



CEPT Report 68

Report B from CEPT to the European Commission in response to the Mandate

“to develop harmonised technical conditions for spectrum use in support of the introduction of next-generation (5G) terrestrial wireless systems in the Union”

Harmonised technical conditions for the 24.25-27.5 GHz ('26 GHz') frequency band

Report approved on 6 July 2018 by the ECC

0 EXECUTIVE SUMMARY

This report addresses Tasks 2 and 3 of the EC Mandate to CEPT to develop harmonised technical conditions for 5G (report B of the EC mandate – see Annex 1).

The technical conditions identified in this Report address sharing and compatibility conditions to ensure protection of other users of spectrum in the 24.25-27.5 GHz frequency band (e.g. EESS/SRS and FSS earth stations) and in adjacent bands (EESS(passive)).

CEPT intends to assess the evolution of WBB ECS system characteristics, including network deployments, within a 5 year timeline, so as to be able to provide additional confidence that such evolution will continue to ensure the adequate protection of other services, in particular space services. A CEPT toolbox will provide information on how to manage coexistence issue at national level with Fixed Links. The possibility to continue to operate fixed links in the band on a shared basis with 5G at national level will depend on the potential mitigation techniques, national coordination, practicality and the extent of 5G deployment, subject to market demand, particularly in less-populated and rural areas.

It is also highlighted that Member States need to maintain, with appropriate provisions in their authorisation for WBB ECS, the possibility for existing and future EESS/SRS receiving earth stations in the 25.5-27 GHz band and FSS transmitting earth stations in the 24.25-25.25 GHz to be used in their respective bands and to safeguard their future operations taking into account the Radio Regulations. Relevant methodologies to assess the coexistence of these earth stations with WBB ECS deployments will be addressed in CEPT in order to aid the process, through the definition of suitable separation/coordination areas around earth stations and/or any other solutions.

The technical conditions as proposed in this CEPT report have been developed on the basis of assumption of an individual authorisation regime. Individual authorisation can cover both nationwide licensing and licensing on a smaller geographic basis than nationwide. At this stage, no technical conditions have been determined that would allow for the possibility of a general authorisation regime under sharing conditions in a way to ensure protection of the other users of spectrum in this band (in particular EESS/SRS earth stations). Also, the compatibility studies were only considering WBB ECS networks used for connections on the ground and did not address the use of UAV and drones connectivity. The use of these UAV and drones within WBB ECS networks could have an impact on the compatibility with existing services and hence connectivity from base stations to terminals on board UAV shall be prohibited in the 24.25-27.5 GHz band and only communications for connectivity from terminals on-board UAV to base stations are authorised. In addition, the connectivity from terminals on board UAV to base stations may have a significant impact, e.g. on separation distance from EESS/SRS earth stations, which requires further study. These UAV operations should not be an obstacle to the deployment of future EESS/SRS earth stations.

CEPT supports the current bilateral cross-border coordination process between relevant CEPT countries.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
5GPPP	5G Public Private Partnership
AAS	Active Antenna System
ACEA	European Automobile Manufacturers Association
BEM	Block Edge Mask
BS	Base Station
CEPT	European Conference of Postal and Telecommunications Administrations
DRS	Data Relay System
EC	European Commission
ECC	Electronic Communications Committee
EDRS	European Data Relay System
EU	European Union
EESS	Earth Exploration Satellite Service
ETSI	European Telecommunications Standards Institute
ESA	European Space Agency
FSS	Fixed-Satellite Service
GSO	Geostationary Satellite Orbit
IMT	International Mobile Telecommunications
ISS	Inter-Satellite Service
ITU-R	International Telecommunication Union-Radiocommunication
LEO	Low Earth Orbit
MEO	Medium Earth Orbit
mMTC	Massive Machine-Type Communications
NGSO	Non-geostationary satellite orbit
RAS	Radio Astronomy Service
RSPG	Radio Spectrum Policy Group
SRD	Short Range Device
SRR	Short Range Radar
SRS	Space Research Service
TS	Terminal Station
UAV	Unmanned Aerial Vehicle
URLLC	Ultra-Reliable and Low Latency Communications
UWB	Ultra Wide-Band
WBB ECS	Wireless Broadband Electronic Communications Service

WLAM Wideband Low Activity Mode
WRC World Radiocommunication Conference

1 INTRODUCTION

This report addresses Tasks 2 and 3 of the EC Mandate to CEPT to develop harmonised technical conditions for 5G (report B of the EC mandate – see Annex 1):

“2. Study and assess the 24.25-27.5 GHz ('26 GHz') frequency band as a 5G pioneer band for use under relevant 5G usage scenarios taking into account the co-existence issues highlighted in the RSPG opinion with respect to fixed links, earth exploration satellite and space research services, fixed satellite services, data relay satellite systems and passive services in the frequency band 23.6-24 GHz. In this regard, identify and study common sharing scenarios with incumbent radio services and applications, for which future demand has been identified.

3. Develop channelling arrangements and common and minimal (least restrictive) technical conditions for spectrum use in the **26 GHz frequency band**, which are suitable for 5G terrestrial wireless systems, in conjunction with relevant usage and sharing scenarios. In this regard, develop harmonised technical conditions to ensure spectrum usage on a shared basis, including protection conditions where necessary, pursuant to the sharing scenarios identified under Task 2, in close cooperation with all concerned stakeholders. These conditions should be sufficient to mitigate interference and ensure co-existence with incumbent radio services/applications in the same band or in adjacent bands, in line with their regulatory status, including at the EU outer borders.”

This CEPT Report provides an overview of existing use in 24.25-27.5 GHz and in adjacent bands, describes the relevant 5G characteristics and analyses the various coexistence issues in the band and adjacent bands. It assesses requirements for cross-border coordination, wherever relevant, including at the EU outer borders.

The relevant technical conditions to be included in the future EC Decision 26 GHz under the Radio Spectrum Decision [1] are provided in Annex 2.

2 EXISTING USE OF 24.25-27.5 GHZ AND ADJACENT BANDS

This band is mainly allocated to fixed links across CEPT. Other usages in the band include EESS, SRS, FSS, ISS (including European data relay system, EDRS) as well as passive services in adjacent band 23.6-24 GHz

In some EU Member States there could have heavy usage (>1000 links or nationwide licences), or intensive usage (more than 18000 links) for fixed links (mainly point-to-point, some point-to-multipoint). Fixed link usage is generally noted as nationwide with higher concentrations in urban areas. Those fixed services support the development of Mobile Broadband and also some governmental usage, in particular in the upper 1 GHz (26.5-27.5 GHz). Fixed services are subject to national authorisations which vary in terms of duration. In some cases, authorisations could have indefinite expiry dates. Besides this authorisation, national coordination processes and bi- and multi-lateral cross-border coordination processes are in place.

Short range devices are also operating under general authorisation in the following bands according to current EC framework:

- 24.25-26.65 GHz “SRR 24 GHz – short range radars”

According to the EC framework, the band 24.25–26.65 GHz is no longer available for automotive short-range radar since 1 January 2018, except during the next 4 years for automotive short-range radar equipment mounted on motor vehicles for which a type-approval application has been submitted pursuant to Article 6(6) of Directive 2007/46/EC of the European Parliament and of the Council [3] and has been granted before 1 January 2018.

CEPT noted that the current automotive SRR market is now massively targeting 79 GHz only, in line with current EC Framework.

- 24.25-27 GHz-Radio determination devices (Tank Level Probing Radar)
- 24.25-26.5 GHz-Radio determination devices (Level Probing Radars)

These above usages are “underlay” as UWB (ultra wide band) technologies involving the intentional generation and transmission of radio-frequency energy that spreads over a very large frequency range, which may overlap several frequency bands allocated to radiocommunication services. They should be able to adapt to any evolution of regulatory framework for radiocommunication services.

- 24.25-24.5 GHz for automotive radars under SRD regulatory framework.

During the review done under the ongoing 7th SRD update, CEPT identifies that WLAM (Wideband Low Activity Mode) in the band 24.25 GHz to 24.50 GHz is not used and also not planned to be used in the future. Automotive radar applications increasingly move towards the frequency range 76-81 GHz (79 GHz). CEPT is currently waiting feedback from ACEA and ETSI on the current and future use of WLAM in the band 24.25-24.50 GHz. If there are no WLAM applications in the market, CEPT intends to withdraw these opportunities from the ERC/REC 70-03 [4] as well as EC Decision for SRD (2017/1438/EU) [5].

The Amateur and Amateur Satellite services have primary allocations from 24.0 GHz to 24.05 GHz and the Amateur service has a secondary allocation in the range 24.05 GHz to 24.25 GHz. Amateur applications and experimentation generally involve weak signal reception from both terrestrial and space borne sources.

Further information about the other usages in the band is included in section 5 on “Coexistence issues”.

3 5G CHARACTERISTICS

3.1 5G USAGE SCENARIOS IN 24.25-27.5 GHZ

There will be a progressive introduction of 5G services in 26 GHz in EU Member States. 5G will be introduced before 2020 in EU Member States (at least in one main city).

5G networks will not only be used to provide faster mobile broadband. They intend also to provide also massive machine-type communications (mMTC) and Ultra-Reliable and Low Latency Communications (URLLC) (see 5GPPP).

In the 26 GHz, 5G services will mainly target urban areas and suburban hotspot areas even if some few deployments in dedicated locations or along major roads and railway tracks could be foreseen in rural areas. This frequency band does not present the characteristics to support a national coverage objective and wide coverage areas. There is no expectation that the bands above 24 GHz will be used for contiguous nationwide coverage of wireless broadband electronic communications services (WBB ECS) networks. There may be a need for hotspots also in rural areas e.g. dedicated locations or along major roads and railway tracks. The deployment of WBB ECS will target only cells with a small range deployed indoor and/or outdoor.

26 GHz networks will benefit from technologies with wider radio channels than in other previously harmonised bands in the EU.

3.2 5G PARAMETERS USED IN SHARING STUDIES

The characteristics of 5G systems used in the sharing studies are those used in the ITU preparatory work for WRC-19 agenda item 1.13, in particular in ITU-R Recommendation M.2101 “Modelling and simulation of IMT networks and systems in sharing and compatibility studies” [6].

3.3 DEFINITION OF TOTAL RADIATED POWER (TRP)

TRP is defined as the integral of the power transmitted in different directions over the entire radiation sphere as shown in the expression below.

$$TRP \stackrel{\text{def}}{=} \frac{1}{4\pi} \int_0^{2\pi} \int_0^{\pi} P(\theta, \varphi) \sin(\theta) d\theta d\varphi \quad (1)$$

where

- TRP is equal to the total conducted power input into the antenna array system less any losses in the antenna array system;
- $P(\theta, \varphi)$: power radiated by an antenna array system in direction (θ, φ) .

$$P(\theta, \varphi) = P_{Tx} g(\theta, \varphi) \quad (2)$$

where

- P_{Tx} : conducted power (Watts) input to the array system;
- $g(\theta, \varphi)$: array systems directional gain along (θ, φ) direction.

The maximum EIRP for an active antenna system (AAS) base station can be written in log domain as follows:

$$EIRP_{max} = TRP + G_E + 10\log_{10} N \quad (3)$$

where G_E is the antenna element gain in dBi, and N is the number of beam forming elements.

3.4 UNSYNCHRONISED AND SEMI-SYNCHRONISED NETWORKS

For cases other than synchronised WBB ECS operations, if no geographic separation between these WBB ECS networks is available, a restricted baseline applies. Less stringent technical parameters, if agreed among the operators of such networks, may also be used. In addition, depending on national circumstances, Member States may define relaxed baseline limit applying to specific implementation cases. CEPT is developing a toolbox for coexistence of WBB ECS in unsynchronised and semi-synchronised mode to help either network operators or Member States to address relevant coexistence issues.

4 COEXISTENCE ISSUES

4.1 FIXED LINKS

CEPT is currently developing a “toolbox” (target date: October 2018) to help the national decision/application process supporting the introduction of 5G in 26 GHz where Fixed Service is in operation, providing mechanisms which allow for continued Fixed Service operation, where necessary.

Due to the nature of 5G services and 5G market demands, there is a need to address the operation of fixed services in that band while introducing 5G. Any migration issues are to be managed at national level and are subject to a national decision. Co-channel deployment of 5G with fixed links remains possible depending on national situations. There is no need to define a common date for management of a migration to an alternative band or to clear the 26 GHz band from fixed services. Due to the nature of fixed service bi- or multi-lateral cross-border coordination may be necessary.

EU Member States are able to manage this coexistence issue at national level according to market demands. Even if there may be a national target to clear the 26 GHz band, this could take time and the EU Framework should allow the possibility for EU member States to manage this fixed services/5G coexistence.

In response to the need of the different market players, flexibility in timescales for release of the 26 GHz band is important to minimise the overall costs associated with 5G deployment and to ensure a balance of the burden between both services.

The possibility to continue to operate fixed links in the band on a shared basis with 5G will depend on the potential mitigation techniques, national coordination, practicality and the extent of 5G deployment, subject to market demand, particularly in less-populated and rural areas.

4.2 EARTH EXPLORATION SATELLITE SERVICE, SPACE RESEARCH SERVICE, FIXED-SATELLITE SERVICE, INTER-SATELLITE SERVICE

Within 24.25-27.5 GHz, two sub-bands are relevant for space and satellite services:

- 25.5-27 GHz allocated to EESS/SRS (space-to-Earth) and which is used or planned to be used in various ESA Science and Earth observation programmes, EC Copernicus programme, EUMETSAT programs and future Earth observation missions requiring to download high volumes of payload data.
- 24.65-25.25 GHz allocated to FSS (Earth-to-space), with minimum antenna diameter of 4.5 m

For EESS/SRS, the interference issue is from 5G networks into earth stations, while for FSS the interference issue is from earth stations into 5G networks.

4.2.1 Earth Exploration Satellite Service and Space Research Service

The band 25.5-27 GHz will extensively be used by GSO and non-GSO meteorological satellites that will transmit raw instrument data in this frequency band. These satellites have been agreed through European meteorological programs and the usage of this band is a key strategic priority to retrieve data for atmospheric physics, environmental and climatic issues. In addition, these data are available in each European country for their respective national meteorological/environment agency.

EESS/SRS earth stations in the 25.5-27 GHz frequency band will nevertheless remain limited in number. However, appropriate provisions are needed in the authorisation for 5G to define precisely how existing and future earth stations will be protected and how future earth stations will continue to have the opportunity to be installed in order to safeguard in a proportionate way the possibility for future deployment in this frequency band.

The impact of EESS/SRS earth stations on the deployment of 5G networks could be minimised if they are deployed away from major conurbations, which is the case of most current and planned earth stations. It has to be noted that the use of the 25.5-27.0 GHz band by EESS systems is now in an early phase, therefore the deployment model (number and location) of future EESS receiving earth stations in Europe is not consolidated at this stage. There is also a need to maintain the possibility for additional earth stations to be deployed in the EU Members States when needed.

EU Member States need to maintain, with appropriate provisions in their authorisation for WBB ECS, the possibility for existing and future EESS/SRS earth stations to use the 25.5-27 GHz band and to safeguard their future operations; They shall define how existing, planned and future earth stations will continue to operate or have the opportunity to be installed without significant impact on 5G deployment.

In the case of EESS/SRS receiving earth stations, this impact might be in terms of a geographical area around the earth station where 5G deployment may need to be constrained to protect the receiving earth station (e.g. by restricting the maximum base station transmit power towards the earth station, restricting 5G deployments).

CEPT has performed technical studies to determine the impact of EESS/SRS protection on 5G deployment in areas around existing EESS/SRS earth stations showing that, assuming an IMT BS eirp of 48 dBm/200 MHz, the separation distances around several EESS/SRS earth stations locations within Europe would be in the order of:

- 4 km around earth stations supporting NGSO EESS satellites;
- 10 km around earth stations supporting GSO EESS satellites;
- 25 to 70 km around the two earth stations supporting SRS spacecraft in Europe (90 km for the ESA station in Malargüe in Argentina).

Relevant methodologies described in an ECC recommendation is under development by CEPT for national implementation to ensure coexistence between 5G networks and EESS/SRS earth stations.

4.2.2 Fixed-Satellite Service

FSS earth stations

The number of FSS earth stations in the 24.65-25.25 GHz frequency band will remain limited, given the applicable regulatory conditions for these services (minimum antenna diameter of 4.5m). Future earth stations should be authorised based on transparent, objective and proportionate criteria to safeguard their future operations and ensuring that they are unlikely to have a significant impact on 5G deployment and coverage. Member States will remain fully responsible for granting or rejecting authorisation to a new satellite earth station application.

Protection of FSS satellite

Studies have shown that coexistence with FSS satellites is feasible (aggregate interference from 5G base stations to GSO FSS satellites will likely fall within the protection criteria for GSO FSS with a large margin) when considering the assumed technical and operational characteristics for 5G. CEPT intends to assess the evolution of WBB ECS system characteristics, including network deployments, in a 5 year timeline, so as to be able to provide additional confidence that such evolution will continue to ensure the adequate protection of other services, in particular space services.

In addition, the harmonised technical conditions include a general provision requiring that outdoor base station deployments shall ensure that the antenna beam is normally below the horizon and outdoor base station shall not have mechanical pointing above the horizon. This would help preventing having 5G base stations with antenna pointing directly towards the sky which, in case there are many such deployments, would significantly increase the interference potential to FSS.

4.2.3 Conclusions

The impact of an EESS/SRS and FSS earth station will be limited to a specific sub-band: i.e. 1.5 GHz for EESS/SRS (25.5-27 GHz) and a maximum of 600 MHz for FSS (24.65-25.25 GHz). In order to ensure that existing and future earth station requirements could be accounted for when granting 5G authorisations, or after they have been granted, EU Member States need to include adequate provisions in their authorisations. However, since the regulatory solutions are likely to vary from country to country, a certain level of flexibility may be necessary at the EU level.

If necessary, any impact could be mitigated by various measures (e.g. requiring an operator with fewer constraints to share access with others, or ensuring frequencies in areas potentially impacted are distributed among operators appropriately). CEPT is developing relevant methodologies described in ECC Recommendations for national implementation to ensure coexistence between 5G networks and EESS/SRS and FSS earth stations.

The technical conditions as proposed in this CEPT report have been developed on the basis of assumption of an individual authorisation regime. Individual authorisation can cover both nationwide licensing and licensing on a smaller geographic basis than nationwide. At this stage, no technical conditions have been determined that would allow for the possibility of a general authorisation regime under sharing conditions in a way to ensure protection of the other users of spectrum in this band (in particular EESS/SRS earth stations).

4.3 DATA RELAY SATELLITE SYSTEMS

Satellite data relay systems (including EDRS - European Data Relay System) operate in 25.25-27.5 GHz. These Inter-Satellite Service (ISS) systems ensure inter-orbital communications between LEO and GEO satellites.

In the figure below the band 25.25-27.25 GHz is used by the link F between NGSO satellites (C) and the DRS satellite (A).

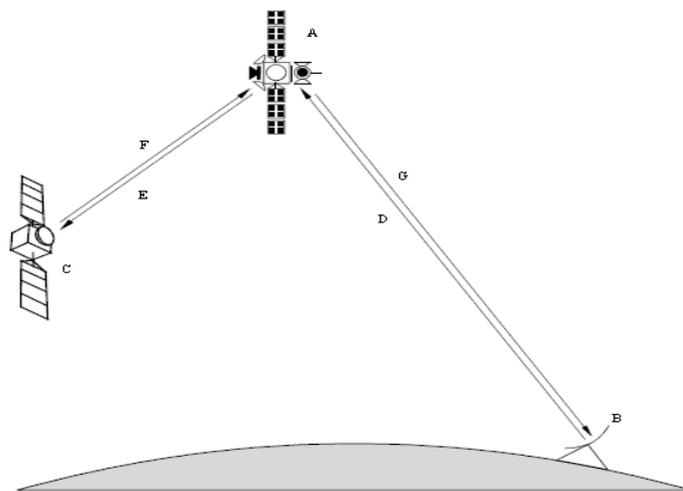


Figure 1: ISS communications overview

Studies have shown that coexistence with satellite data relay systems (including EDRS) is feasible with a large protection margin when considering the assumed technical and operational characteristics for 5G.

In addition, the harmonised technical conditions include a general provision requiring that outdoor base station deployments shall ensure that the antenna beam is normally below the horizon and outdoor base stations shall not have mechanical pointing above the horizon. This would help preventing having 5G base stations with antenna pointing directly towards the sky which, in case there are many such deployments, would significantly increase the interference potential to ISS.

4.4 PASSIVE SERVICES

A range of environmental information is obtained through passive sensing measurements, performed in multiple frequency bands that uniquely correspond to resonances of important atmospheric molecules and which cannot be changed as they are fixed by nature. Most of these bands are covered by RR No 5.340 [9] prohibiting all emissions in that bands. These passive microwave sensors are indispensable for observations of weather and climate from space, requiring access to uncontaminated frequency bands that each provides essential information on specific phenomenology. By nature, passive microwave sensors are particularly sensitive to man-made emissions produced by active services. In the case of frequency bands covered by RR No 5.340, only unwanted emissions are expected.

A number of these EESS (passive) sensors operate in the 23.6-24 GHz in various ESA science and Earth observation programmes, EC Copernicus programme and EUMETSAT programs.

It is hence of utmost importance to limit 5G base stations/user equipment unwanted emissions into these passive sensing frequency bands to relevant levels required to protect these EESS (passive) sensors.

Extensive studies have been performed in CEPT to determine appropriate out-of-band emissions limits in the 23.6-24 GHz band to be applied to 5G stations operating in the band 24.25-27.5 GHz to ensure the protection of (EESS) passive sensors. For the protection of EESS (passive), considering all these studies, CEPT concluded on limits of -42 dBW/200 MHz for 5G Base Stations and -38 dBW/200MHz for 5G User Equipment. These limits have been implemented in the harmonised technical conditions applicable to 5G base stations and User equipment (see Annex 2).

For protection of radio astronomy, generic compatibility studies between RAS in the passive band 23.6-24 GHz and IMT systems in the frequency band 24.25-27.5 GHz show emission-free zones around RAS stations are required to protect this service from IMT unwanted emissions. These would be managed on a national basis and the size of the zone would be dependent on the IMT unwanted emission limits into the 23.6-24 GHz band and local environment.

5 CONCLUSIONS

The technical conditions in this Report address sharing and compatibility conditions to ensure protection of other users of spectrum in the 24.25-27.5 GHz frequency band (e.g. EESS/SRS and FSS earth stations), in adjacent bands (EESS (passive)).

The technical conditions for co-existence between adjacent WBB ECS systems in the 26 GHz band have been developed based on the main assumption of synchronised operation.

CEPT intends to assess the evolution of WBB ECS system characteristics, including network deployments, within a 5 year timeframe, so as to be able to provide additional confidence that such evolution will continue to ensure the adequate protection of other services, in particular space services. A CEPT toolbox will provide information on how to manage coexistence issue at national level with fixed links. The possibility to continue to operate fixed links in the band on a shared basis with 5G will depend on the potential mitigation techniques, national coordination and the extent of 5G deployment, subject to market demand, particularly in less-populated and rural areas.

It is also highlighted that Member States need to maintain, with appropriate provisions in their authorisation for WBB ECS, the possibility for existing and future EESS/SRS receiving earth stations in the 25.5-27 GHz band and FSS transmitting earth stations in the 24.25-25.25 GHz to be used in their respective bands and to safeguard their future operations taking into account the Radio Regulations. Relevant methodologies to assess the coexistence of these earth stations with WBB ECS deployments will be addressed in CEPT in order to aid the process, through the definition of suitable separation/coordination areas around earth stations and/or any other solutions.

The technical conditions as proposed in this CEPT report have been developed on the basis of assumption of an individual authorisation regime. Individual authorisations can cover both nationwide licensing and licensing on a smaller geographic basis than nationwide. At this stage, no technical conditions have been determined that would allow for the possibility of a general authorisation regime under sharing conditions in a way to ensure protection of the other users of spectrum in this band (in particular EESS/SRS earth stations). Also, the compatibility studies only considered WBB ECS networks used for connections on the ground and did not address the use of UAV and drones connectivity. The use of these UAV and drones within WBB ECS networks could have an impact on the compatibility with existing services and hence connectivity from base stations to terminals on board UAV shall be prohibited in the 24.25-27.5 GHz band and only communications for connectivity from terminals on-board UAV to base stations are authorised. In addition, the connectivity from terminals on board UAV to base stations may have a significant impact, e.g. on separation distance from EESS/SRS earth stations, which requires further study. These UAV operations should not be an obstacle to the deployment of future EESS/SRS earth stations

CEPT supports the current bilateral cross-border coordination process between relevant CEPT countries

ANNEX 1: CEPT MANDATE



EUROPEAN COMMISSION

Communications Networks Content & Technology Directorate-General

Electronic Communications Networks & Services
Spectrum

Brussels, 7 December 2016

DG CONNECT/B4

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PUBLIC

RADIO SPECTRUM COMMITTEE

Working Document

**Opinion of the RSC
pursuant to Advisory Procedure under Article 4 of Regulation
182/2011/EU and Article 4.2 of Radio Spectrum Decision 676/2002/EC**

Subject: Mandate to CEPT to develop harmonised technical conditions for spectrum use in support of the introduction of next-generation (5G) terrestrial wireless systems in the Union

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MANDATE TO CEPT

TO DEVELOP HARMONISED TECHNICAL CONDITIONS FOR SPECTRUM USE IN SUPPORT OF THE INTRODUCTION OF NEXT-GENERATION (5G) TERRESTRIAL WIRELESS SYSTEMS IN THE UNION

1. PURPOSE

This Mandate should deliver harmonised technical conditions, including sharing conditions wherever needed, which are suitable for the initial launch (by the year 2020) of next-generation (5G) terrestrial wireless systems in the Union, in selected frequency bands. These conditions should comply with the overarching Union spectrum policy principles of technology and service neutrality and efficient use. In particular, they should ensure the (continued) provision of wireless broadband electronic communications services including relevant 5G usage scenarios such as wireless broadband or the Internet of Things. 5G terrestrial wireless systems are likely to operate both, in existing EU-harmonised frequency bands below 6 GHz and in pioneer frequency bands above 24 GHz.

Timely availability of spectrum designated to 5G in the Union is key for keeping up with the pace of global 5G developments and early infrastructure deployment¹. Therefore, timely deliverables under this Mandate are needed with focus on early available ('pioneer') frequency bands, in order to enable their harmonisation and use for 5G terrestrial wireless systems in the Union. Depending on the evolving assessment of 5G spectrum needs at Union level as well as international developments, the Commission may consider one or more follow-up mandates to CEPT.

2. POLICY CONTEXT AND INPUTS

The ITU-R vision for the next-generation mobile telecommunications² outlines three major 5G usage scenarios for the time frame of 2020 and beyond – enhanced mobile broadband (eMBB), massive machine type communications (mMTC), and ultra-reliable and low latency communications (URLLC). Furthermore, WRC-15 initiated studies on a list of potential additional frequency bands for next-generation (5G) terrestrial wireless systems within the 24.25-86 GHz frequency range³, which should provide deliverables to enable WRC-19 to take a decision under agenda item 1.13 with a focus on global harmonisation.

The 5G Infrastructure Public Private Partnership (5G-PPP)⁴ was launched by the European Commission in 2013 with the goal to develop 5G communication systems and services for the provision of ubiquitous super-fast connectivity and seamless service delivery and thus to foster European leadership in technology and standardisation. The 5G-PPP Infrastructure Association (IA) has delivered concept papers⁵ on a 5G vision as well as on the significance of novel use cases

¹ For example, Korea, Japan or the USA. In this regard, the US regulator (FCC) adopted on 14 July 2016 a Report and Order on 5G spectrum above 24 GHz ("Spectrum Frontiers")

² In the ITU context of "International Mobile Telecommunications for 2020 (IMT2020)", s. ITU Recommendation: https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2083-0-201509-I!!PDF-E.pdf

³ ITU-R Resolution 238 (WRC-15)

⁴ See <https://5g-ppp.eu/>

⁵ See the 5G-PPP brochures: "5G vision" at <https://5g-ppp.eu/wp-content/uploads/2015/02/5G-Vision-Brochure-v1.pdf>, and "5G empowering vertical industries" at: https://5g-ppp.eu/wp-content/uploads/2016/02/BROCHURE_5PPP_BAT2_PL.pdf

originating from connectivity to specific vertical sectors (such as transport, healthcare or media). In terms of spectrum, the 5G-PPP IA emphasizes the need for very wide contiguous carrier bandwidths (e.g. hundreds of MHz up to several GHz) to be provided at a very high overall system capacity with focus on carrier frequencies above 6 GHz. Furthermore, vertical sectors are considered drivers of 5G requirements from the outset with high priority, in particular within frequency bands below 6 GHz. It is also recommended to consider any new bands for 5G use based on assessment and recognition of other services using, or planning to use, these bands. The 5G-PPP IA has liaised with the Radio Spectrum Policy Group (RSPG)⁶ regarding pioneer frequency bands for the Union.

In April 2016, the Commission adopted a package on the "Digitisation of the European Industry"⁷, which identified as a political priority for the Union use cases for next-generation wireless services in the context of the Internet of Things but also stressed the need to prepare the introduction of next-generation wireless broadband services. In September 2016, the Commission adopted its Communication to the Council and the European Parliament "5G for Europe: An Action Plan"⁸, which inter alia puts forward proposed actions on the EU-level identification and harmonisation of spectrum for 5G – pioneer frequency bands as well as additional bands – based on the opinion of the RSPG. The preparatory work for the 5G Action Plan drew on a major input from industry in the telecom and vertical sectors – the "5G Manifesto for timely deployment of 5G in Europe"⁹ – which includes recommendations on pioneer frequency bands for 5G use in consistency with the views of the 5G-PPP.

Therefore, next-generation (5G) terrestrial wireless systems should operate both, in existing EU-harmonised frequency bands below 6 GHz and in new frequency bands above 24 GHz. Potential hybrid business models using fixed or mobile terrestrial network infrastructure and satellite platforms may impact on spectrum use in 5G frequency bands above 24 GHz in the context of providing complementary or convergent services.

The following EU-harmonised frequency bands for terrestrial systems capable of providing wireless broadband electronic communications services are already potentially available for future 5G use:

- Below 1 GHz¹⁰: 694-790 MHz ('700 MHz band'), 790-862 MHz ('800 MHz band'), 880-915 MHz and 925-960 MHz ('900 MHz band').
- Above 1 GHz¹¹: 1452-1492 MHz ('1.5 GHz band'), 1710-1785 MHz and 1805-1880 MHz ('1800 MHz band'), 1920-1980 MHz and 2110-2170 MHz ('paired terrestrial 2 GHz band'), 2500-2690 MHz ('2.6 GHz band'), 3400-3800 MHz ('3.6 GHz band').

⁶ Document "Initiative on pioneer 5G bands" (8 July 2016) from the 5G-PPP to the RSPG public consultation on the Draft RSPG Opinion on spectrum related aspects for next-generation wireless systems (5G)

⁷ See <https://ec.europa.eu/digital-single-market/en/digitising-european-industry>

⁸ See: <https://ec.europa.eu/digital-single-market/en/5g-europe-action-plan>

⁹ Link: http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=16579

¹⁰ Subject to Commission Decisions (EU)2016/687 (700 MHz band), 2010/267/EU (800 MHz band), 2009/766/EC amended by 2011/251/EC (900 MHz band), 2014/641/EU (PMSE in the 800 MHz band)

¹¹ Subject to Commission Decisions (EU)2015/750 (1.5 GHz band), 2009/766/EC amended by 2011/251/EC (1800 MHz band), 2012/688/EU (paired terrestrial 2 GHz band), 2008/477/EC (2.6 GHz band), 2008/411/EC amended by 2014/276/EU (3.6 GHz band)

It should be noted that in all these frequency bands, with the exception of the 900 MHz and 1800 MHz bands, the harmonised technical conditions are based on the concept of block edge masks, in order to facilitate a technologically neutral approach and least restrictive conditions, which allows for the use of any technology that complies with the block edge mask. For the 900 MHz and 1800 MHz frequency bands, the harmonised technical conditions are based on specific technologies referenced through ETSI standards, which are evolving to enable 5G use.

EU-harmonised bands for wireless broadband electronic communications services are potentially to be used for providing amongst other services vehicle-to-anything (V2X) connectivity, machine-to-machine or other IoT applications, e.g. by means of cellular networks. In this regard, the Commission has adopted a Communication on European Strategy on Cooperative Intelligent Transport Systems¹².

In its "Strategic Roadmap towards 5G for Europe: Opinion on spectrum related aspects for next-generation wireless systems (5G)"¹³, the RSPG sets out its priorities and recommendations for pioneer frequency bands for the introduction of 5G terrestrial wireless systems in Europe as follows:

1. The RSPG considers the frequency band **3400-3800 MHz** to be the **primary band** suitable for the introduction of 5G-based services in Europe even **before 2020** given that it is already harmonised for mobile networks and offers wide channel bandwidth¹⁴.
2. The RSPG is of the opinion that 5G will need to be deployed also in bands already **harmonised below 1 GHz**, including particularly **the 700 MHz band**¹⁵, in order to enable nation-wide and indoor 5G coverage.
3. The RSPG recognises the need to ensure that technical and regulatory conditions for **all bands already harmonised** for mobile networks are **fit for 5G use**.
4. The RSPG recommends the **24.25-27.5 GHz** (hereinafter '26 GHz') band as a **pioneer band** for Europe to be harmonised before 2020.

Furthermore, the RSPG considers the 31.8-33.4 GHz band as a promising band, and the 40.5-43.5 GHz band as a viable option in the longer term, for 5G use.

The RSPG expresses a vision that 5G will drive industrial and societal transformation and economic growth in Europe from 2020 and beyond. The strategic roadmap aims to facilitate the launch of 5G on a large scale by 2020, thereby ensuring that the benefits of 5G-based services are available to all European citizens in a timely manner. The RSPG expects that the first major commercial deployments will be based on lower frequencies. One of the reasons is the possibility to reach rapidly a sufficient coverage for addressing enhanced broadband communications and, above all, the machine-type communications market, which may require ubiquity, low latency and low complexity. As regards candidate bands for 5G use above 6 GHz, the RSPG has limited its

¹² Commission Communication on European Strategy on Cooperative Intelligent Transport Systems (C-ITS) at: http://ec.europa.eu/transport/sites/transport/files/com20160766_en.pdf

¹³ Document RSPG16-032 FINAL of 9 November 2016

¹⁴ Ensuring regulatory predictability is important for this band taking into account the ongoing implementation of Decision 2014/276/EU across the Union

¹⁵ It should be noted that the 700 MHz band has been recently harmonised (Commission Decision 2016/687/EU of April 2016) and should remain stable in light of ongoing national award procedures between now and 2020.

consideration to the bands listed by WRC-15, focussing on the frequency bands proposed by Europe at WRC-15, in order to strengthen the global harmonisation opportunities. Therefore, enabling early availability of different pioneer frequency bands under harmonised technical conditions is of strategic importance for the Union for the introduction of commercial 5G services in Europe, possibly preceded by relevant trials and pilots.

The status of ITU-level spectrum allocations and the current use of potential frequency bands for 5G, in particular above 24 GHz, necessitate studies to assess **shared spectrum use** between 5G terrestrial wireless systems and existing or prospective incumbent use as well as compatibility studies with respect to adjacent bands. Sharing studies are of high relevance with respect to terrestrial backhaul or fixed satellite links, in particular with view to existing and future earth stations in the earth exploration satellite service (EESS), space research service (SRS), the fixed satellite service (FSS), and on-board receivers of data relay satellite systems (DRSS). In this regard, the RSPG provides recommendations on spectrum co-existence within the 26 GHz pioneer band, which are relevant for the development of technical conditions for shared spectrum use.

It should be noted that certain non-European countries have identified spectrum for 5G services on a national basis in frequency bands, which are adjacent to priority bands according to the RSPG opinion, most notably within the 27.5-29.5 GHz ('28 GHz') band¹⁶ or the 37-40 GHz band¹⁷. These developments should be taken into account in order to facilitate global interoperability and economies of scale of equipment based on the implementation of a common tuning range.

Therefore, comprehensive studies on the technical conditions for spectrum use in existing EU-harmonised frequency bands below 6 GHz and the pioneer band above 24 GHz¹⁸ for the introduction of 5G terrestrial wireless systems are necessary to enable deployment of evolving and new services and applications (under licensed or licence-exempt operation). These studies should be framed by the Union's policy strategy so as to provide an appropriate spectrum mix for various usage scenarios, to study co-existence scenarios with other radio services and to develop a European approach benefiting to the extent possible from global harmonisation. It is likely that results from the work at ITU level will deliver inputs to the studies under this Mandate¹⁹. In this regard, CEPT is already conducting studies on the pioneer 3.6 GHz and 26 GHz bands to assess harmonised technical conditions for 5G terrestrial wireless systems, as well as on potential extensions of the 1.5 GHz band.

3. JUSTIFICATION

Pursuant to Article 4(2) of the Radio Spectrum Decision²⁰ the Commission may issue mandates to the CEPT for the development of technical implementing measures with a view to ensuring harmonised conditions for the availability and efficient use of radio spectrum necessary for the functioning of the internal market. Such mandates shall set the tasks to be performed and their

¹⁶ A regulatory decision in the USA, according to the FCC's Spectrum Frontier Report and Order and Further Notice of Proposed Rulemaking of 14 July 2016 available at: <https://www.fcc.gov/document/spectrum-frontiers-ro-and-fnprm>; [Korea plans to use the 26.5-29.5 GHz band for early 5G trials in 2018](#)

¹⁷ A regulatory decision in the USA, according to the FCC's Spectrum Frontier Report and Order and Further Notice of Proposed Rulemaking of 14 July 2016; this band is also for study towards WRC-19

¹⁸ Ensuring regulatory predictability is important for the bands within the scope of the tasks of this mandate taking into account ongoing national award procedures until 2020

¹⁹ Linked to Article 1.3 of the Radio Spectrum Decision

²⁰ Decision 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, OJ L 108 of 24.4.2002

timetable. Pursuant to the Radio Spectrum Decision, activities under the Decision must facilitate policy making with regard to the strategic planning and harmonisation of radio spectrum use as well as ensure the effective implementation of radio spectrum policy in the EU while serving the aim of coordination of policy approaches. Furthermore, they shall take due account of the work of international organisations related to radio spectrum management²¹ (such as ITU).

The Radio Spectrum Policy Programme (RSPP) requires Member States, in cooperation with the Commission, to take all steps necessary to ensure that sufficient spectrum for coverage and capacity purposes is available within the Union, in order to enable the Union to have the fastest broadband speeds in the world, thereby making it possible for wireless applications and European leadership in new services to contribute effectively to economic growth, and to achieving the target for all citizens to have access to broadband speeds of not less than 30 Mbps by 2020. Furthermore, the RSPP calls on Member States and the Commission to ensure spectrum availability for the Internet of Things (IoT). The RSPP also stipulates that Member States, in cooperation with the Commission, shall, where appropriate, foster shared use of spectrum²².

Advances in international standardisation as well as rapid international developments regarding 5G trials and spectrum use until 2020 call for a swift and coordinated EU-level process on delivering sufficient and appropriate spectrum for 5G use in the Union according to anticipated deployment of 5G usage scenarios. Therefore, urgent action is needed in line with Union policy priorities and taking due account of relevant progress in international spectrum management to perform technical studies in order to develop harmonised technical conditions for spectrum use for the introduction of 5G terrestrial wireless systems.

4. TASK ORDER AND SCHEDULE

CEPT is herewith mandated to develop harmonised technical conditions for spectrum use of selected frequency bands, which is suitable for 5G terrestrial wireless systems, in compliance with the policy priorities set out in this Mandate. These conditions should allow the provisions of wireless broadband electronic communications services including 5G usage scenarios and take into account needs for shared spectrum use with existing or prospective incumbent uses. CEPT should give utmost consideration to overarching Union-level spectrum policy objectives²³ such as efficient spectrum use and take utmost account of applicable principles of Union law such as technological and service neutrality, non-discrimination and proportionality insofar as technically possible.

CEPT is requested to collaborate actively with the European Telecommunications Standardisation Institute (ETSI) which develops harmonised standards for conformity under the Radio Equipment Directive. In particular, CEPT should take into consideration emerging technologies and ETSI (harmonised) standards, which define 5G systems and facilitate shared spectrum use or foster economies of scale. Furthermore, CEPT is requested to take into account relevant developments at international level and to consider possible synergies.

When developing harmonised technical conditions, CEPT shall focus its efforts on the pioneer bands as identified in this Mandate and take due account of the relevant RSPG recommendations¹³ in respect to other radio services. More specifically, CEPT is mandated to perform the following

²¹ Article of Decision 676/2002/EC (Radio Spectrum Decision)

²² See Articles 6(1), 4(1) and 8(6) of the RSPP

²³ Enshrined in the RSPP and the Radio Spectrum Decision

tasks with view to creating sufficiently precise harmonised technical conditions for the development of EU-wide equipment for the introduction of 5G terrestrial wireless systems in the Union:

1. Review the harmonised technical conditions applicable to the **3.4-3.8 GHz ('3.6 GHz') frequency band, as a 5G pioneer band**, with view to their suitability for 5G terrestrial wireless systems and amend these, if necessary.
2. Study and assess the **24.25-27.5 GHz ('26 GHz') frequency band as a 5G pioneer band** for use under relevant 5G usage scenarios taking into account the co-existence issues highlighted in the RSPG opinion¹³ with respect to fixed links, earth exploration satellite and space research services, fixed satellite services, data relay satellite systems and passive services in the frequency band 23.6-24 GHz. In this regard, identify and study common *sharing scenarios* with incumbent radio services and applications, for which future demand has been identified.

Opportunities for interoperability and economies of scale of equipment such as a common tuning range, including the 26 GHz band, with possible 5G use outside Europe shall be taken into account. The impact of activities outside Europe in the adjacent frequency band for 5G use shall be considered, including a broad range of sharing scenarios that protect existing and future satellite services in the band.

3. Develop channelling arrangements and common and minimal (least restrictive) technical conditions²⁴ for spectrum use in the **26 GHz frequency band**, which are suitable for 5G terrestrial wireless systems, in conjunction with relevant usage and sharing scenarios.

In this regard, develop harmonised technical conditions to ensure spectrum usage *on a shared basis*, including *protection conditions* where necessary, pursuant to the sharing scenarios identified under Task 2, in close cooperation with all concerned stakeholders. These conditions should be sufficient to mitigate interference and ensure co-existence with incumbent radio services/applications in the same band or in adjacent bands, in line with their regulatory status, including at the EU outer borders.

4. Assess requirements for cross-border coordination, wherever relevant, including at the EU outer borders.

Overall, the CEPT should provide deliverables under this Mandate according to the following schedule:

Delivery date	Deliverable	Subject
March 2018	Draft Report A from CEPT to the Commission ²⁵	Description of the work undertaken and the results on Task 1.
June 2018	Final Report A from CEPT to the Commission taking into account the outcome of	Description of the work undertaken and the results on Task 1.

²⁴ Such as the definition of appropriate Block Edge Masks (BEMs)

²⁵ Subject to subsequent public consultation

	the public consultation	
March 2018	Draft Report B from CEPT to the Commission ²⁵	Description of the work undertaken and the results on Tasks 2 and 3.
June 2018	Final Report B from CEPT to the Commission taking into account the outcome of the public consultation	Description of the work undertaken and the results on Tasks 2 and 3.

The relevant results under Task 4 should be included in the deliverables above regarding different frequency bands.

CEPT is requested to report on the progress of its work pursuant to this Mandate to all meetings of the Radio Spectrum Committee taking place during the course of the Mandate.

The Commission, with the assistance of the Radio Spectrum Committee and pursuant to the Radio Spectrum Decision, may consider applying the results of this mandate in the Union, pursuant to Article 4 of the Radio Spectrum Decision and subject to international developments regarding 5G standardisation and spectrum management, and any relevant guidance of the RSPG.

ANNEX 2: CHANNELLING ARRANGEMENT AND LEAST RESTRICTIVE TECHNICAL CONDITIONS

- The frequency arrangement is a TDD arrangement with a block size of 200 MHz;
- This block size could be adjusted to narrower blocks (multiples of 50 MHz) adjacent to other users, to allow full use of spectrum, if required;
- If blocks need to be offset to accommodate other uses, this shift should be done in 10 MHz steps.

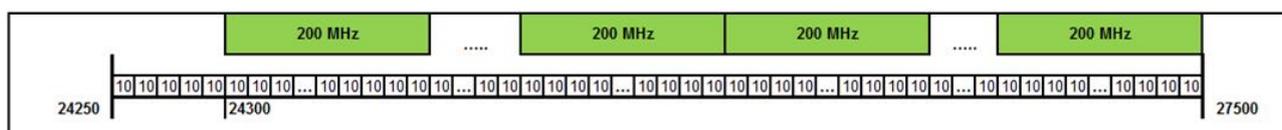


Figure 2 Example of possible frequency arrangements for WBB ECS in the 24.25-27.5 GHz band

The technical conditions presented in this annex have been developed on the basis that the authorisation regime is expected to be on an individual authorisation basis. These conditions include provisions related to the coexistence between WBB ECS systems in the form of block edge masks (BEMs), i.e. related to spectrum licensing and the avoidance of interference between users of spectrum, as well as provisions related to the coexistence with EESS (passive) in the form of unwanted emission limits in the bands 23.6-24 GHz.

A BEM is an emission mask that is defined, as a function of frequency, relative to the edge of a block of spectrum that is licensed to an operator. It consists of components which specify the permitted emission levels in adjacent blocks (transitional region 0-50 MHz below or above operator block) and non-adjacent blocks in the band.

The technical conditions derived below for the frequency range 24.25-27.5 GHz are optimised for, but not limited to, fixed/mobile communications networks (two-way). Therefore, they are derived both for base stations (BS) and terminal stations (TS). The BEMs have been developed to ensure coexistence with other WBB ECS blocks, as well as other services and applications in adjacent bands. Additional measures may be required at a national level to achieve coexistence with other services and applications.

A2.1 BASE STATION

The WBB ECS Base Station (BS) BEM consists of a baseline level, designed to protect the spectrum of other WBB ECS operators as well as emission limits to protect adjacent services (additional baseline level(s)), and transitional levels for coexistence between WBB ECS networks in adjacent blocks.

Table 1 contains the different elements of the BS BEM, and Table 2 to Table 4 contain the power limits for the different BEM elements.

To obtain a BS BEM for a specific block the BEM elements that are defined in Table 1 are used as follows:

- Transitional regions are determined, and corresponding power limits are used.
- For remaining spectrum assigned to WBB ECS, baseline power limits are used.
- For protection of services in adjacent bands, additional baseline is used.

For WBB ECS base stations, baseline requirements and requirements for transitional regions in Table 2 and Table 3 assume synchronised operation. Operators of wireless broadband electronic communication services (WBB ECS) in the 24.25-27.5 GHz band may agree, on a bilateral or multilateral basis, less stringent technical parameters provided that they continue to comply with the technical conditions applicable for the protection of other services, applications or networks and with their cross-border obligations.

Administrations should ensure that these less stringent technical parameters can be used, if agreed among all affected parties.

Table 1: WBB ECS BS BEM elements

BEM element	Definition
Baseline	Applies in spectrum used for WBB ECS, except from the operator block in question and corresponding transitional regions.
Transitional region	These are the regions adjacent to an operator block.
Additional baseline	Additional baseline limits apply in adjacent bands where specific limits for other services are necessary.

Table 2: WBB ECS BS transitional region requirements for coexistence between WBB ECS networks in adjacent blocks (assuming synchronised operation, see note 1)

Frequency range	Maximum TRP	Measurement Bandwidth
0-50 MHz below or above operator block	12 dBm	50 MHz

Table 3: WBB ECS BS baseline requirements for coexistence with WBB ECS networks in other (non-adjacent) blocks in the band (assuming synchronised operation, see note 1)

Frequency range	Protected frequency range	Maximum TRP	Measurement bandwidth
In-band baseline	24.25-27.5 GHz	4 dBm	50 MHz

Note 1: Administrations may define appropriate mitigation measures to be applied in case of unsynchronized or semi-synchronized operations, taking into account, if available, an ECC Report on a toolbox for coexistence of WBB ECS in unsynchronised or semi-synchronised operations. Alternatively, administrations may further develop and use an appropriate block edge mask at national level.

Table 4: WBB ECS BS additional baseline requirement: maximum emissions into the 23.6-24.0 GHz band

Frequency range	Maximum Total Radiated Power (TRP) (see note)	Measurement bandwidth
23.6-24.0 GHz	-42 dBW	200 MHz

Note: This level requirement applies for BS for all foreseen modes of operation (i.e. maximum in-band power, electrical pointing,

Table 5: Conditions applying to the elevation of the main beam from WBB ECS AAS outdoor base stations

Requirement on elevation of the main beam of WBB ECS AAS outdoor base stations
When deploying outdoor base stations, it shall be ensured that each antenna is normally transmitting only with main beam pointing below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the base station is only receiving

This requirement refers to the elevation of the main beam of WBB ECS Active Antenna System outdoor base stations to ensure coexistence with space station receivers

A2.2 TERMINAL STATION

Table 6: WBB ECS terminal station maximum emissions into the 23.6-24.0 GHz band

Frequency range	Maximum emissions (see note)	Measurement bandwidth
23.6-24.0 GHz	-38 dBW	200 MHz

Note: This level requirement applies for terminal station for all foreseen modes of operation (i.e. maximum in-band power, electrical pointing, carrier configurations)

ANNEX 3: LIST OF REFERENCES

- [1] ITU Radio Regulations Edition of 2016
- [2] Decision [676/2002/EC](#) of the European Parliament and of the Council on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision)
- [3] Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles (Framework Directive)
- [4] ERC Recommendation 70-03 Relating to the use of Short Range Devices (SRD), Amended October 2017
- [5] Commission Implementing Decision (EU) 2017/1438 of 4 August 2017 amending Decision 2007/131/EC on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community
- [6] ITU-R Recommendation M.2101-0 "Modelling and simulation of IMT networks and systems in sharing and compatibility studies".
- [7] Radio Spectrum Policy Group Opinion on spectrum related aspects for next generation wireless systems (5G), November 2016
- [8] Radio Spectrum Policy Group Second Opinion on 5G, January 2018