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The Power of IoT

FRMCS rendszer jövőképe és a Kontron részvétele a fejlesztési és pilot folyamatokban

Sümeg – 2025.10.21.

We are building the bridge from GSM-R to FRMCS

Focus on near future

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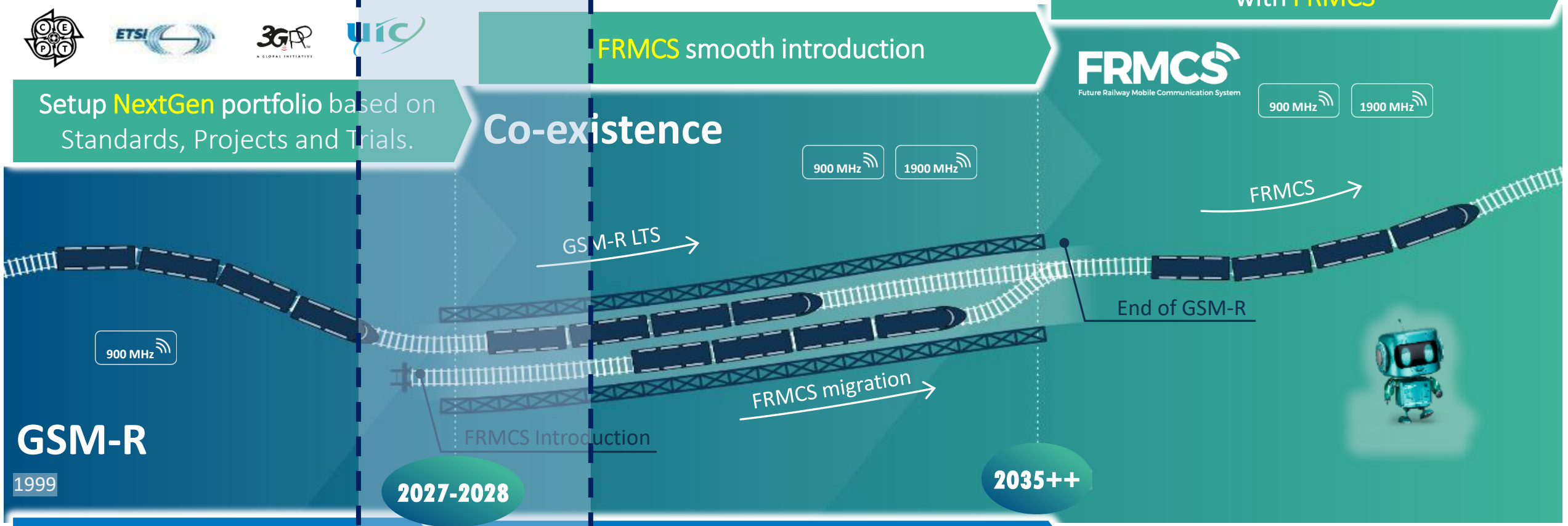
Continue the success of GSM-R with FRMCS

FRMCS smooth introduction

Setup NextGen portfolio based on Standards, Projects and Trials.

Co-existence



Evolve GSM-R portfolio

LONG TERM SUPPORT for our GSM-R solution

Our Mission
Building the bridge between two worlds

One Concept, One Strategy, One Portfolio towards FRMCS

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Applications
Core
Access
Terminals

Dispatcher | Custom App.

MCx | Supp.Services
SIPCore | IWF

OTT Transmission via
Public 4G/5G Mobile Network

Dispatcher | Custom App.
MC Client | MC Client
Hardware | Hardware

NextGen Dispatcher (GEFO, SGP),
Secondary Lines (OTT)

FRMCS
Future Railway Mobile Communication System

Network Management
Provisioning
Virtualization Platform

Add additional
Standardisation (TSI) Input
+ 5G Private Network on
Railway Frequencies


Ministerium für Verkehr des Landes Nordrhein-Westfalen - Landeseisenbahnverwaltung -
Westfälische Landes-Eisenbahn GmbH
Beckumer Str. 70
59555 Lippstadt
Modernisierung Zugfunk, Digitales Zugfunksystem bei der WLE

ETSI
3GPP
5G

Dispatcher | Railway Specifics

R | MCx | Supp.Serv
SIPCore

5GC

R | 5G NR, n100, n101
Hardware

R-Specifics
MC Client
Hardware

FRMCS - Railway

Hardware | VirtP | 5G/LTE NB | 5GC | SIPCore | MCx | MC Client | NG-OAM | Dispatcher

Kontron‘s FRMCS credentials

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FRMCS working groups
Contributing to the FRMCS specification process (SuperGroup, FIS WG, ..)

Europe‘s Rail JU
Innovation Pillar (R2DATO)
System Pillar, FRMCS Deployment Subgroup

ERA EECT Reviews
Finalization of FRMCS V2 specifications

5GRACOM
Coexistence GSM-R / FRMCS in 900MHz
Hybrid FRMCS networks Multipath Tech.

Technical Committee
Railway Communication (TC-RT)
TS 103 765 -1..5 Transport, Service, OB, TS, UE
TS 103 792 Interworking Function

5G Rail
FRMCSv1 sytem validation with focus on TOBA integration & testing

finalized

FRMCS / MCX Plugtests
Multi-Vendor Testing & Validation

5G Network Hybridization

Specification Working Groups
Service & System Aspects (SA WG1 + WG6)
RANx + CNx

MCX technology in FRMCS testing
Erzgebirge Test Track

MORANE2
European FRMCSv2
testing & validation project

ETCS-FRMCS compatibility
Onboard FRMCS migration challenges
Baseline 4 vs Baseline light vs Adapter solution

finalized

Research Projects with (Pre-) FRMCS Field trials

- Shift2Rail – Adaptable Communication System (ACS), Cyber Security (Protection Profile for ACS)
- 5G Victory – Implementation of Vertical Use case for Railways
- 5GRail – Development of prototypes for FRMCS
- Pre-Engineering agreements

Projects ended in 2024

- DB FRMCS/MCx Study and Trial
- Europe's Rail – Innovation Pillar R2DATO

Field Tests ongoing till 2026

- 5G-RACOM – Whitespace and multipath pilot in hybrid network
- SNCF 5G Hybridisation

Field Tests in 2025

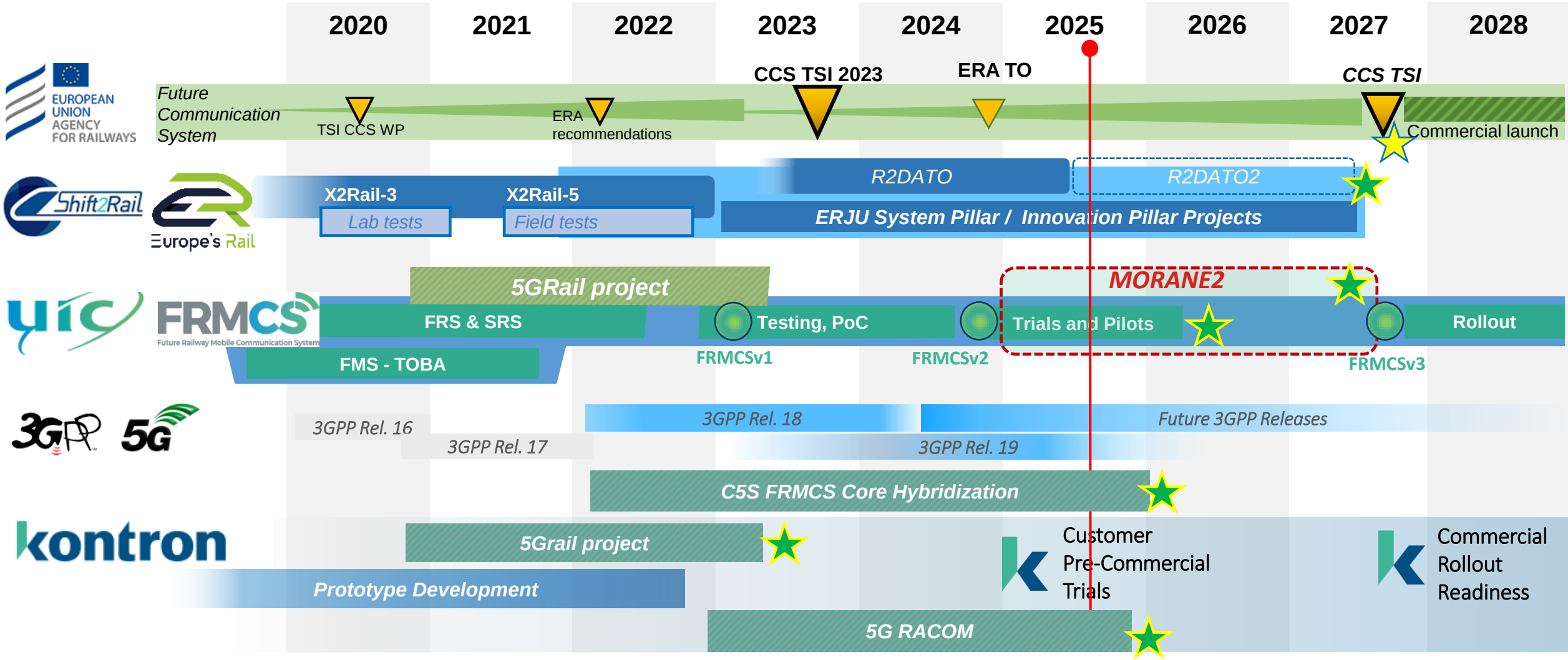
- MORANE 2

Just started ! Field Tests 2027

!!

KONTRON Transportation is leading or being one of the main supplier actors in those projects related to communication

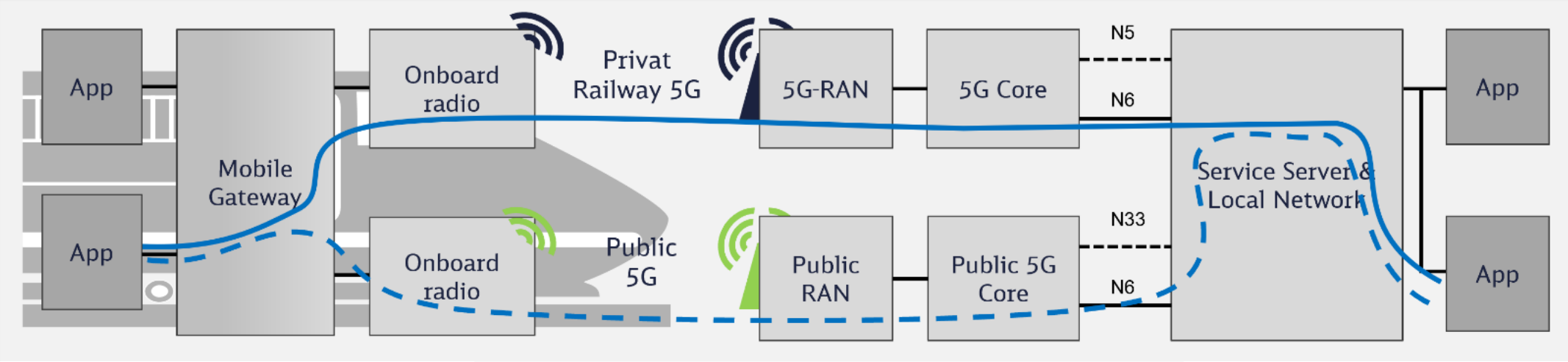
The European Timeline



Ongoing research projects - 5G-RACOM

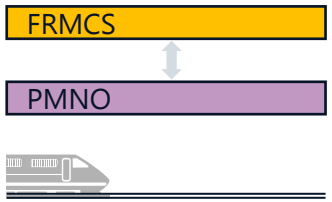
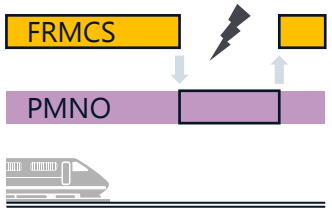
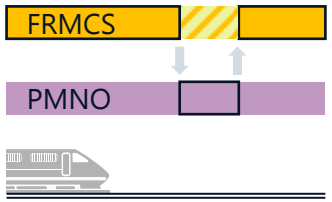
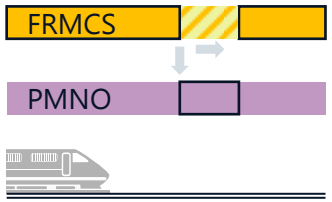
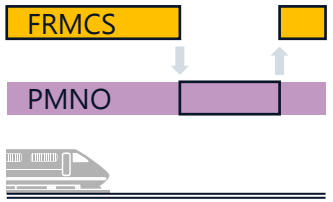
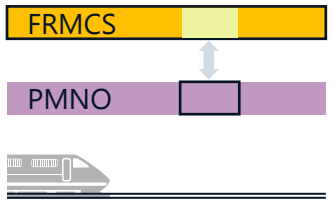
5G for Resilient and Green **RA**il **COM**munications

- German-French Research Project aims at investigating, developing and demonstrating key technologies to achieve a green, resilient, and future-proof FRMCS system – led by SNCF and DB
  - French part: “exploiting the available RMR frequency spectrum most efficiently “ ->**co-located approach and Whitespace Pilot**
    German part: “extending FRMCS towards additional public frequency spectrum via a hybrid network architecture “ ->**Multi-path functionality in Hybrid network** (own 5G plus public MNO 5G network)



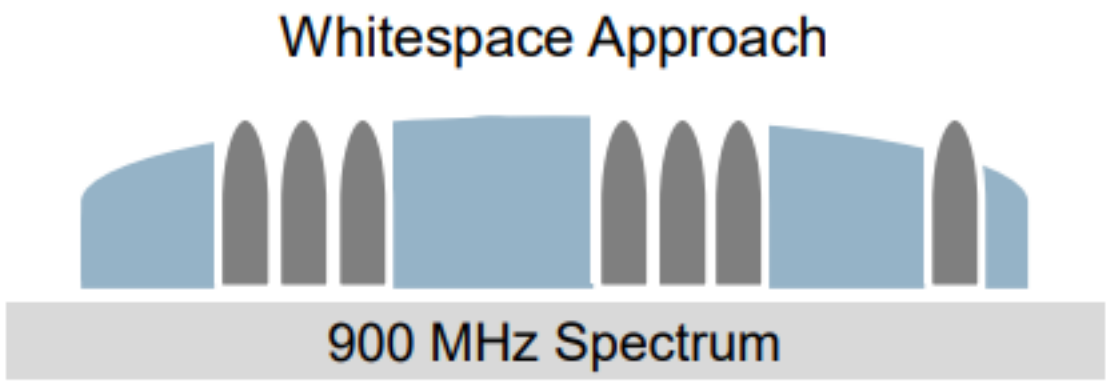
Planned Duration: 3 years - 1.12.2022-30.11.2025

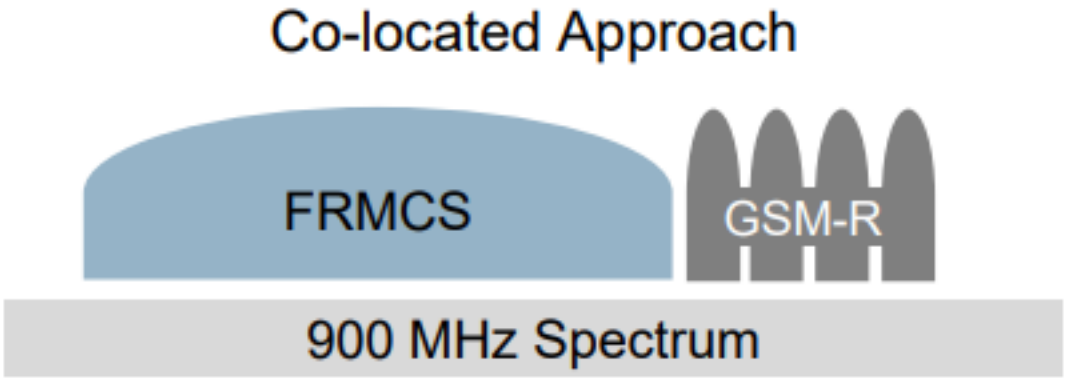
5G-RACOM – Multipath Use Cases

UC1	UC2	UC3	UC4	UC5	UC6
Application-Specific Path Selection	Fallback	Resilience via Path Selection	Resilience via Replication	Coverage Extension	Capacity Extension
					
The PMNO network is by default used for applications that may not use FRMCS (e.g. Diagnostics)	In case the FRMCS network becomes unavailable due to failures or unintended coverage holes, the PMNO network is taking over	In case the FRMCS network quality is poor (QoS is not fulfilled), some data flows are switched to the PMNO network	In case the FRMCS network quality is poor (QoS is not fulfilled), some data flows are duplicated to the PMNO network	In case the FRMCS network coverage ends (intentionally) because the track is not (yet) equipped with FRMCS, the PMNO network takes temporarily over	In case the capacity (data rate) of the FRMCS network is not sufficient, the PMNO network complements

Ongoing research projects - 5G-RACOM

WP2 - Coexistence of FRMCS & GSM-R





- Whitespace
  - Standard 3GPP REL17 and above.
  - Leverage existing ecosystem 5MHz (5G SA UE)
  - Maximize spectrum usage
  - No impact on GSM-R
  - Allows smooth migration form GSM-R to FRMCS in a single step.
  - Ready technology after 5G RACOM

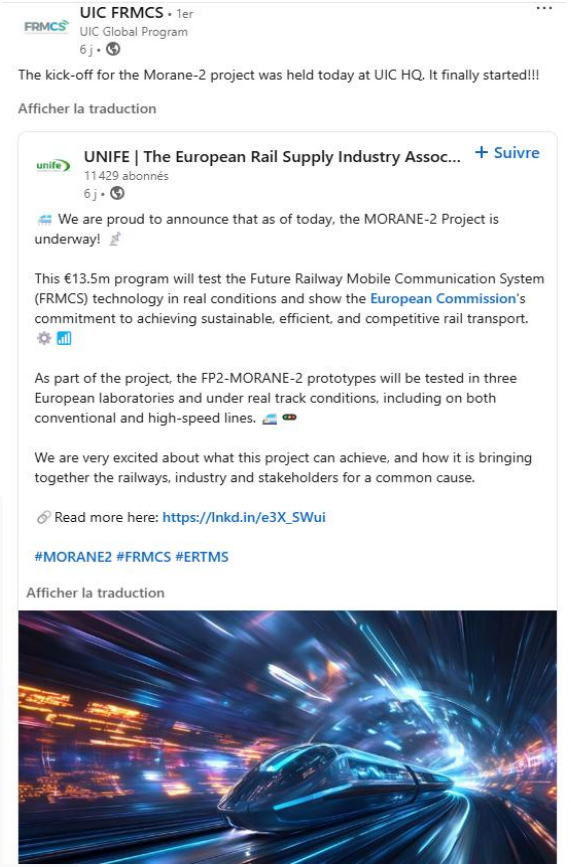
- Below 5MHz (3MHz)
  - Requires on going 3GPP standardization R18/19,
  - Impact on 5G UE/Chipset (small ecosystem)
  - Require GSM-R reparenting (4 to 2,6 MHz)
  - Migration form GSM-R to FRMCS in several step
  - Requires re-engineering to 5MHz when GSM-R OFF
  - No product and niche ecosystem

MORANE2 facts and engagement

- Duration: **30 months**
- Overall Project Funding: 23 Mio€

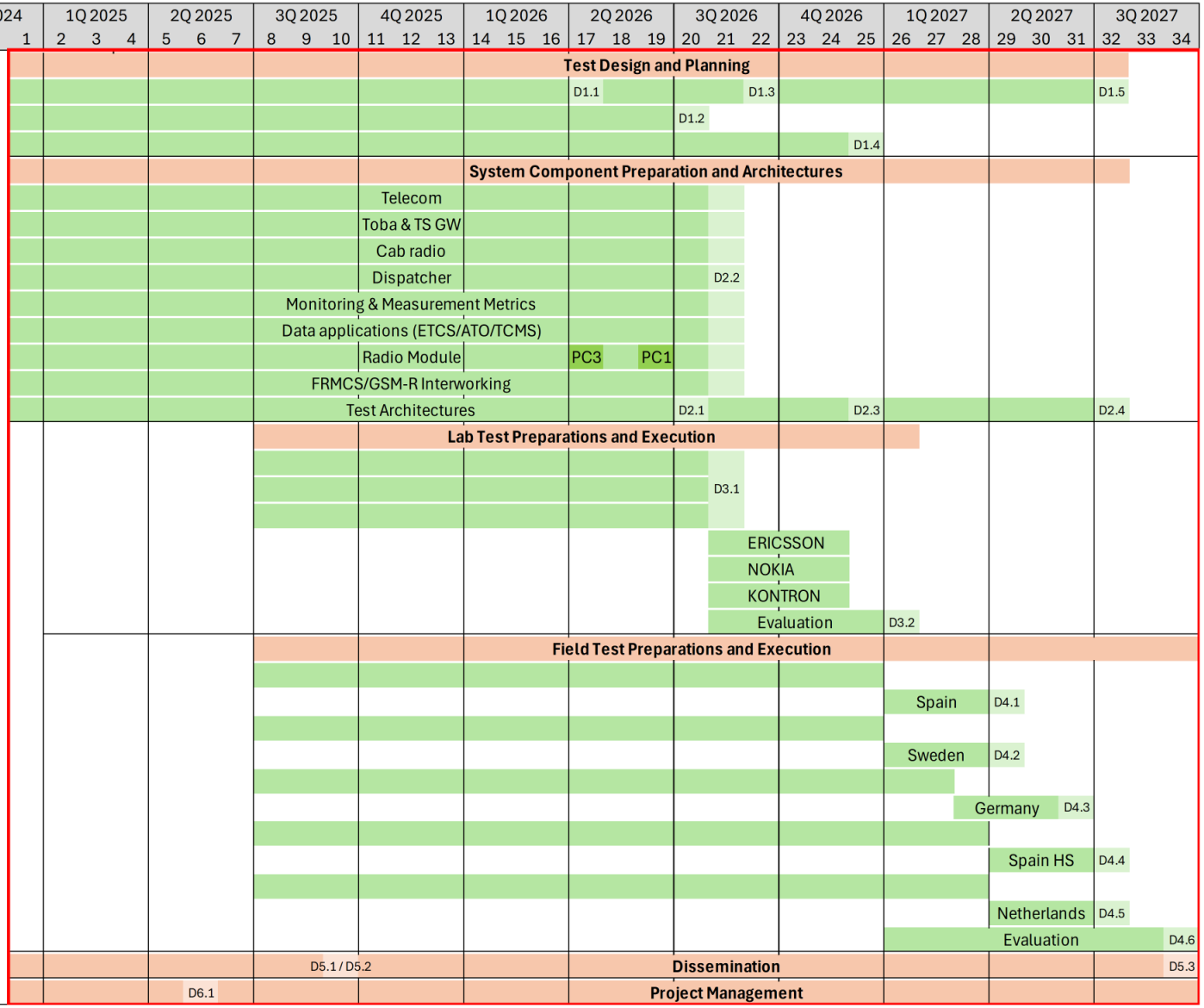
- Project Objectives
  - **Validation of FRMCS V2 Specification** in lab and field on several tracks
  - Deliver **inputs for FRMCS Specification V3** based on the results of the project

  - **UIC as Project Coordinator**
  - 4 active Railways (providing tracks for field tests)
  - 6-7 passive Railways (observing the activities)
  - 12 FRMCS Suppliers
  - 1-2 Public MNOs
  - 2 ETCS/ATO Supplier



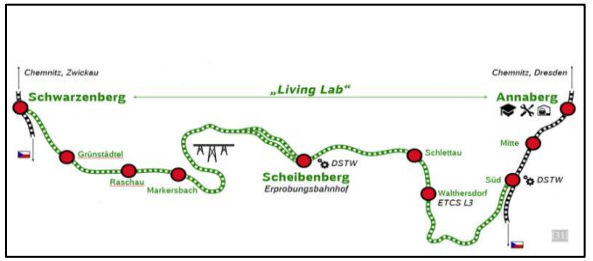
Morane 2 - Project Planning *(Reminder)*

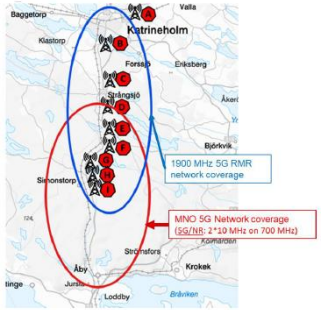
Start	Title	Lead
WP 1	**Test Design and Planning**	**UIC**
Task 1.1	FRMCS Test Specifications	UIC
Task 1.2	Test Plan and Test Methodology for Lab	UIC
Task 1.3	Test Plan and Test Methodology for Field	UIC
WP 2	**System Component Preparation and Architectures**	**UNIFE**
Task 2.1	Telecom (FRMCS Transport and Service Layer)	KONTRON
Task 2.2	TOBA & TS GW	ATSA
Task 2.3	Cab radio	SMO
Task 2.4	Dispatcher	ROT
Task 2.5	Monitoring & Measurement Metrics	VIAVI
Task 2.6	Data applications (ETCS/ATO/TCMS Simulators)	CAF
Task 2.7	Radio Modules	FUNKWERK
Task 2.8	FRMCS/GSM-R Interworking	NOKIA
Task 2.9	Test Architectures	INFRAGO
WP 3	**Lab Test Preparations and Execution**	**ERI**
Task 3.1	Staging of Lab Environment Ericsson	ERICSSON
Task 3.2	Staging of Lab Environment Nokia	NOKIA
Task 3.3	Staging of Lab Environment Kontron	KONTRON
Task 3.4	Lab Tests Ericsson	ERICSSON
Task 3.5	Lab Tests Nokia	NOKIA
Task 3.6	Lab Tests Kontron	KONTRON
Task 3.7	Evaluation & Return on Experience	UIC
WP 4	**Field Test Preparations and Execution**	**TRV**
Task 4.1	Staging of Test Environment Spain	ADIF
Task 4.2	Field Tests Spain	ADIF
Task 4.3	Staging of Test Environment Sweden	TRV
Task 4.4	Field Tests Sweden	TRV
Task 4.5	Staging of Test Environment Germany	INFRAGO
Task 4.6	Field Tests Germany	INFRAGO
Task 4.7	Staging of Test Environment Spain HS	ADIF
Task 4.8	Field Tests Spain HS	ADIF
Task 4.9	Staging of Test Environment Netherlands	PRORAIL
Task 4.10	Field Tests Netherlands	PRORAIL
Task 4.11	Evaluation & Return on Experience	UIC
WP 5	**Dissemination**	**UNIFE**
WP 6	**Project Management**	**UIC**



MORANE2 KONTRON Field Tests Involvement

- Spain – ADIF
  - Conventional line: 5G-Core, 5G RAN (900 MHz and 1900 MHz), MCX/IMS
  - Highspeed line: 5G-Core, 5G RAN (1900 MHz), MCX/IMS
- Germany – DB:
  - MCX/IMS, Trackside Gateway, dispatcher
- Netherlands – ProRail:
  - MCX/IMS
- Sweden – Trafikverket
  - MCX/IMS, dispatcher





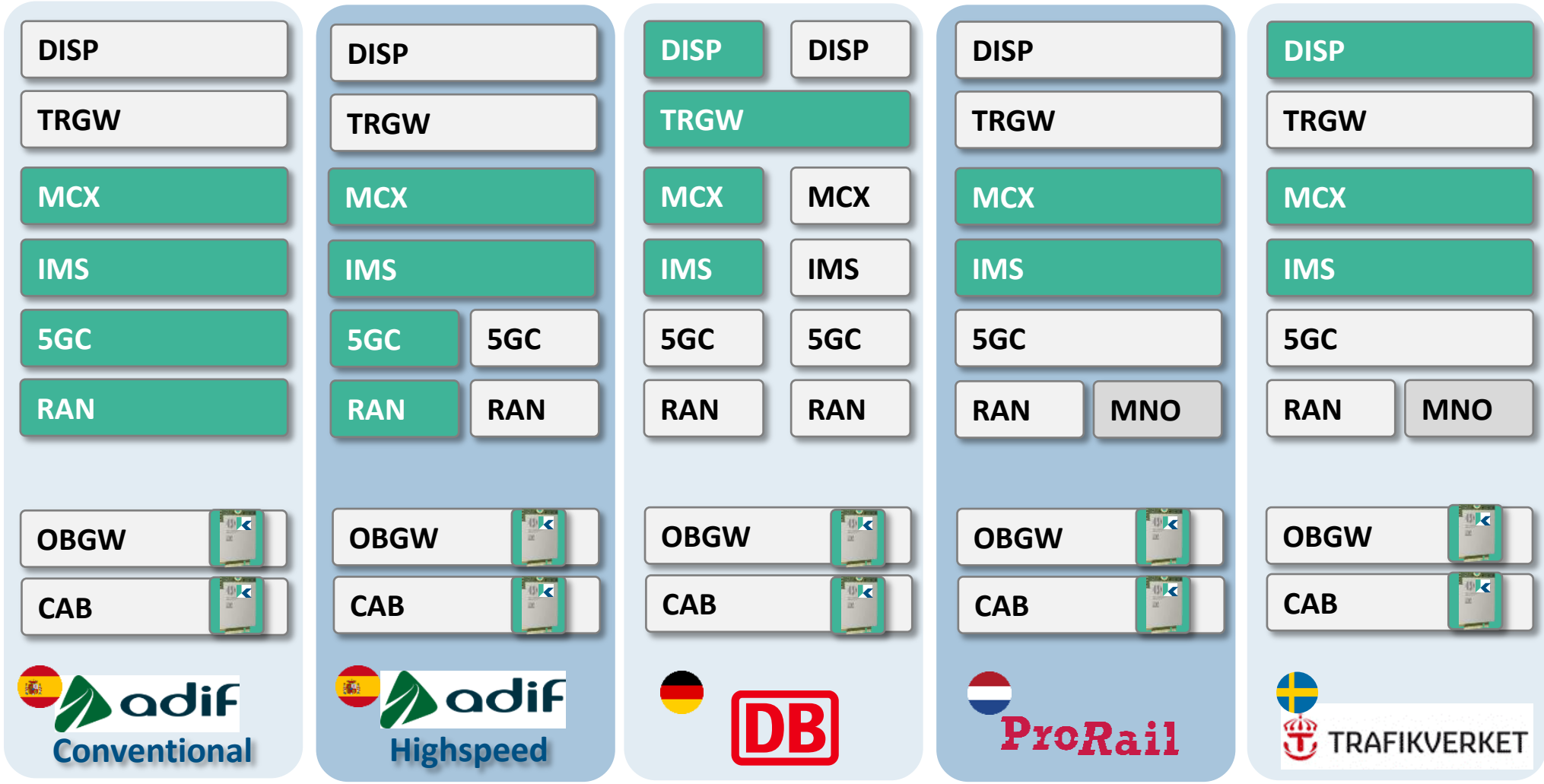
- Kontron is active on all tracks and took the biggest portion of the overall invest/budget delivering 5G-Core, 5G RAN (900 and 1900 MHz), MCX/IMS, trackside gateway and dispatcher cor the field tests

MORANE2 Field Network Setup

	DB	ADIF conv.	ADIF HS	Trafikverket	Prorail
RAN 900Mhz		Kontron			
RAN 1900Mhz	E// - Nokia	Kontron	E// - Kontron	E//	E// - MNO KPN
5GC	E// - Nokia	Kontron	E//	E//	E//
MCX / IMS	Kontron –Nokia/Eviden	Kontron	Kontron	Kontron	Kontron
CabRadio	Funkwerk	Funkwerk	Funkwerk	Siemens	Funkwerk
OBGW	Funkwerk Siemens	Alstom Hitachi	Funkwerk Alstom	Alstom Siemens	Alstom Funkwerk Siemens
TSGW	Kontron	Hitachi	Alstom	Alstom	Alstom
Dispatcher	Kontron Frequentis	Teltronic	Eviden	Kontron	ROT

MORANE2 – Kontron's Involvement & Contribution

KONTRON



Thanks to its experience and portfolio, Kontron is active on all tracks!

KT FRMCS n100 & n101 Modem

Enabling Radio RMR

White Space 900 Mhz

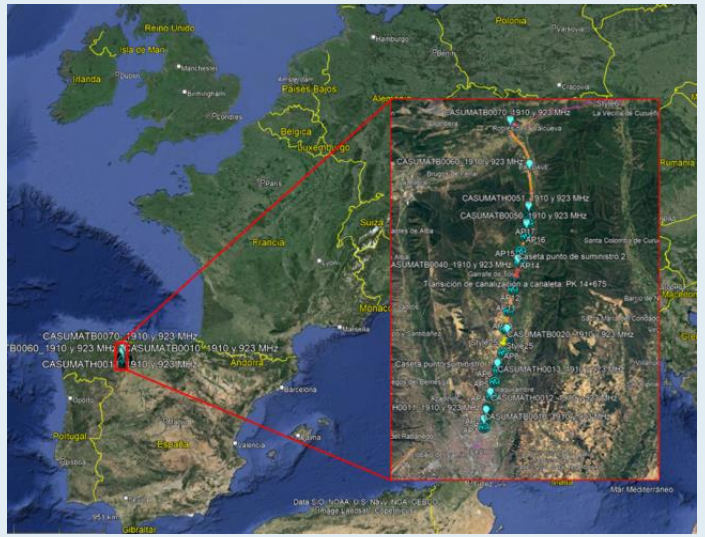
1. 1st tests Racom made on Transposed modem
2. Then 'Real' Modem n100 required!

RRH 900MHz
(n100 RMR 3GPP)

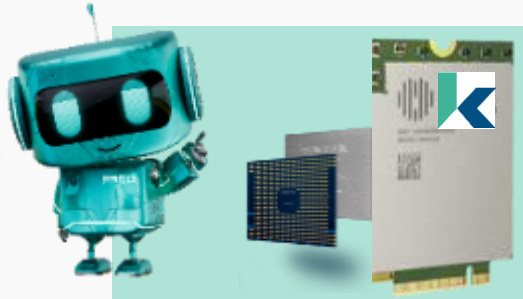
Transposed 900 Modem
(n100 RMR 3GPP)

MORANE 2

1. RAN KT n100 & n101 on ADIF – 2 lines
2. CAB Funkwerk, OBGW, RAN E// & Nokia



Kontron has engaged the main 5G chipset supplier to work on a plan to embed railway functions and feature in a commercial chipset and develop modules and modems for the emerging FRMCS market.



Availability of FRMCS compliant 5G modems supporting RMR spectrum (n100/n101)

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