PRELIMINARY 5G SPECTRUM SCENARIOS & WRC-15 RESULTS

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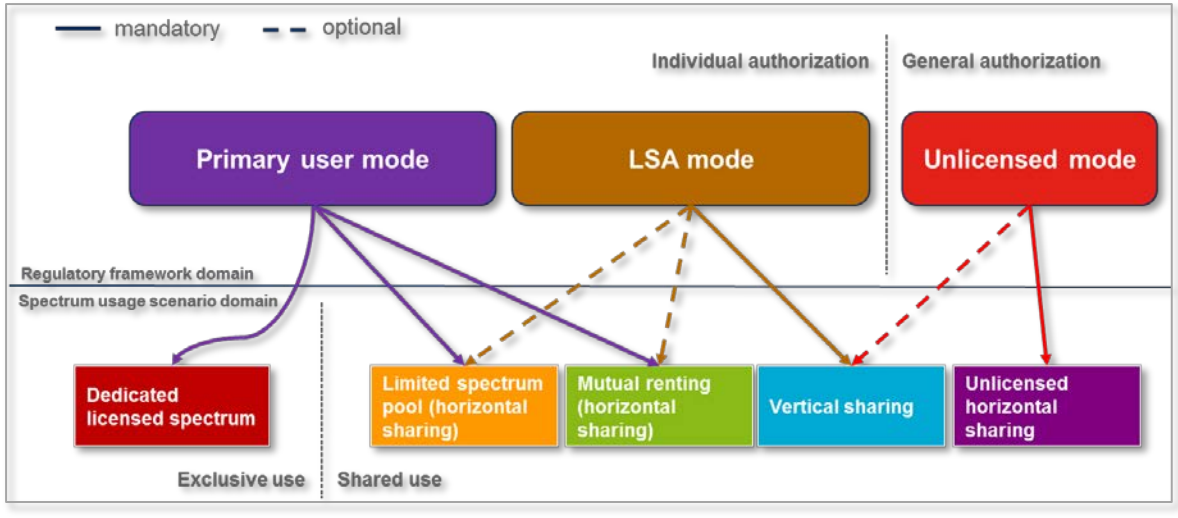
SPECTRUM LANDSCAPE, ACCESS MODES & USAGE SCENARIOS

Usage condition	License / Service				
	License	Dedicated (Exclusive)	Dedicated	LSA	Unlicensed (Shared)
	Service	Primary	Primary		Secondary
Frequency band classification		Exclusive	Shared		License-free
Primary service allocation		Mobile (& other service(s))	Mobile & other service(s)		Mobile & other service(s)
Band Examples		880-915/925-960 MHz Band	1452-1492 MHz Band	2300-2400 MHz Band	5150-5350 MHz Band

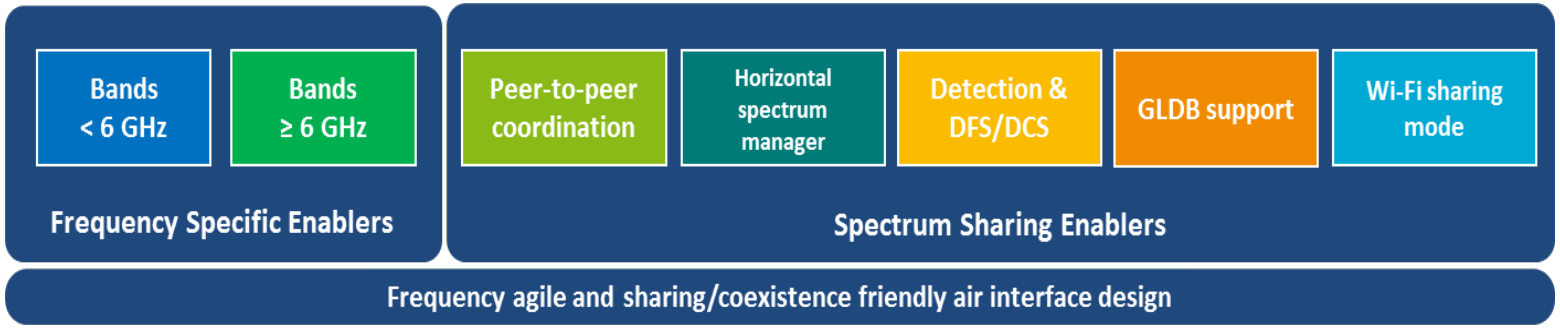
Multiple frequency bands, subject to different regulation including various forms of shared spectrum.

Three spectrum access modes and five basic spectrum usage scenarios - that 5G systems need to support - can be identified.

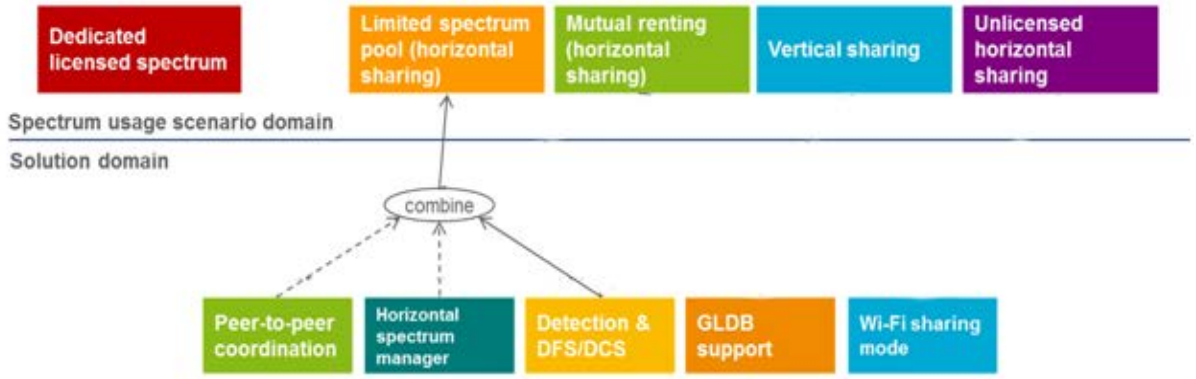


METIS SPECTRUM TOOLBOX

Technical enablers required to support all spectrum usage scenarios.



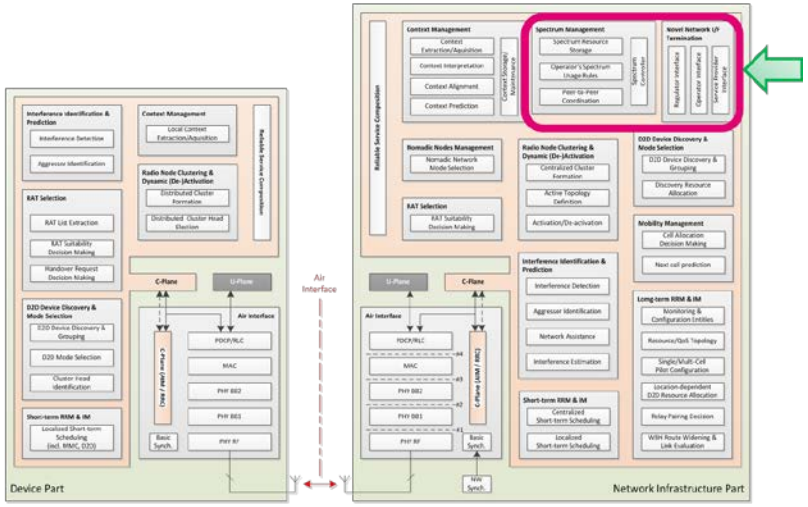
Technical enablers for extending a LSA spectrum sharing scenario with a limited spectrum pool.

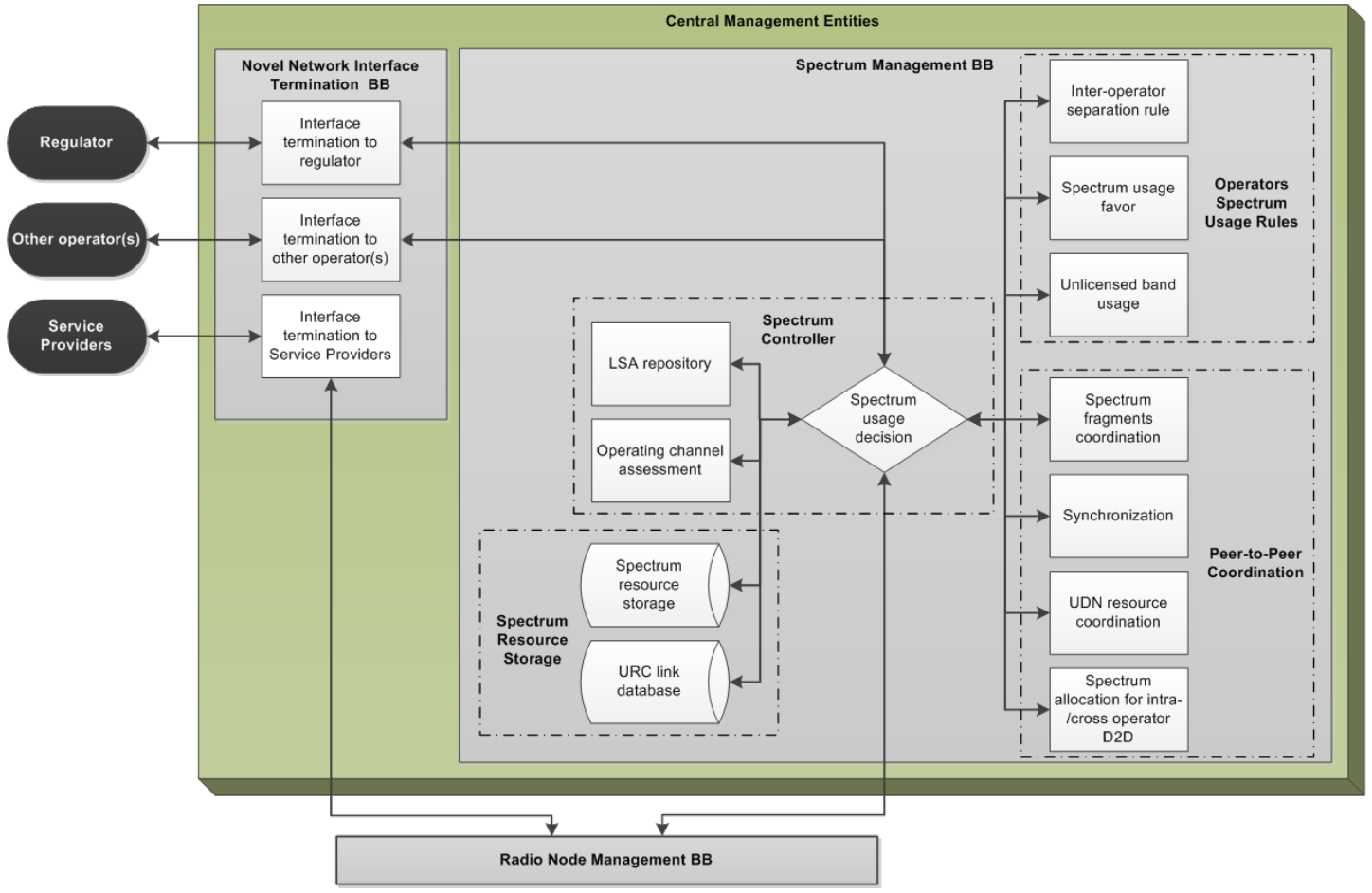


METIS 5G GENERIC FUNCTIONAL ARCHITECTURE

Functional Elements derived from Spectrum Technology Components

- METIS D6.4: Final report on architecture
- https://www.metis2020.com/documents/deliverables/

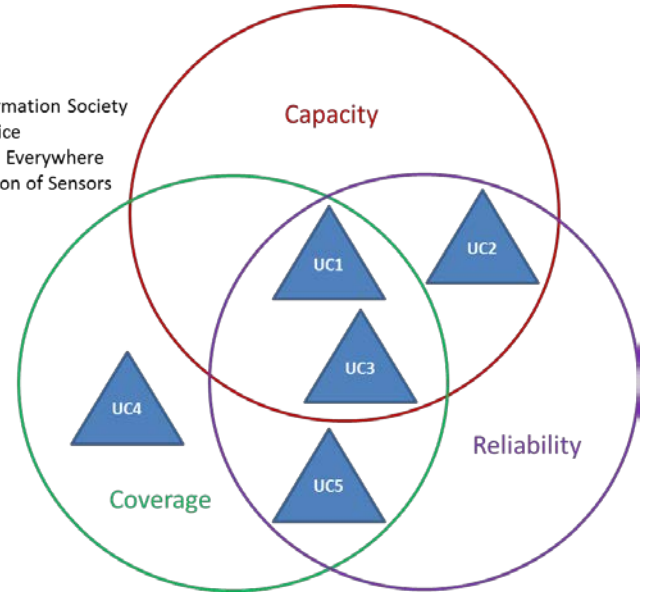




METIS-II 5G USE CASES AND THEIR IMPACT ON SPECTRUM

Use case		Scope of Requirements (Network/User Perspective)	Scope of Services (Service Perspective)	
xMBB mMTC	Dense Urban Information Society	Experienced user data rate / Traffic vol. per subscriber / Nb. of users & devices / Energy efficiency	Broad range of communication services covering needs related to both indoor and outdoor urban daily life (excl. office and factory)	*METIS-I UC enriched by NGNM Mobile Video Surveillance UC*
xMBB	Virtual Reality Office	Experienced user data rate/Traffic volume per subscriber/ Latency	Broad range of communication services in in the (indoor) office context	*METIS-I UC*
xMBB	Broadband Access Everywhere	Experienced user data rate / Availability / Mobility / Energy efficiency	Full coverage topic addressing outdoor/indoor communication needs especially in rural areas	*NGNM Use-Case 50+ Mbps everywhere incl. METIS-I Blind Spot TC*
mMTC	Massive Distribution of Sensors and Actuators	Availability / Number of devices / Energy efficiency	Broadest range of IoT services covered	*METIS-I UC Massive Deployment of Sensors and Actuators*
xMBB uMTC	Connected cars	Latency/ Reliability / Mobility	Strong expectation from the (automotive) industry Belong to the first uMTC services expected to be commercialized	*METIS-I UC on traffic efficiency and safety completed by MBB aspects*

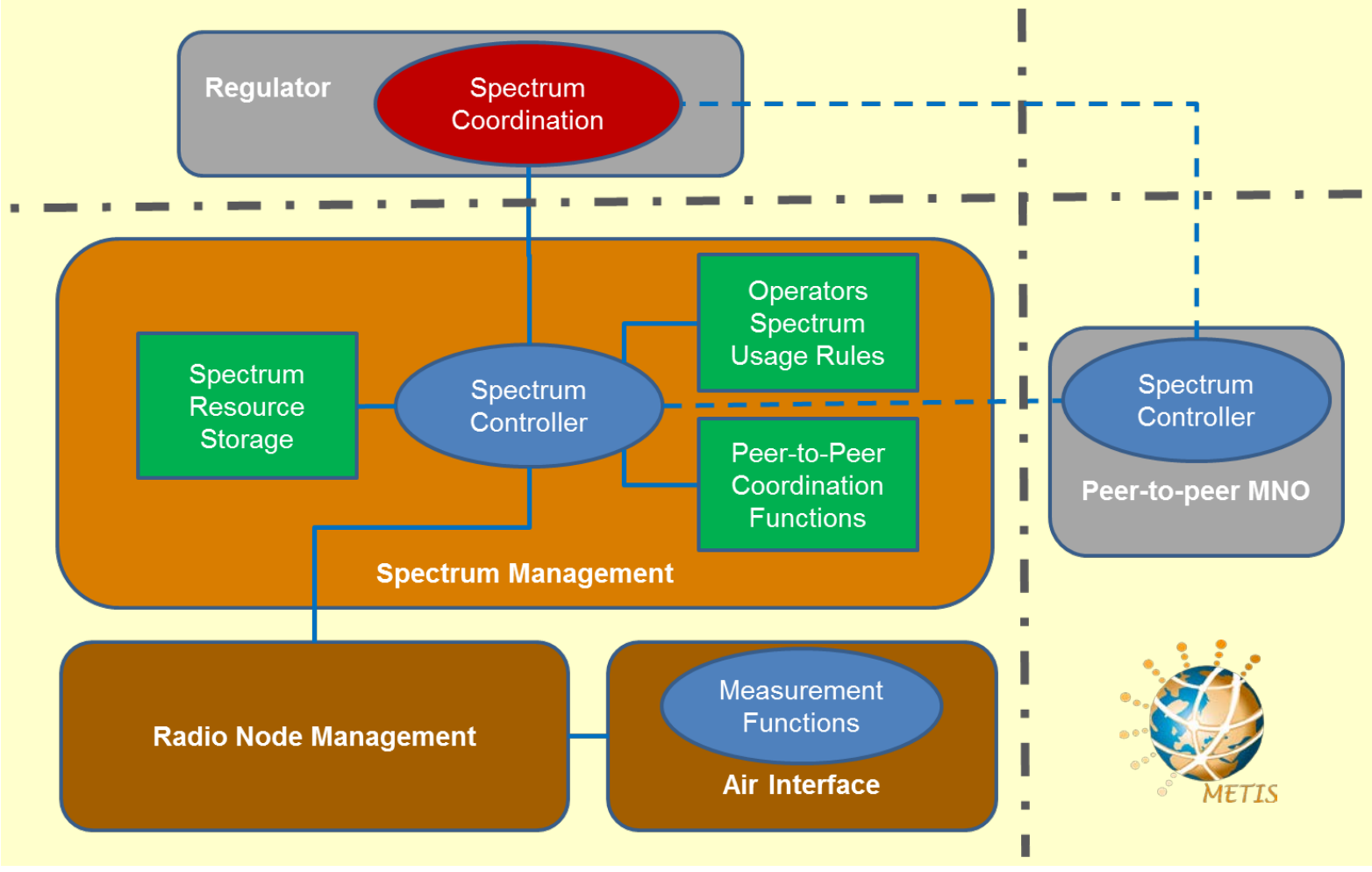
UC1 – Dense Urban Information Society
UC2 – Virtual Reality Office
UC3 – Broadband Access Everywhere
UC4 – Massive Distribution of Sensors and Actuators
UC5 – Connected cars



- Capacity to cope with high traffic per cell → high bandwidth
- Coverage to ensure the availability of 5G everywhere → lower frequencies
- Reliability to fulfill the demands of critical services, requiring stable & predictable operation conditions → dedicated spectrum

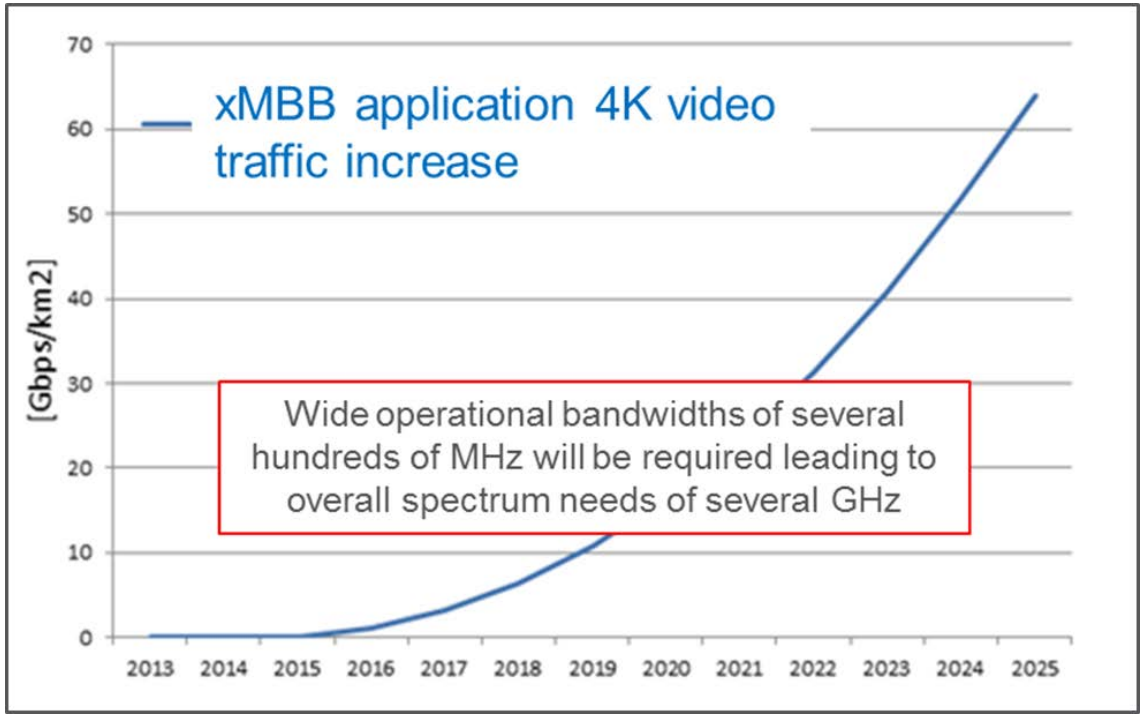
TOWARDS HOLISTIC SPECTRUM MANAGEMENT ARCHITECTURE

METIS-II will define a framework and an architecture for flexible spectrum management and multi-operator collaboration in 5G, with integration of spectrum above 6 GHz and consideration of “new 5G user groups” and vertical industries.

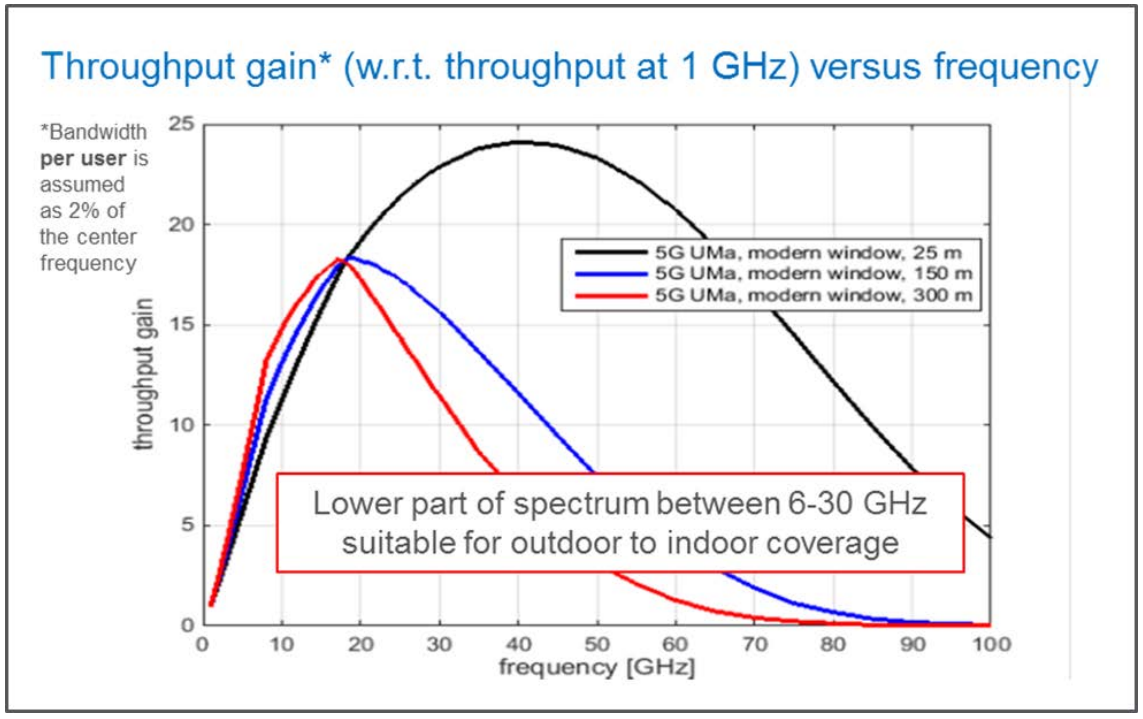


R3.1: "JUSTIFICATION FOR 5G BANDS ABOVE 6 GHZ"

TRAFFIC INCREASE & OUTDOOR-INDOOR COVERAGE



Year	Gbps/km^2	Spectrum bands used in the simulation	Bandwidth required for the DL
2015	2	2.6 GHz, 3.5 GHz	80 + 80 MHz
2025	60-70	2.6 GHz, 3.5 GHz, 10 GHz	80 + 80 + 500 MHz



Throughput gain as a function of frequency is shown, by using Shannon capacity to estimate the throughput and throughput at 1 GHz as reference. Degradation after a certain frequency for outdoor-to-indoor coverage is observed, even with wider channel bandwidths at higher frequencies.

R3.1: “JUSTIFICATION FOR 5G BANDS ABOVE 6 GHZ”

CONCLUSIONS

- 5G service requirements are challenging future mobile networks with regard to coverage, capacity and reliability.
- Example cases for different services (xMBB, uMTC) indicate demand of several hundreds of MHz per network.
- For capacity increase, spectrum and the other two elements (network densification and technical innovations) are exchangeable in macro-cell environments. However, in dense deployments, spectrum is the most effective solution.
- As building penetration depth strongly decreases with increasing frequency, the lower part of the spectrum between 6 -30 GHz is suitable for outdoor to indoor coverage.
- Contiguous bandwidth offers advantages with regard to device complexity, signaling, guard bands and interference.
- Field trials and existing non-mobile technologies indicate the feasibility to use spectrum above 6 GHz also for mobile applications. Technology innovations are required.

A spectrum amount of several GHz is required to be sought in a combination of different suitable frequency bands in various spectrum parts in the whole range up to 100 GHz.

METIS-II Report 3.1 publicly available : https://metis-ii.5g-ppp.eu/documents/deliverables/

WRC-15 RESULTS

NEW SPECTRUM BANDS FOR IMT / IMT2020

AI 1.1 to consider additional spectrum allocations to the mobile service on a primary basis and identification of additional frequency bands for International Mobile Telecommunications (IMT) and related regulatory provisions, to facilitate the development of terrestrial mobile broadband applications, in accordance with Resolution 233 (WRC-12)

- 694 – 790 MHz
- 1427 – 1518 MHz
- 3400 – 3600 MHz

➢ Further bands identified for IMT in individual countries

RESOLUTION COM6/20 (WRC-15): Studies on frequency-related matters for International Mobile Telecommunications identification including possible additional allocations to the mobile services on a primary basis in portion(s) of the frequency range between 24.25 and 86 GHz for the future development of International Mobile Telecommunications for 2020 and beyond

- 24.25 – 27.7 GHz
- 31.8 – 33.4 GHz
- 37 – 43.5 GHz
- 45.5 – 50.2 GHz
- 50.4 – 52.6 GHz
- 66 – 76 GHz
- 81 – 86 GHz

WRC-15 RESULTS

SPECTRUM DEMAND & BANDS IDENTIFIED FOR IMT

Frequency bands identified for IMT in the ITU-R Radio Regulations after WRC-15	
Band (MHz)	Spectrum amount (MHz)
450 – 470	20
694 – 960	266
1427 – 1518	91
1710 – 2025	315
2110 – 2200	90
2300 – 2400	100
2500 – 2690	190
3400 – 3600	200
Total amount	1272 MHz

Total spectrum requirements for "Pre-IMT systems, IMT-2000 and its enhancements and IMT-advanced" in the year 2020 [Source: Report ITU-R M.2290-0]	
Lower user density settings	1340 MHz
Higher user density settings	1960 MHz

Spectrum gap in the year 2020	
Lower user density settings	> 68 MHz
Higher user density settings	> 688 MHz
">" as not all spectrum bands available in every country.	

THANK YOU!