



5G

SPECTRUM OPPORTUNITIES

Miguel Capela

Mobile Network Testing Seminar, 07.06.2019

INDEX

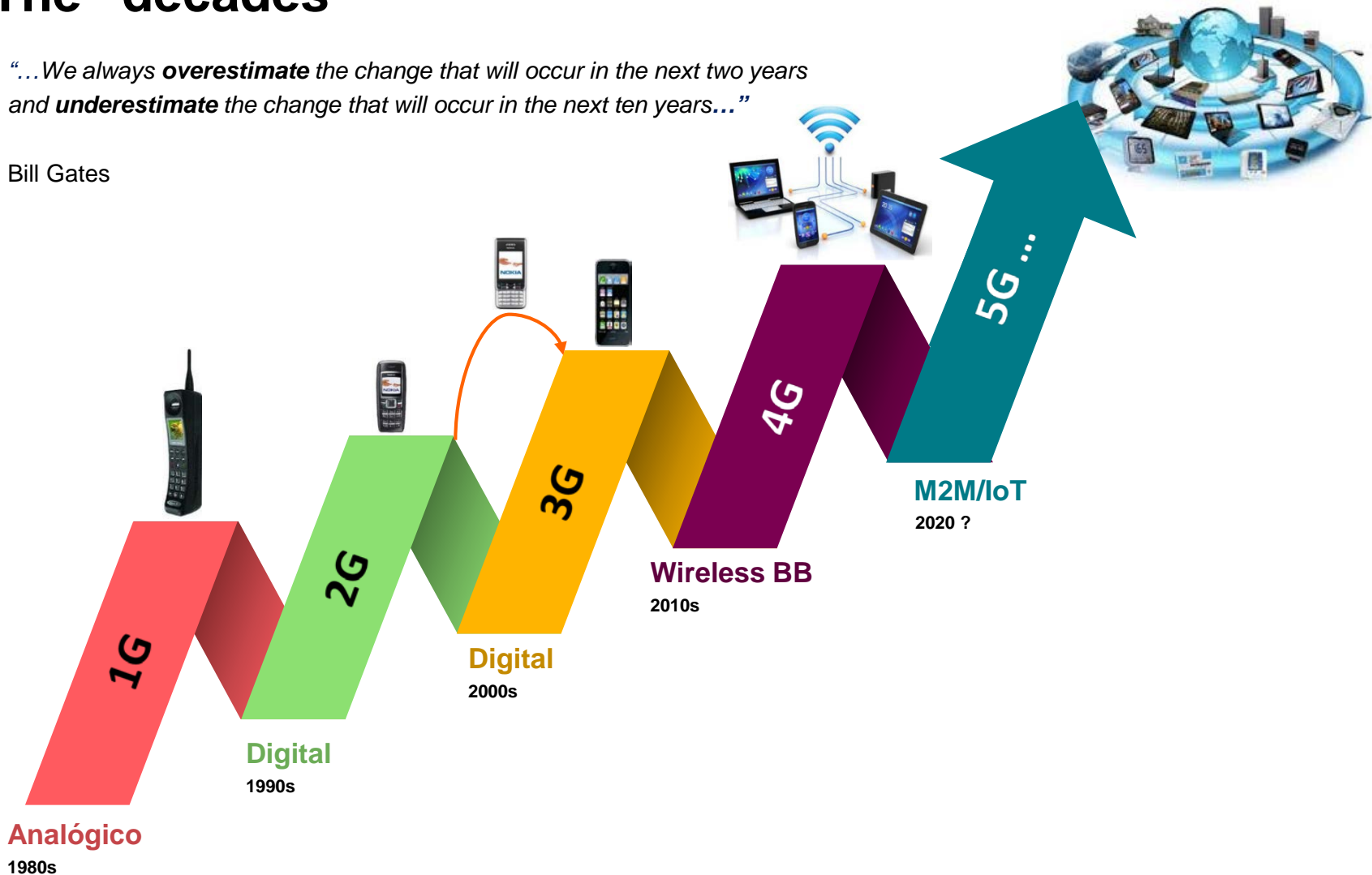
- 1. MOBILE NETWORKS EVOLUTION (AND 5G)**
- 2. THE REGULATORY FRAMEWORK**
- 3. SPECTRUM OPPORTUNITIES**
- 4. CHALLENGES IN PORTUGAL**

1. MOBILE NETWORKS EVOLUTION (AND 5G)

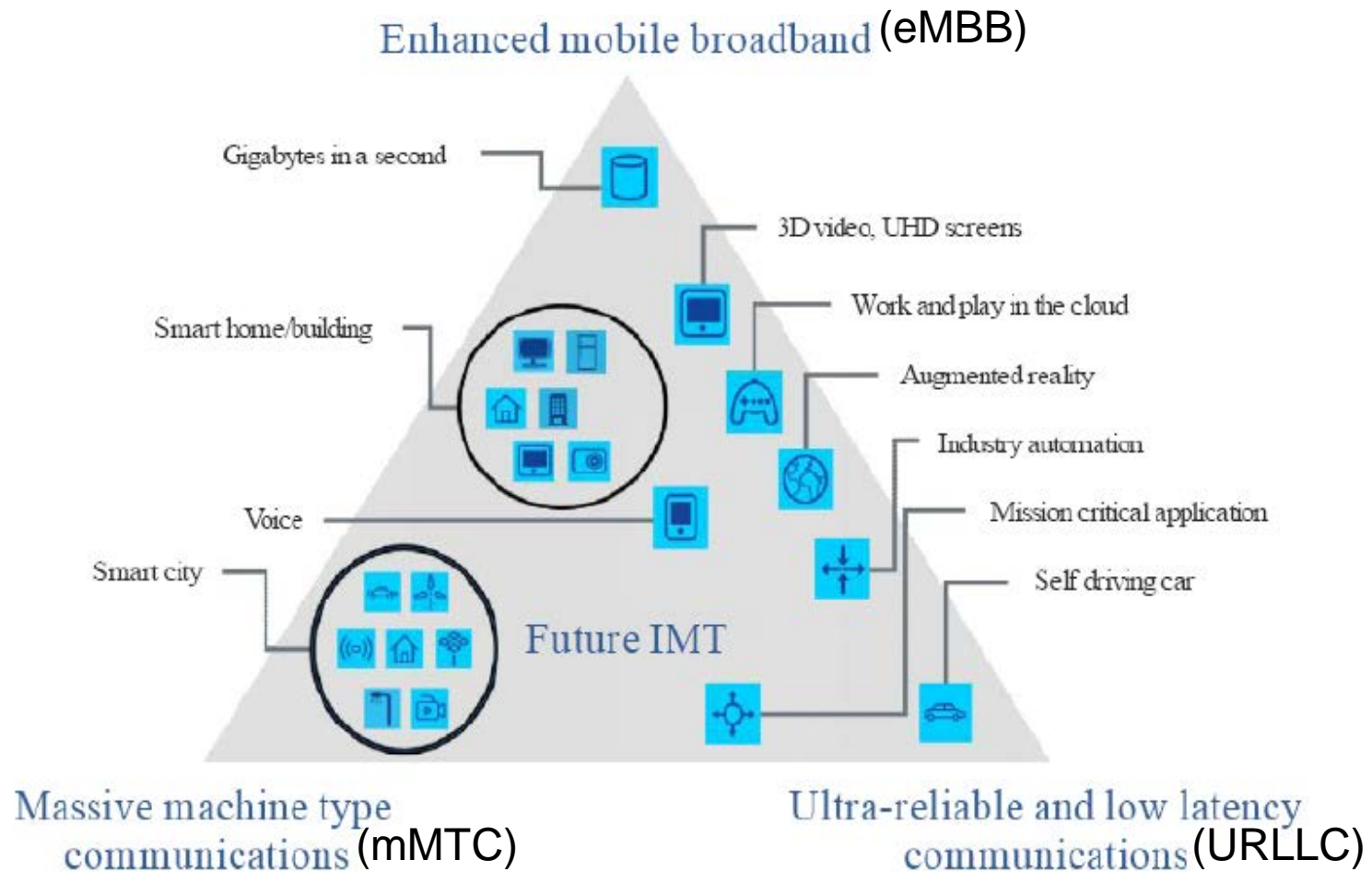
The “decades”

“...We always **overestimate** the change that will occur in the next two years and **underestimate** the change that will occur in the next ten years...”

Bill Gates

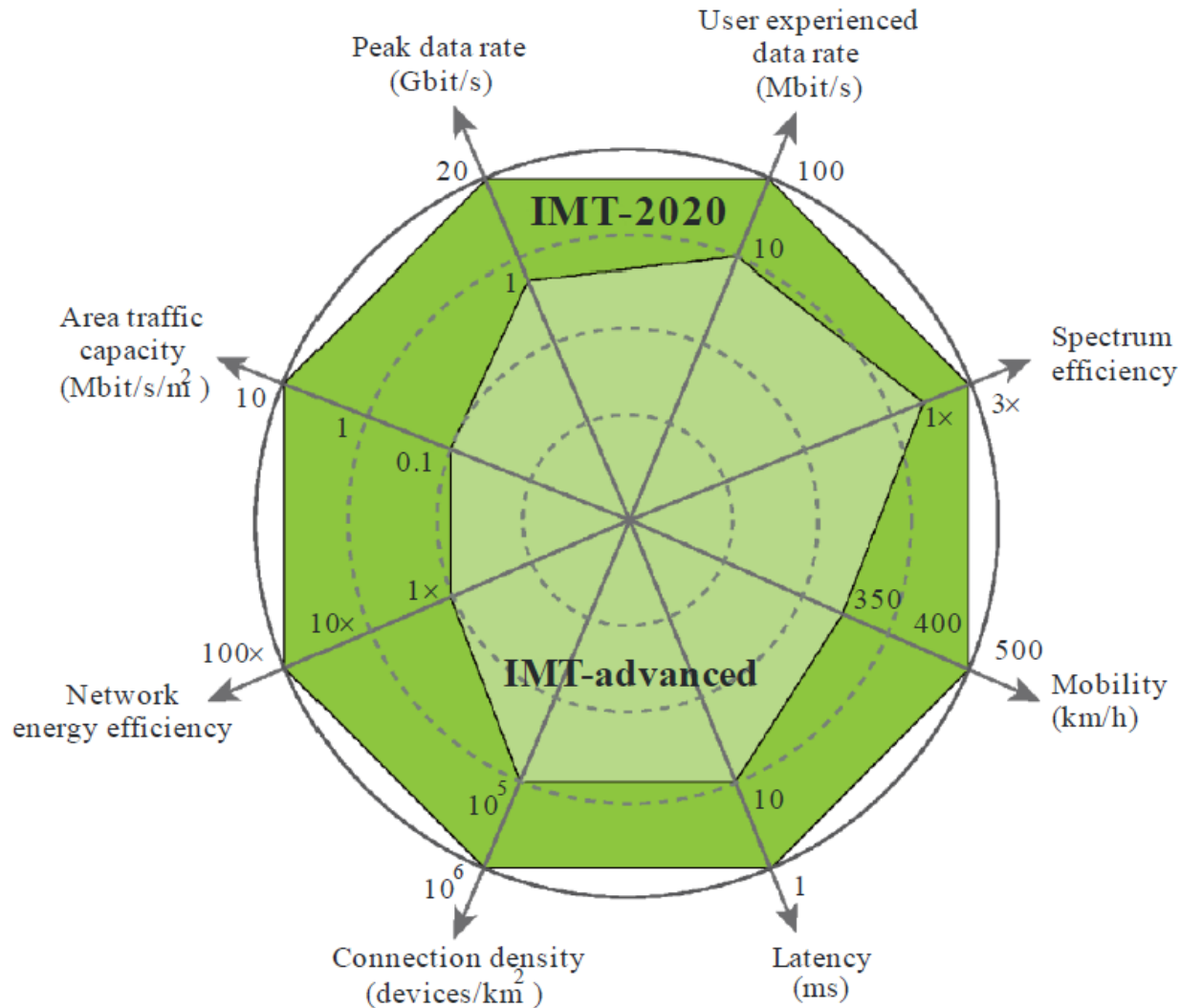


Usage scenarios of IMT for 2020 and beyond



M.2083-02

Capabilities from IMT-Advanced to IMT-2020



Equipment/network manufacturers

Connectivity providers

Automotive

- ▶ Connected cars
- ▶ Infotainment services
- ▶ Platooning

Media and entertainment

- ▶ Live events
- ▶ Immersive media

Manufacturing

- ▶ Logistics tracking
- ▶ Robot control
- ▶ Augmented reality (AR)

Logistics

- ▶ Drone delivery
- ▶ Connected ports

Agriculture

- ▶ Agriculture drones
- ▶ Precision farming

Energy and utilities

- ▶ Smart metering
- ▶ Smart grids

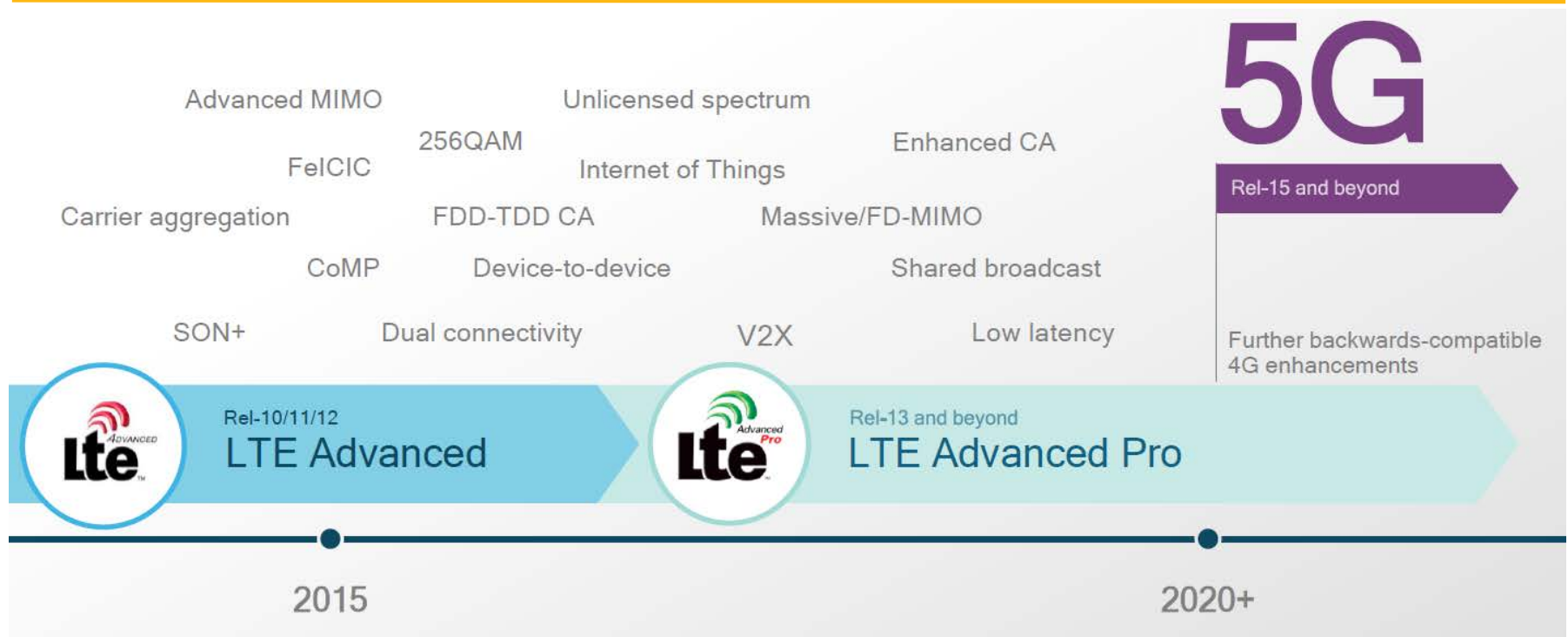
Healthcare

- ▶ Remote monitoring
- ▶ Telesurgery

Source: DotEcon and Axon

- Regulation and “5G”
- What is 5G verticals?
- Should we call it 5G? Or 5G verticals? Or only verticals?

EVOLUTION OF “xG” TECHNOLOGIES



Source: Qualcomm, “Leading the world to 5G”, February 2016

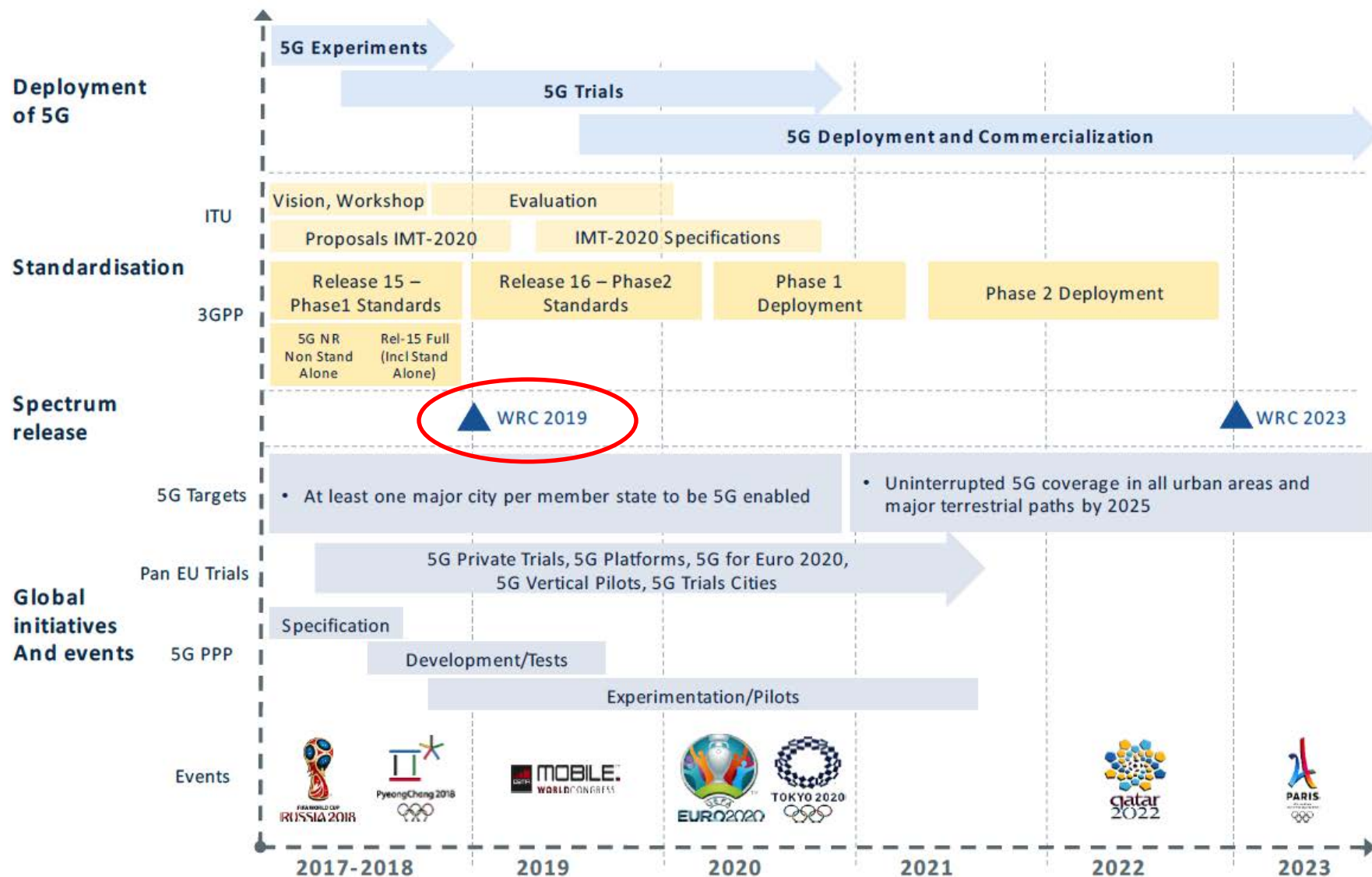


With 5G Still in the Works, 6G Is Already Taking Shape

Source: <https://www.pcmag.com/article/360533/what-is-6g>

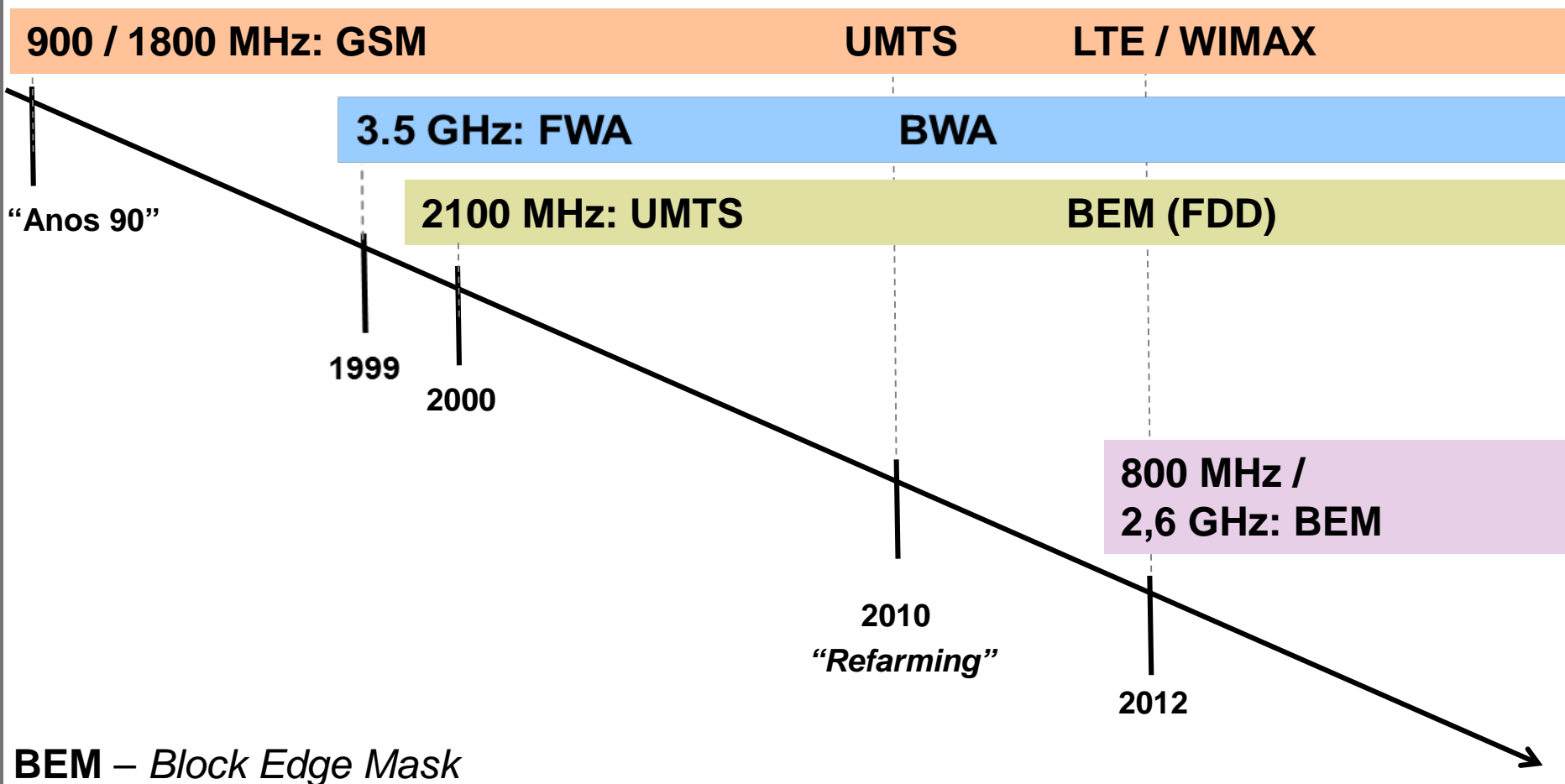
- Long range: LoRaWAN, SigFox (IoT/M2M)
- RLAN (*Radio Local Area Network*) – ex. IEEE 802.11ah
- ITS (*Intelligent Transport Systems*) - IEEE 802.11p
- FRMCS (*Future Railway Mobile radio Communications System*)
- PMR (*Private Mobile Radio*)
- SRDs (*Short Range Devices*)

5G – Roadmap



2. THE REGULATORY FRAMEWORK

Mobile networks evolution in Portugal



- **Individual Authorisation (Rights of Use)**
 - Radio electric license
 - Protected against interferences
 - With costs
 - E.g. Point-to-point links, mobile services
- **General authorisations (Without individual Rights of Use)**
 - License exempt
 - Non protection and non interference
 - Non exclusive and sharing basis
 - Without costs
 - E.g. WiFi, Bluetooth, PMR446

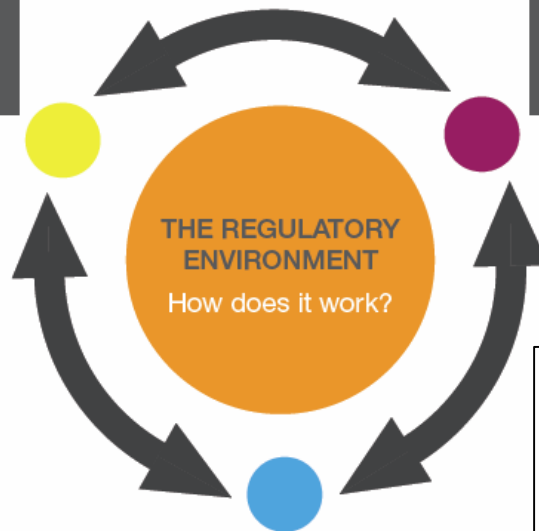
AT EUROPEAN AND GLOBAL LEVEL



- Radiocommunication
- Standardization
- Development



- EU Mandates
- EU Decisions



- ECC Decisions
- ECC Recommendations
- ECC Reports
- CEPT Reports

ECC PT1



3GPP

Fonte: *The European regulatory environment for radio equipment and spectrum – An Introduction*

HARMONIZED BANDS ON ECC

Band	Size (MHz)	ECC framework (main deliverables)
700 MHz (694-790 MHz)	2x30 + 20 (option 0 to 4 blocks of 5 MHz) (SDL)	ECC DEC(15)01
800 MHz (790-862 MHz)	2x30	ECC DEC(09)03
900 MHz (880-915 MHz /925-960 MHz)	2x35	ECC DEC(06)13
1452-1492 MHz	40 (SDL)	ECC DEC(13)03
1.8 GHz (1710-1785 MHz/1805-1880 MHz)	2x75	ECC DEC(06)13
2 GHz (1920-1980MHz/210-2170 MHz)	2x60	ECC DEC(06)01
2.3-2.4 GHz	100	ECC DEC(14)02
2.6 GHz (2500-2690 MHz)	2x70+50	ECC DEC(05)05
3.4-3.8 GHz	400	ECC DEC(11)06
	Total : 1210 MHz	

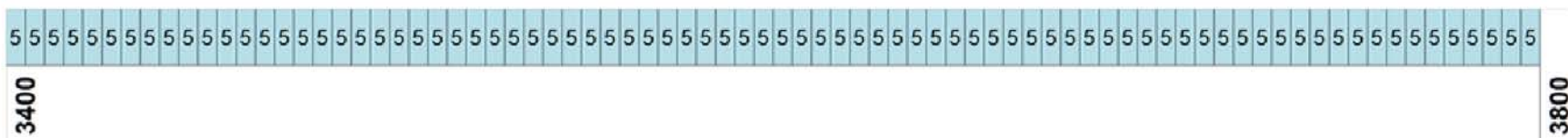
3. SPECTRUM OPPORTUNITIES

- **3.6 GHz (3400-3800 MHz)** will be the **first primary band for 5G** and bring the necessary capacity for new 5G services
- **26 GHz (24,25-27,5 GHz)** will be the **pioneer band in Europe above 24 GHz** to give ultra-high capacity for innovative new services, enabling new business models and sectors of the economy to benefit from 5G;
- **5G can be launched over the existing EU harmonised mobile bands**, including in particular bands below 1 GHz which can enable 5G coverage to all areas (e.g. 700 MHz) ensuring that everyone benefits, while enabling the transition from the current to the next generation of networks.

FREQUENCY BAND 3.4 – 3.8 GHz

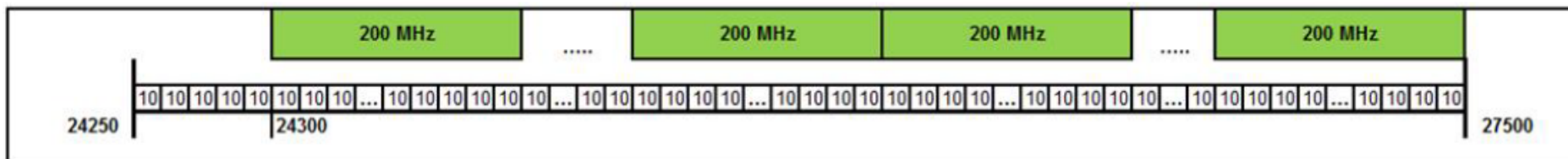
- **ECC/DEC/(11)06** (Amended 26 October 2018) – Harmonised frequency arrangements and least restrictive technical conditions (LRTC) for mobile/fixed communications networks (MFCN) operating in the band 3400-3800 MHz
- **COMMISSION IMPLEMENTING DECISION (EU) 2019/235** (amending Decision 2008/411/EC)
 - Provides harmonised technical conditions for both non-active antenna systems (non-AAS) and active antenna systems (AAS)
 - *Synchronised, Un-synchronised* and *Semi-synchronised* operation
 - Time Division Duplex (TDD)
 - Assigned block sizes shall be in multiples of 5 MHz
 - Large portions of contiguous spectrum, preferably 80-100 MHz

NOTE
(1)



FREQUENCY BAND 24.25-27.5 GHz

- **ECC/DEC/(18)06** (Approved 06 July 2018) – Harmonised technical conditions for Mobile/Fixed Communications Networks (MFCN) in the band 24.25-27.5 GHz
- **COMMISSION IMPLEMENTING DECISION (EU) 2019/784** (14 May 2019)
 - **Synchronised operation.** Unsynchronised or semi-synchronised operation of neighbouring systems requires further studies
 - Authorisation regime based **exclusively on individual rights of use**
 - appropriately protect (e.g. EESS in the 23.6 – 24 GHz, “satellite” in the 25.25 – 27 GHz band)
 - Time Division Duplex (TDD)
 - Assigned block size shall be a multiple of 200 MHz
 - Active antenna systems (AAS)

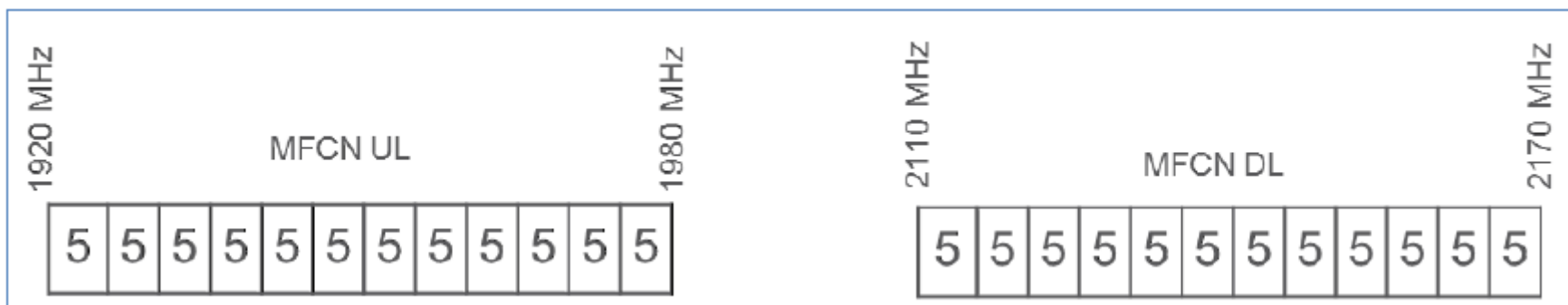


- **ECC/DEC(06)13** (Amended 8 March 2019) - Designation of the bands 880-915 MHz, 925-960 MHz, 1710-1785 MHz and 1805-1880 MHz for terrestrial UMTS, LTE, WiMAX and **IoT cellular systems**

DECIDES

1. that for the purpose of this Decision, UMTS, LTE, **NR** and WiMAX are defined in Annex 1 to this Decision;
 2. that for the purpose of this Decision, **IoT cellular systems** are defined in Annex 2 to this Decision with associated technical conditions;
 3. that administrations shall take all necessary measures to ensure the protection of the continued operation of GSM systems in the 900 MHz and 1800 MHz bands;
 4. that the frequency bands 880-915 MHz, 925-960 MHz, 1710-1785 MHz and 1805-1880 MHz are designated⁵, for terrestrial UMTS, LTE, NR, WiMAX and IoT cellular systems, subject to market demand and national licensing schemes;
- With non-AAS BS in 880-915 MHz and 925-960 MHz frequency bands (i.e. '900 MHz band')
 - With non-AAS BS, NR AAS BS and LTE AAS BS in the 1710-1785 MHz and 1805-1880 MHz frequency bands (i.e. '1800 MHz band')

- **ECC/DEC(06)01** (Amended 8 March 2019) - The harmonised utilisation of the bands 1920-1980 MHz and 2110-2170 MHz for mobile/fixed communications networks (MFCN) including terrestrial IMT systems
 - ECC conducted in 2018 a review of this ECC Decision and, based on this assessment, developed harmonised least restrictive technical conditions (LRTC) suitable for **LTE AAS and 5G (New Radio (NR) including Active Antenna Systems (AAS))**



- 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 (WRC-15)**

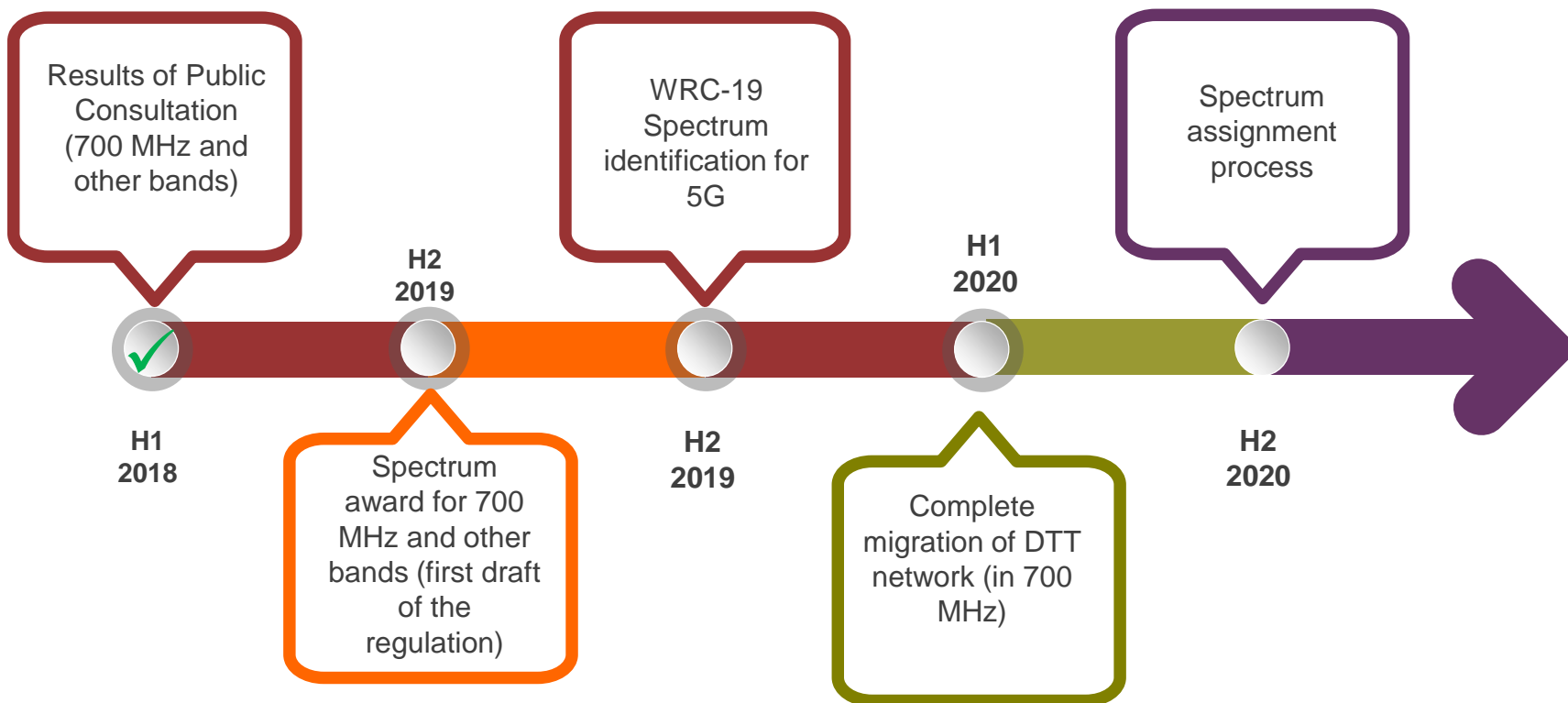
Agenda item (1.13)	Allocation
24,25 - 27,5 GHz	(MS)
31,8 - 33,4 GHz	(no MS)
37 - 40,5 GHz	(MS)
40,5 - 42,5 GHz	(no MS)
42,5 - 43,5 GHz	(MS)
45,5 - 47 GHz	(MS)
47 - 47,2 GHz	(no MS)
47,2 - 50,2 GHz	(MS)
50,4 - 52,6 GHz	(MS)
66 - 76 GHz	(MS)
81 - 86 GHz	(MS)

Agenda item (1.13)	Allocation	Comments
24.25 – 27.5 GHz	(MS)	Decision ECC (18)06 (RoU)
31.8 – 33.4 GHz	(no MS)	
37 – 40.5 GHz	(MS)	CEPT would not oppose a global IMT identification [...] provided that the relevant conditions to ensure protection of incumbent services in the 37-40.5 GHz band and EESS (passive) in the 36-37 GHz band are included
40.5 – 42.5 GHz	(no MS)	CEPT supports an IMT identification for 40.5-43.5 GHz. This is a priority band for CEPT and already identified for future harmonisation in Europe
42.5 – 43.5 GHz	(MS)	
45.5 - 47 GHz	(MS)	-
47 – 47.2 GHz	(no MS)	-
47.2 – 50.2 GHz	(MS)	-
50.4 – 52.6 GHz	(MS)	-
66 - 76 GHz	(MS)	66 – 71 GHz: IMT and WAS should have equal access to the frequency band 66-71 GHz
		71 – 76 GHz
81 - 86 GHz	(MS)	

4. CHALLENGES IN PORTUGAL

700 MHz FREQUENCY BAND

703-708	708-713	713-718	718-723	723-728	728-733			758-763	763-768	768-773	773-778	778-783	783-788
MFCN Uplink						Duplex Gap	TDT	MFCN Downlink					
30 MHz (6 blocos de 5 MHz)						25 MHz		30 MHz (6 blocos de 5 MHz)					



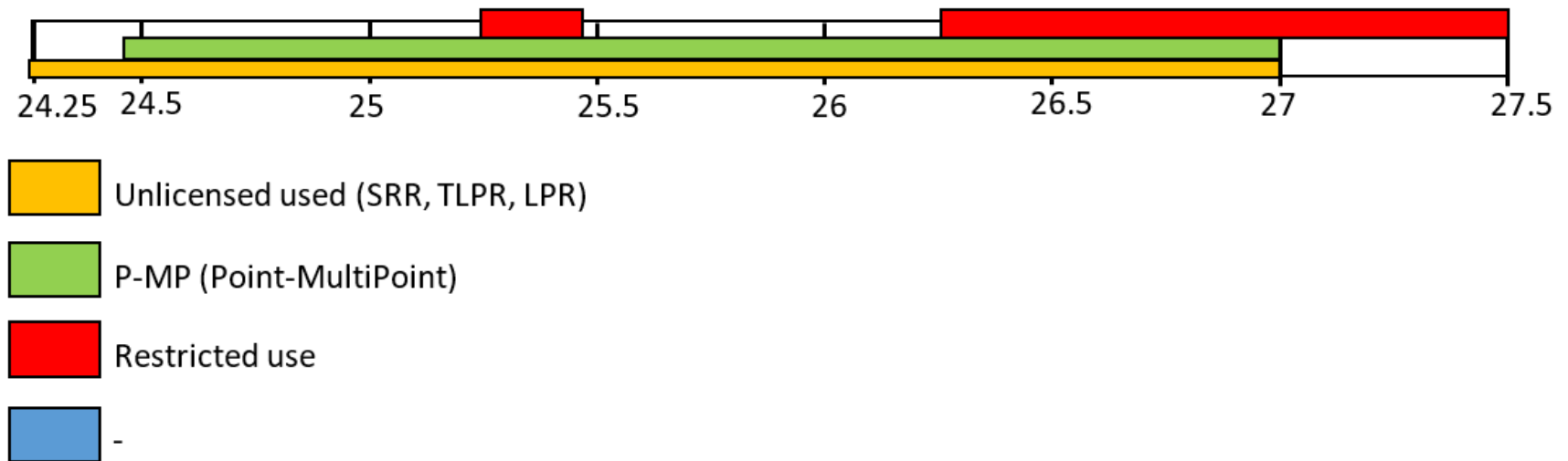
3.4 – 3.8 GHz FREQUENCY BAND

Zona Geográfica	3.4-3.6 GHz			3.6-3.8 GHz		
	3,410-3,438 GHz	3,441-3,469 GHz	3,472-3,500 GHz	3,602-3,630 GHz	3,633-3,661 GHz	3,664-3,692 GHz
	3,510-3,538 GHz	3,541-3,569 GHz	3,572-3,600 GHz	3,702-3,730 GHz	3,733-3,761 GHz	3,764-3,792 GHz
1	MEO	Dense Air	Dense Air	Dense Air	Livre	Livre
2	Livre	Dense Air	Dense Air	Livre	Livre	Livre
3	Livre	Livre	Dense Air	Livre	Livre	Livre
4	Livre	Livre	Dense Air	Livre	Livre	Livre
5	MEO	Livre	Dense Air	Livre	Livre	Livre
6	MEO	Livre	Dense Air	Livre	Livre	Livre
7	MEO	Livre	Dense Air	Livre	Livre	Livre
8	Livre	Livre	Dense Air	Livre	Livre	Livre
9	Livre	Livre	Livre	Livre	Livre	Livre



24.25 – 27.5 GHz in PORTUGAL

- Applications identified in the NTFA (National Table of Frequency Allocations)



Thank you for the attention