



EETT

HELLENIC TELECOMMUNICATIONS & POST COMMISSION

Review of Frequency Bands for the Deployment of 5G Networks

Maroussi, October 2018



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Note. The present document is a non official translation of the Technical Report (originally developed in greek) approved for publication by EETT Decision No 870/1/29-10-2018.



1 Introduction

The purpose of the present document is to inform all interested parties (incumbent and new providers of electronic communication networks, equipment manufacturers, radio-spectrum users in general, verticals) with respect to the radio frequency bands that are currently under review by EETT and are expected to be used for the deployment of fifth generation (5G) wireless broadband networks in the near future, taking also into consideration the relevant developments at a European level.

The frequency bands below 6 GHz that have been already harmonized at CEPT level for Mobile/Fixed Communications Networks (MFCN) are presented in the following Table. It should be noted that the implementation of harmonisation Decisions issued by ECC is not mandatory by CEPT member States. On the contrary, spectrum harmonisation Decisions issued by the European Commission pursuant to Decision No 676/2002/EC of the European Parliament and of the Council (Radio Spectrum Decision) must be implemented by all EU Member States.

Table 1. CEPT harmonized bands for MFCN below 6 GHz

Band	Bandwidth (MHz)	Harmonisation in EU	Harmonisation in Greece
700 MHz (694-790 MHz)	2x30 + 20 (possibility to allocate up to 4 blocks of 5 MHz for SDL ¹ at a national level)	Yes	In progress
800 MHz (790-862 MHz)	2x30	Yes	Yes
900 MHz (880-915 MHz /925-960 MHz)	2x35	Yes	Yes
1500 MHz (1427-1517 MHz)	90 (SDL)	Yes	Yes ²
1,8 GHz (1710-1785 MHz/1805-1880 MHz)	2x75	Yes	Yes
2,1 GHz (1920-1980MHz/2110-2170 MHz)	2x60	Yes	Yes

¹ Supplemental Downlink

² Only in the range 1452-1492 MHz



Band	Bandwidth (MHz)	Harmonisation in EU	Harmonisation in Greece
2,3 GHz (2300-2400 MHz)	100	No	No
2,6 GHz (2500-2690 MHz)	2x70+50	Yes	Yes
3,6 GHz (3400-3800 MHz)	400	Yes	Yes
Total :	1260 MHz	1160 MHz	1030 MHz

Radio frequency bands above 24 GHz that are either under harmonization or have been prioritised for harmonization at CEPT level for MFCN are presented in the following Table.

Table 2. Bands above 24 GHz harmonized or prioritized for MFCN harmonization in CEPT

Band	Bandwidth (GHz)	Harmonisation in EU/CEPT prioritized
26 GHz (24,25- 27,5 GHz)	3,25	EU harmonisation in progress ³
42 GHz (40,5-43,5 GHz)	3	CEPT prioritized ⁴
66-71 GHz	5	CEPT prioritized
Total :	11,25 GHz	

According to Decision No 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual Radio Spectrum Policy Programme (RSPP), at least 1200 MHz of suitable spectrum should have been identified by 2015 (including spectrum already in use), for the deployment of wireless broadband services in order to support Union policy objectives and to best

³ CEPT Report 68, ECC/DEC/(18)06

⁴ CEPT Roadmap 5G



meet the increasing demand for wireless data traffic.

In Greece the harmonised radio frequency bands that have been made available for mobile communications networks are presented in Table 3 and analysed per operator in Figure 1. Consequently, Greece is fully harmonised⁵ with the EU Decisions regarding the availability of radio spectrum frequency bands for MFCN. It's worth noting that in Greece 670 MHz of spectrum have already been licensed for MFCN, from the total of 1100 MHz of harmonised spectrum at EU level.

Table 3. MFCN bands below 6 GHz harmonised in Greece

Band	Authorised Bandwidth (MHz)	Expiry Date
800 MHz	2x30	28-02-2030
900 MHz	2x35	29-09-2027
1500 MHz	0	-
1,8 GHz	2x75	14-11-2027 και 05-12-2035
2,1 GHz	2x45	05-08-2021
2,6 GHz	2x70+40	28-02-2030
3,6 GHz	120	30-04-2029 και 09-04-2037
	Total : 670 MHz	

⁵ The implementation date for the harmonization measures of the 700 MHz band is June 30, 2020

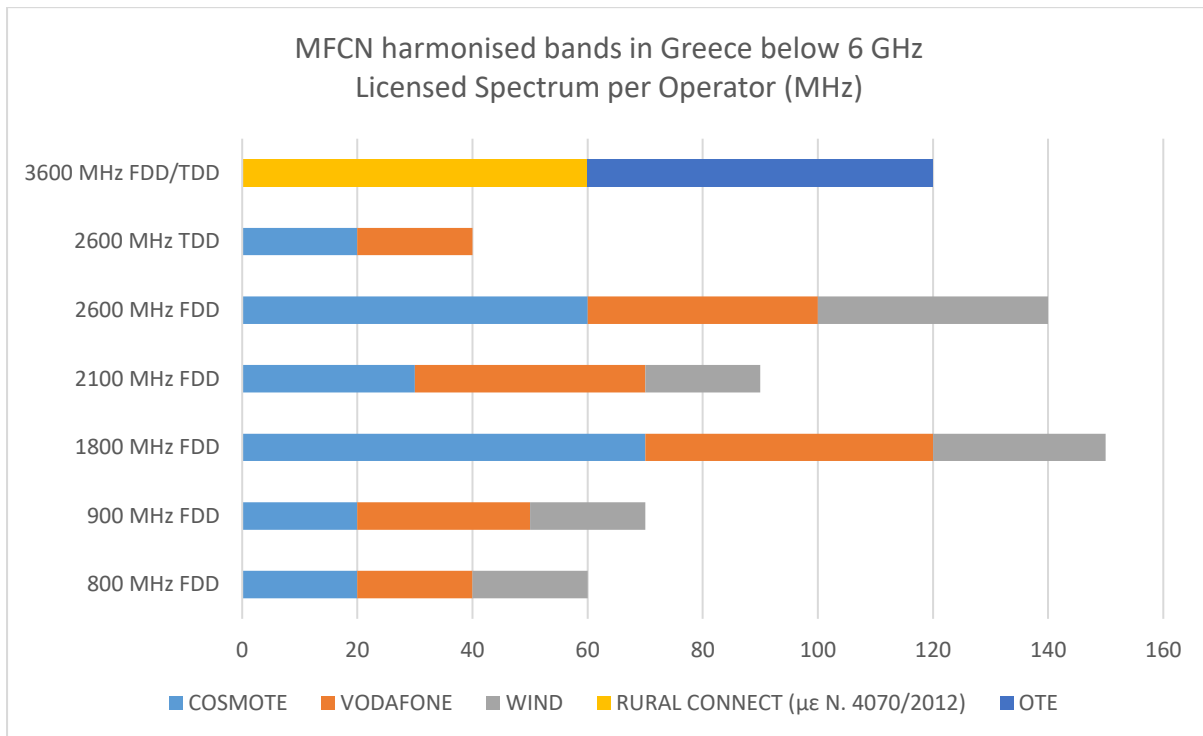


Figure 1. MFCN harmonized bands in Greece below 6 GHz. Licensed spectrum per operator (MHz)

EETT expects that, within the time frame of 2018-2022, both public consultations on technical issues and authorisation procedures will take place for the following MFCN bands:

- 700 MHz
- 1500 MHz
- 2,1 GHz
- 2,3 GHz
- 3,6 GHz
- 26 GHz

The Radio Spectrum Policy Group (RSPG) has identified the importance of the 700 MHz, 3.6 GHz and 26 GHz bands for the development of 5G networks in the EU⁶.

In the next sections the spectrum bands are presented in detail. In the last section the complete set of the bands considered is presented in tabular format along with indicative milestones.

⁶ “Opinion on spectrum related aspects for next-generation wireless systems (5G)
http://rspg-spectrum.eu/wp-content/uploads/2013/05/RPSG16-032-Opinion_5G.pdf



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The present document does not legally bind EETT with respect to the regulatory measures that might be adopted. Moreover, the purpose of this document is informative and the milestones mentioned are indicative given the working assumption of considering each band separately from all the others.



2 700 MHz Band

The 700 MHz band consists of the spectrum range 694-790 MHz that will become available for MFCN deployment after the migration of television broadcasting services below 694 MHz. The ITU Radio Regulations, which were updated at the World Radiocommunication Conference 2015 (WRC-15), allocated the 700 MHz band in Region 1 to the Broadcasting and the Mobile except aeronautical mobile Services on a co-primary basis.

The technical issues related to the use of the 700 MHz band by MFCN have been studied at CEPT level, in CEPT Report 60 and CEPT Report 53. The regulatory framework for the 700 MHz band is defined in Decisions No 2016/687/EU of the European Commission, No 2017/899/EU of the European Parliament and of the Council and ECC/DEC/(15)01 of ECC. According to these Decisions the spectrum available for MFCN in the 700 MHz band is defined as: six blocks of 5 MHz paired spectrum for FDD operation and four blocks of 5 MHz (unpaired) for supplemental downlink operation. It should be noted that the paired spectrum shall be made available for MFCN by all EU Member States, while for the duplex gap (738-758 MHz) consisting of four unpaired blocks other possible uses are foreseen (eg, PMSE⁷, PPDR⁸, M2M), which can be decided at a national level.

The main issues identified with respect to the use of the 700 MHz band are: (i) the migration processes of the incumbent services, (ii) the protection of the spectrally adjacent services especially the terrestrial digital broadcasting service below 694 MHz, (iii) the successful completion of the coordination process with the neighboring countries, (iv) the formation of the appropriate coverage obligations for MFCN in the 700 MHz band in order to improve the services in rural and remote areas as well as indoor and also (v) the study of the appropriate coexistence criteria between MFCN in the bands 703-733 MHz/758-788 MHz and uses that will be determined at the national level for the bands 694-703 MHz, 733-758 MHz and 788-791 MHz.

The 700 MHz band is being used in Greece by the network providers of digital terrestrial broadcasting (ERT and Digea) and the Ministry of Defense. The Ministry of Digital Policy Telecommunications and Media announced on July 27th 2018 the national Roadmap for making available the Digital Dividend II⁹. The Roadmap defines the necessary steps and the relevant milestones for making available the 700

⁷ Programme Making and Special Events

⁸ Public Protection & Disaster Relief

⁹ Announcement of the National Roadmap for making available the second Digital Dividend (700 MHz)



MHz band for MFCN.

Specifically, for the migration of the incumbent services from the 700 MHz band in order for this band to be used for MFCN services, the following steps, amongst others, are required:

- Amendment of the National Frequency Allocation Table
- Modification of the national Digital Terrestrial Broadcasting Frequency Plan
- Development of a detailed transition plan from the current to the new Digital Terrestrial Broadcasting Frequency Plan including timetable and intermediate plans
- Amendment of the existing Rights (of use for radiofrequencies) of the Digital Terrestrial Broadcasting operators (ERT and Digea)
- Implementation of the migration of the incumbent services to the new frequency ranges

Finally, according to the Roadmap, the competitive procedure for granting of the 700 MHz band spectrum rights to MFCN operators is expected to take place in July 2020 and the band is expected to become available for (MFCN) use in December 2020.

Available at : <http://mindigital.gr/index.php/26-g-g-t-t/%CE%B1%CE%BD%CE%B1%CE%BA%CE%BF%CE%B9%CE%BD%CF%89%CF%83%CE%B5%CE%B9%CF%83/2574-700-hz>



3 1500 MHz Band

The band 1427-1517 MHz (1500 MHz) has been harmonised at a European level and provides 90 MHz for the implementation of Supplemental Downlink (SDL). The technique to use additional spectrum for the implementation of an exclusive downlink channel aims to cope with the data traffic asymmetry that occurs between the terminal and the base station. The band consists of the core band, 1452-1492 MHz, and the two extension bands: 1427-1452 MHz and 1492-1517 MHz. The band can only be used in combination with another duplex communication band supported by the relative 3GPP standards.

The technical issues related to the use of the 1500 MHz band by MFCN have been studied, at CEPT level, in CEPT Report 54 and CEPT Report 65. The regulatory framework for the 1500 MHz band is defined in Decision No 2015/750/EU of the European Commission, as amended by Decision No 2018/661/EU, ECC/DEC/(13)03 and ECC/DEC/(17)06 of ECC. According to these Decisions radio spectrum in the 1500 MHz band is partitioned in 18 blocks of 5 MHz each and can only be used for supplemental downlink operation (transmission only from the Base Stations). The main technical issues identified with respect to the use of the 1500 MHz band by MFCN/SDL relate to the protection of services operating in adjacent frequency bands and specifically passive services (Earth Exploration-Satellite, Radio Astronomy, Space Research) below 1427 MHz and Mobile-Satellite (space-to-Earth) service above 1518 MHz. The latter is currently being studied at ECC level. It should be noted that the Mobile-Satellite service in the band above 1581 MHz supports critical aeronautical and maritime communications systems.

In Greece parts of the 1500 MHz band are being used for the operation of Subscriber Rural Networks by OTE, in a limited, well identified locations. The respective Rights (of use for radiofrequencies) will expire on 10/12/2020. Moreover, parts of the 1500 MHz band are being used by Greek military forces.

Following the implementation of Decision No 2015/750/EU, EETT conducted a public consultation in 2016 for the band 1452-1492 MHz the results of which indicated that there is interest from the incumbent mobile service operators for the use of this spectrum band. However, it was also decided that licensing procedures in the band should be postponed in order to overcome coexistence issues with Subscriber Rural Networks and to deal with the limited availability of band compatible mobile terminals in the market, at that time.

According to Decision 2018/661/EU, EU Member States shall designate and make available, on a non-exclusive basis, the 1 427-1 452 MHz and the 1 492-1 517 MHz frequency bands, or a portion thereof,



for MFCN/SDL by October 1st 2018. For the core band, 1452-1492 MHz, this obligation exists from November 8th 2015. In any case, the licensing of the 1500 MHz band on the basis of national demand should be decided by taking into account, especially for the extension bands, the need for protection and continued operation of possible incumbent use to the extent that this is necessary. Furthermore, according Article 1(4) of Decision No 676/2002/EC of the European Parliament and of the Council (Radio Spectrum Decision) EU Member States may not implement specific spectrum harmonisation measures for reasons related to the right of Member States to organise and use their radio spectrum for public order and public security purposes and defence.

According to the above, EETT has submitted a proposal to the competent Minister of Digital Policy Telecommunications and Media in order to conduct a public consultation in accordance with Article 23(2) of Law 4070/2012.



4 2.1 GHz Band

The paired 2.1 GHz band consists of the 1920-1980 MHz and 2110-2170 MHz spectrum ranges. In 2001, three National¹⁰ Rights (of use for radiofrequencies) were granted in the paired 2.1 GHz band to VODAFONE (2x20 MHz), WIND (2x10 MHz) and COSMOTE (2x15 MHz) for MFCN¹¹. The Rights are valid until August 2021. In addition to these three spectrum blocks, there is a 2x15 MHz (1965-1980 MHz and 2155-2170 MHz) spectrum block, that while it was released, it has not been licensed.

The relevant regulatory framework governing the use of the 2.1 GHz paired band is defined in EC Decisions 2012/688/EU and ECC/DEC/(06)01. The revision of the technical terms of the ECC Harmonisation Decision for the 2.1 GHz band is currently under study in CEPT level, taking into account the technological developments for 5G networks^{12 13}. The new Decision is expected in March 2019.

Accordingly, EETT will propose a public consultation in 2019 on the new Spectrum Rights of 120 MHz (2x60 MHz FDD) of bandwidth in total, in the 2.1 GHz paired band, which will be in force from 2021 and onwards.

¹⁰ National: with geographical scope of the whole territory of Greece

¹¹ Main frequency band for 3G services (UMTS)

¹² ECO, "Review of ECC Decision (06)01 (2.1 GHz MFCN) for suitability for 5G" Available at: https://eccwp.cept.org/WI_Detail.aspx?wiid=655

¹³ ECC, "The harmonised utilisation of the bands 1920-1980 MHz and 2110-2170 MHz for mobile/fixed communications networks (MFCN) including terrestrial IMT systems", Available at: https://www.cept.org/Documents/ecc/47276/ecc-18-117-a10_draft-rev-ecc-decision-06-01



5 2.3 GHz Band

The 2.3 GHz band is delimited by the 2300-2400 MHz spectrum range. The band is currently under significant use at a European level and in Greece mainly by video link telemetry systems, (terrestrial and aeronautical) by governmental systems, as well as PMSE applications. The entire 2.3 GHz band (100 MHz) could potentially be used for MFCN¹⁴. There is currently no EC Implementing Decision harmonising the use of the 2.3 GHz band in the European Union.

The harmonised technical conditions governing the use of the 2.3 GHz band are defined in CEPT Report 55 and ECC/DEC/(14)02. Accordingly, the 2.3 GHz band is divided into 20 blocks of 5 MHz. The main technical issues for the 2.3 GHz band have been studied at CEPT level in CEPT Reports 56 and 58 which include technical and regulatory proposals to facilitate sharing between MFCN networks and existing uses, and between MFCN and PMSE respectively.

EETT follows the developments in the 2.3 GHz band at European level and believes that the possibility to exploit part of the 2.3 GHz band for the development of MFCN should be assessed, at least at a preliminary level, before the end of 2019, drawing also on the results of the studies and trials performed in some European countries for licensed shared use based on LSA (Licensed Shared Access).

¹⁴ LTE-TDD

6 3.6 GHz Band

The 3400-3800 MHz (3.6 GHz) band has been harmonised at European level since 2008 for fixed or mobile electronic communications systems. The original Harmonisation Framework (2008) concerned Broadband Wireless (fixed or mobile) systems, which was then (2014) modified to include 4th generation mobile communications systems. Recently, the 3.6 GHz band has been identified as the 'primary' band¹⁵ for the development of 5th generation networks at European level, as it has sufficient bandwidth to support Gbps rates as well as satisfactory propagation characteristics.

The relevant regulatory framework governing the use of the 3.6 GHz band is defined in the Decisions 2008/411/EC (as amended by Decision 2014/276/EU) and ECC/DEC/(11)06, and in the CEPT Report 67. Although currently there is no new EU Implementing Decision for the band, the framework is under revision to include 5th generation networks¹⁶. According to the proposals presented in detail in CEPT Report 67, the total band is divided into 80 blocks of 5 MHz based on TDD. The new BEM masks include the provision for Active Antenna Systems. The main technical issues identified with regard to the use of the 3.6 GHz band concern (i) the protection of adjacent services, namely the Radiolocation Service below 3400 MHz and the Fixed Service and Fixed Satellite Service above 3800 MHz, (ii) the fragmentation of the band from existing uses, and (iii) the development of a national synchronisation framework for TDD networks.

In Greece, in 2014, one National Spectrum Right was granted in the 3.6 GHz band to OTE (3440-3470/3540-3570 MHz). Furthermore, according to Law 4070/2012, Article 21(18), the blocks 3670-3700 MHz and 3770-3800 MHz have been committed by the Greek State until 2037 for the exclusive provision of electronic communications services to underserved areas ("white areas") through the Public Rural Networks.

At the end of 2017, EETT conducted a public consultation in which mobile network operators and manufacturers expressed, in principle, their interest in using the band. Moreover, it was evident from

¹⁵ "Opinion on spectrum related aspects for next-generation wireless systems (5G)
http://rspg-spectrum.eu/wp-content/uploads/2013/05/RPSG16-032-Opinion_5G.pdf

¹⁶ <https://circabc.europa.eu/sd/a/24c99eb0-bf30-4395-b8f5-152c51114cb7/RSCOM18-24%203.6GHz%20amendment.pdf>

the results of the public consultation¹⁷, that the existing limitation in the number of spectrum rights¹⁸ in the band is inconsistent with the need for contiguous spectrum blocks of sufficient bandwidth for the deployment of 5G networks. Furthermore, according to the results of the consultation, the appropriate time for granting spectrum rights in the available part of the 3400-3800 MHz band was assessed to be the fourth quarter of 2019.

The key challenge for the band is the fragmentation of the available today spectrum range of 280 MHz in the band, due to existing spectrum rights, which limits the availability of large enough spectrum blocks (in the range of 80-100 MHz) required by manufacturers to optimize spectrum utilization by 5th generation networks (5G-NR).

In view of the above, and taking into account (i) that the draft new EU Decision sets out the date of release of the 3.6 GHz band by Member States on 30 June 2019, and (ii) the new Electronic Communication Code (as agreed at Coreper level) identifies 31 December 2020 as the end date for the release of the band, it is estimated that the public consultation on the licensing of the 3.6 GHz band will have been completed by the end of 2019.

¹⁷

<https://www.eett.gr/opencms/export/sites/default/admin/downloads/Consultations/RadioCommunications/Results3400-3800MHz.pdf>

¹⁸ Ministerial Decision No 7349/218/12-2-2014



7 26 GHz Band

The 26 GHz band consists of the 24.25-27.5 GHz MHz spectrum¹⁹ range. The regulatory framework governing the use of the 26 GHz-5G band at CEPT level is set out in ECC/DEC/(18)06 and in CEPT Report 68, while the arrangement for the band 24.5-26.5 GHz²⁰ is defined in Recommendation ECC/REC/(11)01.

According to CEPT Report 68 and ECC/DEC/(18)06 the entire band is divided into 200 MHz blocks based on TDD. The main technical issues identified with regard to the use of the 26 GHz-5G band concern: (i) the protection of adjacent services and in particular the passive systems of the Earth Exploration Satellite and Radio Astronomy Services operating below 24 GHz; (ii) the protection of other in-band applications such as fixed links, satellite earth exploration and space exploration systems, fixed satellite service stations and inter-satellite service systems; (iii) the defragmentation of the band and (iv) the development of a national synchronisation framework for TDD networks.

According to the ECC/DEC/(18)06, CEPT countries should make available at least 1 GHz of spectrum in the 26 GHz band for MFCNs by the end of 2020.

Based on the results of CEPT Report 68, a new EC Implementing Decision is expected to be issued, which will also set the date of release of the band by the EU Member States.

Also, according to the new Electronic Communications Code (as agreed at Coreper level), Member States shall take all appropriate measures to allow the use of at least 1 GHz of the 24.25 to 27.5 GHz frequency band for 5G networks by 31 December 2020, provided that there is a clear evidence of market demand and absence of significant constraints for migration of existing users or band clearance.

In Greece, the use of the 26 GHz-FS band has been laid down by Ministerial Decision (69097/1496/20-10-2016, Government Gazette 3455/B/26-10-2016), for a period of 15 years. Furthermore, the Decision limits the number of national spectrum rights in this band up to 15 blocks of 2x56 MHz and prescribes guard bands of 28 MHz between adjacent operators.

¹⁹ 26 GHz-5G

²⁰ 26 GHz-FS

Based on this decision, in 2017, a tender procedure was conducted and three National Rights of Use were granted to COSMOTE (2x112 MHz), VODAFONE (2x56 MHz) and WIND (2x56 MHz) for the deployment of FWA networks (P-P, P-MP links). However, much of the spectrum remains available. According to the Tender Notice, a new 26 GHz-FS authorisation procedure can be launched after February 2019.

EETT is following the developments in the 26 GHz-5G band at European level and is of the view that a public consultation should be undertaken at the end of 2019 or the beginning of 2020, which will also take into account the new EC 26 GHz Implementing Decision which is expected to be finalized during 2019.



8 Indicative Milestones

The following Table summarizes some indicative milestones for the frequency bands currently addressed. These milestones have emerged by considering each frequency band separately.

Table 4. Indicative Milestones for the Authorization of Use of MFCN Bands (2018-2022)

Frequency Band	Available Spectrum	Milestone -Date	Milestone Description
700 MHz	60 MHz FDD 703-733 MHz & 758-788 MHz	December 2020	Availability of the Band
1500 MHz	65 MHz SDL 1452-1517 MHz	end of 2018 / beginning of 2019	Public Consultation
2.1 GHz	120 MHz FDD 1920-1980 MHz & 2110-2170 MHz	2019 August 2021	Public Consultation Expiry Date of Current Rights of Use
2.3 GHz	100 MHz TDD (LSA) 2300-2400 MHz	end of 2019	Public Consultation
3.6 GHz	280 MHz TDD 3400-3800 MHz	2019	Public Consultation
26 GHz	3,25 GHz TDD ²¹ ή 2 GHz TDD ²² 24,25-27,5 GHz	end of 2019 / beginning of 2020	Public Consultation

²¹ (under the prerequisite of re-farming of current uses)

²² (without re-farming of current uses – of which 1.3 GHz without limitations and 0.7 GHz with the limitations of the current 3.6 GHz Ministerial Decision)