

High-Five! – 5G Tales



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calnexsol.com

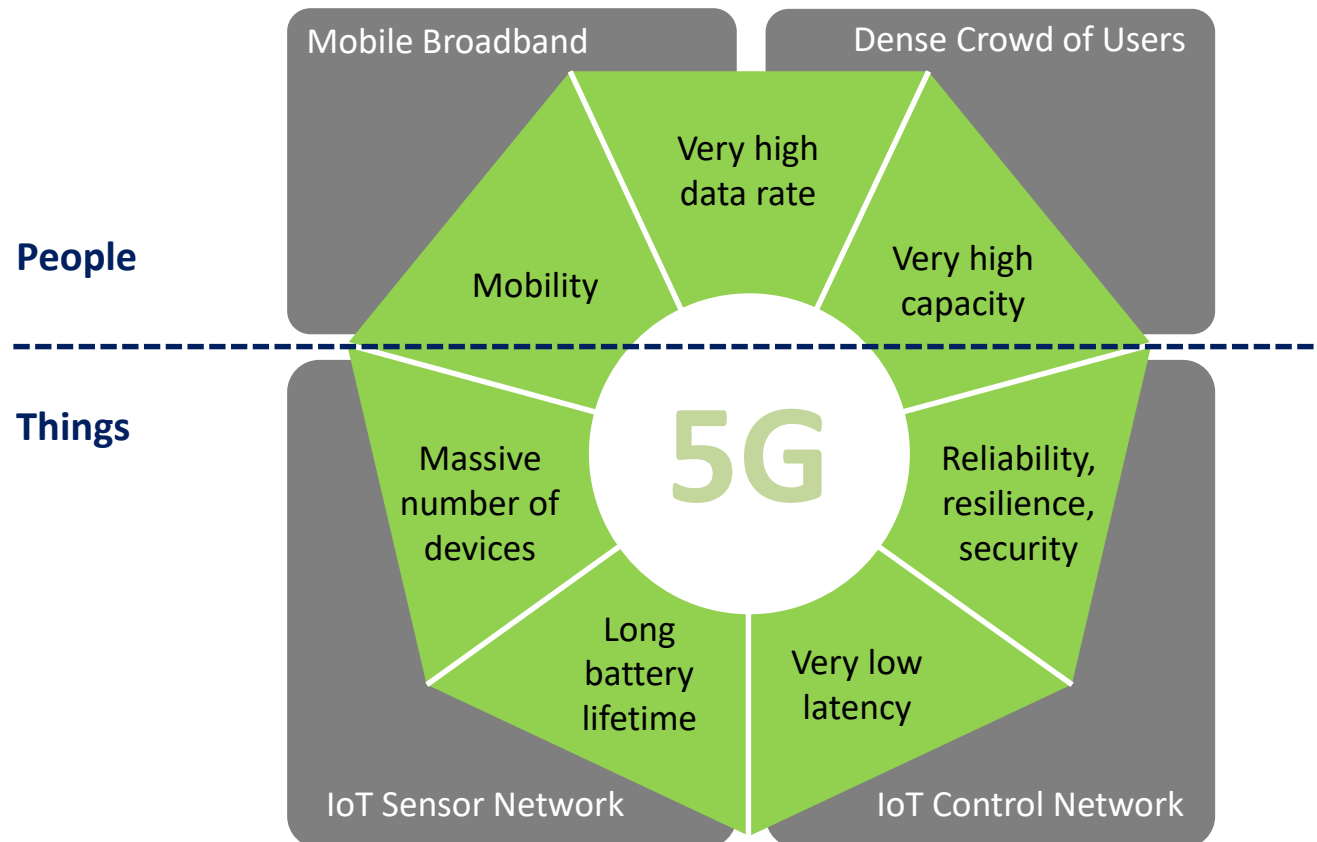


What is 5G?



"4G has changed lifestyles. 5G will reshape societies"

Mr. Li Yue, CEO – China Mobile

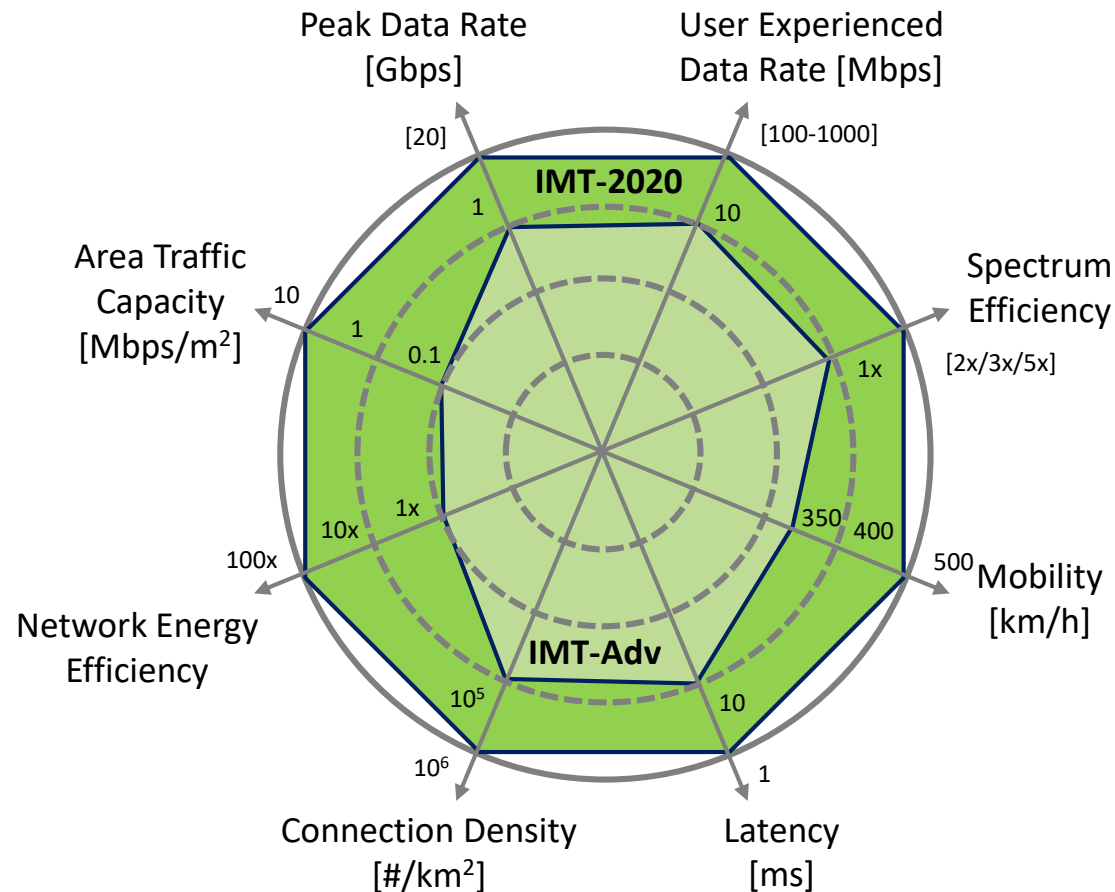


Source: Rohde & Schwarz

What is 5G?



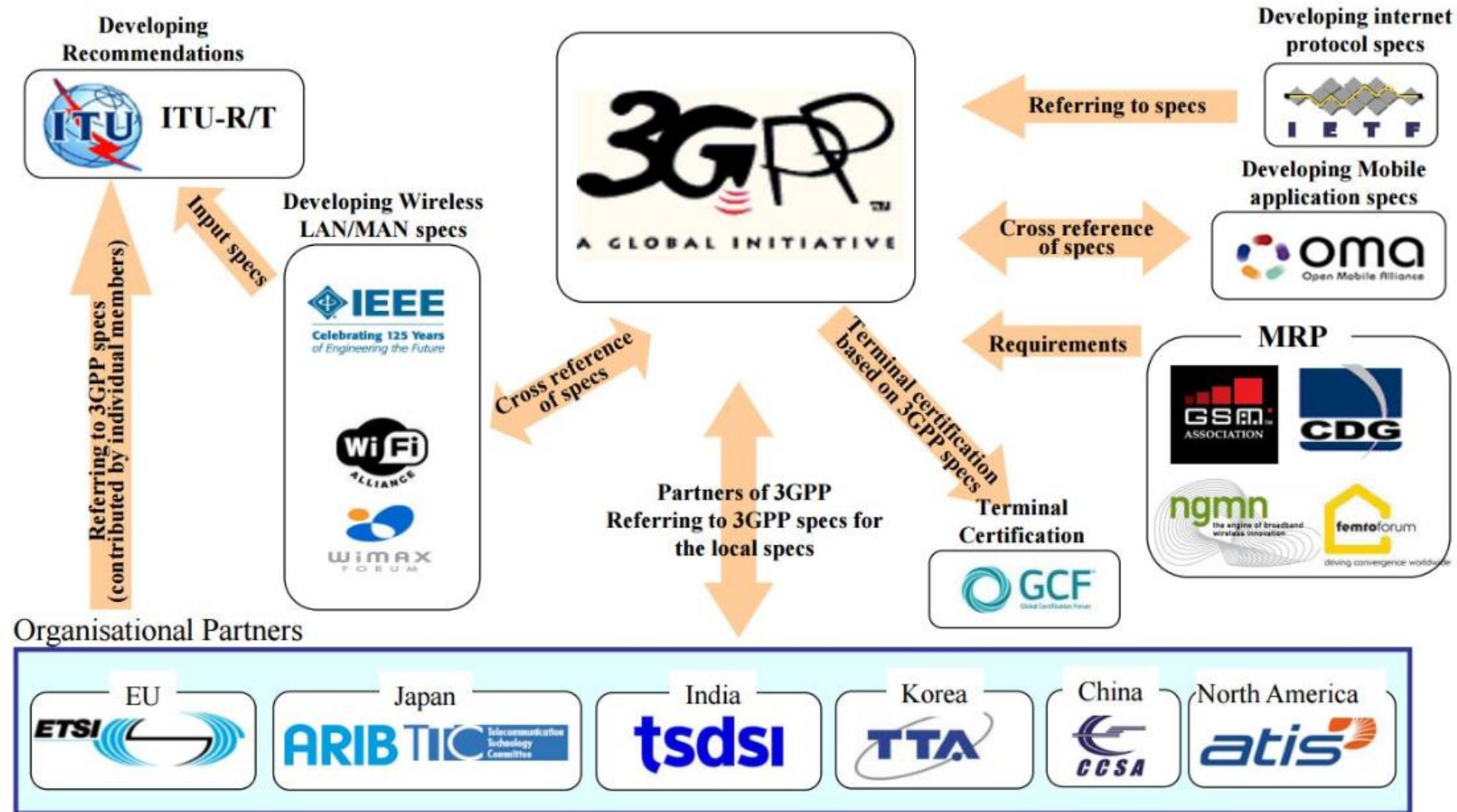
IMT-2020 – the ITU’s vision of “5G” (IMT for 2020 and Beyond)



- IMT-Advanced (LTE, 4G)
- IMT-2020 (5G), relative to IMT-Advanced

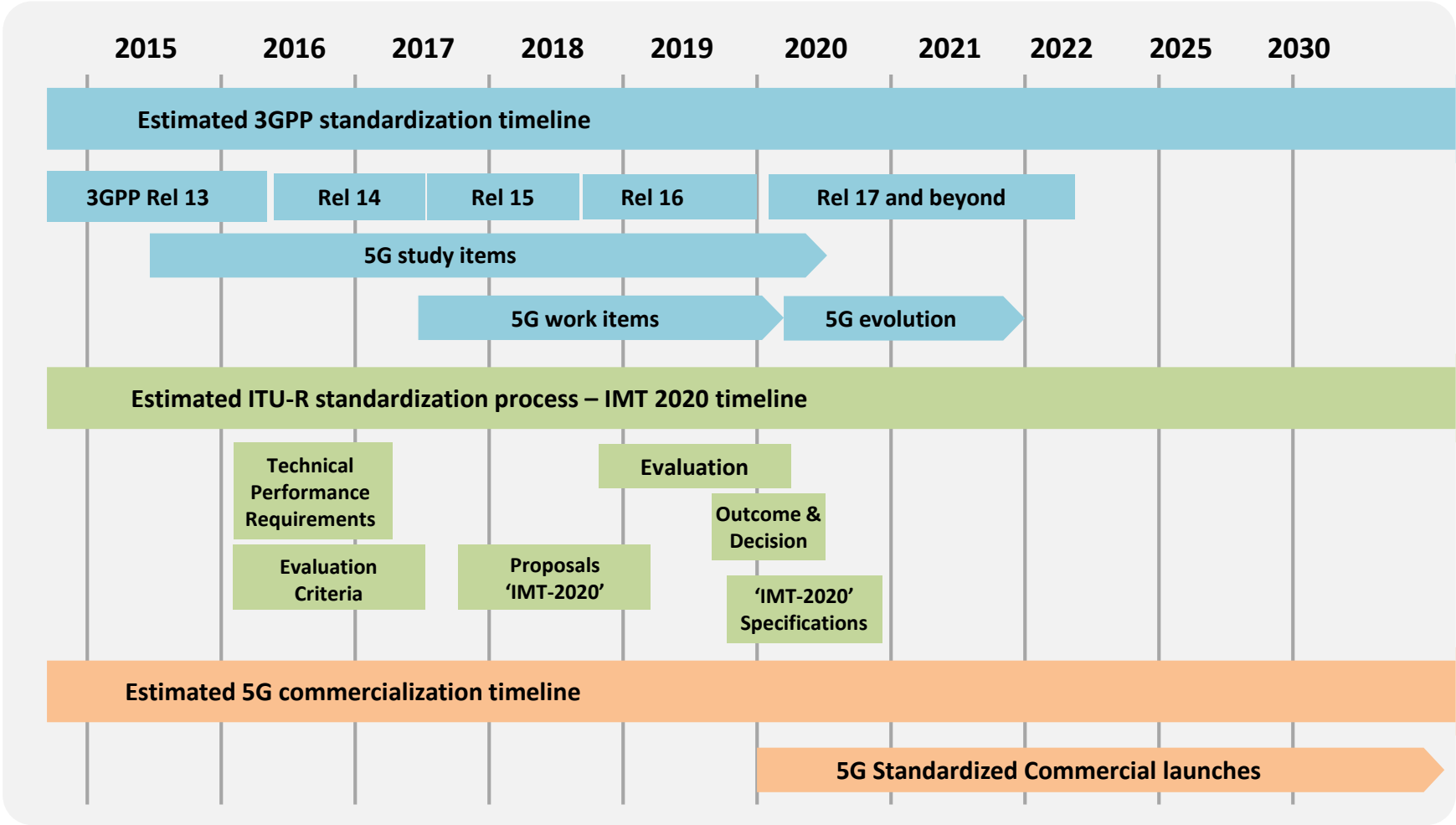
Source: ITU-R M.2083-0 (09/2015)

ITU and 3GPP



Source: 3GPP

5G Timetable – In theory



Source: 4G Americas

5G Timetable – Getting there ...



- 5G RAN PoC Test done, similar to SKT, DoCoMo, AT&T. etc.
- 20-site field trial in Huairou, Beijing with 6 Basestation vendors starts 2017



- Field trials in Tokyo (Odaiba and Sky Tree) starting mid-2017



“The path to Multi-Gigabit to the handset”

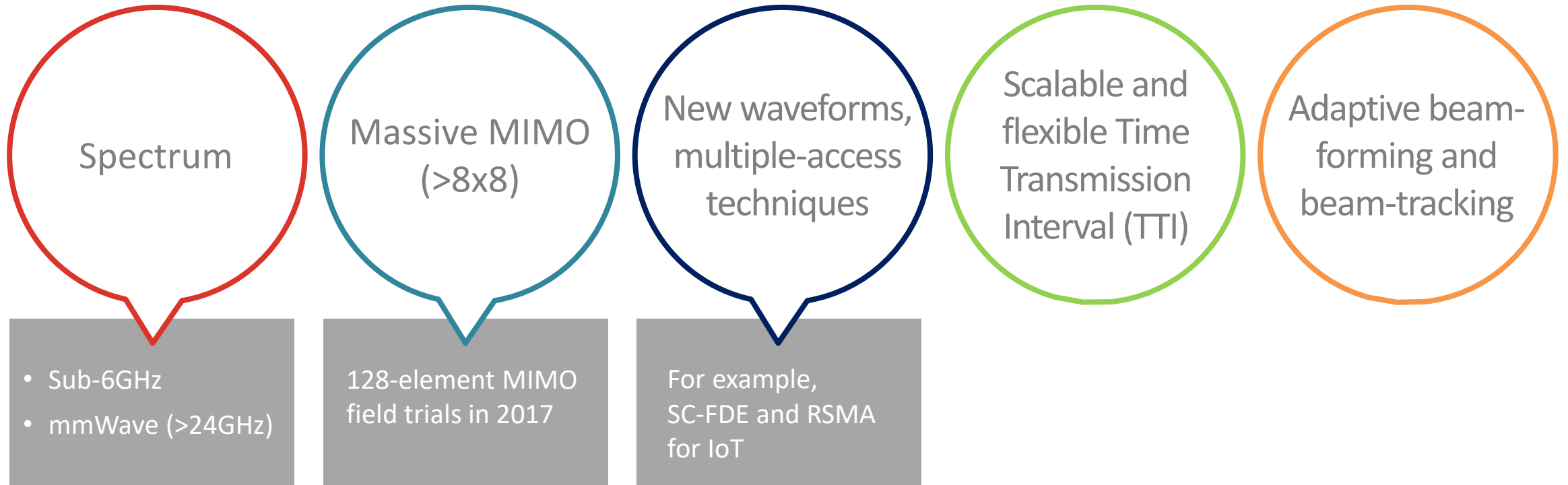
- LTE Small Cells
- Licensed Assisted Access (LAA) added to Small Cells
- mmWave ‘5G’ Small Cells (28GHz, 39GHz, 73GHz)
- New Radio (NR) Macro cells

The New Radio (NR)

5G New Radio Objectives



Peak Data Rate	20Gbps DL; 10Gbps UL
Peak Spectral Efficiency	30bps/Hz – 15bps/Hz
Control Plane Latency	10ms
User Plane Latency	URLLC: 0.5ms UL and DL
Mobility Interruption Time	0ms
Inter-system Mobility	With other IMT systems
Reliability	URLLC: P=10-5 in 1ms
Coverage	mMTC 164dB
Extreme Coverage	100-400km voice/low data
UE Battery Life	mMTC 15 years
Connection Density	mMTC 1M device/km2
Mobility	500 km/h



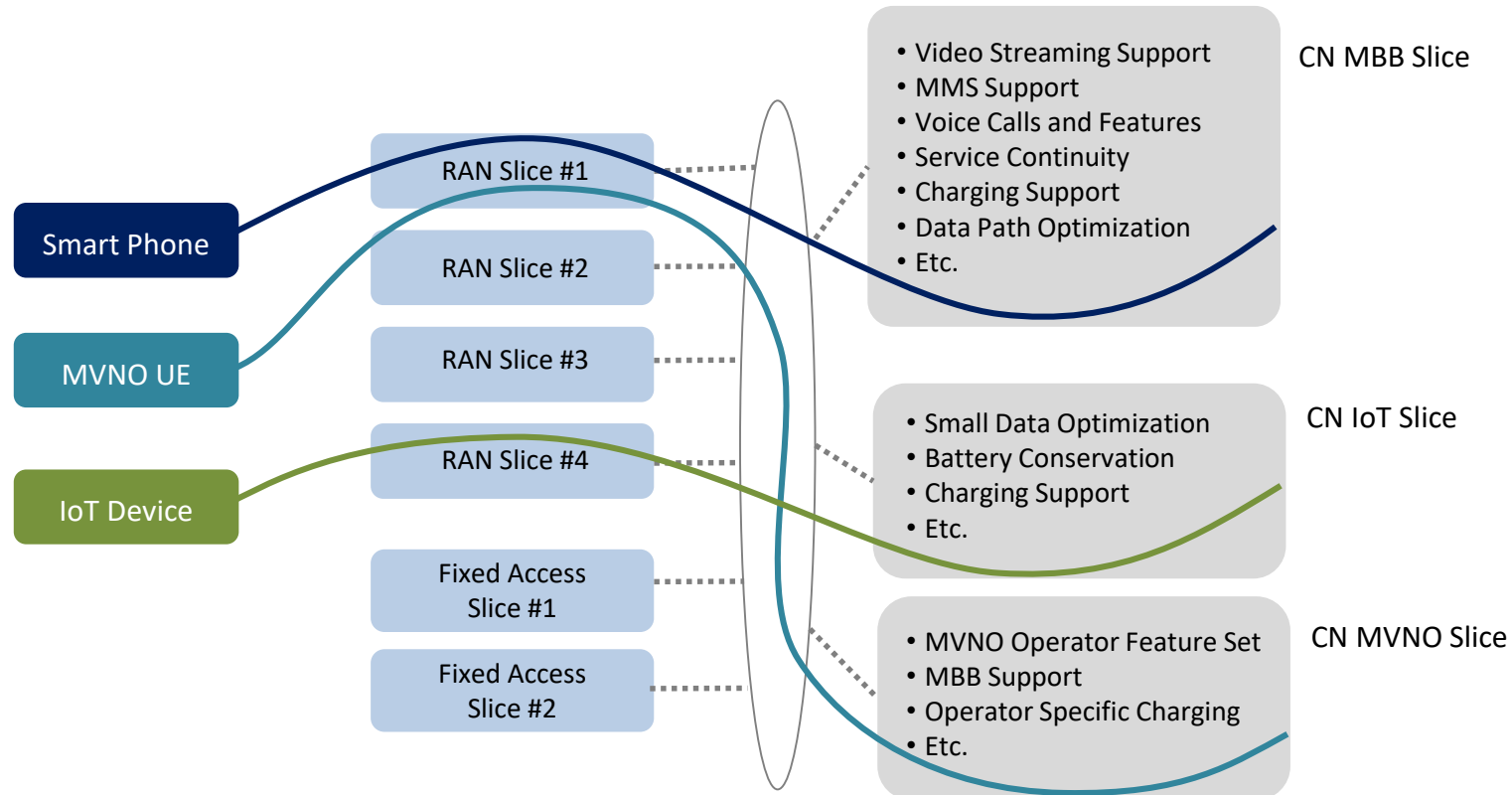
The Next-Gen Core (NGCN)

Network Slicing

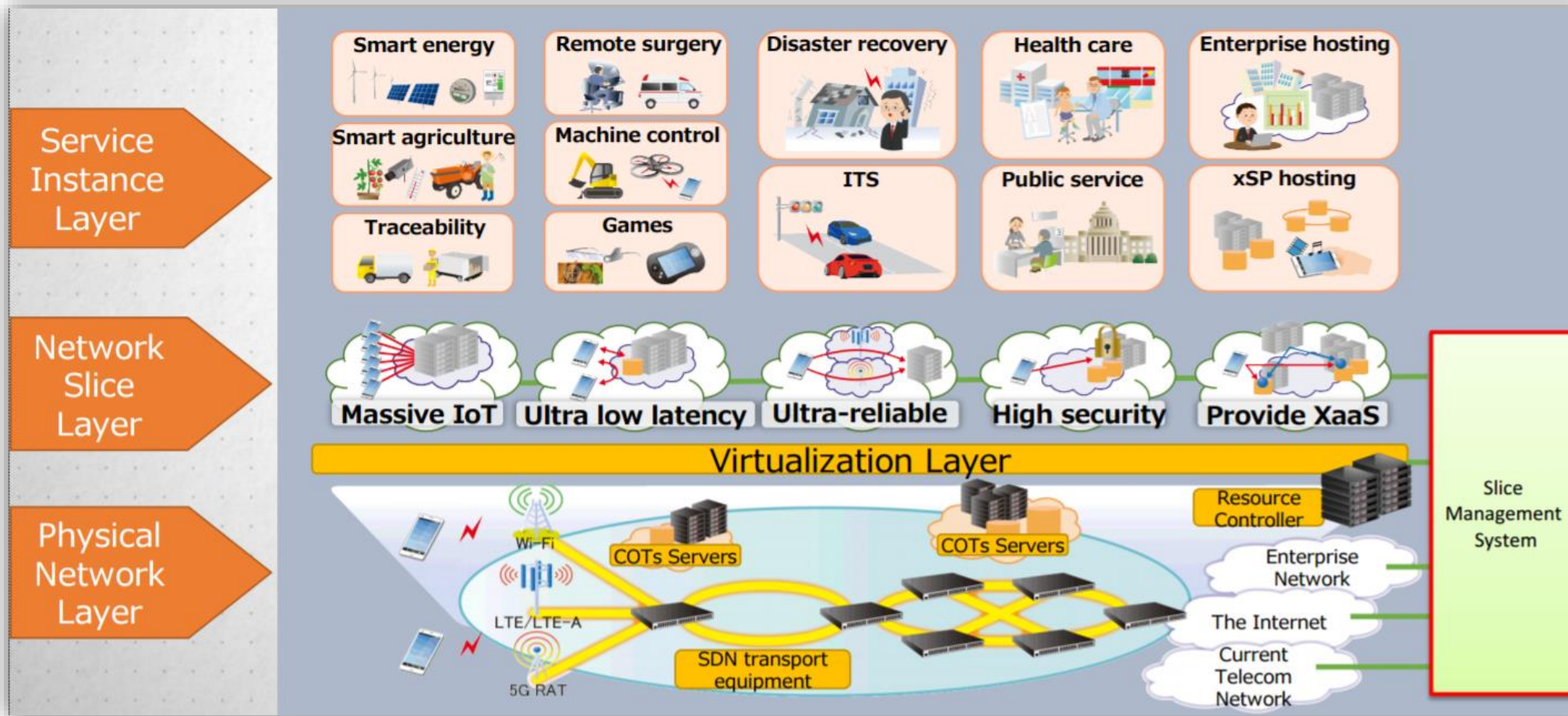


Logical network slices (multiple virtual networks)

- To provide 'Network as a Service'
- Different slices optimised for different 5G use-case needs



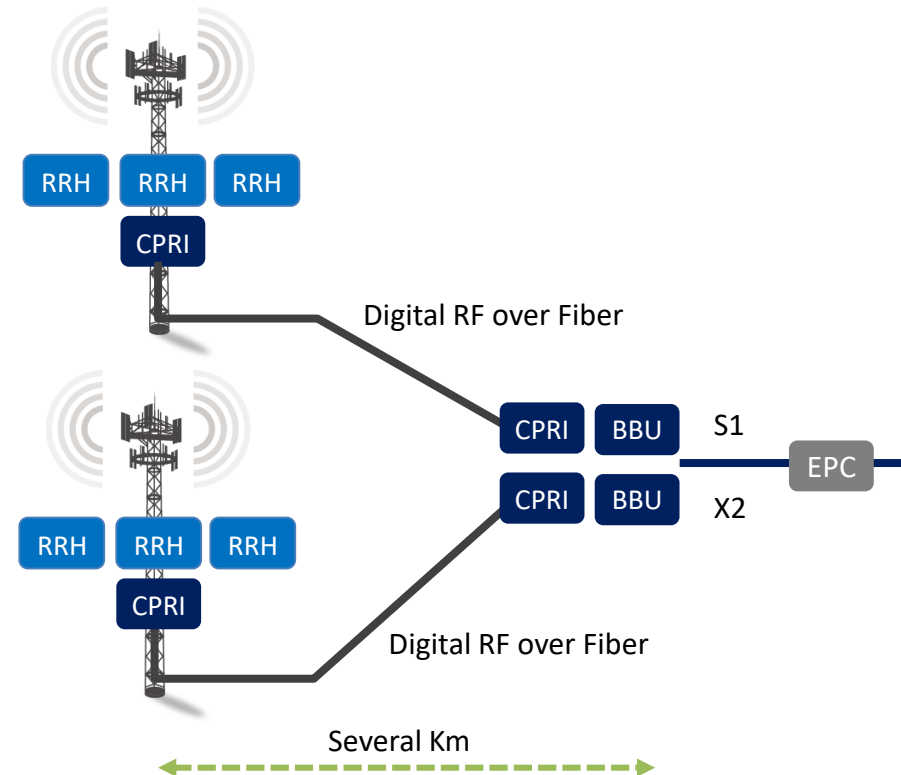
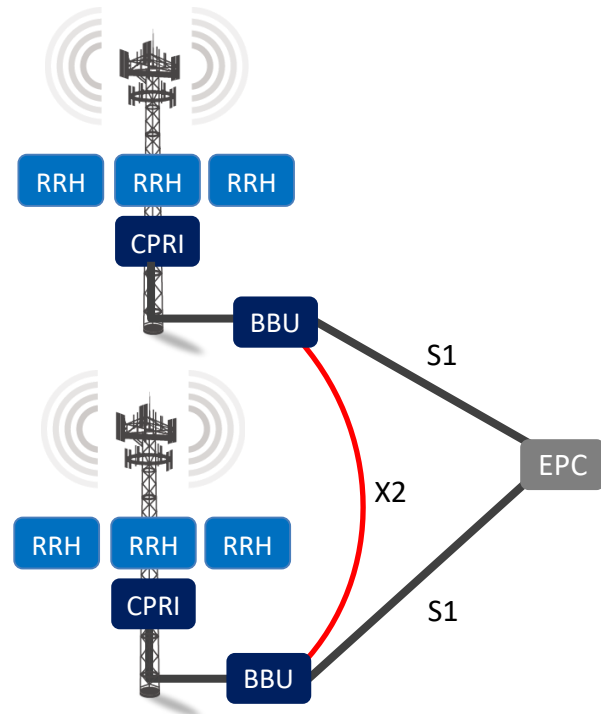
Network Slicing - DoCoMo



Source: NTT DoCoMo

Fronthaul / Backhaul

Fronthaul and Backhaul



- Currently migrating fronthaul to Fiber (CPRI)
- Also migrating to C(entralised)-RAN (also CPRI), BUT . . .

The CPRI Bit-rate Challenge

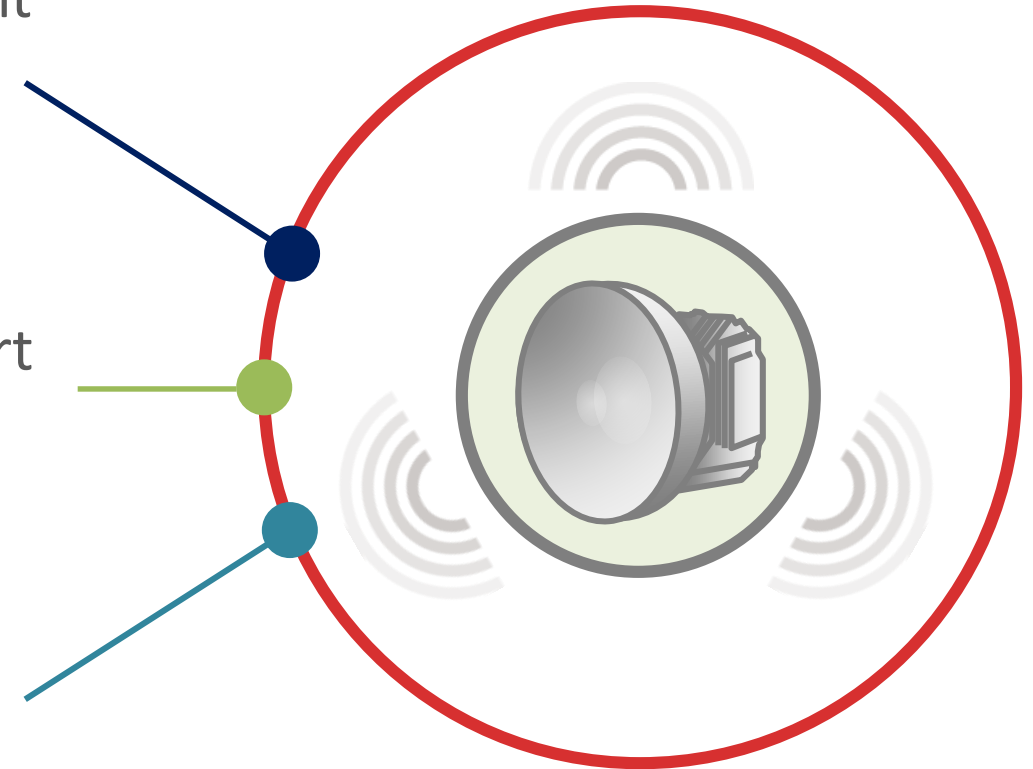


Current CPRI/ORI interfaces		Projected Requirements	
Line Rate	Example Use	Possible Uses	Approx. Line Rate
614.4 Mb/s	10 MHz LTE channel, with 8B10B encoding	1 GHz (mm-wave), 1 antenna	35 Gb/s
4.9152 Gb/s	8 x 10 MHz (multiple antennas, 8B10B)	100 MHz, 8 antennas (sectors/MIMO/CoMP)	28 Gb/s
10.1376 Gb/s	8 x 20 MHz (multiple antennas, 64B66B)	500 MHz, 8 antennas (sectors/MIMO/CoMP)	141 Gb/s
24.33024 Gb/s	24 x 20 MHz (multiple antennas, etc.)	500 MHz, 16 x 8 massive MIMO	2.25 Tb/s

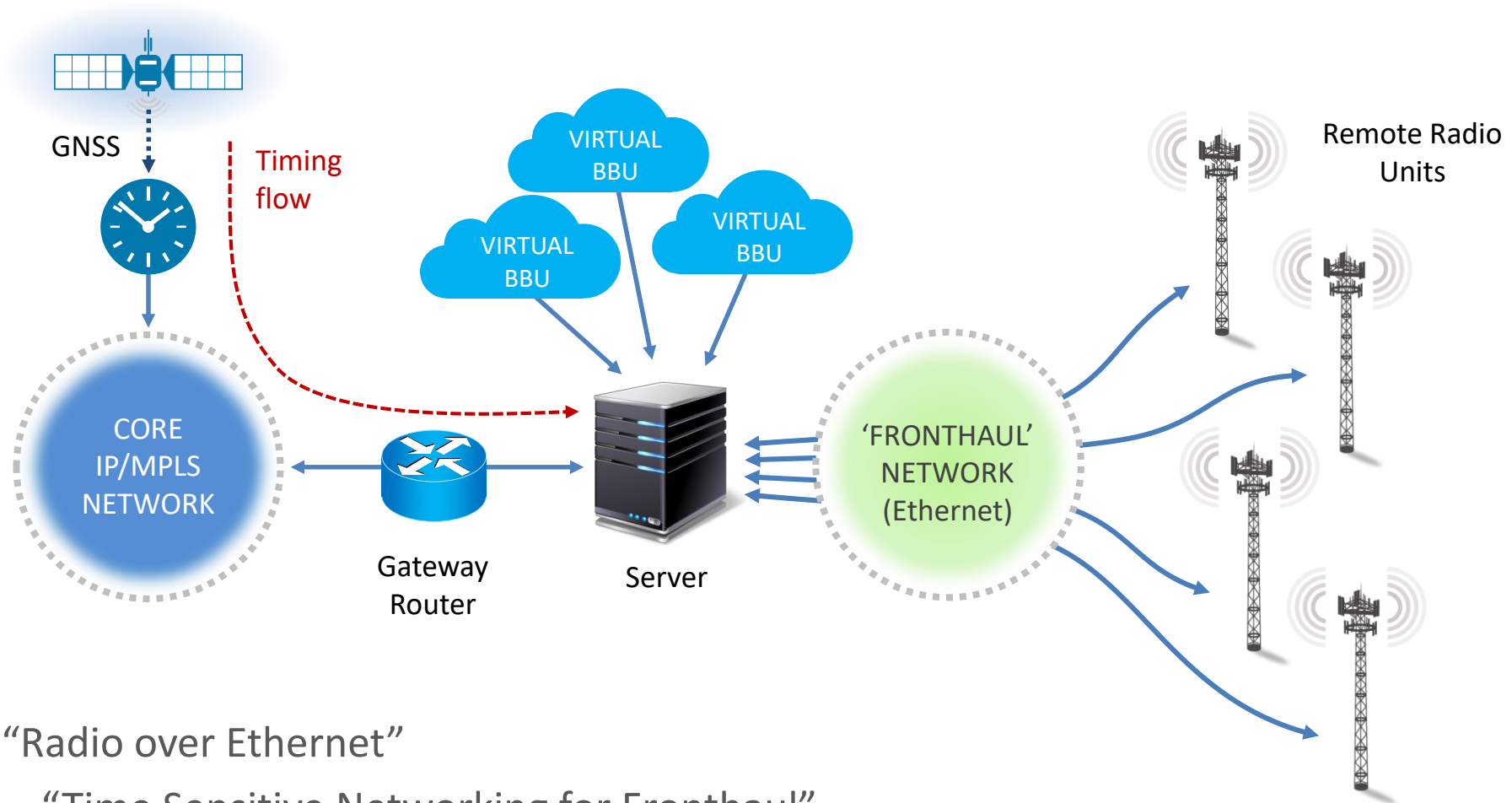
NG Fronthaul



- Investigating moving the functional 'split point' in the fronthaul and use statistical muxing to manage data rate
- Proposing the use of Ethernet as the transport (CPRI-over-Ethernet or Radio-over-Ethernet)
- Investigating the use of evolving Ethernet techniques (TSN, PTP, OAM, etc.) to deliver performance requirements



Fronthaul Architecture



- IEEE1904.3 – “Radio over Ethernet”
- IEEE802.1CM – “Time Sensitive Networking for Fronthaul”

Summary



- 5G is attempting to deliver greater speed, greater density, greater number of connections, greater reliability but with lower power and lower latency
- Wholesale changes need to be made to the Radio, the Core and the Transport Networks
- Initial trials have taken place to verify PoC for each of these areas

