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Is Your Network Ready for the Future Railway Mobile Communication System?

Operators must act now if they wish to ensure their transmission communications network is ready for FRMCS, writes **Nokia**'s Network Infrastructure Transportation Market Leader, Benoît Leridon.

The Future Railway Mobile Communication System (FRMCS) is the upcoming wireless communications infrastructure for digital rail. Led by the European Union Agency for Railways (ERA) and the International Union of Railways (UIC), it's been designed to improve operations through the deployment of digital capabilities. The aim is to use the technology to enhance safety, increase operational efficiency and improve the overall journey experience.

The move to FRMCS from the Global System for Mobile Communications – Railway (GSM-R) is being

championed by rail operators as a way to drive the modernisation of the mobile technologies deployed across rail infrastructure, leveraging 5G radio technology.

However, these goals will require extensions to existing communication networks. For example, the FRMCS uses 5G Core, which means data centre architecture will need to be updated as it's a cloud native technology.

While all operators will eventually have to migrate to FRMCS, some are more prepared than others. For instance, deploying a dedicated 5G transport network is not immediately feasible for all players, so many are instead looking to modify their current transmission network to support 5G backhaul.

A large number have already migrated their backbone network from Synchronous Digital Hierarchy (SDH) to Internet Protocol (IP)/ Multiprotocol Label Switching (MPLS) to enable new rail applications. But while this is a necessary step on the journey, this alone is not enough as FRMCS demands specific network features, such as deterministic latency and resilience.

What Do You Need to Do?

So, what do you need to do to **ensure your backbone communications network is ready for FRMCS**?

There are two main gaps; the first being synchronisation. The network needs to transport synchronisation to the base stations, and this may require new router hardware and/or software.

The second revolves around a network's cell sites, which may require a slight redesign. Depending on your existing infrastructure and the foreseen 5G spectrum, the number of cell sites may need to be increased, some topologies may need to be optimised to reduce latency, and finally the number of nodes in a ring may need to be reduced.

But synchronisation and topology aren't the only considerations. There are broader architectural and operational upgrades that rail operators must consider to truly be FRMCS-ready.

Building a FRMCS-Ready Network

For operators already using IP/MPLS, there's some good news: the extra steps needed to prepare are relatively minor. But if you're still relying on SDH, older MPLS setups or legacy infrastructure, you'll be facing a much bigger leap.

The first step is fully moving to IP/MPLS. This is the only solid foundation for FRMCS, so ensure your routers can support synchronisation protocols such as Precision Time Protocol (PTP) and Synchronous Ethernet (SyncE). Of course, the network will not be dedicated to transport FRMCS, but will be shared with all other critical and eventually less critical applications, becoming a true multi-service network.

Once that's in place, the next step is called segment routing. This modern take on MPLS reduces your dependency on outdated signalling protocols, making it much easier to scale across thousands of nodes and enabling centralised traffic engineering.

Next, it's time to deploy Ethernet VPNs (eVPNs), which will standardise service orchestration and improve reliability. These support both Layer 2 and Layer 3 services and offer active-active redundancy, which is especially useful for latency-sensitive railway applications like signalling and voice services.

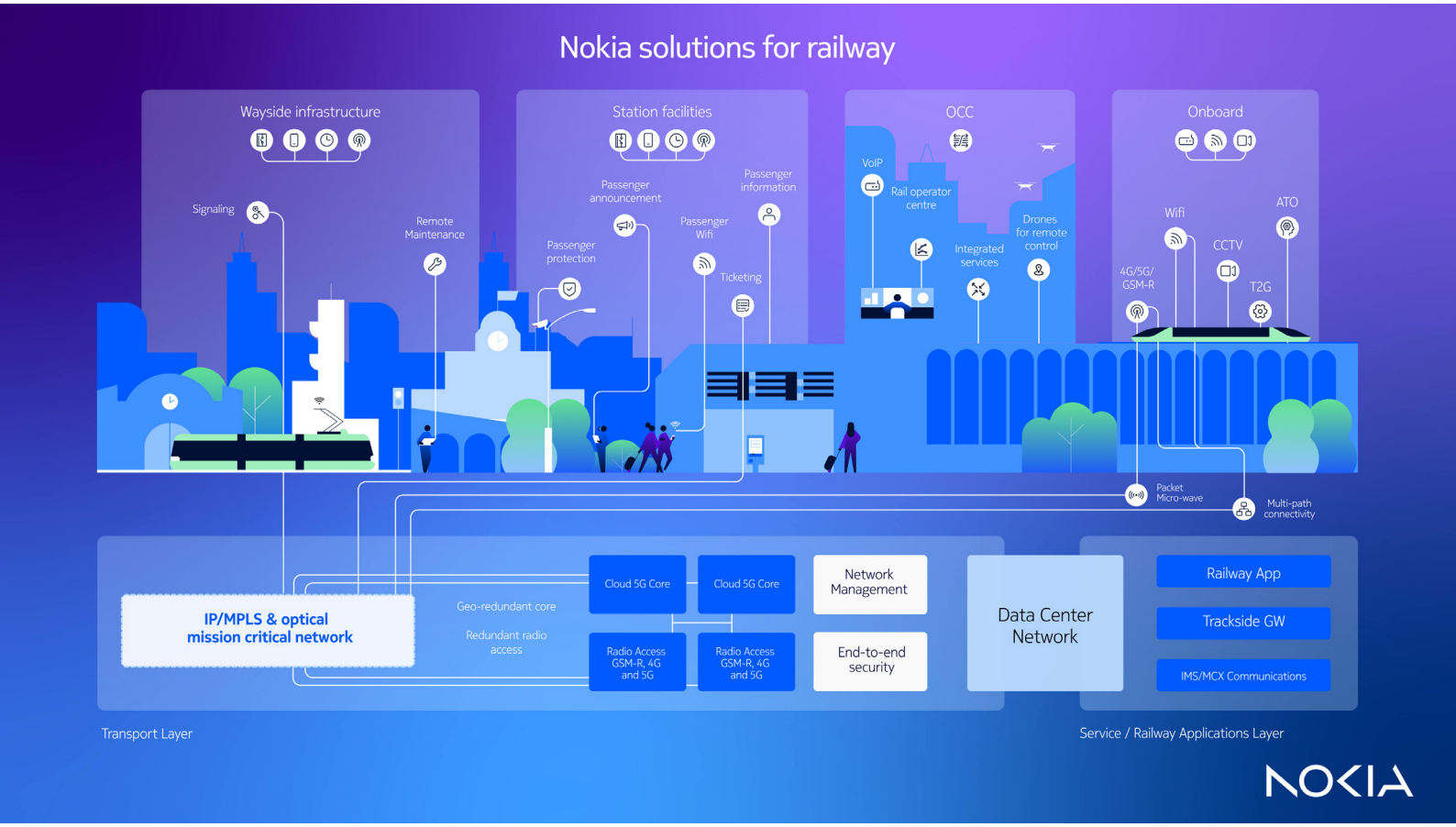
Get Ready for Cloudification

Operators also need to prepare for cloudification, the process of converting applications, data and compute resources to take advantage of cloud platforms. The FRMCS 5G core is built to be cloud-native, so you'll need on-premises **data centres** that can run virtualised, container-based network functions. These need to be designed with redundancy, orchestration and scalability in mind, as they'll be hosting your most critical applications. The tight connection to the multi service MPLS network will have to be enhanced to facilitate and secure end-to-end service from sensor to application.

There are still some open questions around just how much compute sharing will be practical – running CCTV and safety-critical systems side by side for instance, but the direction of travel is clear: rail networks are moving toward shared, cloud-based in-house infrastructure.

Don't Forget Security

Security also needs to be front and centre when



making this transition. A zero-trust model, where all access is treated as untrusted until verified, is increasingly seen as essential. But this can't be effectively implemented without a complete inventory of applications, their interdependencies and access requirements. Therefore, it's imperative that you ensure everything is catalogued, because that's the biggest hurdle to building an effective segmentation (also called zoning) strategy.

Supporting the Transformation

At Nokia, we play a critical role in supporting rail operators through these types of transformations, going beyond equipment vendor to become a strategic partner.

We continue to invest in products purpose-built for mission-critical environments, but what sets us apart is our experience and knowledge of the rail ecosystem. We've worked with rail customers for decades, developing migration plans, helping design architectures and providing coordination support.

Crucially, we also remain one of the only vendors still supporting legacy application transport over IP/MPLS routers, which enables operators to modernise their network without overhauling every legacy system at once.

FRMCS may not start being rolled out until 2028, with the decommissioning of GSM-R beginning in 2032, but the work to prepare must begin now. This is because building or modernising a large-scale communications backbone takes time, especially when dealing with legacy systems. But we're here to help, so if you want a partner on your journey to create a safer, more intelligent and more responsive network for the next era of rail, visit the **Nokia Railways webpage**.

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