How MoySEST brings FRMCS closer to reality

Rail Live 2025 – 26th November 2025

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Introduction and Context

Next-Gen Railways & FRMCS

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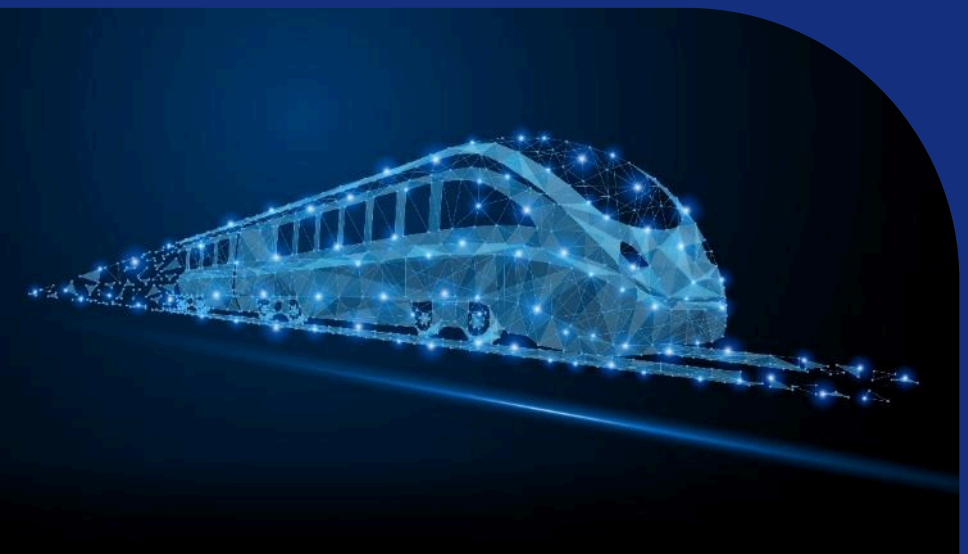
FRMCS
Future Railway Mobile Communication System

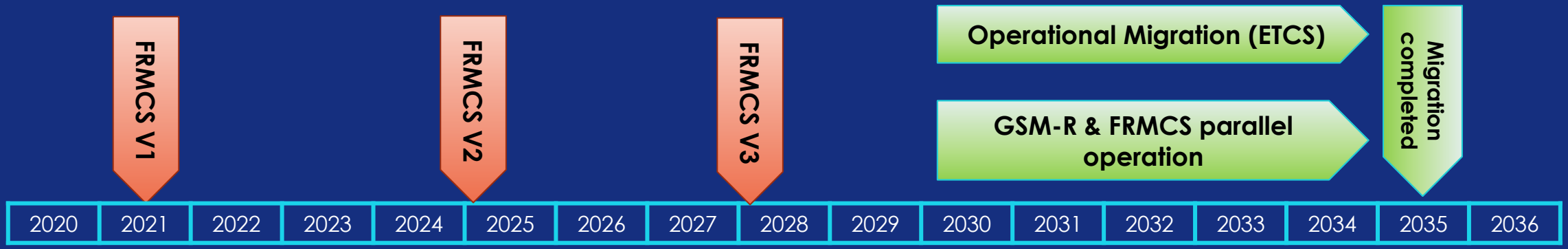
Is **the** opportunity to gain convergence in the solutions for the rail market following GSM-R replacement.



- **High Data Capacity:** Supports bandwidth-intensive services (ATO, telemetry, video, IoT).
- **Low Latency:** Enables safer, faster ETCS and ATO responses.
- **Future-Proof Architecture:** 5G-based, modular, scalable, aligned with 3GPP evolution.
- **Unified Mission-Critical Services:** Voice, data and video integrated in a resilient, interoperable platform.
- **Enabler for Digital Rail:** Foundation for automation, predictive maintenance, and connected assets.

Tentative timeframe for FRMCS to enter operation

Specification progress and validation initiatives



INTERNATIONAL UNION OF RAILWAYS

Other support projects independently managed by Industry Vendors and Railway Infrastructure Managers

The Challenge

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Turning a technological challenge into a competitive advantage

FRMCS requires:

- **Expert development and integration of 5G and MCX**, two multi-purpose technologies that require proper interaction to deliver mission-critical grade.
- **Performance and reliability built for the railway**, reinforced by a high-availability architecture, optimized radio network design and strong cybersecurity measures.
- **Innovation with purpose:** secure, resilient, and future-ready communications for a connected transport ecosystem.

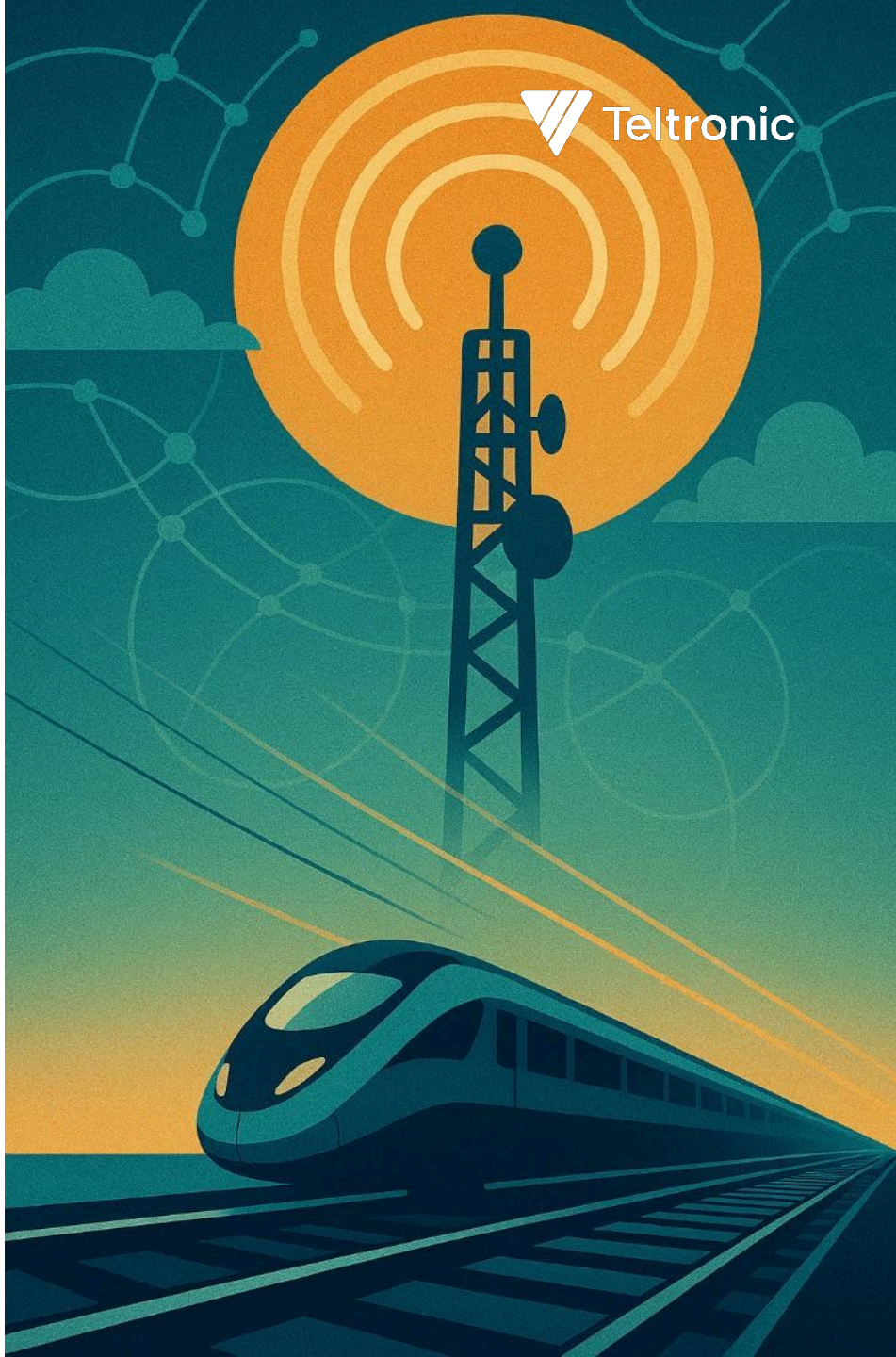
Teltronic's Vision – A Contribution From The Industry's Perspective

Facing the challenges of turning FRMCS into a deployable operational standard, Teltronic— as a mission-critical communications provider—chose to anticipate the final specification release.

We engaged early in a pilot program to **monitor the evolving standard in real conditions**, assess its **performance from every angle**, and **understand the practical implications of its future deployment**.

These insights are being used to **shape and refine the solutions** we will bring to the market in the coming years.

This is the purpose of the MoySEST project.



MoySEST project

Mission Critical Services and Transportation Systems: An initiative selected in UNICO Sectorial 5G – 2022 call, funded by the Spanish Ministry of Economic Affairs and Digital Transformation and the European Union.

Financiado por la Unión Europea
NextGenerationEU

GOBIERNO DE ESPAÑA

Plan de Recuperación, Transformación y Resiliencia

Objective: Design and implement a railway communications system aligned with FRMCS standards, capable of delivering mission-critical services with robust cybersecurity features, leveraging advanced 5G network infrastructure.

Project duration: October 2022 - September 2025. **Total budget:** 7,26M€

Project Focus

MoySEST | Scope of Activity

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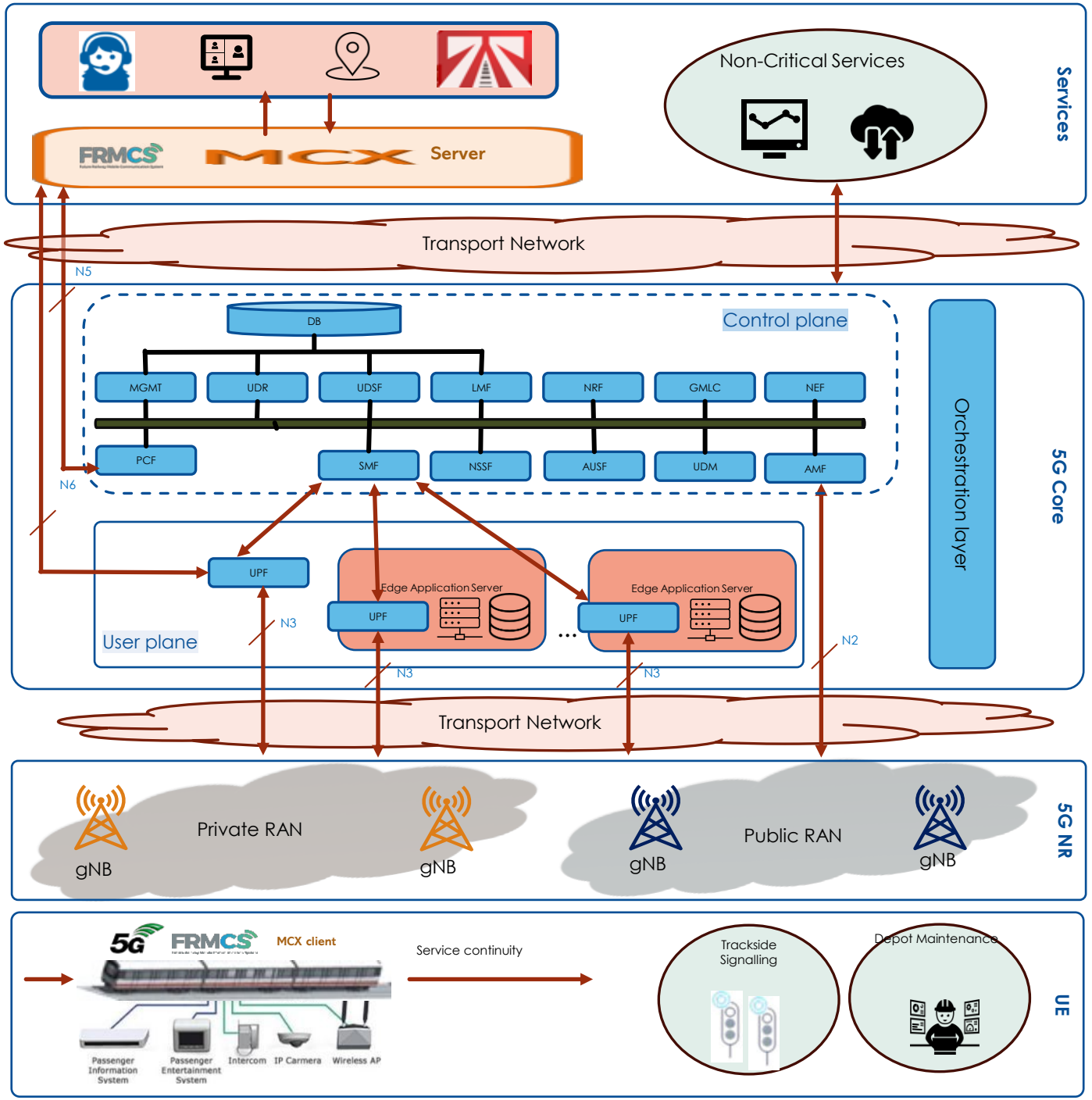
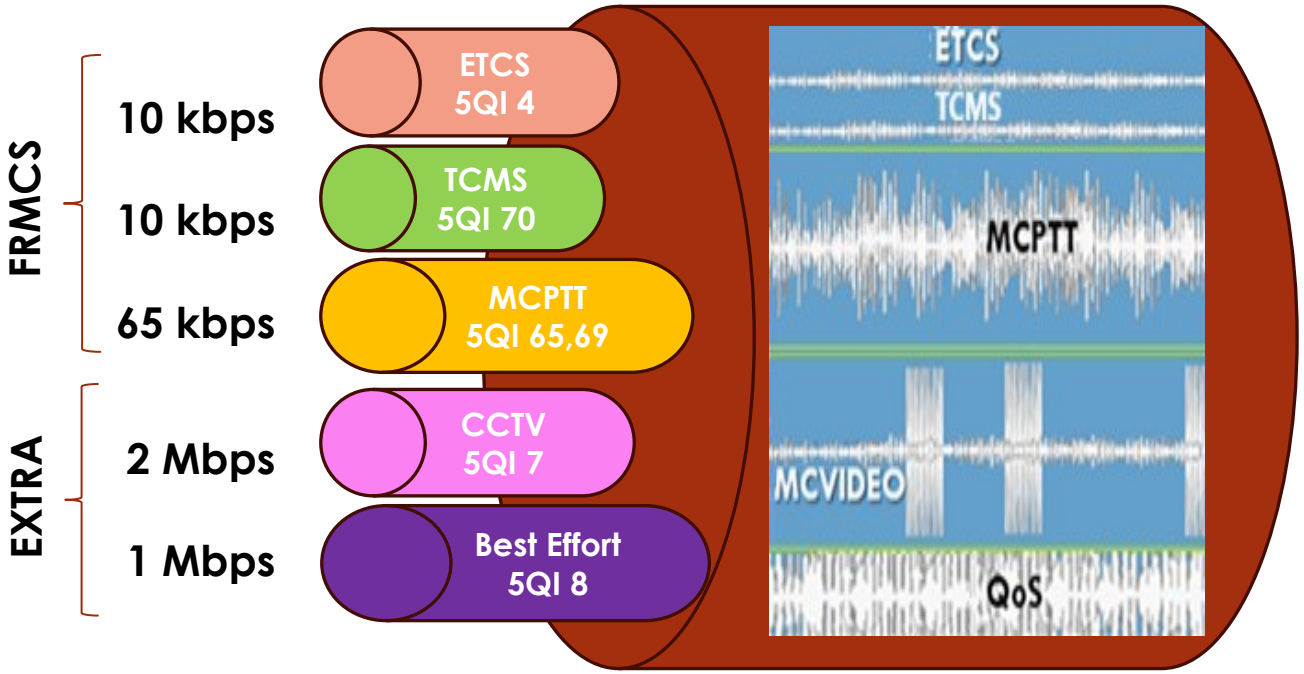
- 5G architecture
- Network optimisation
- Radio planning
- MCX services
- FRMCS requirements
- Interoperability
- Onboard Equipment
- Dispatching
- Cybersecurity
- End-to-end integration

MoySEST | Solution Architecture



Train-to-Ground | Data Traffic (UL)



5QI	Type	Priority	Max Delay Budget	PER	Typical Use / Key Characteristics
4	GBR	5	300 ms	10^{-6}	Streaming; guaranteed bitrate; low packet loss.
7	Non-GBR	7	100 ms	10^{-3}	Interactive video; latency-sensitive.
8	Non-GBR	8	300 ms	10^{-6}	Best-effort data; general traffic.
65	GBR (MC)	5	75 ms	10^{-2}	MCPTT; low latency audio for public safety.
69	GBR (MC)	7	100 ms	10^{-3}	Mission-critical data operations.
70	URLLC	2	10 ms	10^{-5}	Critical control: automation, robotics, rail ATO/CBTC.

FRMCS traffic supported in GSM-R scenarios

Grade of Automation	Applications	Data Rate			
		Uplink (all connections per cell)	Uplink (single connection per cell)	Downlink (all connections per cell)	Downlink (single connection per cell)
GoA1	FRMCS Signalling	20 kbps		20 kbps	
	Voice/Emergency Voice	45 kbps		45 kbps	
	Basic Data	10 kbps		10 kbps	
	ATP Regular Data	10 kbps		10 kbps	
	ATP Compl. Data		10 kbps		10 kbps
	Summary	**85 kbps**	**10 kbps**	**75 kbps**	**10 kbps**

Cybersecurity Framework

ENS 5G Security Requirements

Defines minimum security and operational resilience requirements for 5G public networks in Spain, aligned with European guidelines, including risk management, strong data protection, continuous monitoring and audited controls.

NESAS Evaluation Framework

Provides a globally standardized and audited security framework for assessing vendors' development and lifecycle processes, enabling trusted, comparable and risk-controlled decisions for deploying secure 4G/5G network infrastructure. Supported by 3GPP.

SCAS Technical Specifications

SCAS complements NESAS by defining standardized 3GPP security test specifications for validating the robustness of specific 4G/5G network functions,

ENISA Toolbox Automation

ENISA Toolbox automates audits, risk analysis, and reporting aligned with ENS5G and integrates SCAS test results.

Cybersecurity Framework

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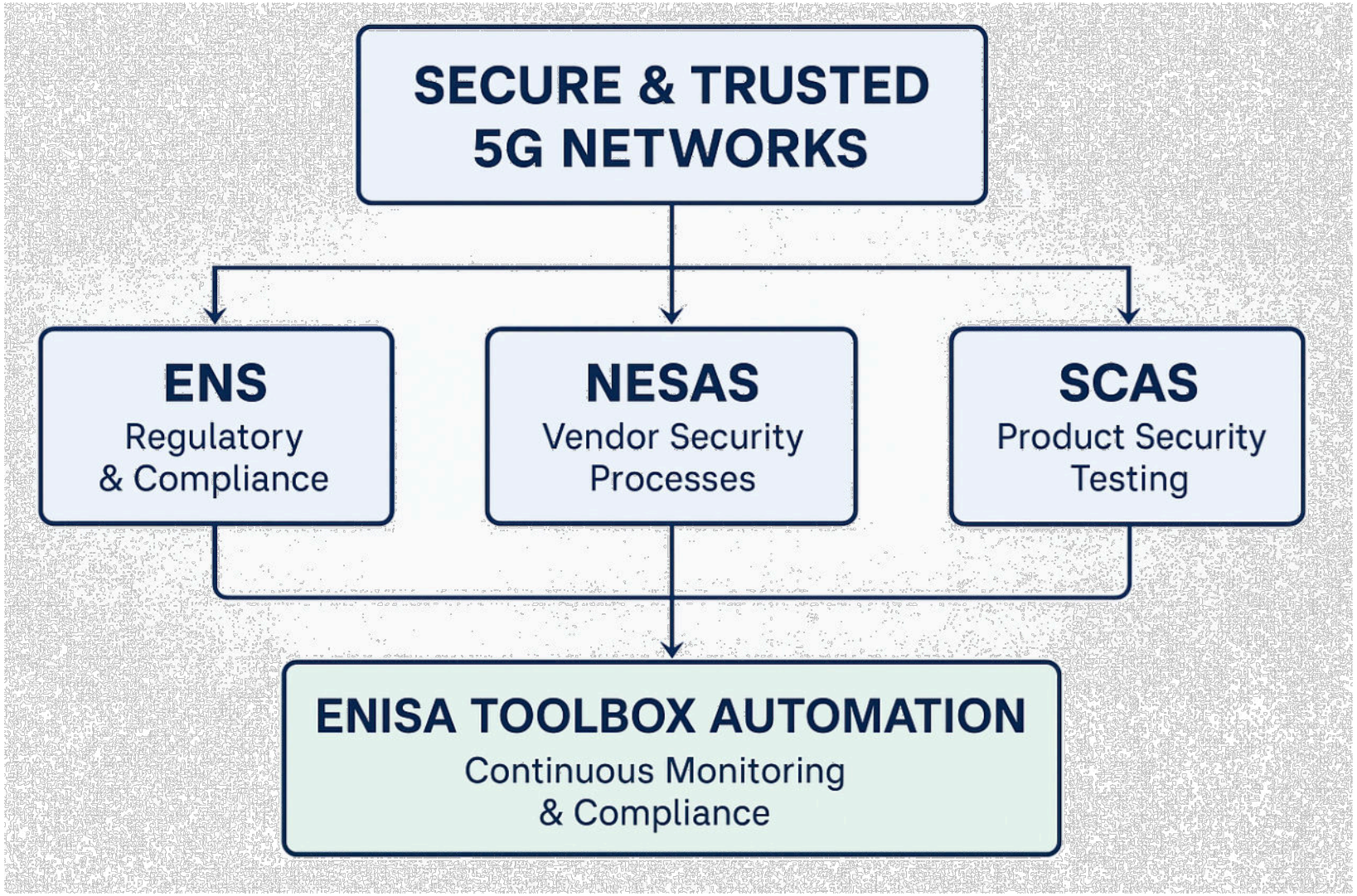

Test & Validation

Functional Validation |

Teltronic's FRMCS Lab – Zaragoza, Spain - H1 2025

Scope of Validation

- MCX services: voice, data, video.
- MCX interoperability.
- On-board, handheld and dispatch communications.
- End-to-end functional integration.
- 5G network optimised configuration and performance.
- Private / public network architecture considerations.
- FRMCS functional and performance requirements. 5QIs and QoS.
- Cybersecurity measures: pen tests and system audits.

Durango Field Tests | Urban/Metro Deployment

Durango, Basque Country - June 2025

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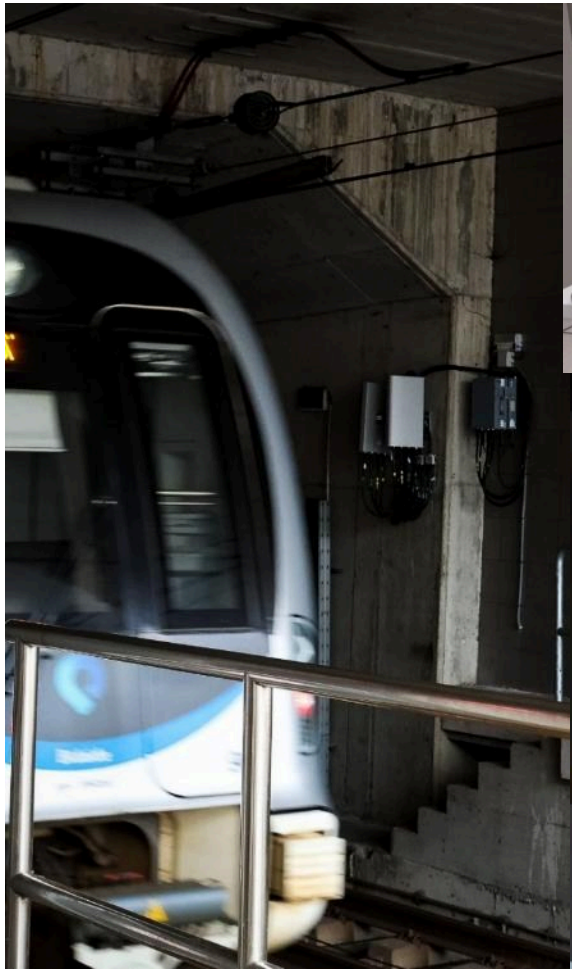
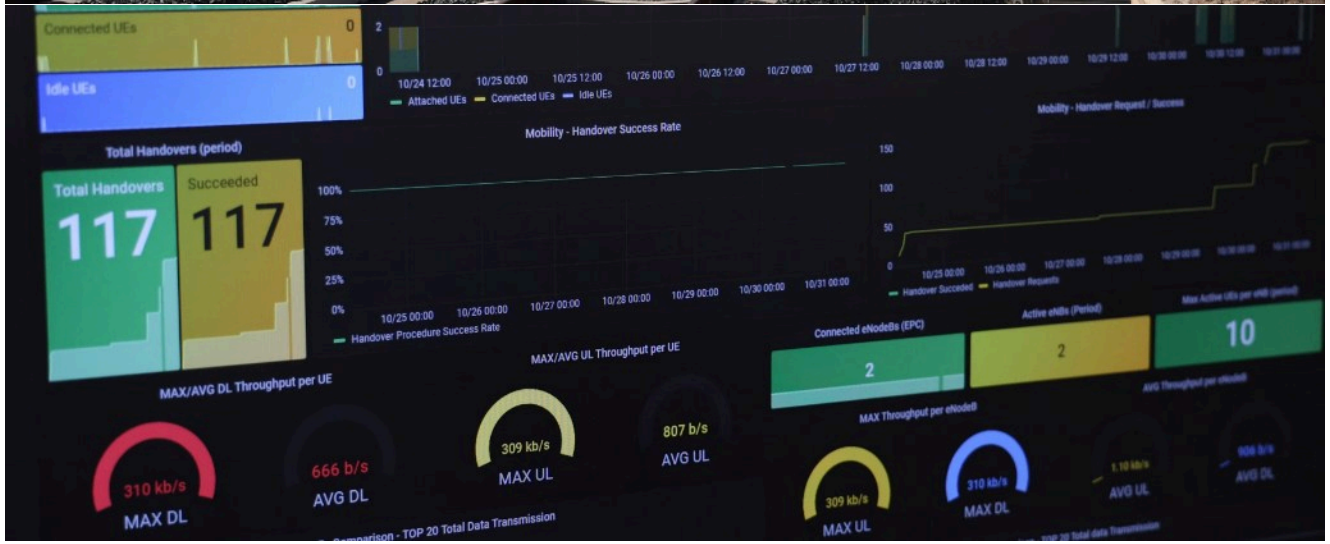


Test Focus

- MCX/FRMCS services: voice, data and video subsets.
- Radio coverage planning: guaranteeing uninterrupted radio connectivity and required QoS levels during tunnel entrances and exits.
- 5G network performance optimization.
- Cybersecurity threats.

Albacete Field Tests | High-speed Line Deployment

Albacete, Madrid-Levante high speed rail network – Sept/Oct 2025



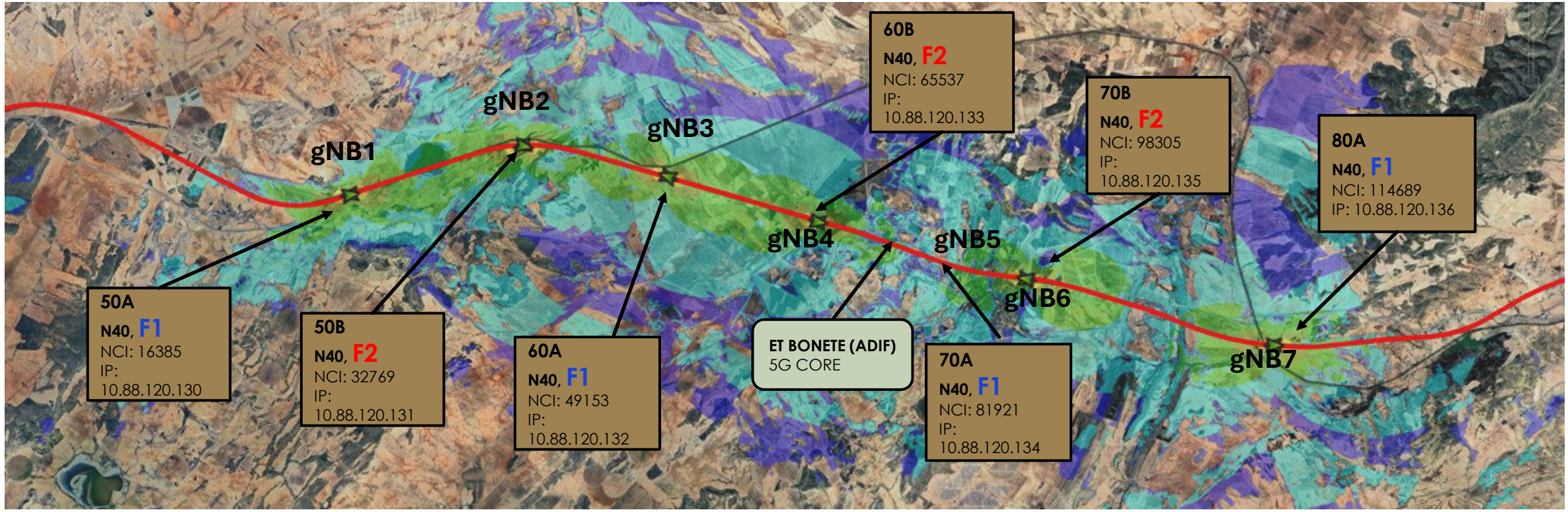
Test Focus

- MCX/FRMCS services: voice, data and video subsets.
- Radio coverage planning:
  - Required QoS levels at high-speed train operation (multiple handovers, Doppler effect).
  - Assessment of different radio deployment strategies.
- 5G network performance optimization.
- Preliminary migration tests.
- Preliminary testing with commercial trains (sept 2025).
- Final testing wave with ADIF's lab train (oct 2025).

Albacete Field Tests | High-speed Line Deployment

Radio planning aspects

Band n40, MIMO 4x4, F1 2362,5MHz / F2 2382,5MHz



37.4 km

TRAIN LINE Madrid-Alicante : SECTION Albacete - Almansa

Albacete Field Tests | High-speed Line Deployment

Trackside Equipment

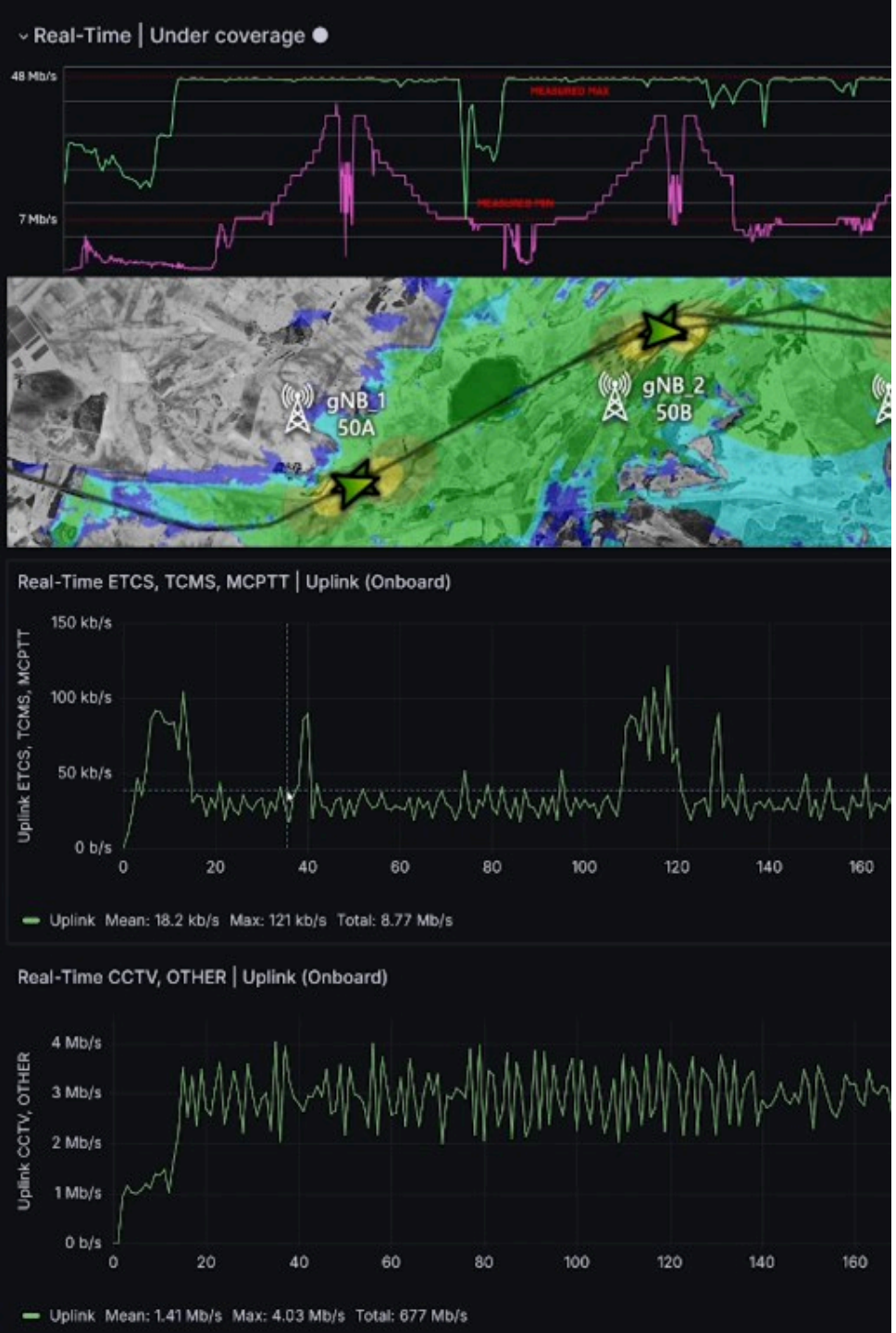
- 5G RAN
- 5G core
- MCX server
- Dispatcher (server + client)
- MCX handhelds

Albacete Field Tests | High-speed Line Deployment

ADIF's Laboratory Train

- On-board equipment (MCX client + 5G router)
- MCX handhelds
- FRCMS signalling generator
- CCTV cameras

Conclusions



Takeaways

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→ It works great! And the field test results even exceeded our initial expectations.

- 5G and MCX already deliver the performance required by current FRMCS specifications, providing a strong foundation for upcoming functional evolution.

- The solution architecture scales beyond GSM-R replacement, supporting deployments from metro and urban rail to long-distance and high-speed environments.

- Real multi-vendor implementations will demand stronger industry alignment and tighter operator-regulator focus on interoperability.

- Private network architectures offer scalable, use-case-adaptable solutions, while deploying FRMCS mission-critical capabilities over public networks may require investments misaligned with their original business cases.

- Beyond interoperability, FRMCS' real challenge lies in efficiently integrating all subsystems within the deployed solution.

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OUR COMMITMENT

- **Support** the development of **global standards** focused on **fit-for-purpose** and **interoperability**.
- **Foster collaboration** across the **technology and industrial transportation ecosystem**.
- **Create differential value** through deep **expertise** in high-availability and mission-critical grade solutions.
- **Empower early adopters** through innovation and a **strong customer-centric approach**.

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WE CAN MAKE IT HAPPEN

Many thanks for your attention!