

**NOKIA**

# Nagyvállalati adatátviteli hálózatok megoldásai a következő évtizedben

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Network Infrastructure

IP Pre Sales

# The world's most trusted supplier of the most critical networks



Communications  
services providers



Cloud providers



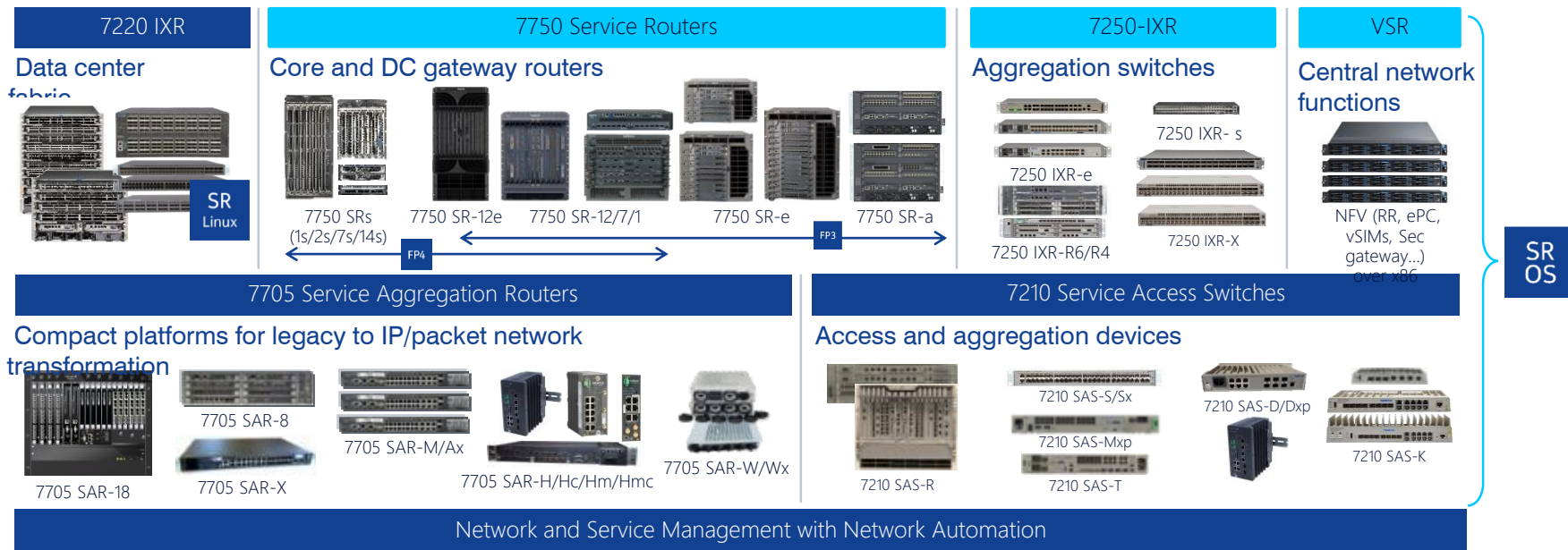
Digital industry



Government



# Service routing portfolio



## Network Services Platform

- Network Operations: Network infrastructure management - Service activation and configuration - Service assurance
- Resource Control: Path control and optimization- Simulation - Multilayer control coordination
- Network Programming: Intent-based networking framework - Workflow automation engine - Pluggable network adaptation toolkit

# How must networks adapt to upcoming technologies ?

Higher  
Bandwidth

More and  
more local  
compute

More  
flexibility

Higher  
Control

Higher Safety and Cybersecurity requirements

# Network trends by segment

Improved communication – efficiency and productivity gains



## Power Utilities

Still a lot of TDM migration projects to remove SDH networks  
Substation Automation projects



## Railways

Still a lot of TDM migration projects to remove SDH networks. All customers haven't conducted a strategic project  
pLTE and FRMCS require adaptation of networks



## Smart Cities

Leverage Deployment of fiber networks for open access, but also internal needs (video protection, IOT, ...)



## Defense

Refresh of existing networks to higher speeds, with still some TDM transformation underway



## Research / Education

Building 400G networks, Moving very large data files at 100Gb/s  
Large DC creation



## Government

Replace dependency on carrier services to lower costs  
Large DC creation

# A specific focus on mission critical and enterprise IP/MPLS

Ruggedized LAN switch

Data center fabric

pLTE core

VNF (Packet Core, vRR, SecGW)

LAN

Mobile router

Cyber security

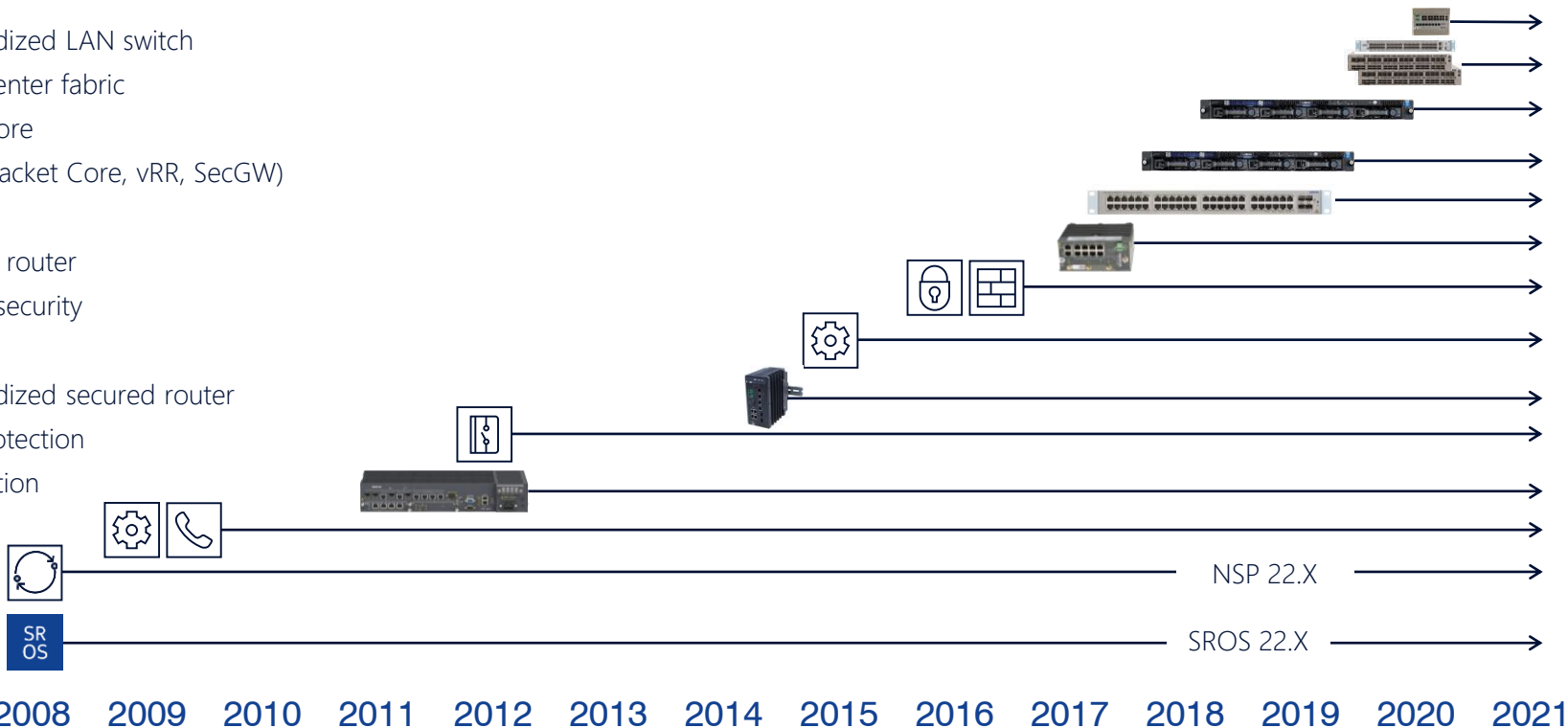
SCAD

Ruggedized secured router

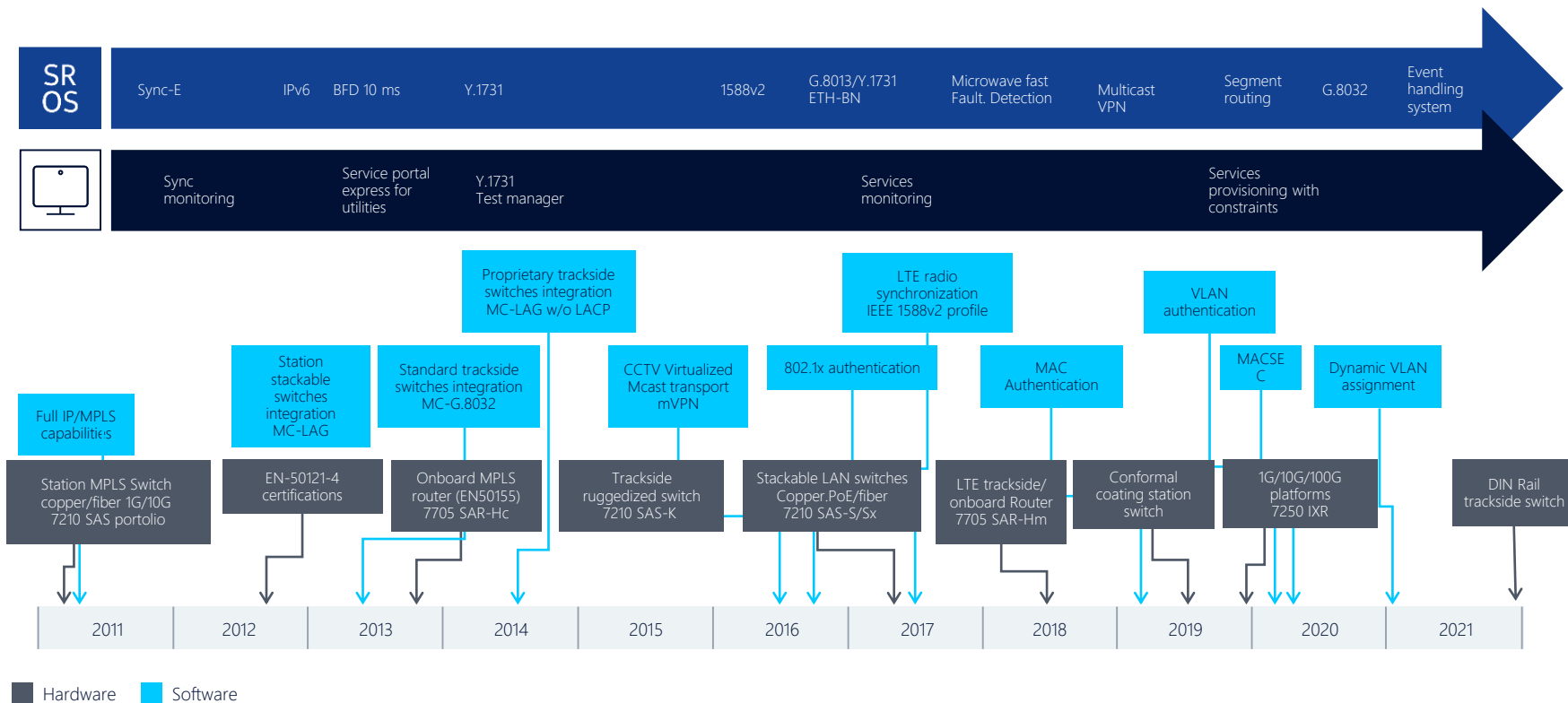
Teleprotection

Substation

Legacy



# Continuous investment and innovation for urban railways



# Nokia IP solutions for transportation

## Mainline railways

- Migrating SDH networks to robust flexible IP/MPLS without changing applications

## Nokia's values

- Natively integrating any application including TDM over IP/MPLS
- Scalable and robust Architecture and products
- Fully sync portfolio for GSM-R and FRCMS

## Solutions

- 7705 SAR-8 TDM to IP
- 7750 SR in core
- 7210 SAS for trackside applications

## Urban rail projects

- Multi-service backbone for all applications (CBTC, PA/PI, CCTV, ...)

## Nokia's values

- Scalable architecture leveraging IP/MPLS for secured transport of applications
- High availability network compatible with short maintenance windows

## Solutions

- 7210 SAS as station router and trackside switch
- 7750 SR or 7250 IXR for core and aggregation

## Air traffic control

- Multi-service backbone for G2G and A2G applications

## Nokia's values

- High control on network behavior leveraging programable network processor
- High stability and flexibility SR OS

## Solutions

- 7705 SAR-8 or 7750 SR as transport routers

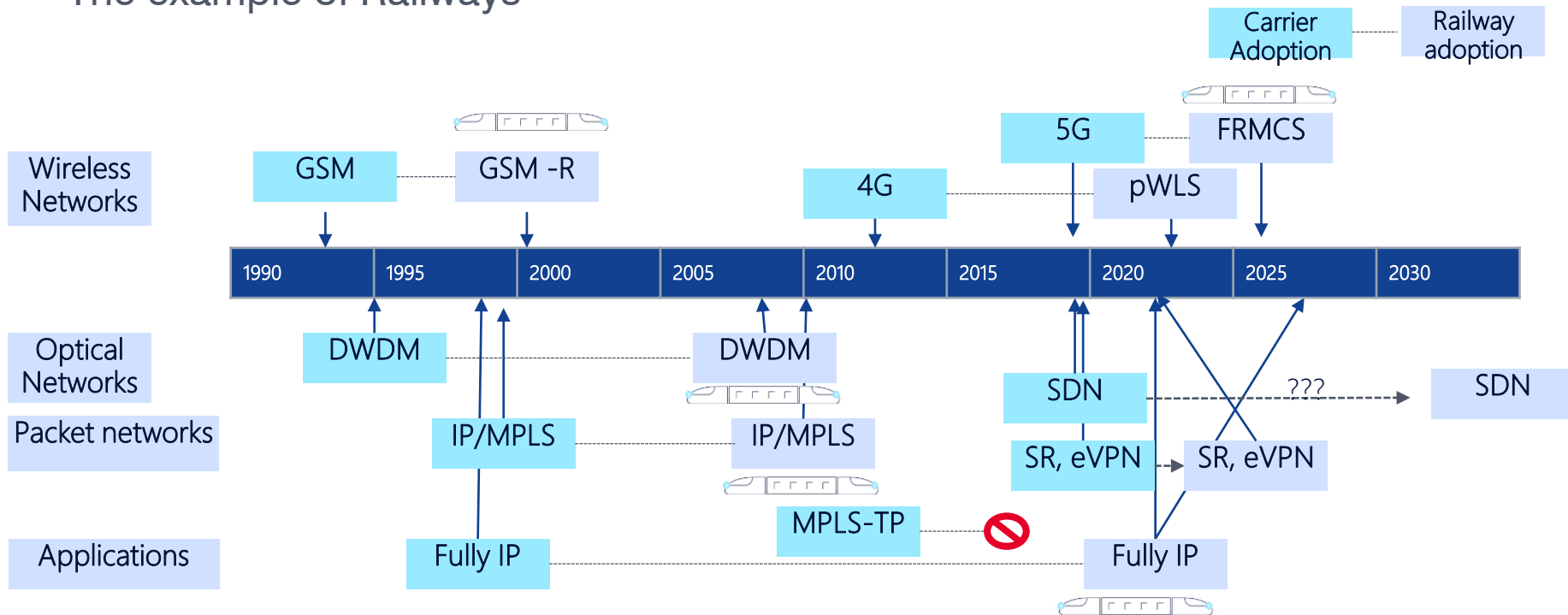
## Other transport markets

- Highways roadside networks
- Port infrastructure network and mobile router



# Telecoms technology adoption in critical networks

## The example of Railways



# IP vision 2022-24

A woman with dark hair is wearing a black VR headset and a grey V-neck shirt. She is holding a white VR controller in her right hand. The background is a dark, rainy surface with vertical streaks of light, resembling a digital rain effect.

# Critical objectives in Nokia IP networks for 2022-24



Performance without penalty



Coherent routing



Security by design



Green focus



Automation and Infrastructure as Code



Digitalization of key industries (Industry 4.0)



Software architectural initiatives

# Data Center evolution

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# Providing an agile data center infrastructure

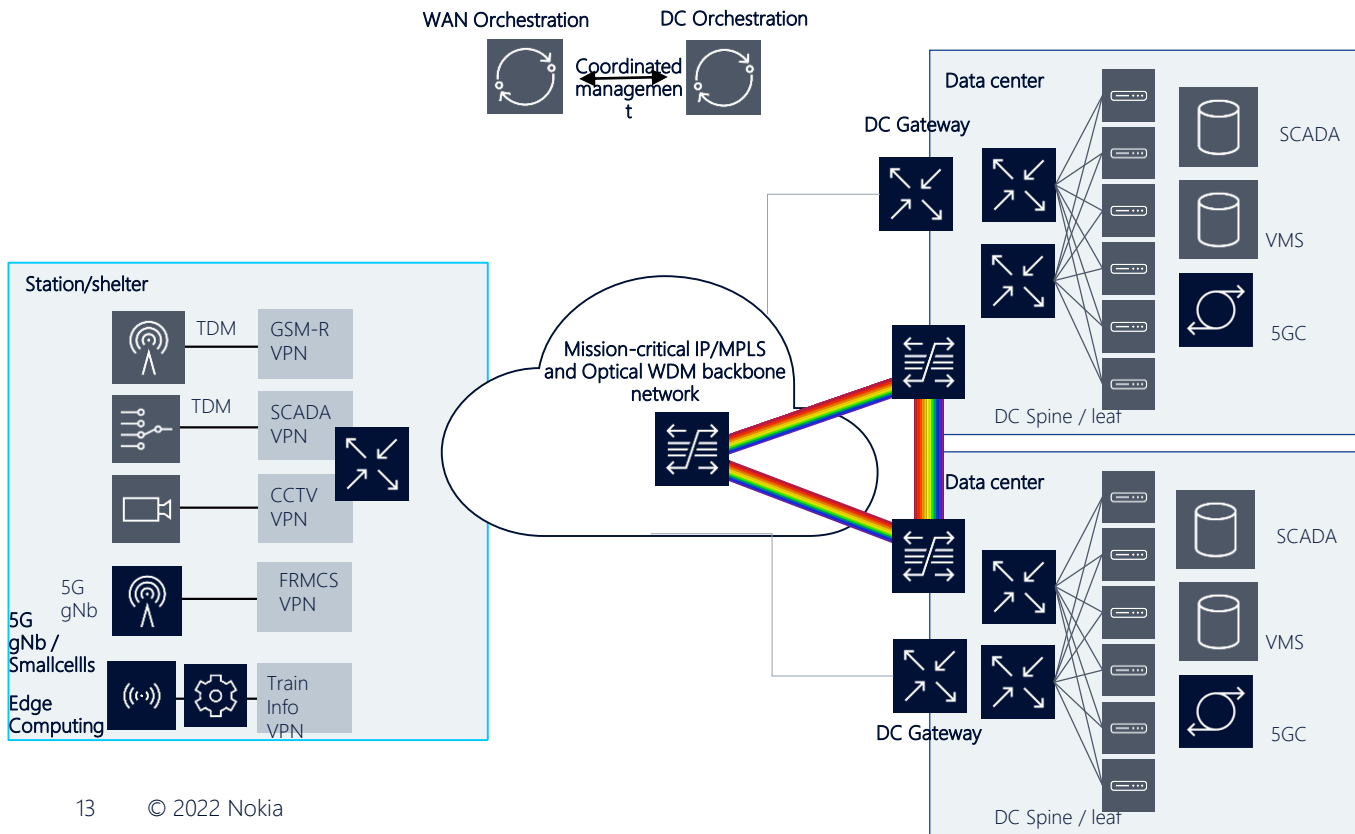
## From static to programmable Private Data Centers

### Highlights

- Build a solid Data Center foundation to prepare for DevOps model
- Bring flexibility to the infrastructure in order to leverage virtualization environment
- Joined orchestration to build end to end services stitched by DC Gateway

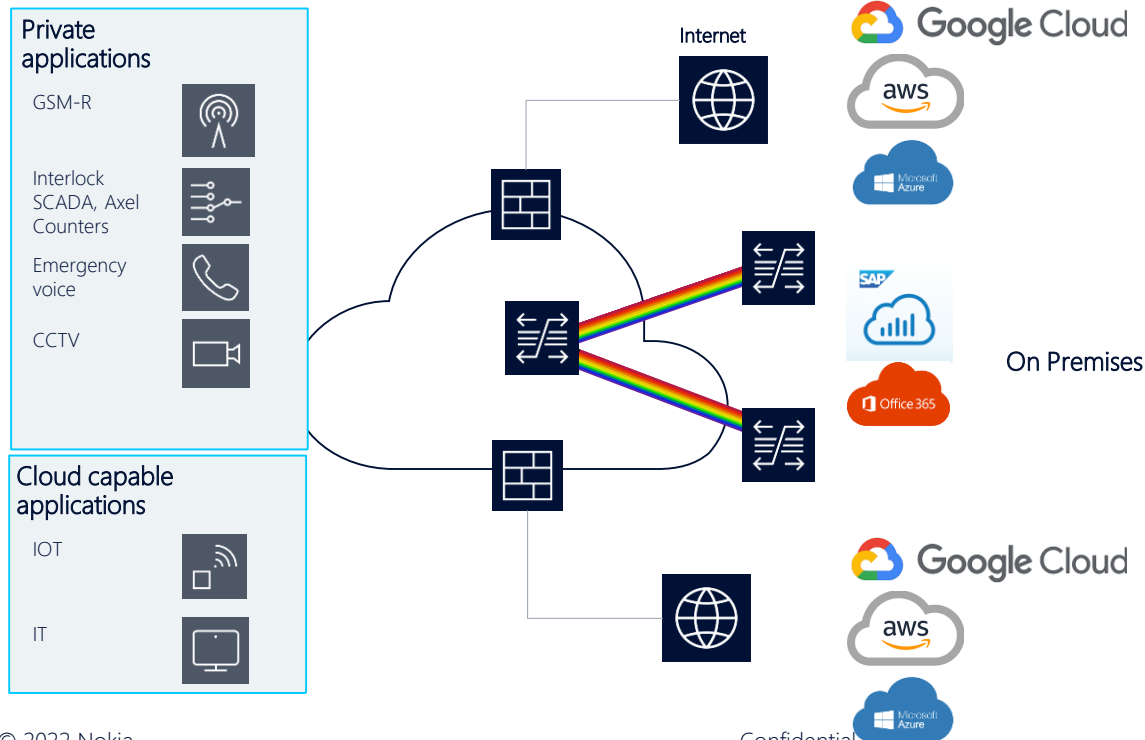
### Benefits

- Scalable reliable redundant DC architecture to cope with critical application and growth
- Programmable fabric to adopt a NETOps model
- Sandbox model for safer simpler operations



# Leveraging public clouds

## Secured connection to public clouds



### Highlights

- IT applications already available from the Cloud
- Some OT applications leverage some Cloud services
- Centralized access to avoid local breakout
- Connection over Internet can be secured using IPSEC or application encryption (SSL).

### Benefits

- Allows secured control and separation of cloud access on a per VPN basis.
- Leverages best in class application without compromise on security and network performance

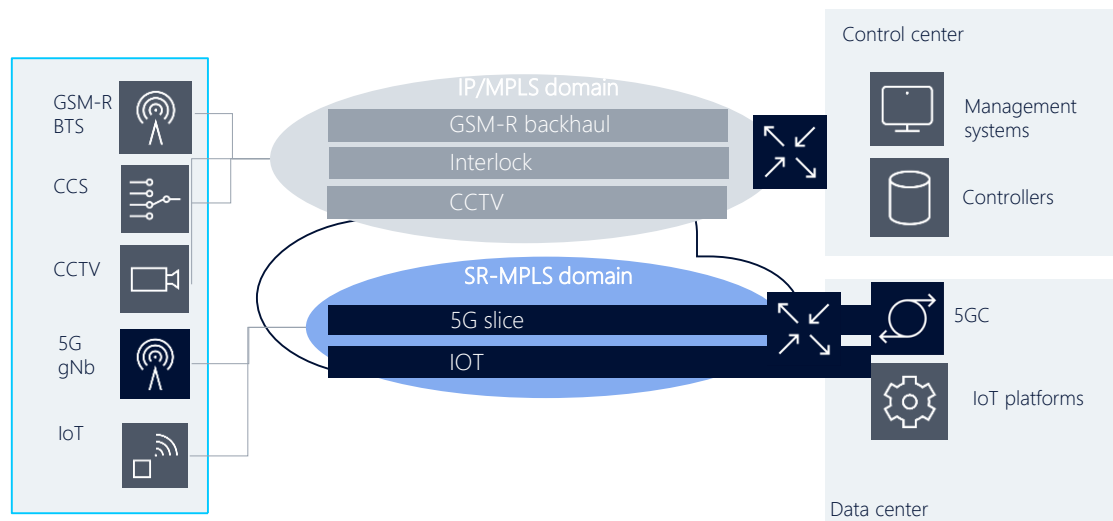
# Wireless Everywhere

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# Converged network embracing 5G

## Unleash Segment Routing for 5G backhaul ... and other



### Highlights

- Segment Routing harnesses the power of network slicing in backhaul to deliver 5G
- Segment routing provides rich Traffic Engineering scenario, along with high resiliency and high scalability
- Segment Routing does not require extensive hardware resources (versus SRv6)

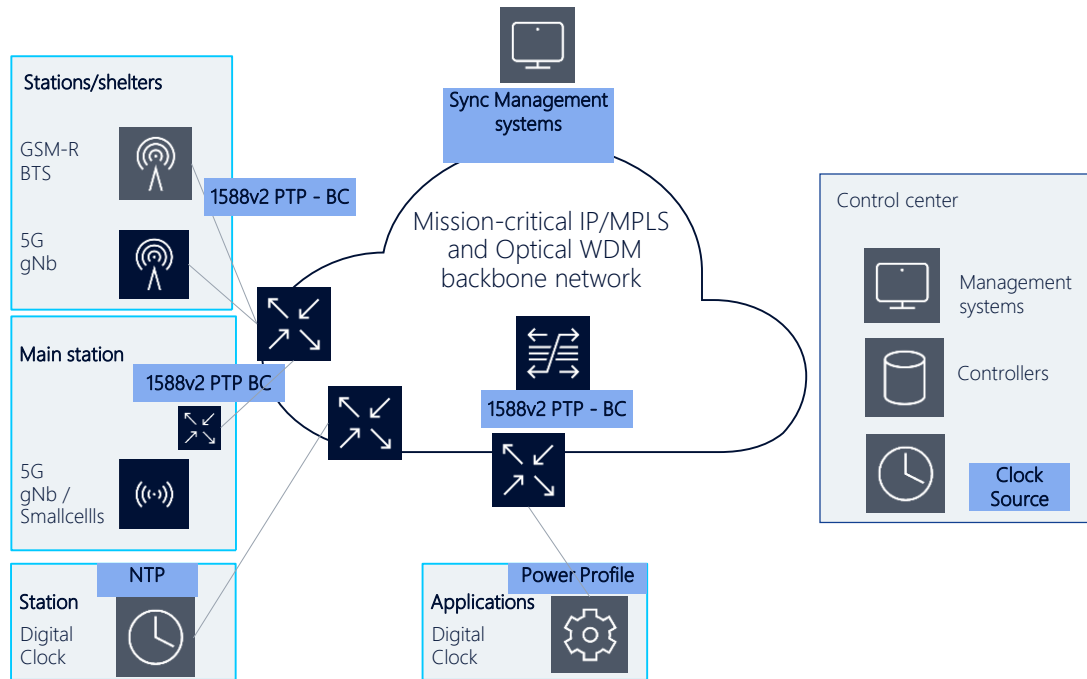
### Benefits

- No disruption to existing network services and applications for existing Nokia IP/MPLS customers
- Future proof and flexible technology



# End to end architecture for synchronization

Requirements of new applications : accurate clocking



## Highlights

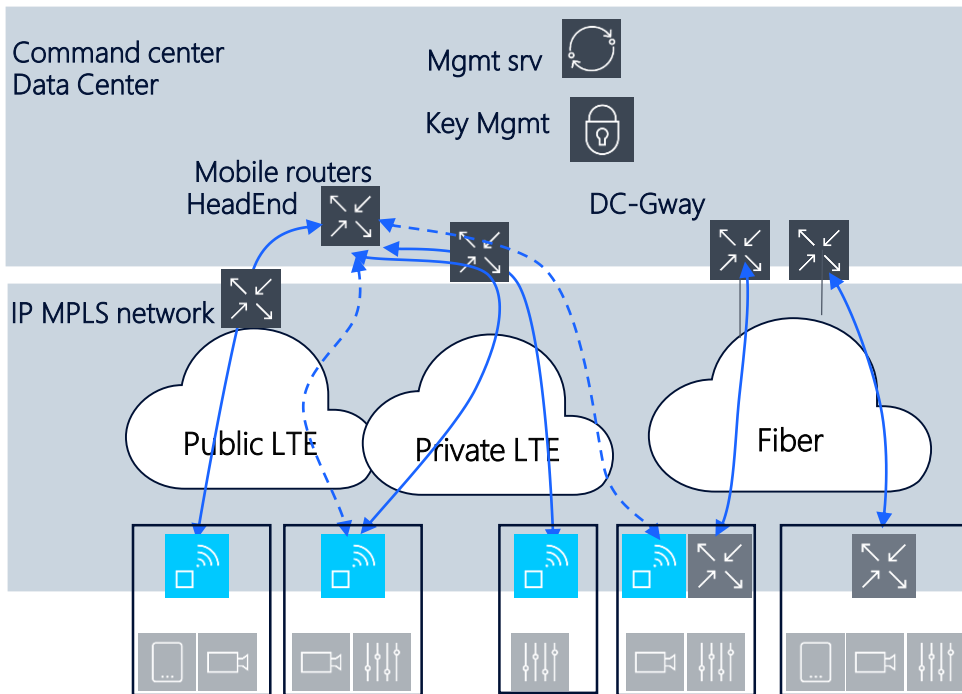
- High Precision Phase and Frequency distribution are mandatory for 4G/5G
- Hardware assisted synchronization
- Interaction of sync. at IP and WDM layer
- NTP with high precision for railway applications
- Some applications leverage sync (Utilities power profile)
- Synchronization is an application as well

## Benefits

- Allows handover at train speed
- Allows distribution of clocking to Small Cells in underground networks
- Avoids GPS issues (costs, security)
- Avoids NTP Scalability issues

# Leveraging LTE for branch site connectivity

What if LTE transport was just another transport ?



## Highlights

- IOT multiplies the number of sites to connect, and makes LTE an ideal technology
- Remote sites should be treated as an extension of the network rather than a set of boxes being deployed
- If backup required, many options available
- Use of IP/MPLS VPNs end to end is possible to facilitate L2, L3 and any to any as well as VPN isolation.

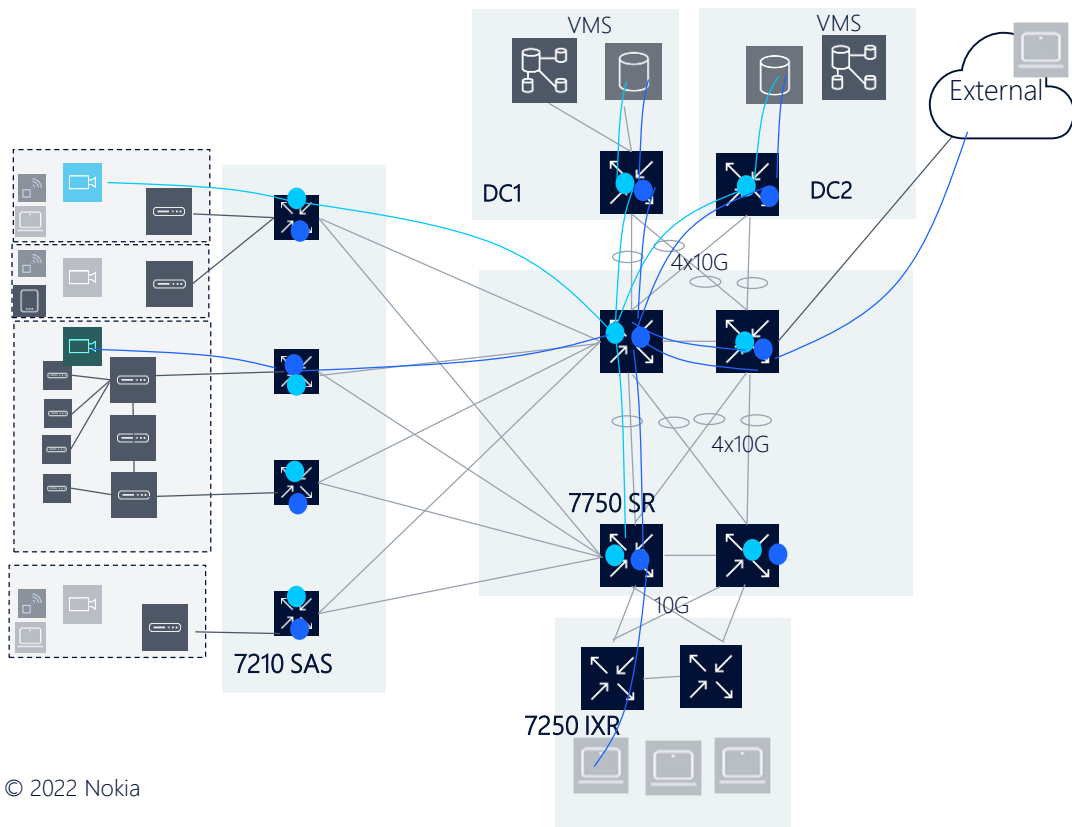
## Benefits

- Single technology end to end with similar provisioning
- Flexibility of evolution from LTE to fiber if applications require it
- Flexibility to run MPLS backup over LTE

# Increasing Operational constraints

# Smart Territory

## The CCTV Challenges



### Highlights

- Networks of >1000 cameras with redundant storage and multiple monitoring sites are common.
- A camera needs to send a minimum of 3 streams
- Use of MPLS Multicast VPNs allows traffic optimization
- High scaling of core routers required to replicate traffic

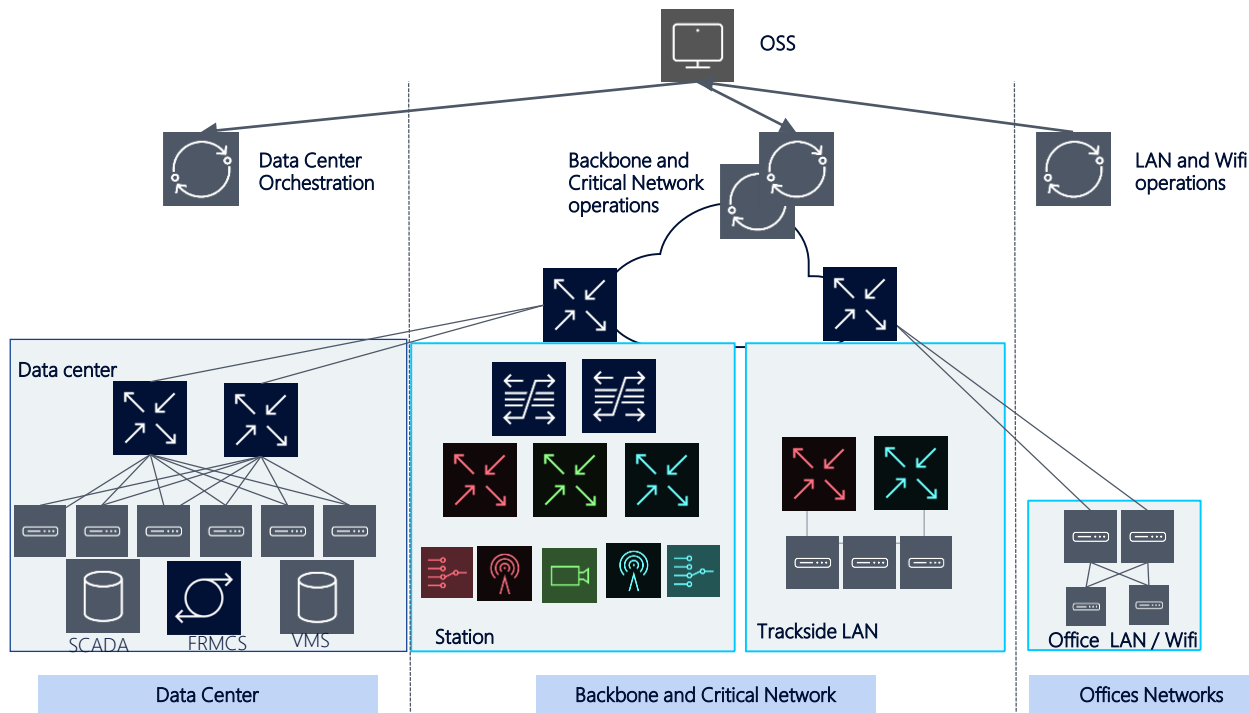
### Benefits

- Optimized delivery of multicast minimizes bandwidth requirements
- Flexible architectures (VMS, monitoring centers, )
- Centralized, simplified and controlled interaction with external agencies.



# Increasing pressure of Safety

## Segregating domains



## Highlights

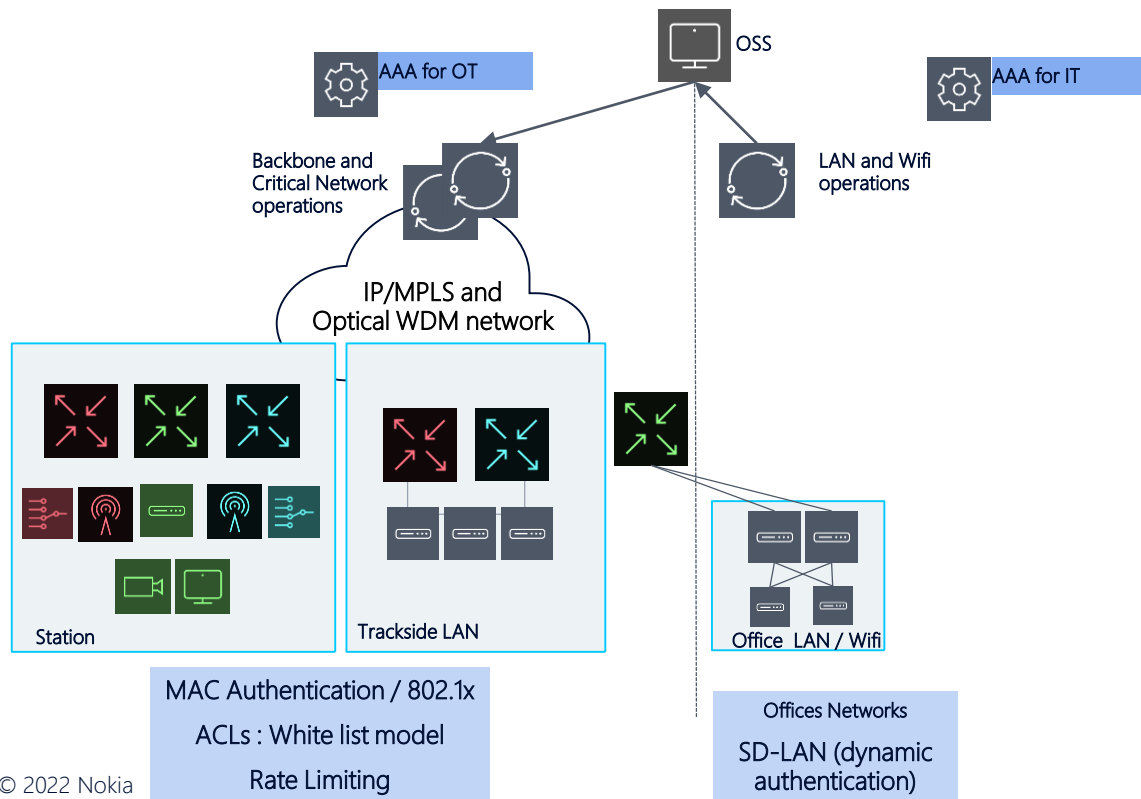
- Critical networks cover WAN and critical LANs (trackside and stations). This provides end to end control on services.
- Office LAN / Wifi do not require end to end service definition (security, control, redundancy).
- Office LAN do require a clear interface with critical WAN (PE-CE model)
- Data Center Orchestration requires different set of technologies

## Benefits

- Simplifies service definition
- Simplifies management life cycle
- Simplifies safety related constraints by removing adherence between domains

# Increasing pressure of Cyber Security

## Secured zero trust network



## Highlights

- Network Authentication along trackside requires life cycle management (not all have 802.1x)
- Trackside applications are more static. White-list and rate limiting can be managed.
- Office LAN do require a dynamic operation (SD-LAN) to adapt to new way of working

## Benefits

- Secured authentication in all network
- Adapts security to network life cycle, reality and constraints
- ACL and Rate limiting protect against network DDoS attacks



Proven Massive  
& Robust  
networks

An adaptation to  
regulatory and  
operational  
constraints

**NOKIA**

Mission Critical  
Communication  
Networks

Smooth  
integration of  
Wireless with  
multiple  
scenarios

A Trusted  
long-term  
partner of  
critical networks

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