Future Railway Mobile Communication System (FRMCS)

IP Optical Network requirements in building FRMCS for modern railways

Introduction

The Future Railway Mobile Communication System (FRMCS), specified by the International Union of Railways (UIC), is a secure and reliable mobile communication system designed for railway operations and applications. It provides an agreed evolution path for enabling rail transport digitalization and automation while ensuring continued rail safety, efficiency and interoperability.
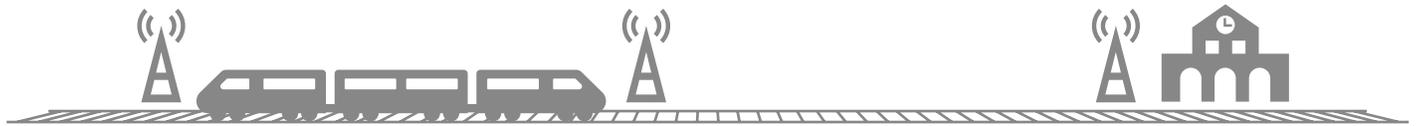
Its predecessor, GSM-R (Global System for Mobile Communications – Railway), was standardized in 2000 by the UIC and has been the cornerstone of railway communication for more than two decades. GSM-R provides a secure, reliable communication platform for voice and data for railways and today covers over 250,000kms of track worldwide. Rail networks are now seeking modernization, with digital transformation enabling increased passenger and freight density, improved operational efficiency, enhanced safety, and support for new services.

What is FRMCS

The next generation rail communications network, FRMCS, must:

- Support the new digital applications and services required for rail modernization
- Ensure cross-border interoperability
- Meet stringent safety regulations

FRMCS is based on 3GPP's 5G standard using mission critical specifications over a frequency spectrum specifically allocated to railways. It requires a 5G Stand Alone architecture with a 5G feature-set supporting Mission Critical Voice, Data and Video, location-based services and roaming.

The evolution to FRMCS will take a phased approach, with FRMCS being introduced to run in parallel with GSM-R. This allows rail operators to implement the FRMCS network in phases, choosing which lines and applications to switch over first, while always maintaining the integrity of their communications network. The goal is to have the network fully transitioned to FRMCS before GSM-R becomes obsolete in 2030.

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FRMCS Architecture

The FRMCS architecture is divided into three strata: Railway Application Stratum, Service Stratum, and Transport Stratum.
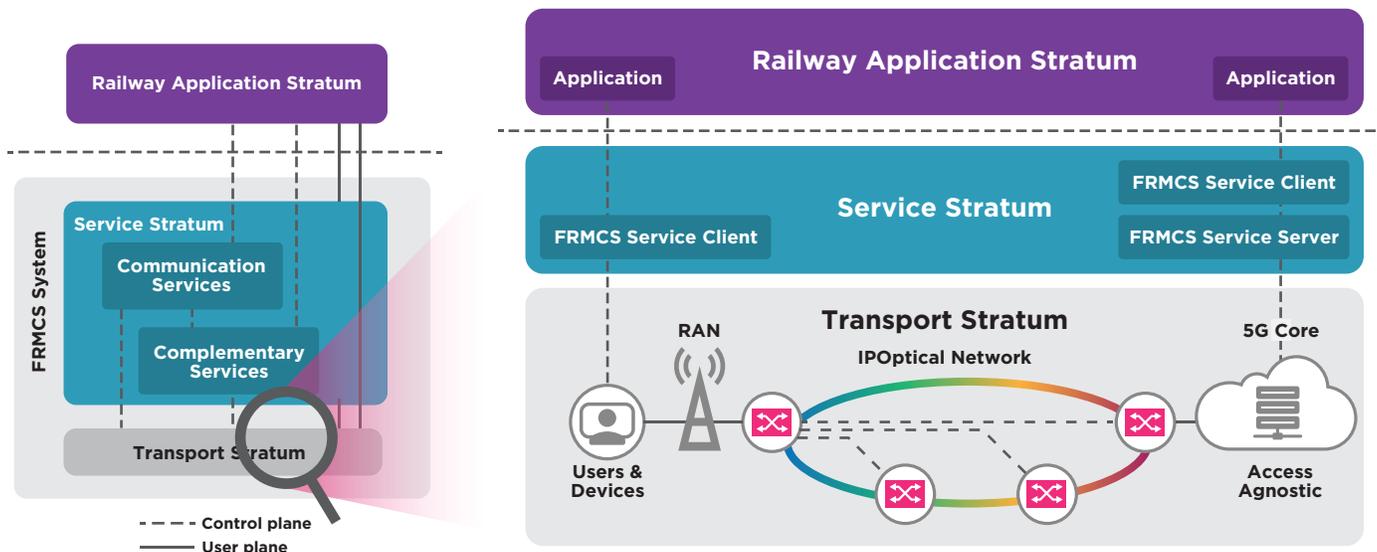
High Level FRMCS Architecture Overview
Source: ETSI TR 103 459 V1.2.1

Railway Application Stratum

The **Railway Application stratum** is not part of the FRMCS system but is what the FRMCS system serves. It encompasses rail applications such as Automatic Train Operations (ATO), the European Train Control System (ETCS), video, voice, and other data applications for railway operations.

Service Stratum

The **Service Stratum** enables connection between authorized users or devices, categorized as Communications Services. It also enables location information services, time synchronization services and other ancillary services, categorized as Complementary Services.

The MCx Server, IMS / SIP Core and FRMCS gateways and clients are some of the components in this stratum. In the diagram, these are simplified as FRMCS client and FRMCS server to illustrate the user plane connection, enabling the connection between applications.

Transport Stratum

The **Transport Stratum** serves as the communication fabric which enables railway operations and applications. It comprises of a full end-to-end 5G network, including end devices and authorized users, the radio access network (RAN), the IP Optical transport network and the 5G core. The IP and Optical network acts as the transport layer between RAN and 5G Core components. The 5G Core is access-agnostic, meaning it can support both wireline and wireless access. Consequently, the IP and Optical network connects 5G components that are not part of the RAN, and which may be distributed throughout the railway network.

Essential IP Optical Network Requirements for FRMCS

The 3 IP and Optical pillars required for a successful FRMCS network are:

5G compliant IP Optical xHaul/Backhaul

- Right-fit form factors IP and Optical for Cell Site Routers, hub sites, aggregation sites and core sites.
- Seamless IP and Optical integration with coherent routing combined with optical line systems (OLS) and optical transport networks (OTN) as required.
- The network must support services delivered by multiple access networks, transporting them to meet their service performance needs.
- Network Slicing with both hard and soft slicing options to segregate services to meet service performance requirements as necessary, support IT/OT convergence on a segregated network, and provide the multitenancy required for evolution to UTelco.
- Advanced synchronization and GNSS receivers are also essential to meet 5G timing and synchronization requirements
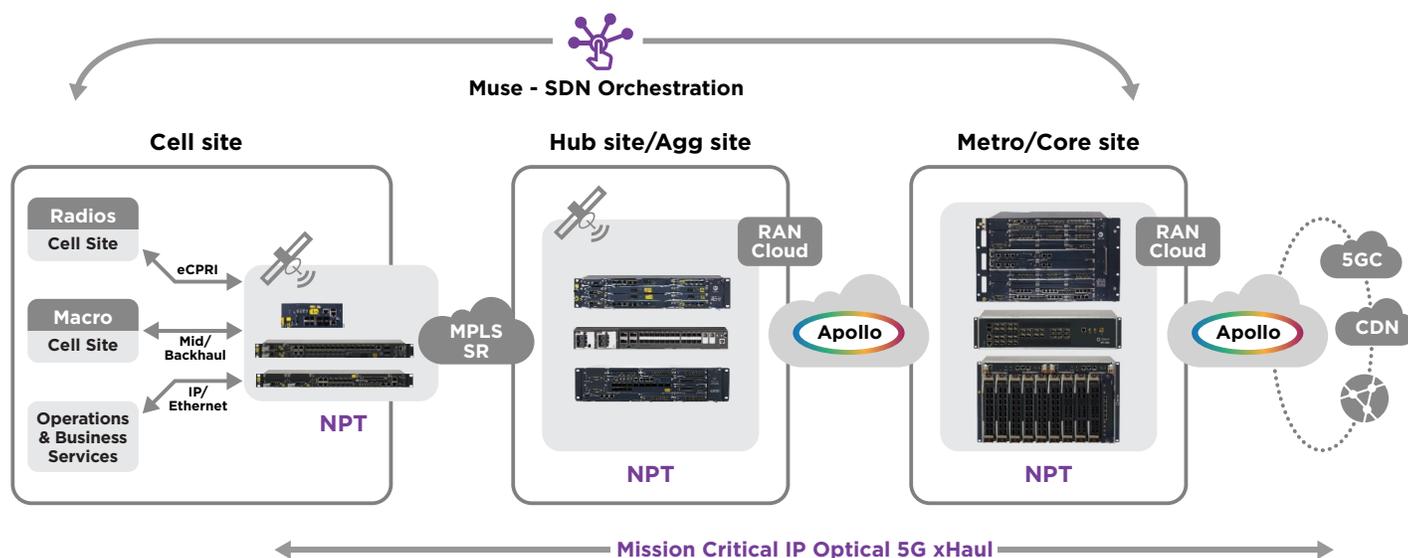
Mission Critical IP Optical Transport

- Provide high-availability hardware form factors with hardware redundancy options
- Support high-availability IP and Optical topologies and protection schemes ranging from 1+1 line protection at the optical layer through to dual/multi-homed networking at the packet layer
- Highly Secured Network with capabilities such as optical encryption and MACsec

End-to-end Multi-Layer IP and Optical Automation

- Full-Service Life Cycle Support (Design, Supply, Deployment, Installation, Configuration, Test and Commissioning)
- Zero-Touch Provisioning (ZTP) and automation capabilities
- Analytics and Reporting with reports such as Power Consumption, Temperature, Network Inventory
- Multitenancy administration for network slices

Ribbon's IP Optical Solutions for FRMCS

Ribbon Communications are experts in both critical infrastructure and 5G mobile networks providing the three pillars required for a successful FRMCS implementation.

Ribbon Has Proven 5G Xhaul Deployments – with multiple form factors, advanced synchronization, multiple architectures and network slicing.

Ribbon Is a Leader IP Optical Transport In Critical Infrastructures – our multi-stack MPLS supports deterministic packet transport using SR-MPLS, IP/MPLS, MPLS-TP as appropriate and provides right-fit form factors for high availability with hardware redundancy options and support for topology redundancy at both IP and Optical layers

Ribbon's MUSE SDN Application Suite – provides automated multilayer IP and Optical lifecycle management

Conclusion

The Future Railway Mobile Communication System (FRMCS) is set to revolutionize the railway industry.

By leveraging 5G technology, FRMCS will support increased passenger and freight density, improve operational efficiency, enhance safety, and offer new services. However, the success of FRMCS depends on its ability to meet the mission-critical needs of the rail industry and this requires a robust IP Optical transport network.

Ribbon Communications combines its extensive 5G xHaul technology, market-leading mission-critical IP Optical solutions, advanced IP Optical automation tools and expertise in modernizing radio and mission-critical networks to provide rail operators with a solution they can trust.

With Ribbon, rail operators can be confident they have all the IP Optical solution components and expertise they require for a successful evolution from GSM-R to FRMCS.

Contact Us   Contact us to learn more about Ribbon solutions.

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About Ribbon

Ribbon Communications (Nasdaq: RBBN) delivers communications software, IP and optical networking solutions to service providers, enterprises and critical infrastructure sectors globally. We engage deeply with our customers, helping them modernize their networks for improved competitive positioning and business outcomes in today's smart, always-on and data-hungry world. Our innovative, end-to-end solutions portfolio delivers unparalleled scale, performance, and agility, including core to edge software-centric solutions, cloud-native offers, leading-edge security and analytics tools, along with IP and optical networking solutions for 5G. We maintain a keen focus on our commitments to Environmental, Social and Governance (ESG) matters, offering an annual Sustainability Report to our stakeholders. To learn more about Ribbon visit **rbbn.com**.