



GRUPPO TIM

Regional Seminar for Europe and CIS - Spectrum Management and Broadcasting

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Future use of millimetre waves for 5G

Session 9: Towards the WTDC 2017 and WRC 2019

Massimiliano Simoni
Frequency Management



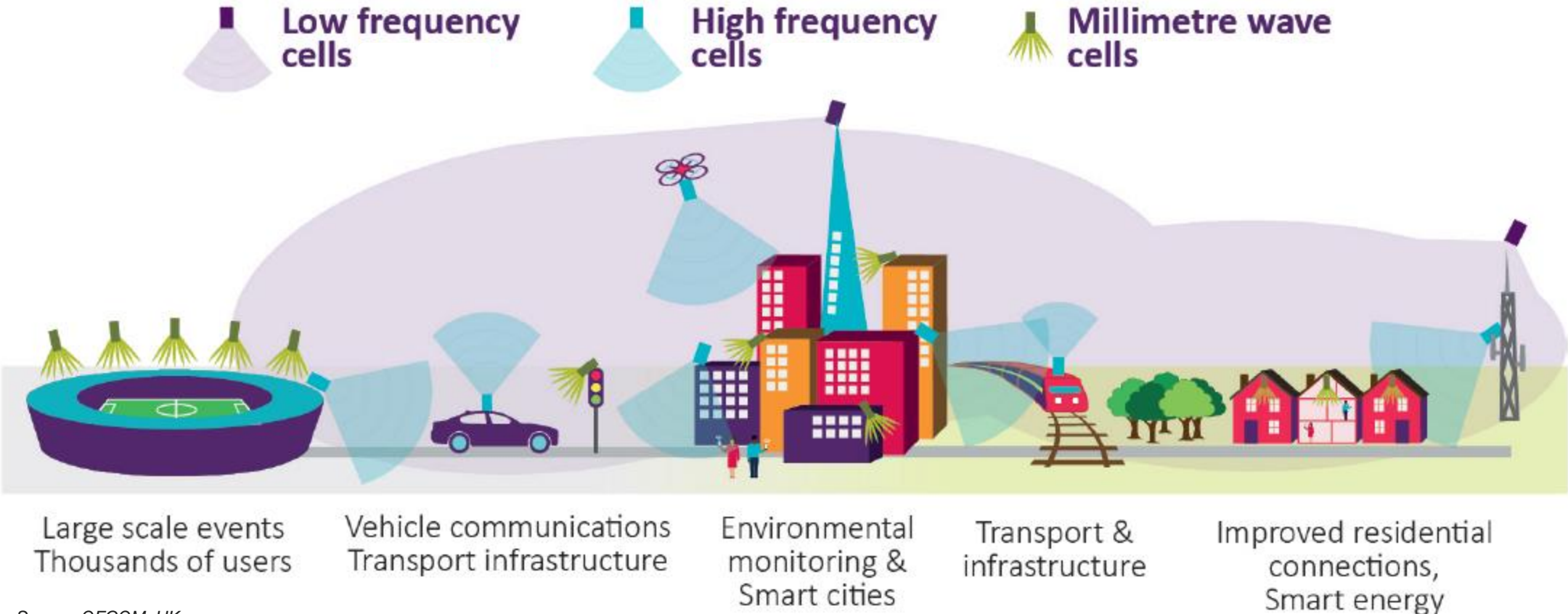
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Agenda

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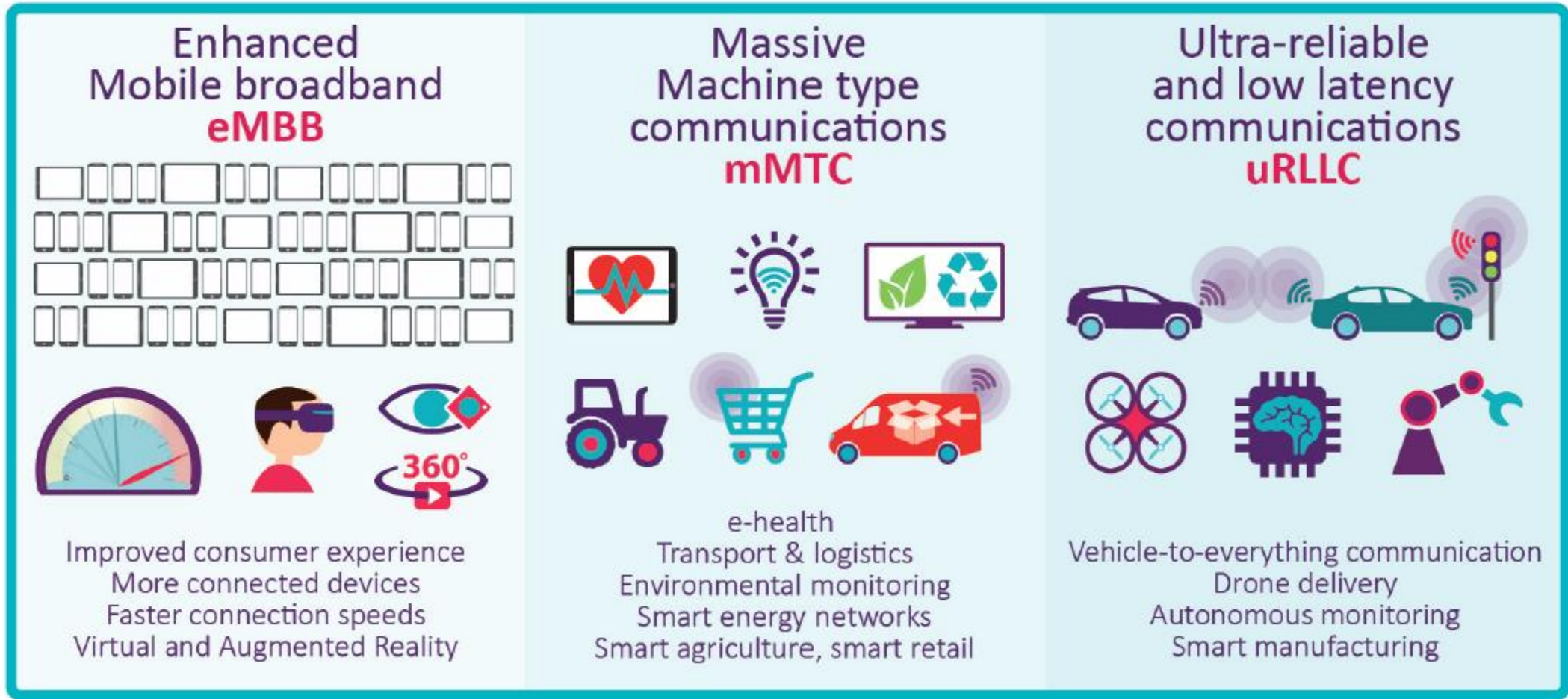
5G scenarios and use cases

5G scenarios



Source: OFCOM, UK

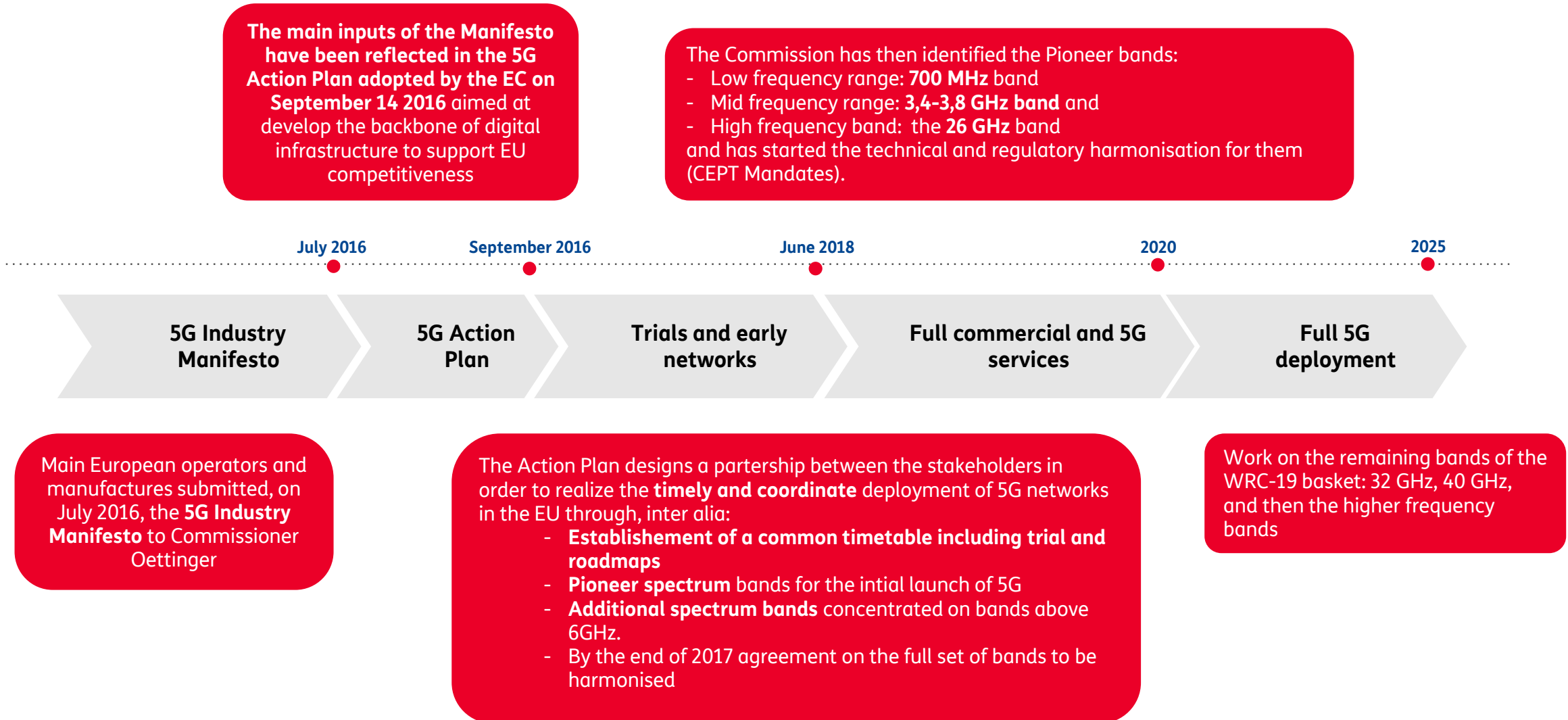
5G envisaged use cases



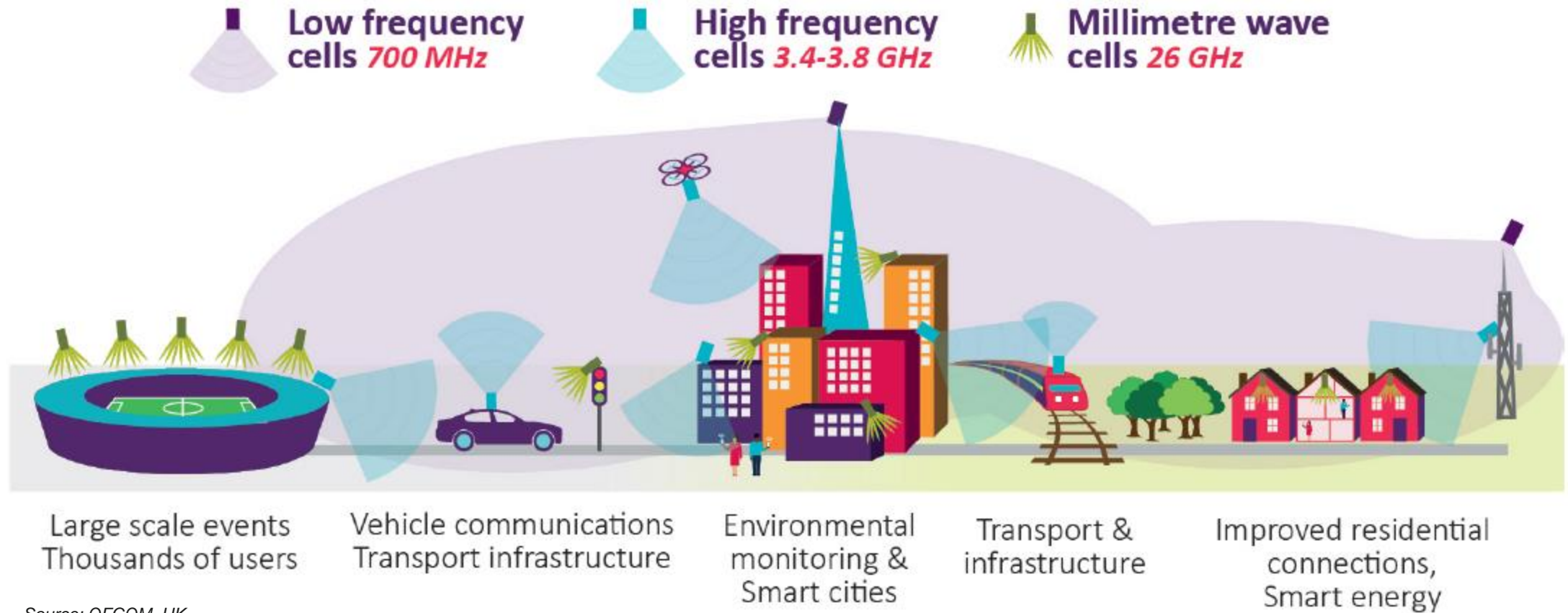
Source: OFCOM, UK

5G spectrum in Europe

5G spectrum in Europe



European 5G pioneer bands



Source: OFCOM, UK

WRC-2015 outcomes

Agenda Item 1.1

WRC 2015 outcomes - Agenda Item 1.1 (1/2)

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)

Final outcomes

UHF band (470-694 MHz): No change to the RR at WRC-15 and a WRC-23 agenda item has been created addressing a review of the spectrum use of the frequency band 470-960 MHz. Parts of the band have been identified for IMT in a few countries in Region 2 and 3, where a mobile allocation already exists for the UHF band.

L band: the bands 1 427-1 452 and 1 492-1 518 MHz have been identified for IMT worldwide. The band 1 452 – 1 492 MHz has been identified for IMT in Regions 2 and 3. In Region 1, the IMT identification of 1 452-1 492 MHz is limited to some African and Middle-East countries. The band was not identified for European countries because of the usage of band which formed the opposition from RCC. However, the primary mobile allocation and the ECC Decision(13)03 form the basis of IMT use of the band 1 452-1 492 MHz in CEPT.

WRC 2015 outcomes - Agenda Item 1.1 (2/2)

C band: 3 400-3 600 MHz: The existing footnote allocation has been transform in a table allocation. In addition, the band has been identified in Regions 1 and 2 to IMT with a pfd limit of $-154.5 \text{ dB(W/(m}^2 \cdot 4 \text{ kHz))}$ produced at 3 metres above ground for 20% of time for the protection of FSS. Nos 9.17, 9.18 and 9.21 apply. The band is also identified for a limited number of Region 3 countries. 3 600-3 700 MHz: the band has only been identified for a few Region 2 countries with associated provisions to protect FSS as specified above for lower part of C-band.

Other bands: agreement has been reached on “NO CHANGE” in allocation table for the following frequency bands:

410-450 MHz,

1 164-1 215 MHz, 1 215-1 300 MHz, 1 300-1350 MHz, 1 350 - 1 400 MHz, 1 518-1 525 MHz, 1 559-1 610 MHz, 1 695-1 710 MHz

2 025-2 110 MHz, 2 200-2 290 MHz, 2 700-2 900 MHz, 2 900-3 100 MHz

3 300 - 3 400 MHz (in Region 1), 3700 – 3800 MHz; 3 800 - 4 200 MHz

4 400-4 500 MHz for Regions 1 and 2, 4 500-4 800 MHz, 4 800-4 990 MHz (in Region 1) 4 990-5 000 MHz

5 350-5 470 MHz, 5 725-5 850 MHz, 5 850-5 925 MHz and 5 925 - 6 425 MHz.

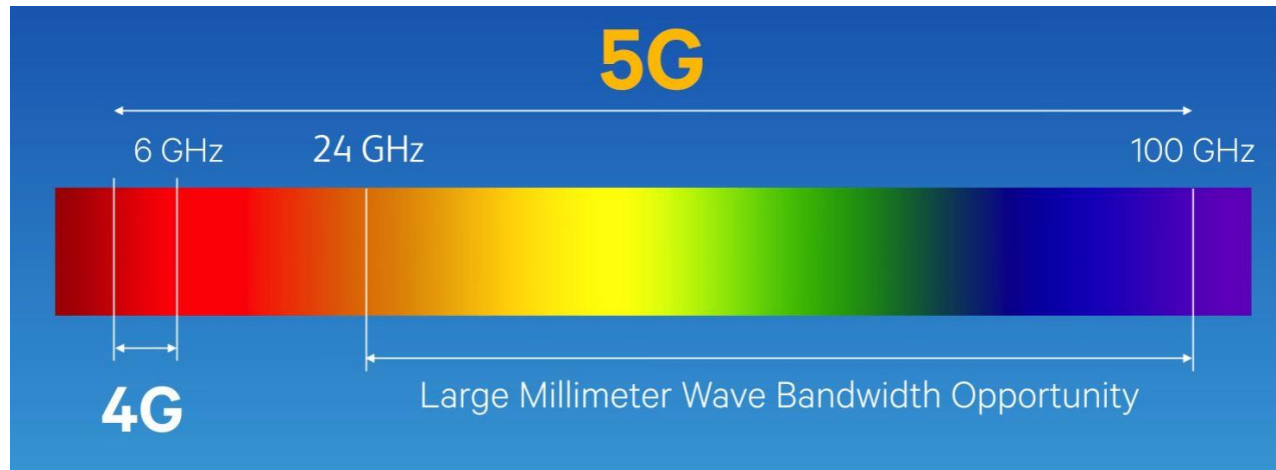
The band 3 300-3 400 MHz has been identified to some African countries in Region 1 and to some countries in Regions 2 and 3. The band 4800-4990 MHz is only identified to IMT in one Region 2 and three Region 3 countries.

Millimetre waves

Millimetre waves

Where?

- Spectrum range: **between 30 GHz and 300 GHz**, wedged between microwave and infrared waves
- Wavelength from **1 millimetre to 10 millimetres**
- Strength can be reduced due to vulnerabilities against gases, rain and humidity absorption (**absorption oxygen peak at 60 GHz**).



Source: National Instruments

- Due to these factors millimetre wavelengths only reach out to a few kilometres.

Millimetre waves

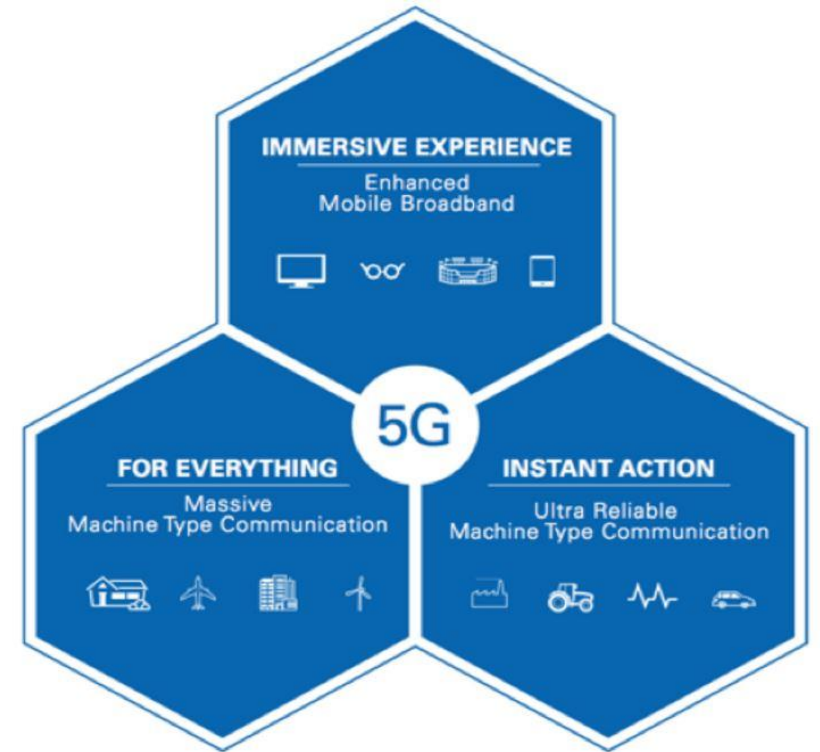
Why?

- **Short transmission paths and high propagation losses** → spectrum reuse, limiting the amount of interference between adjacent cells
- Nevertheless, the extremely short wavelengths of mm wave signals make it feasible for **very small antennas** to concentrate signals into highly **focused beams** with enough gain to overcome propagation losses, where longer paths are required
- The short wavelengths of mm wave signals also make it possible to build **multi-element, dynamic beamforming antennas** that will be small enough to fit into handsets
- **Large bandwidths** of the order of multiple GHz, unavailable at other frequency ranges

Millimetre waves

5G expected capabilities

- Peak throughput per **sector** is of the order of **5 Gbit/s**,
- **Single user** peak throughput of the order of **2-3 Gbit/s**
- Average throughput per sector is expected of the order of **1 Gbit/s**



Source: Qualcomm

- These throughput can be reached with Carrier Aggregation of multiple bandwidths
- 8 x 100 MHz contiguous channels to get 5 Gbit/s
- Such channel bandwidths can be reached only in mmwave bands
- multiple MIMO layers in download
- High modulation schemes both in upload and download

WRC-2019

Agenda Item 1.13

WRC 2019 agenda item 1.13

AI 1.13 to consider **identification** of frequency bands for the future development of **International Mobile Telecommunications (IMT)**, including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution **238 [COM6/20] (WRC-15)**

This AI could be considered a follow-on to AI 1.1 in the previous cycle which considered identification of frequency bands for IMT at frequencies up to 6 GHz. This AI was sometimes described during discussions prior to WRC-15 as an AI for IMT above 6 GHz but in discussions at WRC-15 there majority of the proposals were to study above about 20 GHz.

Bands under consideration which have allocations to the Mobile Service on a primary basis:

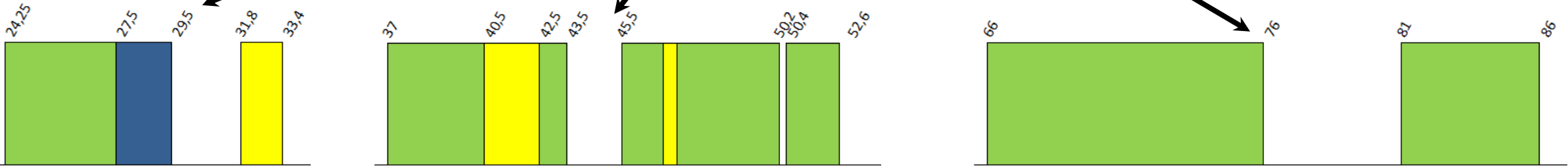
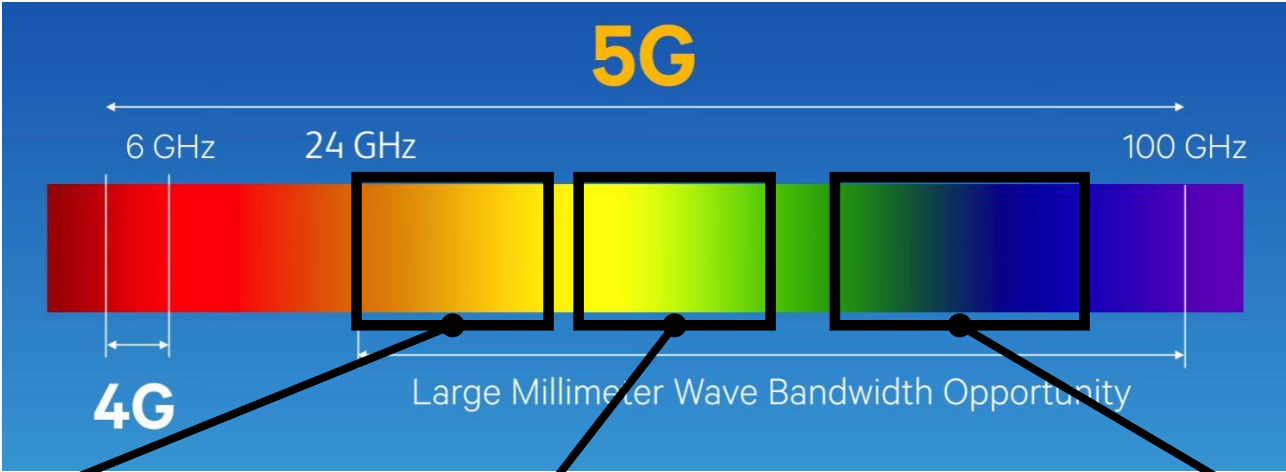
24.25-27.5 GHz, 37-40.5 GHz, 42.5-43.5 GHz, 45.5-47 GHz, 47.2-50.2 GHz, 50.4-52.6 GHz, 66-76 GHz 81-86 GHz

Bands under consideration that may require additional allocations to the Mobile Service on a primary basis:

31.8-33.4 GHz, 40.5-42.5 GHz, 47-47.2 GHz

WRC 2019 agenda item 1.13

What is at stake



WRC 2019 agenda item 1.13

What to study in TG5/1

Frequency band	Affected Service	In band
24,25-27,5 GHz	ISS	24,45 – 24,75 GHz 25,25 – 27,5 GHz
	EESS (s-E)	25,5 – 27,5 GHz
	SR (s-E)	25,5 – 27,0 GHz
	EESS (passive)	23,6 – 24,0 GHz
	Radioastronomy	23,6 – 24,0 GHz
	FS	24,25 – 27,5 GHz

Frequency band	Affected Service	In band
37 – 40,5 GHz	SRS (passive)	36,0 – 37,0 GHz
	EESS (passive)	36,0 – 37,0 GHz
	SRS (s-E)	37,0 – 38,0 GHz
	FS	37,0 – 40,5 GHz
	FSS (s-E)	37,5 – 40,5 GHz
	SRS (E-s)	40,0 – 40,5 GHz
	EESS (E-s)	40,0 – 40,5 GHz

Frequency band	Affected Service	In band
31,8 – 33,4 GHz	RN - Radar	31,8 – 33,4 GHz
	EESS (passive)	31,3 – 31,8 GHz
	RA	31,3 – 31,8 GHz
	SRS (passive)	31,3 – 31,8 GHz
	FS	31,8 – 33,4 GHz
	ISS	32,3 – 33,0 GHz

Frequency band	Affected Service	In band
40,5 – 43,5 GHz	FS	37,0 – 40,5 GHz
	FSS (s-E)	40,5 – 42,5 GHz
	BSS (s-E)	40,5 – 42,5 GHz
	FSS (s-E)	37,5 – 40,5 GHz
	SRS (E-s)	40,0 – 40,5 GHz
	EESS (E-s)	40,0 – 40,5 GHz
	RA	42,5 – 43,5 GHz
	FSS (E-s)	42,5 – 43,5 GHz
	FS	42,5 – 43,5 GHz

What next

What next

- **WRC-2019:** Identification of millimetre bands for IMT-2020
- **WRC-2023:** Agenda Item to study pending issues left open during WRC-2015 (e.g. sub-700 MHz)
- Reassess the **centrality of the ITU-R role** within the standardization process avoiding domestic and subregional standards de facto that may fragment the market
- **Reinforce the ITU-R harmonization process** of the various frequency bands, as it is a fundamental step to deploy a global and virtuous mobile ecosystem. To this extent it is therefore essential that all the Member States and Regional Organizations **work together in close cooperation** well ahead of the WRCs.

“...Mobile communications including mobile broadband communications contribute positively to the economic and social developments of both developed and developing countries. ...”

CPM Report to the WRC-15



Thank you