

5G challenges, requirements and key differentiating characteristics from the perspective of a mobile operator

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Content

- Introduction

- 5G overall roadmap

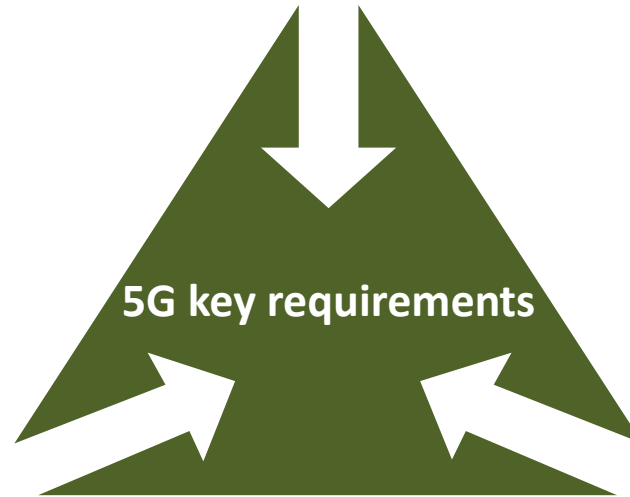
- Use cases and their requirements

- 5G Architecture

- Conclusions



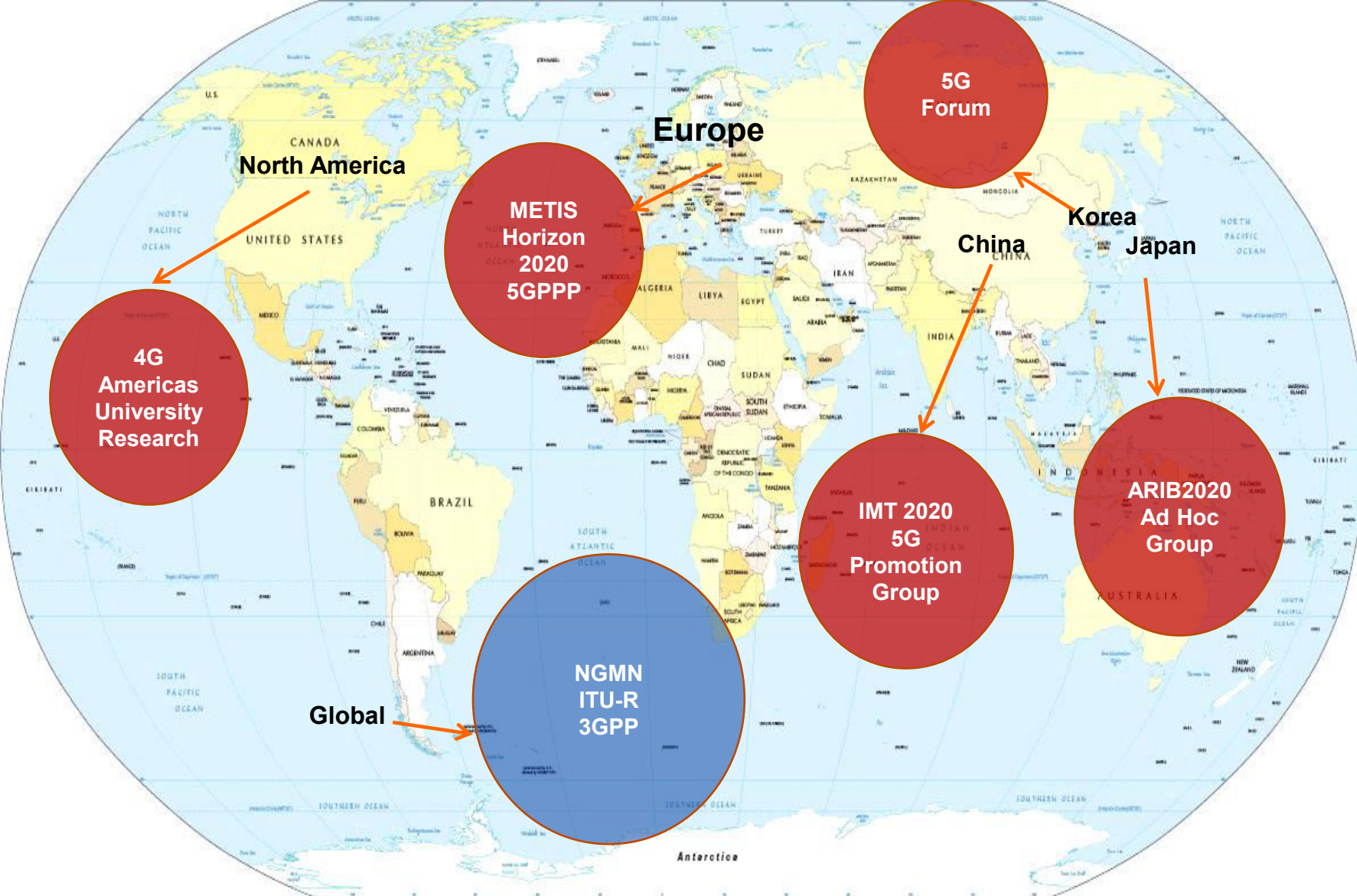
- ❖ Low power consumption
- ❖ Higher capacity and spectrum efficiency and agility
- ❖ Integration of 3GPP and non 3GPP RATs
- ❖ Ultra low latency



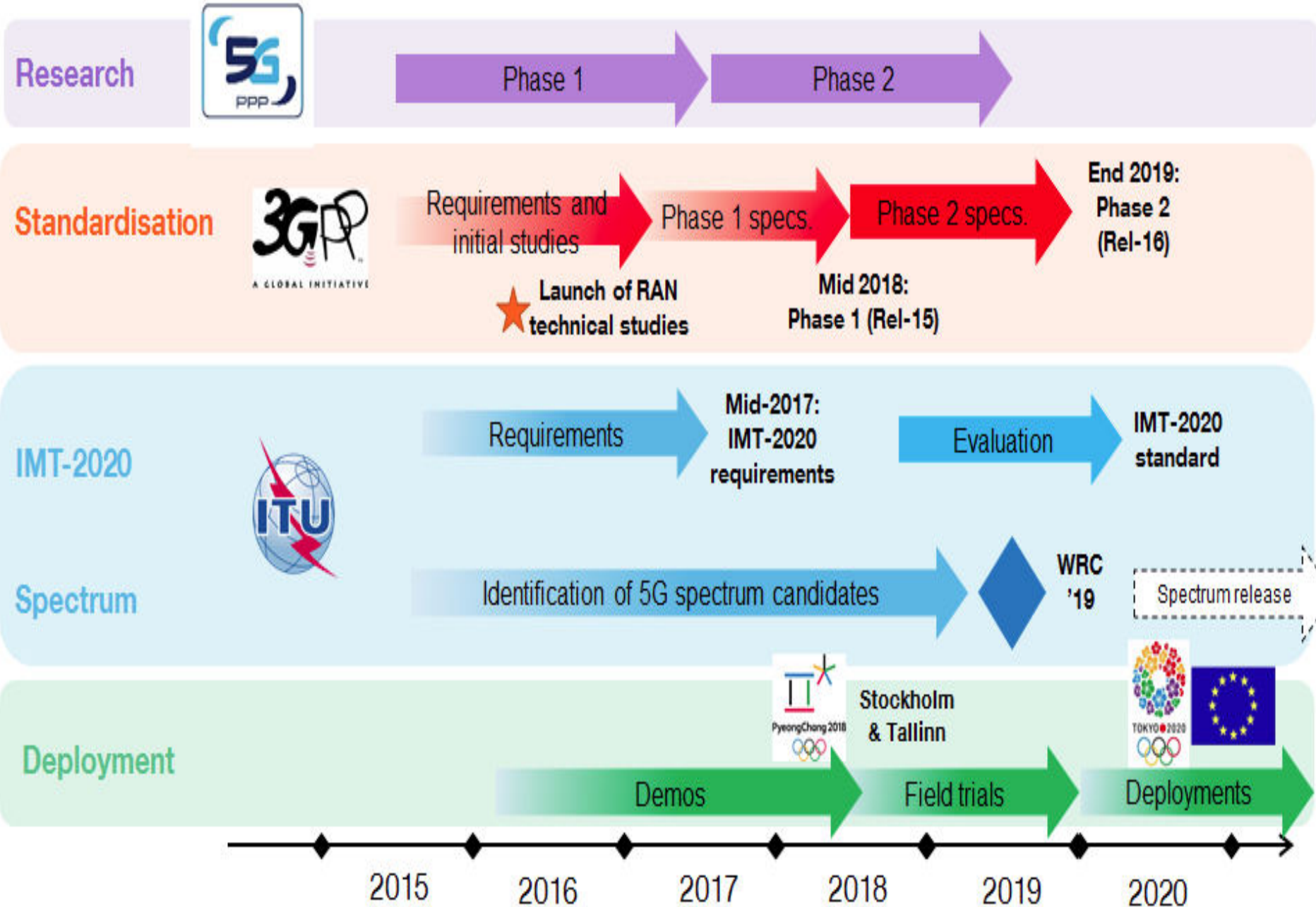
- ❖ Higher number of connected devices
- ❖ Seamless access to different wireless technologies
- ❖ Security and privacy of user`s data
- ❖ Resilience and robustness

- ❖ Convergence between fixed and mobile verticals
- ❖ Flexibility and openness for future integrations
- ❖ Ease of deployment and operation
- ❖ Cost efficiency

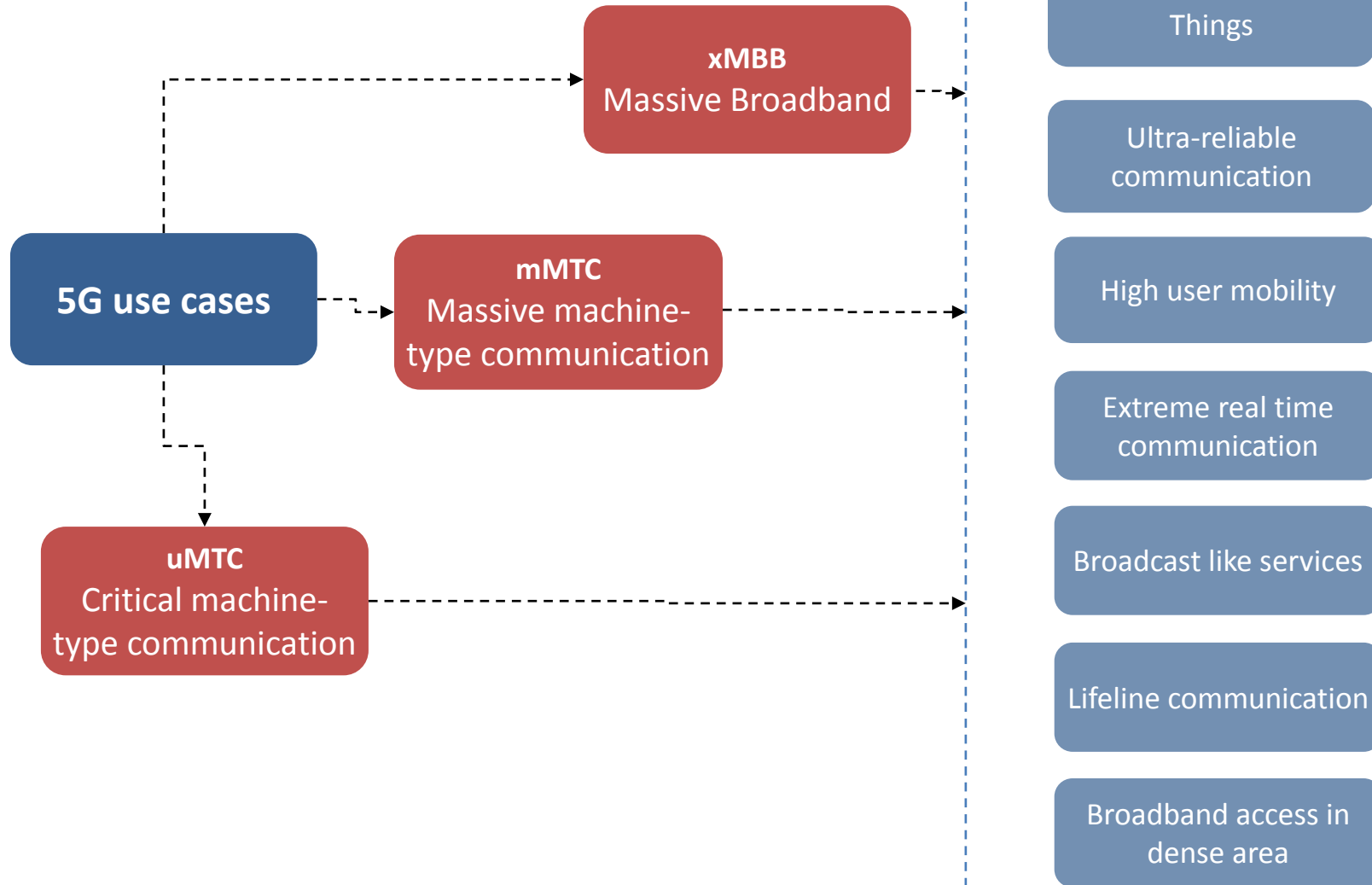
Global initiatives towards 5G



5G overall roadmap

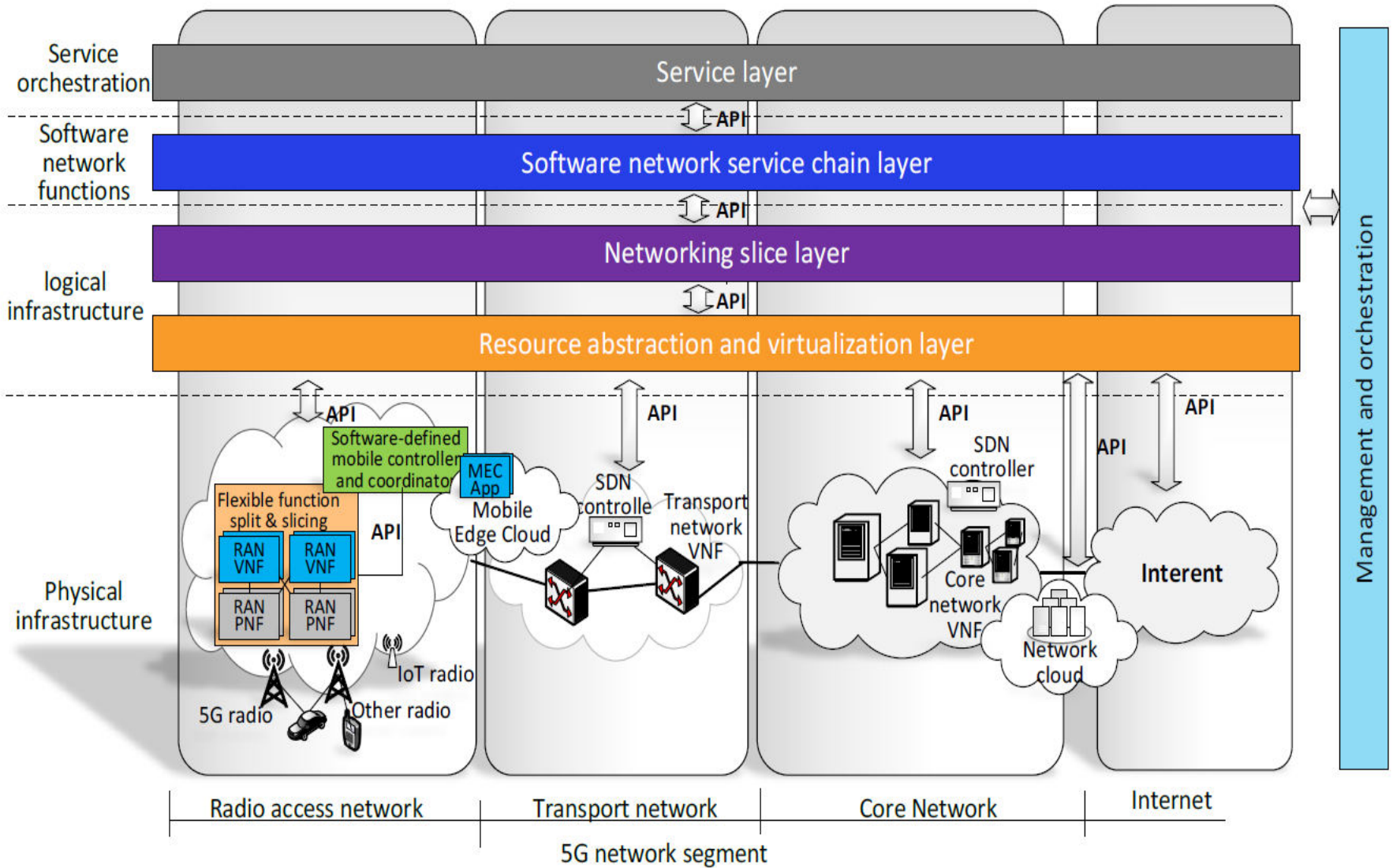


Categories of use cases



	Use case category	User Experience Data Rate	E2E Latency	Mobility	Connection Density	Traffic Density
Broadband access in dense area	Broadband access in dense areas	DL: 300 Mbps UL: 50 Mbps	10 ms	0-100 km/h	200-2500 /km2	DL: 750 Gbps / km2 UL: 125 Gbps / km2
	Indoor ultra-high broadband access	DL: 1 Gbps UL: 500 Mbps	10 ms	Pedestrian	75,000 / km2	DL: 15 Tbps/ km2 UL: 2 Tbps / km2
	Broadband access in a crowd	DL: 25 Mbps UL: 50 Mbps	10 ms	Pedestrian	150,000 / km2	DL: 3.75 Tbps/ km2 UL: 7.5 Tbps / km2
Broadband access everywhere	50+ Mbps everywhere	DL: 50 Mbps UL: 25 Mbps	10 ms	0-120 km/h	400 /km2 in suburban 100 / km2 in rural	DL: 20 Gbps / km2 in suburban UL: 10 Gbps / km2 in suburban DL: 5 Gbps / km2 in rural UL: 2.5 Gbps / km2 in rural
	Ultra-low cost broadband access	DL: 10 Mbps UL: 10 Mbps	50 ms	0-50 km/h	16 / km2	16 Mbps / km2
High user mobility	Mobile broadband in vehicles (cars, trains)	DL: 50 Mbps UL: 25 Mbps	10 ms	up to 500 km/h	2000 / km2 (500 active users per train x 4 trains, or 1 active user per car x 2000 cars)	DL: 100 Gbps / km2 (25 Gbps per train, 50 Mbps per car) UL: 50 Gbps / km2 (12.5 Gbps per train, 25 Mbps per car)
	Airplanes connectivity	DL: 15 Mbps/ user UL: 7.5 Mbps/ user	10 ms	up to 1000 km/h	60 airplanes per 18,000 km2	DL: 1.2 Gbps / plane UL: 600 Mbps / plane
Massive Internet of Things	Massive low-cost/long-range/low-power MTC	Low: 1-100 kbps	seconds to hours	0-500 km/h	Up to 200,000 / km2	Non critical
	Broadband MTC	See the requirements for the Broadband access in dense areas and 50+Mbps everywhere categories				
Extreme real time communication	Ultra-low latency	DL: 50 Mbps UL: 25 Mbps	<1 ms	Pedestrian	Not critical	Potentially high
Lifeline communication	Resilience and traffic surge	DL: 0.1-1 Mbps UL: 0.1-1 Mbps	not critical	0-120 km/h	10,000 / km2	Potentially high
Ultra-reliable communication	Ultra-high reliability & Ultra-low latency	DL: 50 kbps - 10 Mbps UL: few bps - 10 Mbps	1 ms	0-500 km/h	Not critical	Potentially high
	Ultra-high availability & reliability	DL: 10 Mbps UL: 10 Mbps	10 ms	0-500 km/h	Not critical	Potentially high
Broadcast like services	Broadcast like services	DL: Up to 200 Mbps UL: 500 kbps	<100 ms	0-500 km/h	Not relevant	Not relevant

5G overall architecture



Radio Access Network

- Additional layer of small cells into the existing macro-cellular RAN
- Massive MIMO deployment
- Utilization of a new type of frequency band

Transmission Network

- Fiber optic that can transport a large capacity (up to 100 Gb)
- New segments of fiber and the existing ones will be adapted to support new requirements

Core Network

- Virtual Network Functions -VNFs running in virtual machines over standard x86 servers on cloud computing infrastructures orchestrated by a Virtual Infrastructure Manager.
- VNFs deployed by a VNF Manager in different data centers, with respect to the requirements regarding to latency, processing and storage capacity or available transport.

Physical Architecture

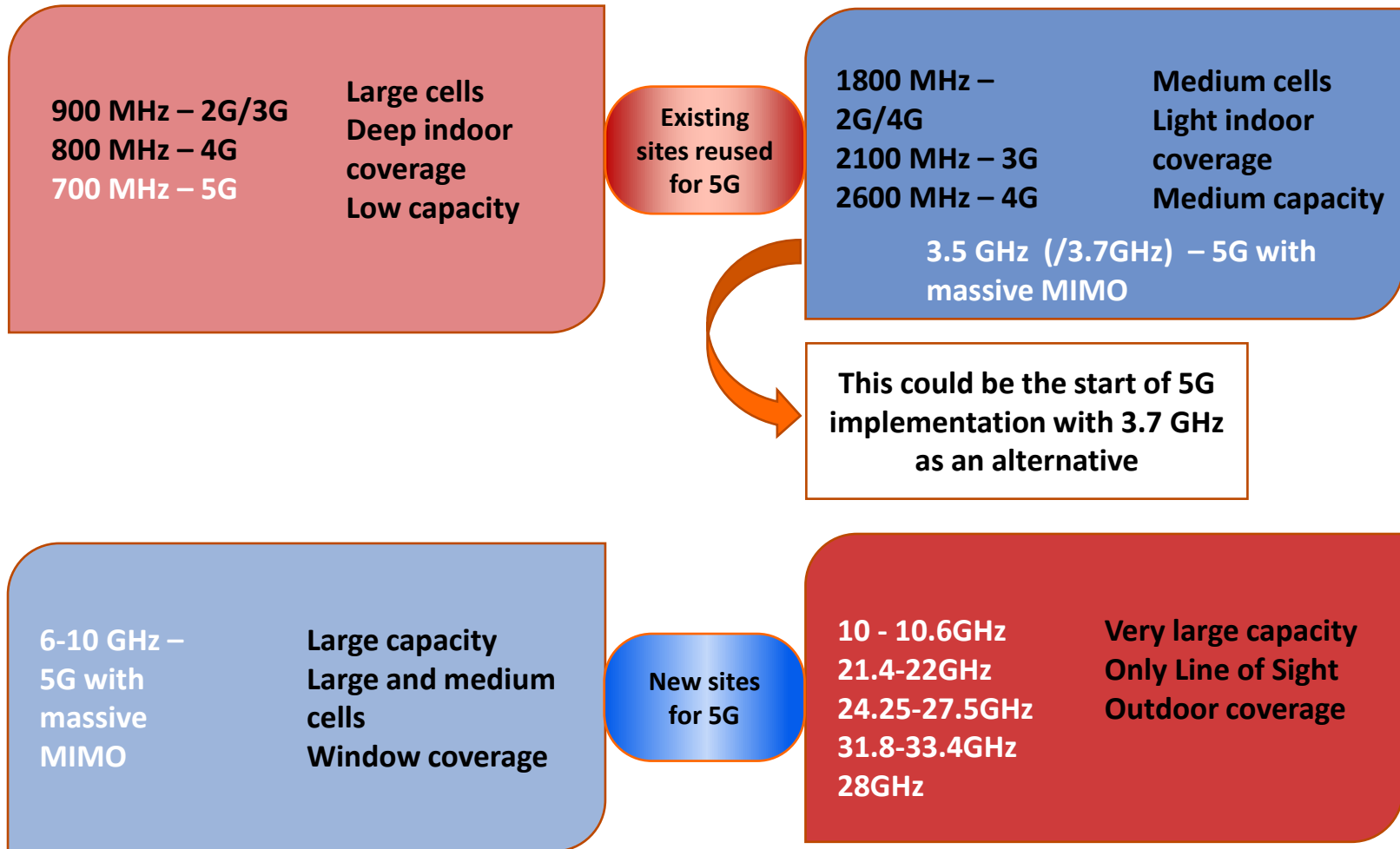
Logical Architecture

- 5G architecture will provide the flexibility to allow a per-slice basis grouping of network functions to logical entities and further the logical to physical architecture in accordance with ETSI (Telecommunication Standards Institute) NFV framework.

- With the ability to program the infrastructure, the control and data plane functions will be tailored according to the real-time network conditions and service needs, enabling scalability of both planes.

- 5G slice is a collection of 5G network functions and specific radio access technology settings that are combined together for the specific use case. It supports the communication service of a particular connection type with a specific way of handling the control and user plane for this service. The aim of a 5G slice is to provide just the traffic treatment required for the case and to avoid any other unnecessary functionality.

Spectrum aspects (frequency recommendation and regulations)



Conclusions



5G will bring:

- ❖ new standard => new spectrum, new radio, new features
- ❖ new way of thinking about mobile network design => virtualization, slicing
- ❖ more capacity
- ❖ flexibility in deployment
- ❖ more opportunities to launch new services
- ❖ ultra low latency
- ❖ connect things to super-networks
- ❖ higher number of connected devices
- ❖ low power consumption

Questions?

thank you!

благодарение!

хвала!

multumesc!

grazie!

merci!

danke!

go raibh maith agat!

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