Nemzeti Média- és Hírközlési Hatóság

Band introduction
the 2300-2400 MHz band

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Executive summary

In Hungary, the 2300-2400 MHz band is allocated to civilian use below 2370 MHz and to non-civilian use above that level. The 70 MHz sub-band available for civilian purposes has a status designed for (fixed and mobile service) terrestrial electronic communications networks. In this sub-band, the technical parameters of the band use are elaborated for TDD-based[1] usage for MFCN[2] purposes [1].

The civilian part of the band is sometimes used by amateur radio and short-range radio-determination applications as well as for video-PMSE[3] purposes as well. With the exception of amateur radio operator licences, it holds for the entire 2300-2400 MHz band that no long-term licences are issued, with both sub-bands characterised by occasional use.

Concerning the sub-band for civic use, mainly the protection of the existing applications and the lack of user demands to MFCN may be the factors that may run or render unnecessary the band's use for MFCN purposes. Therefore, the assessment of user demand in relation to the band is of definitive importance from the perspective of the regulatory tasks.

In the case of emergence of demands for MFCN-purpose use, there are two approaches to the preparatory introduction of the MFCN in the 2300-2400 MHz band:

- establishing the exclusivity of the MFCN (the band may need to be cleared);
- possibility for shared use with other applications in the same band.

Owing to the significant differences in the European Union (hereinafter: EU) member states' band use practices, there is no EU-wide harmonisation obligation in force for the use of the band. Among the existing applications, the EU prioritises the importance the PMSE application, and defines it as a general goal that the necessary frequencies must be reserved for PMSE [2]. In the case of a determinant ratio of user demand emerging for PMSE in the 2300-2400 MHz band, the use of this bandwidth may need to be shared.

A shared use of the band can be implemented in several ways. The current CEPT[4] regulation and the relevant ETSI[5] standards theoretically provide a possibility for shared use by MFCN and PMSE, and the test results for various pilot projects are already available as well, which equally promise good results and easy introduction [5, 6, 7].

[1] Time division duplex, a method that implements two-way communication based on the time division principle
[2] Mobile/Fixed Communications Networks (With regards to the convergence of the fixed and mobile wireless communication services, the CEPT regulation introduced the umbrella term 'MFCN' (Mobile/Fixed Communication Networks). This also includes the IMT (International Mobile Telecommunication) systems used in ITU terminology.)
[3] Programme Making and Special Events
[4] European Conference of Postal and Telecommunications Administrations
[5] European Telecommunications Standards Institute

1 Introduction

As the age of the 5th generation mobile networks, already present in a significant part of our lives approaches, the identification and allocation of new frequency bands for use by broadband mobile systems for new types of applications or conventional mobile networks are becoming increasingly important. The efficiency of use of frequency bands already in use for mobile purposes must be increased, and it is also necessary to identify new frequency bands for such.

The 2300-2400 MHz band is one of the less utilised ones, therefore the possibilities of increasing efficiency were sought at a European level. The European Conference of Postal and Telecommunications Administrations (Conférence européenne des Administrations des postes et des télécommunications, hereinafter: CEPT) have also come to the solution of enabling the introduction of broadband radio applications through shared use, while protecting the existing services.

In Hungary, the band is allocated from 2300 MHz to 2370 MHz for civilian purposes and for non-civilian purposes above 2400 MHz. The 70 MHz sub-band available for civilian purposes has a status designed for (fixed and mobile service) terrestrial electronic communications networks.

The civilian part of the band is sometimes used by amateur radio and short-range radio-determination applications. There are no long term licences in force in the sub-band concerned by non-civilian use. Occasional use characterises both the civilian and non-civilian part of the band. In the civilian sub-band, the use for video-PMSE[6] purposes prevails. This latter is regarded by the EU as an important application. Decision No 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual radio spectrum policy programme[7] (hereinafter: RSPP) has laid down as a general objective to ensure the necessary frequencies for PMSE. A harmonised rule necessary for PMSE purposes has been created twice since the establishment of the RSPP[8]. The RSPG[9] has targeted the elaboration of a long terms PMSE strategy. On the one hand the spectrum requirement and the extent of necessity must be identified, and the possibilities examined. The planned expert's statement will be developed further, based on the feedback received in the course of the EU open consultation and the plenary session may approve it in November 2017.

The EU commissioned the CEPT in March 2014 to elaborate the conditions of the band's harmonised use [9]. Based on the reports prepared, shared use among radio services within the band is feasible, but the use of the frequency band differs significantly in each member states, therefore the harmonisation process was shut down at comitologic level. The current CEPT regulation (I. 2.1.3) and the relevant ETSI standards theoretically provide a possibility for use by MFCN and PMSE, and the test results for various pilot projects are already available as well, which equally promise good results and easy introduction [5, 6, 7].

[6] Programme Making and Special Events Video-PMSE indicates a PMSE application for video transmission purposes.
[7] Radio Spectum Policy Programme (RSPP) [2]
[8] Commission Decisions 2014/641/EU [3] and 2016/339/EU [4]
[9] Radio Spectrum Policy Group

2 Current use

According to the provisions of the NMHH Decree 7/2015 (XI.13.) on the national frequency allocation and the rules of using frequency bands (hereinafter: NFFF), the band is allocated below 2370 MHz for civilian purposes and above 2370 MHz for non-civilian purposes. The entire band is designated with secondary nature for amateur radio applications, tracing which is a difficult task, as the licences are tied to the user's person and not the frequency use in question. It is similarly difficult to assess the use of radio determination tools of tertiary nature, which are allowed to operate without licence. This uncertainty can be reduced by conducting spectrum analyses. The lower sub-band for civilian use is foreseen to be allocated for terrestrial electronic communications networks, while the upper sub-band is designated for non-civilian use. There are currently no long term radio licences in force in the sub-band for non-civilian use. Occasional use is most common in the sub-band below 2370 MHz; short term occasional licences are mostly issued for video-PMSE applications for various special events, such as the Hungarian Grand Prix round of the FIA Formula One World Championship.

2.1 International regulation

Typically the following system and services use the band in the CEPT countries:

- telemetry (terrestrial / aeronautical)
- military use (e.g. UAS[10]);
- video-PMSE;
- amateur radio service (with secondary nature)

Of the solutions built on shared frequency use, one method of sharing is the licensed shared access (hereinafter: LSA) approach. With the help of the LSA, the new application may be allowed in the band while maintaining the exiting incumbent application. The LSA is the regulatory approach the CEPT recommends to member states for MFCN introduction within the band, if the incumbent applications are desired to be kept. The necessary conditions for the introduction of the LSA must be elaborated at national level, by which the continuity of the frequency use of the incumbents can be ensured, i.e. undisturbed use without compromising the quality of service. [8]

2.1.1 EU

The EU commissioned the CEPT to elaborate the technical conditions enabling the introduction of Wireless Broadband (hereinafter: WBB) in the 2300-2400 MHz band [9]. Upon working out the technical conditions, the CEPT had to take into consideration whether the WBB can be introduced while protecting the existing applications. The LSA concept provides a possible solution for this. The CEPT had to work on the technical regulatory solutions whose application can ensure the shared use between WBB and the current applications. As a result, a number of CEPT regulatory documents have been prepared (l. 2.1.3).

RSPG discussed the question of LSA in 2013, detailing its advantages and disadvantages in the form of an expert's statement [10]. Based on the recommendations in the expert's statement, the member states engage in active dialogue with those concerned in order to elaborate the possible LSA solutions. Its recommendations were primarily based on that the use of LSA will make available the band presently used for new usage purposes without the exclusion of the incumbents, increasing the volume of available spectrum and the efficiency of spectrum use. To realise economies of scale, however, requires harmonised conditions of use, standards and tools.

[10] Unmanned Aerial System

2.1.2 ITU

According to the Radio Regulations, the 2300-2450 MHz band is primarily allocated in Region 1 to fixed and mobile services and secondarily for amateur radio and radiolocating services.

	A	B	C	D
1	ALLOCATION TABLE FOR RR FREQUENCY BANDS			ALLOCATION VALID FOR HUNGARY ACCORDING TO RR
2	REGION 1	REGION 2	REGION 3	
362	**2300–2450 MHz** FIXED MOBILE 5.384A Amateur Radiolocating 5,150 5,282 5,395	**2300–2450 MHz** FIXED MOBILE 5.384A RADIOLOCATING Amateur 5,150 5,282 5,393 5,394 5,396		**2300–2450 MHz** FIXED MOBILE 5.384A Amateur Radiolocating 5,150 5,282

In Hungary, according to Annex 2 of the NFFF, only the 2300-2400 MHz band is allocated for fixed and mobile services.

Footnote 5.384A applies to mobile services:

> The bands, or portions of the bands, 1 710-1 885 MHz, 2 300-2 400 MHz and 2 500 - 2 690 MHz, are identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) in accordance with Resolution 223* (Rev.WRC-07). This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. (WRC-07)
> * Note by the General Secretariat of the ITU: this Resolution has been amended by WRC-12.

In the allocation according to the International Radio Regulations, footnotes 5.150 and 5.282 concern Hungary within the 2300-2450 MHz band (NFFF Annex 1), which only set rules for the sub-band above 2400 MHz. In addition, footnote 5.395 also applies to Region 1, but only within France an Turkey, further regulating mobile services.

The preferred frequency arrangement described In Section 4 of Annex 1 of the ITU-R M.1036-5 recommendation, it is advisable to implement TDD based IMT[11] systems over the entire sub-band of 100 MHz [11].

The ITU-R SM.2404-0 recommendation on regulatory tools supporting efficient spectrum allocation discusses LSA as a suitable method of spectrum allocation. [12]

2.1.3 CEPT

[11] International Mobile Telecommunication

The Electronic Communications Committee (hereinafter: ECC) establishes common technical conditions with the least possible restriction in its ECC/DEC(14)02 resolution concerning the use of the 2300-2400 MHz band, in order to facilitate within the band and guide, for the CEPT member states, in a common direction (not on a compulsory basis) or harmonise the frequency use for WBB purposes without rendering the use of the incumbent applications unusable. For this, it determines technical parameters collectively known as a block edge mask (BEM), and provides the recommended channel spacing (20 5 MHz channels, which the operators may consolidate at their discretion). [1]

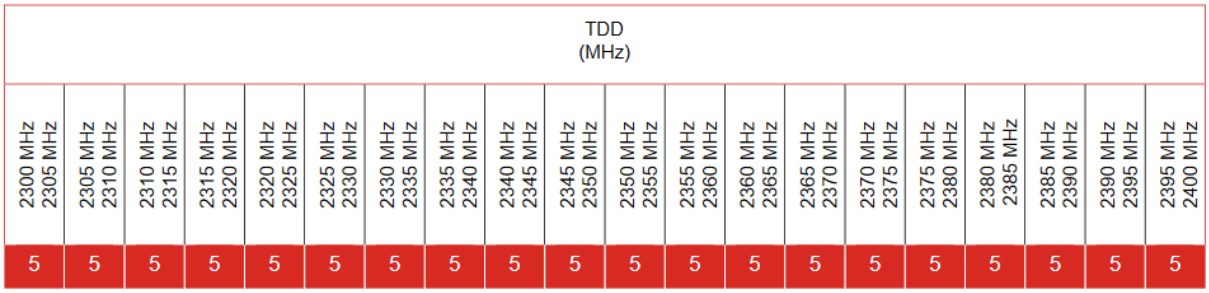

Figure 1: Channel spacing

Upon establishing the BEM, the CEPT does not consider any band use simultaneous to the applications operating in the range below 2300 MHz, adjacent to the band. In order to treat this, the use of the guideline described in ECC 172 report is recommended, which examines the questions of compatibility within the band and between the applications within the band and those in adjacent bands.

The CEPT has elaborated the ERC/REC(14)04 recommendation from the perspective of international coordination (MFCN – MFCN; MFCN – other application). [14]

The ECC 205 report covers LSA detailing the LSA concept worked out within the framework of the CEPT. [8]

Guideline ECC/REC/(15)04 of the ECC on the implementation of the allocation frameworks between MFCN and PMSE in the 2300-2400 MHz frequency band provides guidance for the introduction of LSA in the 2300-2400 MHz band for the administrations. [15]

The 3 reports prepared by the CEPT on commission by the EU [9] (reports 55, 56 and 58) providing the technical conditions of using broadband applications in bands (55) [16], and the conditions and regulatory possibilities that would allow the shared use of the band between the WBB and the incumbent applications (56) [17] WBB and specifically the PMSE as the incumbent application (58) [18].

2.1.4 Standards

The band has been identified by the 3GPP[12] since the LTE release 8 as a possible TDD usage band [3GPP TS 36.104 V8.1.0 (2008-03)] [19].

The ETSI has prepared two technical specifications and a technical report for purposes of using the LSA in bands. These provide system requirements for the LSA-based operation of the broadband mobile electronic communications systems, and concerning the architecture of the systems and the necessary functions. In addition, they also provide a general overview of the (recommended) LSA-based operation of such systems [20, 21, 22].

2.2 National regulation

2.2.1 The provisions of the NFFF

In the following, the provisions of the relevant legal regulations concerning band use have been summarised.

2300 - 2400 MHz (the entire band)

Radio service	Allocation according to usage	Nature of application	Availability	Application	Document
Amateur	Civilian	2	Designated	Amateur radio service	ECC/REC/(02)01 MSZ EN 301783-2
*	Civilian – Non civilian	3	Designated	SRD: radio determination applications	

2300 - 2370 MHz band in civilian application

Radio service	Nature of application	Availability	Application	Document
FIXED	1	Planned	Terrestrial electronic communications networks (IMT, BWA, WiMAX, WiBro, LTE)	ECC/DEC/(14)02
MOBILE (5.384A)	1	Planned	Terrestrial electronic communications networks (IMT, BWA, WiMAX, WiBro, LTE)	ECC/DEC/(14)02

2370 - 2400 MHz band in non-civilian application

Radio service	Nature of application	Availability	Application	Document
FIXED	1	Designated	Terrestrial electronic communications networks (BWA, WiMAX, WiBro, LTE)	
MOBILE (5.384A)	1	Designated	Terrestrial electronic communications networks (IMT, BWA, WiMAX, WiBro, LTE)	
*	3	Designated	Low power wireless broadband data transmission	

[12] 3rd Generation Partnership Project

Further rules for the "Terrestrial electronic communications networks" application:

Access method: especially TDD

The band is divided into 6 5 MHz frequency blocks. Two adjacent blocks may be consolidated, if the licensee is the same. In this case, the two adjacent blocks are considered one block. In the absence of mutual agreement, licensees of adjacent blocks cannot raise objections against interferences caused up to a maximum of 2 dB reduction in fading reserves.

Power density:

- max. 31 dBW/5 MHz peak EIRP for central stations and repeater station to user station direction connection
- max. 5 dBW/5 MHz peak EIRP for fixed user stations
- max. 1 dBW/5 MHz peak EIRP for transportable user stations
- max. 5 dBW/5 MHz peak EIRP for repeater station-central station connection

Further rules for the "Low power wireless broadband data transmission" application:

- Power: max. 100 mW EIRP
- Duty cycle: ≤ 100%

2.2.2 Detailed rules of band use

Annex 3 of the NFFF containing detailed rules only specifies provisions in relation to amateur radio service and SRD[13].

2.2.3 NFFF Annex 3. regulations concerning amateur radio service

Frequency band	Radio service	Max. bandwidth	Highest transmitting power [W]			Transmission mode			**Transmission mode**
		[kHz]	Licence grade						**(With IARU marking)**
			Beginner	CEPT Novice	CEPT	Beginner	CEPT Novice	CEPT	
2300–2320 MHz	Amateur	**			150				
2320–2320.15 MHz	Amateur	**			150			A1A*	telegraph
2320.15–2320.8 MHz	Amateur	**			150			A1A*, A1B, A2A*, A2B, F1A*, F1B, F2A*, F2B, J2A*, J2B, J2E, J3E, R3E	telephone (SSB), telegraph

[13] Short Range Device

2320.8–2321 MHz	Amateur	**			100			signalers	
2321–2322 MHz	Amateur	**			150			F3E	telephone (NBFM)
2322–2400 MHz	Amateur	**			150			A1A*, A1B, A1C, A1D, A2A*, A2B, A2C, A2D, A3C, A3E, F1A*, F1B, F1C, F1D, F2A*, F2B, F2C, F2D, F3C, F3E, F3F, J2A*, J2B, J2C, J2D, J2E, J3C, J3E, J3F, R3E	all transmission modes

2.2.4 NFFF Annex 3. regulations concerning SRDs

The 2300-2400 MHz band overlaps the bands of several UWB[14] type SRD applications:

- 30 MHz-12.4 GHz - GPR/WPR[15] (harmonised);
- 2200-8000 MHz - Material sensing tools and BMA[16] (not harmonised).

2.3 Actual current usage

Neither civilian, nor non-civilian usage licences have been issued for the band.

The NMHH does issue licences for video-PMSE applications in the part of the band below 2370 MHz for short duration events (civilian purposes), such as concerts or sports events.

The frequency use of amateur radio operators is not tied to occasional licences or those concerning connections; instead, similarly to other CEPT member states, the system of personal licences providing entitlement to band use is applied, therefore the use of the band by amateur radio operators is possible in Hungary.

[14] Ultra-Wideband
[15] Ground Probing Radar/Wall Probing Radar
[16] Building Material Analysis

3 Future use

3.1 International regulation

The practical experience gained in connection with the LSA may affect future regulation, especially whether the administrations (countries) protecting incumbent uses will be able to harmonise protection of the incumbent use with the requirement of better band utilisation. We currently have no knowledge of countries implementing LSA in national regulation [7].

From the perspective of future use, the fact that the band is a key military band based on the NATO Joint Civil/Military Frequency Agreement (hereinafter: NJFA).

3.1.1 EU

No EU decision covering the obligations concerning the 2300-2400 MHz band is under way.

3.1.2 ITU

A study is in the making that will cover future regulatory tools, among others the LSA concept.

3.1.3 CEPT

We have no knowledge of new regulatory plans or documents or any in the making. Presently the documents already prepared (l. 2.1.3) are available, among others, the incorporation of LSA into the domestic regulations, if a decision on this is passed.

3.1.4 Standards

New standards are expected to be issued if the regulation changes.

3.2 National regulatory plans

In line with international efforts, the provision and the licensing, as required, of the radio spectrum necessary for the further development of mobile broadband services is one of the key strategic goals of the NMHH for the period between 2016-2020. NMHH's Radio Spectrum Strategy has targeted meeting the PMSE requirements and the examination of the possibilities of shared use. These objectives coincide in the 2300-2400 MHz band. Given that we are in no position to report significant usage in the band, the user demand for the usage of the frequency band is necessary for determining the future steps. Depending on this assessment, decision can be made, among others, on whether there is demand for the use of the band at all. If demand emerges for the applications of more than one radio service, we will have to examine the possibilities of shared use and its possible conditions, or even the introduction of the LSA.

In a later regulatory phase, the NMHH plans, by taking the intensity and nature of PMSE usage and the evolution of user demand, to review the regulations concerning PMSE applications from the technical, tariff and licensing perspective. The announcement of a well defined PMSE application category in a national standard may be necessary due to the increasing importance of PMSE and to facilitate the use of PMSE applications. This will however, only be necessary in case of user demand.

3.2.1 Compatibility of future and the present use

A feature of WBB systems (assuming typical parameters such as national coverage, expected interference protection or exclusive channel usage) is that they may interfere with other applications

within the same band. As a consequence of this, further steps are required to achieve compatibility. The solution however depends on what requirements may emerge and among what systems must compatibility be ensured, therefore the NMHH will only be able to decide on this once demand is assessed.

3.2.2 Band rearrangement and migration possibilities and plans

The 2300-2400 MHz is one of the lesser used bands, where, however, the management of the existing users is not a trivial task. The band's designation for amateur radio service, for use affected by military use as well as for video-PMSE purposes is likewise allowed. The complete rearrangement of the band would concern several user groups.

The clearing of the video-PMSE applications from the band presents little difficulty, if only the technical side of the task is considered. As the band is not allocated for PMSE applications, and only occasional video-PMSE licences are present in the band from time to time, therefore the right of frequency use would not be violated on the PMSE side. Such a measure, however, would contradict the EU's efforts, given the significance of the PMSE applications has been stressed by the EU on multiple occasions, and it would also violate the PMSE manufacturer and user community, as the devices existing and already functioning in the band would become unusable and their possibilities may become restricted. If the band should nevertheless be cleared, the video-PMSE applications may continue operation in other suitable bands. Capacity problems in connection with the video-PMSE bands have not yet emerged to date, but for key events, the devices serving communication have made the available frequency stock scarce.

3.2.3 Management of transitional periods

The question of transitional periods may only be examined in merit id the demand for the band is known.

4 Frequency use and potential sources of interference beyond the borders

There are no coordination agreements in force with the neighbouring countries, as the nature of the present use does not justify this. In the future, however, the planned introduction of the MFCN may necessitate the conclusion of such agreements.

Based on the data available in the ECO Frequency Information System (hereinafter: EFIS), designated by the European Commission as a common access point and operated by the European Communications Office (hereinafter: ECO), the band is used for telecommunications in the Baltics, Russia and Norway. And in the United Kingdom, public consultations have begun in 2017 on the sale of the band for MFCN purposes [23].

Our neighbours have reported allocation to the EFIS according to the following:

	2300 - 2450 MHz	2300 - 2400 MHz	2300 - 2362 MHz	2300 - 2335 MHz	2304 - 2310 MHz	2320 - 2322 MHz	2335 - 2400 MHz	2362 - 2363 MHz	2363 - 2400 MHz
Austria			Cordless cameras		Amateur	Amateur		Defence systems	Cordless cameras
Croatia		SAP/SAB and ENG/OB / Amateur / Radiodetermination applications							
Romania				Aeronautical telemetry / SAP/SAB and ENG/OB / Land mobile / Amateur / UWB applications / MWS			MWS / UWB applications / Amateur / Land mobile / Defence systems / Aeronautical telemetry / SAP/SAB and ENG/OB		
Serbia		Aeronautical telemetry / Defence systems / Amateur / SAP/SAB and ENG/OB / Fixed							
Slovakia	Detection of movement and alert / RFID / Radio LANs / MFCN / PMSE / MBANS / Defence systems / Amateur / Amateur-satellite / Non-specific SRDs								
Slovenia		Amateur / SAP/SAB P to P video links / Cordless cameras / TRA-ECS							
Ukraine									

5 Frequency fees

No fee is established for MFCNs of civilian use, as the sub-band (2300-2370 MHz) is not allocated for this purpose; this is only planned. In case user demand should emerge for application within the MFCN band, it will be necessary to determine one-time and usage fees according to the value of the band.

5.1 One-time fees

When establishing the fees, the band allocation scenario implemented as a result of market surveys must be taken into account.

For determining the one-time sales fees, the other factors influencing frequency use must be taken into account (e.g. interference problems vis-à-vis the neighbouring countries that may necessitate territorial restrictions for certain frequency blocks; this is found out upon completion of coordination).

5.2 Usage fees

Based on the Fee Decree, the licensed party, and the party covered by the scope of block allocation by legal regulation, acquiring right of frequency use in a designated frequency band without tendering procedure, shall only pay a band fee during the validity of the entitlement to frequency use on frequency bands used for services and covered by the scope of block allocation acquired in the context of a tender or auction, or re-sold thereafter.

For determining the fees to be paid after the use of the 2300-2400 MHz frequency band, the Fee Decree will have to be amended, as its Section 20 titled “Fees to be paid for service type bands with block allocation, sold at an auction or a tender” and Annex 9 do not contain this frequency band.

When establishing the fees, the band allocation scenario implemented as a result of market surveys must be taken into account.

6 Scheduling for the introduction of the new regulation and for sales

There are no EU or other obligations for the sale of the band, therefore the scheduling may only be examined in merit id the demand for the band is known.

Related documents

[1] ECC/DEC/(14)02: Harmonised technical and regulatory conditions for the use of the band 2300-2400 MHz for Mobile/Fixed Communications Networks (MFCN)
27.06.2014
http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCDEC1402.PDF

[2] 243/2012/EU: Decision No 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual radio spectrum policy programme;
14.03.2014
http://eur-lex.europa.eu/legal-content/HU/TXT/PDF/?uri=CELEX:32012D0243&from=HU

[3] 2014/641/EU: Commission Implementing Decision of 1 September 2014 on harmonised technical conditions of radio spectrum use by wireless audio programme making and special events equipment in the Union
01.09.2014
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[4] 2016/339/EU: Commission Implementing Decision of 8 March 2016 on the harmonisation of the 2010-2025 MHz frequency band for portable or mobile wireless video links and cordless cameras used for programme making and special events
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10.07.2017
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[8] ECC Report 205: Licensed Shared Access (LSA), CEPT, (02.2014)
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http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP205.PDF

[9] EC, DG-CONNECT (1103207): „Mandate to CEPT to develop harmonised technical conditions for the 2300-2400 MHz ('2.3 GHz') frequency band in the EU for the provision of wireless broadband electronic communications services", (03.2014)
European Council, Directorate-General for Communications Networks, Content and Technology
March 2014
http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=7466

[10] EC RSPG13-538: Opinion on Licensed Shared Access
European Council, Radio Spectrum Policy Group
November 2013
https://circabc.europa.eu/sd/d/3958ecef-c25e-4e4f-8e3b-469d1db6bc07/RSPG13-538_RSPG-Opinion-on-LSA%20.pdf

[11] ITU-R Recommendation ITU-R M.1036-5: Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations (RR) (10.2015)
October 2015
https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.1036-5-201510-I!!PDF-E.pdf

[12] ITU-R Report ITU-R SM.2404-0: Regulatory tools to support enhanced shared use of the spectrum (06.2017)
June 2017
https://extranet.itu.int/brdocsearch/R-REP/R-REP-SM/R-REP-SM.2404/R-REP-SM.2404-2017/R-REP-SM.2404-2017-PDF-E.pdf?Web=1

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[14] ERC/REC/(14)04: Cross-border coordination for mobile/fixed communications networks (MFCN) and between MFCN and other systems in the frequency band 2300-2400 MHz (30.05.2014)
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28.10.2014
http://www.erodocdb.dk/Docs/doc98/official/pdf/CEPTREP055.PDF

[17] CEPT Report 56: Technological and regulatory options facilitating sharing between Wireless broadband applications (WBB) and the relevant incumbent services/applications in the 2.3 GHz band, CEPT, March 2015.
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