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RADIO SPECTRUM POLICY GROUP

Draft Opinion

on

Long-term vision for the upper 6 GHz band

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Explanatory Note - Public Consultation – Draft RSPG Opinion on the Long-Term Vision for the Upper 6 GHz Band (6425–7125 MHz)

The Radio Spectrum Policy Group (RSPG), in accordance with the framework of its Work Programme 2024 and beyond, has developed a draft Opinion on the long-term vision for the upper 6 GHz band (6425–7125 MHz). As part of the Public Consultation on this draft Opinion, the RSPG would like to invite stakeholders to provide their views and comments on the following key points.

Preferred Options for Band Segmentation:

During the preparation of this draft Opinion, the RSPG explored options for the additional introduction of Mobile/Fixed Communications Networks (MFCN) and Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) in the upper 6 GHz band, as shown in Figure 1 in the draft Opinion. The RPSG has a clear preference for a segmentation solution in the context of a prioritised band split[1] between MFCN and WAS/RLAN (see scenario 5 in Figure 1 in the draft Opinion). The group identified four main options for splitting the band between WAS/RLAN and MFCN: at 6425 MHz or 6505 MHz or 6585 MHz or 6745 MHz.

Note: There is a slight preference within RSPG for the 160 MHz option. However, the public consultation will be an opportunity for RSPG to review the option and to decide on the most appropriate one.

The RSPG intends to present one single option in the final opinion at the RSPG Plenary on 12 November 2025.

The RSPG encourages stakeholders to provide input that could assist in identifying the most suitable approach that CEPT will have to take into account for responding to the EC mandate[2].

- **regarding justification of benefits:**

Stakeholders are invited to explain the benefits of each prioritised band split option compared to alternative approaches for meeting future demand, as discussed in the draft Opinion in:

- Chapter 4.2 (for MFCN)
- Chapter 4.5 (for WAS/RLAN).

[1] In a 'prioritised band split', each application would have non-prioritised access to the portion of the band assigned to the other application, if it does not cause harmful interference to the other application.

[2] Link: https://digital-strategy.ec.europa.eu/en/library/radio-spectrum-cept-mandates

- **regarding impact on incumbent services/applications:**

Incumbent stakeholders in the band are particularly encouraged to describe the potential impact of each band split option on their existing services/applications, and to provide the reasoning and justification behind their analysis.

To facilitate an efficient review of the consultation responses, the RSPG kindly requests stakeholders to:

- Structure their comments clearly, following the points outlined above.
- Submissions should be limited to a maximum of four pages and should include clear, well-justified, and concrete feedback, with specific references to relevant sections of the draft opinion.
- Whenever possible, submit responses through relevant associations or representative bodies to ensure a consolidated and coordinated contribution.

In addition, the RSPG has included an annex to the Opinion, which summarises the responses to the questionnaire received from stakeholders.[3]

The RSPG values your input and looks forward to receiving your views on this important matter.

[3] Between 8 July 2024 and 20 August 2024, the RSPG conducted a questionnaire on the long-term vision for the upper 6 GHz band, https://radio-spectrum-policy-group.ec.europa.eu/document/download/c87dc40a-3221-4842-98af-eb625d3557d2_en?filename=Questionnaire_U6GHz-2024.pdf
https://radio-spectrum-policy-group.ec.europa.eu/document/download/58f40db3-ce1a-4a22-bdfb-1bbccb21b2bc_en?filename=responses_questionnaire-U6GHz-rev1.zip

Draft Opinion on Long-term vision for the upper 6 GHz band

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1 Introduction

1.1 Role of the RSPG

The role of the Radio Spectrum Policy Group (RSPG) is to assist and advise the European Commission on radio spectrum policy issues. This includes advice on the coordination of policy approaches, on the preparation of multiannual radio spectrum policy programmes and, where appropriate, on harmonised conditions with regard to the availability and efficient use of radio spectrum necessary for the establishment and functioning of the internal market. In particular, the RSPG "shall assist and advise the Commission […] where appropriate, on harmonised conditions with regard to the availability and efficient use of radio spectrum, necessary for the establishment and functioning of the internal market...".

Furthermore, "the Group shall assist Member States in cooperating with each other and with the Commission […] in support of the strategic planning and coordination of radio spectrum policy approaches in the Union, by: […] coordinating Member States' approaches to the assignment and authorisation of radio spectrum use and publishing reports and opinions on radio spectrum related matters".

1.2 Scope of this Opinion

The upper 6 GHz band (6425-7125 MHz) is subject to the diverse spectrum requirements from different industry stakeholders with interests in MFCN and WAS/RLAN – on the one hand, for high power licensed mobile use (MFCN), and on the other hand, for low power unlicensed WAS/RLAN. The incumbent services and applications in this frequency range, including their future needs, should be taken into account in the development of this opinion.

The incumbent services and applications are:

1) services **with primary status**, fixed service (FS), fixed satellite service (FSS) and mobile service (MS), and
2) those **below primary status**, radio astronomy (RAS) according to footnote RR 5.149 and Earth Exploration-Satellite Service (EESS), according to footnote RR. 5.458.

In the Work Programme for 2024 and beyond, the RSPG agreed on a work item aimed at providing a long-term vision for the upper 6 GHz band. This includes policy recommendations on how to best organise the future use of this band in Europe, with the goal to maximising its contribution to achieving the digital connectivity targets for Europe, as laid down in the Digital Decade Policy Programme 2030 (DDPP). The DDPP highlights the importance of connectivity infrastructure and sets political targets for 2030, including for the deployment of networks with gigabit speed. All end users at a fixed location should be covered by a gigabit network up to the network termination point, and all populated areas should be covered by a next-generation wireless high-speed network with performance at least equivalent to that of 5G.

In the context of technology neutrality, which is a guiding principle for digital connectivity infrastructure of the highest performance, resilience, security and sustainability, all types of communication technologies can to contribute to achieving gigabit connectivity. This includes current and upcoming advancements in fibre, satellite, MFCN, WAS/RLAN or other future systems.

All technologies and transmission systems capable of contributing to this digital target should be treated equally.

Additionally, Article 45, fourth paragraph, of the Directive (EU) 2018/1972 ("European Electronic Communications Code"), provides the possibility to impose proportionate and non-discriminatory restrictions on the types of radio networks or wireless access technologies used for electronic communications services.

This opinion considers and assesses the future use of this band from a strategic and regulatory standpoint, balancing the protection, evolution, and development of incumbent services and applications, including those below primary status. It is noted that scenarios under consideration, even if technically compatible, may not align with the policy objectives of all Member States. To establish a coordinated and uniform approach within the Union, this opinion provides recommendations for the future use of the band in support of Europe's digital connectivity.

Additionally, the opinion will indicate limits of national flexibility, taking into account the implications arising from national licensing conditions, non-interference requirements, and issues related to the free circulation of use. Recommendations should also be developed on how to address the protection and future development needs of incumbent services and applications.

1.3 Considerations

1.3.1 World Radioconference (WRC)

WRC-23 adopted a new footnote RR 5.457E, according to which the frequency bands 6425 - 7125 MHz in Region 1 and 7025-7125 MHz in Region 3 are identified for use by administrations wishing to implement the terrestrial component of IMT. It is noted that these frequency bands are also used for the implementation of wireless access systems (WAS), including radio local area networks (RLANs). This identification preserves full flexibility for Europe to use IMT, RLAN or shared use. The ITU-R Resolution 220 (WRC-23), which addresses provisions for the protection of the existing services, applies.

Furthermore, the WRC-23 adopted Resolution 674, initiating studies for the WRC-27 on: (a) the possible new global primary allocations to the EESS (passive) performing sea surface temperature (SST) measurements within the frequency bands 4.2-4.4 GHz and 8.4-8.5 GHz, without protection from existing services in these bands or in adjacent bands, in order to identify complementary bands to the upper 6 GHz band, where such measurements currently take place, and (b) technical, operational and regulatory issues, including sharing and compatibility with incumbent uses, pertaining to the possible use of the terrestrial component of IMT in the adjacent 7125 – 7250 MHz frequency band in all ITU Regions. This band offers a potential extension of the upper 6 GHz band for wireless broadband (MFCN) use. The 7750-8400 MHz frequency band will also be studied for possible IMT identification for the WRC-27.
In this regard, the EU Member States took a negative position at WRC-23 on identifying spectrum for IMT in the 7-8 GHz frequency range due to strategic military use as well as other satellite and scientific usages.

1.3.2 RSPG work on 6G

In 2023 the RSPG has published an Opinion on "5G developments and possible implications for 6G spectrum needs" In the Annex 1 of that document the RSPG recognised that "there is likely to

be a need for IMT to offer coverage and capacity in mid-bands. Additional mid-bands have not yet been identified. The upper 6GHz is under consideration, noting the interest of both IMT and WAS/RLAN on this band.".[4]

In February 2025 the RSPG has published a Report on "6G Strategic vision"[5]. The RSPG studied the spectrum and network implications for the implementation of the six different usage scenarios defined by the ITU-R. The RSPG also indicated the possible frequency bands for 6G in Europe to be further investigated in preparation of the 6G spectrum roadmap.

RSPG recognised that cost-efficient urban coverage and capacity for some usage scenarios of IMT-2030, e.g. 'Immersive Communication' and 'AI and Communication', will require mid band spectrum supporting larger bandwidth and with similar radio properties as 3400-3800 MHz (coverage/capacity performance) enabling reuse of current base stations sites. The inputs from industry indicated that this spectrum need is 200 MHz for each MNO. Based on RSPG's assessment of possible frequency bands to fulfil this need, the 6425-7125 MHz band[6] seems to be the only option in the new mid band spectrum, due to the uncertainties related to the frequency bands studied in WRC-27 for IMT in Region 1.

The RSPG is currently developing a 6G spectrum roadmap, with the final interim Opinion expected to be published in 2026.

1.3.3 EC Mandate

Pursuant to Article 4(2) of the Radio Spectrum Decision[7], the Commission has issued on the 12 of December of 2024 a *Mandate*[8] *to the CEPT to study feasibility of and develop least restrictive harmonised technical conditions for the potential shared use of the 6425-7125 MHz frequency band for the provision of wireless broadband by terrestrial systems capable of providing wireless broadband electronic communications services and by wireless access systems, including radio local area networks*.

The Mandate addresses in this context feasibility, sharing, coexistence and compatibility studies for the introduction of terrestrial systems capable of providing Wireless Broadband Electronic Communications Services (WBB ECS) and WAS/RLANs in the 6425-7125 MHz frequency band, while giving due account to existing uses (and their evolution and development) in the 6425-7125 MHz band and in the adjacent bands, including at the EU's external border, and the development of harmonised technical conditions based on a preferred (sharing) scenario.

The CEPT is entrusted with the following tasks.

[4] https://radio-spectrum-policy-group.ec.europa.eu/document/download/fa8ec4bd-508c-4c8c-93b9-2ced4c7bedc6_en?filename=RSPG23-040final-RSPG_Opinion_on_5G_developments_and_6G_spectrum_needs.pdf
[5] https://radio-spectrum-policy-group.ec.europa.eu/document/download/89457260-ab6b-495a-9a10-437711cbe831_en?filename=RSPG25-006final-RSPG_Report_on_6G_strategic_vision.pdf
[6] Chapter 10 of RSPG Report on 6G Strategic vision
[7] Decision No 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision) (OJ L 108, 24.4.2002, p. 1).
[8] Radio Spectrum CEPT Mandates

- Task 1– Study and assessment of coexistence and compatibility of (i) terrestrial systems capable of providing WBB ECS with incumbent spectrum users and (ii) WAS/RLANs with incumbent spectrum users. (final results: March 2026)
- Task 2 – Study of feasibility and scenarios for the potential shared use[9] between terrestrial systems capable of providing WBB ECS and WAS/RLANs. (final results: November 2026)

- Task 3 – Development of harmonised technical conditions. (final results: July 2027)

In determining any preferred scenario(s) under task 2, the CEPT shall take due account of this RSPG Opinion on the upper 6 GHz band.

2 Usage of the upper 6 GHz band in EU

In Chapter 2 of these opinion the RSPG analyses:

- 2.1 Current usage
- 2.2 Possible developments
- 2.3 The overall assessment of the incumbent services and applications.

2.1 Current usage

2.1.1 Fixed Service

The 6425-7125 MHz frequency band is co-primary allocated to the fixed service in the Radio Regulations and is actively used for various fixed service applications.

Resolution 220 of WRC-23 recognises that studies have shown co-channel coexistence between IMT and the fixed service is possible, although it may require cross-border coordination between countries and site-by-site coordination if IMT and the fixed service are deployed in the same or adjacent geographical areas.

According to data provided for the developing of the ECC report 173, approved in June 2023, 20 European countries (including 16 EU Member States) operate a total of 12,554 links within the 6425-7125 MHz frequency range.

Several countries have reported their current links, including Lithuania with approx. 200 links, Sweden with approx. 1000 links, Italy with more than 2000 links, Germany below 5000 links, Czech Republic with approx. 170 links, Norway with approx. 1000 links, Finland with approx. 500 links, France with approx. 1800 links, Spain with approx. 1200 links (including 180 destined for emergency services) and Ireland with approx. 200 links in the 6 GHz range.

In contrast, some Member States have a very limited number of fixed links in the upper 6 GHz range, with Hungary reporting a complete lack thereof.

[9]The notion of "shared use" for the purpose of the Opinion should at least include the simultaneous use of the upper 6 GHz band, or portions thereof, by both systems in the same geographical area.

2.1.2 Fixed-Satellite Service

The 6425-7075 MHz frequency band is co-primary allocated to fixed-satellite service (FSS) in the uplink direction.

Resolution 220 (WRC-23) defines an expected e.i.r.p. mask applying to IMT base stations, which will adequately protect FSS satellite reception. In addition, most satellites and earth stations operating in the satellite "C-band" over Europe use the core uplink FSS band 5925-6425 MHz paired with the downlink band 3700-4200 MHz.

The 6700-7075 MHz frequency band is co-primary allocated to fixed-satellite service (FSS) in the downlink direction for non-GSO MSS feeder links.

2.1.3 Mobile Service

The 6425-7125 MHz frequency band is co-primary allocated to mobile service in the Radio Regulations, but its current use for mobile service applications is very limited. For example, in some Member States, frequencies in the 7-8.5 GHz band are temporary authorised for video Programme Making and Special Events (PMSE) applications).

2.1.4 Radio Astronomy Service

Although there is no frequency allocation to RAS in this band, the RR footnote No. 5.149 urges Member States to take all practical steps to protect the RAS from harmful interference in the frequency band 6650-6675.2 MHz.

The 6650-6675.2 MHz frequency band is used for observations of the methanol spectral line, which is considered a milestone in studying star formation during its nascent phases. Observations of this spectral line are of primary importance to radio astronomers worldwide, with many radio telescopes equipped with receivers dedicated to this purpose.

Observations of the methanol spectral line can be conducted by individual observatories or through interferometer measurements. In Europe, several radio telescopes are linked together to form the European Very Long Baseline Interferometry (VLBI) Network[10]. In particular the following observatories are part of this network and have receivers capable of operating within the 6650-6675.2 MHz frequency band, enabling them to observe the methanol spectral line:

- in Italy, observatories of Medicina (Emilia Romagna), Noto (Sicily), and SRT (Sardinia);
- in Latvia, observatory of Irbene;
- in The Netherlands, observatory of Westerbork;
- in Spain, observatory of Yebes;
- in Sweden, observatory of Onsala;
- in Germany, observatories of Effelsberg & Wettzell;
- in Finland, observatory of Metsähovi.

[10] The European VLBI Network (EVN) is operated by the JIV-ERIC, an entity with the legal form of a European Research Infrastructure Consortium, pursuant to Council Regulation (EC) No. 723/2009 of June 25, 2009.

2.1.5 Earth Exploration Satellite Service

Although there is no frequency allocation to EESS the Radio Regulations (RR) recognize this usage by EESS in the footnote RR No. **5.458, which states:** "*Administrations should bear in mind the needs of the Earth exploration-satellite (passive) and space research (passive) services in their future planning of the frequency bands 6425-7075 MHz and 7075-7250 MHz.*". However, this recognition of usage does not guarantee rights for international protection.

Passive microwave sensor measurements for sea surface temperature (SST) measurements are carried out over the oceans, including the coastal areas in the frequency ranges 6425-7075 MHz and 7075-7250 MHz.
Several satellites are already in orbit and are carrying out measurements in this band, some other are planned. Measurements around 6 GHz offer the best sensitivity to sea surface temperature, though they include a small contribution from salinity and wind speed, which can be corrected using complementary measurements around 1.4 GHz and 10 GHz.

2.2 Possible developments and future spectrum demand for the band use

2.2.1 Fixed Service

The situation regarding possible developments of fixed service differs between Member States. Some Member States consider the radio links will remain important in the future for applications such as feeding of e.g. FM radio stations, digital terrestrial television stations, and mobile backhaul. Some administrations are particularly concerned when these applications are of importance to the national defence, for example, transmission for national backhauling for Public Protection and Disaster Relief (PPDR) networks; or for important public announcements (i.e., the emergency warning system used to alert the public in case of accidents, serious events, or disruptions of essential services) which are transmitted via national radio and terrestrial TV networks, as well as mobile networks.

For example, the usage of the upper 6 GHz band for radio links in Sweden and Italy is extensive and is unlikely to decline in the near future, as no viable alternatives have been identified to replace the nationwide radio link networks. In fact, the number of links may increase.

The Czech Telecommunication Office (CTU) foresees the continued operation of fixed links beyond 2030. In a national study (link: https://ctu.gov.cz/en/study-spectrum), CTU explored potential actions in the event of reallocating the band from fixed links to MFCN/5G. The study concludes that migrating fixed links or repurposing the band would be highly challenging. Additionally, CTU examined legal and procedural measures, and issues related to potential economic compensation for existing users. It is estimated that a minimum of EUR 4 million (depending on the scenario) would be necessary to compensate fixed service users for vacating the band. Consequently, CTU does not plan to clear the spectrum from incumbents.

On the other hand, the use of upper 6 GHz frequency band for fixed radio links in Finland decreased from 700 to 500 during 2024 and Slovenia, from 14[11] to 9 (18 licenses)[12] and is expected to continue declining as applications for new links are directed to other frequency bands.

[11] ECC Report 173, version 27-04-2018, *ECCRep173-Band-by-band-analysis.xlsx* - https://docdb.cept.org/download/3971
[12] https://www.akos-rs.si/registri/seznam-registrov/frekvence

The reallocation of the fixed radio links from upper 6 GHz to the higher frequency band is currently under investigation in Lithuania, and no new links are being allocated in this band.

Furthermore, the ECC Report 173 indicates a total of 21012 active links in the frequency range 5900-7100 MHz with 12554 of them in the 6425-7125 MHz frequency range. Some administrations (Bulgaria, Croatia, Italy, Moldova, Netherlands, and Türkiye) reported an increasing trend in use, while others (Cyprus, France, and Germany) suggest a possible reduction. Stability is reported by several administrations, with Germany also mentioning potential reallocation. Slovenia notes possible coexistence with MFCN, and Sweden highlights of the sub-band strategic importance. Congestion is reported by some administrations (Bulgaria, Croatia, Serbia, Spain, Sweden, and Switzerland).

2.2.2 Fixed-Satellite Service

The Fixed Satellite Service remains important for satellite-based applications such as uplink MSS feeder links and downlink non-GSO MSS feeder links.

2.2.3 Mobile Service

The ITU-R M.2160-0 Recommendation, approved by the Radio Assembly in 2023, sets out the framework and overall objectives of the future development of IMT for 2030 and beyond. According to this Recommendation the motivation for the development of IMT-2030 is to continue to build an inclusive information society and contribute to the United Nations Sustainable Development Goals (SDGs), emphasizing inclusivity, connectivity, sustainability, innovation, security, standardization, and interoperability.

To meet capacity and coverage needs, multiple frequency ranges are required, as no single range satisfies all deployment criteria. The upper 6 GHz frequency band offer a balance between coverage and capacity.

In the past, new bands had been identified for each new mobile generation of IMT. Whether this should continue in the future needs further investigation.[13]

Despite challenges such as increased propagation loss compared to the 3.5 GHz band, the upper 6 GHz frequency band could potentially reuse existing cellular grids, supporting the introduction of macro-cellular 6G networks.

The upper 6 GHz band has attracted interest for WAS/RLAN due to its potential to provide additional spectrum for licence-exempt devices.

2.2.4 Radio Astronomy Service

The measurement of the methanol spectral line is only possible at 6668.518 MHz. Therefore, the 6650-6675.2 MHz frequency band remains crucial for observations, essential for star formation studies.

[13] https://radio-spectrum-policy-group.ec.europa.RSPG25-006final-RSPG_Report_on_6G_strategic_vision.pdf

2.2.5 Earth Exploration Satellite Service

The 6425-7250 MHz band is planned for the global use by the Copernicus Imaging Microwave Radiometer (CIMR), one of the six high-priority candidate missions of the Copernicus programme. This mission would enhance the programme's ability to support the EU Green Deal objectives, particularly in addressing climate change.

WRC-27 will consider a possible co-primary EESS allocation in the 4.2- 4.4 GHz and 8.4-8.5 GHz frequency bands to provide additional possibilities for sea surface temperature (SST) measurements and the necessary regulatory protection.

2.3 The overall assessment of usage of the upper 6 GHz band

2.3.1 Fixed Service

For some Member States, the continued use of the band for radio links remains highly important such as feeding FM radio stations, digital terrestrial television stations, and mobile backhaul. Therefore, any scenario to introduce new services in the upper 6 GHz band should consider that some Member States require long-term access to this band for fixed services, whether nationwide or in specific geographic areas.

Where feasible, Member States may consider refarming the band for mobile service applications by migrating fixed service applications to other frequency bands. Alternatively, where practicable, Member States may consider reducing fixed service use by limiting fixed service applications to specific geographic areas or to certain frequency ranges within the upper 6 GHz.

Fibre connections may also reduce the need for point-to-point (P-P) links, potentially leading to decreased use of the band for fixed links in some countries.

Given these considerations and further taking into account Member States where refarming of the band for mobile service applications is anticipated, bi- or multi-lateral agreements would likely be necessary to ensure the protection of fixed links in neighbouring States where their continued deployments and operation remain essential.

2.3.2 Fixed-Satellite Service

Any sharing scenario proposing the introduction of new services in the upper 6 GHz band need to ensure long term access to this band for fixed satellite services, as invited by Resolution 220 (WRC-23). This is crucial to maintain the integrity and functionality of fixed satellite services.

2.3.3 Mobile Service

The introduction of new mobile service applications in the upper 6 GHz frequency band should be consistent with potential future decisions by the European Commission. A clear framework should be established to guide the introduction of these services, ensuring compliance with regulatory requirements.

2.3.4 Radio Astronomy Service

Any sharing scenario proposing the introduction of new mobile services applications (WAS/RLAN or MFCN) in the upper 6 GHz band need to ensure the protection of the radio astronomy observations, taking into account that, due to the intrinsic physical properties of the phenomenon, emissions from the methanol spectral line can occur only within the 6650-6675.2 MHz frequency band.

The WRC-23 studies from CRAF on the use of IMT indicate an in-band separation distance of 400-500 km and appr. 200 km in the adjacent band. These studies did not consider terrain factors and assumed different power levels. Therefore, CEPT is studying further the coexistence between MFCN and RAS under Task 1 of the EC Mandate, and reviewing the issue of adequate separation distance including requirement to WAS/RLAN and MFCN for their respective operation in the band.

2.3.5 Earth Exploration Satellite Service

Studies submitted to ITU-R indicated that SST measurements by satellite in the frequency range 6425-7125 MHz could be significantly degraded in the coming years, depending upon the application, due to the amount of interference from the foreseen increased usage, high power licensed mobile use (MFCN) or low power unlicensed WAS/RLAN use, under the existing mobile allocation.

SST is a vital component of climate system, as it exerts a major influence on the exchange of energy, momentum and gases between the ocean and the atmosphere. SST largely controls the atmospheric response of the ocean to meteorological and climatic time scales. Continuous measurements are crucial to ensure the protection of populations from major climatic events.

SST measurement by satellite, in the microwave domain, remains the only method enabling daily and global SST observations, independent of meteorological conditions (i.e. the presence of clouds). Although the 6425-7250 MHz band remains the most sensitive for these measurements, they could be achieved using additional frequency bands that offer a similar response to SST and a favorable interference environment.

Therefore, in order to achieve this continuous SST measurement on a long-term basis, WRC-23, under the WRC-27 Agenda item 1.19, resolved to invite the ITU Radiocommunication Sector to complete in time for the 2027 World Radiocommunication Conference sharing and compatibility studies to determine the possibility of a future allocation to the EESS (passive) of complementary frequency bands in the frequency ranges 4200-4400 MHz and 8400-8500 MHz without protection from existing services in these frequency bands and in adjacent bands and invites administrations to participate actively in the studies and provide the information required for WRC-27 EESS (passive) allocation, in accordance with Resolution 674 (WRC-23).

3 Questionnaire on Long-term vision for the upper 6 GHz band

Between 8 July 2024 and 20 August 2024, the RSPG conducted a questionnaire on the long-term vision for the upper 6 GHz band[14]. Stakeholders were invited to outline the expected demand for

[14] Questionnaire on the Long-term vision for the upper 6 GHz band

MFCN or WAS/RLAN in this band before and beyond 2030, along with an evaluation of its environmental and socio-economic sustainability.

Additionally, stakeholders were asked to provide insights into the potential role of the upper 6 GHz band for MFCN or WAS/RLAN, including key use cases, projected deployments (e.g., base station density), spectrum availability and spectrum needs, socio-economic impact assessment timelines, and relevant advancements in standardization and technology.

For existing services and applications, incumbents (fixed service, fixed satellite service, radio astronomy service, UWB applications, EESS passive measurements) were requested to detail their spectrum needs through 2030, assess the potential impacts of new uses on their operations, and suggest measures to enhance compatibility[15].

4 RSPG evaluation of spectrum demand

Based on information collected from various stakeholders[16], RSPG has identified several aspects.

4.1 Key factors driving spectrum demand for MFCN

Among others, GSMA, ETNO, and MNOs have outlined the future spectrum demand driven by the continuously increasing data transmission volumes.

With 6G, advanced usage scenarios will emerge, enabled by technologies such as artificial intelligence, integrated sensing and communication (ISAC), and capabilities that go beyond those of 5G. Potential 6G application areas range from supporting extremely high data rates for immersive virtual reality (VR) and augmented reality (AR) to advanced applications in fields such as the Internet of Things (IoT), autonomous driving, and telemedicine. The increasing adoption of, digital twins, and real-time industrial automation, will further drive demand for reliable, high-capacity and high-mobility wireless connectivity, ultra-low latency supported by e.g. edge computing. Smart city infrastructures, enhanced public safety networks, and next-generation satellite-terrestrial integration will also require additional spectrum resources. Furthermore, future networks will need to accommodate new forms of massive machine-type communications (mMTC). All these new use cases will intensify the need for spectrum.

4.2 Options to fulfil that future capacity and coverage demand for MFCN

To meet the growing MFCN demand in dense areas the following main options could be considered:

1. **Spectrum Refarming, Determination and Harmonisation**
    - **Refarming Existing Bands:** Transitioning currently used MFCN bands to support newer mobile generations.
    - **The increased usage of already harmonised mmWave spectrum:**
        1. 26 GHz
        2. 42 GHz

[15] More details can be found in document A (Annex - Summary of responses to the questionare), subchapter A.1.7.
[16] All information can be found in A (Annex - Summary of responses to the questionnaire)

3. 57-71 GHz (unlicensed)
- **Determining and harmonising new spectrum:**
  1. UHF band, such as 600 MHz
  2. Upper 6 GHz band
  3. Possible THz bands

2. **Technological Advancements to improve spectrum efficiency**
   - **Advanced Modulation Techniques:** Implementing more efficient modulation schemes to maximize the use of available spectrum.
   - **MIMO:** Utilizing massive/advanced multiple-input multiple-output (MIMO) technology to increase capacity and coverage.
   - **AI and Machine Learning:** Leveraging artificial intelligence and machine learning for dynamic spectrum management and network optimisation.
3. **Infrastructure Enhancements**
   - **Dense Network Deployment:** Increasing the density of small cells and base stations, [where feasible,] to enhance network capacity and coverage.
   - **Fibre Backhaul:** Expanding fibre optic networks to support the high data throughput required by 6G.
4. **Regulatory and Policy Measures**
   - **Incentives for Innovation**: Providing incentives for Innovation
     1. Upgrade to newer mobile generations
     2. A fast 6G roll-out
     3. Promoting implementation of interworking solutions
5. **Spectrum Sharing:**
   - **Implementing Spectrum Sharing Techniques:** Allow multiple mobile applications to coexist in the same frequency band by using
     1. Sensing and avoiding mechanism
     2. Indoor-Outdoor separation
     3. Geographical separation
   - **Spectrum sharing to improve coexistence with the incumbents:** To protect existing radio services and applications
     1. Geographical separation
     2. Frequency separation
     3. Time separation
     4. Other mitigation techniques
6. **Solutions for interworking between MFCN and WAS/RLAN:**
   - Offloading the indoor mobile traffic to WAS/RLAN by leverage MFCN Core functionalities[17]:
     1. Non-3GPP Interworking Function (N3IWF)
     2. Trusted Non-3GPP Gateway Function (TNGF)
     3. Evolved Packet Data Gateway (ePDG) to support Voice over WiFi (VoWiFi)
   - Improve seamless authentication between MFCN and WAS/RLAN by implementing frameworks and standards such as:
     1. Passpoint[18] & Hotspot 2.0

[17] ETSI TS 123 501 V16.6.0 (2020-10) 5G; System architecture for the 5G System (5GS) (3GPP TS 23.501)
[18] https://www.wi-fi.org/discover-wi-fi/passpoint

2. OpenRoaming[19]

4.3 Role of the upper 6 GHz band to fulfil future capacity and coverage demand for MFCN

In the Digital Decade Policy Programme 2030[20], the upper 6 GHz band (6425-7125 MHz) potentially plays an important role to fulfil the future MFCN demand. It also supports Europe's future connectivity and competitiveness goals as outlined in the Digital Decade Policy Programme 2030, in allowing Europe meeting its future goals for connectivity and competitiveness. This band offers several benefits, in particularly for urban suburban coverage using the 3600 MHz grid and other high traffic areas such as football stadiums.

1. **Spectrum Availability:**
   - The upper 6 GHz band provides a significant amount of contiguous spectrum that can be utilized for high-capacity services.
   - The upper 6 GHz band is the only new mid-band to support the introduction of 6G in Europe, offering wider channels.
2. **Balance between Coverage and Capacity:**
   - The propagation characteristics of the upper 6 GHz band strike a balance between coverage and capacity, making it suitable for both urban and suburban deployments.
3. **Support for Advanced Use Cases:**
   - The band can support advanced use cases such as high-definition video streaming, AR/VR applications, and real-time industrial automation.

In conclusion, the future demand for MFCN can be met through a combination of additional spectrum, spectrum refarming, technological advancements, infrastructure enhancements, and regulatory measures. The upper 6 GHz band can play an important role in this ecosystem, providing the necessary spectrum resources to support the next generation of mobile communications.

4.4 Key factors driving spectrum demand for WAS/RLAN

The demand for Wireless Access Systems, including Radio Local Area Networks (WAS/RLAN), is expected to grow significantly in the coming years. This growth is driven by the increasing reliance on wireless connectivity for various applications, including home and enterprise networking, public Wi-Fi, and the Internet of Things (IoT) and the proliferation of data-intensive applications, such as high-definition video streaming, online gaming, and cloud-based services.

4.5 Options to fulfil the WAS/RLAN Demand

To meet the WAS/RLAN demand, the following options can be considered:

1. **Spectrum refarming and determination:**
   - **Determining and harmonising new spectrum**

[19] https://wballiance.com/openroaming

[20] Digital Decade Policy Programme - Article 4 (2) (a) all end users at a fixed location are covered by a gigabit network up to the network termination point, and all populated areas are covered by next-generation wireless high-speed networks with performance at least equivalent to that of 5G

        - Upper 6 GHz band
    - IEEE 802.11bq project[21] was approved by IEEE in Dec. 2024 targeting non-standalone Wi-Fi within the 42-57 GHz.
    - **Use of already harmonised spectrum**
        - 2.4 GHz, 5 GHz and lower 6 GHz
        - 57-71 GHz harmonised band for wideband data transmission devices according Decision (EU) 2025/105[22] . IEEE 802.11bq project was approved by IEEE in Dec. 2024 targeting non-standalone Wi-Fi within the 57-71 GHz range, which may further enhance the performance and usability of the band.
2. **Technological Advancements:**
    - **Advanced Modulation Techniques**: Implementing more efficient modulation schemes to maximize the use of available spectrum.
    - **Multi-Link Operation (MLO)**: Simultaneous use of 2.4 GHz, 5 GHz, 6 GHz frequency bands to increase reliability of the connection between AP and terminals, and lower latency.
    - **Enhanced Multi-User MIMO:** Enabling simultaneous communication with multiple devices
3. **Infrastructure Enhancements:**
    - **Dense Network Deployment**: Increasing the density of access points
    - **Fibre-to-the-room**: Expanding fibre optic networks.
4. **Regulatory and Policy Measures:**
    - **Incentives for Innovation**: Providing incentives for Innovation
        - Upgrade Access Points to latest technologies
5. **Spectrum Sharing:**
    - **Implementing Spectrum Sharing Techniques:** Allow multiple services to coexist in the same frequency band by using
        - Sensing and avoiding mechanisms
        - Indoor-Outdoor separation
        - Geographical separation
        - Location-aware mechanisms, including database solutions
    - **Preamble Puncturing:** Exclusion of sub-channels to protect other services (e.g. for RAS in the absence of location awareness or geographical separation)
6. **Interworking:**
    - MNO implementation of a seamless secured roaming between Wi-Fi and mobile networks.

It is important to note that most measures will inevitably require the replacement of Wi-Fi routers, which will incur some costs.

[21] https:/standards.ieee.org/ieee/802.11bq/11872/
[22] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202500105

4.6 Role of upper 6GGHz Band to fulfil future WAS/RLAN demand

The upper 6 GHz band potentially plays an important role to fulfil the future WAS/RLAN demand and meeting Europe's future goals for connectivity and competitiveness. as it offers a large contiguous block of spectrum that can support high-capacity, low-latency wireless local access. It also supports Europe's future connectivity and competitiveness goals as outlined in the Digital Decade Policy Programme 2030[23]. This band is well suited, for handling the increasing data traffic and using additional channels with larger bandwidths (e.g. 320 MHz).

The upper 6 GHz band (6425-7125 MHz) can play an important role to fulfil the demand for WAS/RLAN. This band offers several advantages:

1. **Spectrum Availability**:
    - The upper 6 GHz band provides a significant amount of contiguous spectrum that can be utilized for high-capacity WAS/RLAN services and can be combined with the lower 6 GHz band (5945-6425 MHz) to provide additional wider channels.
2. **Balance of Coverage and Capacity**:
    - The propagation characteristics of the upper 6 GHz band allow coverage within buildings even through walls.
    - The upper 6 GHz would provide additional non-overlapping 80 MHz and 160 MHz channels, facilitating WAS/RLAN access point planning in environments such as schools and hospitals. It would also enable additional 320 MHz channels, which can enhance capabilities such as sub-meter positioning[24].
3. **Support for Advanced Use Cases**:
    - The larger bandwidth 320 MHz can support advanced WAS/RLAN use cases such as Holographic Applications, AR/VR and online gaming for AR/VR application.

In conclusion, the future demand for WAS/RLAN can be met through a combination of spectrum identification, technological advancements, infrastructure enhancements, and regulatory measures. The upper 6 GHz band can play an important role in this ecosystem, providing the necessary spectrum resources to support the next generation of wireless access systems and can use existing chipset of the market.

4.7 Possible MFCN and WAS/RLAN shared use

CEPT has developed ECC Report 366 *on the feasibility of a potential shared use of the 6425-7125 MHz frequency band between MFCN (5G/6G) and WAS/RLAN*.

One of the main conclusions of this ECC report is that shared use between full power MFCN and WAS/RLAN LPI operating on the same channel is not possible without negative consequences for WAS/RLAN and MFCN spectrum access and user experience. A reduction of MFCN BS e.i.r.p. by about 25 dB (57 dBm) was studied in order to enable indoor WAS/RLAN operations and outdoor MFCN base stations in the same geographical area. Several studies and trials indicate that reduced

[23] Digital Decade Policy Programme - Article 4 (2) (a) all end users at a fixed location are covered by a gigabit network up to the network termination point, and all populated areas are covered by next-generation wireless high-speed networks with performance at least equivalent to that of 5G

[24] https://standards.ieee.org/ieee/802.11bk/11117/

MFCN BS e.i.r.p. levels will negatively impact the MFCN coverage and capacity when using the existing outdoor macro base station grids, leading to limited indoor coverage. Some studies indicated little to no impact on outdoor coverage/capacity, while others indicated significant reduction in outdoor capacity/coverage in the Upper 6 GHz band.

A number of studies specifically examined the probability of WAS/RLANs successfully detecting the presence of MFCN signals using the existing WAS/RLAN energy detection mechanism based on Wi-Fi technical standards. None of these studies indicated that WAS/RLANs would be able to detect MFCN signals in all indoor locations, to implement a functionality fully sufficient to avoid interference.

In addition to the current energy detection mechanism, three new detection techniques to improve the detection of MFCN signals by WAS/RLAN equipment have been explored in order to reduce interference from MFCN to WAS/RLAN and implement the MFCN priority mechanism in scenarios where WAS/RLAN is not the prioritised user. The ECC Report 366 highlights the complexity of practical implementation of such detection techniques.

All potential detection techniques would require further work with development, standardisation, harmonisation and compliance testing.

4.8 Summing-up

Mobile/Fixed Communications Networks (MFCN)

There is a rapid increase in the absolute data traffic over mobile networks over the past two decades. However, the percentage increase rate has been declining. Data traffic continues to grow strongly in absolute incremental terms[25]. The demand for more MFCN spectrum is likely to occur around 2030 with the launch of 6G MFCN networks. The upper 6 GHz band could help address some of the expected future capacity needs as outlined by the Mobile Network operators.

Mobile stakeholders indicated in the upper 6G questionnaire and in the input to the RSPG 6G strategic vision that the upper 6 GHz band is essential for the deployment of 6G services using macro-base stations with the same macro base station deployment grid (e.g. the 3.6 GHz band) and that 200 MHz for each operator with conditions that allow deployment with standard macro base station power levels are needed in this band. Furthermore, according to mobile stakeholders, citizens and industrial users would benefit from more competitive offers resulting from cost effective deployments.

MFCN coverage in the upper 6 GHz band is not expected to be continuous in rural areas. The base stations in rural areas. Base stations in the areas are expected to be few in number and will be isolated installations at specific locations. Additionally, future capacity needs for MFCN in localised areas could also be partially accommodated by other frequency bands like mmW-bands, through mobile network densification or interworking[26] (e.g. offloading of indoor traffic) with WAS/RLAN.

Band 7125–7250 MHz as part WRC-27 Agenda Item 1.7

[25] Ericsson Mobility Report

[26] See chapter 4.2 Solutions for interworking between MFCN and WAS/RLAN

Studies are foreseen under Agenda item 1.7 on the potential IMT identification in the frequency range 7125-7250 MHz. For the time being, it remains undecided whether and to what extent this band could serve as a possible extension of the 6 GHz for MFCN usage, given the need to protect EESS (E-s) and SRS (E-s) which have characteristics substantially different from GSO FSS satellite in the 6 GHz band.

Wireless Access Systems and Radio Local Area Networks (WAS/RLAN)

The vast majority of indoor data traffic today is carried by WAS/RLAN to the end-user equipment. Data traffic continues to grow strongly in absolute incremental terms[27]. The upper 6 GHz band could help address some of the expected future capacity needs as outlined by the WAS/RLAN industry by providing additional non-overlapping 80 MHz and 160 MHz channels, facilitating WAS/RLAN access point planning in in environments such as schools and hospitals. It would also enable more 320 MHz channels, which can enhance capabilities such as sub-meter positioning.

The additional capacity requirements for WAS/RLAN could also be partially addressed through densification of access points or by leveraging mmWave bands with the next generation of Wi-Fi[28]. The WAS/RLAN industry indicated in the upper 6G questionnaire that additional spectrum for WAS/RLAN would strengthen investments in multigigabit infrastructure and provide capacity for potential access to the evolution of fibre networks such as XGS-PON[29].

4.9 Impact of spectrum sharing with incumbent users

Sharing studies with incumbent users are being conducted by CEPT under EC Mandate Task 1.

Fixed Service (FS)

The fixed service remains an essential technology in several Member States for communications infrastructure, such as provision of services in rural areas and for specific applications such as broadcasting and mobile backhaul. In addition, in some Member States, fixed links belong to critical infrastructure.

Low-power indoor WAS/RLANs appear to pose fewer constraints for Fixed Service than outdoor mobile use (MFCN) for which further studies are currently being conducted by CEPT under EC Mandate Task 1.

A flexible, shared use of the band could be pursued, subject to coordination measures to be studied under EC Mandate Task 1. This would allow countries to support both the fixed service and mobile applications (MFCN and WAS/RLAN) as needed. At the same time, the transition from radio links to alternative technologies such as fibre, or migration of FS links to other bands when possible, could be considered.

Fixed-Satellite Service (FSS)

[27] https://www.analysysmason.com/research/content/regional-forecasts-/fixed-network-data-rdfi0-rdmb0/
[28] IEEE 802.11bq project was approved by IEEE in Dec. 2024 targeting non-standalone WAS/RLAN within the 42 – 71 GHz range
[29] ITU-T G.9807.1: 10-Gigabit-capable symmetric passive optical network

The fixed-satellite service in the upper 6 GHz band is essential, especially for mobile-satellite-based uplink and downlink feeder links. The protection and safeguarding of uplink FSS operations is ensured by adherence to the expected e.i.r.p. mask defined by WRC-23, which is obligatory in accordance with RR5.457E Resolution 220 (WRC-23)[30].

In areas with potential interference to FSS downlink earth stations, MFCN operations should be carefully regulated and limited to exclude specific geographical areas.

Radio Astronomy (RAS)

The methanol spectral line is unique for studying star formation and is crucial for the European VLBI [31]Network. Given the fixed nature of the Radio Astronomy Service sites in the frequency band 6650- 6675.2 MHz adequate protection should be maintained when introducing new MFCN or WAS/RLAN services. A European coordination framework is essential to support scientific progress in radio astronomy while enabling balanced spectrum use.

Earth Exploration Satellite Service (EESS)

The Earth Exploration Satellite Service, especially the measurement of sea surface temperature in the upper 6 GHz band, is vital for climate monitoring and protection against extreme weather events. It is also crucial for the Copernicus Imaging Microwave Radiometer (CIMR), one of the six high-priority candidate missions of the Copernicus programme. However, the introduction of high-density mobile service application (MFCN) and WAS/RLAN in the in the frequency range 6425-7125 MHz could progressively increase interference with these observations, depending on the specific application. To ensure continuous long-term sea surface temperature (SST) measurements, studies are being conducted under WRC-27 Agenda Item 1.19 to consider new primary EESS (passive) allocations in the 4.2-4.4 GHz and 8.4-8.5 GHz frequency bands, complementing the 6425-7250 MHz band. The 6425-7250 MHz band offers the highest sensitivity for these observations and will continue to be used, operating as an application of non-primary service, for SST measurements despite the possible allocation of new frequency bands to EESS and the global interference from IMT and WAS/RLAN.

Ultra-Wideband (UWB)

UWB applications operate on a non-interference and non-protected basis[32].

WAS/RLAN below 6425 MHz

The continuous operation of WAS/RLANs in the adjacent lower 6 GHz band (5945-6425 MHz) needs to be ensured, in accordance with the harmonised technical conditions defined in Commission Decision (EU) 2021/1067.

[30] **5.457E** The frequency bands 6 425-7 125 MHz in Region 1 and 7 025-7 125 MHz in Region 3 are identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of these frequency bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Resolution **220 (WRC-23) a**pplies.

[31] Very-long-baseline interferometry

[32] COMMISSION IMPLEMENTING DECISION (EU) 2024/1467

5 RSPG recommendation on the upper 6 GHz band

As outlined in this opinion, the current usage and future spectrum needs in the upper 6 GHz band vary across Member States. This divergence is expected to persist beyond 2030 within the EU. Consequently, establishing a unified approach for all Member States in the near future appears challenging, primarily due to differing national spectrum requirements.

Given these circumstances and the increasing spectrum demands in the upper 6 GHz band, the RSPG has explored the following options for the additional introduction of MFCN and WAS/RLAN in this band.

Full band options:

1. Entire upper 6 GHz band for WAS/RLAN.
2. Entire upper 6 GHz band for MFCN.

Band split options:

3. Band split:

   Each application has access only to its designated portion of the upper 6 GHz band.

4. Segmented band split:

   Each application has access to its designated portion of the upper 6 GHz band and, with specific restrictions, to a third shared portion within the upper 6 GHz band. In the shared segment, neither WAS/RLAN nor low power MFCN have priority, and both could potentially operate concurrently.

5. Prioritised band split:

   Each application would have non-prioritised access to the portion of the band assigned to the other application, if it does not cause harmful interference to the other application.

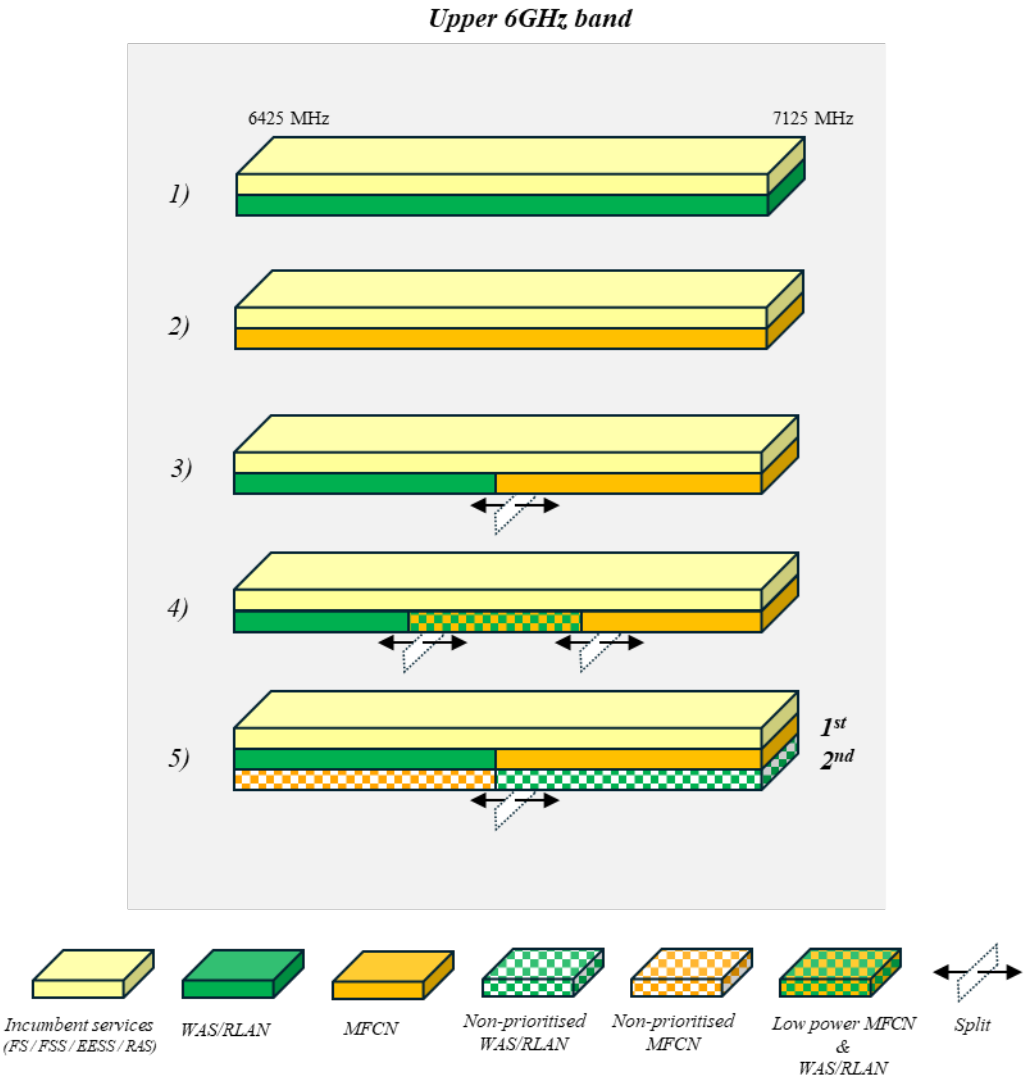

Figure 1 - Possible long-term usage scenarios between MFCN and WAS/RLAN

The RSPG has formulated the following recommendations to provide strategic guidance for Member States, contribute to ongoing efforts within CEPT and ETSI with the goal to develop harmonised technical conditions for the future usage and support the development of the European 6G spectrum roadmap. The recommendations hereafter have been carefully developed after assessing the above different approaches to utilizing the upper 6 GHz band alongside existing incumbent services (FS, FSS, EESS, and RAS):

5.1 Considerations on the current usage

1. RSPG notes the diverse spectrum requirements for both new and existing services across Member States. It also recognises the importance for certain Member States to address the

spectrum needs of current users[33] in the upper 6 GHz band, including FS, FSS and RAS, beyond 2030.

2. RSPG emphasises that achieving harmonised technical conditions for the use of MFCN and WAS/RLAN in the upper 6 GHz band across Europe is a key objective. Member States should seek ways to support this goal while considering incumbent needs.
3. RSPG notes the competing interest for access to the upper 6 GHz band from different industry stakeholders, particularly those focused on MFCN and WAS/RLAN. On the one hand, the WAS/RLAN industry is requesting at least two 320 MHz channels together with the lower 6 GHz band (5945-6425 MHz) with the same technical conditions as in the already harmonised spectrum. On the other hand, the MFCN sector is seeking up to 200 MHz additional bandwidth per operator, without power limitation.
4. RSPG recommends a flexible use of the band in terms of allowing countries to maintain existing fixed service usage while supporting additional mobile applications (MFCN and WAS/RLAN) as needed.
5. RSPG is of the view/notes that the protection and safeguarding of uplink FSS operations shall be ensured by a compliance of MFCN BS to the expected e.i.r.p. mask which has been adopted by WRC-23. Noting that there is a limited number of FSS downlink earth stations, the RSPG is of the view that Member states should protect them.
6. Given the fixed nature of the Radio Astronomy Service sites in the frequency band 6650-6675.2 MHz the RSPG is of the view that an adequate protection should be ensured.
7. RSPG underscores the importance of primary allocations in all Regions to the Earth exploration-satellite service (passive) in the frequency bands 4200-4400 MHz and 8400-8500 MHz, in accordance with Resolution 674 (WRC-23) for measuring the sea surface temperature to complement the upper 6 GHz band measurements.

5.2 Recommendations on development of use

Immediate demand

1. RSPG sees no immediate significant spectrum needs for MFCN or WAS/RLAN services in Europe, as the lower 6 GHz band for WAS/RLAN and the mobile spectrum in other MFCN bands are not yet fully utilized.
2. RSPG notes the mid to long term demand from different industries to access the upper 6 GHz band, on the one hand for WAS/RLAN and, on the other hand for MFCN.
3. RSPG is of the opinion, that, although the spectrum needs for MFCN and WAS/RLAN in the upper 6 GHz band are not evidentially immediate, a clear direction of the future use of this band should be indicated well before 2030 in order to give certainty to industries.
4. RSPG recommends that future EU regulatory actions should facilitate, to the greatest and most expedient extent feasible, the envisaged shared usage of the upper 6 GHz band in providing maximum long-term societal benefits.
5. RSPG recommends that Member States be afforded flexibility not to award spectrum where no demand arises for MFCN in the band.

[33] The band 6425-7250 MHz will also continue to be used beyond 2030 for EESS measurements, in spite of the lack of regulatory protection, because this is the band where the most accurate measurements are obtained

5.3 Policy recommendations on a band split with prioritisation within the upper 6 GHz.

1. RSPG is of the view that, as a scarce resource, the available spectrum should be utilized as efficiently as possible. Consequently, sharing options need to be explored and implemented provided they are practical and offer adequate planning security.
2. RSPG emphasises that consideration of spectrum sharing is of key importance in this band in the sense that incumbent services, MFCN and WAS/RLAN services could all potentially access the upper 6 GHz band, on the basis that technical studies or national decisions support this possibility, thus maximising the benefits for European society.
3. RSPG is of the view that the different interests for spectrum access to the upper 6 GHz band should be addressed by proposing a spectrum split with prioritisation, taking into consideration the following key elements:
    a. maximized exploitation of sharing potential;
    b. prioritised use for WAS/RLAN over MFCN in lower part of the band;
    c. prioritised use for MFCN over WAS/RLAN in upper part of the band;
    d. protection of RAS and other incumbent services as appropriate.

4. The RSPG has considered several options for the prioritised band split. Four of these options have received significant support, assigning 0 MHz, 80 MHz, 160 MHz or 320 MHz to WAS/RLAN, respectively.

Note: There is a slight preference within RSPG for the 160 MHz option. However, the public consultation will be an opportunity for RSPG to review the option and to decide on the most appropriate one.

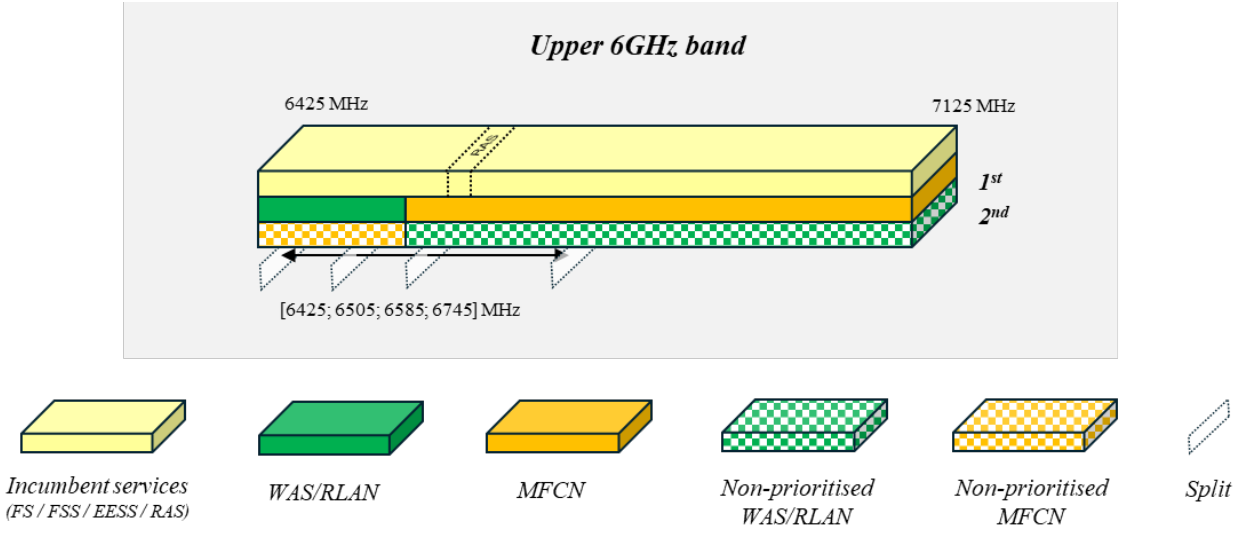

Figure 2 - Several options for segmenting the upper 6 GHz band

5. The RSPG has further developed one option with band segments detailed below:

Note: The 160 MHz option is provided at this stage just as an example

6425-6585 MHz

- RSPG recommends a prioritised use for WAS/RLAN.
- RSPG recognise the need for CEPT to investigate the non-prioritised low power MFCN usage within this WAS/RLAN segment.

6585-7125 MHz

- RSPG recommends a prioritised use for full power MFCN.
- RSPG recognise the need for CEPT to investigate the non-prioritised WAS/RLAN usage within this full power MFCN segment.
- CEPT should, within the scope of the EC Mandate (Task 1 and Task 2), study the exact size of the possible necessary guard band for protection of both applications.

6645-6685 MHz

- RSPG recommends that, in countries with radio astronomy (6650- 6675.2 MHz) or with MFCN stations within the coordination zone, there will be a need to ensure protection of RAS by coordinating MFCN usage in the band 6645- 6685 MHz.

6. The RSPG is of the view that this scenario could be the basis for an EC implementing decision following the mandate from EC to CEPT. However, given that CEPT has not yet completed its assessment of the technical possibilities and limitations related to sharing and coexistence, the RSPG reserves the right to revisit and, if necessary, revise its position following the conclusion of Tasks 1 and 2 of the mandate.

5.4 Further on the upper 6 GHz band

1. RSPG recognises the need to ensure continuous operation of WAS/RLANs in the adjacent lower 6 GHz band (5945-6425 MHz) in accordance with the harmonised technical conditions defined in Commission Decision (EU) 2021/1067.
2. RSPG encourages the mobile industry to develop products for the entire upper 6 GHz band.
3. RSPG acknowledges that CEPT should assess and further develop solutions based on the recommendations given in this Opinion regarding, among others:
   a) provisions for the protection of RAS from MFCN and WAS/RLAN use;
   b) the necessary technical conditions to enable adjacent use of MFCN and WAS/RLAN within the upper 6 GHz band;
   c) detailed mechanisms for WAS/RLAN to operate as a non-prioritised user;
   d) a detailed analysis of the possibility of WAS/RLAN VLP to operate as a non-prioritised user in the upper 6 GHz band;
   e) detailed mechanism for low power MFCN to operate as a non-prioritised user;
4. RSPG acknowledges the strategic role of seamless interworking between MFCNs and WAS/RLAN in the future and invites CEPT and BEREC to take appropriate actions.

5.5 Study the possibility of operation as a non-prioritised user

The RSPG recommends to study the possible WAS/RLAN operation as a non-prioritised user in areas where MFCN coverage is unavailable, such considerations should address among others:

a) the merit of enabling WAS/RLAN deployment in specific cases where WAS/RLAN capacity needs would benefit from using the full upper 6 GHz and where no MFCN is expected to be deployed, e.g. a large factory in rural areas;
b) the risk of WAS/RLAN installations using the upper 6 GHz band being disrupted when a new MFCN base station is switched on, particularly in locations such as hospitals, stadiums, schools, universities and factories in urban or sub-urban areas;
c) the adequate protection of MFCN in its prioritised portion of the upper 6 GHz band;
d) the wish of some administration to allow access of WAS/RLAN to the non-prioritised portion of the band only on a licensed basis.

The RSPG recommends to study the possible low power MFCN operation as a non-prioritised user.

Member States should maintain the authority to determine whether both cases, low power MFCN and/or WAS/RLAN, non-prioritised usage is allowed.

If sufficient evidence confirms the technical and regulatory feasibility of such non-prioritised usage, supported by CEPT studies, the next step will be to refine the details and develop solutions to enable the non-prioritised access to the band.

This follow-up work could be part of a follow-up Opinion of the RSPG.

5.6 Consideration on the 7125-7250 MHz band

RSPG is of the view that, if this frequency band is identified for IMT, this frequency band may be considered for extending the MFCN band in the upper 6 GHz range, as part of a follow-up opinion of the RSPG after WRC-27.

Annex

Table of contents

I. Introduction

This Annex presents summary of responses to the questionnaire supporting the Opinion on Long-term vision for the upper 6 GHz band.

The following respondents provided answers to the questionnaire:

01	Association of Mobile Network Operators (APMS)		22	EUMETNET	
02	GSMA		23	Committee on Radio Astronomy Frequencies (CRAF)	
03	Ericsson		24	Associazione Italiana Internet Provider	
04	ETNO		25	CSC - Finnish IT Center for Science	
05	HÉT Spectrum WG		26	BREKO	
06	Huawei		27	FTTH Council Europe	
07	Nokia		28	Multi-company (Amazon Inc.,., Cisco Systems Inc., Intel, Hewlett Packard Enterprise, Meta Platforms Ireland Limited)	
08	PIIT		29	GÉANT	
09	Vodafone		30	AVM	
10	Samsung		31	Telecommunications Operator in CZ-PL-SK	
11	BTG		32	Deutsche Glasfaser	
12	RATEL		33	Dynamic Spectrum Alliance (DSA)	
13	Ultra Wide Band (UWB) Alliance		34	Ekahau	
14	Firo Consortium		35	Post Luxeembourg	
15	Telespazio		36	SURF	
16	EBU – European Broadcasting Union		37	EWE TEL	
17	IT-EOLO		38	IEEE 802	
18	Teracom		39	Wentzo	
19	Agenzia Spaziale Italiana / Italian Space Agency		40	WBA	
20	CRTV		41	SUNET/NUNOC	
21	European Space Agency (ESA)				

The comment from GSOA was submitted after the extended deadline without requesting a further extension and is not summarised in this document. The comment is uploaded on the RSPG web page for information.

Responses are structured in the following parts:

- PART 1: Questions directed to the MFCN and the WAS/RLAN stakeholders,
- PART 2: Summary of responses,
- PART 3: Questions directed to the stakeholders providing incumbent services in the upper 6 GHz band,
- PART 4: Summary of responses.

As the upper 6 GHz band is the focus of competing demands from existing users and potential additional users, such as the Mobile and WAS/RLAN Industries, the following outlines the different views.

Considering the correlation between the responses from different stakeholders, the following summary clusters responses into two main groups which are referred to as “View 1” and “View 2”.

II. Summary of responses to the questionnaire

PART 1: Questions directed to the MFCN and the WAS/RLAN stakeholders

A – Questions directed to the MFCN and the WAS/RLAN stakeholders:

I) Explain the demand for MFCN or WAS/RLAN in the U6 GHz band before and beyond 2030

(see the summary of responses in section A.1.1)

II) Provide information about the sustainability of the above explained demand especially the:
1) environmental impact assessment
2) social economic impact

(see the summary of responses in section A.1.2)

III) Provide information about:
1) the possible role of the upper 6GHz for MFCN or WAS/RLAN
2) use cases, expected deployments (e.g. number of BS for MFCN) and timeframe

(see the summary of responses in sections A.1.3, A.1.4 and A.1.1.13)

IV) Provide information about standardization and technology impact

(see the summary of responses in sections A.1.5)

PART 2: Summary of responses

A.1.1 The demand for MFCN or WAS/RLAN in the U6 GHz band before and beyond 2030

A.1.1.1 *Input on: MFCN spectrum availability and spectrum need*

View 1

- Existing MFCN allocations are still heavily underutilized[34]
- MFCN spectrum needs can be accommodated in other bands (3.8-4.2 GHz for Private 5G/6G networks, WRC-27 AI 1.7, mmW)[35]

View 2

- In a cellular MFCN network, the spectrum is used in a base station that serves up to thousands of users within its service area of hundreds of meters or kilometres. That large coverage area, together with the possibility of seamless hand over between base stations, provides a fertile foundation for a wide range of future unknown applications,

[34] HPE
[35] Wi-Fi Alliance, HPE

including, critical applications that require assured Quality of Service (QoS) or in which end users are moving or outside their home Wi-Fi (ETNO)

- 2 GHz of mid-band spectrum needed per country by 2030 to deliver MFCN-2020 target performance (accounting for densification in current mid-bands both indoors and outdoors and high-bands as well as Wi-Fi offload)
- MFCNs need sufficient contiguous spectrum availability without unjustified deployment limitations allowing ecologically viable deployments

A.1.1.2 *Input on: WAS/RLAN spectrum availability and spectrum need*

View 1

- No gigabit connectivity without U6 GHz for RLAN, new spectrum is urgently needed to avoid QoE degradation
- 10+ non-overlapping channels are needed
- 5x 160 MHz channels at 5 GHz and L6 GHz bands can support gigabit coverage to only ca. 50-60% of residential building area
- 320 MHz-wide channels is expected to be of high importance only for certain enterprise use cases
- Large BW channels enable Wi-Fi-based location and sensing

View 2

- The major converged service also provides RLAN solutions to their customers as part of their fixed-service offering. These operators have therefore the interest to provide high quality RLAN service to their customers (MNOs in France have 73.85% FBB market share, 69.7% in Germany)
- A Wi-Fi AP typically serves 1-5 persons indoors in a single household, providing the last metres of over-the-air connectivity to the fixed infrastructure on a best-effort basis (ETNO)
- The existing bands allow Wi-Fi to consistently achieve Wi-Fi throughput levels which exceed 1 Gbit/s even in high-interference urban scenarios
- Coverage, rather than capacity, is the key constraint for WiFi performance in the home today
- mmWave bands being considered for WiFi-8
- New WiFi-7 features, WiFi-8 will evolve further. Need to deploy latest generation APs (significant share of Wi-Fi 4 equipment still in the market, L6 GHz APs deployment has not been very fast)
- Lack of evidence for the claims indicating the need for channel re-use factors of up to 7. High re-use of large channel BW would be spectrum inefficient. Mobile cellular technologies support full frequency reuse between cells

A.1.1.3 *Input on: MFCN traffic trends*

View 1

- Mobile carries only 5% of total traffic. Considering that 70% to 80% are generated indoors only ca. 1% of total data traffic is generated outdoors and transmitted by mobile networks
- MBB traffic growth pace is slowing down
- No 5G capacity crunch before 2030
- MFCN capacity bottlenecks only occur in very small geographical areas and can be addressed with existing mid- and high-bands

View 2

- Data volumes continue to grow at an annual rate of ~25%-30%
- Between 2019 and 2023, global mobile data traffic grew 3.5 times from 39 to 137 EB per month. Mobile traffic per connection grew from 6.6 GB/month to 17.3 GB/month
- While the year-on-year growth rate is expected to slowly decrease over time, traffic continues to grow strongly in absolute incremental terms: in 2023, the increase in global mobile data traffic was more than the absolute traffic level in 2018 (...)
- The incremental data traffic added to networks in 2027 is estimated to be equivalent to the total mobile data traffic carried in networks in Europe in 2019
- By 2029, Mobile traffic levels in Europe is estimated to be ca. 9x the levels in 2019: a relatively conservative forecast based on a gradual evolution of services and their use today. There are emerging technologies and capabilities such as Gen AI, AR/VR, edge cloud computing, network slicing etc which could result in considerably higher mobile traffic levels in the next 5 years
- Mobile traffic / user in the EU will increase, on average, from 13 GB/month in 2022 to 76 in 2030 (25% CAGR). Over the same period, fixed data consumption / home will increase from 224 to 912 GB/home/month (19% CAGR)
- Some urban 5G cells in larger markets will begin to experience service-impacting capacity limitations on their primary 5G capacity layer (3.5GHz) in around 2028-29

A.1.1.4 ***Input on: WAS/RLAN traffic trends***

View 1

- Ca. 90% of Internet traffic travels via fixed lines and ca. 90% of it is relayed to end users via Wi-Fi. This trend is set to continue
- 20% average data consumption increase per year until 2030 in fixed networks - despite the already extremely high levels
- Wi-Fi usage has increased by 53% in European households in 2023
- The absolute growth in fixed data traffic is likely to be almost 5x the absolute MBB traffic growth between 2022 and 2030
- 93.9% of the EU's enterprises use FBB connections to access the Internet via Wi-Fi
- 12 devices on average connected in homes in Europe. The number of Wi-Fi devices per user is proliferating

- Wi-Fi devices processing power, screen resolution, streaming video support (now at 4k/8k HD), camera performance, and antenna functionality. has increased exponentially
- AR/VR taking up, fixed networks are the more likely beneficiaries of widespread adoption of AR/VR
- New applications: consumer gaming, advanced manufacturing, demand low latency transmissions. Beyond 2030, new applications and technologies will likely require ultra-reliable, low-latency, and high-throughput

View 2

- NOTE: no additional comments were provided

A.1.1.5 *Input on: Comparison MFCN vs. WAS/RLAN deployment issues*

View 1

- Macro cellular deployment
  - High-quality AR/VR services cannot realistically be provided from public MFCNs using high-power outdoor macro BSs
  - Per-site EMF limits have already been reached so that additional antennas (for 6 GHz MFCN) cannot be installed
  - U6 GHz trials showed that wide area MFCNs cannot deliver sufficiently high UL data rates (mainly due to UEs' limited power (mainly smartphones
- Densification
  - MFCN spectrum needs can be accommodated in a variety of other frequency bands including 3.8-4.2 GHz (which will absorb enterprise MFCN (low-medium power) needs. High mobile usage is driven by the absence or unaffordability of fixed networks, which is usually temporary
- Indoor coverage
  - The average building entry loss (> 20 dB, higher for energy-efficient green buildings) does not allow O2I coverage (BS power can be increased but there are limits to UE power (>23 dBm UE power would interfere FS
- Interworking / Wi-Fi offloading
  - MNOs benefit from Wi-Fi offload, persuading MNOs to adopt Passpoint and OpenRoaming, as a standard feature, will be key to offloading a good percentage of the current indoor traffic on public operator networks to indoor Wi-Fi networks
- Role for 6G
  - 6G will require heavy investments, MNOs need to achieve a return on their investment in 5G networks before they can invest in U6 GHz and new networks
  - No 6G widespread deployment in the EU until 2035
  - unique 6G use cases and related spectrum needs are speculative

View 2

- Macro cellular deployment (reuse 3.6 GHz grid):

  - field studies and tests have shown the possibility of creating contiguous coverages with the 6 GHz band by reusing existing cellular macro sites both in terms of performance and in terms of coexistence with services that already use these frequencies

- Densification
  - MNOs have already densified networks and continue to do that in areas with capacity shortages. However, extreme densification is not a viable solution neither technically, economically, nor ecologically
  - In a scenario where the U6 GHz cannot be deployed for MFCN, the estimated number of small cells required for a large market is of around 30,000 to 50,000 small cells for the UK leading to very high prohibitive costs (between 7 to 15 times the annual TCO of deploying 6GHz spectrum on existing macrocell sites)
  - Small cell deployments also come with significant practical and technical challenges, in terms of: finding, building and operating new sites in urbans areas; ensuring coverage and performance where required - across outdoor and, in particular, indoor areas (where the majority of traffic is consumed today) especially if using mmWave spectrum; and managing mobility and interference between different network layers and sites.
  - Extreme network densification to compensate the deficit of mid-bands spectrum for delivery of the targeted performance levels would translate into 3-5x higher total cost of network ownership over a ten-year period and 1.8-2.9x greater carbon footprint. This, without addressing the practical restrictions in acquiring the additional sites required within an already dense network grid, the technical challenges including harmful interference management and mobility management, or the economic feasibility in terms of both CAPEX and OPEX resulting from such extreme densification.

- Indoor coverage
  - Most traffic over cellular networks is delivered to users indoors, with estimates ranging around 70-80% Mid-bands delivering higher capacity indoors than low bands and a higher percentage of connections. This can be the result of technological advances applied to upper mid-bands like massive MIMO and beamforming
  - Indoor traffic and in mobility scenarios will grow
  - Extensive trials from various European MNOs using advanced prototype network equipment demonstrated the significant performance benefits achieved across both outdoor and in particular indoor areas (where the majority of mobile network traffic is consumed) when deploying the U6 GHz for MFCN on existing macrocell sites.

- Interworking / Offloading is limited – end-user decision
  - Offloading indoor traffic to RLAN Wi-Fi networks is limited by end-user decisions driven by security concerns, the complexity inherent to connect to private Wi-Fi APs (registration and initial login / re-login) or lack of access to the corporate Wi-Fi (from personal smartphones or when visiting others' sites)

- Role for 6G
  - The 6 GHz band supports unleashing the full potential of 5G SA in the second half of the decade where needed, and in the longer perspective enables the telecom operators to deploy the best technology in the band for the next telecommunication generation, 6G (ETNO)
  - Depending on the market's characteristics and traffic growth, the additional spectrum in the U6 GHz will be used to address the service-impacting high traffic load that macro BSs are expected to experience in the 2027-2028 timeframe, facilitating the high-performance of 5G services and laying the foundation of 6G. As each new generation of mobile technology benefited of an initial deployment band, and taken into account the shortage of suitable spectrum for 6G early rollouts, a direct connection between 6G and the U6 GHz band has also been made. Independent reports, such as those from BIS Research, suggest that by 2035, the 6G market in Europe could be worth up to $240.02 billion9. However, U6 GHz alone will not be able to sustain such growth and spectrum from the 7.125-8.4 GHz is needed to be further studied for 6G
  - The U6 GHz band is currently the only opportunity for initial 6G deployments expected for 2030. The U6 GHz, depending on when it is made available, as well as potential spectrum identified at WRC-27, should be part of this longer-term spectrum roadmap to enable mobile evolution towards 6G/MFCN-2030 and provide the option for wider bandwidth carriers. A successful launch – where appropriate – of a competitive 6G in Europe using the U6 GHz band can only start with at least 200 MHz assignments per MNO in this band
- Larger Channel BW
  - 200 MHz per operator for efficient and effective rollouts
  - Larger channel bandwidths also form a key component of any technology evolution. Large contiguous spectrum blocks (compared to fragmented blocks) support better performance with less complex deployment and operation
  - The evolution of semiconductor allows to process increasingly larger RF bandwidths and more antenna elements at constant cost and energy efforts
  - The trials in particular validate the incremental capacity benefits achieved by using larger 200 MHz channels relative to the typical 100 MHz deployments in the 3.5GHz band today. Larger channel bandwidths translate into better cost efficiency to support new or evolved higher bit-rate customer services and general network traffic growth. The use of larger 200MHz channel bandwidths in the U6 GHz band can provide between 40%-50% better capacity cost efficiency (cost/GB) than 3.5GHz radio equipment today. Channel bandwidths greater than 200MHz would naturally improve capacity cost efficiency further.

A.1.1.6 ***Input on: WAS/RLAN deployment issues***

View 1

- FTTH/B subscribers in Europe: 121M in Sept. 2023, 201M by 2029 from
- Number of homes passed: 244M in Sept. 2023, 312M by 2029

- FBB operators are rolling out XGS-PON / symmetric speeds of up to 10 Gbit/s.
- Average speeds increased by 37% / year between 2017 and 2024
- The average DL speed is now more than 109 Mbit/s
- Some EMEA operators are offering 25 Gbit/s FBB to residential customers
- WiFi-bottlenecks would disincentivize fibre investments

View 2

- 55% of households had a fixed broadband subscription with a nominal speed of at least 100 Mbit/s in 2023, and 14% of households had a fixed broadband subscription of at least 1 Gbit/s in the same year

A.1.2 Information about the sustainability of the above explained demand

A.1.1.7 *Environmental impact – WAS/RLAN*

View 1

- The combination of fibre and Wi-Fi is the most efficient solution in terms of energy consumption, performance, and flexibility. Reducing energy consumption and emissions related to transportation
- Current FTTH access networks have been found to consume 2.5 times less energy than current 5G mobile networks: while fibre access consumed 2g CO2e/h, transmission via 5G networks caused an amount of 5g CO2e/h
- Making the full 6 GHz band licence-exempt allows more channels, leading to reduced interference, leading to lower power consumption, thus the most energy-efficient approach
- Maximising the bandwidth of single frequency bands is a more sustainable option than combining several narrower sub-bands through carrier aggregation
- If more 160 MHz and 320 MHz channels were made available in the U6 GHz band, devices would be able to transmit in much shorter periods, which would help improve service predictability, and, importantly, minimize transmission energy.
- Video streams and XR services that can help people conduct meetings and interact with one another effectively without being physically present in the same location
- Wi-Fi supports the proliferation of smart home technologies, which optimize energy usage. Smart thermostats, lighting systems, and appliances connected via Wi-Fi...
- Today, data sheets of APs mention a Mean-Time-Between-Failures of 1,128,980 hours. That is a mean time of more than 128 years between consecutive failures of a single Wi-Fi AP
- Various vendors have implemented the ability to put an AP in deep sleep when there are no users in the building which reduces the power consumption
- The IEEE802.11 family of standards defines a number of energy-saving mechanisms: Target Wake Time (TWT), as an energy-efficient scheduling mechanism for transmissions between an AP and a wireless client. Wi-Fi 7 specification built on IEEE P802.11be project specifies multi-link operation (MLO), which defines an energy-

efficient way for an AP to manage and coordinate traffic over several bands with a multi-link device (MLD)

View 2

- It has been claimed that a transfer of traffic from fixed to mobile would drastically increase the energy consumption of wireless networks. This conclusion is based on the wrong assumption that energy use and data transmission is linear. One example on the non-linearity relationship is that during the Covid-19 pandemic, data transmission in mobile networks grew by 50% while the electricity consumption remained flat
- The availability of the U6 GHz band for Wi-Fi would not translate to any reduction in carbon emission, given that the DDPP 2030 connectivity targets can be met with the latest Wi-Fi technology using the bands already available for RLAN/Wi-Fi in Europe
- Any comparison between FTTH + Wi-Fi and 5G networks power consumption should also account for the great differences existing between the two (complementary) networks: coverage for example: the power consumption of 5G networks addresses the needs for end users connectivity across mid contiguous areas (e.g. citywide)

A.1.1.8 ***Input on: MFCN environmental impact assessment***

View 1

- 5G mobile networks are significantly less energy efficient for the same amount of data traffic than FTTH networks
- Connecting an indoor device to an outdoor station uses an excessive amount of energy, resulting in more frequent recharge, increased battery wear, and hence electronic waste
- MFCNs operating in the U6 GHz band would be a fully redundant network delivering lower performance than the fibre network already in place. With lower performance
- Fibre is considerably more energy-efficient than FWA

View 2

- Significant impact of spectrum policy and availability for mobile networks on carbon emission. More efficient networks with fewer BSs not only increases the energy efficiency of mobile networks but creates an enabling effect enhancing sustainable productivity by reducing carbon emission from other industries and sectors
- Increasing the amount of spectrum frequencies per site is a more environmental-friendly way to increase capacity than increasing the number of sites since the carbon emission savings from having less network densification outweigh the incremental carbon emission costs of deploying and operating new mid-band radios at existing sites (aiming at delivering the 5G/MFCN-2020 data rate requirements in urban areas)
- With limited spectrum, operators require more BSs to serve the same amount of traffic. This results in more energy use per unit of traffic and increased footprint in terms of equipment, construction and transport, therefore a higher carbon footprint from MNOs
- Restricted spectrum assignments result in higher retail prices and lower quality of service. Reducing the amount of spectrum for mobile by 100 MHz could result in 5% lower 5G penetration. This would limit the enablement effect of mobile on other industries

- Small cell densification would result in a 3 to 6 times increase in energy consumption. This considers radio network energy alone and excludes any energy increases in other parts of the network (e.g. supporting transmission network) or the energy associated with civil works required to build the new sites. There are also significant environmental impacts which need to be considered in building these new sites across urban areas
- In the absence of additional mid-band spectrum compared to what is available today, the delivery of MFCN-2020 performance levels in a city like Paris would require a ×4.1 increase in the number of 5G BSs, and a ×2.2 increase in power consumption

A.1.1.9 *Input on: Social economic impact assessment*

View 1

- Wi-Fi contributes to gross domestic product (GDP) growth in Europe positively by providing low-cost broadband access and helping to bridge the digital divide by maximally utilizing the available backhaul connectivity
- Delaying Wi-Fi access to the upper 6 GHz band harms European consumers and impede technological development. But most importantly, the allocation of the upper 6 GHz band is not a mere question of technology. Whether the spectrum policies for the next decade fully recognize or not the role of Wi-Fi as a key technology will very much determine EU's ability to innovate and to deliver on its gigabit promise

View 2

- The availability of the whole 6 GHz band for RLAN was not found to be the most beneficial allocation in any of the considered analyses
- Opening the entire 6 GHz band to MFCN will have a direct impact on GDP via the increased competitiveness of European businesses on a global scale.

A.1.3 The possible role of the upper 6GHz for MFCN or WAS/RLAN

A.1.1.10 *Input on: Role of the U6 GHz band for MFCN*

View 1

- Would require: multi-year 6 GHz incumbent relocation. No scale before 2030 at the earliest, larger investments (i.e., billions of euros) to develop, implement, deploy and operate the MFCNs
- Unlikely to be economically viable: questionable ROI, limited market scale and harmonisation
- EU DDPP 5G targets are expected to be met this year already without U6 GHz band
- Not suitable for MFCNs providing large area coverage.
- U6 GHz would only be used to increase capacity in very dense urban areas
- Alternatives bands in the mid-range and mmW bands
- 5G usage trends show that additional mid-band spectrum is not required

- FWA is not a replacement for Wi-Fi, it still needs Wi-Fi to provide indoor connectivity to users

View 2

- Converged operators providing fixed and mobile connectivity support the licensed use of the U6 GHz in due time with full power addressing BB traffic growth (indoor, outdoor, country-wide)
- Essential for Europe: largest remaining mid-band single block of spectrum in this decade and likely beyond, able to accommodate larger channel BWs (e.g. 200 MHz) this makes the U6 GHz for MFCN - enabling it to be at the forefront of mobile network evolution through the introduction of 5G Advanced or initial 6G deployments
- 1st step (second half of the decade / before the end of the decade / little before 2030 / starting from 2027-2028, depending on the market) to accommodate 5G traffic growth
- 2nd step (> 2030): creating a strong spectrum baseline for 5G-Advanced network operators will be able to evolve to 6G in a practical, cost-effective, environmentally friendly manner
- Licensed spectrum provides certainty, incentivises investment, and gives predictability for MNOs to develop long-term plans. Spectrum fees are strong incentive towards efficient use of spectrum. Licensed usage enables administrations and operators to ensure compliance with the respective usage conditions. It helps providing secure, reliable, and good quality service for end-users
- Any regulatory restrictions applied to limit power levels below these standard levels would have a significant impact on coverage and performance (i.e. would not allow reusing the same grid as 3.6 GHz band). It is unlikely that European MNOs would deploy the band for mobile networks in case of such regulatory restrictions.
- Only a licensed spectrum usage enables administrations and operators to ensure compliance with the respective usage conditions. Spectrum with guaranteed rights of use helps provide secure, reliable, and good quality service for end-users.

A.1.1.11 ***Input on: Role of the U6 GHz band for WAS/RLAN***

View 1

- U6 GHz should be allocated for Wi-Fi (and NR-U) long before 2030. Enabling Gigabit Wi-Fi
- No alternative spectrum
- Current Wi-Fi spectrum can only support gigabit coverage for ca. 50-60% of residential building area, not sufficient to support the DDPP 2030 goals for all indoor scenarios
- U6 GHz is crucial for addressing the enterprise networking domain
- “Fiber to the room”, is usually unfeasible. And even where feasible not directly accessible through laptops and smartphones, and thus does not limit the demand for Wi-Fi from the guests/patients/visitors
- If coexistence between Wi-Fi and MFCN is required in U6 GHz band, Wi-Fi should have full access to the entire 6 GHz band, at least indoors and that, if MFCN is used

in U6 GHz band, transmission powers outdoor should be low enough not to cause interference with Wi-Fi

- In areas where fixed access and WiFi networks do not exist – such as recreation areas or other vast public spaces, MFCN signals in the U6 GHz band would add to society's connectivity needs
- Interworking should not take place at the physical layer, as the 3GPP and IEEE 802.11 protocols do not work together well when they share the same frequency bands (where Wi-Fi loses out as it is less aggressive, even when 3GPP protocols use Listen-Before-Talk). All efforts to bring them to practise have failed, including the standardised solutions such as LWA, LWIP, LAA, and LTE-U
- On "hybrid sharing" (outdoor MFCN and indoor RLAN): the strength of the signal emitted by the MFCN BS is the decisive parameter. Based on technical studies, this scenario is only feasible if MFCN's are authorized to operate at considerably lower powers than that permitted in the 3.5 GHz band. Unfortunately, the MNOs and their infrastructure providers have made clear their interest to operate high-power wide area mobile networks everywhere. This defeats the idea of sharing the U6 GHz band between RLAN/Wi-Fi and MCFN. The transmissions from high power mobile networks will simply overwhelm the receivers of indoor Wi-Fi networks APs and client devices
- Even with low signal strength, it is not possible to flatly avoid disturbances of indoor WiFi-networks, since it depends on parameters such as distance from cell tower or the type of walls and buildings in between. Since pilot signals force any WiFi devices within reach to switch channels from the U6 GHz band to any other spectrum that may be available for WiFi, even signals of low strength may practically render the band useless for WiFi in the surroundings
- On the possible band-split: There are no exact figures how a split between RLAN/Wi-Fi and MFCN should be defined, still it is a fact that a coexistence only can be delivered with dedicated band portions for RLAN/Wi-Fi and MFCN purposes. A favourable allocation would then be to allocate 6425 – 6875 MHz to unlicensed usage (aligned with UNII-6 and UNII-6 bands in the USA), and 6875 – 7125 MHz to licensed usage (aligned with the UNII-8 frequency band)

View 2

- The upper 6 GHz band will not play a significant role for supporting WAS/RLAN use cases
- Wi-Fi performance can often be improved by replacing the Wi-Fi access point with newer (not even the newest) equipment
- Wi-Fi 7 supports Multi-Link Operation (MLO) allowing simultaneous reception and transmission across different frequency bands and channels (2.4 GHz, 5 GHz, 6 GHz)
- Wi-Fi 8 is expected to support new frequencies in the mm-wave frequency range, 42-71 GHz, and to provide data rate up to 100 Gbps
- Beyond 2030, network densification is a way to improve capacity and spectrum efficiency in locations with high-capacity demand. We expect that Wi-Fi network densification with Fiber To The Room (FTTR) solution start to appear in such

locations. Denser Wi-Fi configurations could also take advantage of higher frequencies in the 42-71 GHz range for providing extremely high throughputs

- 2.4, 5 and lower 6 GHz are under any conditions sufficient to be consistent with the European Union Digital Decade Policy Programme connectivity objectives for 2030 for all end users at fixed locations. The test shows that the key constraint for Wi-Fi is coverage which can be effectivity addressed through densification of access points instead of additional spectrum resources Wi-Fi performance can often be improved by replacing the Wi-Fi AP with newer equipment
- Beyond 2030, denser Wi-Fi configurations could also take advantage of mmW spectrum (Wi-Fi 8 is expected to support mmW in the 42-71 GHz range, providing data rate up to 100 Gbit/s)
- Unlicensed use has no incentive towards more efficient use of spectrum: very low frequency reuse, slow replacement Wi-Fi equipment with more recent technologies to make a more efficient spectrum use are also not coordinated and tend to be consumer-driven (e.g. Wi-Fi 4 continues to represent a significant % of connections, modest European market share of L6 GHz equipment (7.6% of total 2023 shipments)
- Mobile has been designed by 3GPP/ITU to operate in clean, licensed contiguous spectrum with standard power with user terminals moving throughout any coverage area in different locations. Wi-Fi has been designed by IEEE to operate in licence-exempt shared contiguous spectrum with low power with user terminals moving throughout a limited local area. Co-channel operation at the same place and same time would result in harmful interference and degradation in the performance of systems
- Other non-traditional options such as spectrum sensing mechanisms and database sharing solutions, while possibly theoretical appealing may lead in practice to challenges in deployments and therefore limited successful implementations. Concerns with such solutions range from complexity of solutions considered, implementation and running costs, breakdown of roles between governments and stakeholders, to the net benefit of such deployments to the two technologies
- There might be value in the use of the band to enhance Wi-Fi connectivity in geographic areas where MFCNs are not eventually deployed and welcome the ongoing efforts to assess different options. We feel, in any case, that regulators have a duty to ensure that the costs of facilitating that possibility do not outweigh the benefits. They should, in other words, acknowledge that spectrum sharing should not be the objective, but a tool introduced only after careful assessment of costs and benefits to society
- While discussions continue in Europe on harmonised use of the U6 GHz band for MFCN and potential sharing scenarios with RLAN/Wi-Fi, it is vitally important Europe does not define conditions or mechanisms which prevent or restrict all the potential benefits of the band (see above), and which increase development costs, introduce ecosystem fragmentation and create uncertainty around timescales - all of which will have a significant negative impact on Europe achieving its DDPP connectivity targets by 2030 (DDPP) as well as Europe’s competitiveness and leadership position in the global market
- Furthermore, given that the majority of mobile traffic originates indoors, there is no clear rationale for attempting to enforce an outdoor mobile use of the band and an

indoor Wi-Fi use of the band ("indoor/outdoor split)". The mobile industry has expressed great concerns in investing in network infrastructure under restrictions on the EIRP of MFCN BSs (thereby, according to the proponents of this approach, precluding MFCN indoor coverage or at least de-prioritising this with respect to RLAN/Wi-Fi indoor coverage) such constraints due to the prohibitive costs that would be required to build ubiquitous wide area (e.g. citywide) outdoor coverage, as well as the restrictions this would place on MFCN use indoors. MNOs are extremely concerned by such an approach that will degrade the capacity and performance of the band to an extent where its value for cellular deployments drops to the point where it will not be used. As the majority of mobile use is indoors and supported by mid-bands standard power BSs, reducing the U6 GHz power would limit its coverage and capacity making it in practice similar to mmWaves bands. Limiting the power of the macro BSs would produce a capacity loss of 40% up to 90% of the U6 GHz band and so, result in a very inefficient usage of the band for mobile that is unacceptable for justifying the capex to deploy another frequency layer

- On the possible band-split: Any frequency segmentation option that results in constrained mobile spectrum and reduced economic/GDP impact should be avoided. The optimal use of this band for widearea mobile services require a minimum of 200 MHz per operator for efficient and effective rollouts

A.1.4 Use cases, expected deployments (e.g. number of BS for MFCN) and timeframe

A.1.1.12 *Input on: MFCN Use cases and expected deployments*

View 1

- No MFCN equipment available for use in the U6 GHz band, and that is likely to remain the case for some time
- No compelling use cases for 5G MFCN in the U6 GHz band have been presented until now.

View 2

- Current deployments in the 3.5 GHz band can be taken as a proxy for future deployments in the 6 GHz band to address future capacity needs. MNOs expect U6 GHz to be primarily deployed as an overlay on existing 3.5 GHz macrocell sites. One leading European MNO has currently deployed 3.5 GHz spectrum for 5G networks on over 18,500 sites with 52,000 antennas across its markets in Europe (incl. UK) – nearly 3x the number of BSs deployed 2 years earlier – providing high speed 5G network coverage in over 250 cities
- Future demand expected to be driven by mobile broadband (indoor and outdoor) serving a high number of indoor and outdoor use cases and applications
- Anytime, anywhere mobile network connectivity for XR and other evolved services will be fundamental for digital societies and economies, enhancing work, education, health and social communication and interaction. Smaller, lighter and more stylish XR devices (e.g. AR glasses) are expected in the medium term, allowing a shift from local to wide-area use. XR could be the next paradigm shift after the smartphone, XR user

will consume more data relative a to MBB user today due to continuous high-resolution video streams as well as edge cloud computation offload.

- Additional use cases beyond 2030 in the 6G timeframe (e.g holographic communication) for which additional spectrum to what is available today and expected to be available by 2030 (U6 GHz) Various AR/VR applications with sensing, multimedia are expected to enhance 5G use cases or being new 6G use cases. All of those require mobility
- Smaller, lighter and more stylish XR devices (e.g. AR glasses) are expected in the medium term, allowing a shift from local to wide-area use. XR could be the next paradigm shift after the smartphone, and many believe XR glasses will overtake the smartphone as the main device type in cellular networks long-term. XR user will consume more data relative a to MBB user today due to continuous high-resolution video streams as well as edge cloud computation offload. Anytime, anywhere mobile network connectivity for XR and other evolved services will be fundamental for digital societies and economies, enhancing work, education, health and social communication and interaction
- All of those require mobility, capacity on the highways.
- Applications with sensing are expected to enhance 5G use cases or being new 6G use cases
- FWA: while in the dense urban areas, fiber dominates, its usage decreases the further one moves from the center. In fact, outside the cities (e.g. villages), FWA is the predominant solution. Allocating the upper 6 GHz to MFCN can improve the business case for FWA by increasing the bandwidth and thus speeds for users...
- Hong Kong plans to begin the 6 GHz assignment process in November 2024. The initial device ecosystem for U6 GHz licensed use will likely be driven by larger markets such as China, which has already identified the U6 GHz band for licensed allocation. Commercial devices to be available in the near future

A.1.1.13 ***Input on: WAS/RLAN Use cases and expected deployments***

View 1

- Latency-sensitive high throughput applications e.g. real-time XR for health, education and gaming, robotics, industrial automation
- Most of AR / VR applications will be used indoors, where Wi-Fi is the technology of choice. Wi-Fi will be widely used to connect smartphones to VR/AR headsets outdoors. AR/VR require a minimum throughput from 400 to 2.35 Gbit/s and a maximum streaming interactive latency in the order of 10 ms
- Enterprise / Industrial applications: automation (manufacturing factory robots and sensors, Automated Ground Vehicles, Autonomous Mobile Robots), AR, logistics, warehouses, monitoring systems ... with stringent QoS requirements
- Residential users in densely populated areas, smart homes, smart cities, enterprise / Industrial applications, high-density environments (stadiums, convention centres, airports, train stations, urban areas, healthcare, education), smart cities, offices, public administrations, hospitality (hotels & resorts)

- The latest Wi-Fi technology is already on the market (e.g., South Korea, US)

View 2

- Allocating the spectrum to RLAN/Wi-Fi would then limit the benefits of XR to confined locations and best effort use cases, and thus reducing the value for the European society.

A.1.5 Information about standardization and technology impact

A.1.1.14 *Input on: MFCN Standardisation and technology impact*

View 1

- judging from the demonstrations of 6 GHz MFCN prototypes given by various MNOs, it would likely take years before U6 GHz MFCN equipment would be mature enough for deployment
- Given China's stated intention to allocate the entire 6 GHz band to MFCN, Chinese companies could gain a significant technological advantage over their European counterparts

View 2

- June 2022: 3GPP completed the technical specifications of 5G NR band n104 (in Rel. 17) for the U6 GHz band for licensed 5G services. First band combinations between n104 and n78 in Rel. 18. Ongoing improvements in Rel. 19
- Following WRC-23, 3GPP started the work (RP-240829) to add the Expected e.i.r.p. mask (see WRC-23 Res.n 220) and related conformance testing to 3GPP specifications. Work planned to be finalized by Dec 2024
- Several trials and tests have taken place in the last 2 years involving several EU operators and suppliers. More trials are being planned with suppliers using more advanced pre-commercial network equipment to drive further performance enhancements for U6 GHz deployments on macro cells

A.1.1.15 *Input on: WAS/RLAN Standardisation and technology impact*

View 1

- Jan. 2024: Wi-Fi Alliance introduced Wi-Fi CERTIFIED 7™ based on IEEE P802.11be technology. With the introduction of 320 MHz channel BW
- Nov. 2023: IEEE 802.11 WG approved the creation of a new project, IEEE P802.11bn also known as Wi-Fi 8, to work on a major amendment, entitled "Enhancements for Ultra High Reliability" for next generation wireless LAN that applies to carrier frequency operation between 1 GHz and 7.250 GHz. Backward compatibility and coexistence with legacy IEEE 802.11 devices in the 2.4, 5 and 6 GHz license-exempt bands will be ensured
- IEEE P802.11bn targets at increasing MAC throughput by 25%, improving latency by 25%, and reducing the MAC Protocol Data Unit loss by 25% relative to IEEE

P802.11be. This project also aims to provide a mechanism to reduce power consumption for APs (including mobile APs) and improved peer-to-peer (P2P) operation compared to IEEE P802.11be operation.

View 2

- 3GPP has standardised the L6 GHz band for unlicensed use, enabling 5G NR-U deployments
- May 2021: IEEE completed the 802.11ax-2021 standard for Wi-Fi 6/6E products to operate over the entire 6 GHz band (5925-6425 MHz).
- IEEE is now working on the 802.11be standard for Wi-Fi 7 to be finalized by end of 2024. Wi-Fi 7 builds on Wi-Fi 6E and aims to improve data throughput, stability, and latency. While Wi-Fi provides access to multiple spectrum bands, devices prior to Wi-Fi 7 typically choose only one band to make transmissions. With multi-link operation (MLO), Wi-Fi 7 devices can simultaneously connect on multiple bands, enabling faster speeds through aggregation
- IEEE 802.11bn (Wi-Fi 8) is to be the next 802.11 standard. Wi-Fi 8 will explore mmW frequencies and more advanced antennas, and will continue to improve multiple AP coordination and transmission.

PART 3: Questions directed to the stakeholders providing incumbent services in the upper 6 GHz band

B. Questions directed to the stakeholders providing incumbent services in the upper 6 GHz band, such as: Fixed service, Fixed satellite service, Radio astronomy service, SST (Sea Surface Temperature) sensors, UWB.

I) Explain impact of possible future usage of the upper 6GHz for MFCN and/or WAS/RLAN on existing services:

1) What are your current and future spectrum needs (before and beyond 2030) in the upper 6GHz band?

(see the summary of responses in section A.1.6)

2) What impact on your service do you expect from the introduction of MFCN and/or WAS/RLAN in the upper 6GHz band? General views, impact on specific service

(see the summary of responses in section A.1.7)

3) What measures could improve compatibility from your perspective?

(see the summary of responses in section A.1.8)

PART 4: Summary of responses

A.1.6 Current and future spectrum needs for incumbent services

A.1.1.16 *Input on: Current and future spectrum needs for FS*

- Primary FS allocation
- U6 GHz is the highest frequency band that can be used in critical weather conditions
- FS links at U6 GHz are expected to continue in many European countries beyond 2030
- According to invites n. 4 from Res. 220 (WRC-23), a Working Document Toward Draft New Report on regulatory aspects methodology for sharing and mitigation techniques between MFCN and FS in the U6 GHz band is under development
- Many MNOs operate FS links in the U6 GHz band for radio site backhauling in a number of markets in Europe. Generally, long-haul links (typically 20 to 50 km hop lengths, 50% of links of one major MNO are below 4 km) with high relevance in less populated areas outside urban areas, though may require a single central aggregation point within or near an urban area. There is demand for wider channel BW for mobile network backhauling to enable 5G data rates, however such demand will not be addressed by FS links in the 6 GHz band. Thousands of radio links used by operators in one country
- Used by broadcasters (both public and commercial) in certain European countries to provide feeds for DVB-T/T2, FM, DAB distribution. Fixed video links (CEPT ERC/REC 14-02) are key to DTT reliable distribution network (from production centers to DTT transmitters). Increase in recent years due to the following causes: refarming of 700 MHz; 4 GHz and L6 GHz bands are overcrowded; difficulties in sharing the L6 GHz band with RLAN/Wi-Fi which cause interference to FS links; DVB-T2 leads to at last 50% transmission capacity increase for each multiplex
- With reference to one country: used for the provision of telecommunication services for local public authorities including PPDR over long distances (> 40 km, incl. locations where fibre connection is not available (rural areas or protected landscape areas)
- Also used as backhauling for utilities networks

A.1.1.17 *Input on: Current and future spectrum needs for FSS UL*

6425-7075 MHz

- Some residual use by broadcasters in some countries to operate satellite distribution with UL below 6725 MHz (paired with 3.4-3.7 GHz band for DL)

6700-7075 MHz

- Feeder links for NGSO of MSS, essential for maritime operations as well as for the aviation industry
- Telecommand and control signalling on which satellite operations safety relies

A.1.1.18 *Input on: Current and future spectrum needs for EESS (passive) / SST*

- 6425–7075 and 7075–7250 MHz are unique for EESS (passive) measurements since they correspond to the peak sensitivity to SST (Sea Surface Temperature). SST, together with ocean salinity, are one of the drivers of ocean circulation, which is key for any numerical weather / Ocean prediction or numerical ocean prediction model
- CIMR (Copernicus Imaging Microwave Radiometer) is one of the expansion missions of the EU Earth Observation Programme Copernicus. It is being developed by ESA and it is due for launch in 2028: a constellation of two satellites, each carrying a multi-frequency microwave radiometer to provide a range of key observations. The radiometer will observe in the 6675-7075 MHz band, specifically to observe SST and its operation are expected to go well beyond 2030

  - ITU's RR 5.458 notes that bands 6425–7075 MHz and 7075–7250 MHz are used for passive microwave sensor measurements for Earth-exploration satellite and space research and that Administrations should bear these needs in mind in future planning

A.1.1.19 *Input on: Current and future spectrum needs for RAS*

6650.0–6675.2 MHz

- Observations of the 6.6685192 GHz methanol maser spectral line is essential to study the formation of massive stars. Methanol maser emission is emitted from a small area in the sky. An ideal target for very long baseline interferometry (VLBI), using large networks of antennas such as the Very Long Baseline Array in the US or the European VLBI Network (EVN)
- Observations have increased world-wide. Carried out with many radio antennas, single dish as well as telescope arrays, for 1000s of hours / yr.
  In Europe, the band is used by stations in Belgium, Finland, Germany, Italy, Latvia, The Netherlands, Norway, Poland, Spain, Sweden, Switzerland, UK
- ITU-R RR footnote 5.149 which states: "in making assignments to stations of other services to which the bands: […] 6 650–6 675.2 MHz […] are allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. […]
- Res. 220 (WRC-23) invites administrations 3: "to take all practical steps to protect the RAS from harmful interference in the frequency band 6 650-6 675.2 MHz, […]" (unlike RR 5.149, Resolution 220 does not refer to assignments, only)

A.1.1.20 *Input on: Current and future spectrum needs for UWB*

- Devices mainly use UWB Ch. 5 (6.2-6.8 GHz) and UWB Ch. 9 (7.7-8.3 GHz). Some devices use UWB Channel 6 (6.7-7.3 GHz)
- Key use cases: secured and high accuracy ranging peer-to-peer applications between smartphones and various (consumer) devices. It is expected that more applications will rely on UWB based location information, including safety-related applications (e.g.

indoor navigation for mobility impaired people, communication, measurement, location, imaging, surveillance, and medical systems)

- The IEEE Std 802.15.4 standard UWB is the foundation of application specifications developed by the Car Connectivity Consortium (CCC), FiRa, CSA, omlox/PROFIBUS, AES, UWBA and others
- The next generation of UWB technology, being developed under IEEE P802.15.4ab, will continue to require access to the U6 GHz band. This project builds on IEEE Std 802.15.4z-2020, which utilizes both the 6 and 7 GHz bands
- UWB does not need exclusive access to spectrum, so long as new incompatible uses are not introduced into the bands
- Anticipating continued expansion of spectrum needs in the U6 GHz band before and beyond 2030
- Forecast: more than 1 billion UWB-enabled devices (e.g. smartphones and laptops) shipped annually worldwide by 2025

A.1.7 Impact on incumbent services

A.1.1.21 *General views related to the WAS/RLAN introduction*

- LPI and VLP Wi-Fi would allow all incumbent users to continue using the band and even to expand. Wi-Fi would effectively be “invisible”, accessing the spectrum without affecting existing users. Both the indoor and the outdoor network can utilize the U6 GHz frequency band efficiently without the threat of significant interference.
- No substantial problems when WAS/RLAN operate indoor, there could be some interference when they operate outdoor
- The effects of outdoor VLP systems interferences are destructive and difficult to resolve
- RLANs can operate under constraints that do not cause unacceptable interference to incumbent operations
- The location of potential WAS/RLAN interferers is unkonwm in case of WAS/RLAAN operating in unlicensed spectrum

A.1.1.22 *General views related to the MFCN introduction*

- MFCN deployments require priority spectrum access to maintain the necessary QoS. Therefore, MFCNs cannot avoid interfering and/or tolerate interference from the incumbents. Several European countries will therefore need to trigger a protracted and complex incumbent relocation process
- Only a licensed spectrum usage enables administrations and operators to ensure compliance with the respective usage conditions. MNOs' MFCN licenses specifically allow any conditions to be set, if needed, to protect existing use, such as protection/coordination zones. MFCNs network details are planned in advance, potential aggregate interference can be known well in advance, any restrictions

imposed by the coordination process can be readily implemented by the MFCN operators

A.1.1.23 *Views related to FS by a MFCN introduction*

View 1:

- Problematic interferences expected from MFCNs, particularly in the case of macro-cellular deployment
- The protection of FS links could require such large separation distances that sharing might not be feasible. WRC-23 studies showed the need for 10s to 100s km separation distances. Further studies would be beneficial
- Potential need to migrate FS links to other ranges: higher bands (e.g. 10 GHz) cannot be used as they are not suitable for covering the same distances. There would be, at least, the need to include intermediate links (depending on the frequency in use) with consequences in terms of environmental, energy and economic impacts

View 2

- Whether the U6 GHz is assigned for use by RLAN/Wi-Fi or MFCN, there will be a need for coordination with FS links in the same geographic area, including through the use of geographic and/or frequency separation, and in some cases migration to other bands (with the 2025-2030 timeframe in mind). Coordination can be performed more readily and reliably in the case of MFCNs,
- U6 GHz is used for long-hops links, meaning that only one link is expected to be in the same area as the MFCN large scale deployments, enabling both services to remain in the band with coordination. Since MFCN demand is typically highest in populated urban/suburban areas, coexistence with FS may be feasible. FS links are generally deployed as elevated highly directional P2P radio beams between a transmitter and a receiver
- Regulators can evaluate and consult on the respective use and demands of services before deciding on license conditions and timelines
- More granular levels of coordination and management are possible for FS links managed by MNOs. MNOs accept that there will be some links where coexistence with mobile deployment may be more challenging, at least in the short term. MNOs expect to replace FS links in U6 GHz band with other solutions, e.g. fibre, other FS bands, where and when needed
- Studies agreed towards WRC-23 reflect that separation distances between 1-10 km are needed for the FS side lobe interference scenario, and up to several tens of kilometres (fixed link mainlobe: for an unmanaged, uncoordinated, worst-case scenario - where an MFCN BS transmitter, also using narrow beams to direct signals to users on the ground, may have a beam pointing directly to the FS receiver)

A.1.1.24 *Views related to FS by a WAS/RLAN introduction*

View 1:

- RLAN/Wi-Fi operate typically on license-exempt spectrum with low power. Demand is mainly in populated areas whereas FS links are primarily in less populated areas, and therefore the impacts might be low

View 2:

- Coordination would not be possible for the end-users of licence-exempt RLAN/Wi-Fi equipment, and would need to be implemented via appropriate automated coordination databases with the ability to leverage information provided to them on the locations and characteristics of the RLAN/Wi-Fi equipment. In reality it is impossible to ensure the use is as allowed (e.g. LPI, VLP outdoors)
- As the adoption of RLAN/Wi-Fi in the U6 GHz band increases, particularly in densely populated areas, FS services are more likely to experience interference from nearby RLAN/Wi-Fi devices
- E.g. RLAN/Wi-Fi interferences to Meteorological radars in 5 GHz are being discussed in ECC
- Measurements discussed at ECC SE45 suggest that pulsed/bursty signals of the type transmitted by Wi-Fi equipment may have a greater harmful impact than continuous/noise-like signals of equal power
- Work is ongoing in ECC SE19 (WI SE19_49) to provide a generic methodology for deriving protection criteria for any source of time-varying interference to an FS receiver
- In the US, there are several FCC filings on RLAN/Wi-Fi interference in the 6 GHz band

A.1.1.25 *Views related to FSS by a MFCN introduction*

- MFCN BS e.i.r.p. and the projected number of deployed BSs presented in ECC PT1 are significantly higher than those assumed in the studies preceding WRC-23. Limits defined for mitigation techniques such as the MFCN “expected e.i.r.p. mask” which depend on the number of deployed BSs would have to be re-assessed

A.1.1.26 *Views related to RAS by a MFCN introduction*

- As the methanol maser frequency is fixed by nature, it is not possible to shift the observing band to other frequencies (unlike EESS)
- Minimum separation distances, which would be required for the protection of RAS observations, are large. For the in-band sharing scenario, several 100s km may be necessary and at least several 10s km for adjacent frequencies or in the spurious domain. Therefore, any coordination between RAS and MFCN could not be addressed at national level only

A.1.1.27 *Views related to EESS by a MFCN and WAS/RLAN introduction*

- The introduction of MFCN and/or RLAN/Wi-Fi is expected to have a negative impact on our current usage of this frequency band
- The WRC-23 ECP for AI 1.2 recognises the potential degradation to SST measurements and thus to the prediction of major climatic events: Some studies submitted to ITU R WP 7C indicate that the introduction of high-density deployments of applications in the mobile service in the U6 GHz band, depending upon the application, could interfere with SST measurements in locations up to several thousand kilometres from the coast

A.1.1.28 *Views related to UWB by a MFCN introduction*

- The introduction of MFCN in the U6 GHz band would not allow the reliable implementation of UWB in Channel 5. Due to the fact that UWB devices operate at extremely low power levels (at the maximum UWB mean e.i.r.p. spectral density of -41.3 dBm/MHz and maximum peak e.i.r.p. of 0 dBm), making them highly susceptible to interference from higher-power systems. Impulse radio signals are comprised of pulse durations in the order of a nanosecond, typically transmitted in short bursts with gaps between pulses
- Ch. 9, the "last remaining band", is also threatened by a potential MFCN identification in WRC-27 AI 1.7
- Transmit power of MFCN limits may be between 61 and 65 dBm/(5 MHz). Thus MFCN power spectral density may be cs. 50 dB higher than RLAN/Wi-Fi, and 100 dB higher than UWB

A.1.1.29 *Views related to UWB by a WAS/RLAN introduction*

- Transmit power of RLAN devices are maximum e.i.r.p of 23 dBm with maximum mean e.i.r.p spectral density of 10 dBm/MHz
- It has been demonstrated that UWB can coexist with 802.11 RLANs effectively when transmit power is reasonable and sufficient separation in space is provided, there are gaps in the Wi-Fi transmissions, and mitigations are taken by the UWB device to detect the RLAN/Wi-Fi

A.1.8 Measures that could improve compatibility

A.1.1.30 *Measures that could improve the compatibility between FS and MFCN*

View 1:

- RSPG suggested to the EC and Member States to overcome MFCN spectrum fragmentations and evaluate the phase-out of legacy MFCN technologies in the next 10 years rather than requesting additional spectrum
- Migration of FS links to other bands with suitable characteristics is very complex

- Coordination mechanism will need be defined allowing new services to coexist with incumbents, prioritising continuity of service
- Need to finalize studies in ITU before taking decisions

View 2:

- FS links and Mobile network coexistence can be handled through coordination and/or geographic separation. Regulators can specify through licence conditions where and when MNOs can deploy BSs, and through knowledge of BSs and FS links locations can identify potential sources of interference and take any mitigating action
- Some of the findings from the ECC Report 303 ("toolbox") providing mechanisms which allow for continued FS operation in the 26 GHz pioneer band, where appropriate could be also relevant for the U6 GHz band and help achieving coexistence.
- One leading MNO expects to replace FS links in U6 GHz band with other solutions/bands or even reconfigure their fixed network topology in specific circumstances where and when needed to facilitate MFCN demands. Growing availability of fibre in urban areas in particular may decrease the need for wireless backhauling in urban areas. The vast majority of sites in urban areas in Europe are already connected via Fibre or other FS backhaul solutions not using the U6 GHz band
- A framework for the gradual migration of existing spectrum use should be considered, including identifying alternative spectrum for relocating current users and assessing the hardware capabilities of existing backhaul deployments to allow for relocation within the band, enabling partial and gradual spectrum clearance

A.1.1.31 *Measures that could improve the compatibility between FS and WAS/RLAN*

- No measures can improve compatibility as the main issue of locations unknown remains

A.1.1.32 *Measures that could improve the compatibility between FSS UL and MFCN*

- FSS UL operations shall be guaranteed without imposing any limitation to the future deployment of the FSS networks
- Need to develop a European regulatory framework for the use of the U6 GHz band to ensure unrestrained long-term operation of FSS with a clear indication of all the required mitigation measures, considering the available results from CEPT studies

A.1.1.33 *Measures that could improve the compatibility between RAS and MFCN*

- Separation distances and the dependency on the following factors / potential mitigation measures is being investigated in ITU-R WP7D
  1. Clutter loss

2. Location of RAS observatories (ideally in remote locations with some level of natural terrain shielding). In practice this can only apply to new observatories and, unfortunately, some of the already-established European RAS facilities are in rather open terrain
3. MFCN AAS equipment beam forming to minimise the radiated power towards the radio telescopes
4. So far, studies have revealed that BSs have a much higher interference potential than UE. Thus, one possibility would be to also limit or coordinate the use of DL channels in the RAS frequency band and manage the deployment of BSs near RAS stations

A.1.1.34 *Measures that could improve the compatibility between EESS (passive) / SST and MFCN*

- Due to the expected interference in the 6-7 GHz range, WRC-27 AI 1.19 considers possible new primary allocations to EESS (passive) in the 4.2-4.4 and 8.4-8.5 GHz bands. It is expected that these two new frequency bands would complement the observations performed in the 6-7 GHz range and provide, thanks to channel diversity, some degree of mitigation to the received interference

A.1.1.35 *Measures that could improve the compatibility between UWB and MFCN*

- It is strongly recommended to preserve UWB channel 9 as a safe-haven for UWB, especially from a perspective of a potential MFCN identification of the 7/8 GHz at WRC-27 under AI 1.7
- Potential measures
  1. Encourage “using only what you need” through regulatory incentives: This can promote innovation that enables new users to share with existing users and improve the overall efficiency of spectrum use
  2. Consider power limitations
  3. Consider Time Domain Gaps: duty cycle restrictions to provide silent periods during which UWB can slot its transmissions
  4. Intelligent Spectrum Usage and Sharing (ISUS): sensing the current spectrum usage and radio service activities in micro geo environments to adapt in ways that avoid causing harmful impacts to other spectrum users.
  5. Predictive Intelligent Spectrum Usage and Sharing (PISUS): deploying AI based prediction of spectrum usage and radio service deployment depending on the daytime, the week day / calendar day (public holidays etc.) and geo location including the business and public surroundings

A.1.1.36 *Measures that could improve the compatibility between UWB and WAS/RLAN*

- RLAN power levels indoors and activity factors can be made more compatible with UWB
- Ongoing work in IEEE 802 is developing new techniques to improve coexistence performance both ways