Enablers to secure sufficient access to adequate spectrum for 5G

Deliverable D3.2

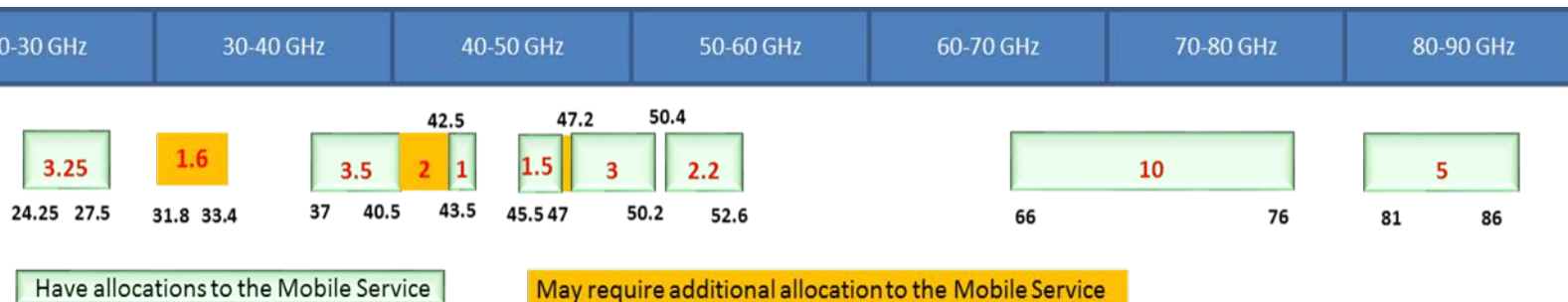2017-06-30

Contents (Abstract)

Frequency bands for 5G

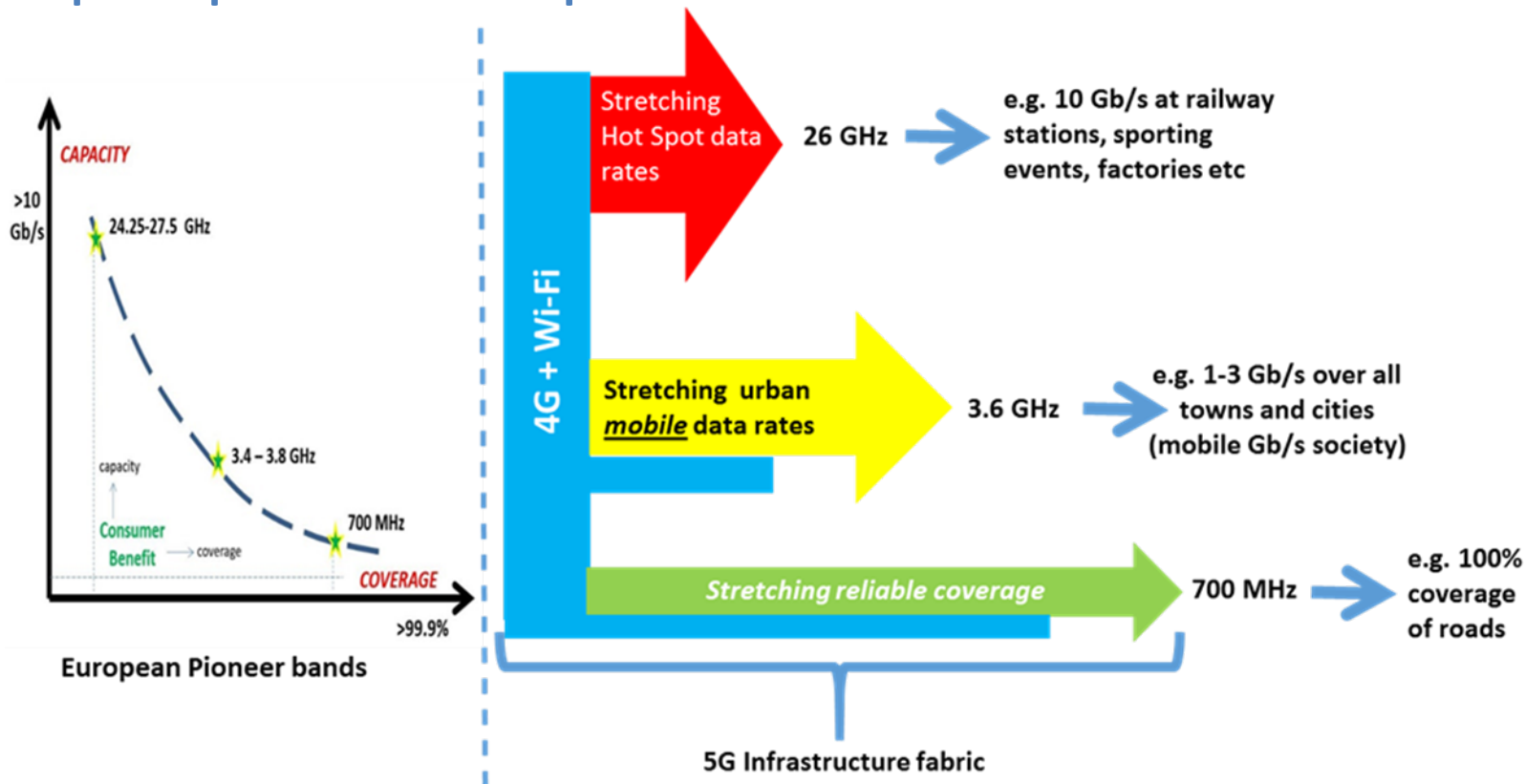**Main frequency bands under consideration/discussion for 5G deployment**

› 600/700 MHz bands (e.g. in US, Europe)

› 3.3-3.8 GHz range (e.g. in Europe, China, Japan, South Korea)

› 24.25-29.5 GHz range (e.g. in Europe, China, Japan, South Korea, US)

Frequency bands to be studied in ITU-R for 5G/IMT-2020 for WRC-19

20-30 GHz	30-40 GHz	40-50 GHz	50-60 GHz	60-70 GHz	70-80 GHz	80-90 GHz

			42.5	47.2	50.4	

3.25   1.6   3.5 2 1   1.5   3   2.2   10   5

24.25 27.5   31.8 33.4   37 40.5   43.5   45.5 47 50.2 52.6   66   76   81   86

Have allocations to the Mobile Service

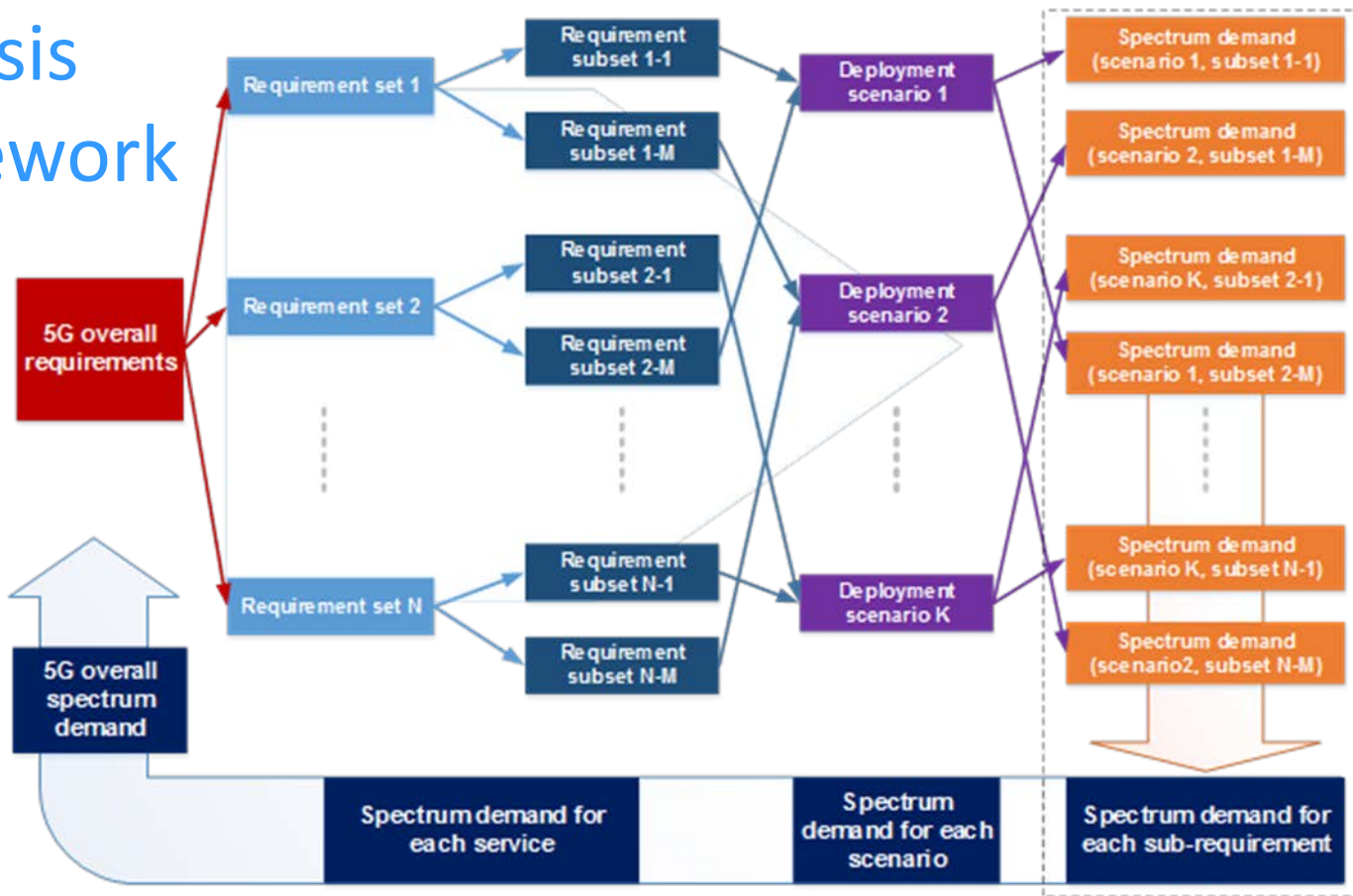May require additional allocation to the Mobile Service
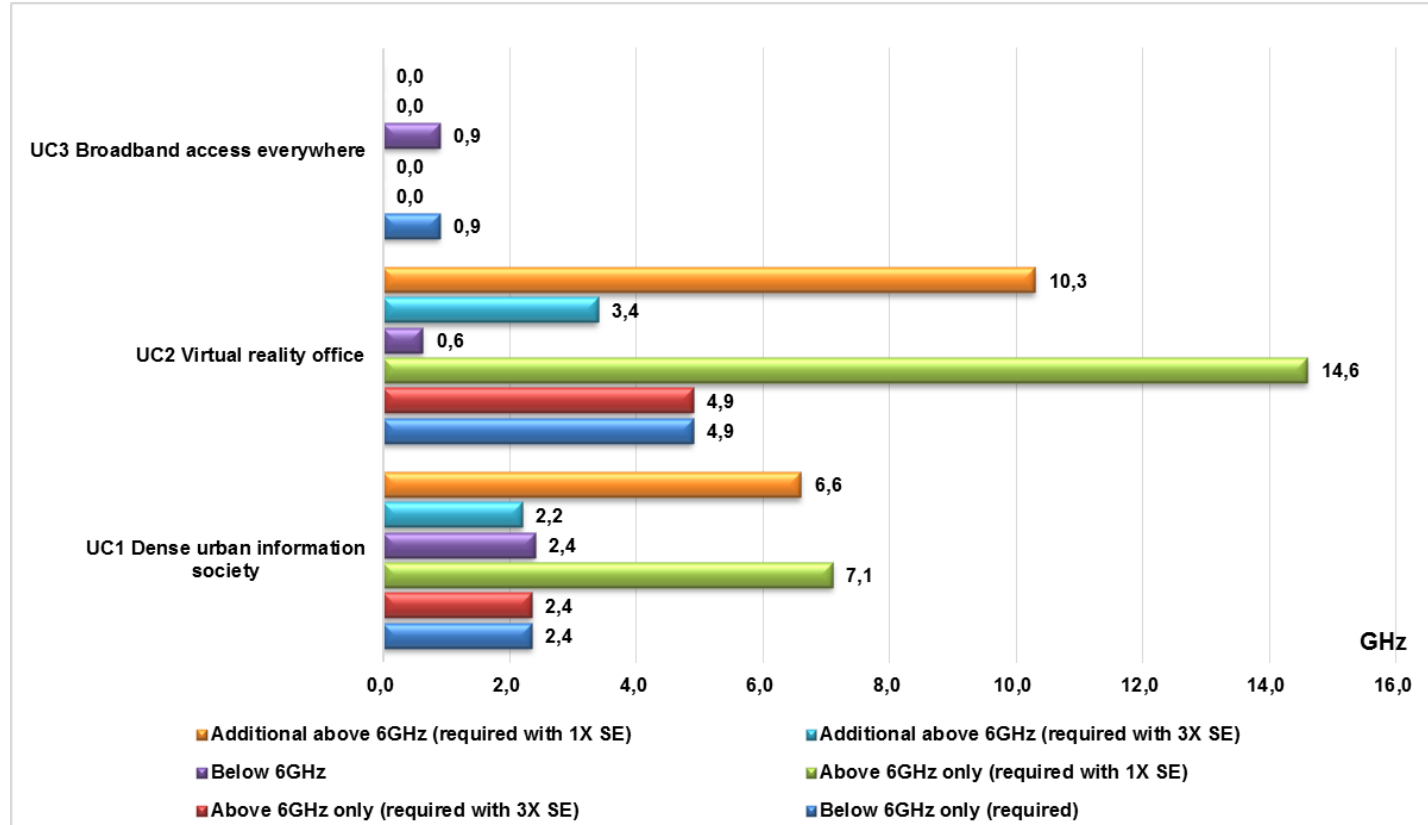
Frequency bands for 5G

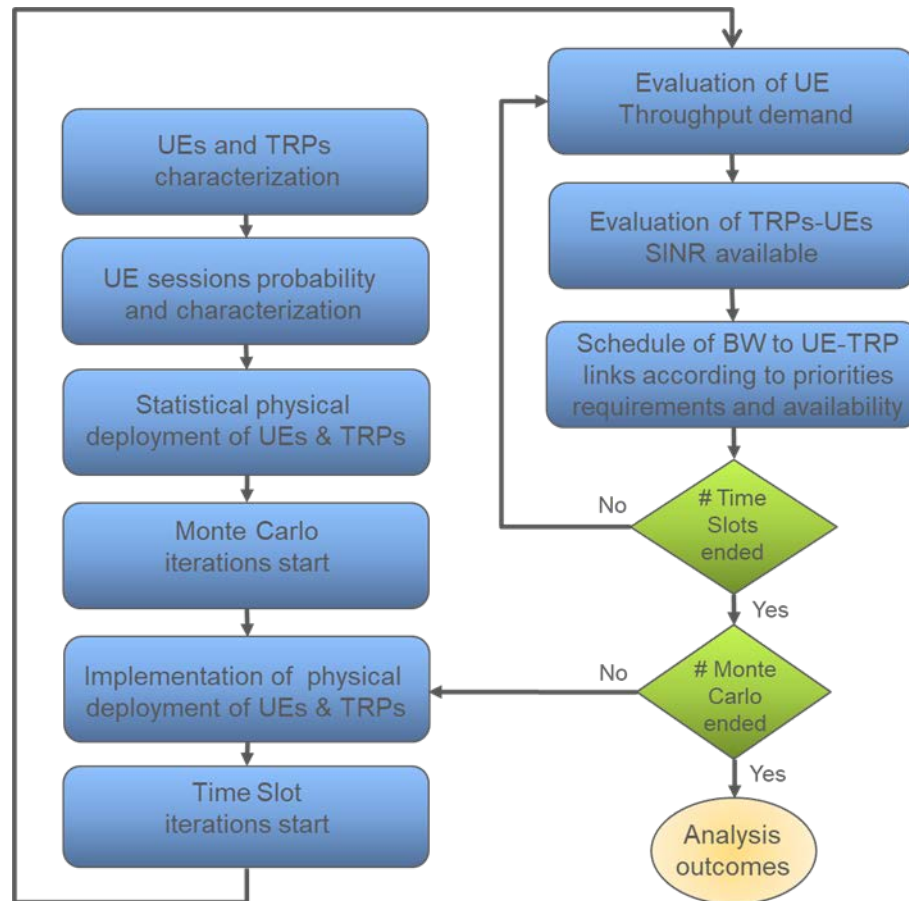## European spectrum roadmap towards 5G

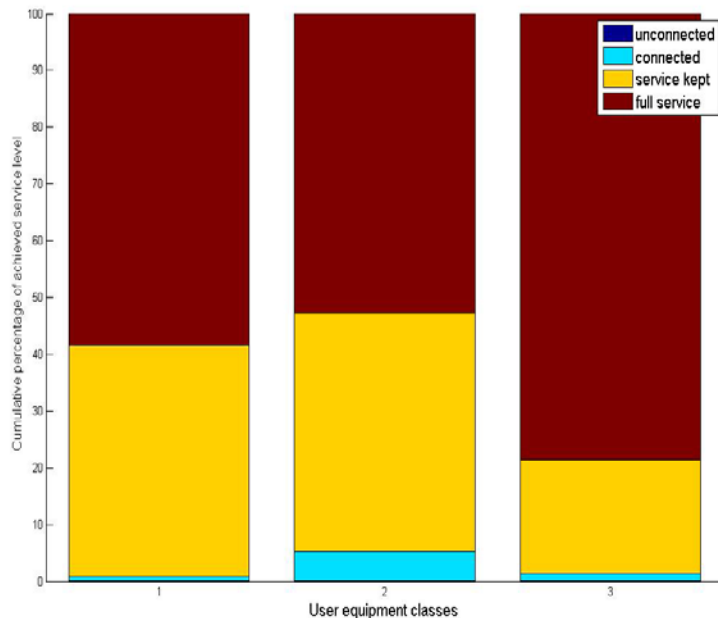# Spectrum bandwidth demand: Analysis framework

Spectrum bandwidth demand:
Analysis results for xMBB use cases
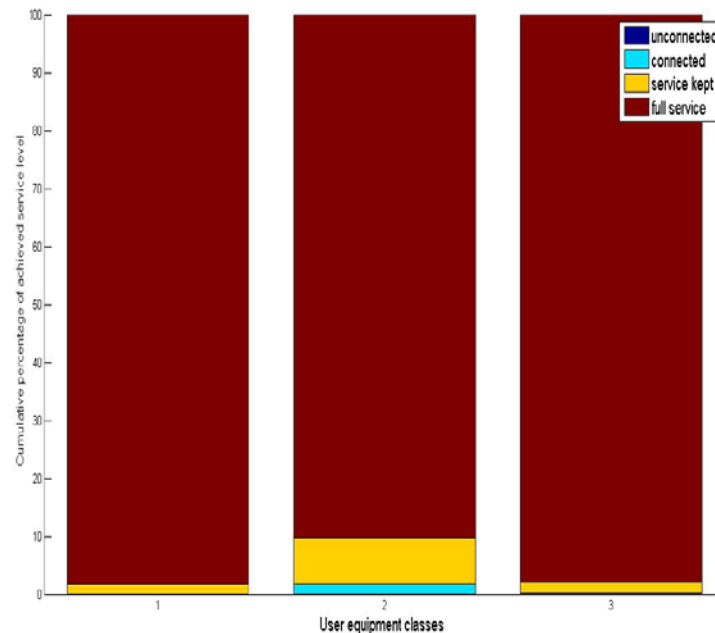
Spectrum bandwidth demand: Analysis tool

Results for Dense Urban Scenario (Use Case 1)

Achieved service levels for different UE classes
(fc1=200 MHz and fc2=1000 MHz)

Achieved service levels for different UE classes
(fc1=200 MHz and fc2=3000 MHz)

Results for Broadband Access Everywhere (Use Case 3)
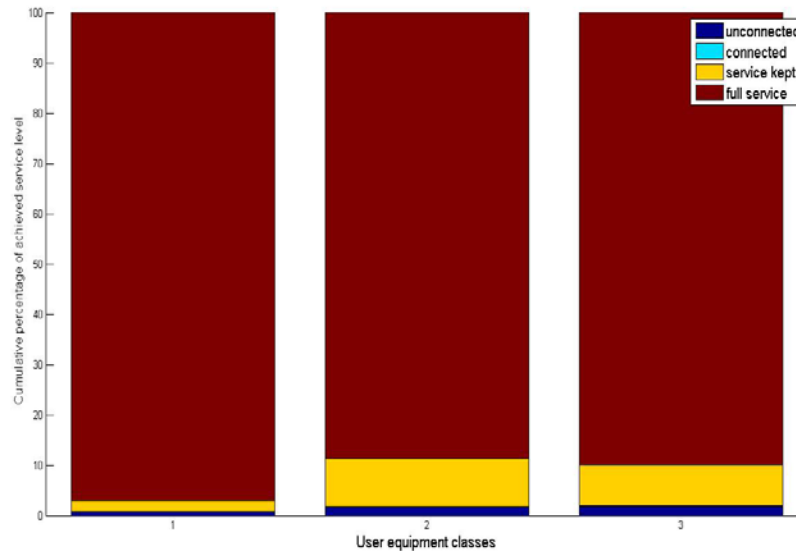
Achieved service levels for different UE classes
(fc = 1000 MHz)

Spectrum bandwidth demand: Analysis results for UC5 – Traffic efficiency and safety
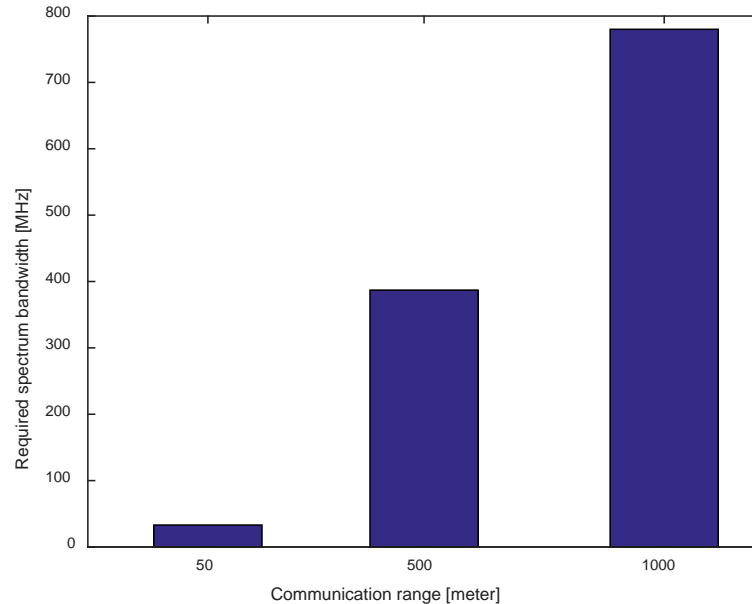
Spectrum bandwidth demand for different communication ranges
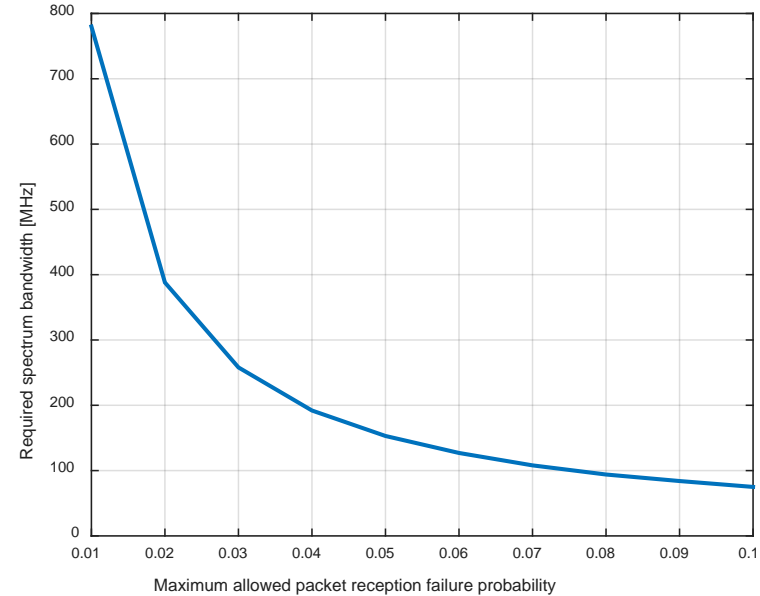
Spectrum bandwidth demand as a function of the allowed packet reception failure probability

Enhanced concept for spectrum management and spectrum sharing for 5G

Technical enablers (1 and 2) for advanced spectrum management and sharing

Overview of the application context aware concept

QoS driven Scheduler architecture for Spectrum Sharing

Technical enablers (3, 4 and 5) for advanced spectrum management and sharing

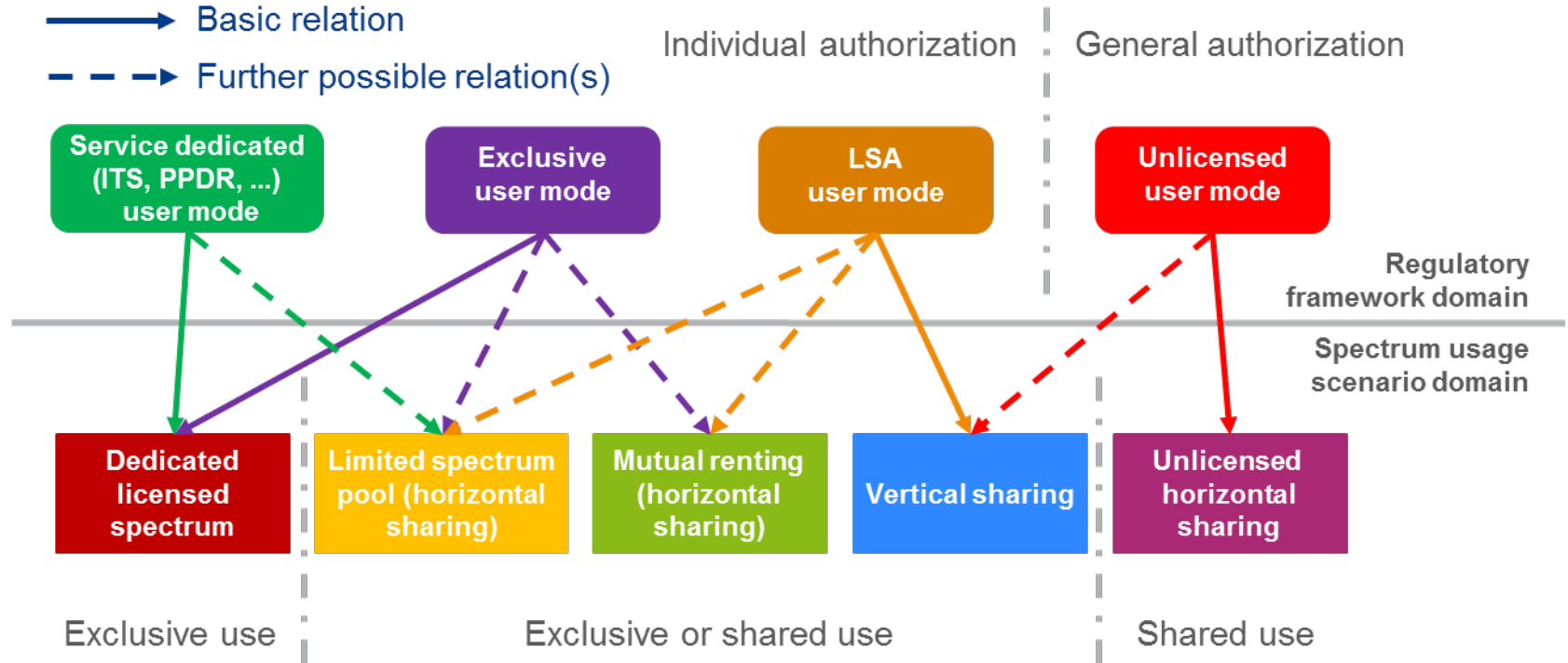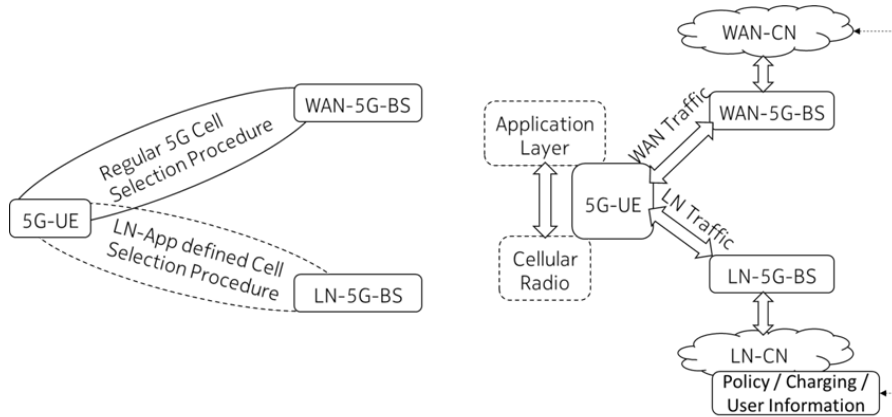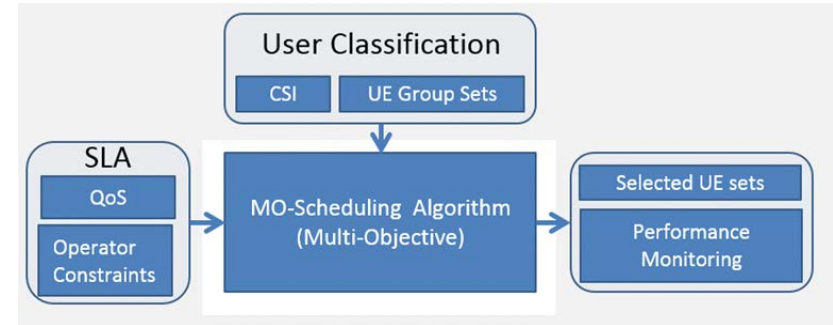| 24.25 - 27.5 (3.25)	27.5 - 29.5 (2.0)

19%

37 - 39.5 (2.5)	39.5 - 41.5 (2.0)	41.5 - 43.5 (2.0)

16%

Tuning range (examples)

5G Core, Spectrum Manager and Analytics

LN_1

LN_2

Potentially interfering beam turned off by the spectrum manager
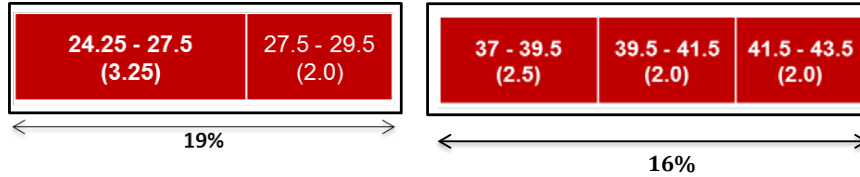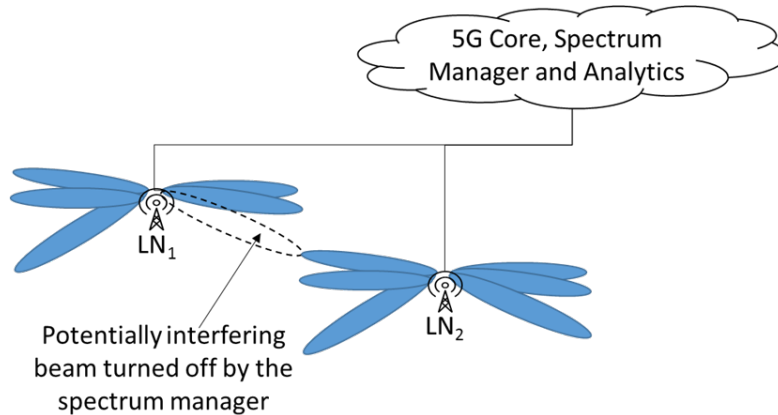
Potential operation of geographically limited LSA

transmission from AP1

transmission from AP2

AP1

AP2

UE1

Talk

UE2

Detection area of energy from AP1

Detection area of energy from AP2
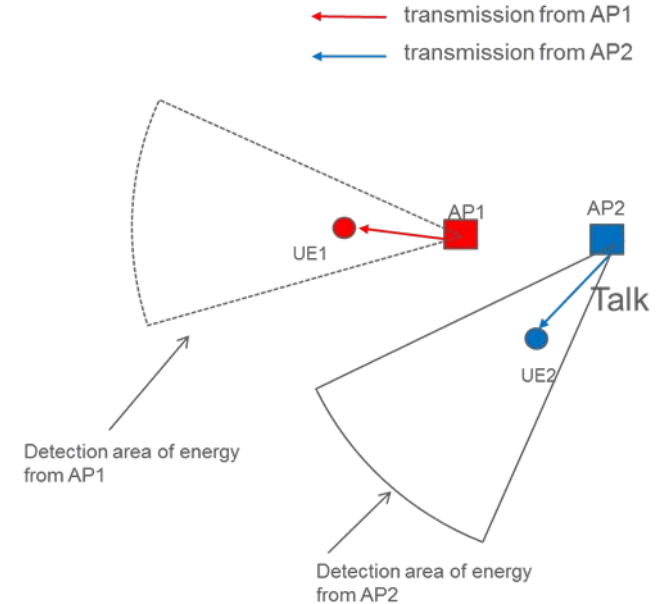
Directional Listen-Before-Talk: AP1 and AP2 do not interfere each other so that both transmit

Technical enablers (6 and 7) for advanced spectrum management and sharing
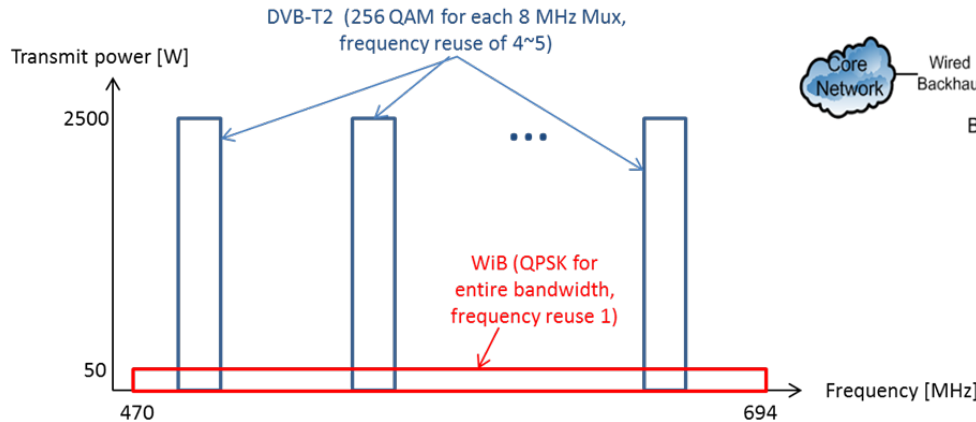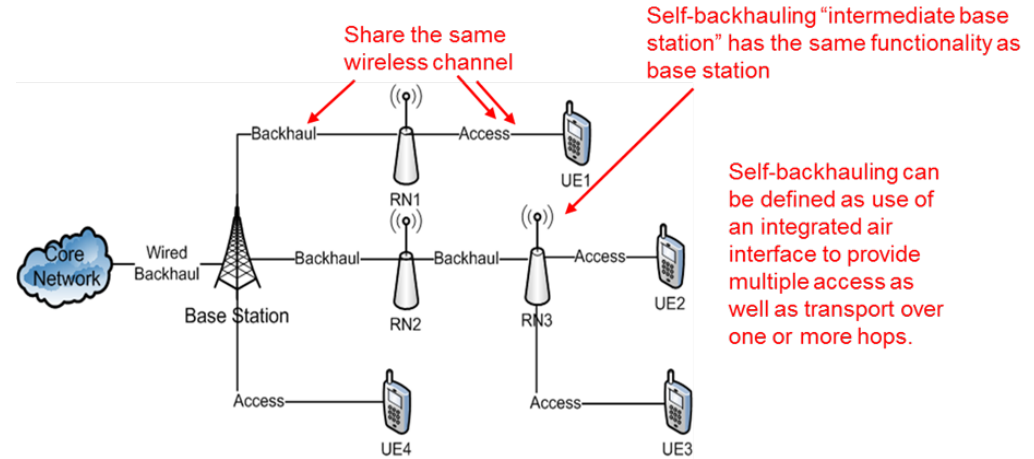

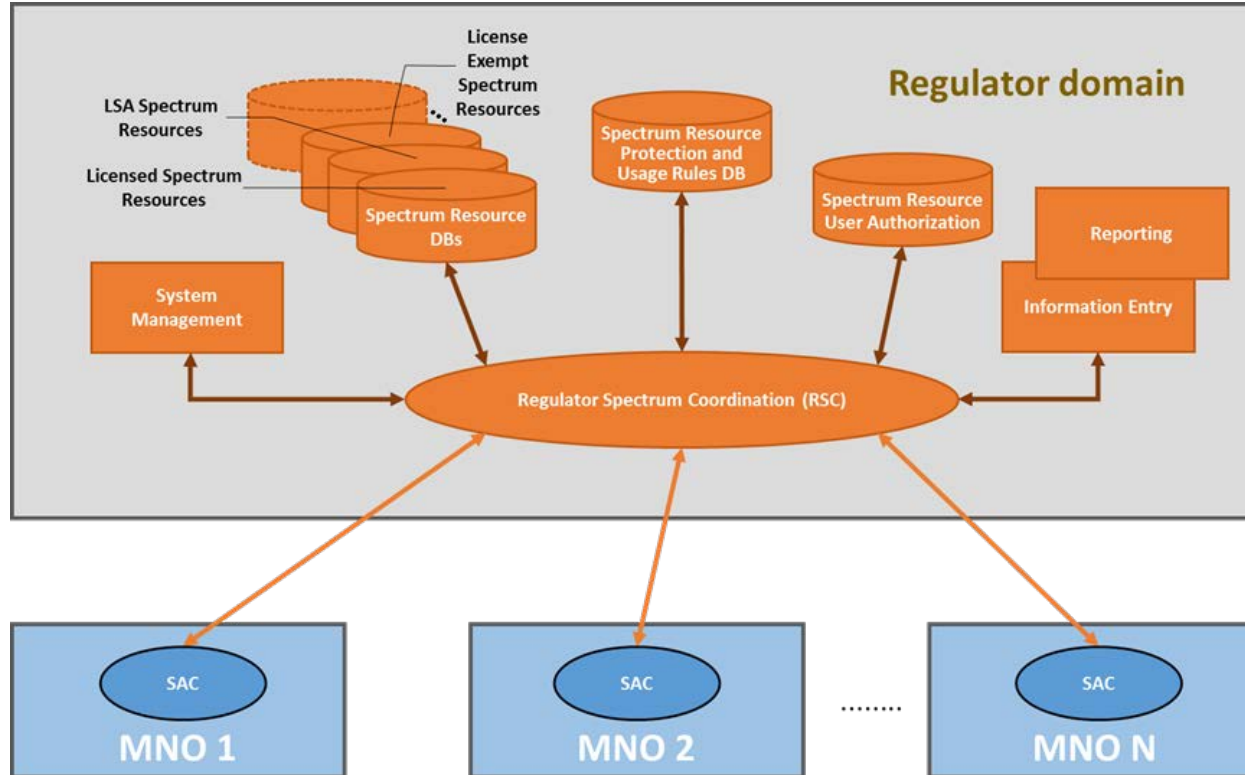Cooperative system concept for broadcast and unicast delivery

Self-backhauling generic concept

Analysis of different technical enablers

| Technical Enablers N.A. = Not Applicable		Application Context Aware Local Service Provisioning	QoS driven Scheduler for Inter-Operator Spectrum Sharing	Tuning ranges (in mmW spectrum)	Studies on listen before talk with high gain beam-forming	Cooperative system concept for broadcast and unicast delivery in UHF band	Self-backhauling in 5G bands	Geo-graphically limited Licensed Shared Access
Applied spectrum usage KPIs	Availability	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Capacity	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Coverage	No	No	No	No	Yes	No	No
	Increase of spectrum per operator	Yes	Yes	Yes	Yes	Yes	N.A.	Yes
	Relative spectrum occupation rate	No	Yes	No	Yes	Yes	Yes	Yes
Applied METIS-II Use Cases	Dense urban information society	Yes	Yes	Yes	Yes	No	Yes	Yes
	Virtual reality office	Yes	Yes	Yes	Yes	No	No	Yes
	Broadband access everywhere	No	Yes	No	Yes	Yes	No	Yes
	Massive distribution of sensors and actuators	No	Yes	No	No	No	No	No
	Connected cars	No	Yes	No	No	No	No	No
Spectrum ranges supported	< 1 GHz	No	Yes	No	No	Yes	No	No
	1 - 3 GHz	No	Yes	No	No	No	No	No
	3 - 30 GHz	Yes	Yes	Yes	Yes	No	No	Yes
	> 30 GHz	Yes	Yes	Yes	Yes	No	Yes	Yes
Network Deployment Scenarios supported	Rural Macro	No	No	No	No	Yes	No	No
	Urban Macro	No	No	No	No	No	No	No
	Outdoor Small Cell	Yes	Yes	Yes	Yes	No	Yes	Yes
	Indoor Small Cell	Yes	Yes	Yes	Yes	No	No	Yes
	Nomadic Node	No	No	No	No	No	No	No
	D2D	No	No	No	No	No	No	No

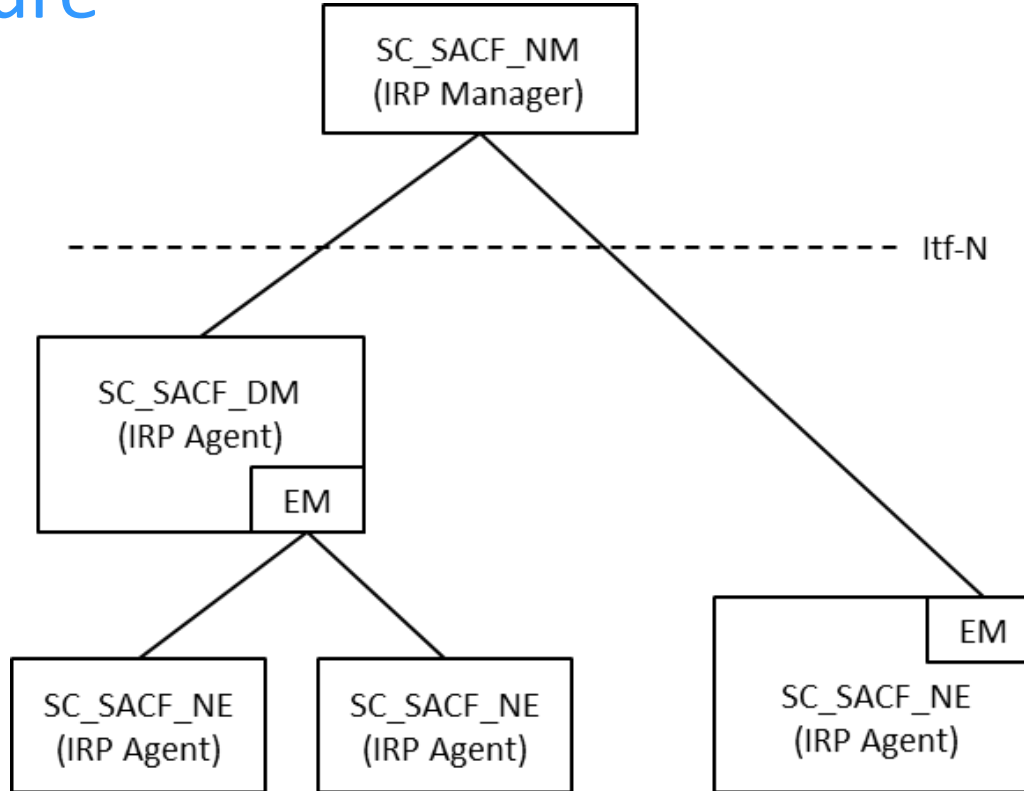# Spectrum Management System (SMS) in the Regulator domain

Holistic Spectrum Management architecture

Operator Spectrum Management comprising a central "Spectrum Assignment Coordination" (SAC) entity with interfaces to internal and external functional entities
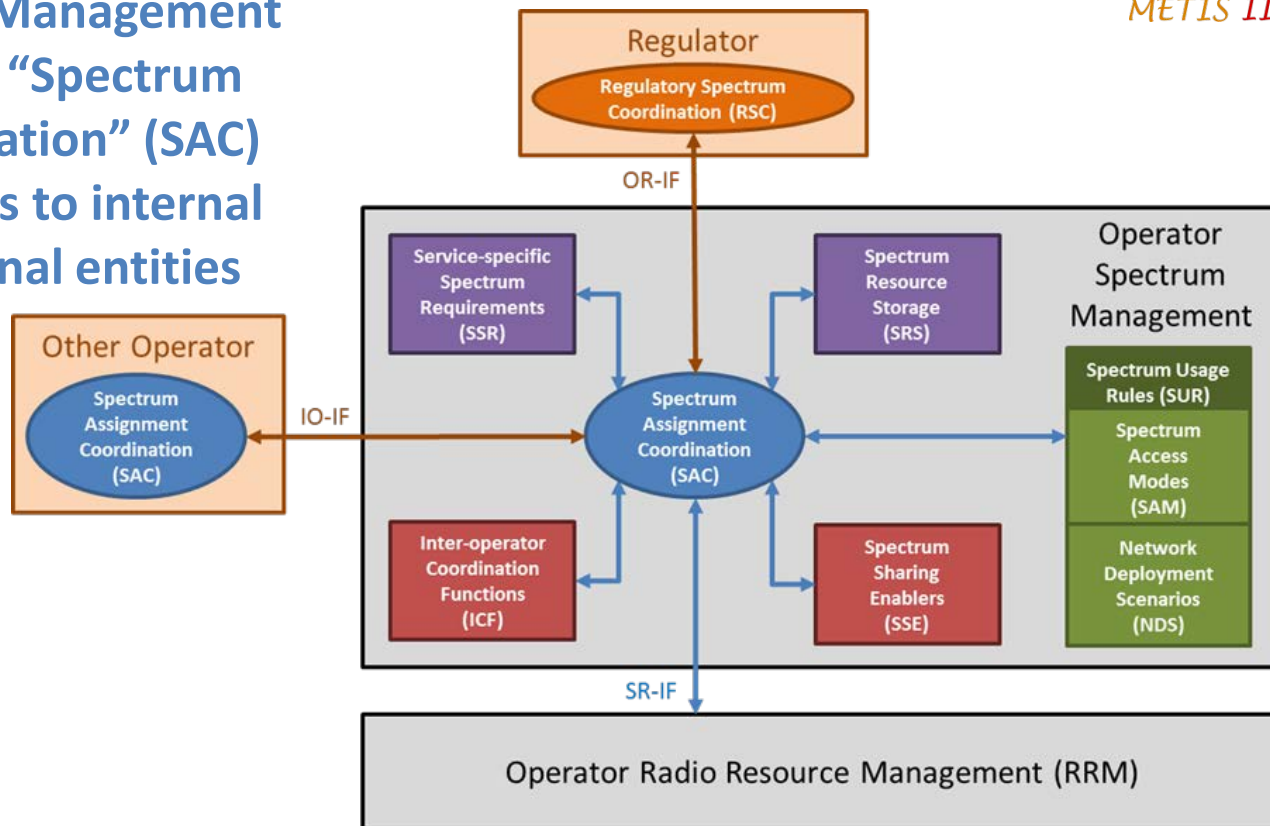
Implementation of the SAC into a SON architecture

Key Messages on 5G spectrum

› Success of 5G depends on the access to sufficient amount of contiguous, wide and globally harmonized new frequency bands.

› Exclusive licensed spectrum is essential for providing the expected QoS and for securing investments, shared spectrum usage (e.g. by LSA scheme) is a suitable supplementary option.

› Availability of sufficient and adequate spectrum for 5G requires quantity assessment (spectrum bandwidth demand) and quality assessment (e.g. coverage/propagation conditions, authorization schemes).

Thank You

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