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FRMCS-Transition starts laying the tracks toward a sustainable and intelligent future

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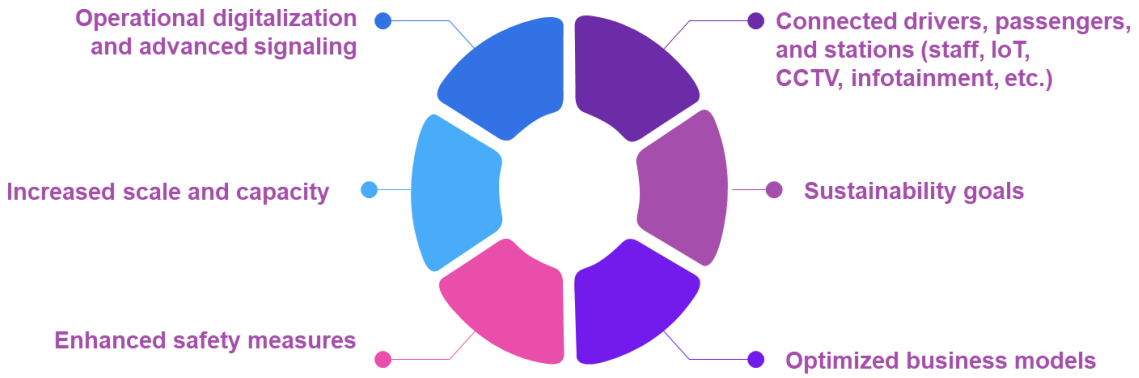
Omdia view

Railways are at the forefront of governments' focus. They aim to create a sustainable, safe, and modern transport industry. The perfect example of this global trend is the European Union's ambitious plan to double passenger transport by 2030 and freight transport by 2050, highlighted in its official "European Year of Rail" program strategy in 2021. Similar initiatives are unfolding across the globe, including in China, Australia, India, North Africa, and Latin America, highlighting the universal recognition of railways as a cornerstone of future transportation systems.

Full steam ahead: Railway communications are undergoing a digitalization evolution

The railway industry is undergoing a profound technological transformation, driven by several key factors. This transformation is laying the wireless foundation for the intelligent railway systems of tomorrow, promising a complete paradigm shift in how railway networks are conceived and operated.

Figure 1: Signals for change – technology transformation of railways



Source: Omdia

The motivation behind this technological shift is multifaceted:

- Improved capabilities: Increasing supported speeds, shortening train intervals
- Enhanced efficiency: Boosting the reliability of operations and maintenance procedures and ultimately supporting fully automatic train operations (ATO)
- Passenger-centric approach: Guaranteeing safety and comfort for all railway users
- Cost optimization: Streamlining expenses while improving service quality

Approaching the end of the line: GSM-R systems obsolescence

Achieving these ambitious goals is only possible with reliable rail traffic management systems and effective train control systems (TCS). Currently, most railways worldwide are supported by the European TCS (ETCS), which relies on GSM-R. GSM-R is based on 2G GSM circuit-switching technology to enable voice communications and limited data transmissions for specific rail use cases. However, as the demands of evolving railway operations increase, it has become apparent that more advanced communication technology is required.

GSM-R is rapidly approaching the end of its lifecycle. It is no longer capable of supporting the long-term objectives of railway operators. The railway industry has already acknowledged GSM-R's obsolescence. Omdia predicts GSM-R will enter its maintenance stage after 2025 and reach its end-of-life shortly after 2030. This impending technology sunset is the main catalyst driving the development, standardization, and rollout of more advanced technology capable of replacing GSM-R and addressing future railway network demands.

Next stop: The Future Railway Mobile Communication System

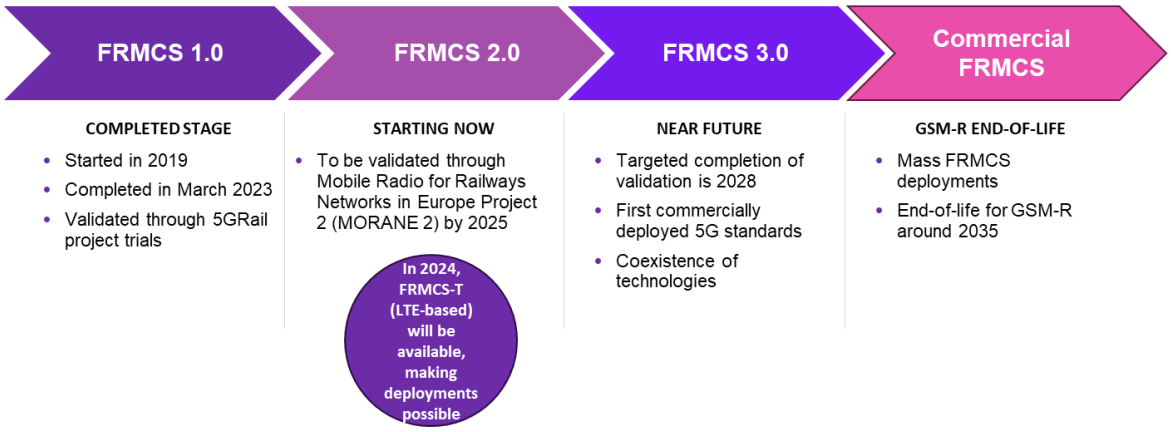
The International Union of Railways (UIC) initiated the Future Railway Mobile Communication System (FRMCS) program to address GSM-R's aforementioned limitations. It was initially developed for European railway networks, a market that boasts a well-developed 5G broadband infrastructure and strong railway interconnections between countries. FRMCS was set up to provide railways with a standardized, future-proof communication solution capable of supporting advanced rail operations and services.

FRMCS builds on 3GPP-based 5G standalone and mission-critical (MCX) architectures to support the new ETCS as a replacement for GSM-R. Additionally, FRMCS aims to converge railway operators' different wireless communication needs under a single technology. This includes—among other services—multimedia agile dispatch, video and multimedia services, operating data management, predictive maintenance, and passenger multimedia for enhanced comfort. FRMCS aims to create a comprehensive, integrated communication platform for modern railway networks.

FRMCS's key performance highlights include the decoupling of its network and service, the use of standard IP interfaces for rapid new service deployments, and a modular foundation design for wireless technology to facilitate its evolution path. It also offers multiservice capability and stable RF coverage in high-speed scenarios. These features ensure that FRMCS can adapt to future technological advancements and meet diverse railway communication needs.

The FRMCS timeline shows steady progress. FRMCS V1 specifications were published in late 2023 and tested and validated in high-profile trials. FRMCS V2 specifications are being finalized for publication by 2025. FRMCS V3, the final specification and validation phase, is expected to be completed by 2028. The FRMCS 1st Edition should be ready for European deployments by 2028, marking a significant milestone in railway communication evolution.

Figure 2: FRMCS timeline – a journey to success



Source: Omdia

Railway operators recognize the critical importance of starting their transition programs as soon as possible. Given that GSM-R market support is nearing its end, postponing the inevitable evolution toward FRMCS systems could result in significant downtime and enormous costs for infrastructure overhauls. Omdia strongly advocates that proactive planning and the implementation of a staged transition toward FRMCS are crucial to ensure continuous, efficient railway operations and to avoid potential operational disruptions.

Mind the gap: FRMCS-Transition as the technology bridge

UIC has also considered the needs of railway operators outside the European market in its development of FRMCS. Omdia estimates that current European Rail Traffic Management Systems (ERTMS) investments outside Europe represent more than half of the global ERTMS market worldwide. However, a successful FRMCS rollout relies on ubiquitous and uninterrupted 5G connectivity, which poses major challenges for emerging markets with limited 5G infrastructure or a lack of 5G spectrum availability.

To address challenges in markets without widespread 5G infrastructure, UIC worked on a parallel solution, FRMCS-Transition (FRMCS-T). This solution is designed to facilitate the application of FRMCS principles to 4G networks and can be applied globally. FRMCS-T aims to be functionally similar to FRMCS 5G, respecting mandatory functional requirement specifications while allowing necessary adaptations to work with existing 4G infrastructure.

To facilitate its adoption, FRMCS-T was designed to be applicable to various frequency bands, supporting most of the spectrum defined in 3GPP E-UTRA terrestrial use cases. This flexibility ensures compatibility with the spectrum regulations of different countries. Furthermore, FRMCS-T technical guidelines also recommend support for public communication service providers' (CSPs') frequency bands, simplifying technology adoption in partnership with local CSPs and enhancing the global implementation of FRMCS principles in their railway networks.

On the platform to success: Gradual evolution from GSM-R to FRMCS 5G through FRMCS-T

With these developments, the railway industry has a clear path for gradual evolution from GSM-R to FRMCS 5G through 4G LTE. FRMCS-T allows for a smoother transition, minimizing disruptions while maximizing the benefits of advanced broadband communication technology. It provides a flexible roadmap for railway operators worldwide to modernize their railway communication systems, guarantees a timely evolution, and future-proofs their investments.

Appendix

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Omdia Commissioned Research

This piece of research was commissioned by Huawei.

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