

Spectrum Regulation in 5G and beyond

Part 1

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Presentation overview

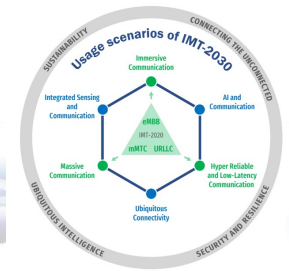
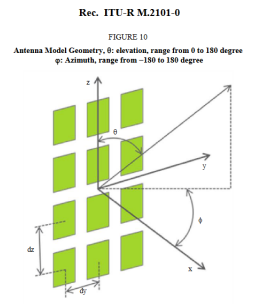
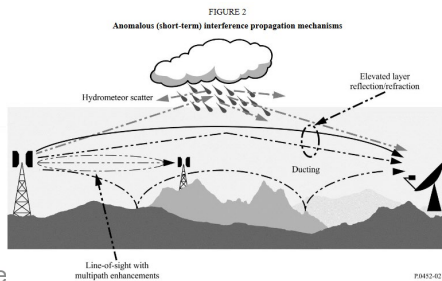
1. The Global context
 - a. The International Telecommunication Union
 - b. The World Radiocommunication Conference
2. European context (CEPT)
 - a. CEPT organisation and structure - ECC and ECO
 - b. Relationship with other organisations – ETSI and EC
3. CEPT initiatives towards 6G
4. Key challenges in the use of spectrum

Global context - ITU

- International Telecommunication Union ([ITU](#)) – UN specialised agency for ICT
 - [193 member states](#) plus 1000 sector members – companies, universities, international organisations
 - [Oldest UN agency](#) - originally 'International Telegraph Union' established in 1865
- 3 sectors:
 - [ITU-R](#) – Radiocommunication
 - [ITU-T](#) – Telecommunication standardisation
 - [ITU-D](#) – Development
- Frequencies are allocated to different services through the [Radio Regulations](#) – an international treaty

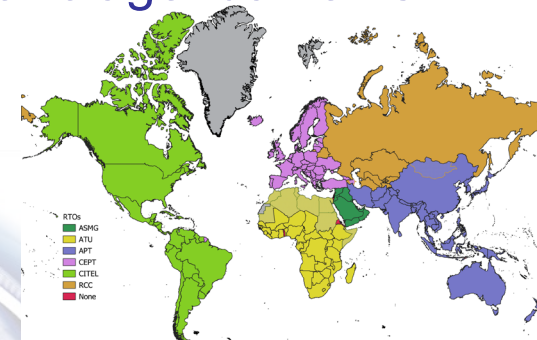
Global context - ITU

- ITU-R Recommendations provide technical characteristics for use in coexistence studies
 - Propagation models – P series
 - Antenna patterns for mobile/fixed/satellite services
 - System characteristics – e.g. M.2101 defining 5G (IMT-2020) modelling parameters, M.2160 on 6G (IMT-2030) framework
- ITU-R Reports provide results of technical studies



CEPT and the ITU

- CEPT is 1 of 6 regional organisations represented at the ITU
- CEPT develops European Common Proposals for WRC and other ITU Conferences
 - Negotiations are coordinated between CEPT delegations at the Conference with the aim to reach consensus with other regional groups
- The 4 year period between WRCs is used intensively for meetings and technical studies to reach consensus on specific agenda items
 - Preparation for next WRC in 2027 is already underway...





CEPT Introduction

- Organisation gathering policy makers and regulators from 46 countries across Europe:
 - Promote cooperation between Members
 - Contribute to creating a European dynamic market
 - Promote harmonisation of telecommunication, radio spectrum and postal regulations
- Established in 1959 with 19 original members





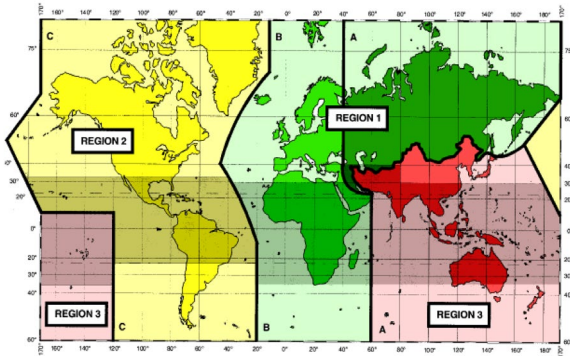
CEPT the European Regional Organisation

Based on the ITU Constitution and Convention:

- ITU Member States reserve “the right to form regional organizations, for the purpose of settling telecommunication questions which are susceptible of being treated on a regional basis”.
- Regional organisations are admitted to Radiocommunication Conferences to participate in advisory capacity.
- Regional organisations are authorised to participate to the work of each ITU Sector.



Regional organisations preparing WRC



For the allocation of frequencies to the different services the Radio Regulations divide the world in 3 Regions.



[European Conference of Postal and Telecommunications Administrations \(CEPT\)](#)

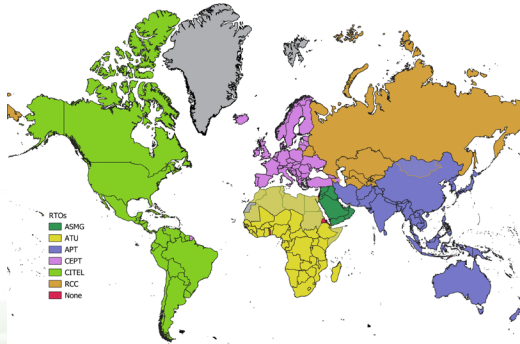


[Inter-American Telecommunication Commission \(CITEL\)](#)



[Regional Commonwealth in the Field of Communications \(RCC\)](#)

There are 6 Regional Telecommunications Organisation that operate in the different areas of the world.



[Asia-Pacific Telecommunity \(APT\)](#)



[Arab Spectrum Management Group \(ASMG\)](#)



[African Telecommunications Union \(ATU\)](#)



ECO as the CEPT Focal Point

- Permanent point of contact with other Regional Telecommunication Organisations recognised by the ITU
- **Promotion of relationships between the CEPT and the other Regional Organisations in a spirit of cooperation and compromise**
- Assistance for the CEPT preparation to the meetings:
 - Compilation and distribution of informative material on the status of the WRC preparation in CEPT, including Preliminary positions to the Conference
 - Mutual exchange of positions on the various agenda items at WRCs.
 - Assembling of CEPT Delegations to other Regional Organisations' meetings
 - Remote attendance to WRC preparatory meetings outside CEPT, as part of the CEPT delegation.

World Radiocommunication Conferences (WRC)

RADIO REGULATIONS

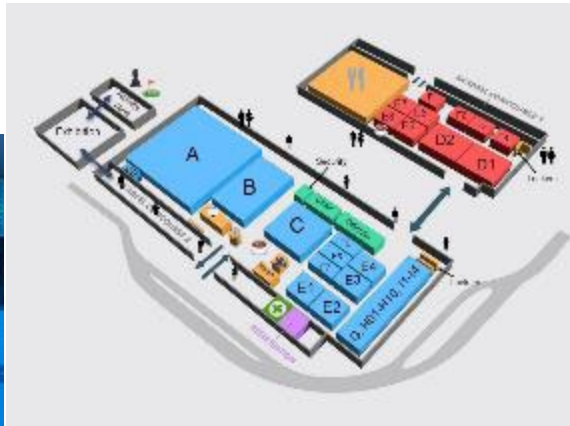


- **ITU Radio Regulations is the international treaty governing the use of the radio-frequency spectrum and the geostationary-satellite and non-geostationary-satellite orbits. RR has a binding nature for ITU Members.**
- RR is elaborated and revised by administrations and members during World Radiocommunication Conferences (WRCs), based on the **Agenda approved by the ITU Council.**
- **RR incorporates the decisions of the WRCs including all Appendices, Resolutions, Recommendations and ITU-R Recommendations incorporated by reference.**

- WRCs are held every three to four years and update the Radio Regulations, considering radiocommunication matter of worldwide character.
- WRC decides on a high level international framework, which is afterwards implemented on a regional basis in all regional organisations.
- Every WRC sets the agenda of the following WRC, taking into account recommendations made by the previous WRC.

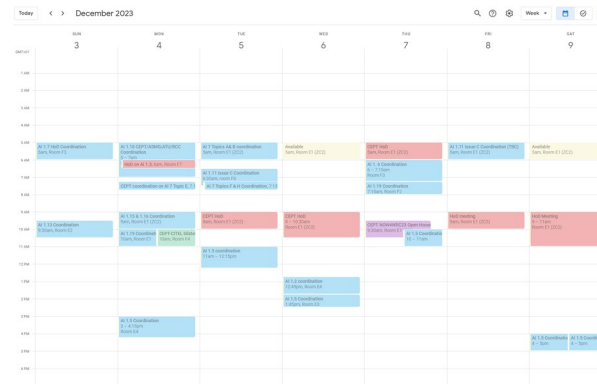
Organisation and logistics

- Over 3900 participants – largest ever WRC
- 790 CEPT participants (183 women) from 44 CEPT countries
- 4 weeks of meetings, sessions every day (until late...)
- Plenary->Committees->Sub-working groups->drafting groups
- Informal/offline discussions, ad-hoc groups...



CEPT coordination

- Regular heads of delegation meetings – 14 in total
- 4 General Coordination Meetings
- Dedicated meetings for specific agenda items
 - e.g. 13 meetings for agenda item 1.5 on UHF review

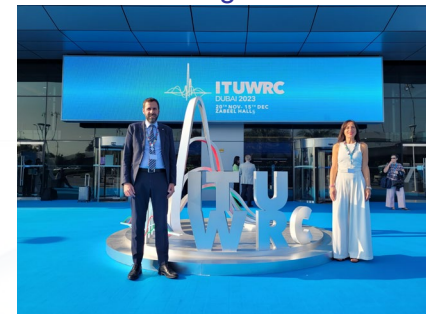
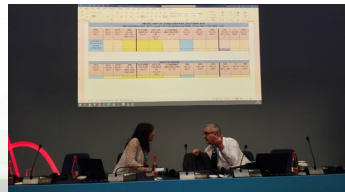
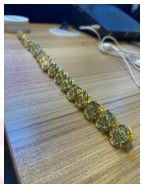
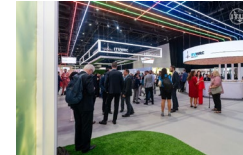


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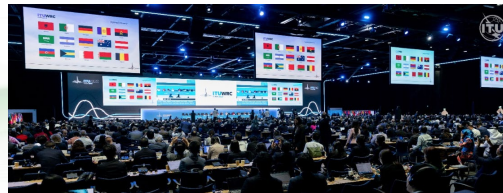
ECO role in short

- Provide 2 experts attending WRC-23 for its whole duration and remote IT support for the coordination tools
- Assist in the development, submission and management of the ECPs through the ITU-R tools
- Provide specialist support to CPG Chair and the CEPT Coordination Team on:
 - Organisation of CEPT Coordination and HoD meetings
 - Procedural matters, working methods and working arrangements
 - Ensuring consistency in CEPT actions at the Conference
 - Assist in the promotion of CEPT positions and strategies at the Conference
- Act as focal point between CEPT and the other Regional organisations
- Act as contact point between the CEPT Coordination team and the national delegations;
- Provide support for practical arrangements regarding the usage of meeting facilities at the Conference Centre
- Provide electronic tools for CEPT coordination, including a dedicated group within the ECC website and a chat system;
- Develop continuous overview and weekly reports on the progress achieved in the course of each of the four weeks of WRC;
- Publish on the CEPT portal and disseminate through social media news and releases on the results achieved during the Conference on topics of interest for Europe;
- Assist CEPT from remote during the RA-23 and CPM27-1. (*chat, ECPs*)
- Assist the CEPT Network of Women for WRC-23.



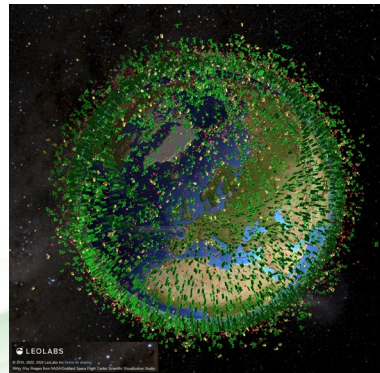
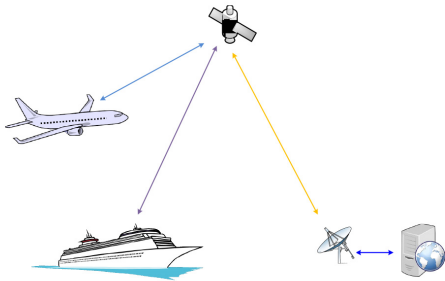
Key outcomes from WRC-23 - Mobile

- WRC-23 (20 November-15 December 2023) agreed a range of new allocations and technical conditions to enable new services and ensure protection of existing users
- Mobile:
 - 6425-7125 MHz identified for International Mobile Telecommunications (IMT) in Region 1 (encompassing Europe, Middle East and Africa) – enabling the band for 5G and 6G – Wi-Fi usage recognised
 - Identification of existing mobile bands below 3 GHz for use by high altitude platforms operating as IMT base stations (HIBS)
 - New secondary mobile allocation in 470-694 MHz in Region 1 with further review in 2031 – allows countries to deploy mobile networks while ensuring TV broadcasting can continue to use the band



Key outcomes from WRC-23 - Satellite

- Satellite:
 - New bands for “earth stations in motion” in 12.75-13.25 GHz, 17.7-20.2 GHz and 27.5-30 GHz – facilitating high speed connectivity on board aircraft and ships
 - Updated regulatory procedures to reflect the recent increase in demand for megaconstellations
 - New frequencies for inter-satellite links
 - Facilitation of procedures for new entrants



Key outcomes from WRC-23 - Others

- Maritime
 - Modernisation and enlargement of the Global Maritime Distress and Safety System
- Aeronautical
 - improved communications in remote areas and over the oceans
- Scientific services
 - recognised role of space monitoring for climate change;
 - spectrum for space research for deep space and, in perspective, lunar communications
- Agreed agenda for next WRC in 2027 (19 agenda items) and preliminary agenda for 2031 (14 agenda items)
- Approval of the new ITU-R Resolution on gender equality and equity at the Radiocommunication Assembly 2023



The [Radio Regulations](#), Edition 2024, will entry into force on 1st January 2025

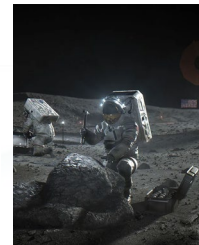
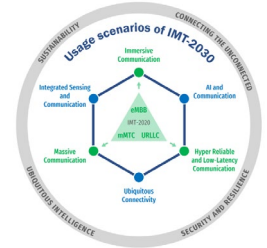
Some topics on the WRC-27 agenda

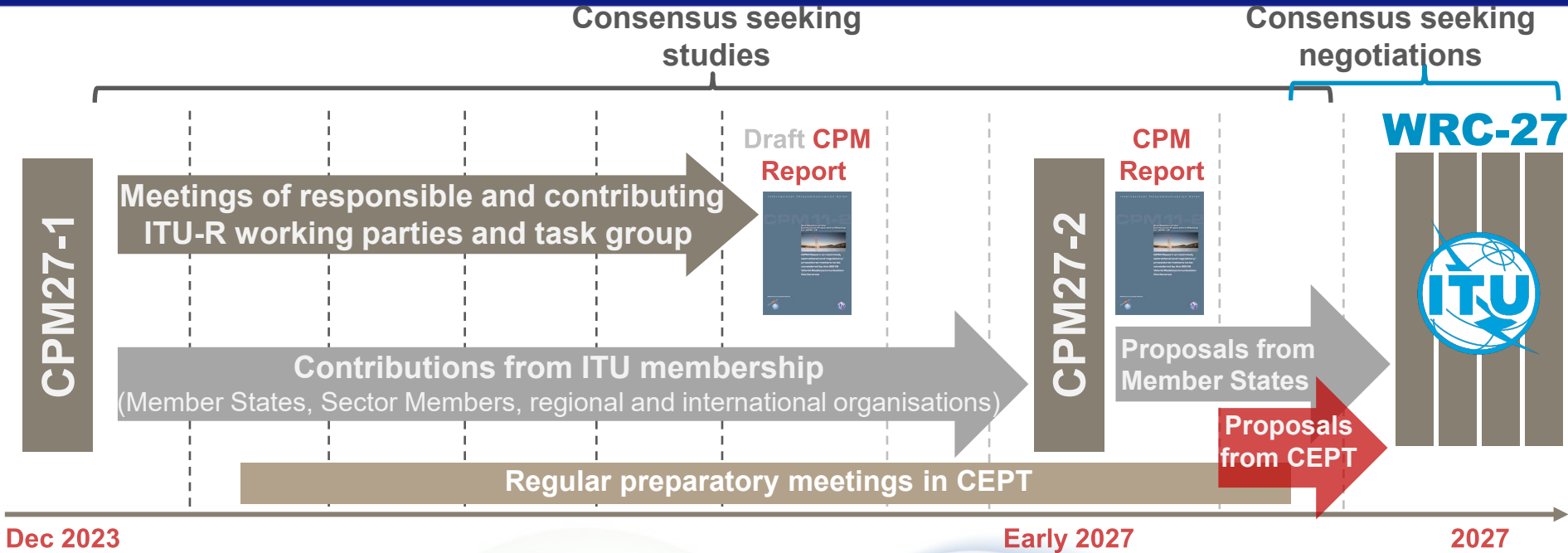
- The majority of [WRC-27 agenda items](#) are related to satellite:
 - Possible new allocation to mobile-satellite service (MSS) in existing terrestrial mobile bands, to provide complementary coverage (direct-to-cell)
 - Possible new MSS allocations to support satellite-IoT and other applications in ranges from 1427 to 2160 MHz
- Possible IMT identification to enable 6G in:
 - 4400-4800 in Region 1 (EMEA) and 3 (Asia-Pacific)
 - 7125-7250 and 7750-8400 MHz in Region 1, 7125-8400 MHz in Region 2 (Americas) and 3
 - 14.8-15.35 GHz
- Review of space research allocations for development of communications networks on the Moon!

SPACE
100%

SpaceX's new direct-to-cell Starlink satellites relay their 1st text messages

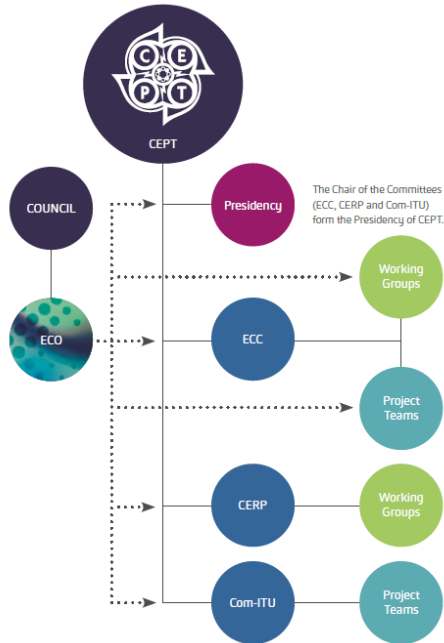
News By Mike Wall published January 11, 2024







CEPT structure and Committees



- **ECC**: Electronic Communications Committee – telecommunications harmonisation and European co-ordination and preparation for ITU-R meetings
- **Com-ITU**: Committee for ITU Policy – European co-ordination for ITU meetings
- **CERP**: European Committee for Postal Regulation – postal regulation, as well as European co-ordination and preparation for meetings of the Universal Postal Union (UPU)
- **ECO**: European Communications Office - Permanent office of the CEPT in Copenhagen
- ECO's governing body is the ECO Council made up of representatives from each of the ECO Convention's signatory countries

CEPT Electronic Communications Committees (ECC)

Electronic Communications Committee ([ECC](#))

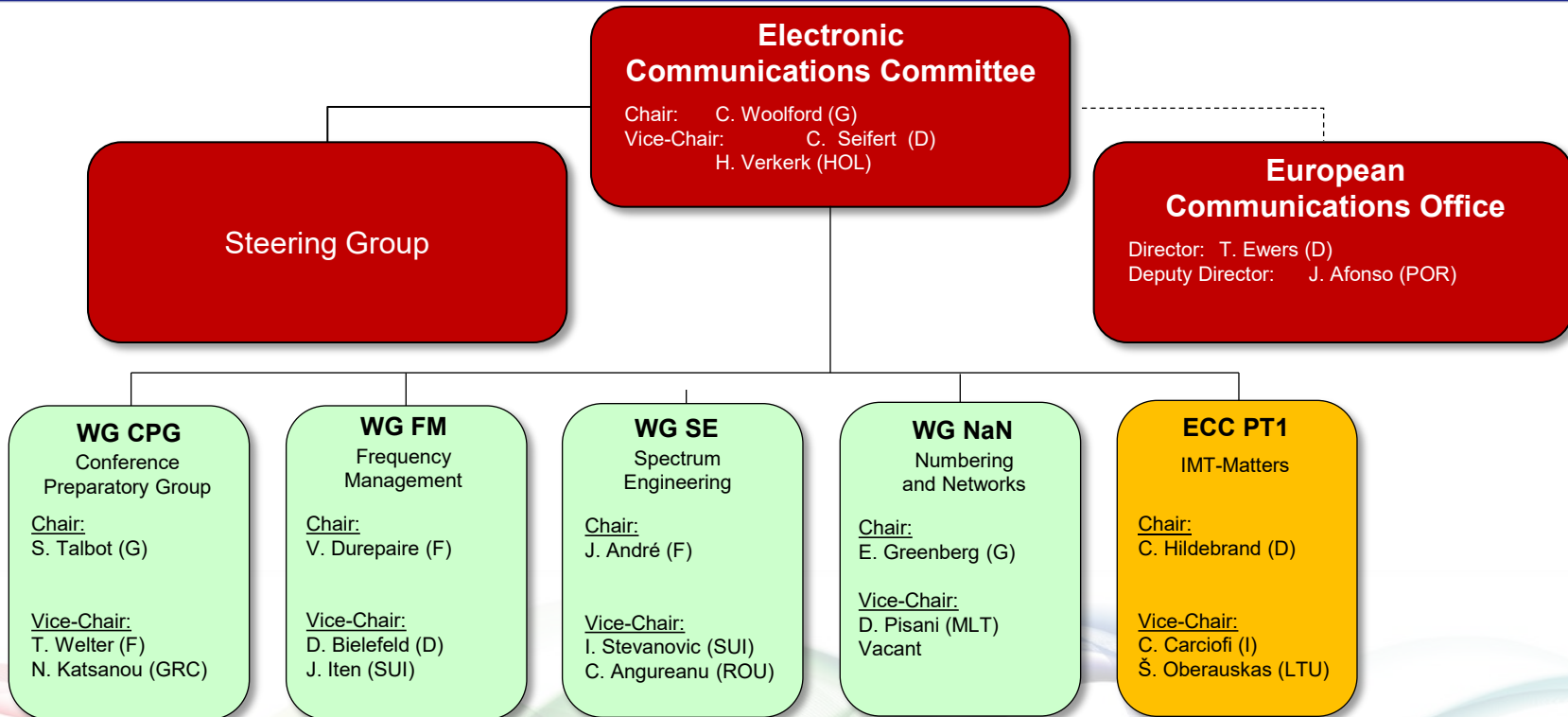
The ECC considers and develops policies on electronic communications activities in European context, taking account of European and international legislation and regulations. The primary objective of the ECC is to enable the efficient, effective and harmonised use of the radio spectrum, satellite orbits and numbering resources across Europe

Mission

- develops common policies and regulations for Europe
- considers European and International legislation
- prepares European Common Proposals to represent European interests in international organisations, especially in the ITU
- provide a focal point for information
- cooperates with other bodies

The [2020-2025 ECC strategic plan](#) defines the key priorities of ongoing work

ECC Structure



ECC Deliverables

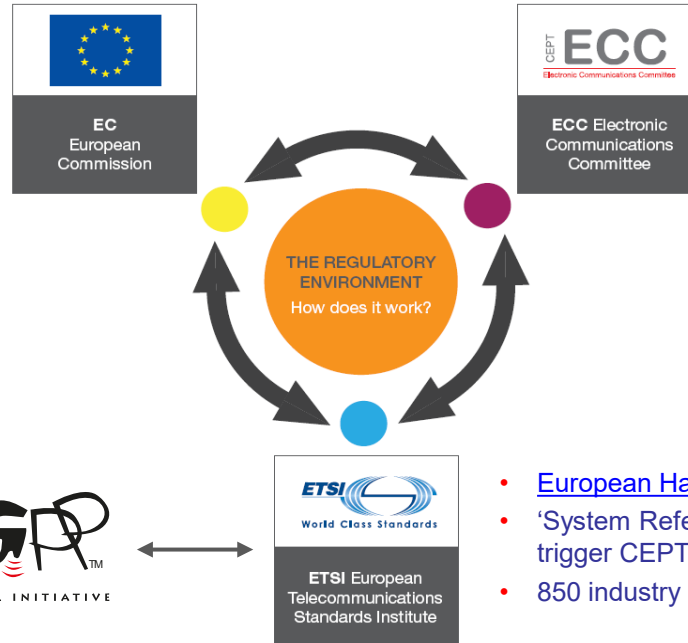
Deliverables

- [ECC Decisions](#) – spectrum harmonisation and exemption from licensing for equipment
- [ECC Recommendations](#) – guidelines for administrations (e.g. cross-border co-ordination, channelling plans)
- [ECC Reports](#) – results of technical studies – e.g. coexistence studies to inform development of ECC Decisions
- [CEPT Reports](#) – technical analysis in response to Mandates from the European Commission



European regulatory framework for radio spectrum and equipment

- Single market issues (27 Member States)
- Binding regulations ([EC Decisions](#)) based on:
 - the technical expertise of CEPT/ECC ([CEPT Reports](#))
 - ETSI harmonised standards



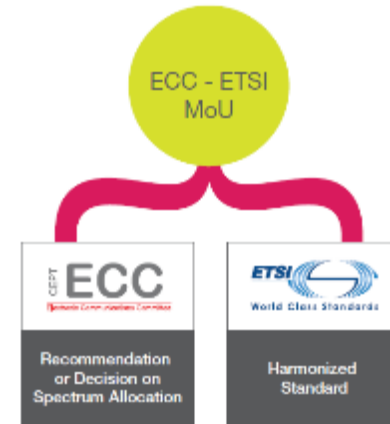
- Consensus based voluntary harmonisation ([ECC Decisions](#)) for 46 member countries
- Spectrum designation to systems/applications and technical conditions for its use

- [European Harmonised standards](#) (EN) for radio equipment
- 'System Reference Documents' (SRDoc) which inform and trigger CEPT/ECC work
- 850 industry members and European national regulators

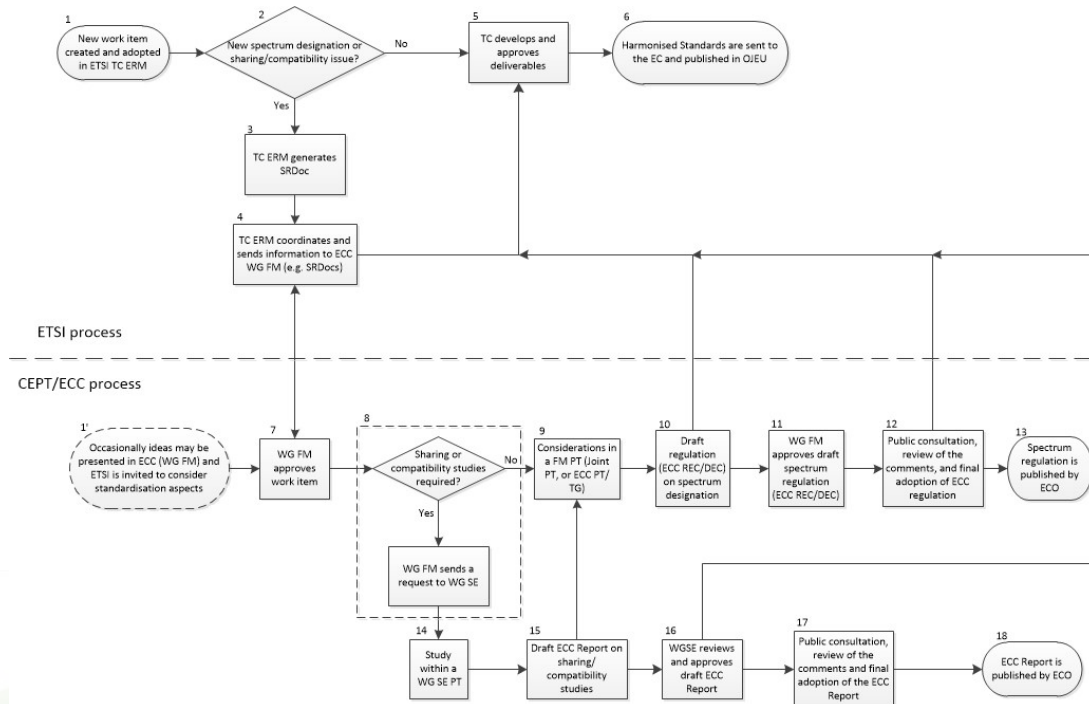
European Regulatory process

REGULATORY PROCESS STEP-BY-STEP

1. ETSI develops “System Reference Documents” to accompany requests for aligned radio frequencies in CEPT countries
2. Identification of candidate frequency bands
3. ECC conduct coexistence studies between services in same and adjacent bands.
SEAMCAT has pivotal role in assessing interference and coexistence scenarios
4. ECC determine technical parameters and conditions for spectrum sharing
5. ECC adopts ECC Decisions, Recommendations and Reports based on sharing and compatibility studies
6. The ETSI Standardisation process crafts technical standards for devices operating within the determined parameters
7. ETSI harmonised standards are published in Official Journal of EU



European Regulatory framework workflow



European collaborative framework

Harmonisation and Consistency:

- Collaboration between ECC, ETSI, and the EU ensures consistency in regulations, technical standards, and industry implementation.

Balancing Innovation and Regulation:

- The collaborative framework supports innovation by providing clear rules and standards that promote the efficient use of spectrum resources.
- By involving technical expertise and regulatory oversight, the framework ensures that innovations meet the requirements of fair spectrum sharing and interference management.

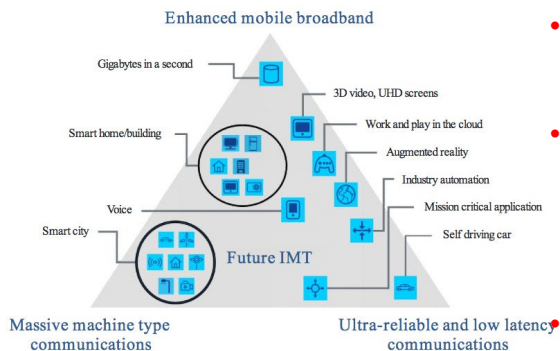
Benefits of Collaboration:

- Efficient spectrum use: Collaborative decisions lead to optimal use of scarce radio spectrum.
- Interoperability: Standardised technical specifications enable devices to work seamlessly across Europe.
- Regulatory clarity: ECC Decisions and ETSI standards provide a clear roadmap for industry players.
- Stakeholder Involvement: Industry, academia, and research institutions participate in CEPT, ETSI, and EC activities

European Standardization Process

- Importance of Standardisation
 - Ensuring harmonised and interoperable systems across Europe
 - Facilitating efficient use of spectrum resources and technological advancements
- ETSI's pivotal Role in Standardisation
 - Developing technical standards for various sectors, including telecommunications and radiocommunications
 - Bridging the gap between regulatory requirements and industry innovation
- Harmonisation with CEPT/ECC Decisions and Recommendations
 - Alignment of ETSI standards with CEPT's technical conditions for effective regulatory implementation

The CEPT Roadmap for 5G and beyond

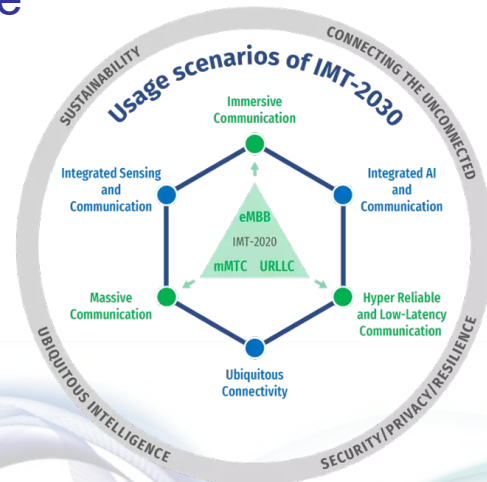


Source: [ITU-R Recommendation M.2083](#)

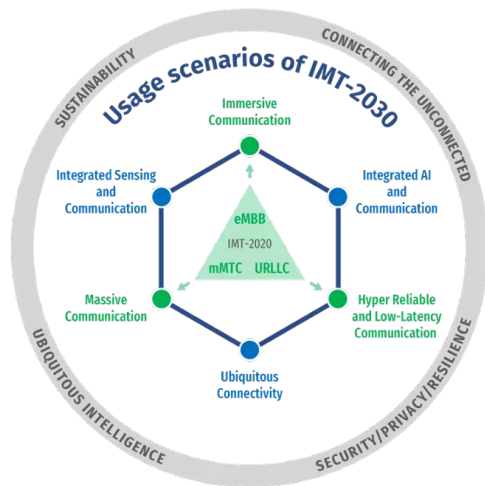
- The ECC approved in November 2016 [the CEPT roadmap for 5G](#) with a comprehensive list of actions regarding the fifth generation of mobile technology
- A new future looking [roadmap for '5G and beyond'](#) was launched in November 2020 and updated as live document until July 2023
- In 2018 ECC developed and approved **harmonisation measures for the 5G pioneer bands** :
 - **3.4-3.8 GHz**
 - **24.25-27.5 GHz**
 - These address **least restrictive technical conditions for the use of the band**, updates for the use of **active antenna systems**, **cross-border coordination** measures
- In 2019 ECC started the **review of existing harmonised spectrum for suitability for 5G**
 - 900 MHz & 1800 MHz
 - 2.1 GHz
 - 2.6 GHz
- In consideration of the WRC-19 outcomes on 5G, ECC:
 - Revised the limits to protect passive services in the 23.6-24 GHz
 - Approved harmonisation measures for the 40.5-43.5 GHz
 - Confirmed the suitability of the existing framework for the 40.5-43.5 GHz band

ECC activities – Development of CEPT 6G roadmap

- ECC is defining the **CEPT Roadmap for 6G**
- The CEPT Roadmap is expected to be approved in November
- Several main tasks are under discussion and the actions for those tasks are being defined:
 - Harmonisation
 - WRC-23
 - WRC-27
 - Other challenges



IMT-2030

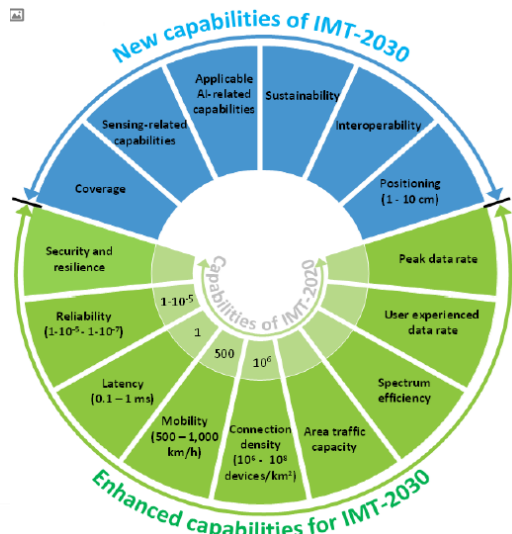


The “Wheel diagram”, Recommendation [ITU-R M.2160](#)

- **6 usage scenario for IMT-2030**
 - eMBB → Immersive Communication
 - mMTC → Massive Communication
 - uRLLC → HRLLC (Hyper Reliable & Low Latency Communication)
 - Ubiquitous Communication
 - AI and Communication
 - Integrated Sensing and Communication

- **4 overarching aspects** that act as design principles commonly applicable to all usage scenarios:
 - Sustainability
 - Connecting the unconnected
 - Ubiquitous intelligence
 - Security/resilience

IMT-2030 Capabilities



- The Framework Recommendation identifies **15 capabilities** for IMT-2030
 - Nine of those capabilities are derived from existing IMT-2020 systems
- The range of values given for capabilities are estimated targets for research and investigation of IMT-2030
 - All values in the range have equal priority in research and investigation
- IMT-2030 is expected to help address the need for increased environmental, social and economic sustainability and also support the goals of the Paris Agreement of the United Nations Framework Convention on Climate Change

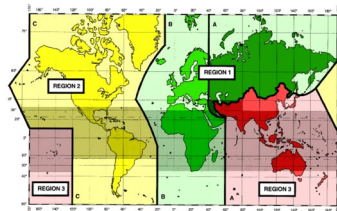
The "Palette diagram", Recommendation [ITU-R M.2160](#)



Mobile – Spectrum for 5G and 6G

WRC-23

- **6425-7125 MHz** identified for IMT to enable 5G and future 6G. The use of the band for Wi-Fi is recognised
- Mobile bands below 3 GHz for “high altitude platforms operating as IMT base stations” (**HIBS**)
- **470-960 MHz** (UHF band) reviewed, with a new secondary mobile allocation created in 470-694 MHz encompassing most CEPT countries. Possible further actions in the wider UHF at WRC-31
- Upgrade of allocation in **3.6-3.8 GHz**.
- Additional IMT identifications in some countries and regions outside Europe in 3.3-3.4 GHz, 3.6-3.8 GHz and 10-10.5 GHz



WRC-27



4 YEARS OF GLOBAL PREPARATION

Possible new IMT identifications for 5G and 6G in the bands (or parts thereof):

- **4400-4800 MHz** in Region 1 and 3
- **7125-7250 and 7750-8400 MHz** in Region 1;
- **7125-8400 MHz** in Region 2 and 3;
- **14.8-15.35 GHz**



IMT 4.4, 7, 8 & 15 GHz - European Common Allocations (1/2)

4400 – 4800 MHz

4400 MHz	4500 MHz	4500 MHz	4800 MHz
PMSE		FSS Earth stations	
PMSE		PMSE	
UWB applications		PMSE	
Aeronautical military systems		UWB applications	
Land military systems		Radiodetermination applications	
Maritime military systems		Land military systems	
Telemetry/Telecommand (military)		Maritime military systems	
		Telemetry/Telecommand (military)	
		Aeronautical military systems	

14.8 – 15.35 GHz

14.8 GHz	15.35 GHz
Radio astronomy	
Fixed	
Aeronautical military systems	
Land military systems	
Maritime military systems	

The **European Table of Frequency Allocations and Applications (ECA Table)** provides the main usage of spectrum within CEPT countries for the frequency range from 8.3 kHz to 3000 GHz
<https://efis.cept.org/sitecontent.jsp?sitecontent=ecatble>



Direct to Device/Cell

In bands allocated to the mobile-satellite service MSS

- Satellite connectivity ready to be provided in the bands already allocated to the Mobile-Satellite Service
- 3GPP has specified NTN bands in Release 17:
 - n255 (1626.5-1660.5 (Earth-to-space) / 1525-1559 MHz (space-to-Earth)
 - n256 (1980-2010 (Earth-to-space) / 2170-2200 MHz (space-to-Earth)
 - Others under study for Release 18 and beyond
- WRC-27 will discuss possible new allocations of additional to MSS in the frequency bands:
 - **2010-2025 MHz** (Earth-to-space) and **2160-2170 MHz** (space-to-Earth) in Regions 1 and 3
 - **2120-2160 MHz** (space-to-Earth) in all Regions

In bands allocated to the mobile service MS

- Direct connectivity between space stations and IMT user equipment is **not currently internationally recognised/protected** in bands allocated to MS
- WRC-27 will discuss possible new allocations to MSS in 694/698 MHz and 2.7 GHz, taking into account Recommendation ITU-R M.1036
- Challenges:
 - **Interference issues**
 - **Cross-border issues**
 - **Specific Regional/National circumstances**

ECC – harmonization of the 6 GHz band

- Studies on possible technical conditions under which WAS/RLAN could operate and coexist with existing services in the 6425-7125 MHz band.
 - technical and operational characteristics WAS/RLAN in the band
 - sharing and compatibility issues with incumbent users
- Feasibility and sharing studies on the potential shared use of the 6425-7125 MHz frequency band between Mobile/Fixed Communication Networks and WAS/RLAN.
- No regulatory measure under consideration so far.
- A Mandate to CEPT from the European Commission is expected in November.

ECC ongoing work on Direct-to-Cell

- Exploring the regulatory and technical elements of satellite based Direct-to-Cell (D2C) communications via existing available smartphones
- Understanding of direct-to-cell satellite connectivity and explore relevant regulatory and national licensing issues.
Cellular devices are unmodified smartphones
(including 3GPP NTN in MSS bands and/or connectivity in MFCN bands).
- Focus on satellite-to-cellular device systems operating in frequency bands without satellite allocations (i.e. MFCN bands).
- Work expected to be concluded in February 2025.

The big picture

Key challenges for spectrum management

- Increasing shared and dynamic use of spectrum
- Sustainability of future telco
- Ensuring equal opportunities
- Cross domain technology trends
- Multi player cooperation