3GPP RAN 5G-Workshop

Perspective on spectrum usage in next generation mobile communications

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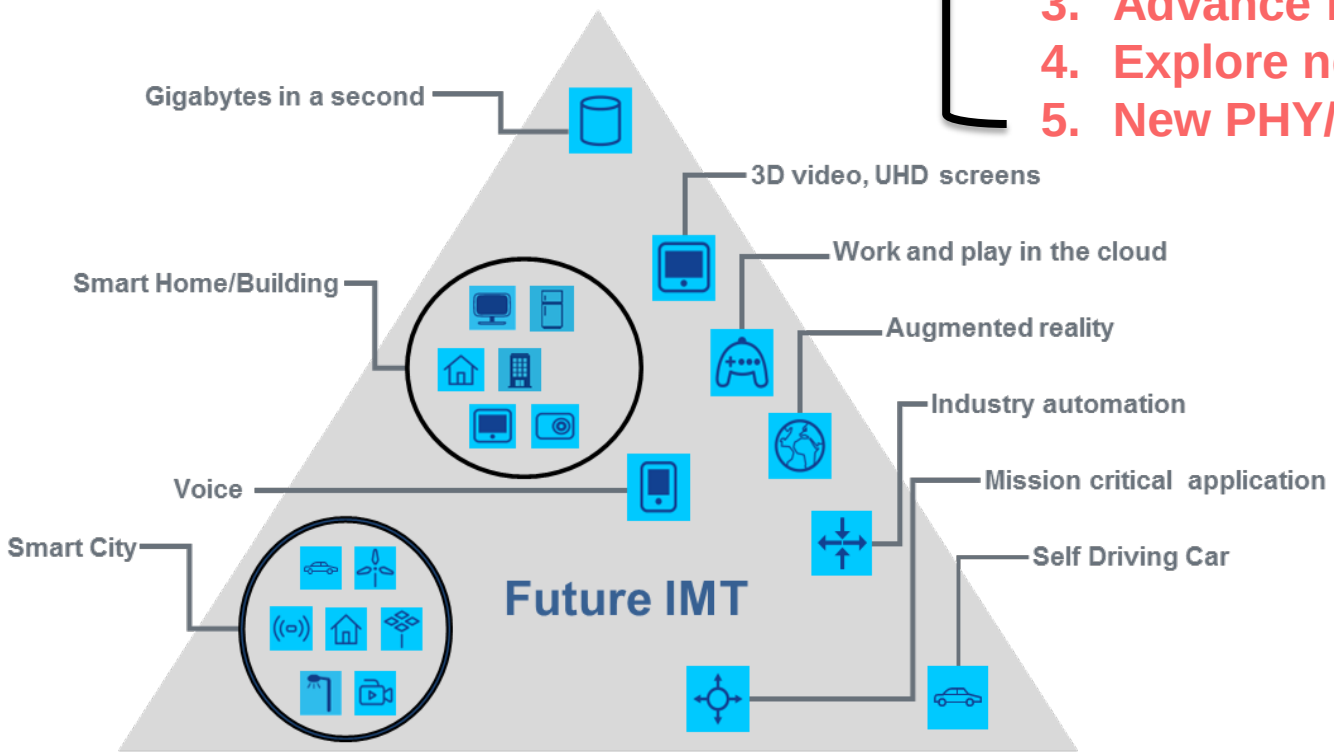
Technologies to Enhance Mobile Broadband

Usage Scenarios of IMT for 2020 and beyond

Enhanced Mobile Broadband

1. Flexible spectrum usage
2. New multiple access and duplex scheme
3. Advance multiple antenna
4. Explore new spectrum
5. New PHY/waveform



Massive Machine Type Communications

Ultra-reliable and Low Latency Communications

Source: WP5D #22, Jul 2015

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Spectrum requirement in 2020

ITU-R (IMT)	WRC-07 estimates - 2007 (Report ITU-R M.2078)	Higher market setting	**1720 MHz**, by 2020
		Lower market setting	**1280 MHz**, by 2020
	WRC-15 Updates - 2013 (under discussions)	Higher market setting	**1960 MHz**, by 2020
		Lower market setting	**1340 MHz**, by 2020
European Union	Radio Spectrum Policy Programme objective (2012)		**1200 MHz**, by 2015

Spectrum requirements from ITU-R and European Union.

Country	Source	Traffic increase forecast	Available IMT spectrum (MHz)	MBB spectrum requirement (MHz)	TOTAL (MHz)
USA	FCC National BB Plan (2010)	x 35 (from 2009 to 2014)	547 (by 2009)	+ 275 (by 2014) + 500 (by 2020) For mobile and fixed broadband	1322 (by 2020)
Canada	Global Mobile BB Forum 2012		553 (by 2014)	+ 300 / 500 (by 2015) + 400 / 600 (by 2022)	1253 / 1653 (by 2022)
Australia	ACMA paper Towards 2020 – future spectrum requirements for mobile BB	x 30 (from 2007 to 2014)	840 (by 2012)	+ 300 (by 2020)	1081 (by 2020)
Japan	AWG workshop for future IMT (AWG-13/INP-136)	x 2 (on a yearly basis)	500 (by 2012)	+ 300 (by 2015) + 1000 (by 2020)	1800 (by 2020)
China	ITU-R WP5D#15 (document 5D/256)	x 600 (from 2010 to 2020)	570 (by 2012)	570 / 690 (by 2015) + 800 / 1120 (by 2020)	1490 / 1810 (by 2020)

Spectrum requirements from countries in other regions.

Source: ITU-R Report M.2290 , The full spectrum of possibilities-Huawei Europe

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Candidate Band for WRC-15

WRC-15 Potential Candidate Bands	WRC-07 Candidate Bands	WRC-07 Identified Bands
1. 470-694/698 MHz	1. 410 - 430 MHz	1. 450-470 MHz
2. 1350-1400 MHz	2. 450 - 470 MHz	2. 698-806 MHz (Region 2 & parts of Region 3)
3. 1427-1452 MHz	3. 470 - 862 MHz	3. 790-862 MHz (Region 1 and parts of Region 3)
4. 1452-1492 MHz	4. 2300 - 2400 MHz	4. 2.3-2.4 GHz
5. 1492-1518 MHz	5. 2700 - 2900 MHz	5. Parts of 3.4-3.6 GHz in a large number of countries
6. 1518-1525 MHz	6. 3400 - 3600 MHz	
7. 1695-1710 MHz	7. 3600 - 3800 MHz	
8. 2700-2900 MHz	8. 3800 - 4200 MHz	
9. 3300-3400 MHz	9. 4400 - 4990 MHz	
10. 3400-3600 MHz		
11. 3600-3700 MHz		
12. 3700-3800 MHz		
13. 3800-4200 MHz		
14. 4400-45 00 MHz		
15. 4500-4800 MHz		
16. 4800-4990 MHz		
17. 5350-5470 MHz		
18. 5725-5850 MHz		
19. 5925-6425 MHz		

GSMA ASKS FOR MORE "LOW" FREQUENCY SPECTRUM IN WRC-15

- DON'T STOP WATCHING <6GHZ TECHNOLOGIES

- DON'T STARE AT >6GHZ BAND ONLY

- Sharing studies conducted by the ITU show that sharing between IMT mobile broadband and incumbent services is possible in all of the 19 candidate bands.

The GSMA believes that the most likely bands to accommodate global harmonisation for IMT are:

- Sub-700MHz UHF (470-694/698 MHz)
- L-Band (1350-1400 & 1427-1518 MHz)
- 2.7-2.9 GHz
- C-Band (3.4-3.8 GHz & 3.8-4.2 GHz)

Source: WRC-15: REGULATORY CONSIDERATIONS.– IT & CPM-15- A Guide to WRC-15 Agenda Item 1.1 – GSMA & Preparatory studies for WRC-15 and the work of JTG 4-5-6-

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2016~2019 Candidate Bands for Taiwan

Planning Content	Band(MHz)	Remark
Mobile broadband businesses	608~698	
	2300~2400	Need to consult with current radio operators
	3400~3800	
Digital television and mobile television respectively. (May study for introducing the TVWS sharing method into Taiwan)	530~596	Will evaluate the possibility of introducing TVWS into Taiwan
	596~608	
IEEE 802.11 series and LTE-U	5150~5350	Depend on the development state of new International technologies
	5470~5850	

Source: Ministry of Transportation and Communications R.O.C.: Spectrum Providing Plan

NCC may release 500~600MHz to be “White Space” in 2017 or later (By Commercial Times).

Source: Commercial Times, 2015/8/17 (http://www.chinatimes.com/newspapers/20150817000040-260202)

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Revitalizing Spectrum for Practical Usage

- Dynamic Spectrum Sharing Promotions
  - III catalyzed Taiwan Dynamic Spectrum Access Pilot Group with domestic and international partners (May, 2014).
  - III signed a MOU with Telecom Technology Center under NCC (Taiwan Regulator) for DSA Tech Cooperation(Aug. 2015).
  - Upcoming Workshop: Unleashing the full potential of radio spectrum(15 Oct. 2015) in Taipei, Taiwan.

- Spectrum Sharing Tests in Taiwan
  - Outdoor secondary sharing in Fu-Hsin Township, 2014
  - LSA based program, 2015~
  - DSS Lab, 2016~

Chang, San-Cheng
Vice Primer of Taiwan R.O.C., addressed a speech at the TTC-III MOU ceremony

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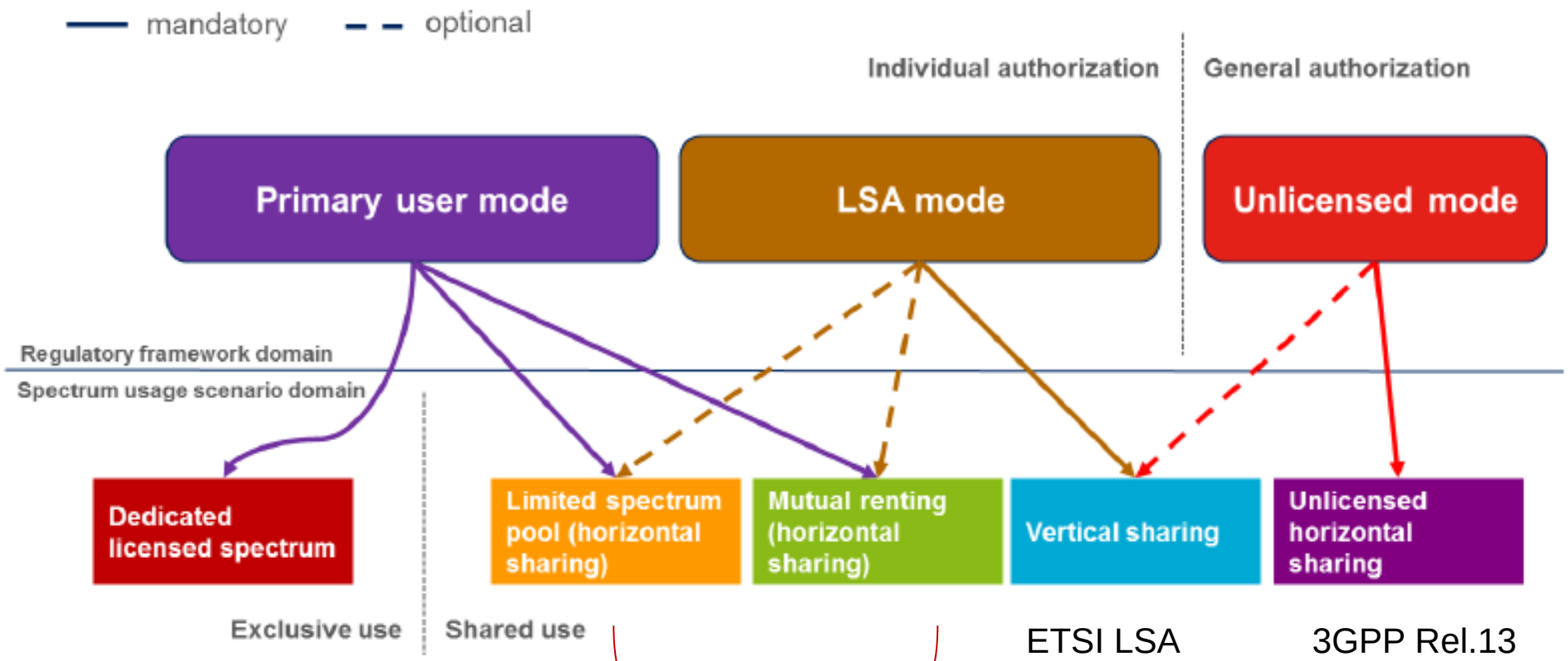
Spectrum Usage

- Operator spectrum sharing



3GPP ~Rel.13

ETSI LSA
3GPP Rel.13
SA5

3GPP Rel.13
LAA

3GPP should study these cases Rel.14 and beyond.

Source: METIS, Future spectrum system concept. April 2015

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Facilitate Spectrum Usage

- Radio access improvements:
  - Multiple carriers/RATs aggregation
    - Variable/Dynamic connections
    - Multi-states transition
    - Aggregate triggering
    - Shared band aggregation
  - No more bound between FDD/TDD
    - New duplex scheme (e.g., Full duplex)
      - 2G : FDD, 3G: FDD, TDD, 4G : LTE: FDD/TDD, 5G : XDD

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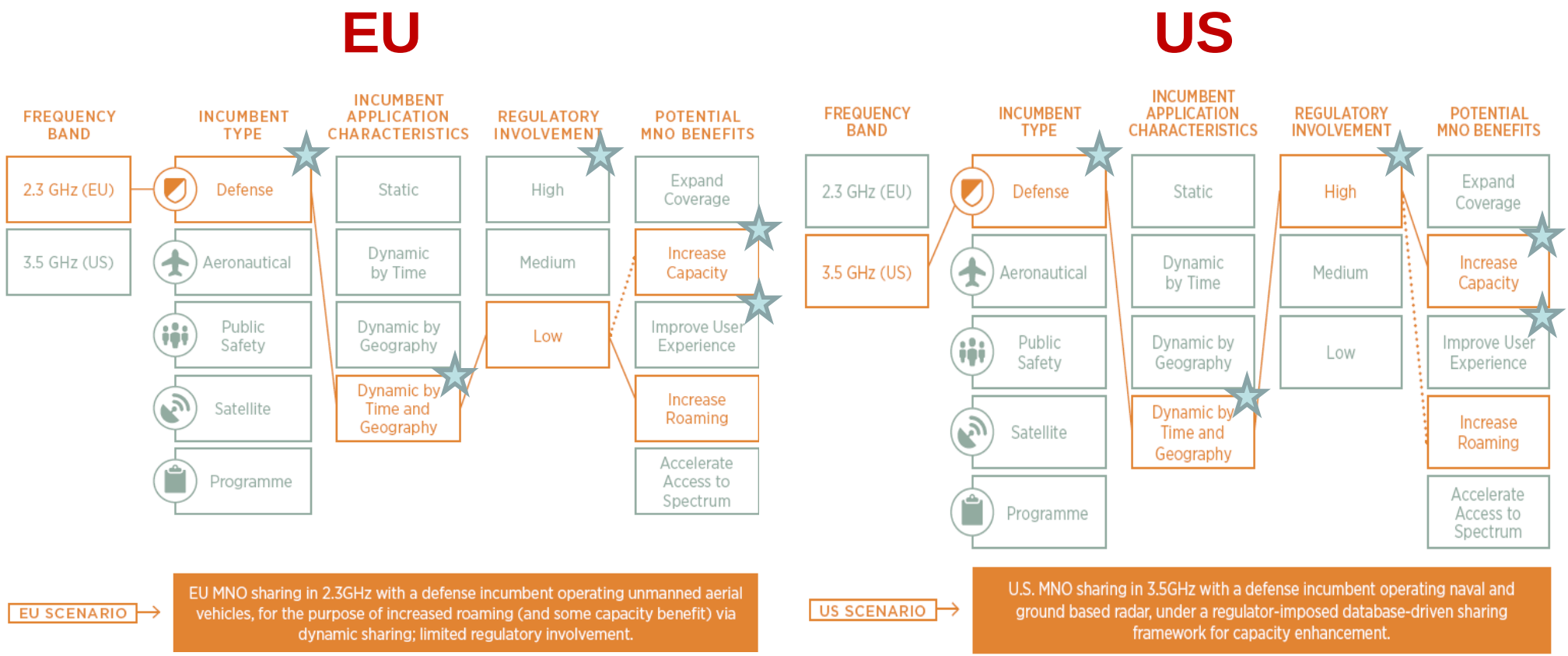
Scenarios of LSA (EU and US)



Source: The Impact of Licensed Shared Use of Spectrum - GSMA

☆ III's view on initial stage of LSA in 3GPP Rel.14 and beyond.

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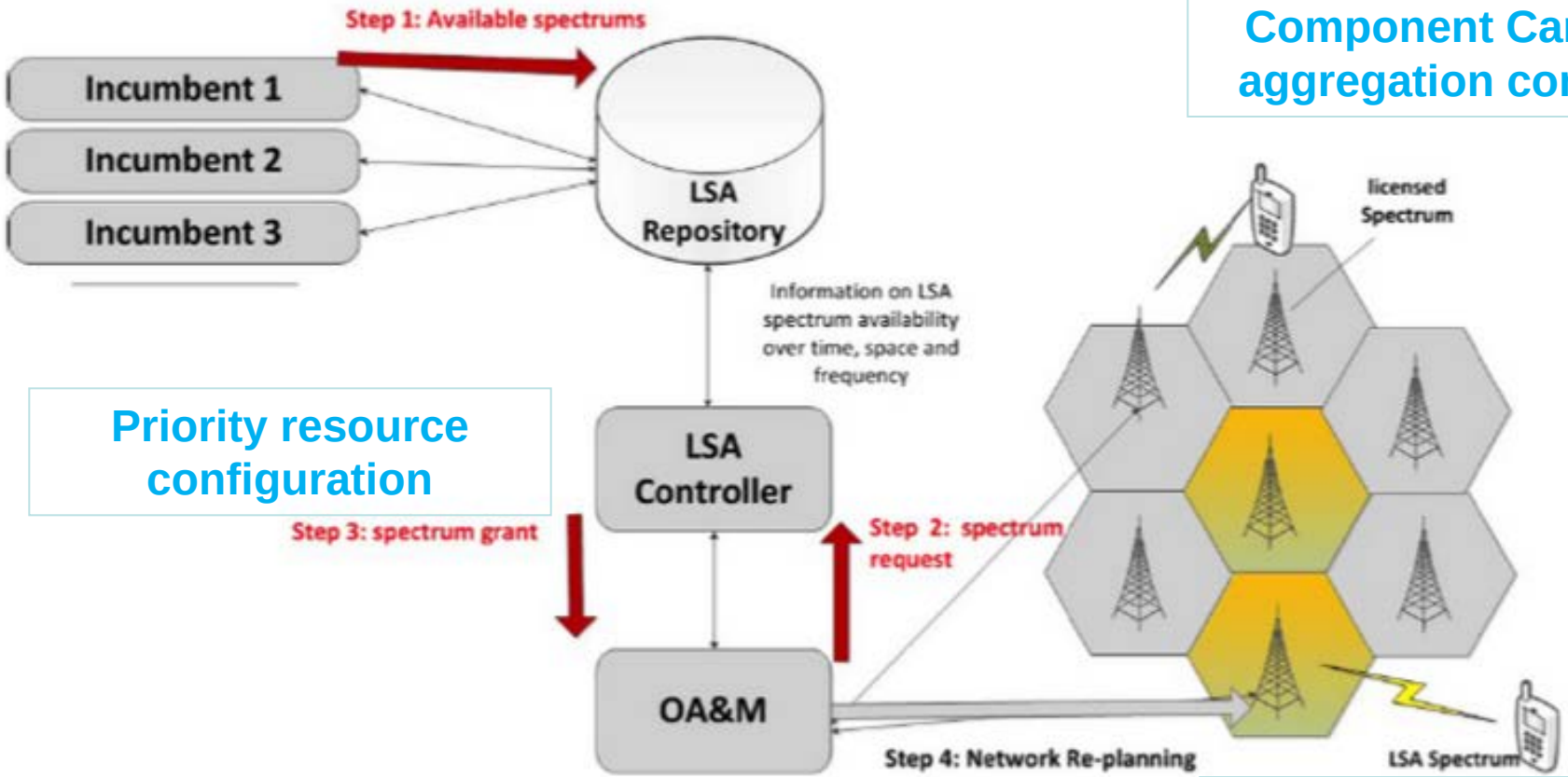
Potential Technical Topics in Spectrum Sharing



Component Carrier aggregation control

Priority resource configuration

LSA Architecture currently being defined by ETSI

UE behavior considered

- **HO Policy**
- **Cognitive sensing while transmission**

Source: IEEE TCCN SIG CR in 5G - New Spectrum Usage Paradigms for 5G, November 4th 2014

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Observations

- Technologies which support spectrum extension are crucial for Bandwidth Explosion in 2020 & Beyond.
  - Large amount of carriers bring challenges on management/control.
- Unlicensed/Shared Band Mobile Use and Cognitive Spectrum Sharing are important.
  - More techs/coordination issues on flexible/dynamic usage of license spectrum, share spectrum and unlicensed spectrum.

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THANK YOU

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