	Staging of Lab Environment Nokia	NOK																						D3.1														
Task 3.3	Staging of Lab Environment Kontron	KON																																				
Task 3.4	Lab Tests Ericsson	ERI																																				
Task 3.5	Lab Tests Nokia	NOK																																				
Task 3.6	Lab Tests Kontron	KON																																				
Task 3.7	Evaluation & Return on Experience	UIC																																				

The purpose of WP3 is :

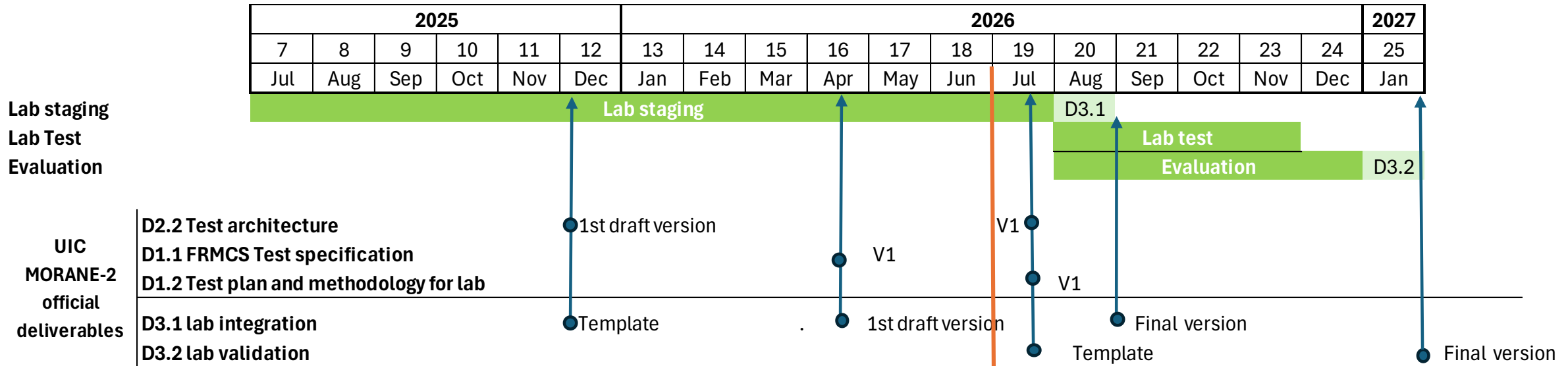
- For the lab test preparation phase to
 - To integrate the FRMCS and Application prototypes defined in WP2 in three labs
 - ERICSSON – Düsseldorf, Germany
 - NOKIA – Budapest, Hungary
 - KONTRON – Montigny-le-Bretonneux, France and Vienna, Austria
 - To provide remote access to the relevant labs for partners to perform tasks on their equipment;
 - Integration activities to set the targeted FRMCS network;
- For the lab test execution phase to
 - Execute the test cases assigned to lab;
 - Report test results;
 - Evaluate test results.

Note that IM will participate in the tests as observers.

WP3 - Lab Test Preparations and Execution



Planning



Lab preparation status

The preparation and staging of the 3 labs is at 85%+ completed.

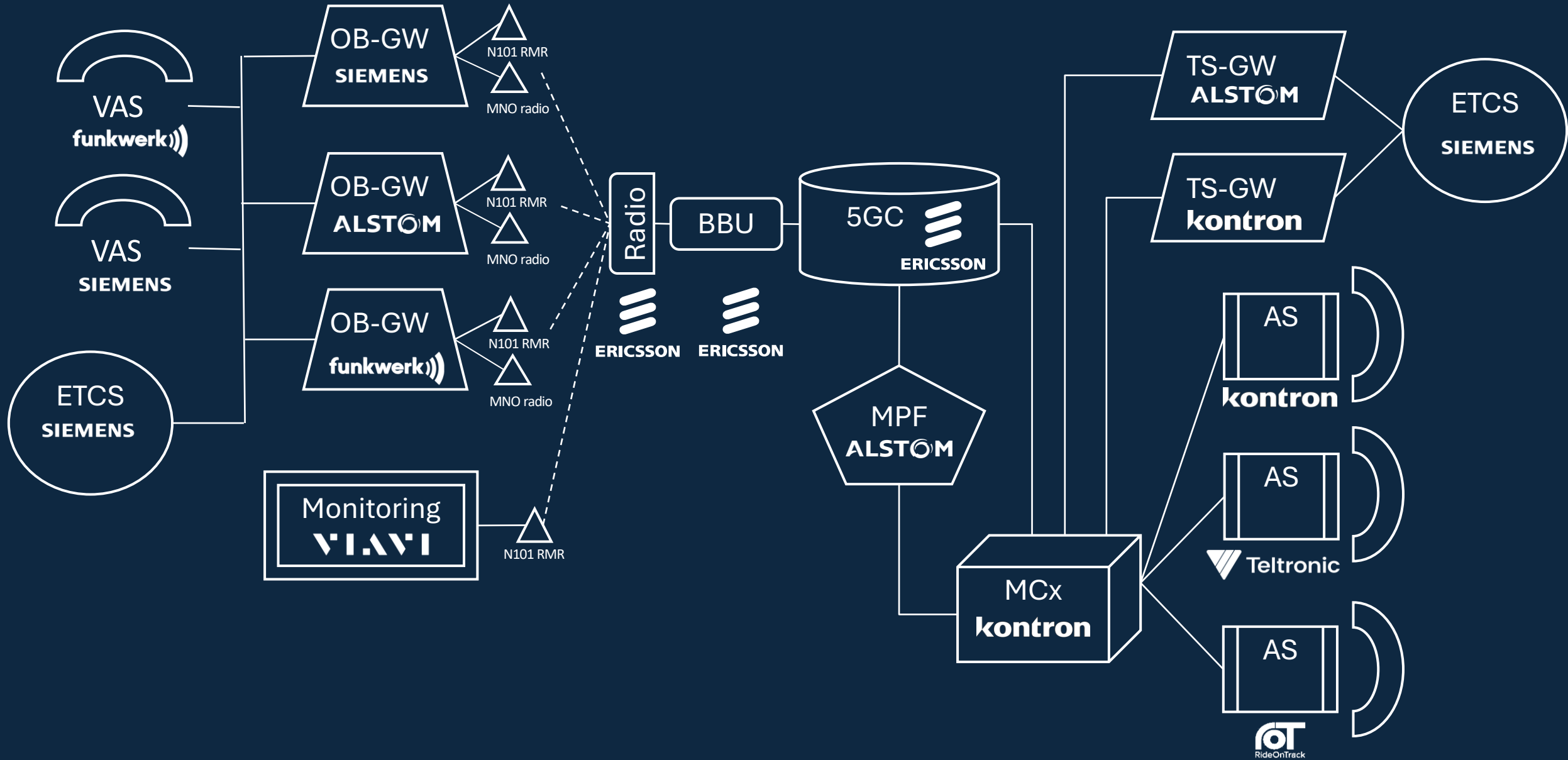
- A few equipment are still not yet available. They will be shipped second half of July.
- Pre-test activities are on-going on the 3 labs.
- The list of test cases is finalized.
- The split of the test cases per lab is done.
- Test strategy and test plan for the 4-month duration of the lab text execution is on-going.

Ericsson Lab in Düsseldorf

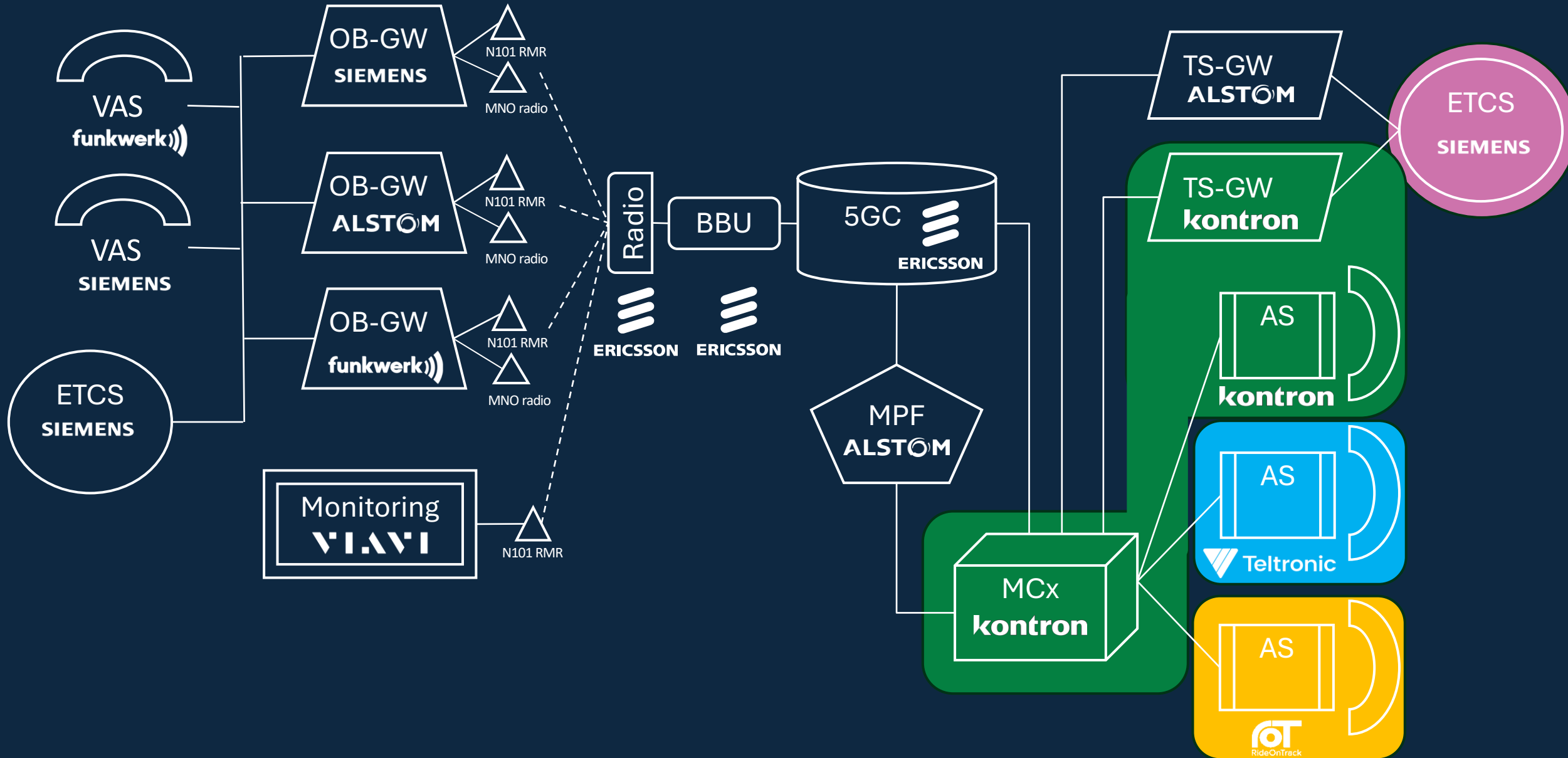
Test cases

- Voice TC
 - Multi-train communication
 - Controller to controller communication
 - REC
 - Location service
- Functional
 - Operation & maintenance procedures
 - IP addressing and routing
 - Network selection management
 - MOCN
 - Multipath

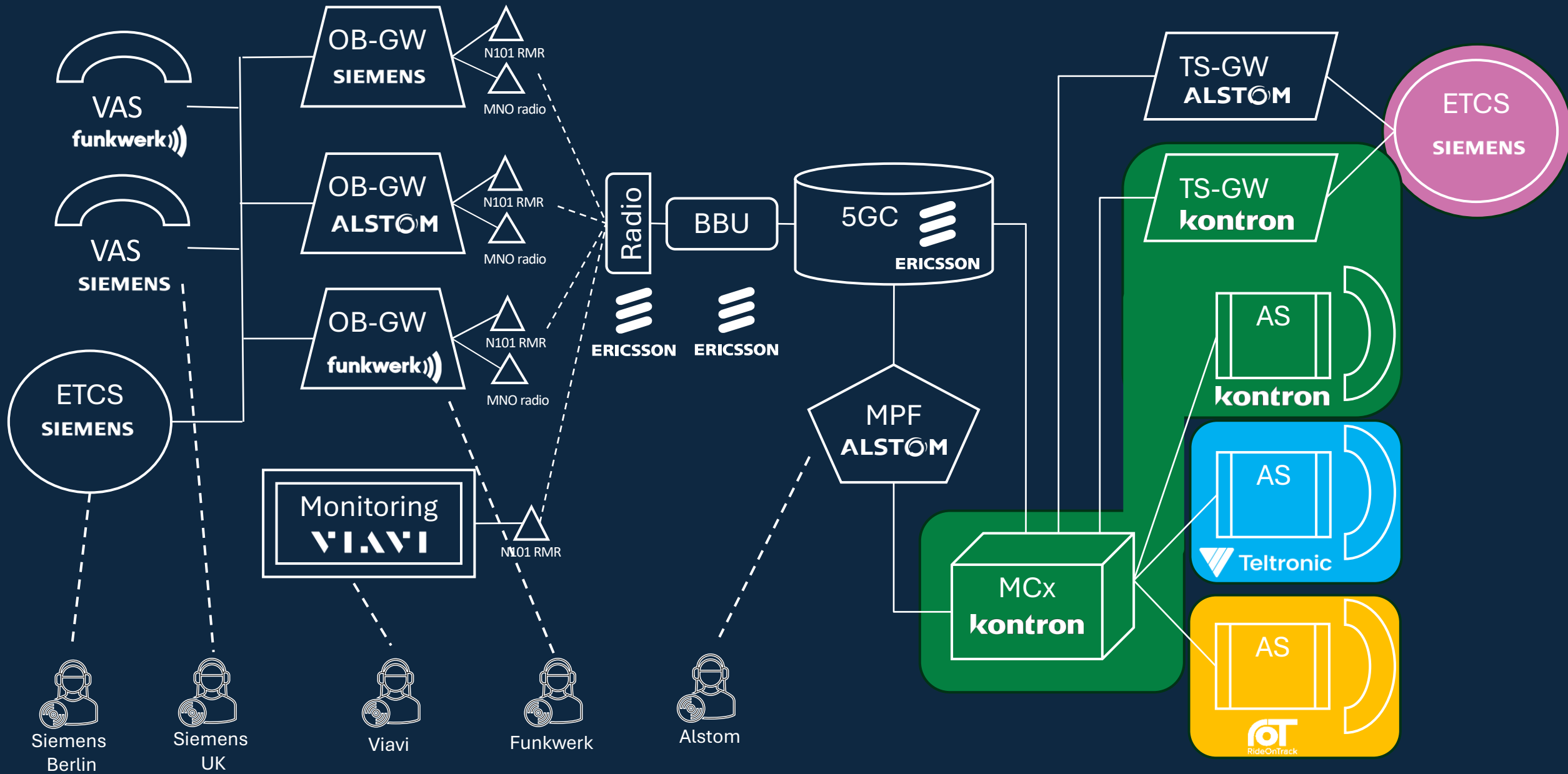
Ericsson lab Düsseldorf - architecture



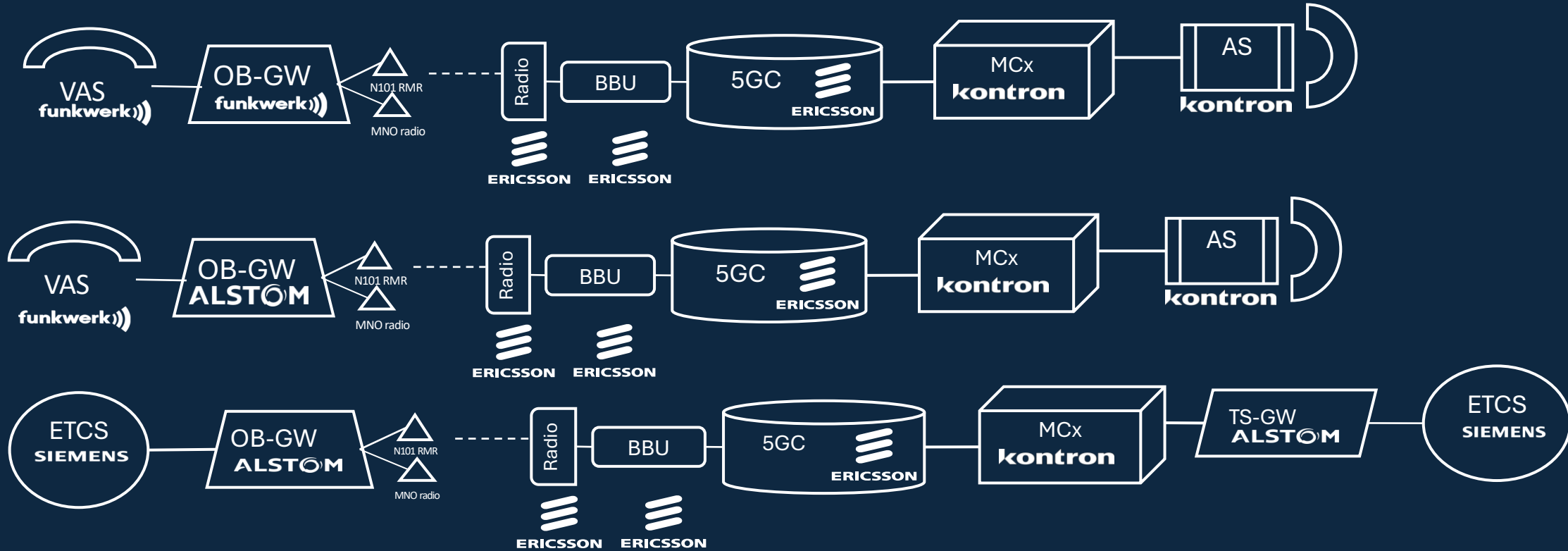
Ericsson lab Düsseldorf - architecture



Ericsson lab Düsseldorf - architecture



Pre-test activities



Video Ericsson Lab

Questions?

Thank You!

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Work Package 3 Lab – Nokia

Michael Kloecker, Nokia



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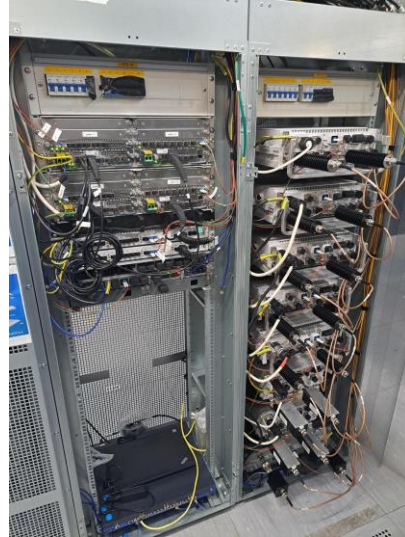
This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101196125.

Lab Impressions

NOKIA



Budapest Site



5G gNB
Band n101



Datacenter
FRMCS 5G Core



Partner
MCX, Dispatcher, OB



RF Test
Equipment

SIEMENS

ERICSSON



EVIDEN

 **kontron**
S&T Group

VIAXI

FREQUENTIS
FOR A SAFER WORLD

funkwerk 



Test Scope – Focus Nokia Lab Budapest

WP3 Nokia Lab focus

- **~70 Test Cases**
- Hybrid setup: local deployment and remote connection to other partner labs
- realization with **several partners** allows to distribute test scope in efficient way and to reach maximum test coverage
- Remote connection to Field / Germany BTS/gNB -> benefit of experience from 5GRail
- Main focus is GSM-R Interworking and Border Crossing
- Border crossing with different PLMN only possible in Field setup in WP4, some derisking tasks

ETCS, ATO, TCMS

VAS – Train to/from Controller

REC – Railway Emergency Call

Functional Addressing

Location Dependent Addressing

Authorization Role Management

Border Crossing

GSM-R Interworking & Network Transition

Multipath

QoS Arbitration

Addressing Modes

Measurements

High Speed

MNO
MOCN, Roaming

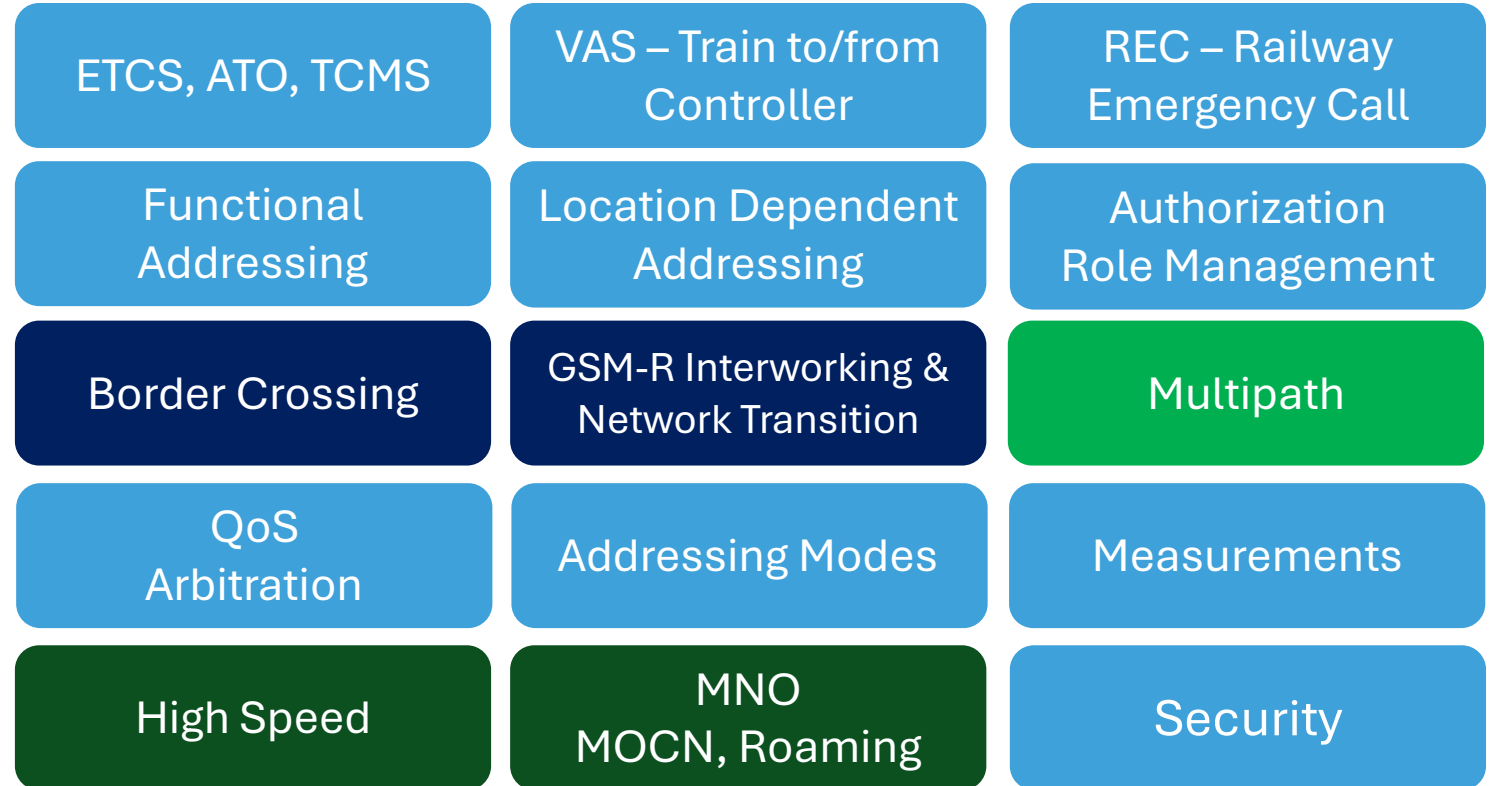
Security

FP2-Morane2 Focus Areas

Test Scope – Focus WP3 - Nokia Lab

WP3 Nokia Lab focus

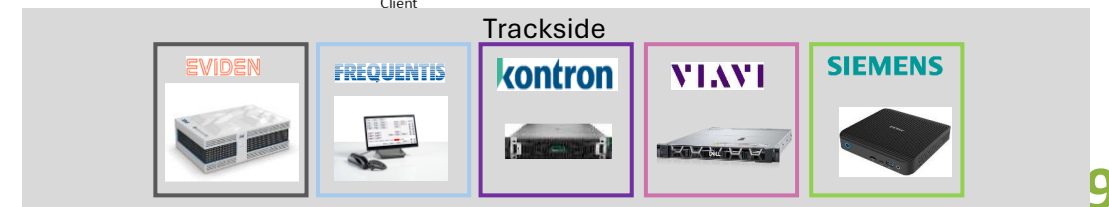
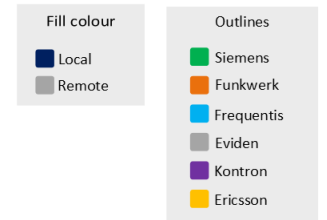
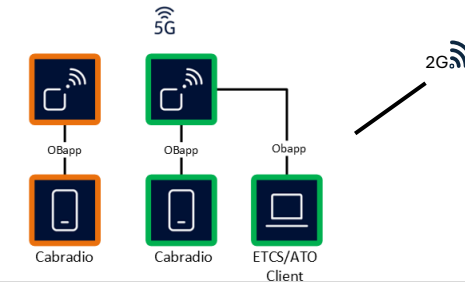
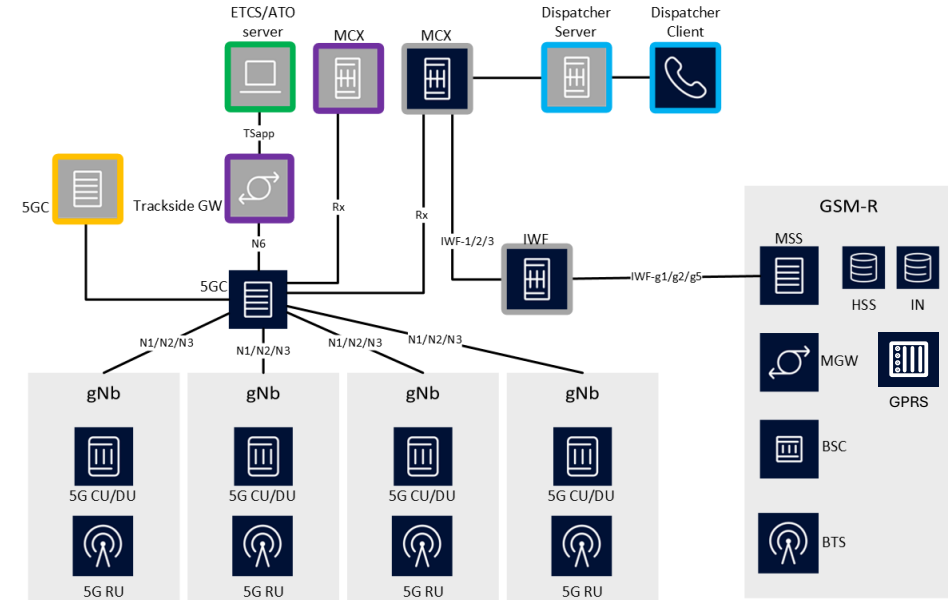
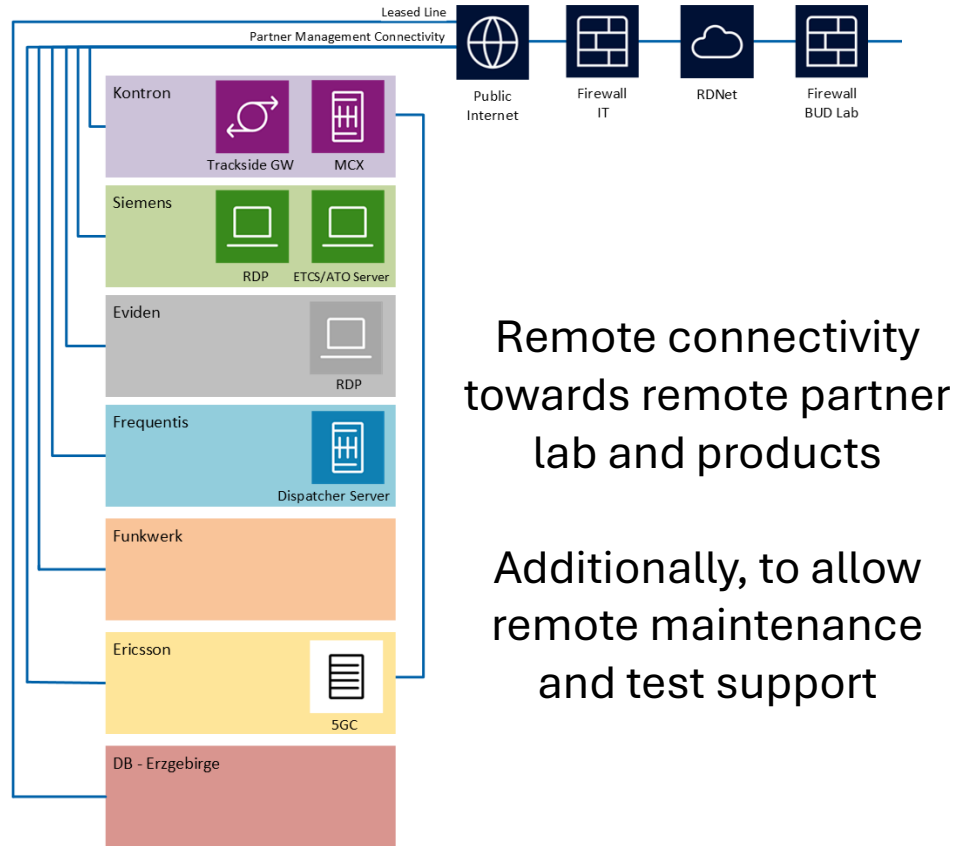
- **~70 Test Cases**
- Hybrid setup: local deployment and remote connection to other partner labs
- Realization with **several labs and fields** allows to distribute test scope in efficient way and to reach maximum test coverage
- Remote connection to Field / Germany BTS/gNB -> benefit of experience from 5GRail
- Main focus is GSM-R Interworking and Border Crossing
- Border crossing with different PLMN only possible in Field setup in WP4, some derisking tasks
- Integration is ongoing, first tests with GSM-R interworking executed



WP3 Lab main focus

WP3 Lab implicitly covered

Nokia WP3 Lab setup - Details



Nokia WP3 Lab setup Status

WP3 Detailed Test Time Plan under preparation

Partner	Product	Deployment Remote/Local	VPN Setup (Test & Maintenance)	Status
Funkwerk	CAB Radio OB Gateway	Local Local	Ok	Integrated, Radio/Modem tests executed e2e test planning . Remote Maintenance
Siemens	CAB Radio OB Gateway	Local Local	Pending	Installation pending
Siemens	ETCS Onboard ETCS Trackside	Local Remote	OK	Integration ongoing Remote setup
Kontron	Trackside GW	Remote	Pending	Connection setup ongoing
Eviden	MCX Server GSM-R IWF	Local	OK	Integrated and tests ongoing Test UE call e2e done
Viavi	Onboard Trolley Trackside Measurem. Server	Local Local	Pending	Pending Installation Integration not started
Frequentis	Dispatcher Terminal Dispatcher Server	Local Remote	OK	Integration ongoing
Ericsson	Core	Remote	Pending	Setup for WP4 started
DB	Field Radio	Remote	Started	Plan for remote Core-radio configuration for WP4

WP4
Pre activities

Next Steps until Lab test begin

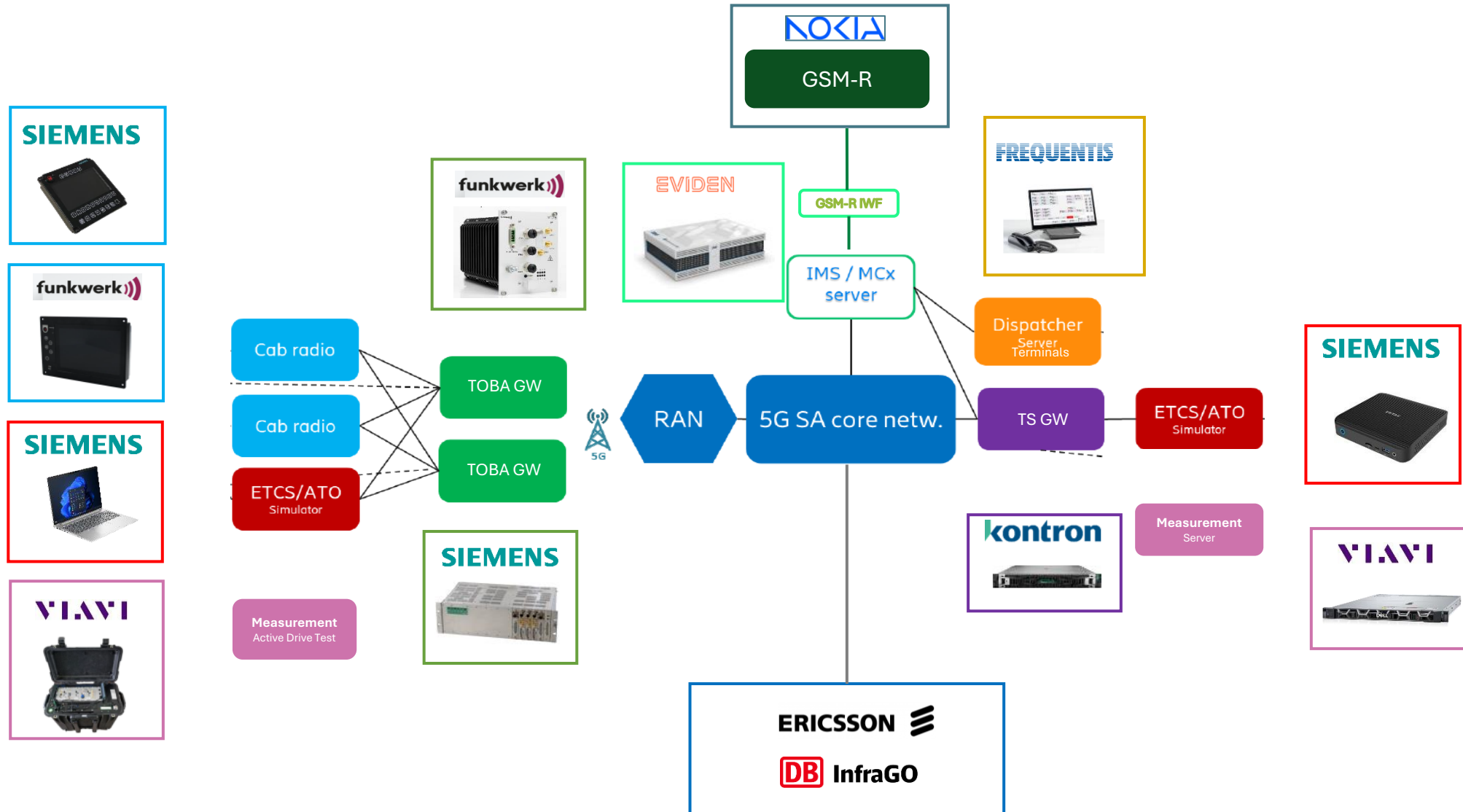
Finalize partners integration :

- Viavi (Trolley/Responder calls)
- Siemens Cab Radio and OB GW installation & integration
Siemens ETCS integration
- Eviden MCX Server SW updates
- Frequentis Dispatcher – MCX Server integration
- GSM-R IWF e2e test with CAB & OB GW, Group Call test
- Kontron Trackside GW integration with Nokia Core and MCX Eviden and Trackside ETCS

Remote Setup

- Nokia – Kontron, Siemens, Ericsson, DB (for WP4 test activity)

Nokia WP3 Lab setup – Partner Products



Thank You!

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Work Package 3 - Kontron Transportation



30 June 2026 – Philippe Wamster

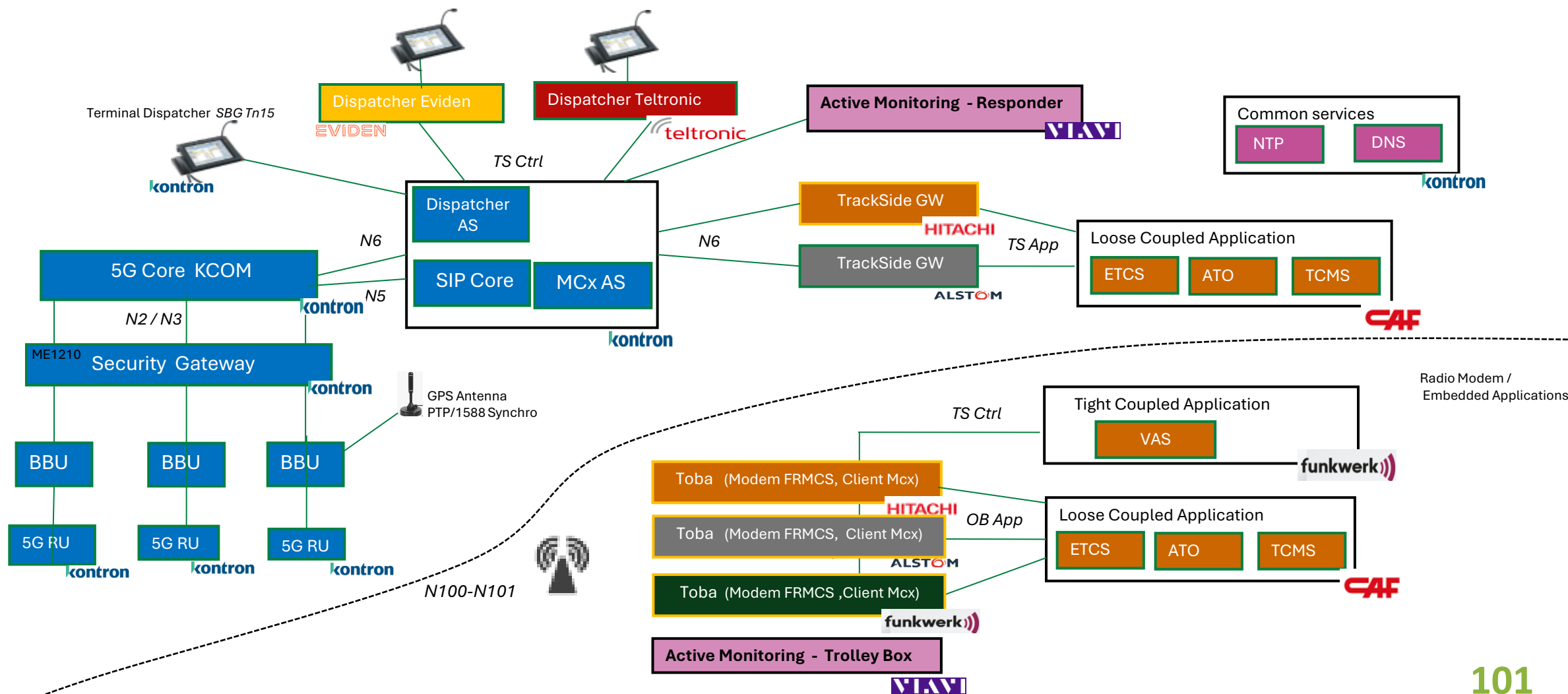


Co-funded by
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This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101196125.

2 - Kontron Lab configuration dedicated to Morane-2 WP3

- ❖ **Vienna Lab** : SIP Core / MCx, Track Side Gateway and Dispatcher Kontron to E// Lab and field tests
- ❖ **Montigny-Le-Bretonneux Lab** : dedicated for Kontron WP3 Lab tests execution and WP4 ADIF field tests



WP3 Kontron – Partners Integration Status

Company	Applications	Local / Remote	Eqpt	VPN UP	Register / Publish	Modem FRMCS	Apps Traffic
Alstom	Toba + Track Side	Local	Toba	Y	Y	N	Y (ETCS, ATO) TCMS planned w26 Interop TOBA ATSA - TS HITACHI
			TS	Y	Y		Y (ETCS, ATO) TCMS planned w26
Hitachi	Toba + Track Side	Local	Toba	Y	Y	N	To plan with CAF
			TS	Y	Y		To plan with CAF Interop TOBA ATSA - TS HITACHI
Funkwerk	Toba + Cab Radio	Local	Toba	Y	Y	Y	VAS in remote : OK PTP and GC VAS2 in MTY end of June
CAF	Applications	Local	Apps	Y			Y (ETCS, ATO)
Viavi	Active Monitoring	Local	Responder	Y	Y (Client MCx)		N (KPI Measurement)
			Trolley			N	
Eviden	Dispatcher	Remote	Dispatcher	Y	Y		Y (PTP and GC)
Teltronic	Dispatcher	Remote	Dispatcher	Y	Y		Y (PTP and GC)



To finalize in July

Current and next activities before end of July :

- ❖ Finalize partners integration : Viavi (Trolley/Responder calls), Funkwerk VAS, Modem FRMCS (Alstom, Hitachi, Viavi)
- ❖ Complete D3.1 document. Draft in progress [Partner - Documents - All Documents](#)
- ❖ Dry Run tests
- ❖ Tests planification :
 - Intra-site : tests case execution in Kontron Lab (Contributors and planification of tests cases in Kontron Lab)
 - Inter-site : tests execution between the different Lab (Kontron, Nokia and E//)

Assesements :

- ❖ WP3 tests with IPV4 network
- ❖ WP3 maintained operationnal during WP4 tests for support

Kontron Tests Coverage

❖ Organization of Kontron WP3 Test Cases execution with partners based on the file :

FP2-MORANE-2 - Kontron - Proposal of TC_Distribution.xlsx

Extract :

D1.1	D1.2	D1.4	TC number (with reference to D1.1 parts of the document, Part 2: APM xxx, Part3: SFxx)	TC ID	Kontron lab	Proposal for interop	Test Leader	Target Date of execution
				2		Handover		
Y	KT	ADIF	SF062	N100_N101_HO_001	Y	FWK-HITACHI-KT-KT	Kontron	w36
Y	KT	ADIF	SF063	N100_N101_HO_002	Y	FWK-HITACHI-KT-TELTRONIC	Kontron	w36

❖ Current view Kontron Tests coverage and partners contribution:

Type of tests	Tests Number	Site	Comments
Handover	2	Montigny	
Common functions (Roles management)	8	Montigny	
Location and Time	3	Montigny	
Voice and REC calls	17	Montigny	
Data applications (ETCS/ATO/TCMS)	5	Montigny	
Performances Measurements	16	Montigny	
Inter-Domain Eviden - Kontron	6	Vienna	VPN inter-Lab still to setup
TOTAL	57		

Partners contribution (Kontron Lab)		Number of WP3
Toba / TS	Hitachi	15
	Funkwerk	17
	Alstom	21
VAS1 - VAS2	Funkwerk	28
Applications	CAF	12
Dispatcher	Eviden	8
	Teltronic	13
	Telematix	8
Network	Kontron MTY	50
	TOBA to affect	2
	Dispatcher to affect	8

Planification in progress with partners

Thank You!

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Coffee Break 15 Minutes



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Work Package 4



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Speakers



Per-Olof Egnell
Trafikverket
WP4 Lead



Bernd Holfeld
DB InfraGO



Jos Nooijen
ProRail



Jesus Santiago Molina
ADIF

Agenda

- **Introduction and Overview**
- **Status Staging of Test Environments**
- **Next steps**
- **Questions**

Agenda

- **Introduction and Overview**
- **Status Staging of Test Environments**
- **Next steps**
- **Questions**

Field Test Environments



Spain Conventional Line

- 25 km length | max. 80 km/h
- FRMCS 900 (n100) + FRMCS 1900 (n101)



Sweden Conventional Line

- 40 km length | max. 200 km/h
- FRMCS 1900 (n101)



Germany Conventional Line

- 12 km length | max. 80 km/h
- FRMCS 1900 (n101)



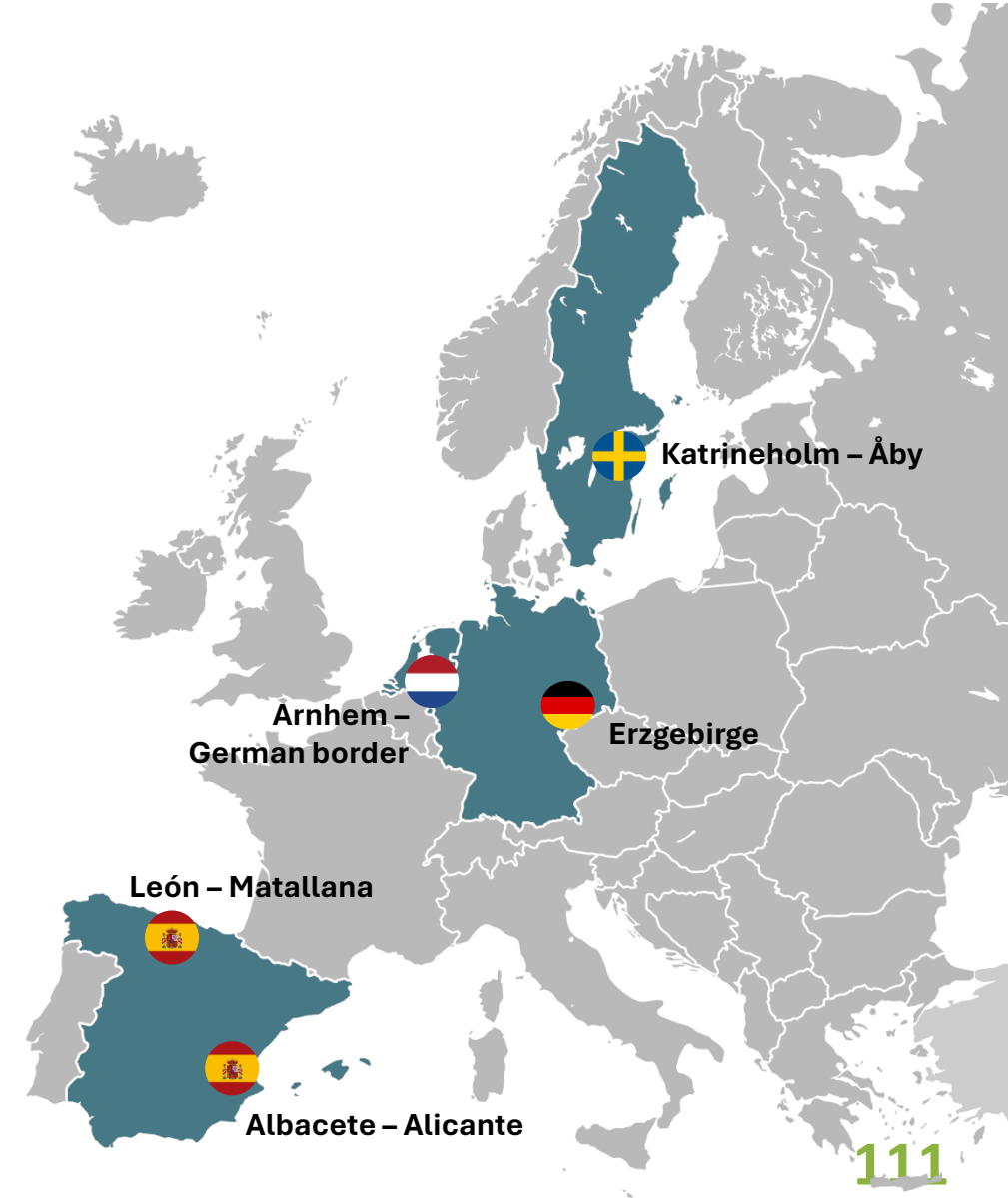
Spain High Speed Line

- 60 km length | max. 300 km/h
- FRMCS 1900 (n101)



Netherlands Conventional Line

- 20 km length | max. 140 km/h
- FRMCS 1900 (n101)



Field Test Scope



Spain Conventional Line

- Basic FRMCS functionality and system performance (voice and data)
- Transfer between FRMCS 900 (n100) and FRMCS 1900 (n101)



Sweden Conventional Line

- Basic FRMCS functionality and system performance (voice and data)
- MOCN scenario with Telia on MNO 700 (n28)



Germany Conventional Line

- FRMCS border-crossing scenarios (voice and data)
- FRMCS/GSM-R interworking (voice) and transition (data)



Spain High Speed Line

- Principle FRMCS high speed environment and system performance tests (voice and data)



Netherlands Conventional Line

- FRMCS over MNO (Multipath, Roaming and MNO subscriptions) complementing FRMCS



Q1/27

*Basic FRMCS
functionality
(voice, data)*

Q2/27

*More complex
test scenarios*

- *High-speed*
- *FRMCS BX*
- *GSMR IWF*
- *MNO*
- *Multipath*

Field Test Suppliers

 		 				 		
 	 	 						
 	 	 	 		 	 		
 	 	 						
 	 	  						
	5G Network	TOBA GW	MCX/IMS	TS GW/Multipath	Cab radio	Dispatcher	ETCS/ATO Simulator	Monitoring

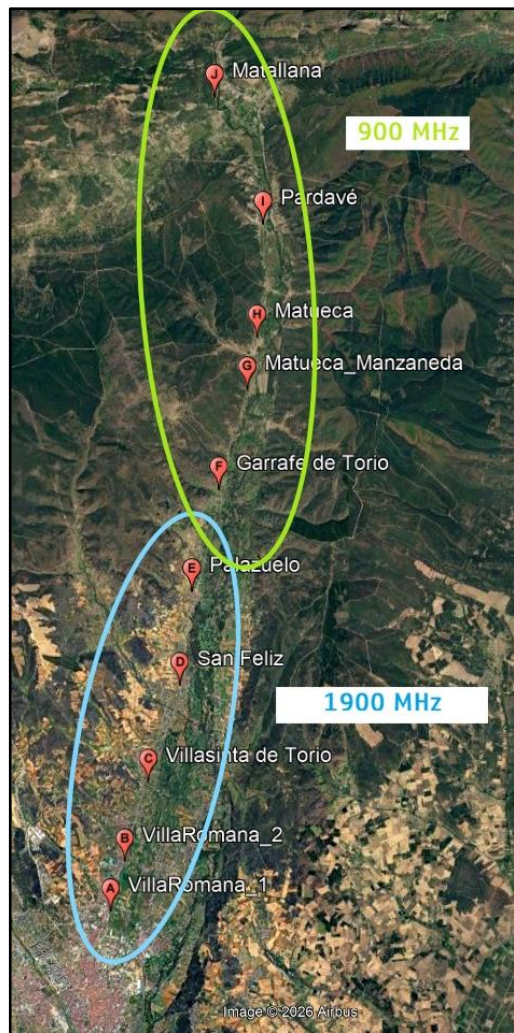
Agenda

- Introduction and Overview
- Status Staging of Test Environments
- Next steps
- Questions



Field Test Environment - Spain

Conventional Line (CL)



2x2 MIMO antennas with GPS





Task 4.1 – Staging of Test Environment Spain CL

ADIF + RENFE, CAF, TELTRONIC, EVIDEN, ALSTOM, FUNKWERK, VIAVI, KONTRON, HITACHI, UIC

Objective

Setting up the field test environment in the regional line in Spain. It includes specifying a detailed test architecture and preparing the test track and rolling stock required for validating functionalities and system aspects.

Current situation

Actions in preparation phase:

- Partially deployed infrastructure.
- Fiber and energy designs validated.
- Initial train preparation activities started.

Pending milestones

- Civil Works pending finalization.
- RAN installation.
- Leased Lines availability.
- On-Board equipment installation.
- Train operations and security coordination for test runs.

Preparation activities and progress

Field testbed

30%

Towers/masts partially deployed; power and transmission/fibers validated.

FRMCS equipment

15%

Agreed solution. RAN installation expected from sept-2026; Leased Lines operational during September.

Test Train

55%

Antennas and energy rack installed; RENFE-ADIF coordination ongoing.

On-Board equipment

20%

Physical and technical requirements under validation; Risk analysis and installation under assessment.

Test plan

64%

D1.1 delivered; D1.2 lab/field distribution ongoing.

Operation, safety and authorization

30%

Test instructions, train drivers and operational risk analysis in preparation.

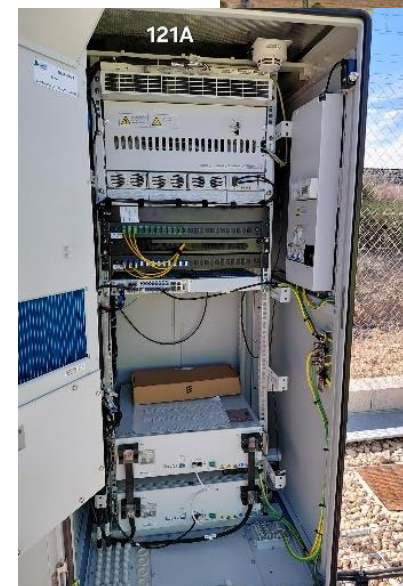
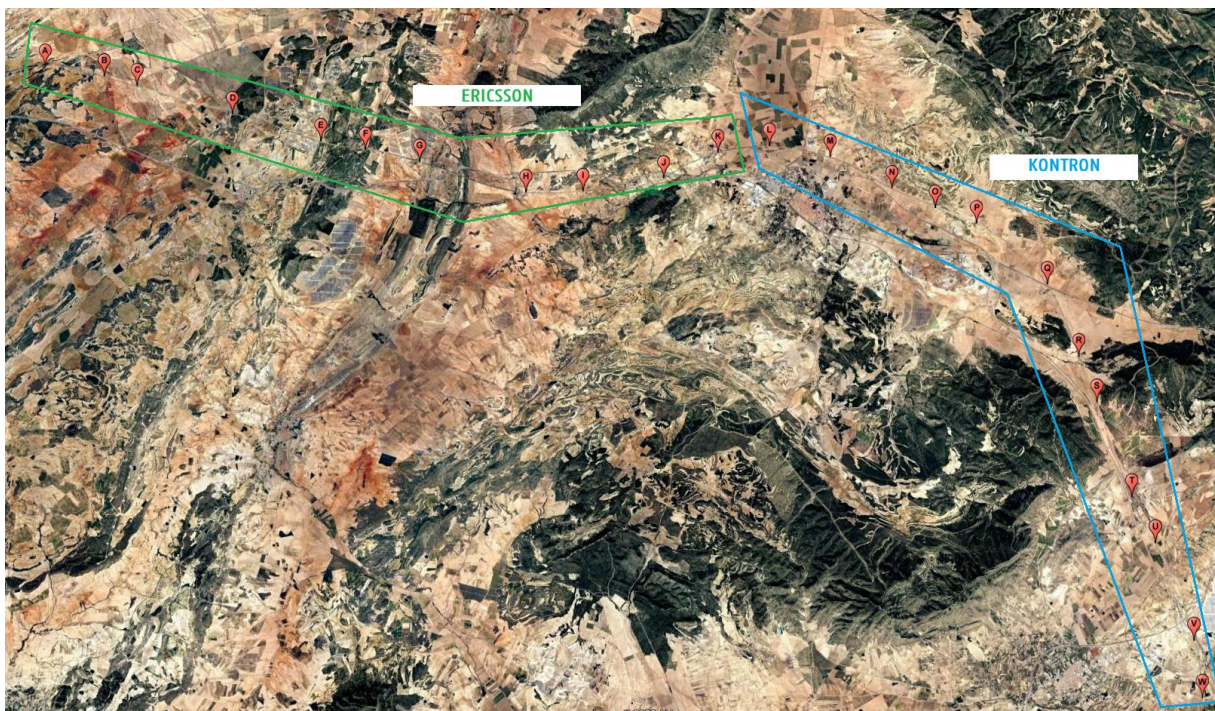
Timeline up to field test

	Sep 26	Oct 26	Nov 26	Dec 26	Q1 27
Transport / leased line	installation		operational		
Civil Work+ power/fiber	finalization				
FRMCS RAN deployment	installation				
RAN integration / core / transport		integration			
On-Board Equipment			installation		
Pre-tests E2E					pre-tests
TC campaign + T4.2 reporting					Field tests execution



Field Test Environment - Spain

High Speed Line (HSL)





Task 4.7 – Staging of Test Environment - Spain HSL

ADIF + CAF, TELTRONIC, ERICSSON, KONTRON, ALSTOM, FUNKWERK, VIAVI, UIC

Objective

Setting up the field test environment in the high-speed line in Spain. It includes specifying a detailed test architecture and preparing the test track and rolling stock required for validating functionalities and system aspects.

Current situation

- Actions in preparation phase:
- Infrastructure available from 5G operators project.
 - Fiber designs validated.
 - Train preparation activities started.

Pending milestones

- Complete fiber segregation and router configuration.
- Confirm Ericsson/Kontron RAN deployment windows.
- Leased Lines availability.
- Complete the train adaptation and on-board installation plan.

Preparation activities and progress

Field testbed

70%

Infrastructure prepared within 5G operator project; fiber segregation and router configuration pending.

On-Board equipment

20%

Physical/technical requirements under validation; installation planned around Q1 2027.

FRMCS equipment

15%

Solution agreed; Ericsson and Kontron RAN deployment/integration windows to be confirmed; Leased Lines operational during September.

Test plan

64%

D1.1 delivered; D1.2 lab/field distribution ongoing.

Test Train

30%

Equipment requirements transferred to the train adaptation contractor; train adaptation expected by the end of 2026.

Operation, safety and authorization

30%

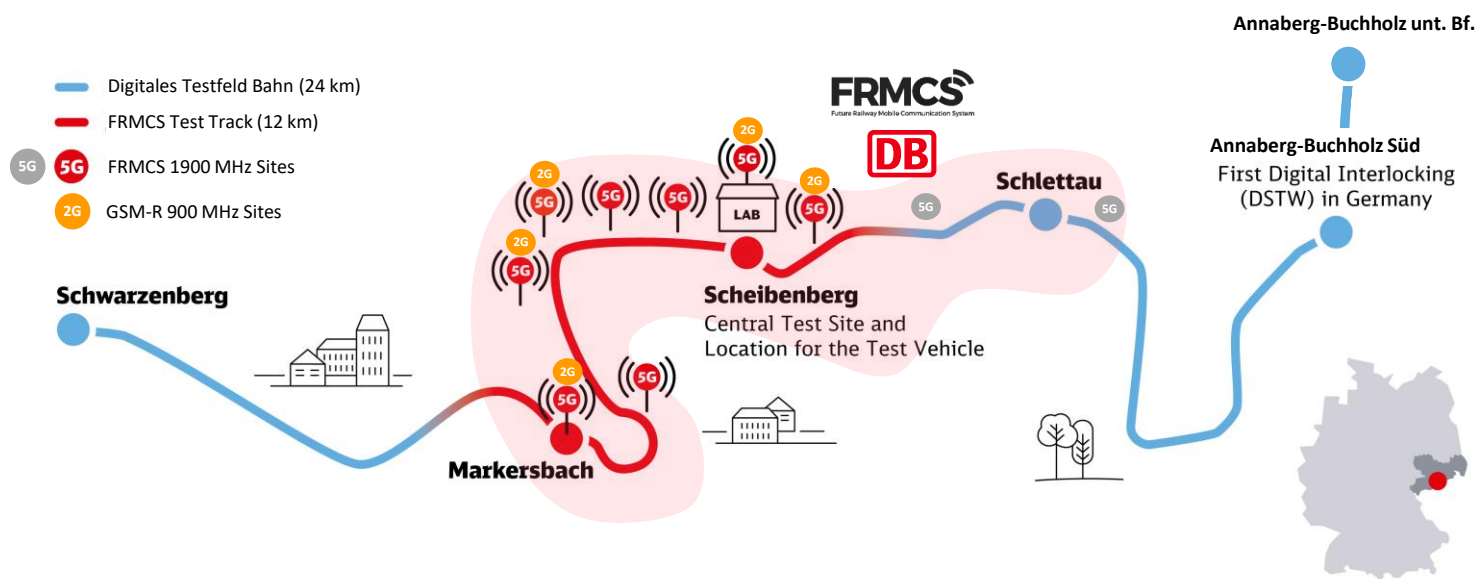
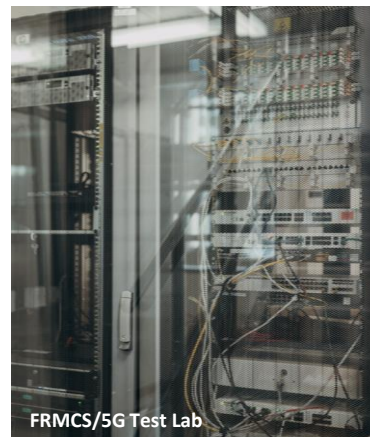
Test instructions, train drivers and operational risk analysis in preparation.

Timeline up to field test

	July 26	Aug 26	Sep 26	Oct 26	Nov 26	Dec 26	Q1 27	Q2 27
Transport / leased line			installation			operational		
Fiber segregation / routers	finalization							
RAN deployment Ericsson/Kontron						installation		
RAN integration / core / transport						integration		
On-Board Equipment						installation		
Pre-tests E2E + optimization							pre-tests	
TC campaign + T4.8 reporting								Field tests execution

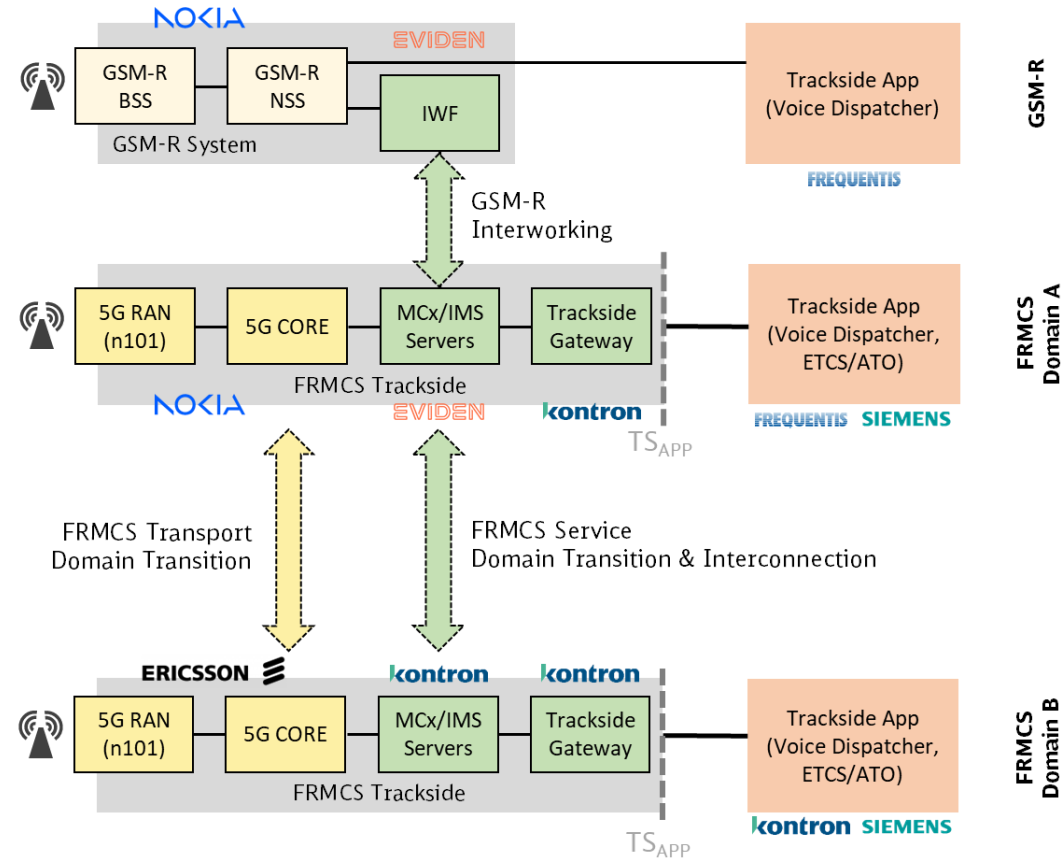
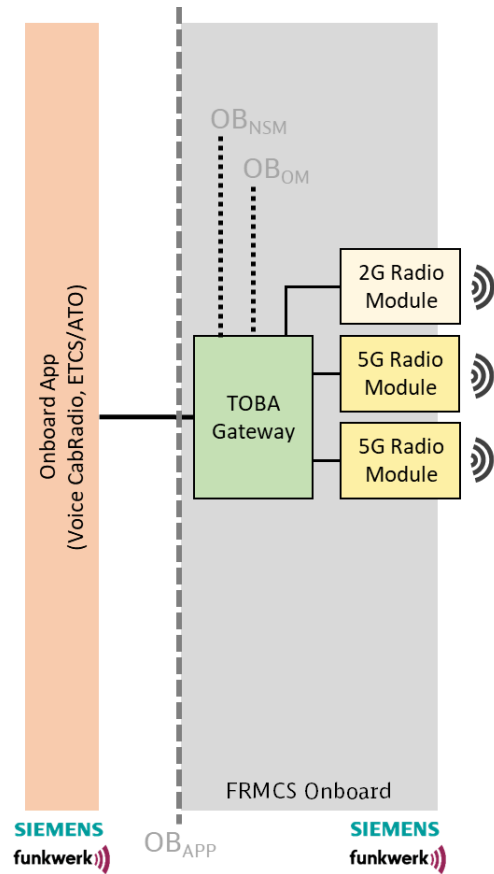


Field Test Environment - Germany





Validation Scope Germany BX Scenarios & IWF



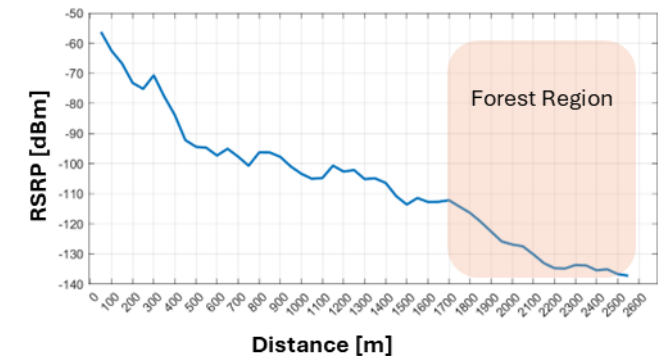
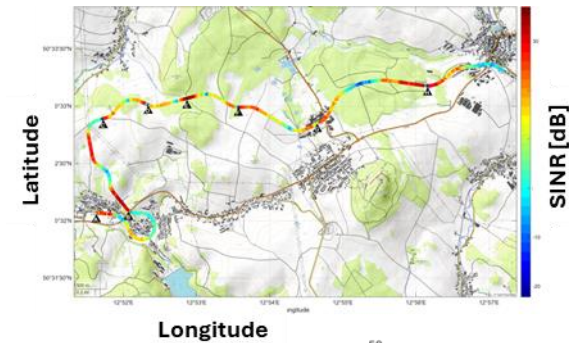


Pre-Testing Activities - Germany N101 Radio Module

- early 1900 MHz RAN measurements with focus on **UE attachment**, cell **handover** relations, **coverage** and **radio performance** in both Ericsson and Nokia networks
- 31 dBm Funkwerk radio module of first generation (within MTC18) and passive scanners
- both stationary and drive tests



28	5]	144.03-146.01	sec	5.00	MBytes	21.1	Mbits/sec
75	5]	146.01-148.04	sec	5.12	MBytes	21.1	Mbits/sec
	5]	148.04-150.03	sec	5.00	MBytes	21.1	Mbits/sec
	5]	150.03-152.01	sec	5.12	MBytes	21.2	Mbits/sec
Trans	5]	152.01-154.04	sec	5.00	MBytes	21.1	Mbits/sec
1.36	5]	154.04-156.02	sec	1.38	MBytes	2.64	Mbits/sec
9.88	5]	156.02-160.39	sec	4.12	MBytes	21.2	Mbits/sec
9.88	5]	162.02-164.01	sec	5.00	MBytes	21.1	Mbits/sec
6.88	5]	164.01-166.04	sec	5.12	MBytes	21.2	Mbits/sec
has t	5]	166.04-168.02	sec	5.00	MBytes	21.1	Mbits/sec
148.6	5]	168.02-170.64	sec	4.75	MBytes	32.1	Mbits/sec
9.6	5]	170.64-172.04	sec	5.38	MBytes	21.1	Mbits/sec
Time	5]	172.04-174.02	sec	5.00	MBytes	21.2	Mbits/sec
Time	5]	174.02-176.00	sec	3.25	MBytes	13.2	Mbits/sec
Time	5]	176.00-178.07	sec	6.88	MBytes	29.5	Mbits/sec
Time	5]	178.07-180.03	sec	5.00	MBytes	21.2	Mbits/sec
Time	5]	180.03-182.01	sec	5.12	MBytes	21.2	Mbits/sec
Time	5]	182.01-184.04	sec	5.00	MBytes	21.1	Mbits/sec
Time	5]	184.04-186.03	sec	5.00	MBytes	21.2	Mbits/sec
Time	5]	186.03-188.00	sec	5.12	MBytes	21.1	Mbits/sec
Time	5]	188.00-190.04	sec	5.12	MBytes	21.2	Mbits/sec





Task 4.3 – Staging of Test Environment - Germany

INFRAGO + ERICSSON, EVIDEN, FREQUENTIS, FUNKWERK, KONTRON, NOKIA, SIEMENS, VIAVI, UIC

Preparation Activities and Progress

Field testbed

80%

8 of 10 towers have been constructed (fiber-connectivity and power supply exists); 2 of 10 towers come in Oct. 2026.

FRMCS trackside equipment

75%

FRMCS RAN equipment from Nokia and Ericsson installed on 8 of 10 towers; 2 of 10 towers come in Q4 2026; Leased Lines to Remote 5G Cores are progressing.

Test train

80%

Choice of 3-4 trains will be available; all being equipped with 2x2 H+S antennas (incl. GPS) and similar cable length; no fixed installations of train OB equipment but flexible mounting

On-board equipment

20%

Early network pre-testing with 1st radio module version; Clarifications on pre-testing with 2nd radio module version and BX & IWF onboard equipment ongoing

Test plan

30%

Few FRMCS functional end-to-end test cases in D1.1 / D1.2; BX and IWF test cases mainly for D1.3

Operation, safety and authorization

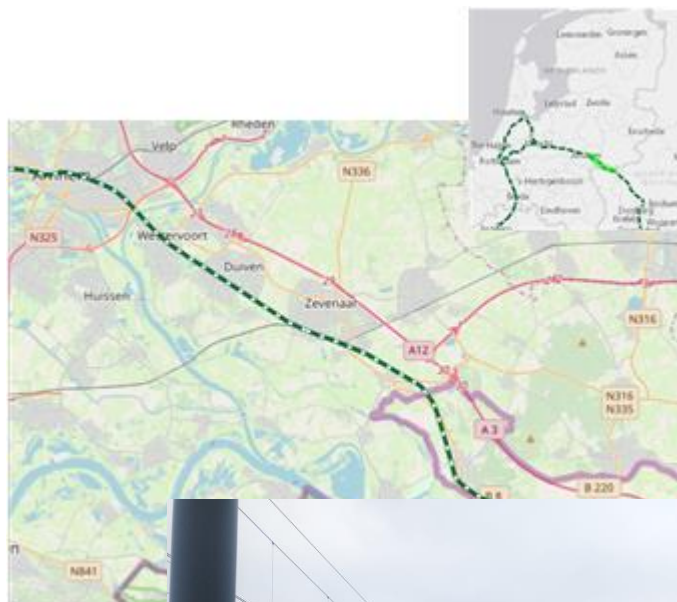
60%

Test during daytime, usually Tuesday to Thursday (with Monday and Friday for train transfer); Approx. 8 two-directional test runs per day; Drive test runs need 6-8 weeks in-advance planning to clarify operations

Preliminary Timeline

	June 26	July 26	Aug 26	Sep 26	Oct 26	Nov 26	Dec 26	Q1 27	Q2 27	Q3 27
Leased line to Labs Ericsson/Nokia	setup phase				leased line operations					
RAN deployment Ericsson/Nokia				additional 2 sites						
RAN & Lab Core integration					connect Core					
Network perform. & optimization	Pretests 1 st RM version				Pretests 2 nd RM version & Network Performance					
On-Board Equipment					Onboard Gateway Pretests					
Functional Pre-tests E2E + BX						End-to-End Pretests				
TC validation phase + reporting								Drive Tests BX & IWF		

Field Test Environment - Netherlands





Task 4.9 – Staging of Test Environment - Netherlands

PRORAIL + ERICSSON, KPN, RIDE ON TRACK, ALSTOM, FUNKWERK, VIAVI, UIC

Objective

Setting up the field test environment at the conventional line in The Netherlands. It includes specifying a test architecture and preparing the test track and rolling stock.. FRMCS Multipath, RMR1900, MNO national roaming and public subscriptions are the main topics for validation.

Current situation

- Architecture design and radio planning completed
- Passive Infrastructure available (1 site under construction)
- Transmission design completed, installation in progress.
- Measurement rain preparation activities started.
- Design for MNO national roaming completed

Pending milestones

- Start RAN deployment in Q3 2026
- International Leased Lines delivery.
- Contracting the measurement train
- Lab test execution in Q1 2027
- Field test execution in Q2/Q3 2027

Preparation activities and progress

Field testbed

50%

Infrastructure prepared within 5G operator project; fibre segregation and router configuration pending.

FRMCS equipment

50%

Solution agreed; Ericsson RAN deployment/integration windows to be confirmed; Leased Lines operational in Q4 2026.

Test Train

30%

Equipment requirements transferred to the train adaptation contractor; train adaptation expected by the end of 2026.

On-Board equipment

20%

Physical/technical requirements under validation; installation planned around Q2/Q1 2027.

Test plan

50%

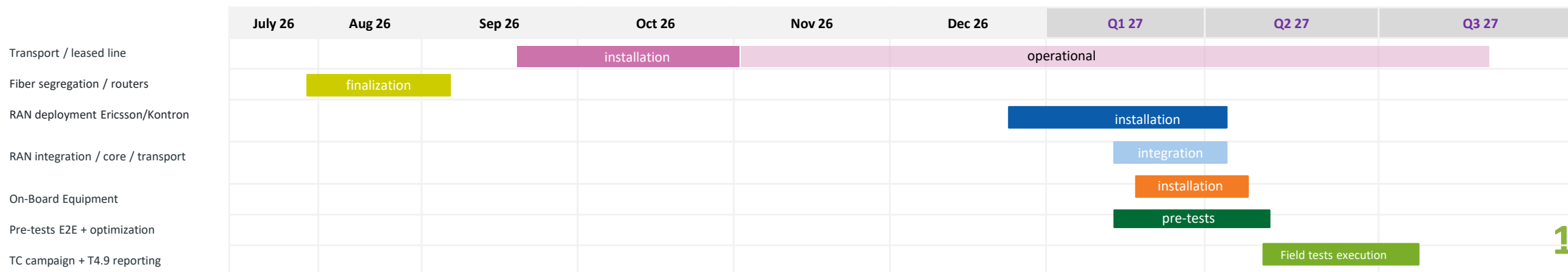
D1.1 delivered; D1.2 lab/field distribution ongoing.

Operation, safety and authorization

20%

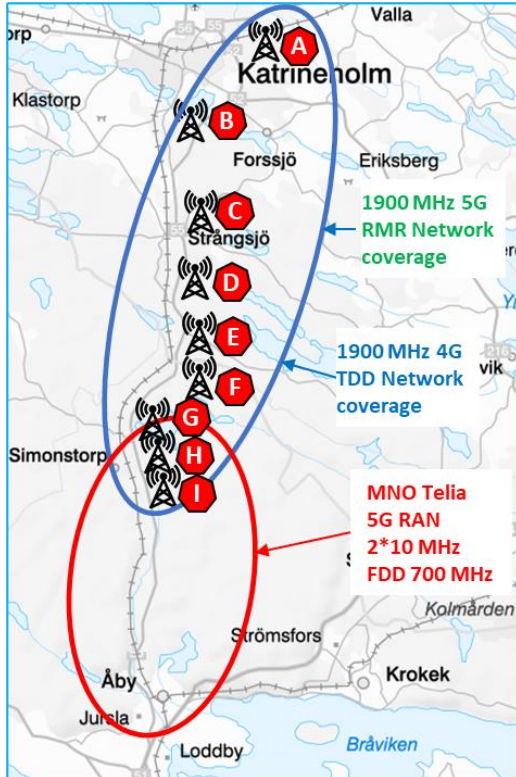
Test instructions, train drivers and operational risk analysis in preparation.

Timeline up to field test



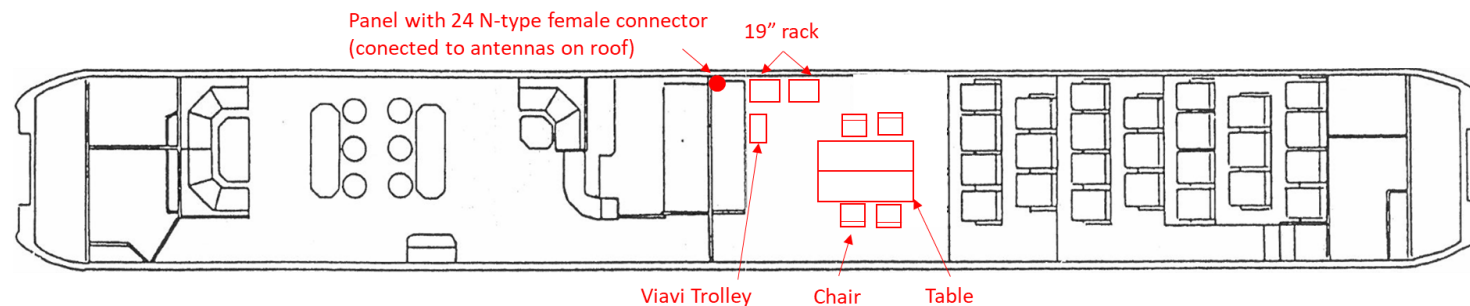
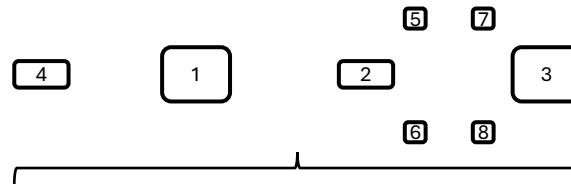


Field Test Environment Sweden



Antennas for testing FRMCS and Tetra on Vehicle:

- | | |
|----------------------------|--------------------------------|
| 1: H&S 4-port 1399.99.0153 | 4: H&S 2-port 1399.99.0130 |
| 2: H&S 2-port 1399.99.0130 | 5,8: H&S 380-430 MHz 87010005 |
| 3: H&S 4-port 1399.99.0153 | 6,7: H&S 694-2700 MHz 87010023 |





Task 4.3 – Staging of Test Environment - Sweden

TRAFIKVERKET + ERICSSON, SIEMENS, ALSTOM, VIAVI, KONTRON, Telia (MNO/MOCN)

Objective

Setting up the field test environment in the regional line in Åby, Sweden. It includes specifying a detailed test architecture and preparing the test track and rolling stock required for validating functionalities and system aspects.

Current situation

Actions in preparation phase:

- All passive infrastructure deployed.
- Operative 4G TDD test track
- Operative test Vehicle with 8 antennas for tests
- Preparation for replacing 4G RRU-s with 5G RRU
- Preparation for more electrical power on vehicle

Pending milestones

- RRUs installed for operative 5G n101 FRMCS test track.
- Leased Lines availability.
- On-Board equipment installation and integration.
- Necessary electrical power on test vehicle.

Preparation activities and progress

Field testbed

100%

Towers/masts deployed; power and transmission/fibers validated.

FRMCS equipment

50%

Agreed solution. RAN n101 installation expected from late September 2026; Leased Lines operational 1st of October 2026.

Test Train

60%

8 Antennas installed (FRMCS & TETRA). WiFi & Dual Band Diplex Filters on board. Vehicle currently used for tunnel (TDD n101) and TETRA tests. Planning for rack for TOBA Equipment. Overhaul of electrical power.

On-Board equipment

20%

Physical and technical requirements under validation; Risk analysis and installation under assessment. (Two 19" half rack)

Test plan

64%

D1.1 delivered; D1.2 lab/field distribution ongoing. Test cases focusing on MOCN with MNO Telia on n28 and FCAPS.

Operation, safety and authorization

70%

Test on daytime, Monday to Thursday on ordinary track. Test is done with own vehicle. Working timetable for test runs derived from requests 1 month in advance. Aprox. 10 test runs/day.

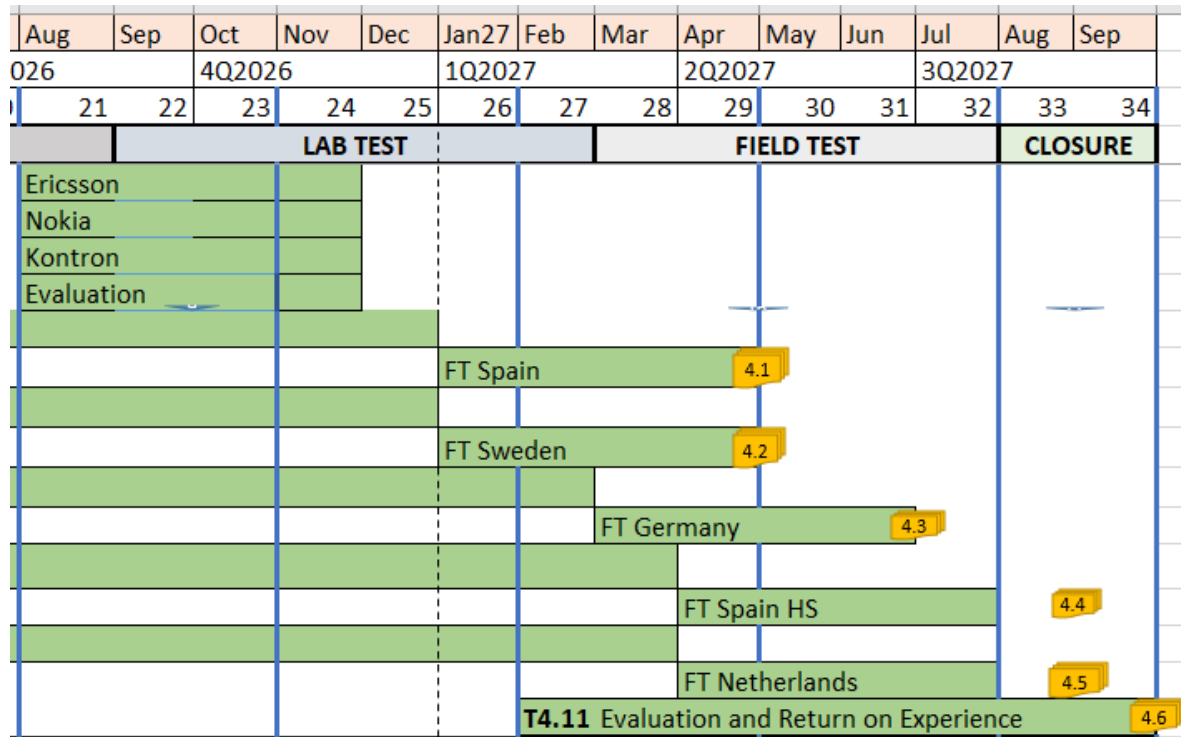
Timeline up to field test

	Sep 26	Oct 26	Nov 26	Dec 26	Q1 27
Transport / leased line	installation		operational		
Civil Work+ power/fiber ✓ [Ok]					
FRMCS 5G Radio deployment		installation			
RAN integration / core / transport			integration		
On-Board Equipment			installation		
Pre-tests E2E + optimization				pre-tests	
TC campaign + T4.4 reporting					Field tests execution

Agenda

- Introduction and Overview
- Status Staging of Test Environments
- Next steps
- Questions

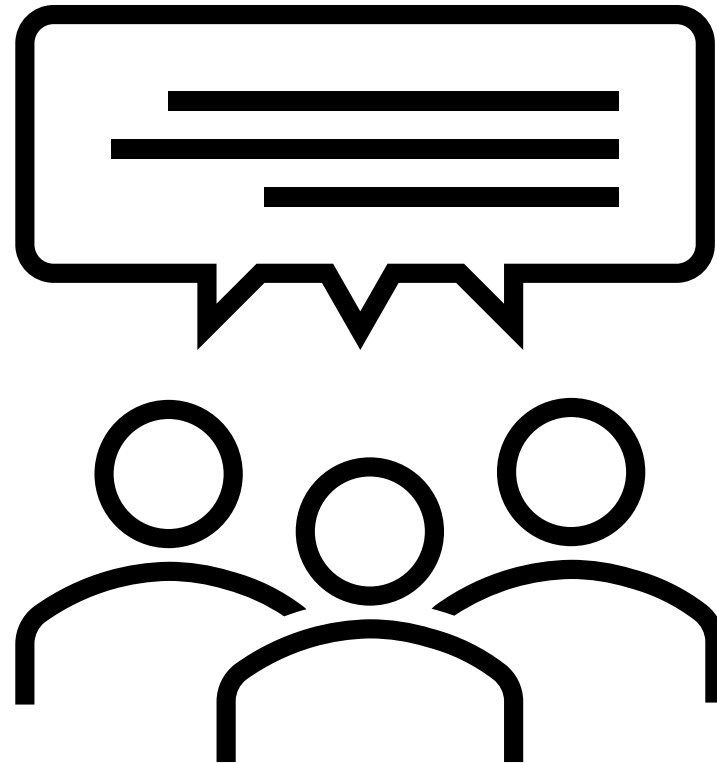
Next: Detailed co-ordination plans for Test Activities during the field test period – January – July 2027



	Adif CL	TRV+Telia	InfraGO	Adif HS	ProRail+KPN
Ericsson		Y	Y	Y	Y
Kontron	Y			Y	
Nokia			Y		
Alstom	Y	Y		Y	Y
Funkwerk	Y		Y	Y	Y
Hitachi	Y				
Siemens		Y	Y		Y
Kontron	Y	Y	Y	Y	Y
CAF	Y			Y	
ROT					Y
Teltronic	Y			Y	
Eviden	Y		Y		
Frequentis			Y		
Viavi	Y	Y	Y	Y	Y

Agenda

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Conclusion

Jean-Michel Evangelou, UIC



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Thank You!

**Safe travels and see
you soon.**



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