From GSM-R to Future Railway Mobile Communication System (FRMCS)

Bologna,9 Maggio 2018

Topics

1

Standardization Overview and Status

2

FRMCS and Migration Aspects from GSM-R

Driver for Next Generation Broadband Communication - FRMCS

Future Railways Mobile Communication System

Demand for Broadband Application

- Increasing operational efficiency
- Improving Customer experience

Optimization of networks

- Further unifying network technology
- Reduce complexity
- Increase flexibility

Long Term Support

- Support ERTMS/ETCS for next decades
- Manage obsolescence of GSM technology

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Broadband enables new services

Customer loyalty

- Passenger Information
- News & travel information
- Travel route visualization
- Internet, email, chat *)
- Passenger suggestion box

New revenues

- BBoT: Broadband on Trains
- Video on demand, Audio books
- Gaming
- “On the fly” seat reservation
- Bistro shopping
- Advertising (indirect revenue)

Efficiency & process automation

- Real time CCTV
- Alarm notifications
- Fleet management
- Energy metering
- Real-time vehicle tracking
- Ticketing
- Passenger counting
- Optimizing bistro processes
- Automated Train Operation
- Replacement of wireline communication
- Sensors
- Predictive Maintenance
- Self Organized Networks (SON)

Ground to Train trends

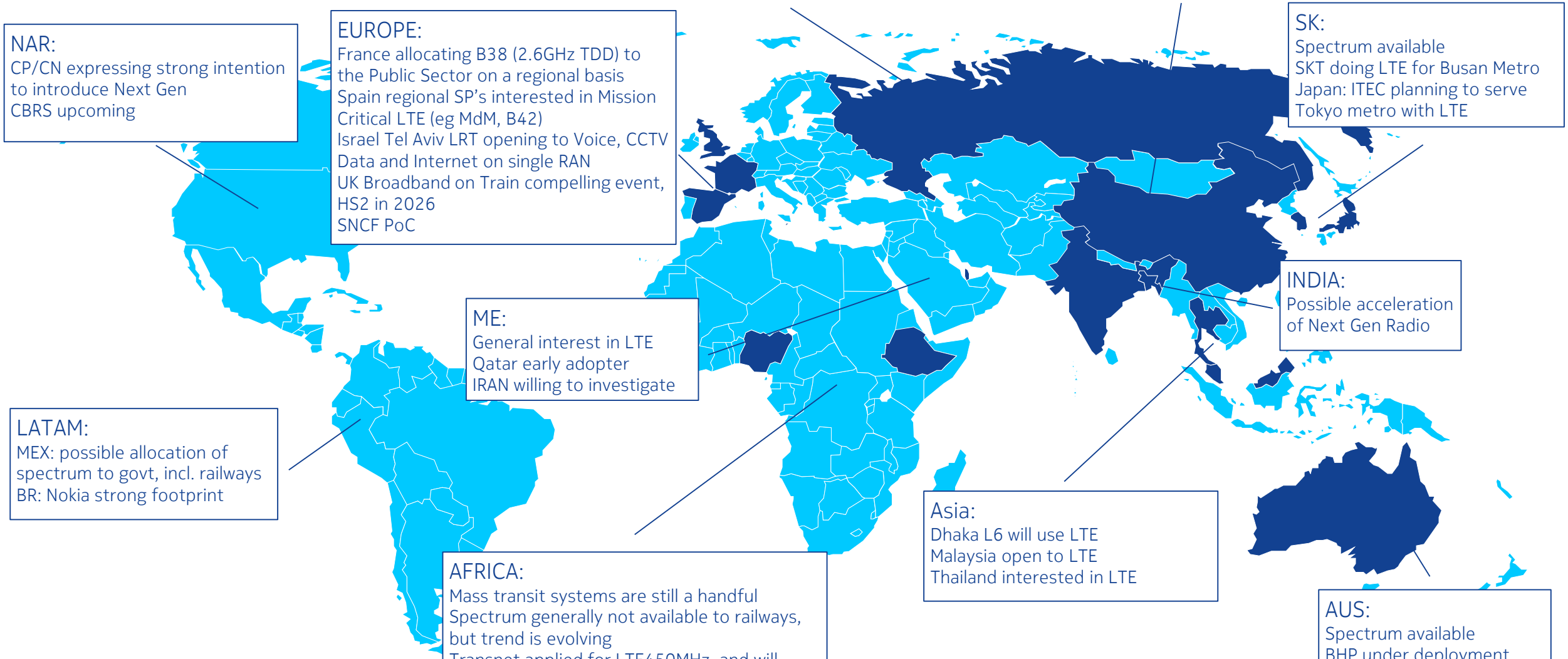
RUSSIA:
Broadband applications via SP's or in unlicensed spectrum with proprietary solutions
Tele2 successful trial with MEC

GHCN:
acceleration of Next Gen Radio
Metros already deploying LTE

NAR:
CP/CN expressing strong intention to introduce Next Gen
CBRS upcoming

EUROPE:
France allocating B38 (2.6GHz TDD) to the Public Sector on a regional basis
Spain regional SP's interested in Mission Critical LTE (eg MdM, B42)
Israel Tel Aviv LRT opening to Voice, CCTV Data and Internet on single RAN
UK Broadband on Train compelling event, HS2 in 2026
SNCF PoC

SK:
Spectrum available
SKT doing LTE for Busan Metro
Japan: ITEC planning to serve Tokyo metro with LTE



ME:
General interest in LTE
Qatar early adopter
IRAN willing to investigate

INDIA:
Possible acceleration of Next Gen Radio

LATAM:
MEX: possible allocation of spectrum to govt, incl. railways
BR: Nokia strong footprint

Asia:
Dhaka L6 will use LTE
Malaysia open to LTE
Thailand interested in LTE

AFRICA:
Mass transit systems are still a handful
Spectrum generally not available to railways, but trend is evolving
Transnet applied for LTE450MHz, and will deploy LTE1800 for port operations
RFI for Sitarail in Cote d'Ivore

AUS:
Spectrum available
BHP under deployment
Several PTA's deploying LTE

Remote Train Control is next gen pushed by railways vendors

Russian Railways evaluating remote train control at railways yards

Project details:
Train control system: MALS by Siemens
Average train speed: up to 3 km/h
Control method: 2 way communication –Telemetry/Train signaling
Monitoring method current: visual by Control Center tower located in the center of railways yard
,

Luzskaya railways yard station, Saint Petersburg region, Russia

Number of tracks at the station: 30 tracks in average
Railways yard spread: up to 30km
Number of railways yards in Russia: ~1500 yards

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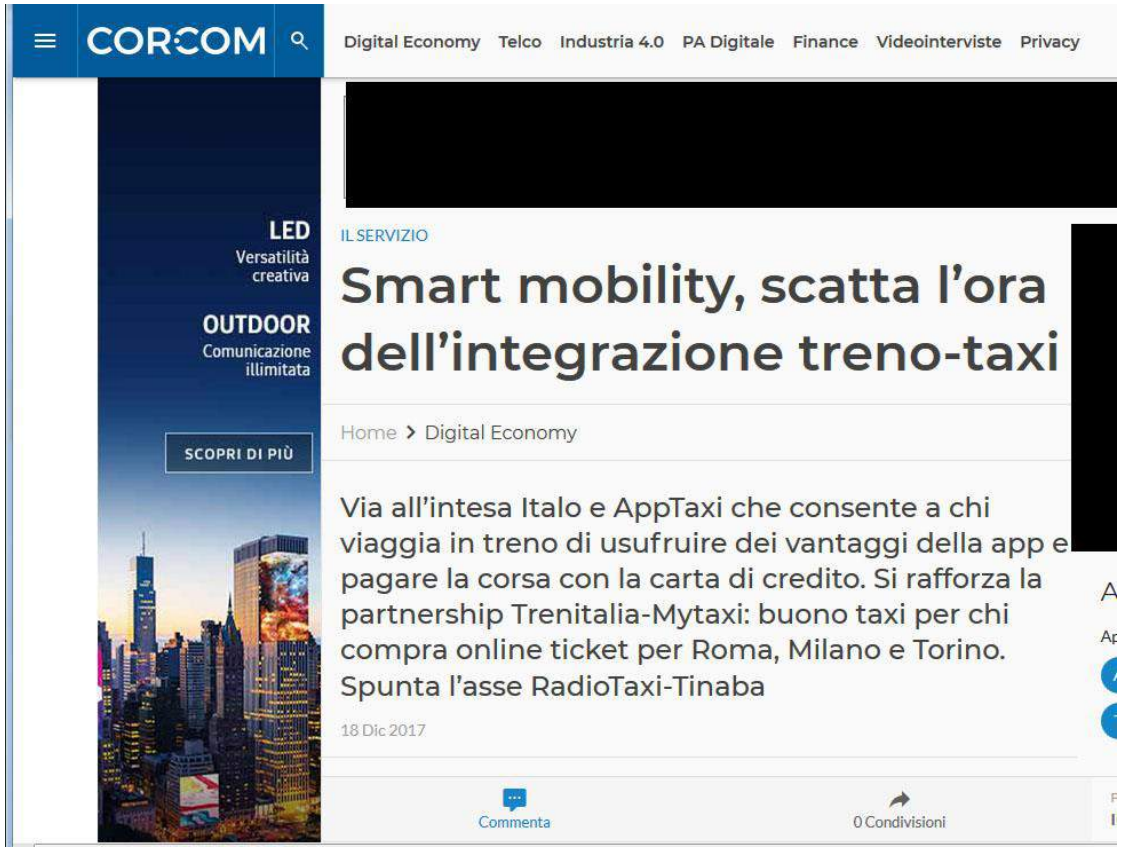
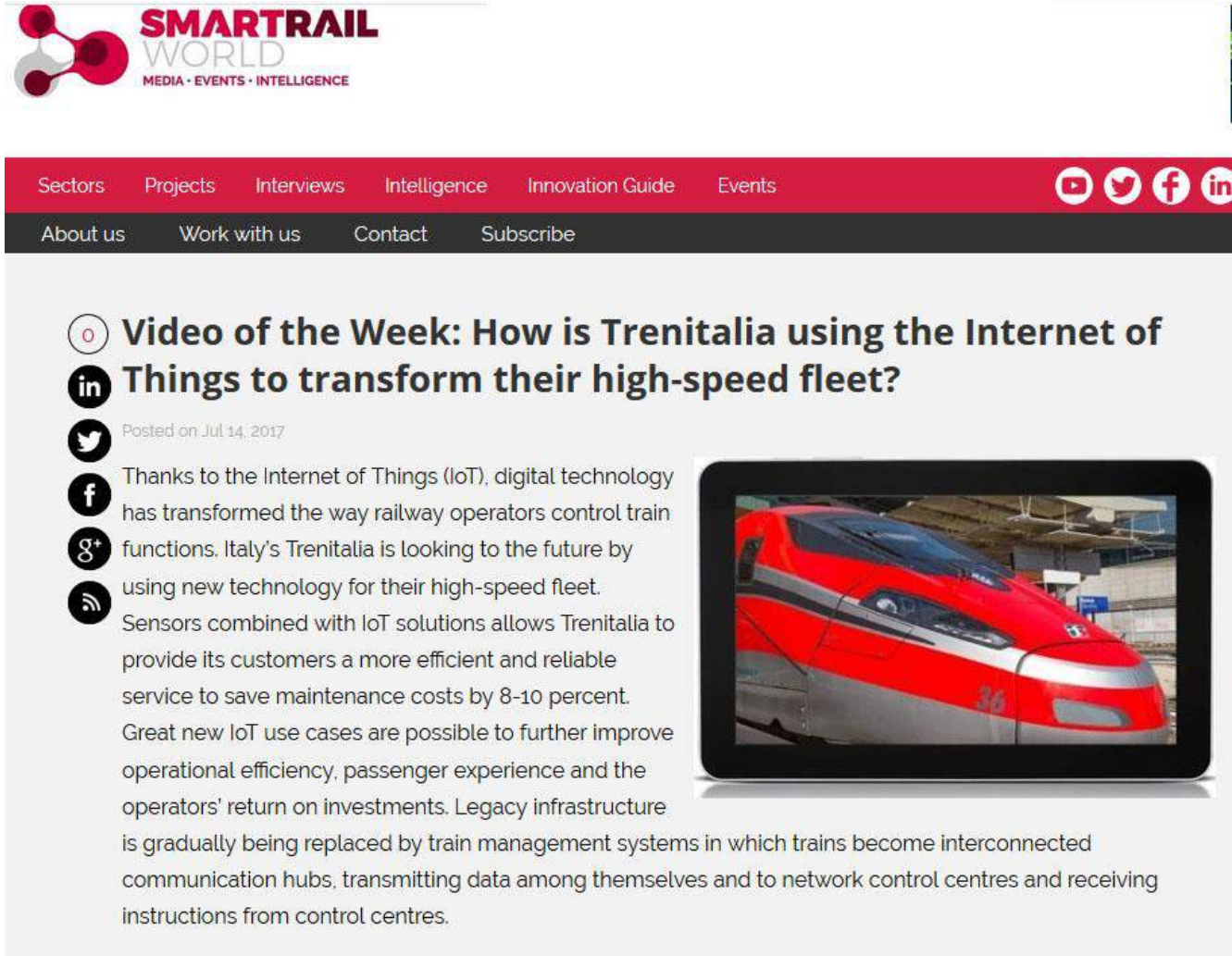
Example of trends in Italy





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Convergence towards one integrated technology for rail

Services

- Train Control (ETCS, CBTC, PTC,..)
- Mission critical voice
- Operational applications
- Passenger applications

Radio technologies

- **GSM-R** for operational communication & ETCS
- **Public GSM & others** for maintenance, electricity meters,...
- **Wi-Fi** for traffic offload in train stations
- **Analog** for shunting on low traffic lines & non-critical com.
- Separate **ERTMS** and **CBTC** radio
- **Passenger BBoT via public 2G/3G/4G, SAT, Flash OFDM**

→ **LTE** for all services

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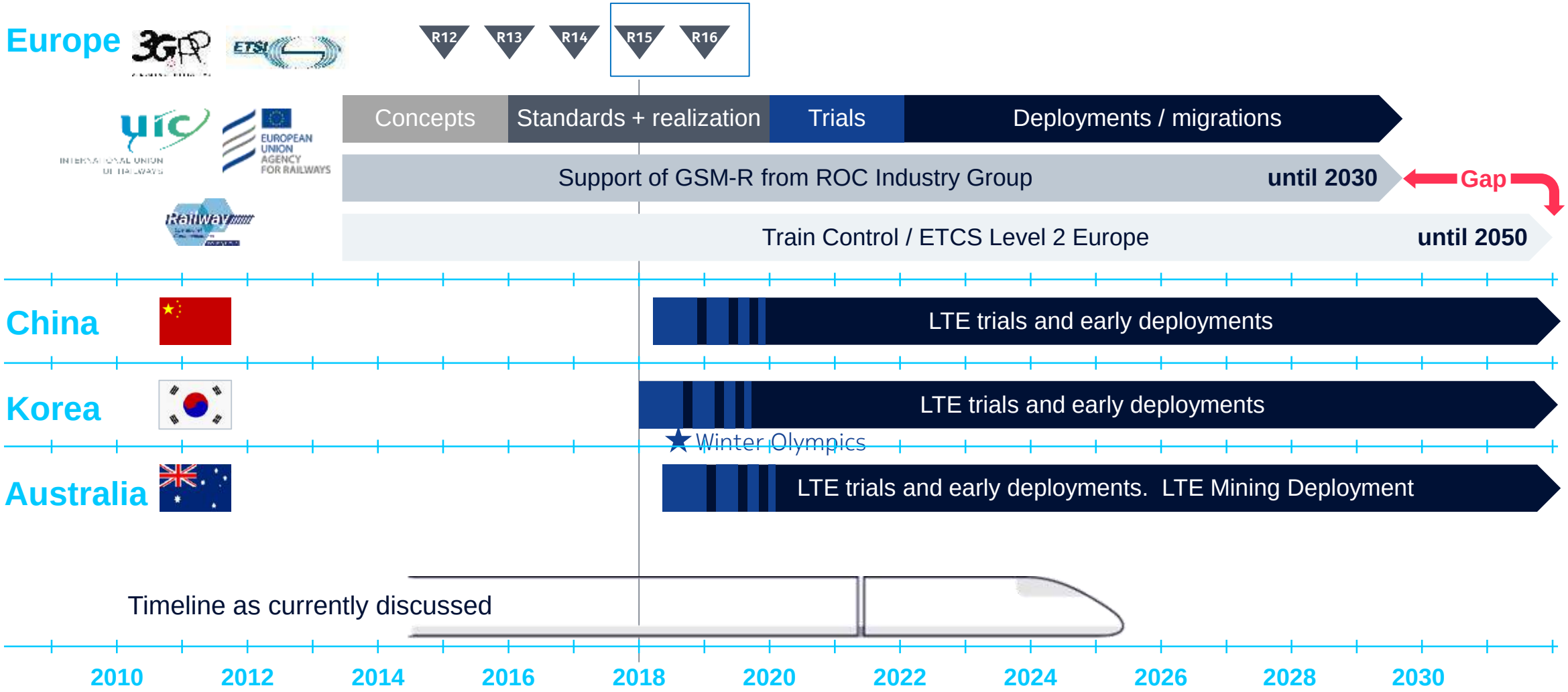
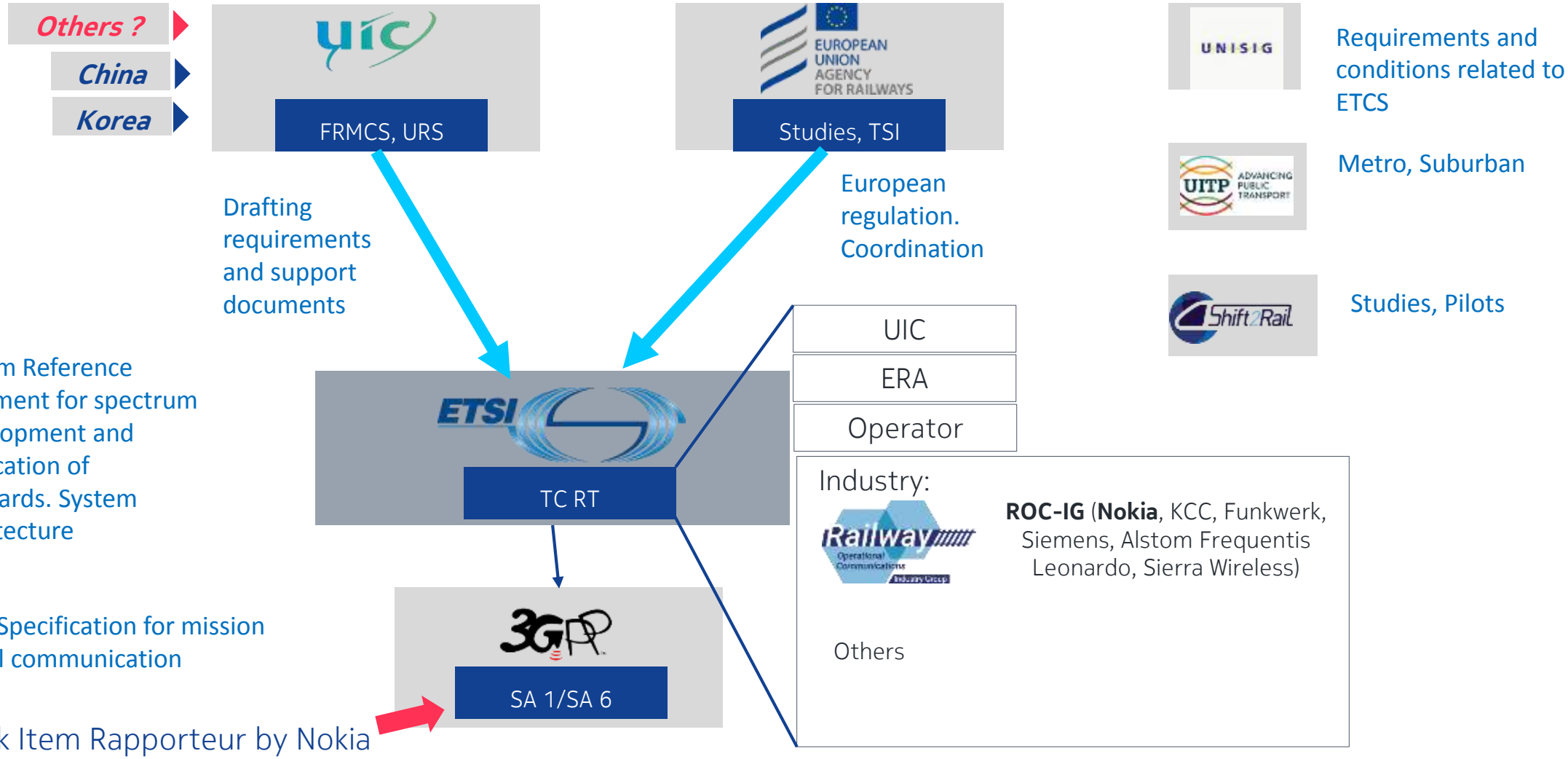
GSM-R is expected to be supported until about 2030

Different speed of LTE/FRMCS deployments in Europe and other regions



Next Generation –High level overview on involved bodies & activities

EU Agency for Railways: Coordination WP



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UIC User Requirement Specification

FRMCS / URS

Critical Communication Applications	Performance Communication Applications	Business Communication
Voice incl. Group calls Train Control M2M & Telemetry (critical)	M2M & Telemetry, CCTV, Passenger Info, Staff communication, Lineside (fixed)	WiFi on Board
essential for train movements and safety	to improve the performance of the railway operation	to support the railway business operation in general, such as wireless internet
Eirene / New	Eirene / New	New

Comparison to GSM-R/EIRENE. Existing enhancements of EIRENE like features


INTERNATIONAL UNION OF RAILWAYS

Future Railway Mobile Communication System

User Requirements Specification

Source: FRMCS Functional Working Group
Date: 29th of March 2016
Reference: FU-7100
Version: 2.0
No of pages: Cover + 96 pages

Adobe Acrobat Document

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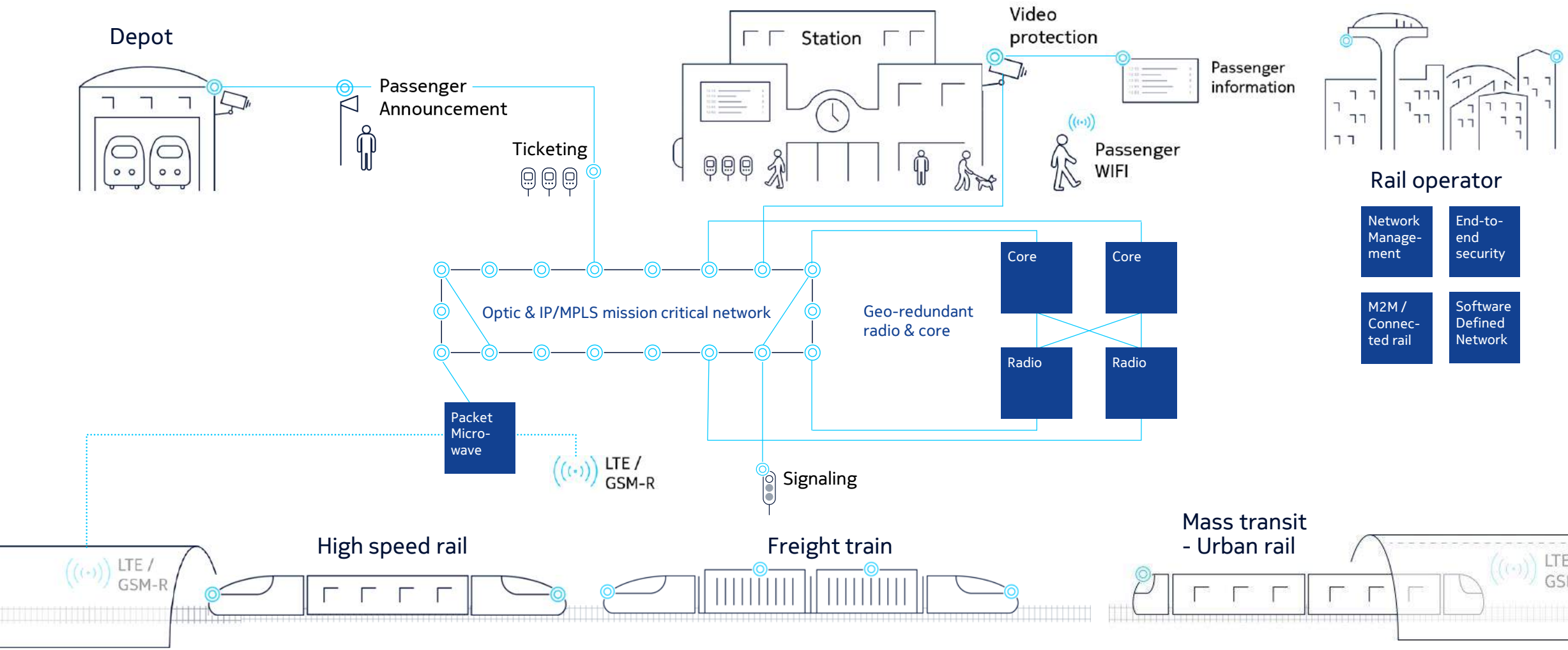
e2e railway Nokia solutions



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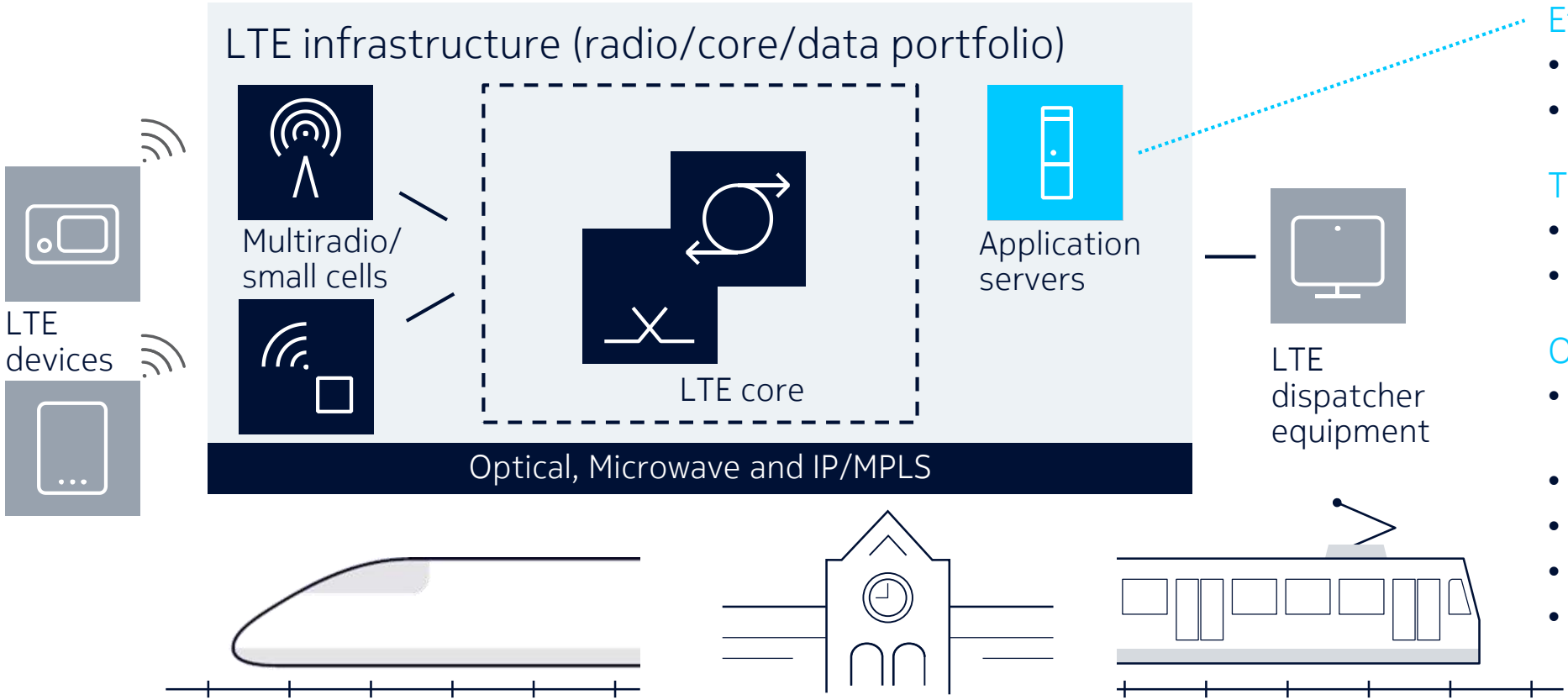
Industry vision:
FRMCS will be implemented on LTE Network



Efficiency & automation
- Fleet management
- Energy metering

Trackside & stations
- M2M communication
- CCTV

On board
- Passenger Information Service
- Emergency call points
- Broadband on Train
- CCTV
- Ticketing

Flexible deployment scenarios depending on customer strategy

End-to-end LTE railway trackside, station & onboard services

Future evolution towards 5G

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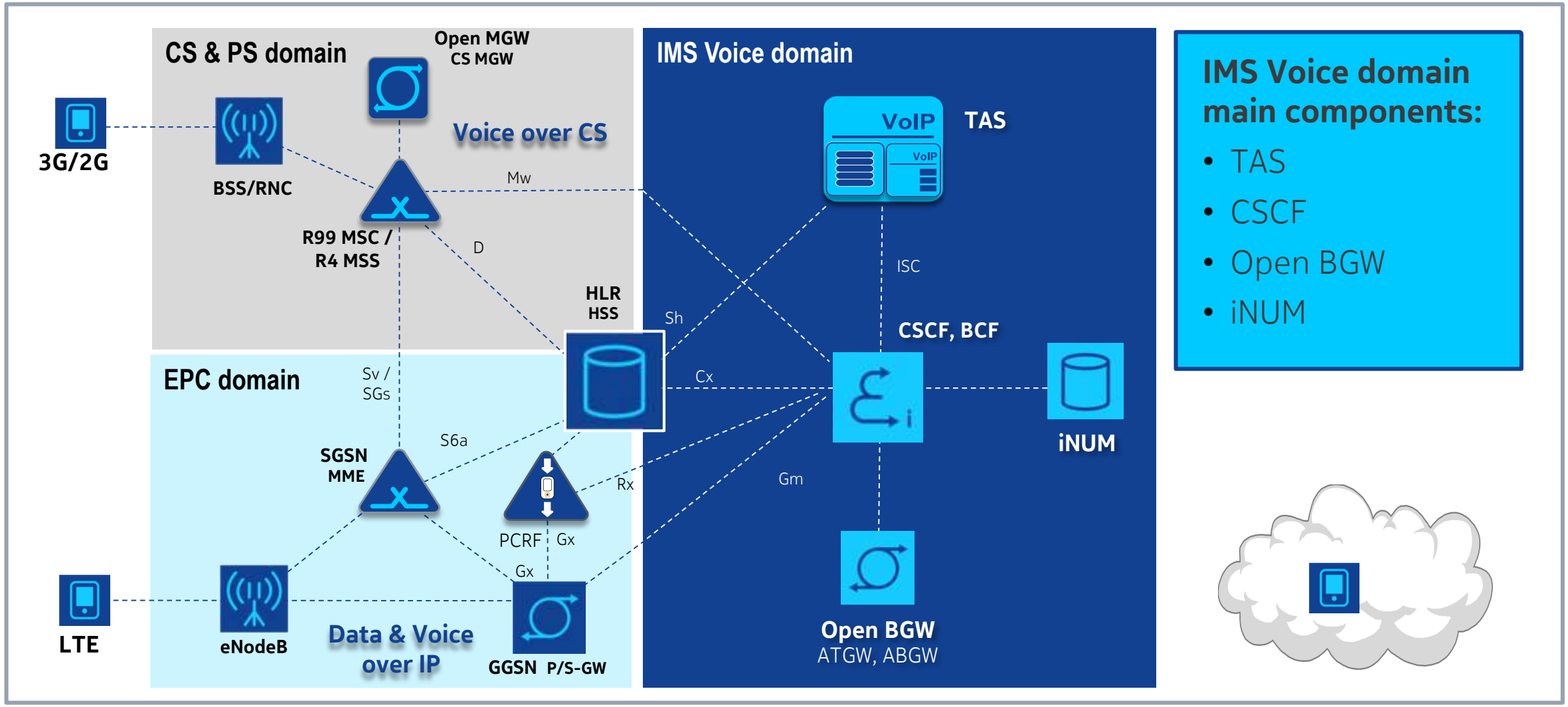
LTE: IMS / VoLTE Domain – Network Architecture



IMS Voice domain main components:

- TAS
- CSCF
- Open BGW
- iNUM

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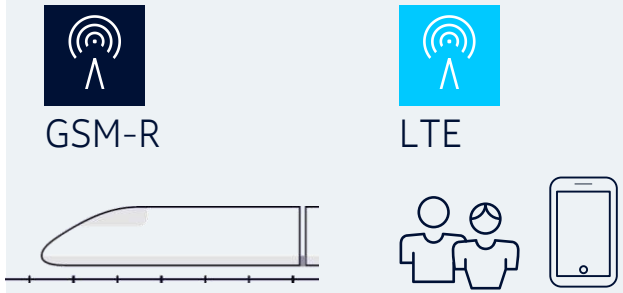
GSM-R to full LTE migration

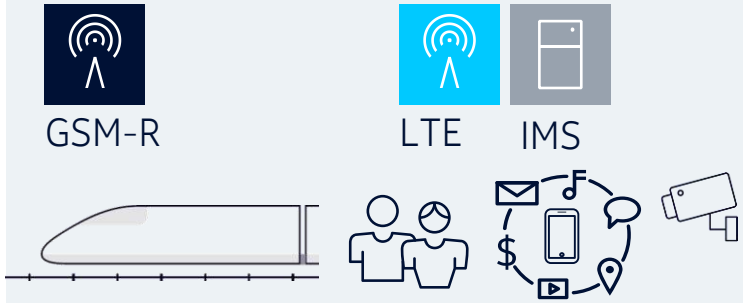
A stepwise approach , flexible for different markets and segments

GSM-R + LTE pure data overlay



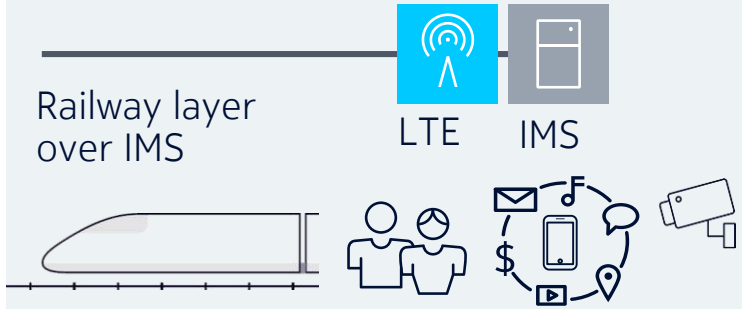
- Mission critical voice & location over GSM-R
- High speed data over LTE (database access)
- Over the Top PTT (proprietary)

GSM-R + LTE multimedia



- Mission critical voice over GSM-R
- Multimedia over LTE (incl. voice, video, maintenance applications, PTT)

Full LTE for Railways



- All services over LTE
- Multiple user communities (highest priority: Rail, Public Safety; lower priority: Service Provider)

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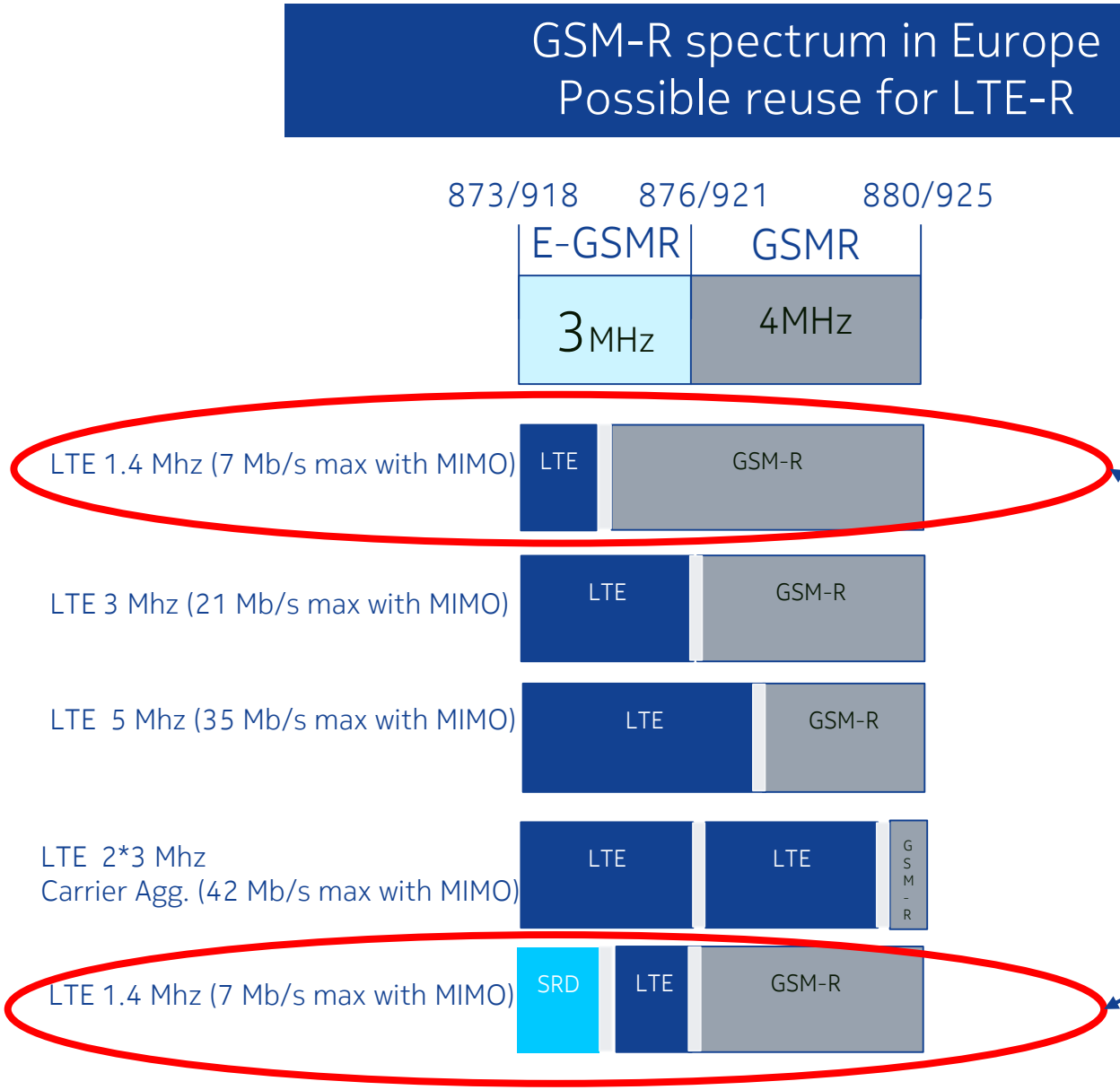
Spectrum for LTE – under discussion in Europe in ETSI/UIC/ERA



This is currently focused in ETSI NG2R as most applicable solution for the mission critical features defined by FRMCS

CEPT WG-FM56 (discussions in FR, etc...)

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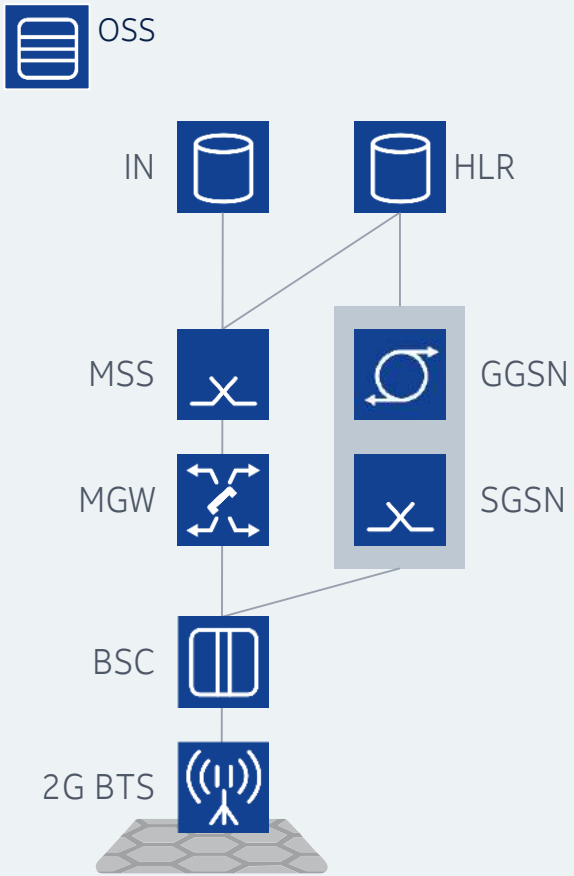
From GSM-R to Next Generation Railway Communication

GSM-R voice & data



HLR evolves to HSS

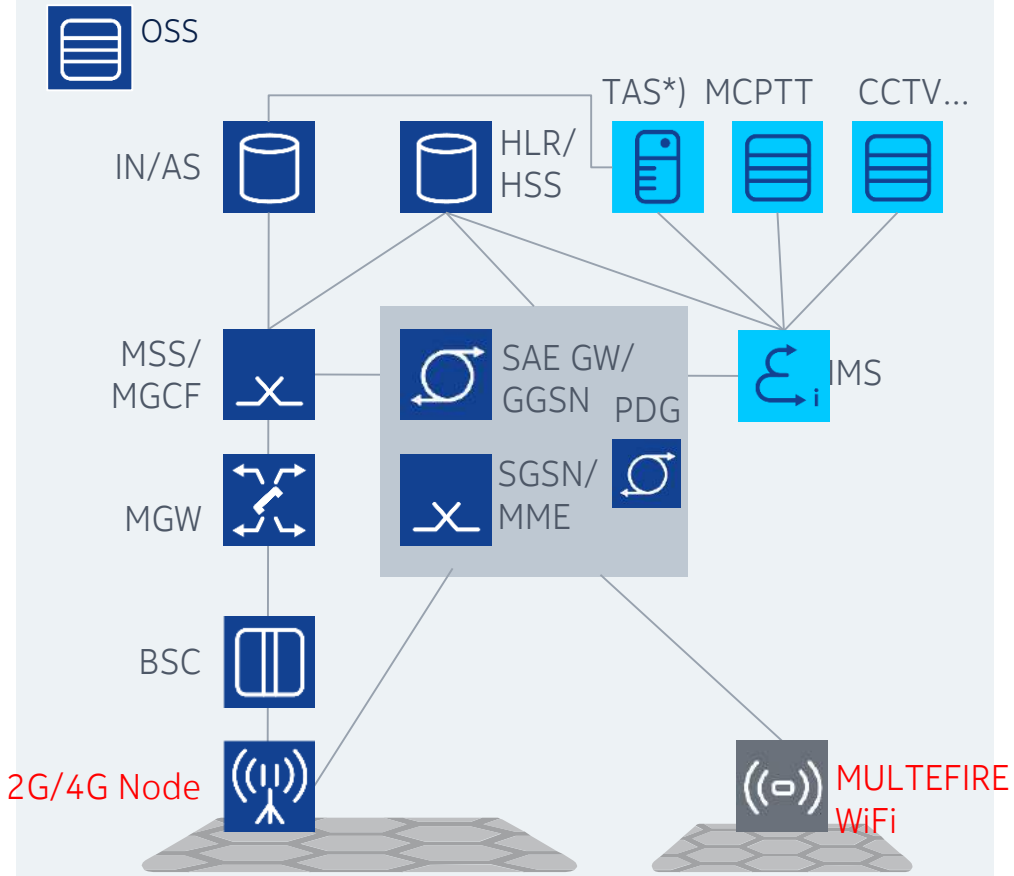
IN system evolution
IMS application server. ICS architecture option

GPRS evolves to EPC
Nokia: same HW&SW today

MSS & MGW
Interworking (functionality of a MGCF/MGW) with VoIP IMS networks (eSRVCC).

LTE BTS
Same Node for 2G and 4G
Non 3GPP WiFi access: Core or Radio aggregation

GSM-R + LTE for Railways



*) TAS comprises of MMTel services (IR.92, IR.94 and beyond), SCC AS (Session transfer, T-ADS,CAMEL Homing)
IP-SM-GW (SMSoIP, SIP IM, T-ADS), IM-SS, MRFC (tones and announcements, conference)
Regulatory services (LI, ACR, MNP), Charging (online, offline), VMS, IVR interfaces
Repository interfaces: Sh, MAP and LDAP

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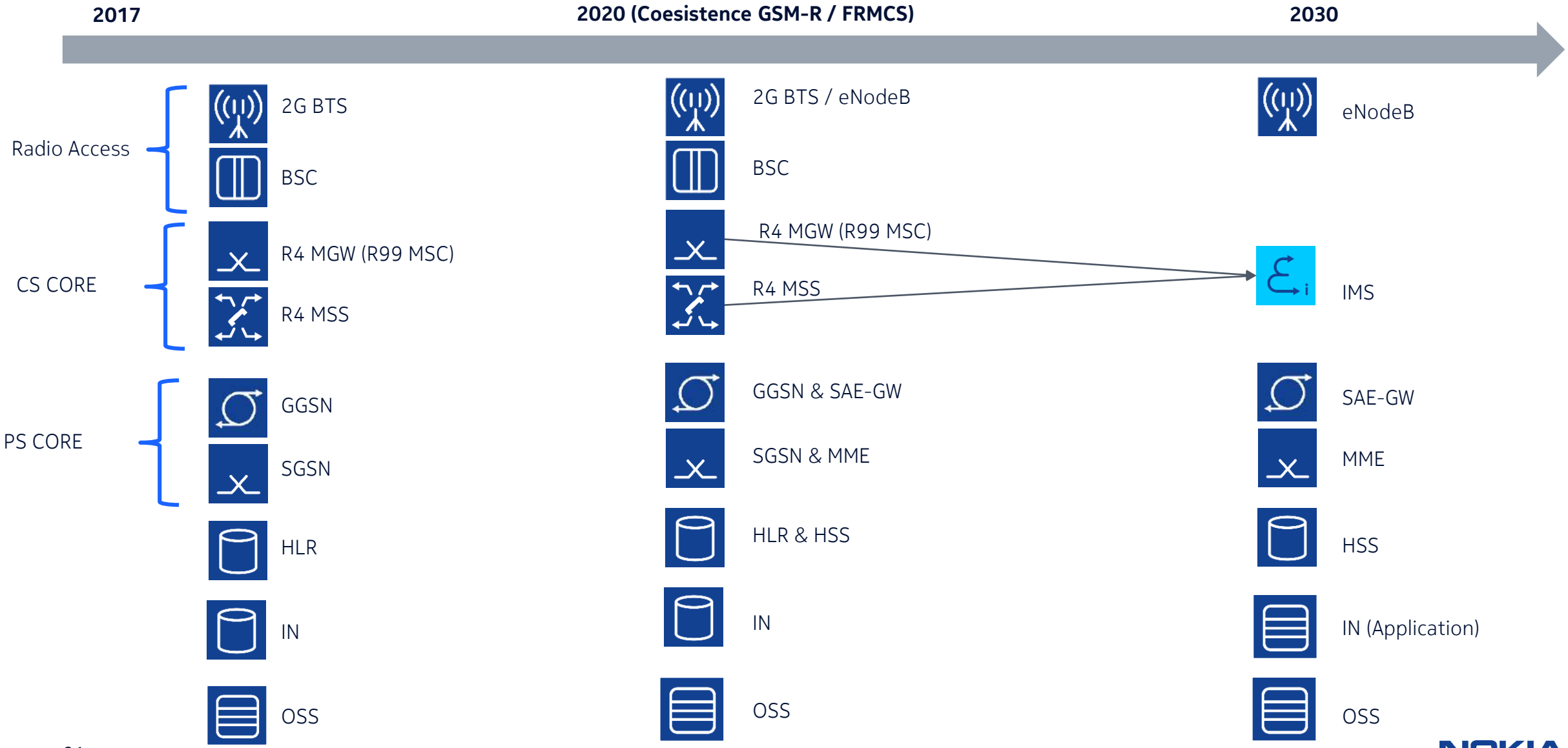
RFI Network Evolution towards 2030



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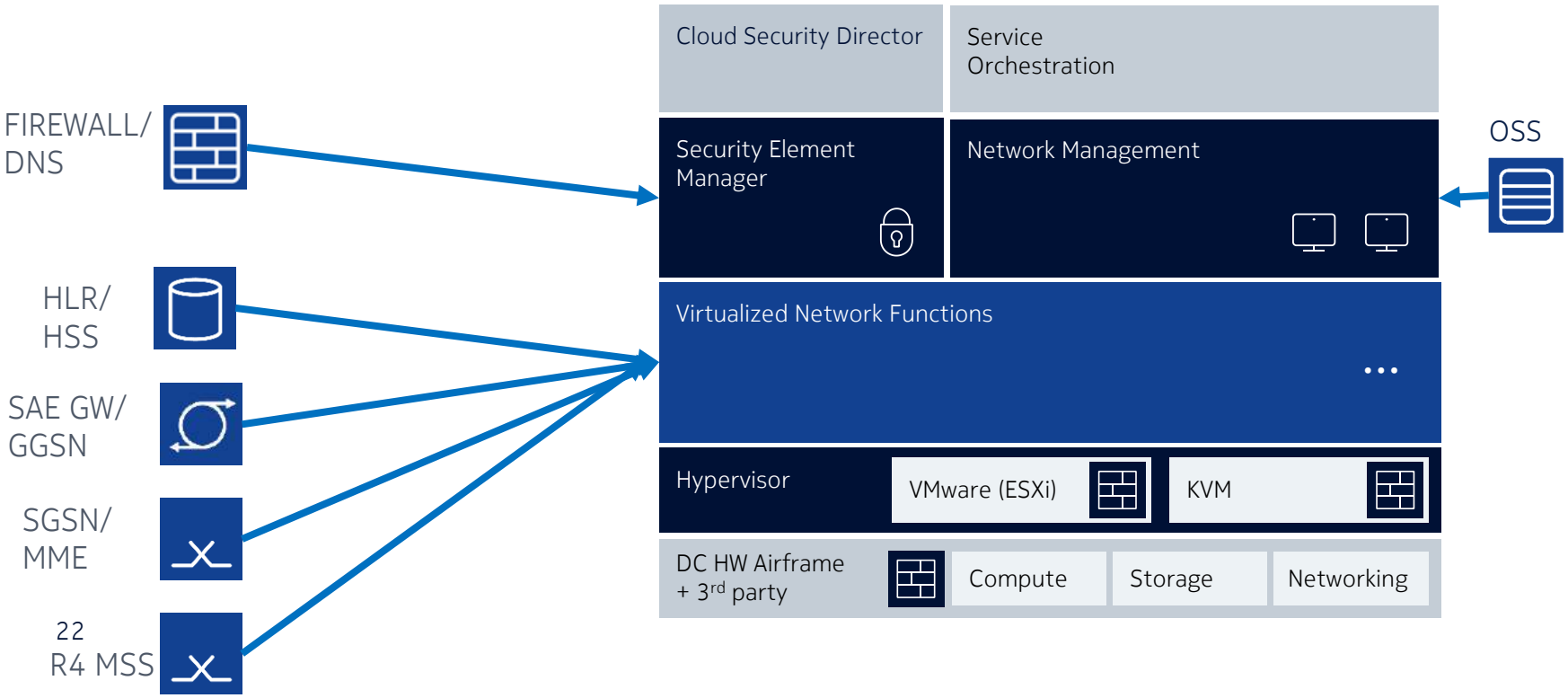
Virtualization

- Less Footprint
- Less Power
- Less Complexity
- More resource flexibility



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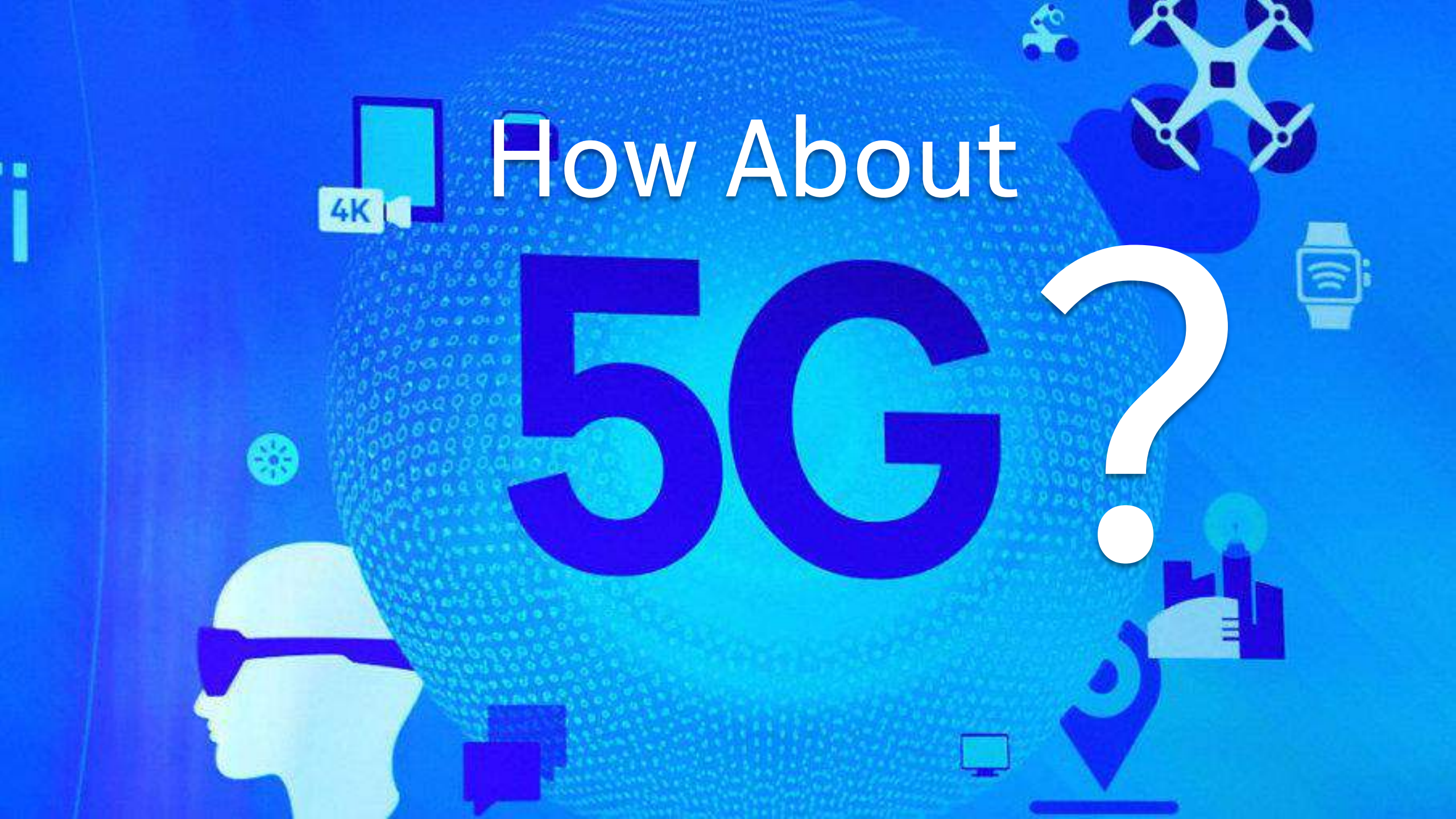
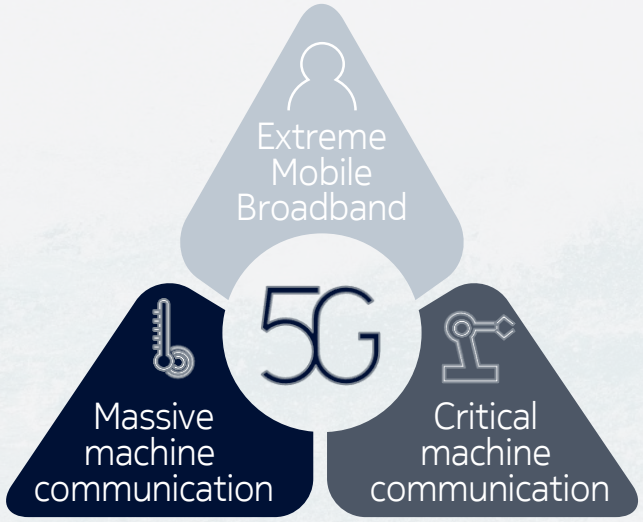

How About
5G
?
4K

5G is expected to be introduced in ~2020

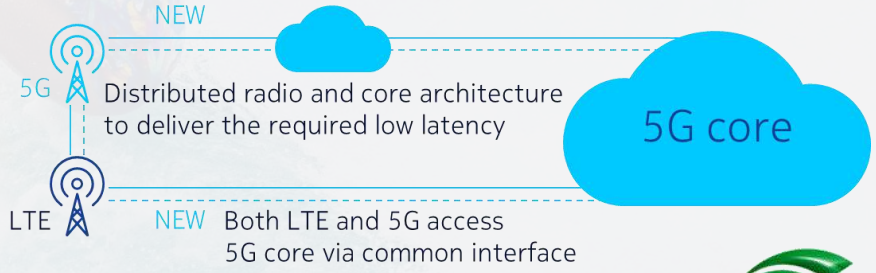


- 10 Gbps network speeds
- Extremely low latency
- New applications based on massive broadband capabilities

LTE provides a foundation for 5G and will remain the main cornerstone in 5G for railway communication

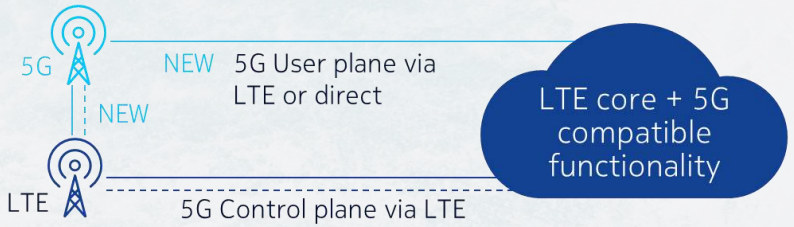
5G phase 2

New 5G core network and standalone 5G radio access without the need for an LTE anchor



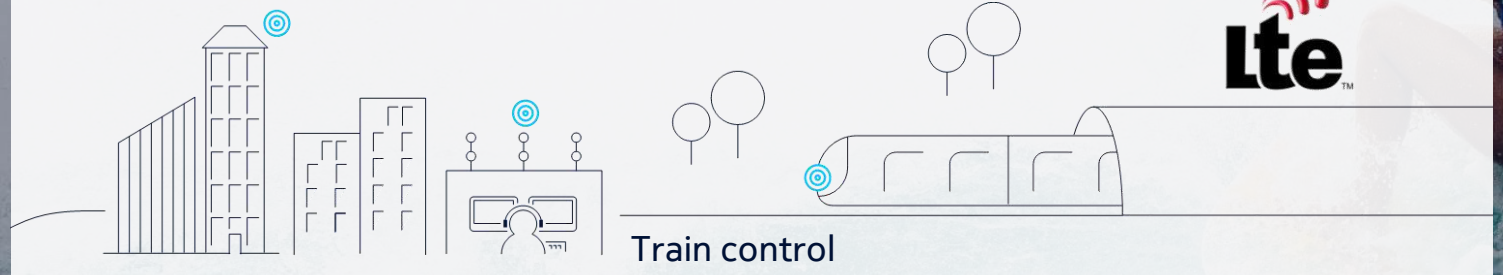
5G phase 1

5G radio in a dual connectivity mode with LTE as an anchor

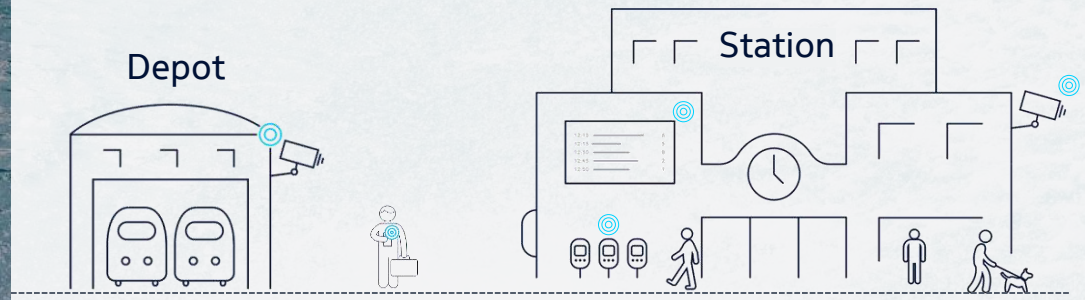


Today

LTE technology for mission-critical voice



+ 5G for non-critical massive broadband



Shared deployment (network slicing)

- LTE is intrinsic part for 5G introduction
- LTE as such already provides support for 5G concepts like IOT support (with LTE-M, NB-IOT, cloudification of core and radio)
- 5G focus initially on high density deployments (6GHz up to 30/60/60 GHz)
- 5G to rely on OFDM technology as well -> we are talking about evolution of radio, not revolution. Especially for low band (e.g. MiMo like LTE)

Thank You

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