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ANCOM's Position
on awarding rights of use for the spectrum resources
available in the frequency bands

694-790 MHz,

790-862 MHz,

1427-1517 MHz,

2500-2690 MHz,

3400-3800 MHz

and

24.25- 27.5 GHz

January 2019

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1. Introduction

This document (*Position Paper* or *Position*) lays down the position of the National Authority for Management and Regulation in Communications (ANCOM) on awarding rights of use for the spectrum resources available in new frequency bands on a European level for broadband mobile communications systems, respectively 694-790 MHz (*the 700 MHz band*) and 1427-1517 MHz (*the 1500 MHz band*), as well as in the frequency sub-bands not awarded during the previous selection procedures (2012 and 2015) in the 790-862 MHz (*the 800 MHz band*), 2500-2690 MHz (*the 2600 MHz band*) and 3400-3800 MHz bands.

This Position also concerns the awarding of new rights for the use of frequencies in the long run, in the 3400-3800 MHz band, as well as in the 24.25-27.5 GHz band (*the 26 GHz band*), which is to be harmonised on a European level, for the introduction of 5G technologies.

In the context of the rapid growth of broadband wireless data traffic and of the economic, industrial and social importance of the digital economy, expanding the capacity of wireless electronic communications networks has become a necessity. Ensuring adequate and sufficient radio spectrum resources for the effective deployment and for increasing the capacity of wireless broadband networks is paramount for meeting the growing demand for broadband data traffic and to foster the development of innovative digital communications services.

The additional frequencies to be made available to providers of public electronic communications networks and services will contribute to ensuring the spectrum resources needed for the efficient deployment of broadband electronic communications services both by using existing technologies and by implementing next generation technologies, also known as 5G or IMT-2020.

The new generation of communications technologies will enable the provision of seamless, highly reliable mobile connectivity, with very high data rates and very low latency, capable of supporting the transmission of growing amounts of data, connecting millions of users and smart objects in the IoT sector, as well as a wide range of new innovative applications such as: self-driving and connected vehicles, advanced industrial manufacturing processes and robotics, tele-surgery, virtual or augmented reality, intelligent agriculture, intelligent energy grids, smart homes and cities.

The availability of adequate spectrum for the deployment of 5G technologies is a key element for the development of high-performance electronic communications networks that can meet the requirements concerning very high data capacity and speed, very low latency (real-time communications) and high availability. High-performance broadband networks, such as 5G networks, are the engine of digitization and are indispensable for the achievement of the connectivity and coverage targets set at European level by the Digital Agenda for Europe 2020¹ and by the EC document *Connectivity for a Single Digital Competitive Market: towards a European Gigabyte Society*², to facilitate the digital transformation of economy and the development of the Gigabyte Society.

The spectrum resources needed at industry level with a view to supporting the development of 5G technologies consist of a combination of frequency bands below 1 GHz, between 1 and 6 GHz and above 6 GHz, with different characteristics, offering different benefits, in accordance with the requirements of versatile 5G applications.

The frequency spectrum below 1 GHz is important for ensuring effective coverage of wide areas and improved indoor coverage, due to the propagation of radio waves over long distances and better indoor penetration compared to those in the higher frequency bands.

The spectrum between 1 GHz and 6 GHz is suitable for the early introduction of 5G as it offers relatively large bandwidths and a good balance between coverage and capacity.

¹ [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC0245R\(01\)&from=EN](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC0245R(01)&from=EN)

² final COM (2016) 587, <https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-587-EN-F1-1.PDF>, and the Staff Working Document of the Commission SWD (2016) 300 f, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016SC0300&from=EN>

The frequencies above 6 GHz, especially those above 24 GHz (in the millimetre waves range³), allows the provision of very high data rates and capacity, necessary for 5G deployments, and are suitable for providing 5G services in densely populated urban areas.

At the international level, the designation of new 5G harmonized frequency bands is an item on the agenda of the World Radiocommunication Conference-2019 (WRC-19) organised by the International Telecommunication Union - Radiocommunication Sector (ITU-R), based on a list of candidate frequency bands in the 24 GHz - 86 GHz range, identified at the previous WRC in 2015 (WRC-15)⁴, in order to achieve the broadest possible global harmonization for IMT-2020 systems, taking into account the results of the ITU-R studies.

At the European level, besides the frequency bands already harmonised for the provision of broadband mobile services, RSPG⁵ has identified the 700 MHz, 3400-3800 MHz and 26 GHz bands as priority bands for the introduction of 5G mobile communications systems in the Union.

Access to adequate spectrum resources is a vital element for the future commercial success of existing market players and of potential new entrants in the mobile communications sector, impacting the future competitiveness of the mobile communications market. Therefore, the draft strategy initiated by this Position document focuses on laying down effective rules in the selection procedure, which should lead to a distribution of spectrum resources among the operators that could foster competition.

ANCOM's Position on awarding spectrum usage rights in the above-mentioned frequency bands is aimed at establishing the manner and conditions for access in these bands, so that the outcome of the selection procedure should set the premises for the optimal use of the frequency spectrum, to the benefit of the end-users and in the interest of promoting competition in the mobile communications market.

With a view to preparing the process of awarding spectrum usage rights in the said frequency bands, in 2017 ANCOM conducted a public consultation on awarding the spectrum usage rights in the new frequency bands harmonised on a European level for broadband mobile communications systems, i.e. 694-790 MHz and 1452-1492 MHz, as well as in the frequency sub-bands that were not acquired during the selection procedures of 2012 and 2015 within the 800 MHz, 2600 MHz and 3400-3600 MHz bands.

The consultation was aimed at obtaining information from the interested parties as regards their interest in acquiring frequency usage rights in these bands, and also regarding the period considered to be adequate for this auction. Moreover, the Authority aimed to clarify a series of technical and economic aspects regarding access to the spectrum resources in these frequency bands and the awarding conditions, i.e. some elements that could influence results, such as the selection procedure design, minimum spectrum requirements, the maximum spectrum amounts available to be acquired by one operator in various frequency bands (below 1 GHz and above 1 GHz), the validity period of the frequency usage rights, the coverage obligations or certain access obligations associated with the licences and the starting prices in the auction.

ANCOM has drawn up this *Position Paper on awarding rights of use for the spectrum resources available in the frequency bands 694-790 MHz, 790-862 MHz, 1427-1517 MHz, 2500-2690 MHz, 3400-3800 MHz and 24.25- 27.5 GHz*, also considering the views and suggestions expressed during the 2017 public consultation.

Given the importance of the limited spectrum resources available, the impact of the decision on awarding spectrum usage rights in the frequency bands covered by this Position Paper and the latter's effect on the electronic communications market, ANCOM deems it useful to consult all stakeholders, in order to ensure transparency and impartiality in the decision-making process and the predictability of the adopted regulatory measures.

³ Since wavelength is defined as a proportion of light velocity to wave frequency, a 1 mm wavelength is obtained at the frequency of 30 GHz; nevertheless, it is common practice to use this terminology for spectrum above 24 GHz, as well.

⁴ Resolution 238 (WRC-15)

⁵ RSPG: The Radio Spectrum Policy Group, established on grounds of Decision no. 2002/622/EC of 26 July 2002 amended by Decision no. 2009/978/EU of 16 december 2009, which adopts important opinions in support of and for the information of the European Commission (EC) on matters regarding radio spectrum policies

With a view to identifying the optimal solution for awarding the spectrum usage rights for the frequencies available in the 700 MHz, 800 MHz, 1500 MHz, 2600 MHz, 3400-3800 MHz and 26 GHz bands, in pursuit of ensuring the achievement of the objectives regarding the efficient use of the frequency spectrum and of maximizing economic and social benefits for the society, ANCOM invites all stakeholders to express their views on the position expressed by the regulator in this document.

The reasoned opinions expressed in the public consultation will serve to substantiate the decision insofar as the manner and conditions for awarding spectrum usage rights for the frequencies available in the above-mentioned bands are concerned, so that the most efficient use of the frequency spectrum resources, with the greatest socio-economic benefits, should be achieved.

2. Purpose

This Position Paper is aimed at establishing the objectives, principles, conditions and procedure of awarding the spectrum usage rights for the radio frequency resources available in the 694-790 MHz, 790-862 MHz, 1427-1517 MHz, 2500-2690 MHz and 3400-3800 MHz bands for the provision of public broadband mobile communications networks and publicly available broadband mobile communications services, so that the targets regarding the optimal use of the frequency spectrum and promoting competition in the mobile communications market should be reached.

Furthermore, ANCOM's Position gives an overview of the current usage of the 26 GHz band at national level and of the international regulations in force or in progress regarding the usage of the 26 GHz band for broadband mobile/fixed communications networks (MFCN⁶). Moreover, based on the elements presented in the Position Paper, measures for awarding usage rights are proposed to be implemented in this frequency band.

3. Objectives

The radio spectrum available is a valuable and limited resource for the broadband applications and technologies it is intended for. Therefore, it needs to be managed as efficiently as possible, so as to ensure the premises for optimal use in the long run both, both for the deployment of high-performance, state-of-the-art communications networks capable of providing broadband innovative services and for promoting competition in the communications services market, which should bring about benefits for end-users.

In identifying the optimal solution for granting the spectrum usage rights in the 700 MHz, 800 MHz, 1500 MHz, 2600 MHz, 3400-3800 MHz and the 26 GHz bands, ANCOM pursues the following objectives for the rational and efficient management of the frequency spectrum resource:

- ensuring the conditions for efficient allotment and optimal use of the radio spectrum resource;
- ensuring conditions of fair and non-discriminatory access to the radio spectrum resource;
- ensuring the conditions for fostering competition in the mobile communications market and avoiding spectrum hoarding;
- fostering efficient investment in infrastructure and promoting innovation;
- ensuring conditions for the efficient use of the allotted frequency spectrum, and for the deployment of broadband mobile communications services;
- ensuring flexibility in the use of spectrum, technological neutrality and services provided and promoting new technologies;

⁶ Concerning the convergence of mobile and fixed wireless communications services, the regulations of the European Conference of Postal and Telecommunications Administrations (CEPT) introduced the term MFCN (Mobile/Fixed Communications Networks), which includes IMT (International Mobile Telecommunications) networks as well as and other communications networks that fall under land mobile and fixed services.

- ensuring the technical conditions for coexistence among the systems to be implemented in the sub bands concerned (including systems in other radiocommunications services for which these frequency bands – usually above 3 GHz – are allocated on a primary basis), between these systems and other radiocommunication systems in the adjacent bands, as well as between these systems and systems operating in the same frequency bands on the territory of neighbouring countries, in order to avoid harmful interferences.

4. Brief history and current status of the spectrum usage rights in the bands harmonised for MFCN

4.1. 800 MHz and 2600 MHz bands

During August - September 2012, ANCOM held the competitive selection procedure organised for awarding the spectrum usage rights in the 800 MHz, 900 MHz, 1800 MHz and 2600 MHz bands.

The respective selection procedure enabled simultaneously auctioning off frequency blocks in all the available spectrum bands and acquiring spectrum portfolios that included frequency blocks in various spectrum bands, adequate for providing broadband mobile public electronic communications networks and services on a national level.

The radio frequency spectrum auctioned out was organised as follows:

- a) for awarding the spectrum usage rights valid from 01.01.2013 to 05.04.2014:
 - the paired frequency bands 890-915 MHz/935-960 MHz, corresponding to 2 x 25 MHz bandwidth, split into 10 duplex blocks of 2 x 2.5 MHz each;
 - the duplex frequency bands 1722.7–1752.7 MHz/1817.7-1847.7 MHz, corresponding to 2 x 30 MHz bandwidth, split into 6 duplex blocks of 2 x 5 MHz each.
- b) for awarding the spectrum usage rights valid from 06.04.2014 to 05.04.2029:
 - the paired frequency bands 791-821 MHz/832-862 MHz (*800 MHz band*), corresponding to 2 x 30 MHz bandwidth, split into 6 duplex blocks of 2 x 5 MHz each;
 - the paired frequency bands 880-915 MHz/925-960 MHz (*900 MHz band*), corresponding to 2 x 35 MHz bandwidth, split into 7 duplex blocks of 2 x 5 MHz each;
 - the paired frequency bands 1710-1785 MHz/1805-1880 MHz (*1800 MHz band*), corresponding to 2 x 75 MHz bandwidth, split into 15 duplex blocks of 2 x 5 MHz each;
 - the paired frequency bands (FDD) 2500-2570 MHz/2620-2690 MHz, corresponding to 2 x 70 MHz bandwidth, split into 14 duplex blocks of 2 x 5 MHz each;
 - the unpaired frequency band (TDD) 2570-2615 MHz, corresponding to 45 MHz bandwidth, split into 3 TDD blocks of 15 MHz each.

The auction produced the following outcomes, as regards the allotment of the radio frequency spectrum:

- a) for the period 01.01.2013 – 05.04.2014:
 - in the frequency bands 890-915 MHz/935-960 MHz:
 - Orange Romania (*Orange*) acquired 5 blocks of 2 x 2.5 MHz each, standing for 2 x 12.5 MHz bandwidth;
 - Vodafone Romania (*Vodafone*) acquired 5 blocks of 2 x 2.5 MHz each, standing for 2 x 12.5 MHz bandwidth.
 - in the frequency bands 1722.7-1752.7 MHz/1817.7-1847.7 MHz:
 - Orange acquired 3 blocks of 2 x 5 MHz each, standing for 2 x 15 MHz bandwidth;
 - Vodafone acquired 3 blocks of 2 x 5 MHz each, standing for 2 x 15 MHz bandwidth.

b) for the period 06.04.2014 – 05.04.2029:

- in the 800 MHz band:
 - Telekom Romania Mobile Communications (former Cosmote Romanian Mobile Telecommunications), hereinafter referred to as *Telekom Mobile*, acquired one 2 x 5 MHz block;
 - Orange acquired 2 blocks of 2 x 5 MHz each, standing for 2 x 10 MHz bandwidth;
 - Vodafone acquired 2 blocks of 2 x 5 MHz each, standing for 2 x 10 MHz bandwidth.

- in the 900 MHz band:
 - Telekom Mobile acquired 2 blocks of 2 x 5 MHz each, standing for 2 x 10 MHz bandwidth;
 - Orange acquired 2 blocks of 2 x 5 MHz each, standing for 2 x 10 MHz bandwidth;
 - Vodafone acquired 2 blocks of 2 x 5 MHz each, standing for 2 x 10 MHz bandwidth;
 - RCS&RDS acquired one 2 x 5 MHz block.

- in the 1800 MHz band:
 - Telekom Mobile acquired 5 blocks of 2 x 5 MHz each, standing for 2 x 25 MHz bandwidth;
 - Orange acquired 4 blocks of 2 x 5 MHz each, standing for 2 x 20 MHz bandwidth;
 - Vodafone acquired 6 blocks of 2 x 5 MHz each, standing for 2 x 30 MHz bandwidth.

- in the 2500-2570 MHz/2620-2690 MHz (FDD) bands:
 - Telekom Mobile acquired 2 blocks of 2 x 5 MHz each, standing for 2 x 10 MHz bandwidth;
 - Orange acquired 4 blocks of 2 x 5 MHz each, standing for 2 x 20 MHz bandwidth;

- in the 2570-2615 MHz (TDD) band:
 - 2K Telecom acquired 2 blocks of 15 MHz each, standing for 30 MHz bandwidth;
 - Vodafone acquired one 15 MHz block.

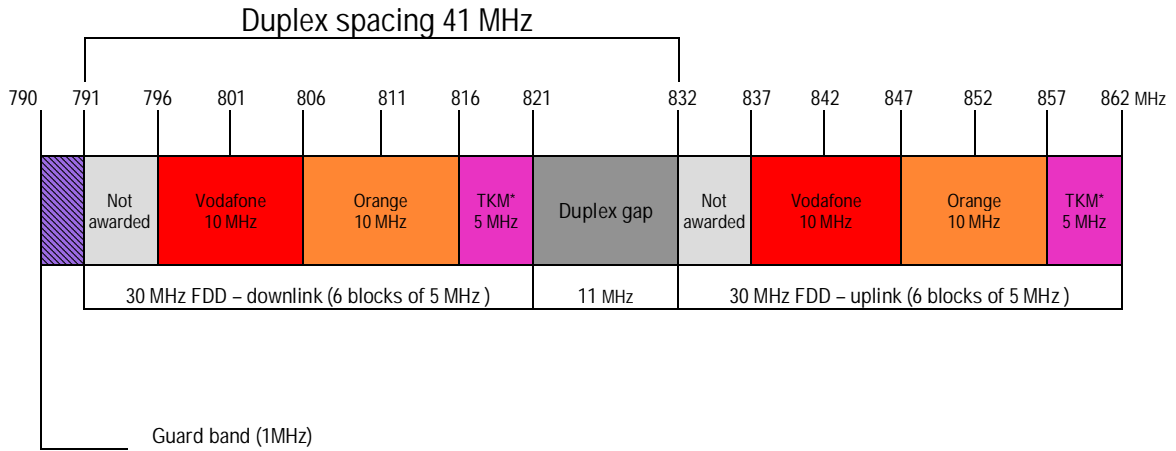
Thus, in the 800 MHz band, ANCOM awarded 5 of the 6 duplex 2 x 5 MHz blocks auctioned off, one 2 x 5 MHz block remaining unacquired. The paired frequency sub-bands corresponding to the remaining block in the 800 MHz band are: 791-796 MHz/832-837 MHz.

In the 2600 MHz FDD band, ANCOM awarded 6 blocks of 2 x 5 MHz out of the available 14 blocks, 8 blocks of 2 x 5 MHz remaining unacquired. The paired frequency sub-bands corresponding to the remaining 8 blocks of 2 x 5 MHz in the 2600 MHz FDD band are: 2530-2570 MHz/2650-2690 MHz.

Upon completing the auction for awarding the rights of spectrum use in the 800 MHz, 900 MHz, 1800 MHz and 2600 MHz bands, ANCOM issued the licences for granting new spectrum usage rights in the 800 MHz, 900 MHz, 1800 MHz and 2600 MHz bands. The licences issued to Telekom Mobile, Orange, RCS&RDS, 2K Telecom and Vodafone are valid for a 15-year period, from 06.04.2014 to 05.04.2029.

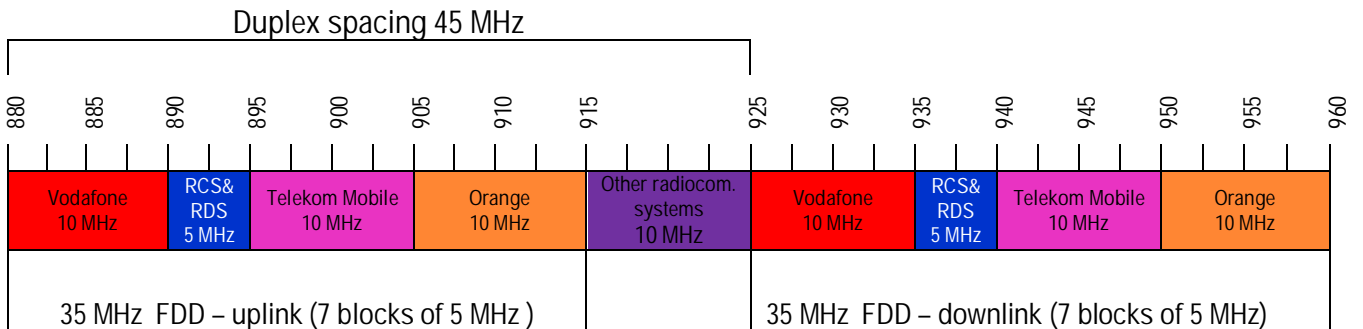
The allotments of each mobile communications operator in the frequency bands auctioned off are illustrated below:

791-821 MHz/832-862 MHz bands
 - allotments valid during 06.04.2014 – 05.04.2029 -

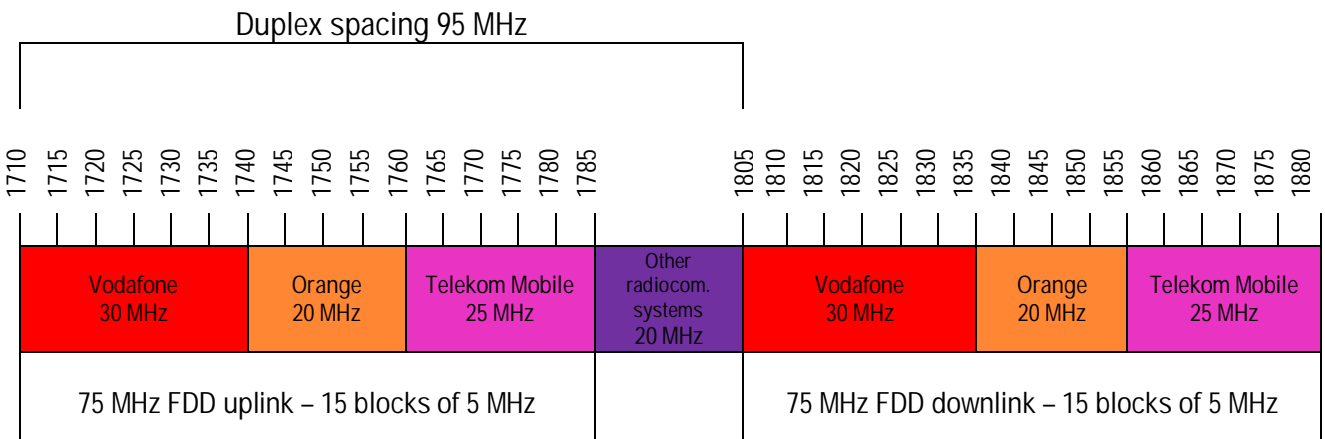


*TKM – Telekom Mobile

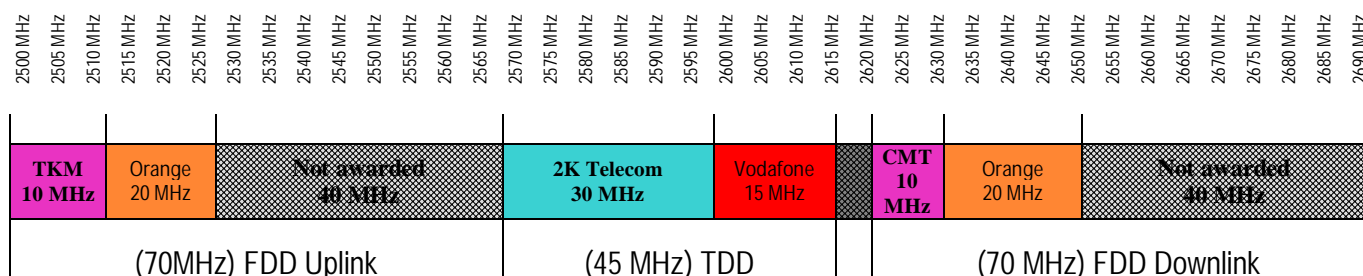
880-915 MHz/925-960 MHz bands
 - allotments valid during 06.04.2014 – 05.04.2029 -



1710 - 1785 MHz / 1805 - 1880 MHz bands
 - allotments valid during 06.04.2014 – 05.04.2029 -



The 2500 – 2690 MHz band
 - allotments valid during 06.04.2014 – 05.04.2029

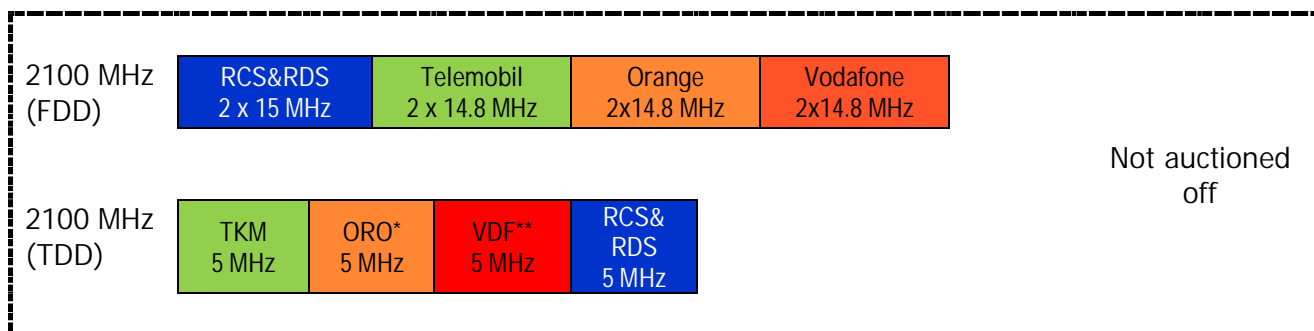
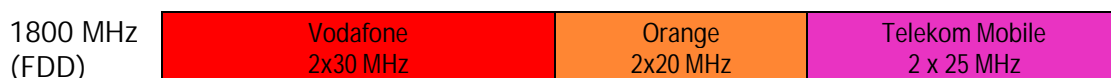
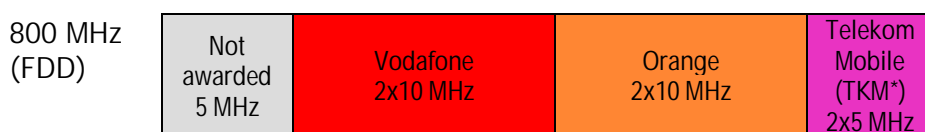


TKM – Telekom Mobile

The spectrum usage rights awarded to 2K Telecom in the 2500-2690 MHz were transferred to RCS&RDS in 2015.

The spectrum portfolios currently held by mobile communications networks operators in all the frequency bands designated for the provision of public electronic communications networks and mobile electronic communications services are illustrated below:

Spectrum portfolios by bands and holders



2600 MHz
(TDD)

RCS&RDS (transferred by 2K Telecom) 1x30 MHz	Vodafone 1x15 MHz
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*ORO - Orange

**VDF - Vodafone

4.2. The 3400-3800 MHz band

The 3400-3600 MHz and 3600-3800 MHz frequency featured different evolution patterns over time in Romania, both in terms of their usage and of their regulation, until 2015, when ANCOM issued the President's Decision no. 390/2015, by which the *Strategy and Action Plan for the Deployment and Development of Broadband Communication Systems at National Level in the 3400-3800 MHz frequency band for the period 2015-2025* (hereinafter referred to as the *Strategy for the usage of the 3400-3800 MHz band*) was adopted.

The above-mentioned strategy has harnessed the results of a complex and long-lasting public consultation process launched in 2006 for both frequency bands (3400-3600 MHz and 3600-3800 MHz) which subsequently included a complex interlacing of both public consultation steps and regulatory actions jointly, for the two bands at a time, and independently, for each of these frequency bands. There were milestone actions envisaging both of the bands (in 2011 and 2013), as well as actions aimed at each of the two, separately: in 2009, for the 3600-3800 MHz band and in 2014 for the 3400-3600 MHz band.

The sinuous unfolding of this public consultation process was due to the occurrence of objective circumstances, outside the Authority's scope of action, which were triggered by the context of international regulation and of the spectrum usage at a national level, at different moments in time.

The laborious process of developing the 3400-3800 MHz Band Usage Strategy culminated in the final consultation that took place in the first half of 2015, which drove to the adoption of the ANCOM President's Decision no. 390/2015, in line with the views of all the stakeholders in the national electronic communications sector.

ANCOM's approach to elaborating the above-mentioned strategy and action plan was based on the provisions of art. 5 of Government Emergency Ordinance no. 18/2008 on the establishment of some measures for the reorganization of the radio spectrum usage in the frequency band 3600-3800 MHz, approved, with amendments and completions, by Law no. 259/2008, with the subsequent amendments.

The 3400-3800 MHz Band Usage Strategy established the principles, conditions and procedure of awarding frequency usage rights, for the provision of broadband electronic communications services, as well as the method of refarming the entire 3400-3800 MHz band.

The strategy adopted by the ANCOM President's Decision no. 390/2015 also aimed at avoiding the risk of wasting or excessive fragmentation of radio spectrum allotments, ensuring the principle of technological neutrality and attracting those market players that hold the necessary financial and technical capabilities to make the most of the potential of these frequency bands.

Moreover, the above-mentioned strategy set out the deadlines and the schedule of the actions in pursuit of the Authority's main decision taken by this normative act, namely the organization of a selection procedure in the 3400-3800 MHz band, in 2015. Also, the strategy and action plan included all the technical and administrative elements necessary for the proper organisation of the selection procedure.

Part of the provisions of the on amending Decision 2008/411/EC on the harmonisation of the 3400 - 3800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community was implemented through the ANCOM President's Decision no. 390/2015.

The other steps needed to complete the licensing process in the respective band were performed following the adoption of the strategy and the action plan for the 3400-3800 MHz band, in order to fully implement the provisions of Commission Implementing Decision 2014/276/EU.

Thus, upon the entry into force of the 3400-3800 MHz Band Usage Strategy, the measures laid down in therein have been implemented through the preparation, public consultation and adoption of the necessary technical and administrative regulations for the organization of the competitive selection procedure for awarding the frequency usage rights in the 3410-3800 MHz band in 2015, mainly as follows:

- the ANCOM President's decision on the adoption of the selection procedure rules,
- the Terms of Reference for the respective selection procedure, which provided in detail all the technical and administrative elements for the unfolding of the selection procedure.

ANCOM also elaborated the Government's draft decision proposing the amounts of the minimum license fee for the above-mentioned usage rights.

In the second half of 2015, ANCOM carried out the competitive selection procedure for awarding spectrum usage rights in the 3410-3800 MHz band, for the provision of public electronic communications networks and services at national level, through MFCN networks, and completed it before the end of the year.

In December 2015, the winners of the selection procedure received the licenses issued by the Authority, which included the frequency bands acquired following the auction. These licenses entered into force on 1 January 2016 and are valid for 10 years until 31 December 2025.

Five operators have obtained spectrum allocations in the 3400-3800 MHz band at national level, as follows:

- two operators have obtained allotments in the 3400-3600 MHz band,
- two operators have obtained allotments in the 3600-3800 MHz band,
- one operator has obtained allotments in both frequency bands mentioned above.

Currently there is still radio spectrum available in the 3400-3600 MHz band, while the 3600-3800 MHz band is fully occupied.

During 2017, the spectrum resources still available in the 3400-3600 MHz band were listed in a public consultation (along with other frequency bands harmonized at European level, where spectrum was available at a national level) with a view to awarding frequency usage rights for terrestrial systems capable of providing broadband wireless electronic communications services.

The history of the 3400-3800 MHz band regulation and usage over time (from 2000 to 2014) is detailed Chapter I of the Strategy Paper adopted by the ANCOM President's Decision no. 390/2015.

The outcome of the 2015 selection procedure and a brief history of this band's regulation and usage (including graphs) – and including the developments and steps taken between 2015 and 2017 (duly explained) – are presented in Chapter II Section 2 of the Public Consultation Document developed by the Authority in 2017, which covered (inter alia) all aspects of the 3400-3800 MHz band and is available on the ANCOM website, here:

http://www.ancom.org.ro/en/uploads/forms_files/CONSULTARE_ACORDARE_SPECTRU_70_0_800_1500_2600_MHz_3,5GHz_en_11_iulie_20171499780173.pdf

Therefore, only the 2018 developments will be presented hereunder.

In this time interval, one notable change occurred in the licenses in force in the 3400-3800 MHz band, namely 2K Telecom SRL fully transferred its usage rights under the license held in the 3400-3600 MHz band - obtained following the 2015 selection procedure - in favour of Orange Romania, the latter consolidating its frequency portfolio in that band.

Thus, the spectrum resources in the 3400-3600 MHz band are currently allotted at national level as follows:

- the sub-bands 3420-3440 MHz/3520-3540 MHz are allotted for Vodafone Romania S.A;
- the sub-bands 3440-3450 MHz/3540-3550 MHz are allotted for Orange Romania S.A;
- the sub-bands 3465-3490 MHz/3565-3590 MHz are allotted for Orange Romania S.A.

The spectrum resources in the 3600-3800 MHz band are currently allotted at national level as presented in the 2017 Public Consultation Document:

- the sub-band 3600-3645 MHz is allotted for Orange Romania S.A.;
- the sub-band 3645-3700 MHz is allotted for government networks,
- the sub-band 3700-3750 MHz is allotted for RCS&RDS S.A.;
- the sub-band 3750-3800 MHz is allotted to The National Company *Radiocommunications* S.A.

The frequency spectrum resources currently available in the 3400-3600 MHz band consist of 5 duplex 2x5 MHz channels that are not part of a contiguous spectrum portion, as follows:

- the sub-bands 3410-3420 MHz/3510-3520 MHz,
- the sub-bands 3450-3465 MHz/3550-3565 MHz.

Due to the specificity of the FDD arrangement currently in use in this band, the side guard sub-bands (3400-3410 MHz and 3590-3600 MHz) and the and duplex gap (3490-3510 MHz) are not occupied (as they cannot be allotted to operators under this type of arrangement).

4.3. The 24.25-27.5 GHz band

One can see a usage history starting from 2000 for the 24.5-26.5 GHz frequency band (as shown below), whereas for the 24.25 - 24.5 GHz and 26.5 - 27.5 GHz bands, the Authority has never received requests for frequency usage rights on a permanent basis.

Therefore, in these frequency bands, spectrum usage licenses have never been issued for non-governmental operators, nor for own use purposes (according to the "first come first served" principle), or for the provision of public electronic communications networks and publicly available services, as no - comparative or competitive - selection procedures have ever been organized and carried out in these bands. Therefore, no usage history is available as such, for the frequency bands 24.25 - 24.5 GHz and 26.5 - 27.5 GHz (as in the case of other bands covered by this position paper).

One aspect is noteworthy concerning the 26.5 - 27.5 GHz band. During 2018, experimental radio transmissions were performed in this frequency band for a limited period, in a clearly defined, narrow geographical area. The operator who received a temporary license for spectrum usage from the Authority had the sole objective of testing the 5G radio access at fixed access points, without providing publicly available electronic communications services.

The usage history of the 24.5-26.5 GHz band (from 2000 to 2013) is available in the *Position Paper on the usage of the 24.5- 25.5 GHz/25.5-26.5 GHz bands on a national level*, developed in November 2013 (hereinafter referred to as the *24.5-26.5 GHz Band Usage Strategy*) and available, in Romanian, here:

http://www.ancom.org.ro/uploads/links_files/Pozitie_benzi_24_26_GHz.pdf.

Therefore, this section will present the developments in the regulation and usage of the 24.5 – 26.5 GHz band in Romania, starting from 2014.

The 24.5-26.5 GHz Band Usage Strategy was adopted by ANCOM, having consulted all the stakeholders in the national electronic communications sector, based on the relevant provisions of the Government Emergency Ordinance no. 111/2011 on electronic communications, approved with amendments and completions by Law no. 140/2012, as amended and completed.

The Strategy Paper was necessary following the clearly declining trend of the Romanian operators' interest for providing public point-to-multipoint (PMP) fixed wireless access (FWA)

radiocommunications networks, noticeable during 2010-2013 (as well as before). Moreover, operators holding PMP FWA national licenses have requested the Authority's permission (and received it) to install and operate radio-relay links for generic data transmissions (not directly related to carrying the traffic from one's own PMP FWA network). In support of their demand, the operators brought the need for efficient and effective use of the radio spectrum. Frequency assignments for radio-relay links were made within the same frequency sub-bands allotted under the operators' existing licenses for providing public networks in the 24.5-26.5 GHz band.

ANCOM identified these trends at the time and - in the strategy document - presented its view on the reasons for the occurrence of this situation and explained its decision to change the type of application for which the 24.5-26.5 GHz band was designated, while keeping the band assignment for the same radiocommunications service, i.e. the fixed service.

Subsequent to the publication of the above-mentioned document on the Authority's website, the measures set out therein were implemented. In this respect, ANCOM issued new licenses for radio-relay links upon the request of the holders of licences for public the provision of PMP FWA radiocommunications networks in the 24.5-26.5 GHz band.

All three operators holding licenses in force, in the fixed service, for the provision of public electronic communications networks and services at national level through PMP FWA networks requested and received new licences (two in 2013 and one in 2014), again in the fixed service, but for radio-relay links.

The new usage rights for radio-relay links were awarded in the same frequency sub-bands that had previously been allotted by the licences for the PMP FWA national public networks held by the respective operators. The validity of these licenses was extended in 2016, for another five years, and expires at various moments during 2021.

Only two of the three operators mentioned above have applied for and have been granted the right to benefit from the transition period provided by the 24.5-26.5 GHz Band Usage Strategy, using this transitional right until the deadline set out in the Strategy. Thus, they kept operating base stations on the PMP FWA national public networks until 31 December 2015, while requesting new frequency assignments for medium/high capacity radio-relay links within the sub-bands allotted under the new licenses, which were necessary for the development of their own backhaul networks for carrying the traffic resulted from the access networks operated by them in different bands and using different technologies.

After the issuance of the above-mentioned three licenses, the Authority has no longer registered any further requests for new frequency usage licenses in the fixed service in the 24.5-26.5 GHz band - from operators that had not held previous usage rights in this frequency band, irrespective of the type of application - this proving again the low overall interest shown for the 24.5 band - 26.5 GHz by the national electronic communications market at that time.

Furthermore, assignments for specific frequencies were still in force in 2014, for three radio-relay links in the upper range of the 24.5-26.5 GHz band, operated by two operators. One of these gave up its two links in 2017.

The one still in use is a cross-border link and operates in the upper range of the respective band (with a validity term ending in 2021).

5. Regulatory framework

5.1. Applicable legislation

The legal provisions in force that are relevant in this public consultation procedure are the following:

- Government Emergency Ordinance no.111/2011 on electronic communications, approved with amendments and completions by Law no.140/2012, with the subsequent amendments and completions (*Framework-Ordinance*);

- Government Emergency Ordinance no. 11/2012 on the release of the 830-862 MHz, 1747.5-1785 MHz, 1842.5-1880 MHz and 2500-2690 MHz frequency bands approved by Law no. 165/2012, with the subsequent amendments and completions;
- Government Emergency Ordinance no. 18/2008 establishing certain measures for reforming the use of the radio spectrum in the 3600-3800 MHz frequency band, approved, with amendments, by Law no. 259/2008, with the subsequent amendments;
- Decision No. 243/2012/EU of the European Parliament and of the Council establishing a multiannual radio spectrum policy programme;
- Decision (EU) 2017/899 of the European Parliament and of the Council on the use of the 470-790 MHz frequency band in the Union;
- Commission Implementing Decision (EU) 2016/687 on the harmonisation of the 694-790 MHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services and for flexible national use in the Union;
- Commission Decision 2010/267/EU on harmonised technical conditions of use in the 790-862 MHz frequency band for terrestrial systems capable of providing electronic communications services in the European Union;
- Commission Implementing Decision (EU) 2015/750 on the harmonisation of the 1452-1492 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Union, amended by Commission Implementing Decision (EU) 2018/661;
- Commission Decision 2008/477/EC on the harmonisation of the 2500 - 2690 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community;
- Commission Decision 2008/411/EC on the harmonisation of the 3400-3800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community, amended by Commission Implementing Decision 2014/276/EU; (Note: The European Commission has recently adopted a new Draft Decision amending Commission Decision 2008/411/EC, to be published in the Official Journal of the European Union. This Position Paper aims at implementing the newly updated Commission Decision 2008/411/EC);
- Order of the Minister for Communications and Information Society no. 789/2009 on approving the National Table of Frequency Allocations, with the subsequent amendments;
- ANCOM President's Decision no. 390/2015 on the approval of the Strategy and of the action plan for the implementation and development of broadband communications systems in the 3400-3800 MHz band, on a national level, for 2015-2025.

The specialized legislation in the field of electronic communications stipulates that the individual spectrum usage rights are granted for one of the following purposes: i) to ensure the efficient use of the limited radio spectrum resource, ii) to avoid harmful interferences on the networks operated by other persons using the radio spectrum in accordance with the legal provisions, iii) to ensure the technical quality of the service provided, or iv) to fulfil other general interest objectives.

Furthermore, the electronic communications regulatory framework allows a holder of spectrum usage rights to use any technology available for each type of application established in the NTFA, in accordance with the requirements of the European Union legislation or to provide any electronic communications service, as established in the NTFA, in accordance with the requirements of the European Union legislation. Exceptions from the principle of technological or service neutrality will need to be clearly defined.

In accordance with Article 26(1) of the Framework Ordinance, licenses for the use of radio frequencies shall be granted through an open, objective, transparent, non-discriminatory and proportionate procedure.

Moreover, according to Article 25 of the Framework Ordinance, ANCOM may decide to limit the number of licences to be granted in a radio frequency band, when it is necessary to ensure the efficient use of radio frequencies or to avoid the occurrence of harmful interferences. Where ANCOM resorts to this measure, it must also: consider the need that this measure should bring the users maximum benefits and foster competition; give all stakeholders - including users and consumers - the opportunity to express their views on this measure; publish any decision that limits the number of licenses, together with the reasons grounding this measure.

In the case of licenses whose number has been limited, ANCOM grants the right of use through a procedure that must fulfil – as well – several conditions, set out in Article 26(2) of the Framework Ordinance. Thus:

- a) the procedure type must be competitive or comparative selection;
- b) the procedure must be objective, transparent, non-discriminatory and proportionate;
- c) the procedure must not result into restricting, preventing or distorting competition;
- d) the granting of rights of use must normally take place within eight months from the receipt of a request therefor, which may be amended - if necessary - to comply with an international agreement on the use of the radio spectrum or of the orbital positions in which Romania is a party.

5.2. International, national and European technical regulations

5.2.1. Technical regulations on the usage of the 700 MHz band

According to the NTFA, the 694-790 MHz frequency band (*the 700 MHz band*) is allocated to the broadcasting service on a primary basis. Taking into account that the band was allocated in the ITU Region 1 (of which Romania is part) also to the land mobile service on a primary basis, by No. 5.312A of Article 5 of the ITU Radiocommunication Regulation - 2016 edition (RR-ITU), being identified at the World Radiocommunication Conference of 2015 (WRC-15) for IMT systems, according to the provisions of No. 5.317A, the band allocation in Romania will be updated by amending the NTFA in accordance with RR-ITU.

ANCOM will propose to amend the NTFA by allocating the 694-790 MHz frequency band to the land mobile service, on a primary basis, and designating the 703-733 MHz and 758-788 MHz bands for usage in FDD7 mode by terrestrial systems capable of providing wireless broadband electronic communications services (IMT - International Mobile Telecommunications), as well as the 738-753 MHz band for usage in SDL8 mode, by IMT systems.

At EU level, Decision (EU) 2017/899 of the European Parliament and of the Council on the use of the 470-790 MHz frequency band in the Union, published on 17 May 2017, regulates both making available the 694-790 MHz band for use by terrestrial systems capable of providing wireless broadband electronic communications services, and lays down a series of obligations thereon for the EU Member States, as follows:

1. By 30 June 2020, Member States shall allow the use of the 700 MHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services under the harmonised technical conditions established by the Commission pursuant to Article 4 of Decision No 676/2002/EC on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision). Member States may, however, extend the above-mentioned term for up to two years based on duly justified reasons set out in the Annex to the Decision. The justified reasons for such a delay are limited to:
 - unresolved cross-border coordination issues resulting in harmful interferences;
 - the need to ensure, and the complexity of ensuring, the technical migration of a large amount of the population to advanced broadcasting standards;

⁷ FDD: Frequency Division Duplex

⁸ SDL: Supplemental Downlink

- the financial costs of transition exceeding the expected revenue generated by award procedures;
 - *force majeure*.
2. In order to allow the use of the 700 MHz frequency band, Member States shall conclude all the necessary cross-border frequency-coordination agreements within the Union.
 3. Member States will conduct cross-border coordination activities with third countries (non-EU countries) on the use of frequencies in the 470-790 MHz band both for terrestrial broadcasting services and for wireless broadband electronic communications services.
 4. When authorising the use of the 700 MHz band, Member States shall take due account of the need to achieve the target speed (at least 30 Mbp/s both indoors and outdoors) and the quality objectives set out in Article 6(1) of the RSPP, including coverage in predetermined national priority areas, such as along major land transport routes.

The above-mentioned Decision also provides the obligation that, no later than 30 June 2018, Member States shall adopt and make public their national plan and schedule ('national roadmap'), including detailed steps for fulfilling their obligations regarding the awarding and usage of the spectrum resources in the 470-694 MHz frequency band in accordance with the Decision provisions, upon consultation with all the relevant stakeholders.

Commission Implementing Decision (EU) 2016/687 on the harmonisation of the 694-790 MHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services and for flexible national use in the Union, adopted on 28 April 2016, harmonises the technical conditions for the availability and efficient use of the 694-790 MHz frequency band in the Union for terrestrial systems capable of providing wireless broadband electronic communications services.

Therefore, Commission Implementing Decision (EU) 2016/687 designates the frequency bands 703-733 MHz and 758-788 MHz (2x30 MHz) for harmonised usage for terrestrial systems capable of providing wireless broadband electronic communications services in the Union, on a non-exclusive basis.

The decision also provides that such designation should be without prejudice to the right of Member States to organise and use their spectrum for public safety and public security purposes and for defence. The frequency bands 703-733 MHz and 758-788 MHz, or a subset thereof, may also be used for PPDR radio communications. If PPDR radio communications are implemented in the above-mentioned bands, the relevant technical conditions for wireless broadband electronic communications services in the annex to the Decision will be used.

As for the other parts of the 700 MHz band, the Commission Implementing Decision (EU) 2016/687 lays down several options for use which the Member States may choose based on their national needs:

- the 738-758 MHz frequency band (up to 20 MHz of spectrum) may be allotted in full or in part for use by terrestrial systems capable of providing wireless broadband electronic communications services, as a supplementary downlink band (limited to base station transmission);
- the paired frequency bands 698-703 MHz and 753-758 MHz (2x5 MHz) and the paired frequency bands 733-736 MHz and 788-791 MHz (2x3 MHz) may be allotted for use in full or in part for PPDR radio communications;
- the paired frequency bands 733-736 MHz and 788-791 MHz (2x3 MHz) may be allotted for use for M2M radio communications, as well;
- the paired frequency bands 694-703 MHz and 733-758 MHz may be allotted for use in full or in part for wireless audio PMSE equipment (such as radio microphones).

Harmonised plan of the 700 MHz band according to Commission Implementing
Decision 2016/687/EU

Bands	694-698	698-703	703-733	733-736	736-738	738-743	743-748	748-753	753-758	758-788	788-791
PPDR 2x3 MHz			UL MFCN	UL PPDR						DL MFCN	DL PPDR
PPDR 2x5 MHz		UL PPDR							DL PPDR		
M2M 2x3 MHz				UL M2M							DL M2M
SDL 4x5 MHz						DL MFCN SDL					
PMSE	PMSE			PMSE							
Bandwidth (MHz)	4	5	30	3	2	5	5	5	5	30	3

The 700 MHz band is already available in Romania, but its use by MFCN networks on the national territory without major restrictions depends on the actual usage of broadcasting services in the neighbouring countries and of other radiocommunications services to which the band is allocated in these countries (both EU Member States and non-EU countries).

Since the 700 MHz band is allotted for digital terrestrial television (DTT) in the neighbouring countries, in line with the provisions of Geneva Agreement 2006, if some of these countries will keep using DTT services in the 694-790 MHz frequency band after 30 June 2020, the usage of the band by the land mobile service and, respectively, by IMT systems in Romania would be severely restricted by the technical conditions of coexistence with the broadcasting service, in order to ensure mutual protection against harmful interference.

Although the EU Member States have the obligation to release the 694-790 MHz band and to make it available for the provision of wireless broadband electronic communications services by 30 June 2020, with the possibility of extending the deadline by up to two years, on the basis of duly justified reasons set out in the Annex to the Decision no. 2017/899/EU of the European Parliament and of the Council, 70% of the Romanian border is with non-EU countries, which are not bound by this obligation.

For the efficient deployment of MFCN networks in the 700 MHz band, this frequency band had to be refarmed in the neighbouring countries in order to relocate DTT services in the 470-694 MHz band and to release the 694-790 MHz band.

Thus, in December 2017, ANCOM signed a Multilateral Framework Agreement with all the neighbouring countries (EU Member States and non-EU countries) that were members of the South European Digital Dividend Forum – SEDDIF, on the re-planning of digital terrestrial television in the 470-694 MHz band. ANCOM also signed bilateral agreements with Bulgaria, Hungary and Serbia, stipulating compliance with the deadlines laid down in Decision (EU) 2017/899 of the European Parliament and of the Council for making available the 700 MHz frequency band for use by terrestrial systems capable of providing wireless broadband electronic communications services in the Union (30 June 2020 and, respectively, 6 September 2020 for Hungary).

In the Republic of Moldova, the 700 MHz band is not used for DTT, while negotiations with Ukraine on the new DTT Plan in the 470-694 MHz band are in the final stage. The agreement could not be finalized because the administration of Ukraine was not able to provide a firm deadline for the switch-off in the 700 MHz band. Negotiations will continue by ANCOM's participation in the BSDDIF regional group (Black Sea Digital Dividend Implementation Forum), in which the Ukrainian administration is a member, as well as by bilateral meetings, so as an agreement on the release of the 700 MHz band should be reached.

At the latest BSDDIF meeting, in December 2018, ANCOM's representatives made an analysis of Ukraine's actual usage of the 700 MHz band in border areas, considering DTT stations in operation with impact on the mobile communications services to be implemented, and proposed

a solution for replacing the DTT channels of those stations with channels in the 470-694 MHz band, which Romania will coordinate in favour of Ukraine. The representatives of Ukraine agreed on the solution and will submit it to the country's decision-makers for approval. They also promised to implement this solution in an agreement at the next meeting, expected to be held in the spring of 2019. The above-mentioned solution involves the priority and gradual replacement of TV channels in the 700 MHz band in the border area with Romania, starting May 1, 2019 - the officially announced date for the switching-off of analogue terrestrial television in Ukraine, provided that this process should be completed no later than June 30, 2020. Moreover, Ukraine's representatives reiterated that no new digital terrestrial television station will be installed in the 700 MHz band on the territory of their country.

In accordance with the provisions of Decision (EU) 2017/899 of the European Parliament and of the Council, ANCOM developed and adopted "The National Roadmap for The Allotment and Future Use of The 470-790 MHz Frequency Band"⁹, a document containing detailed measures planned for the management of the radio spectrum with a view to allotting the 470-790 MHz band, and especially the 694-790 MHz band, as well as the associated regulatory measures.

In this document, ANCOM set out making available 2 x 30 MHz (6 blocks of 2x5 MHz) in the 700 MHz band, respectively the paired frequency bands 703-733 MHz and 758-788 MHz for the provision of MFCN networks in FDD operation mode, as well as 15 MHz (3 blocks of 5 MHz), i.e. the 738-753 MHz sub-band, for SDL MFCN, through a competitive selection procedure for awarding the frequency usage rights in these bands, which will provide for the use of these frequency bands by technologically neutral MFCN networks starting from 30 June 2020.

Furthermore, ANCOM set out allotting the paired sub-bands 698-703 MHz and 753-758 MHz (2x5 MHz) and the paired sub-bands 733-736 MHz and 788-791 MHz (2x3 MHz), for the deployment of a dedicated BB-PPDR communication network, in addition to the 2x30 MHz available for MFCN networks in the 700 MHz range, which can be partially used to provide BB-PPDR services through the public electronic communications network infrastructure.

Further regulations relevant for the usage of frequencies in the 700 MHz band for MFCN networks are mentioned in section 10.3.1. of Chapter 10, regarding the technical conditions for the usage of frequencies associated to the usage rights to be awarded in this band.

5.2.2. Technical regulations on the usage of the 800 MHz band

According to the provisions of the NTFA, corroborated with the provisions of Government Emergency Ordinance no. 11/2012, the 790-862 MHz frequency band (*the 800 MHz band*) is allocated for non-governmental use.

Concerning the applications allowed in the 790-862 MHz band and the harmonized technical conditions for the use of this band, the provisions of the Commission Decision no. 2010/267/EU on harmonised technical conditions of use in the 790-862 MHz frequency band for terrestrial systems capable of providing electronic communications services in the European Union (TRA-ECS) shall apply.

Thus, the electronic communications systems that can use the 790-862 MHz band are terrestrial systems complying with Decision 2010/267/EU. Any available technology that complies with the harmonized technical conditions established by the above-mentioned Decision may be used.

Moreover, the provisions of the Decision of the Electronic Communications Committee (ECC) of the European Conference of Postal and Telecommunications Administrations (CEPT) ECC/DEC/(09)03 on harmonised conditions for mobile/fixed communications networks (MFCN) operating in the band 790 - 862 MHz are also applicable.

⁹ http://www.ancom.org.ro/en/uploads/links_files/Foiaia_de_parcuru_pentru_banda_UHF_470-790_MHz_en.pdf

Further relevant technical regulations are mentioned in section 10.3.2. of Chapter 10.

5.2.3. Technical regulations on the usage of the 1500 MHz band

In accordance with the provisions of the NTFA, the 1452-1492 MHz band is allocated to the broadcasting service, to the broadcasting-satellite service and to the mobile service – excepting the aeronautical mobile service – on a primary basis.

The 1452-1492 MHz band was not identified at WRC-15 for IMT systems in the CEPT countries because of opposition from the countries of the Regional Commonwealth in the field of Communications (RCC), which laid down certain conditions for the usage of this band by IMT, for reasons related to the protection of the aeronautical mobile service used for aeronautical telemetry in these countries (in accordance with No. 5.342 of Art. 5 of RR-ITU, providing an additional allocation for the aeronautical mobile service in these countries). Consequently, the identification of the 1452-1492 MHz band for IMT in Region 1 of the ITU is limited to some countries in Africa and the Middle East (according to No 5.346 of Article 5 of the RR-ITU).

However, the band is harmonized in the European Union for terrestrial systems capable of providing electronic communications services within the Union, in accordance with the provisions of Commission Implementing Decision (EU) 2015/750, amended by Commission Implementing Decision (EU) 2018/661.

WRC-15 identified the frequency bands 1427-1452 MHz and 1492-1518 for IMT systems on a global level. In ITU Region 1, including the European Union, these frequency bands are allocated, on a primary basis, to the mobile service - except aeronautical mobile - and to the fixed service, as well as to the Earth exploration service (Earth-to-space) (in the band 1427-1429 MHz).

In accordance with the provisions of No. 5.341A of Art. 5 of RR-ITU (2016), in Region 1, the frequency bands 1427-1452 MHz and 1492-1518 MHz have been identified for IMT. This identification does not exclude the use of the frequency bands by any other applications in the radiocommunications services for which the band has been allocated and does not set a priority within the RR-ITU. The use of IMT stations in these bands is conditioned by obtaining the agreement under Art. 9.21 of RR-ITU as to the aeronautical mobile service used for aeronautical telemetry in accordance with No. 5.342 of Art. 5 of RR-ITU.

According to No. 5.342, in Ukraine, the frequency band 1429-1535 MHz is allocated also to the aeronautical mobile service on a primary basis, exclusively for aeronautical telemetry purposes on the national territory. After 1 April 2007, the use of the frequency band 1452-1492 MHz for aeronautical telemetry is conditioned by agreement between the administrations involved.

Commission Implementing Decision (EU) 2018/661 of 26 April 2018 amends Implementing Decision (EU) 2015/750 by extending the harmonisation of the 1452-1492 MHz band in the 1427-1452 MHz and 1492-1517 MHz frequency bands. It sets out harmonised conditions for making available and efficiently using the whole 1427-1517 MHz band for terrestrial systems capable of providing electronic communications services in the Union.

At CEPT level, the provisions of Decision ECC (13)03 on the harmonised use of the frequency band 1452-1492 MHz for Mobile/Fixed Communications Networks Supplemental Downlink (MFCN – SDL), approved on 8 November 2013, amended on 2 March 2018.

Concerning the 1427-1452 MHz and 1492-1517 MHz bands, at CEPT level, the provisions of Decision ECC (17)06 on the harmonised use of the frequency bands 1427-1452 MHz and 1492-1518 MHz for Mobile/Fixed Communications Networks Supplemental Downlink (MFCN SDL), approved on 17 November 2017 (reviewed on 2 March 2018), are applicable.

Moreover, a report¹⁰ has been developed and is in the process of being approved within CEPT/ECC regarding the technical criteria for the cross-border coordination on the use of the 1427-1518 MHz band by IMT systems in the land mobile service and by the aeronautical telemetry systems in the aeronautical mobile service on the territory of countries concerned by No. 5.342 of

¹⁰ <https://cept.org/files/9522/Draft%20ECC%20Report%20296.docx>

Art. 5 of RR-ITU. The technical report is aimed at offering guidance to administrations with a view to concluding bilateral technical agreements between the countries involved.

Ukraine has aeronautical telemetry systems in operation in the 1429-1535 MHz on its territory, for the protection of which cross-border coordination is required with the IMT systems to be implemented on the territory of Romania.

In Romania, the 1452-1492 MHz band is not used by the broadcasting service, nor by the broadcasting-satellite service, being available for use by IMT systems.

The 1427-1452 MHz and 1492-1518 bands are currently allocated for shared non-governmental/governmental use, in accordance with the provisions of the NTFA. In the 1492-1518 MHz, radio-relay links for low-capacity data transmissions are in operation.

Since the 1427-1517 MHz band is not wholly released for making it available for use by IMT (MFCN) systems, in a first stage, ANCOM will allot only the 1452-1492 MHz band for the supplemental downlink of MFCN networks.

Other relevant technical regulations are mentioned in section 10.3.3. of Chapter 10.

5.2.4. Technical regulations on the usage of the 2600 MHz band

According to the provisions of the NTFA, corroborated with the provisions of Government Emergency Ordinance no. 11/2012, the 2500-2690 MHz band (*2600 MHz band*) is allocated for non-governmental use.

Concerning the applications allowed in the 2500-2690 MHz band and the harmonized technical conditions for the use of this band, the provisions of the Commission Decision 2008/477/EC on the harmonisation of the 2500-2690 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community (TRA-ECS) shall apply.

The electronic communications systems that can use the 2500-2690 MHz band are terrestrial systems that comply with the block edge masks (BEM) as set out in the Annex to Decision 2008/477/EC. Any available technology that complies with the harmonized technical conditions established by the above-mentioned Decision may be used.

Moreover, the provisions of Decision ECC/DEC/(05)05 on the harmonised utilization of spectrum for Mobile/Fixed Communications Networks (MFCN) operating in the 2500-2690 MHz band, approved on 18 March 2005, amended on 3 July 2015 are applicable for this band.

Other relevant technical regulations are mentioned in section 10.3.4. of Chapter 10.

5.2.5. Technical regulations on the usage of the 3400-3800 MHz band

5.2.5.1. Frequency band allocations, designation for various types of applications

A. Global level (ITU)

For the 3400-3600 MHz band, in Region 1 (where Romania is included), Art. 5 of ITU's Radiocommunication Regulation (2016 edition) provides the following:

- allocations on a primary basis for the radiocommunication services: fixed, fixed-satellite (space-to-Earth) and mobile (except aeronautical mobile);
- allocations on a secondary basis for the radiolocation service.

Nevertheless, footnote No. 5.430A - relevant for the above-mentioned mobile service - provides that the allocation of the frequency band 3400-3600 MHz to the mobile, except aeronautical mobile, service is subject to prior cross-border coordination on the use of frequencies with the potentially affected administrations. Within the same footnote, the 3400-3600 MHz frequency band is identified for systems in the International Mobile Telecommunications (IMT).

The footnote also includes a set of restrictive technical conditions for base stations or mobile stations (operating in the mobile service), relevant conditions in the process of coordination with Earth stations of other potentially affected administrations, aimed at protecting Earth stations

in satellite communications services. In addition, stations operating in the mobile service in this band benefit from limited protection from space stations of satellite communications services.

For the 3600-4200 MHz frequency band (which includes the 3600-3800 MHz band, relevant for this Position Paper), in Region 1 (where Romania is included), Art. 5 of ITU's Radiocommunication Regulation (2016 edition) provides the following:

- allocations on a primary basis for the radiocommunication services: fixed, fixed-satellite (space-to-Earth);
- allocation on a secondary basis for the mobile service.

B. Regional level (CEPT)

According to the European Common Table of Frequency Allocations (ECA), contained in the ERC 25 Report (October 2018 edition), the allocations harmonized at CEPT level for the 3400-3600 MHz band are as follows:

- primary allocations for the following radiocommunications services: fixed, fixed-satellite (space-to-Earth), mobile (except aeronautical mobile),
- allocations on a secondary basis for the amateur and radiolocation services.

The ECA stipulates that the allocations for the two services with secondary status are limited to 3410 MHz. Thus, in the 3400-3410 MHz sub-band, the ECA recommends, on a secondary basis, civilian and military radiolocation applications (radars placed on aircraft, as an extension of the primary allocation for the radiolocation service in the 3300-3400 MHz band) and amateur applications.

Therefore, in order to ensure radio-electric compatibility between systems operating in adjacent bands, the rights frequencies usage rights in this band were awarded in 2015 above the 3410 MHz threshold, which represents the edge of the lower side guard strip for the arrangement of radio channel type FDD in this band (note: however, the TDD channel arrangement in the above-mentioned band starts at 3400 MHz).

For the entire 3400-3600 MHz band, the ECA recommends the following harmonised applications, according to the options of the CEPT member countries and to their national context:

- MFCN (mobile/fixed communications networks) applications, based on Decision no. ECC/DEC/(11) 06 (amended in 2014 and 2018) and ECC/REC/(15)01; the ECA also recognizes the use of this band for IMT applications, based on the RR-ITU (footnote above);
- fixed-satellite applications (Earth stations);
- generic UWB applications, based on the following CEPT regulations: ECC/DEC/(06)04, ECC/REC/(11)09, ECC/REC/(11)10
- PMSE applications (only in some European countries, Romania not included); these applications consist of occasional broadcasts for the production of audio-visual materials for radio and TV (outside studios), and include ENG-OB applications (consisting of temporary, occasional broadcasts to studios, reportages, news, shows, cultural/sports events and other audio-visual materials produced outside studios).

According to the European Common Table of Frequency Allocations (ECA), contained in the ERC 25 Report (October 2018 edition), the allocations harmonized at CEPT level for the 3600-3800 MHz frequency band are as follows:

- allocations on a primary basis for radiocommunication services: fixed, fixed-satellite (space-to-Earth), mobile;
- there are no secondary allocations in this frequency band.

For the 3600-3800 MHz band, the ECA recommends the following harmonized applications, according to the options of CEPT member countries and their national context:

- MFCN (mobile/fixed communications networks) applications, based on Decision no. ECC/DEC/(11)06 (amended in 2014 and 2018) and ECC/REC/(15)01;

- medium/high capacity point-to-point fixed links (based on Recommendation ERC/REC 12-08), within the 3600-4200 MHz band;
- fixed satellite applications (Earth stations), with priority for civil networks, within the 3600-4200 MHz band;
- Earth Stations on Vessels (ESV) (based on Decision No. ECC/DEC/(05)09) within the 3700-4200 MHz band;
- generic UWB applications based on the following CEPT regulations: ECC/DEC/(06)04, ECC/REC/(11)09, ECC/REC/(11)10.

Regarding the applications of interest for this position paper, for the entire 3400-3800 MHz band, CEPT Decision ECC/DEC/(11)06 on Harmonised frequency arrangements and least restrictive technical conditions (LRTC) for mobile/fixed communications networks (MFCN) operating in the band 3400-3800 MHz, adopted on 09 December 2011 and modified (for the second time) on 26 October 2018, shall apply.

C. EU level

Concerning the above-mentioned frequency band, the European Commission issued Decision 2008/411/EC of 21 May 2008 on the harmonisation of the 3400 - 3800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community.

This Decision, which contains provisions on the harmonization of the use of radio frequencies within the European Community, was adopted based on Decision of the European Parliament and of the Council no. 676/2002/EC and is, according to European Union rules, mandatory for national implementation.

Decision no. 2008/411/EC was implemented in Romania through the National Radio Frequency Band Award (TNABF), edition 2009, approved by the MCSI Order no. 789/11.11.2009, published in the Romanian Official Journal, Part I, no. 834 and 834bis of 03.12.2009.

Commission Implementing Decision 2014/276/EU of 2 May 2014 amended Decision 2008/411/EC, updating its annex (which contains technical provisions for the use of the respective band).

Recently, a new draft EC decision amending Decision 2008/411/EC has been finalized at EC level. This new project has been adopted and will be published by the EC in the near future. It also amends the modified annex to the initial decision. The most important change is that the TDD channelling is mandatory in the 3400-3600 MHz band, replacing the optional channelling (FDD and TDD) for this band, as foreseen in the current Decision (2008/411/EC as amended by 2014/276/EU).

Moreover, the new European Electronic Communications Code adopted by the European Parliament and by the Council by Directive (EU) 2018/1972 of 11 December 2018 sets the deadline of 31 December 2020 for the implementation of the new technical provisions on the use of the 3400-3800 MHz frequency band, contained in the annex to the new draft decision adopted for this band, as mentioned above.

The new EC decision on the harmonized use of the 3400-3800 MHz band will be implemented in Romania through this Position Paper and through the Terms of Reference to be prepared (based on this Position Paper) during the selection procedure to be organized in the 3.4-3.8 GHz band. The Terms of Reference will be developed and published after the adoption of this Position Paper, after the publication of the new EC decision.

D. NATO level

No harmonised applications of military interest are provided in this frequency band.

E. National level

In the National Table of Frequency Allocations (NTFA) - 2009 edition, as subsequently amended (MCIS Order no.701/30.07.2010, published in the Romanian Official Journal, Part I, No. 629 of 07.09.2010, and by ANCOM President's Decision No. 1640/14.10.2011, published in the Romanian Official Journal, Part I, No. 765 of 30.10.2011), the allocations for the 3400-3600 MHz and 3600-3800 MHz bands coincide with those in the ECA.

Concerning the applications allowed by the NTFA in the 3400-3800 MHz band, it is worth mentioning that at present ANCOM is updating this Table, considering the most recent editions of the ITU RR and ERC 25 (ECA table).

Under the current NTFA, the entire 3400-3600 MHz band is allocated for non-governmental use (NG status). However, the fact that the 3400-3410 MHz sub-band can be used by aircraft radar - a preferred application for government systems - implies the possibility of operating government equipment in the sub-band for such applications.

In accordance with the NTFA in force, the 3600-3800 MHz band is allocated as follows:

- the 3600-3685 MHz sub-band for non-governmental (NG) use,
- the 3685-3700 MHz sub-band for shared governmental/non-governmental use (G/NG), as it has switched from non-governmental (NG) use as of September 2010, according to MCIS Order no. 701/30.07.2010, published in the Romanian Official Journal, Part I, no. 629 / 07.09.2010;
- the 3700-3800 MHz sub-band for non-governmental (NG) use.

As mentioned above, the NTFA is currently being reviewed, and the 3600-3800 MHz band allocation will be updated as follows:

- the 3600-3645 MHz sub-band will remain allocated for NG use;
- the 3645-3655 MHz sub-band will be allocated for shared G(A)/NG use;
- the 3655-3700 MHz sub-band will be allocated for shared G(A)/NG use;
- the 3700-3800 MHz sub-band will remain allocated for NG use.

It is worth mentioning that the allocations of the different frequency sub-bands in the 3600-3800 MHz band (specified above) will be valid until 31.12.2025. After that date, the entire 3600-3800 MHz band will be allocated for NG use.

5.2.5.2. Other technical regulations on the usage of this frequency band

In addition to the CEPT Decision ECC/DEC/(11)06 updated in 2018 and ECC/REC/(15)01 modified in 2016 (and targeting cross-border co-ordination for MFCN networks including in the 3400-3800 MHz band), other relevant technical regulations for this frequency band are the following:

- CEPT report 67 containing the CEPT response to the EC *Mandate to develop harmonised technical conditions for spectrum use in support of the introduction of next-generation (5G) terrestrial wireless systems in the Union*, the section on the examination of harmonized technical conditions for the 3400-3800 MHz band;
- ECC Report 287 containing Guidance on defragmentation of the frequency band 3400-3800 MHz;
- ECC Report 281 on the Analysis of the suitability of the regulatory technical conditions for 5G MFCN operation in the 3400-3800 MHz band;
- ECC Report 278 on Specific UWB applications in the bands 3.4-4.8 GHz and 6.0-8.5 GHz.

A Draft ECC report on technical issues on the synchronized MFCN operation in the 3400-3800 MHz band. The document presents technical tools for national administrations to manage the coexistence of MFCNs operating in the band in question in synchronized, unsynchronized and semi-synchronized modes of operation, thus assisting them in choosing options for the national regulatory framework on the synchronization regime.

5.2.6. Technical regulations on the usage of the 24.25-27.5 GHz band

5.2.6.1. Frequency band allocations and designation for various applications

A. Global level (ITU)

Art. 5 of RR-ITU (2016 edition) provides, for the frequency band 24.25-27.5 GHz – in Region 1, where Romania is located – a contiguous allocation for the fixed service, on a primary basis. Portions of the 24.45-27.5 GHz band are allocated also for other radiocommunications services, as follows:

- a) in the 24.45-24.65 GHz sub-band there is a primary allocation for the inter-satellite service (communications among the Earth's artificial satellites);
- b) in the 24.65-24.75 GHz sub-band there are primary allocations for the following radiocommunication services: inter-satellite and fixed-satellite (Earth-to-space);
- c) in the 24.75-25.25 GHz sub-band there is a primary allocation for the fixed-satellite service (Earth-to-space);
- d) in the 25.25-25.50 GHz sub-band there are primary allocations for the mobile and inter-satellite radiocommunication services and a secondary allocation for the standard frequency and time signal-satellite service;
- e) in the 25.5-27.0 GHz sub-band there are primary allocations for the following radiocommunication services: mobile, inter-satellite, space research (space-to-Earth), Earth exploration-satellite (space-to-Earth) and a secondary allocation for the standard frequency and time signal-satellite service (Earth-to-space);
- f) in the 27.0-27.5 GHz sub-bands there are primary allocations for the mobile and inter-satellite radiocommunication services.

It is noteworthy that the 24.25-27.5 GHz band is one of the bands mentioned in Resolution 238 (elaborated in WRC-15), which requires sharing and compatibility studies to ensure radio-electric protection for the existing radiocommunication services – on the one hand – and studies to assess the spectrum needs for the IMT terrestrial component – on the other hand – with a view to introducing IMT systems in portion(s) of the frequency range between 24.25 and 86 GHz for the future development of IMT-2020 and beyond.

The results of all studies conducted within the ITU-R following the requirements of Resolution 238 (WRC-15) will be considered and examined in the context of item 1.13 on the agenda of the World Radiocommunication Conference 2019 (WRC-19) - the most important event (every four years) in the field of world radiocommunications, which will take place during October-November 2019.

Following the WRC-19 debates, the most appropriate decisions will be taken as regards the overall harmonization of the use of the spectrum to be designated for IMT-2020 and beyond, in very high frequency bands, for the next four years.

B. Regional level (CEPT)

According to the European Common Table of Frequency Allocations (ECA), contained in the ERC 25 Report (October 2018 edition), the frequency band 24.25-27.5 GHz contains one allocation harmonized at CEPT level for the fixed service.

Parts of the frequency band 24.25-27.5 GHz (with one exception) contain allocations harmonized at CEPT level for various other radiocommunication services, as follows:

- a) in the 24.25-24.5 GHz sub-band there is a primary allocation for the mobile service;
- b) in the 24.65-25.25 GHz sub-band there is a primary allocation for the fixed-satellite service (Earth-to-space);
- c) in the 25.25-25.50 GHz sub-band there are primary allocations for the mobile and inter-satellite services;

d) in the 25.5-27.0 GHz there are primary allocations for the radiocommunication services: mobile, inter-satellite and space research (space-to-Earth), and a secondary allocation for the Earth exploration-satellite service (space-to-Earth).

e) in the 27.0-27.5 GHz sub-band there are primary allocations for the radiocommunication services: mobile and inter-satellite, as well as a secondary allocation for the Earth exploration-satellite service (space-to-Earth).

For the 24.25-24.5 GHz band, the ECA recommends the following harmonized applications, according to the options of CEPT member countries and their national context:

1) point-to-point links, based on CEPT Recommendation T/R 13-02, a document containing channelling arrangements for the 26 GHz band as well;

2) PMSE applications, based on Recommendation ERC/REC 25-10;

3) MFCN applications, based on Decision ECC/DEC/(18)06;

4) radiodetermination professional short-range applications such as industrial Level Probing Radars/Tank Level Probing Radars (LPR/TLPR), based on Decision no. ECC/DEC/(11)02 and Recommendation ERC/REC 70-03;

5) Automotive Short-Range Radars (SRR) (collision mitigation and traffic safety applications), based on Decision ECC/DEC/(04)10 (amended in June 2012) and on Recommendation ERC/REC 70-03.

For the 24.5-26.5 GHz band, the ECA recommends the following harmonized applications, according to the options of CEPT member countries and their national context:

1) point-to-point links, based on CEPT Recommendation T/R 13-02, a document containing channelling arrangements for the 26 GHz band as well;

2) FWA applications, based on Recommendation ECC/REC/(11)01, a document containing various channelling scenarios for broadband FWA networks, for the 26 GHz band as well;

3) MFCN applications, based on Decision ECC/DEC/(18)06;

4) radiodetermination professional short-range applications such as industrial Level Probing Radars/Tank Level Probing Radars (LPR/TLPR), based on Decision no. ECC/DEC/(11)02 and Recommendation ERC/REC 70-03;

5) Automotive Short-Range Radars (SRR) (collision mitigation and traffic safety applications), based on Decision ECC/DEC/(04)10 (amended in June 2012) and on Recommendation ERC/REC 70-03.

For the frequency band 26.5-27.5 GHz, the ECA recommends the following harmonized applications, according to the options of CEPT member countries and their national context:

1) MFCN applications, based on Decision ECC/DEC/(18)06;

2) radiodetermination professional short-range applications such as industrial Tank Level Probing Radars (TLPR), in the 26.5-27.0 GHz band, based on Recommendation ERC/REC 70-03;

3) Automotive Short-Range Radars (SRR) (collision mitigation and traffic safety applications), in the 26.5-26.65 GHz band, based on Decision ECC/DEC/(04)10 (amended in June 2012) and on Recommendation ERC/REC 70-03;

4) land military systems.

C. EU level

Currently, there are no European Commission (EC) decisions harmonizing the use of this frequency band for the provision of public electronic communications networks and services in the Union.

It is important to note, however, that a draft EC decision on the harmonization at EU level of the use of the 24.25-27.5 GHz band for the provision of public networks and electronic communications services is being developed. This draft decision is expected to be adopted and published by the EC later this year.

Furthermore, the new European Electronic Communications Code (adopted by the European Parliament and by the Council by Directive (EU) 2018/1972 of 11 December 2018) sets the deadline of 31 December 2020 for the implementation of the new technical provisions on the use of the frequency band 24.25-27.5 GHz, as provided in the annex to the above-mentioned draft decision. More specifically, the aforementioned term refers to making available a spectrum quantity of at least 1 GHz for use if there are strong market demands on the market and there are no significant restrictions on the migration of existing users in that sub-band and its release. The Directive also provides for the possibility of extending that term for reasons relating, inter alia, to the difficulties encountered in refarming the respective band.

For TLPR radiodetermination short-range applications and for Automotive Short-Range Radars (SRR) there are European Commission decisions that provide harmonized technical conditions, without ensuring radioelectric protection, for the use of the respective band by these types of applications, and their exemption from licensing.

Thus, the use of the spectrum by automotive short-range radar equipment in the Community is regulated by Decision 2005/50/EC, as amended by Commission Implementing Decision 2011/485/EU.

LPR/TLPR (Level Probing Radars/Tank Level Probing Radars) radiodetermination short-range applications use ultra-wideband modulation techniques (UWB).

TLPR applications use spectrum in accordance with Commission Decision 2009/381/EC, successively amended by Decisions 2010/368/EU, 2011/829/EU, 2013/752/EU and Commission Implementing Decision (EU) 2017/1483. LPR applications use the frequency spectrum in accordance with Commission Decision 2013/752/EU as amended by Commission Implementing Decision (EU) 2017/1483. LPR applications use the frequency spectrum in accordance with the provisions of Commission Implementing Decision no. 2013/752/EU amending Decision 2006/771/EC on the harmonisation of the radio spectrum for use by short-range devices and repealing Decision 2005/928/EC, subsequently modified by Commission Implementing Decision (EU) 2017/1483 of 8 August 2017 amending Decision 2006/771/EC on harmonisation of the radio spectrum for use by short-range devices and repealing Decision 2006/804/EC.

D. NATO level

There are no harmonized applications of military interest in the 24.25-26.5 GHz frequency band, as the band concerned has non-governmental use status in Europe.

The 26.5-27.5 GHz frequency band is harmonized at NATO level and is included in the 2014 NJFA agreement.

E. National level

In the NTFA, approved by the MCIS Order no. 789/2009 with the subsequent amendments (MCIS Order no. 701/30.07.2010, published in the Romanian Official Journal, Part I, no. 629 of 07 September 2010 and ANCOM President's Decision no. 1640/14.10.2011, published in the Romanian Official Journal, Part I, no. 765/31 October 2011), the frequency band 24.25-27.5 GHz contains a contiguous allocation on a primary basis for the fixed service. Portions of the frequency band 24.25-27.5 GHz (excepting one portion) are also allocated to other radiocommunication services, as follows:

a) in the sub-band 24.25-24.5 GHz there is an allocation on a primary basis for the mobile service;

b) in the sub-band 25.25-25.50 GHz there are primary allocations for the mobile and inter-satellite radiocommunication services;

c) in the 25.5-27.0 GHz sub-band there are primary allocations for the following radiocommunication services: mobile, inter-satellite and space research (space-to-Earth), as well as a secondary allocation for the Earth exploration-satellite service (space-to-Earth).

d) in the 27.0-27.5 GHz sub-band there are primary allocations for the following radiocommunication services: mobile and inter-satellite, as well as a secondary allocation for the Earth exploration-satellite service (space-to-Earth).

Concerning the applications allowed by the NTFA in the 24.25-27.5 GHz band, it is worth mentioning that at present ANCOM is updating this Table, considering the most recent editions of the ITU RR and ERC Report 25 (ECA table).

Under the current NTFA, the 24.25-27.5 GHz band is allocated as follows:

- the 24.25-24.5 GHz sub-band is allocated for non-governmental (NG) use;
- the 24.5-26.5 GHz sub-band is allocated for non-governmental (NG) use;
- the 26.5-27.5 GHz sub-band is allocated for shared governmental/non-governmental G(A)/NG use.

5.2.6.2. Other technical regulations on the usage of this frequency band

Besides CEPT Decision ECC/DEC/(18)06 of 6 July 2018 on the harmonised technical conditions for Mobile/Fixed Communications Networks (MFCN) in the band 24.25-27.5 GHz, corrected 26 October 2018, there are several draft technical regulations relevant for this frequency band, all currently in progress (excepting the first one), as follows:

- CEPT Report 68 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" – section regarding the harmonised technical conditions for the 24.25-27.5 GHz frequency band;
- draft Recommendation regarding the shared use of the 26 GHz band by 5G networks and Earth stations in the Earth exploration-satellite and space research services;
- draft Recommendation regarding the shared use of the 26 GHz band by 5G networks and Earth stations in the fixed-satellite service;
- draft ECC Report on Guidance to administrations for Coexistence between 5G and Fixed Links in the 26 GHz ("Toolbox");
- draft ECC Report on technical issues regarding network synchronisation in the 26 GHz band.

6. Future technologies - 5G

"5G" is the term used with reference to the next (fifth) generation of mobile telecommunication technologies, also known as IMT-2020 (International Mobile Telecommunications - 2020) in ITU terms.

The "5G" concept stands for both an evolution of radio networks, to meet future data transmission requirements, but also a revolution in architecture, which will allow the development of flexible networks at efficient costs. The 5G network will give the users a notion of infinite Internet or of endless capacity on the network, which means that there will always be enough available capacity for any kind of data transfer required. With the flexibility of configuring and allocating limited resources/capacity both in time and in space, the network will be able to respond to local data demand by providing enough capacity to meet real-time service needs.

It is expected that 5G will integrate the new radio access networks with previous generations (3G, 4G, Wi-Fi) radio access technologies without interruption. Thus, 5G means converging previous technology generations. This is the first time when a new generation of technologies integrates preceding ones into a new contiguous and dynamic radio access network, through connectivity management mechanisms.

On a global level, progress has been achieved in setting targets, defining applications for the new connectivity generations and in testing technologies.

5G will enable connecting billions of IoT users and smart objects (Internet of Things), transmitting high amounts of data with very low latency, the provision of secure and reliable transmissions everywhere. Also, 5G technologies will be more efficient and will allow cost savings per unit of data carried.

At present, regulatory and standardization bodies, industry and academia work together to develop the 5G technologies. The proposed 5G objectives are: Providing uninterrupted coverage, very high end-to-end data transfer rates, very low latency, high reliability of the communications and low power consumption. The applications considered include improved broadband communications, large-scale machine-to-machine (M2M) communications, Internet of Things (IoT), health applications, residential automation, industrial automation and sensors.

5G technologies will enrich the global communications ecosystem by improving mobile broadband communications, expanding the range of applications that may be implemented by increasing data transfer speeds, on the one hand, and the ability to integrate IoT devices on the other. These objectives will be achieved by adopting new, more efficient radiocommunication techniques and system architectures that use a wide range of radio spectrum bands, from the traditional mobile communications bands up to the frequency bands in the millimetric Wave range (above 24 GHz).

6.1. Categories of 5G uses

Compared with previous generations, 5G will be different due to new and improved capabilities that enable a wide range of uses and applications. The usage scenarios for IMT 2020 and beyond include:

- Enhanced mobile broadband communications (eMBB¹¹): Broadband mobile communications deal with person-centred uses for access to multi-media content, services, and data. The demand for broadband mobile communications will continue to grow, leading to improved mobile broadband communications. The enhanced mobile usage scenario will bring along new application areas and additional requirements to existing mobile broadband applications. This usage scenario covers a variety of cases, including coverage of extensive or limited (hotspot) areas with different requirements. For the "hotspot" case, for example, for a high-density area, a very high traffic capacity is required, the mobility requirement is low, and the end-to-end data speed is greater than that for covering an extended area. For the coverage of an extended area, ubiquitous coverage and medium or high mobility are desired, with an increased end-to-end data rate compared to existing speeds. However, the data speed requirement may be less demanding compared to the "hotspot" coverage.
- Ultra-reliable and low-latency communications (uRLLC¹²): This usage scenario has stringent requirements for capabilities such as high speed, low latency and high availability. Some examples are the wireless control of industrial manufacturing or manufacturing processes, tele surgery, of automated distribution in a smart network, transport safety and other mission-critical applications.
- Massive machine-type communications (MMTC¹³): This usage scenario is characterized by a very large number of connected devices, typically transmitting a relatively low volume of data that are not delay-sensitive. Devices must have low cost and very high battery autonomy.

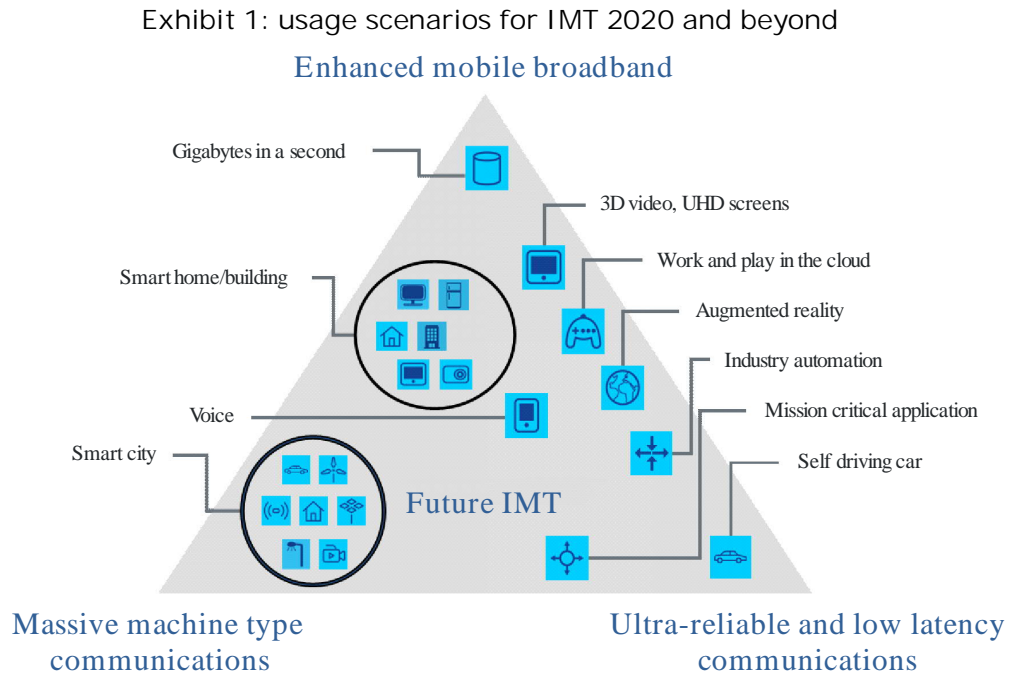
Further use cases, not yet foreseen, are expected to occur. It is therefore necessary for future IMT systems to have the flexibility to adapt to new usage scenarios that may involve a wide range of requirements.

¹¹ Enhanced mobile broadband communications

¹² Ultra-reliable and low latency communications

¹³ Massive Machine Type Communications

Exhibit 1 illustrates examples of IMT usage scenarios foreseen for 2020 and beyond.



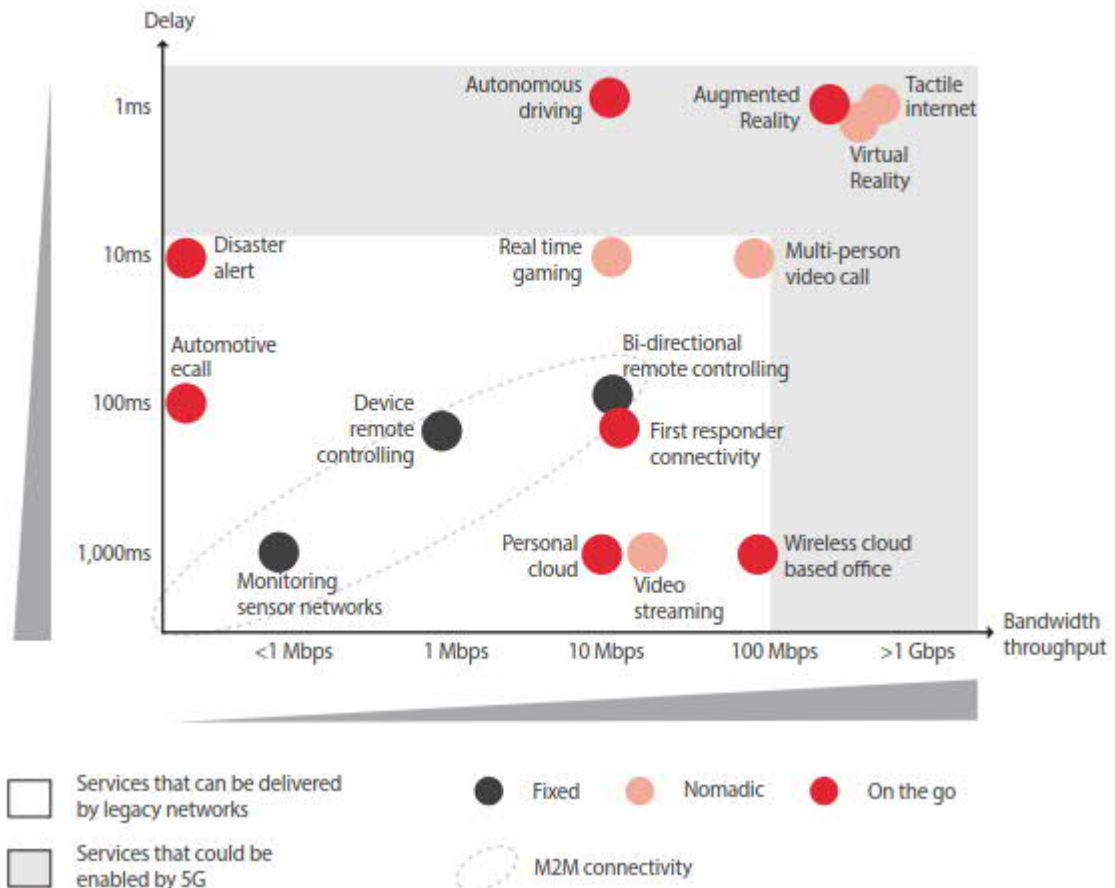
M.2083-02

Source: Recommendation ITU-R M.2083-0 – IMT vision – General framework and main objectives for the future development of IMT 2020 and beyond

Not all applications have the same requirements and need the same performance of 5G networks. Future Internet services must meet a variety of requirements, from low data rates (e.g. data transmitted by sensors and IoT) to very high speeds (e.g. high definition video streaming) and with different latency values (e.g. delays are less tolerated in video conference calls than in video streaming, where buffer-memory can be used). Leaving aside autonomous vehicles, augmented reality and tactile internet, it is considered that many of the applications can be provided, at least theoretically, by existing networks. Networks will have to meet different service quality requirements for different types of applications (e.g. a few seconds delay may be fatal to a tele-surgical application), as the traditional internet offers no guarantee as to when and if the transmitted data reach the end-user.

Exhibit 2 illustrates the bandwidth (data rate) and latency requirements for generic applications.

Exhibit 2 – bandwidth and latency requirements for generic applications



Source: GSMA Intelligence, 2015

6.2. Capabilities and technical requirements for 5G technologies (IMT-2020)

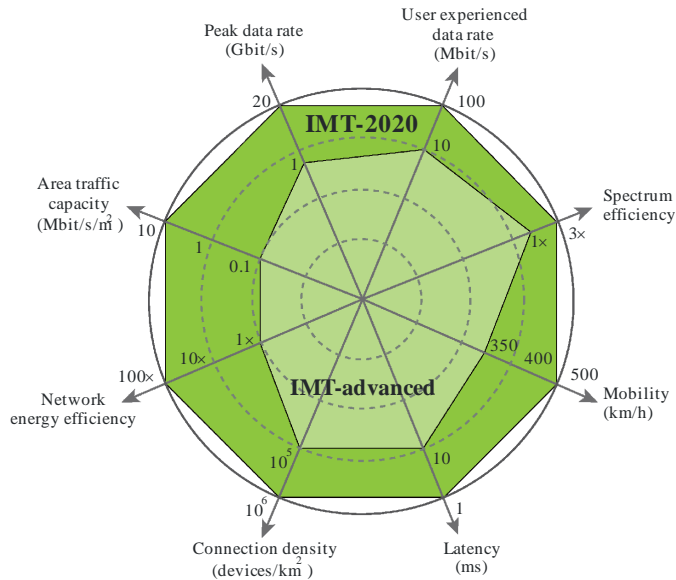
In order to support the delivery of all categories of 5G applications, and in particular of cutting-edge ones such as virtual reality, augmented reality, tactile internet or self-driving cars and connected vehicles, 5G technologies will have to meet a number of technical requirements that ensure the enhanced performance of the previous generation systems. 5G objectives, in terms of overall performance, are quantified as follows:

- peak data speed (downlink): 20 Gbit/s;
- data speed as experienced by the user: from 100 Mbit/s to 1 Gbit/s;
- connection density: at least 1 million devices per km²;
- traffic volume density: 10 Mbit/s/m²;
- peak spectrum efficiency (downlink): 30 bit/s/Hz;
- bandwidth: at least 100 MHz;
- bandwidth in high frequency bands (above 6 GHz): up to 1 GHz
- latency:
 - for eMBB: 4 ms;
 - for uRLCC: 1 ms;
 - mobility: four mobility cases have been defined:
 - stationary: 0 km/h;
 - pedestrian: from 0 km/h to 10 km/h;
 - pedestrian: from 10 km/h to 120 km/h;
 - pedestrian: from 120 km/h to 500 km/h.

A series of 5G challenges have also been identified, as follows:

- 100 times higher traffic capacity (traffic volume density) by area;
- 10-100 times higher number of connected devices;
- 100 times enhanced energy efficiency;
- 10 times longer battery life;
- latency: less than 5 ms;
- ensuring a perceived connection reliability of 99.999%.

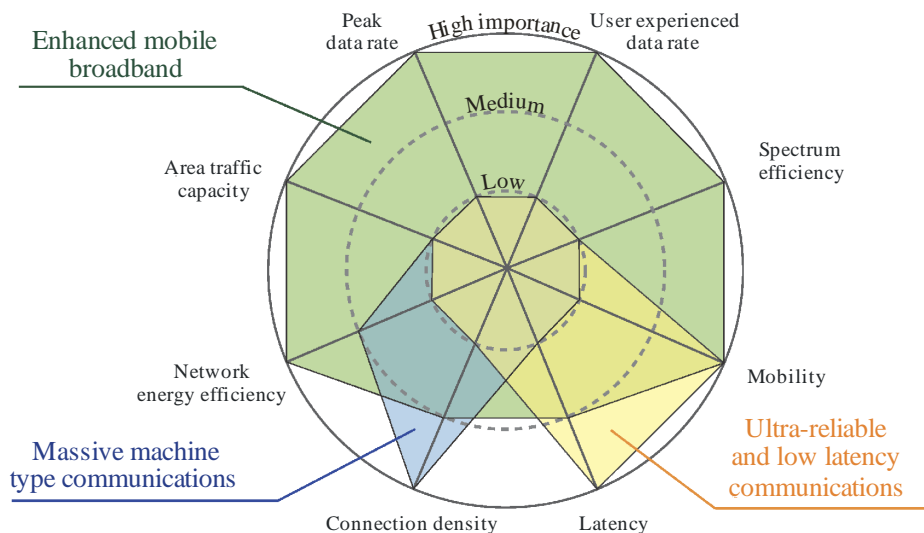
Exhibit 3 presents the improved performance of IMT-2020 (5G) systems compared to that of IMT-Advanced Systems (4G).



M.2083-03

Source: ITU-R Recommendation M.2083-0 - IMT Vision - General framework and main objectives for the future development of the IMT for 2020 and beyond

The importance of each key performance item in each of the above usage scenarios is illustrated in Exhibit 4.



M.2083-04

Source: ITU-R Recommendation M.2083-0 - IMT Vision - General framework and main objectives for the future development of the IMT for 2020 and beyond

6.3. The 5G standardization process

Currently used 3G and 4G mobile communications systems are based on IMT standards developed by the ITU. Detailed specifications for IMT-2000 (3G) have been in place since 2000, while IMT-Advanced (4G/LTE) specifications have been approved by the ITU - Radiocommunications Sector (ITU-R) in 2012. The next step is developing complete 5G specifications (under the ITU concept of IMT-2020) to support future generations of broadband communications and Internet connectivity (IoT). The completion of these specifications at international level is planned for 2020, while the implementation of the 5G is foreseen to start in 2020.

ITU's work on IMT-2020 systems has resulted in a vision and action plan for 5G development. In 2015, the ITU-R published the Recommendation on the vision of future IMT¹⁴ systems. At present, the process of defining technology is under way.

Then the ITU launched the call for proposals for candidate radio interface technologies for the terrestrial component of IMT-2020 systems, as well as the invitation to participate in their subsequent evaluation.

In the next stage, in the year 2017, the ITU working group responsible for IMT systems has finalized the definition of requirements as regards the technical performance¹⁵, criteria and assessment methodology for the new IMT radio interface.

Furthermore, the ITU-R will address spectrum issues for IMT, both for the frequency bands already identified for IMT systems and for the bands under analysis for future use. The entire process is scheduled to end in 2020, when a Recommendation of the ITU-R containing the detailed technical specifications of the IMT-2020 (5G) systems is to be issued.

It is important to underline that IMT standards are developed not only at the ITU level; it is an extensive international collaboration and coordination process, in which, besides the ITU member states, numerous other stakeholders take part: equipment manufacturers, communication networks operators, relevant international, regional and national organizations, partnerships and fora in the field of developing standards.

Proposals for 5G standards are expected to be submitted from October 2017 to mid-2019. The 3GPP¹⁶ (a consortium of industry associations and standardization organizations, including the European Telecommunications Standardization Institute - ETSI) standards for 5G will be published starting 2018 or 2019.

ITU will undertake an evaluation considering the defined criteria, assisted by independent evaluation groups established for this purpose. The participation in these groups is not limited to the ITU members. The evaluation reports of the evaluation groups will be presented and analysed in the ITU responsible working group and will be the basis of the consensus decision on the proposed radio interfaces to be included in the IMT-2020 standard.

Thus, the action plans of relevant standardization bodies, such as ITU and 3GPP, focus on studying technological requirements and adopting standards by 2020.

In December 2017, 3GPP announced having completed the Release 15 standard for the new 5G (5G New Radio - 5G NR) radio interface in a scenario based on existing LTE networks ("non-standalone" scenario), and by mid-2018 the stand-alone version of 5G NR.

Looking ahead, the completion of 3GPP standard Release 16, expected for 2019, will allow full compliance with all ITU requirements for 5G (IMT-2020), while marking the second phase in 5G technology development.

The timetable for the evolution of standardization and development of 5G technologies at international level is illustrated in the figure below:

¹⁴ ITU-R Recommendation M.2083-0 (09/2015) - IMT Vision - General framework and main objectives for the future development of the IMT for 2020 and beyond

¹⁵ ITU-R M.2410-0 (11/2017) - Minimum requirements related to technical performance for IMT-2020 radio interface(s)

¹⁶ Third Generation Partnership Project

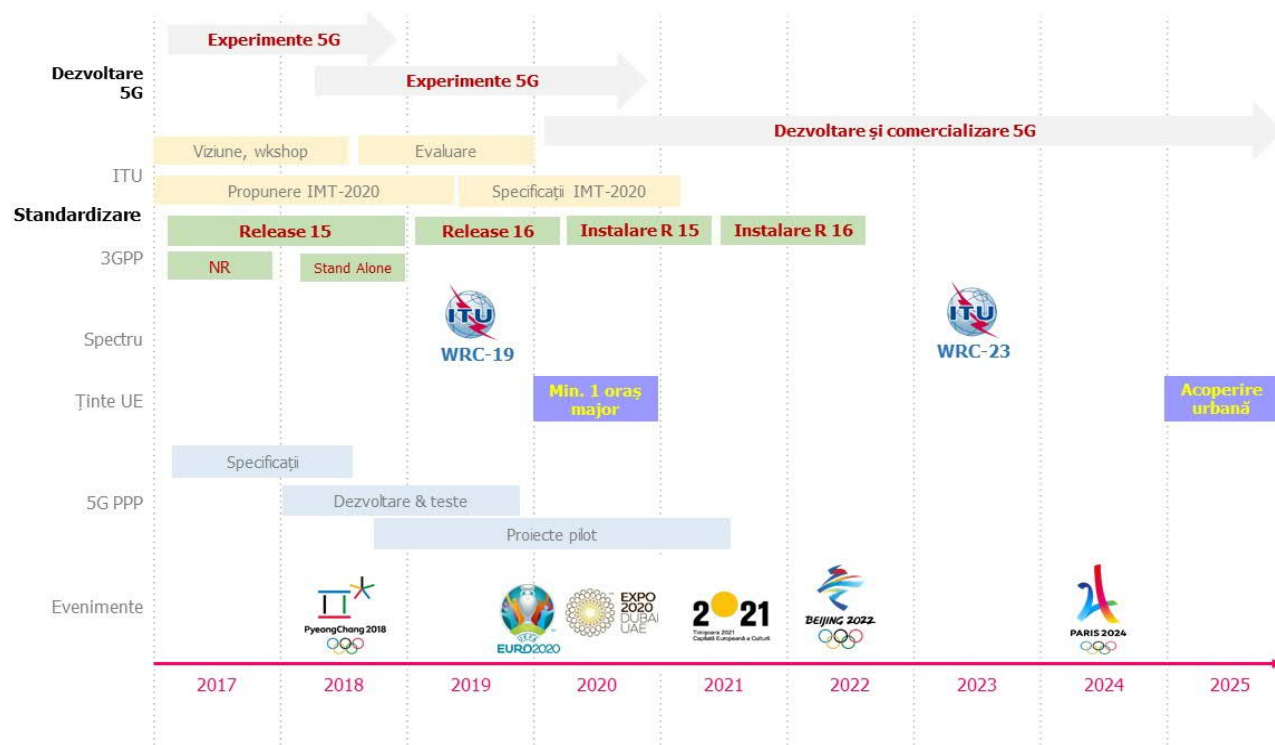


Figure 5 Source: ANCOM, based on Dot-econ and publicly available information

6.4. Radio frequency spectrum for 5G

6.4.1. 5G frequency spectrum harmonisation, on a global level

5G networks will operate in a wide range of frequency bands. In addition to the traditional frequency bands, below 3 GHz, (to which the 700 MHz band will be added), 5G will use the higher radio frequencies of the microwave spectrum (approximately from 24 to 300 GHz), which can provide much larger bandwidths, although propagating over short distances.

Decisions on the global harmonization of radio spectrum use are made at the World Radiocommunication Conference (WRC) meetings, which the ITU hosts every four years, the allocations of the frequency bands for different radiocommunication services and systems being established by the ITU Radio Regulations adopted during the WRC.

As regards the radio spectrum for IMT systems, once with the progress made by the WRC of 2015 (WRC-15) in identifying globally harmonized additional frequency bands and arrangements in the spectrum below 6 GHz for the operation of IMT systems, this WRC acknowledged also potential future requirements for large and contiguous spectrum blocks in the higher frequency bands, needed to develop 5G technologies.

In order to meet the very high 5G data speed requirements, bandwidths much larger than those currently available in 3G and 4G bands are required, which are achievable only in higher frequency bands.

Consequently, WRC-15 decided to introduce the issue of identifying 5G spectrum in the high frequency bands on the agenda of the next WRC, of 2019 (WRC-19), and proposed 11 frequency bands over 24 GHz to be analysed for the purpose of identifying additional frequency bands for the future development of IMT-2020 systems.

The candidate frequency bands for the introduction of IMT-2020 (5G) are the following: 24.25-27.5 GHz; 31.8-33.4 GHz; 37-40.5 GHz; 40.5-42.5 GHz; 42.5-43.5 GHz; 45.5-47 GHz; 47-47.2 GHz; 47.2-50.2 GHz; 50.4-52.6 GHz; 66-76 GHz and 81-86 GHz.

At present, for the preparation of this topic on the WRC-19 agenda, studies are in progress at the ITU level, on the sharing and compatibility of IMT-2020 systems with other radiocommunication services and systems for which these bands are already allocated on the

international level and with the adjacent bands in order to identify new frequency bands for IMT systems in the 24 GHz to 86 GHz frequency spectrum. The globally harmonised bands to be used for the roll-out of 5G technologies will be established at the WRC-19.

6.4.2. 5G frequency spectrum harmonisation measures, on a European level

5G is considered a major driver of industrial transformation¹⁷ by means of broadband radiocommunications services provided at Gbps¹⁸ speeds, providing support for new types of applications that will connect devices and objects (IoT) and by the versatility of software virtualization that will enable innovative business models across multiple activity sectors (e.g. transport, health, manufacturing, logistics, energy, media, entertainment, etc.). These transformations have already started with existing technologies but will need 5G to achieve their full potential in the coming years.

The European Commission's Digital Single Market Strategy (DSM Strategy)¹⁹ and the Communication *Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society*²⁰ emphasizes the importance of very large capacity networks such as 5G networks as a key advantage for Europe to compete in the global market.

The European Commission and the Member States, in cooperation with the RSPG, have recognized the importance of early identification at EU level of common "pioneer" frequency bands to allow the early launch of 5G, starting from 2018²¹.

The following frequency bands harmonised on a European level for terrestrial systems capable of providing broadband electronic communications services could already be made available for future use for 5G networks:

- below 1 GHz: 694-790 MHz (700 MHz band), 790-862 MHz (800 MHz band), 880-915 MHz and 925-960 MHz (900 MHz band);
- above 1 GHz: 1452-1492 MHz (1500 MHz band), 1710-1785 MHz and 1805-1880 MHz (1800 MHz band), 1920-1980 MHz and 2110-2170 MHz (2100 MHz band), 2500-2690 MHz (2600 MHz band), 3400-3800 MHz.

In the document *A strategic roadmap for 5G: "Opinion on spectrum related aspects for next-generation wireless systems"*²², RSPG identified as priority bands for the introduction of 5G mobile communications systems on a European level the following frequency bands:

1. the 3400-3800 MHz band – deemed as the appropriate primary band for the introduction of 5G services before 2020, as it has already been harmonized at European level for MFCN networks and offers large radio channel bandwidths;
2. the 694-790 MHz band – deemed as an important band required to ensure indoor coverage at a national level;
3. the 24.25-27.5 GHz band (the 26 GHz band) – deemed as a "pioneer" band for the early introduction of 5G systems in Europe, by 2020, as it offers more than 3 GHz of contiguous frequency spectrum and enables high, 5G-specific data transfer rates and capacities.

In December 2016, the European Commission issued a mandate to CEPT to develop harmonised technical conditions for spectrum use in support of the introduction of 5G in the European Union.

¹⁷ 5G-PPP, 5G Vision, <https://5g-ppp.eu/wp-content/uploads/2015/02/5G-Vision-Brochure-v1.pdf>

¹⁸ 5G will enable data connections featuring speeds above 10 Gbps, latency below 5 ms and the capacity to use any spectrum resources available (de la Wi-Fi la 4G) and to manage millions of simultaneously connected devices.

¹⁹ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0192&from=EN>

²⁰ final COM (2016) 587, <https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-587-EN-F1-1.PDF>, as well as Staff Working Document SWD (2016) 300 f, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016SC0300&from=EN>

²¹ 5G for Europe Action Plan

²² Document RSPG16-032 FINAL of 9 November 2016

Thus, CEPT was mandated to carry out a series of actions with a view to defining harmonized technical conditions that are sufficiently precise to foster the development of equipment at European level for the introduction of 5G systems in the Union, as follows:

1. Review the harmonized technical conditions applicable to the 3400-3800 MHz frequency band, as a primary 5G band, with view to their suitability for 5G technologies and amend them, if necessary;
2. Study and assess the 24.25-27.5 MHz frequency band as a 5G pioneer band for use under relevant 5G usage scenarios, considering radio co-existence with existing services and systems in the same band or in adjacent bands; in this respect, identify and study common sharing scenarios with incumbent radio services and applications.
The opportunities for interoperability and economies of scale of equipment such as the common tuning range, including the 26 GHz band, with possible 5G use outside Europe shall be considered. The impact of activities carried out outside Europe in the frequency band adjacent to that already considered for 5G use - i.e. 27.5-29.5 GHz (the 28 GHz band) - shall be considered, including a wide range of sharing scenarios to ensure protection of existing and future satellite services in the 28 GHz band.
3. Develop channelling arrangements and harmonized minimal (least restrictive) technical conditions for spectrum use in the 26 GHz frequency band, which are suitable for 5G terrestrial wireless systems, considering the relevant usage and sharing scenarios;
4. Assess requirements for cross-border coordination, including with non-EU countries.

The Electronic Communications Committee (ECC) within the CEPT, at its meeting of November 2016, adopted the CEPT roadmap for 5G, which outlines the main targets to be pursued with a view to harmonising spectrum use for 5G and to preparing for WRC-19 agenda item regarding the identification of frequency bands for IMT systems above 24 GHz. The CEPT roadmap also identifies the related ECC activities aimed at accomplishing these objectives.

The ECC Working Group on IMT Systems (ECC PT1) has developed two CEPT reports on harmonization measures for 5G - CEPT Report 67 on the 3400-3800 MHz band and CEPT Report 68 on the 26GHz band - in response to the mandate received from European Commission. These reports were submitted to the European Commission in July 2018 and underpin the analysis of the Radio Spectrum Committee to develop relevant European Commission regulations for the two frequency bands.

In line with the CEPT Roadmap, ECC PT1 initiated work on harmonization measures for 5G in a first set of frequency bands, especially in 3400-3800 MHz band:

- 3400-3800 MHz: this band has already been harmonized for Mobile/Fixed Communications Networks (MFCN) through Decision ECC/DEC/(11)06.
 - Activities have been carried out to review the harmonized technical conditions contained in the above-mentioned decision in order to ensure their suitability for 5G technologies. In this respect, the ECC Report 281 containing proposals for reviewing the technical conditions was published in July 2018. The proposed amendments reflect the use of active antenna systems (AAS) for 5G. Decision ECC/DEC(11)06 was accordingly reviewed in October 2018.
 - In October 2018, ECC Report 287 was published, offering guidelines for helping administrations in solution for defragmentation the 3.4 - 3.8 GHz band, as licences for the use of this band are in force in many CEPT countries.
 - Draft ECC Report 296, currently under public consultation, is aimed at providing a toolbox for administrations regarding the coexistence of MFCNs in synchronised, unsynchronised and semi-synchronised operation in 3400-3800 MHz band. The Report is planned to be finalized in March 2019.
- 24.25-27.5 GHz: CEPT has identified the 26 GHz band for early European harmonization as it offers over 3 GHz of contiguous spectrum and more favourable propagation characteristics than the higher frequency bands under consideration.

- Studies have been developed on the compatibility of IMT systems with all existing services in the same band and in adjacent bands, in particular for ensuring the protection of existing and future Earth stations in Earth Exploration Satellite Services (EESS) and in Space Research Services (SRS). The ECC working group dedicated to IMT issues was tasked to develop a decision setting the harmonized technical conditions for the introduction of 5G in the 26 GHz band.
- Consequently, ECC PT1 developed Decision ECC/DEC(18)06, setting the harmonized technical conditions for the introduction of 5G systems in the 26 GHz band. The Decision was adopted by ECC and published in July 2018.
- Moreover, ECC PT1 was tasked to develop a technical toolkit to support the national administrations in managing the coexistence of 5G systems with the fixed service (FS), with earth stations of the EESS/SRS and of the fixed satellite service (FSS), and to analyse the options for synchronisation in the band. The Draft ECC Recommendation (19)01²³ on the coexistence with EESS/SRS receiving earth stations in the 26 GHz band is currently under public consultation and is to be finalized in March 2019. Other deliverables are planned to be finalized in July 2019.

The ECC PT1 is also responsible for preparing the WRC-19 agenda item on identifying the frequency bands for IMT 2020/5G above 24 GHz. Studies have already been developed in this working group regarding the pioneer frequency bands and further activities are under way at European level based on the CEPT Roadmap for 5G. ECC PT1 also participated in the relevant activities of ITU-R, within TG 5/1, on the identification of frequency bands for IMT-2020/5G in bands above 24 GHz.

Studies have been developed at European level regarding the sharing and compatibility between IMT-2020 systems and other systems in different radiocommunications services operating in the frequency bands identified by WRC-15 for future 5G use: 24.25-27.5 GHz; 31.8-33.4 GHz; 37-43.5 GHz; 45.5-50.2 GHz; 50.4-52.6 GHz; 66-76 GHz; 81-86 GHz.

The list of priority bands in the CEPT Roadmap was updated in November 2017 as follows:

- 24.25 – 27.5 GHz
- 40.5 – 43.5 GHz
- 66 – 71 GHz

ECC PT1 drew up the draft CEPT European Common Proposal (ECP) for WRC-19, with a view to identifying these bands for IMT.

7. Additional frequency spectrum for MFCN networks

7.1. Additional spectrum requirements for mobile communications networks

With the growing demand for connectivity and access to an ever-wider range of communications services and applications that require intensive data traffic, including new services and innovative applications provided by 5G technologies, making available suitable radio spectrum in a timely manner has become essential for enhancing the future development of mobile broadband systems.

5G technologies will enrich the global communications ecosystem in the future for enhanced mobile broadband communications, expanding the range of possible applications by increasing the data transfer rate and reducing the latency, on the one hand, and through the ability to integrate IoT devices on the other.

²³ [https://cept.org/files/9522/Draft%20ECC%20Recommendation%20\(19\)01.docx](https://cept.org/files/9522/Draft%20ECC%20Recommendation%20(19)01.docx)

The new generation of mobile communications technologies will enable the provision of seamless mobile coverage with very high data transfer rates (peak data rates above 10 Gbps) and very low response time (latency below 5 ms), a very high reliability of communications and low power consumption. These performances will make it possible to transmit an increasing amount of data, connect millions of users and smart objects in the IoT sector, as well as a series of innovative applications that require very high data transfer rates and very low latency.

These objectives will be achieved by adopting new, more efficient radiocommunications techniques and system architectures that use a wide range of radio spectrum bands, from the traditional mobile communications bands (below 3 GHz) up to the frequency bands in the millimetre range (above 24 GHz)²⁴.

Radio spectrum requirements identified at industry level to support the development of 5G technologies are a combination of frequency bands below 1 GHz, between 1 GHz and 6 GHz and over 6 GHz, with different propagation characteristics that offer various advantages.

The frequency spectrum below 1 GHz is important for ensuring effective coverage of extended areas and improved indoor coverage due to the propagation of radio waves over long distances and to their better indoor penetration compared to the frequencies in higher bands.

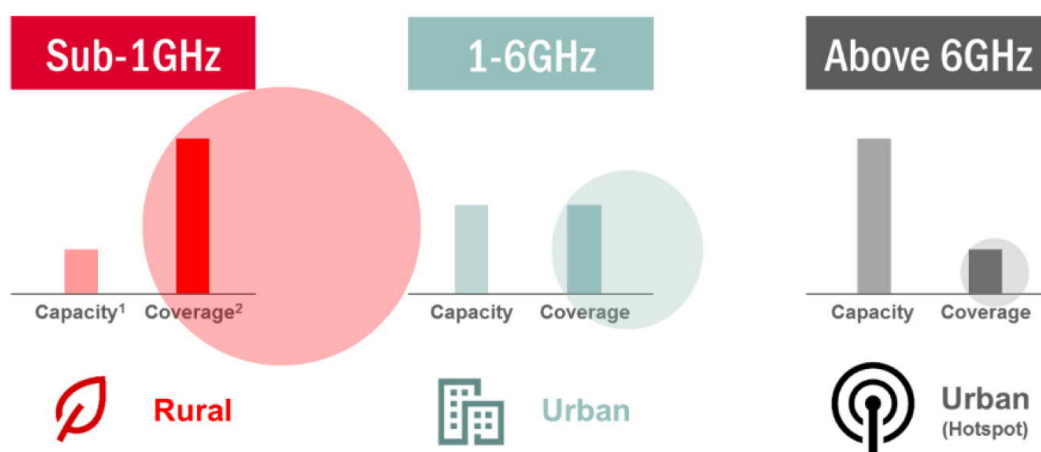
Frequency bands below 1 GHz are suitable to support IoT services and extended mobile broadband coverage in a variety of areas, from urban to suburban and rural areas.

The frequency spectrum between 1 GHz and 6 GHz is suitable for the early introduction of 5G as it offers relatively large bandwidths and a reasonable mix of coverage and capacity for 5G services.

The frequency spectrum above 6 GHz, and especially that above 24 GHz (mmWave spectrum), offers significant capabilities due to radio channels with very large bandwidths that can be allotted for mobile communications networks, which allows the provision of enhanced mobile broadband applications, with very high data rates and very low, 5G-specific latency. This spectrum is suitable for the deployment of small cells and for the provision of 5G services in densely populated urban areas. The disadvantage of using high frequency bands (millimetre waves) is the considerably narrower cell coverage due to their propagation over short distances.

The variety of requirements and spectrum needs involved by the 5G usage scenarios and specific application categories triggers a variety of 5G deployment options along with the different frequency bands suited to support all the usage scenarios.

Exhibit 6 Capacity and coverage for each spectrum category



Source: GSMA, Road to 5G: Introduction and Migration, April 2018

²⁴ Since wavelength is defined as a proportion of the light velocity to wave frequency, a wavelength of 1 mm is obtained at a frequency of 30 GHz; however, it is common practice to use the term *mmWave spectrum* also for the frequency spectrum above 24 GHz.

At European level, the RSPG identified the following frequency bands as priority bands for the early introduction of 5G mobile communications systems in the Union: the 700 MHz (694-790 MHz) band, the 3400-3800 MHz band and the 26 GHz (24.25-27.5 GHz) band.

The 700 MHz band is considered an important frequency band because, similarly to the 800 MHz band, it is suitable to provide efficient coverage over wide areas, as well as improved indoor coverage, due to the propagation of radio waves over longer distances and to better indoor penetration compared to higher frequency bands.

The frequency spectrum available in the 700 MHz band, in addition to that in the 800 MHz band, provides the opportunity for MFCN networks to ensure a cost-effective coverage in rural areas.

Moreover, the 700 MHz band, similarly to other bands below 1 GHz, is suitable for the provision of narrowband IoT services, which require wide area coverage and very good indoor penetration.

The 700 MHz band is extremely useful for the implementation of MFCN networks, due to the benefits of its intrinsic physical features, which allow cost effective coverage with broadband services (including indoors) and promoting new services and broadband radio communications technologies. The 700 MHz band will complement the frequency spectrum below 1 GHz already used for the provision of broadband mobile communications services through LTE technology and will facilitate the deployment of 5G networks and the large-scale introduction of innovative digital services.

The 3400-3800 MHz band is deemed an appropriate primary band for the introduction of 5G services before 2020, as it offers large radio channel bandwidths and a good coverage/capacity balance, ensuring significant capacity growth and supporting enhanced broadband communications, as well as applications requiring low latency and high reliability, such as mission critical applications (industrial automation and robotics).

The 26 GHz band is considered to be a "pioneer" band for early 5G harmonization in the EU by 2020, as it offers more than 3 GHz of contiguous spectrum and enables the provision of ultra-high-density and very high-capacity networks over short distances, as well as revolutionary 5G applications and services, which involve very high data transfer rates, increased capacity and very low latency.

Usually, the frequency spectrum below 1 GHz is used to provide coverage, while the frequency spectrum above 1 GHz is used to provide capacity for mobile communications networks.

Early allocation of the above-mentioned three key bands sets the premises that the development of 5G networks can benefit from the synergies created by the simultaneous use of these bands.

7.2. Frequency spectrum available

In 2019, ANCOM will make available to the providers of public wireless broadband electronic communications networks and services, the following spectrum amounts in the frequency bands 700 MHz, 800 MHz, 1500 MHz, 2600 MHz and 3400-3800 MHz:

- 2 x 30 MHz (FDD) in the 700 MHz band;
- 1 x 15 MHz (SDL) in the 700 MHz band;
- 2 x 5 MHz (FDD) in the 800 MHz band;
- 1 x 40 MHz (SDL) in the 1500 MHz band;
- 2 x 40 MHz (FDD) in the 2600 MHz band;
- 90 MHz (TDD) in the 3400-3800 MHz band, for a shorter period (01.01.2020 – 31.12.2025);
- 400 MHz (TDD) in the 3400-3800 MHz band, for a longer period (01.01.2026 – 31.12.2035).

A snapshot of the frequency spectrum available for awarding for MFCN networks is presented below:

Frequency band	Available spectrum	Bandwidth	Validity period
700 MHz	703-733 MHz / 758-788 MHz • 2 x 30 MHz FDD	60 MHz FDD	01.01.2020 – 31.12.2034
	738-753 MHz • 1 x 15 MHz SDL	15 MHz SDL	01.01.2020 – 31.12.2034
800 MHz	791-796 MHz / 832-837 MHz • 2 x 5 MHz FDD	10 MHz FDD	01.01.2020 – 31.12.2029
1500 MHz	1452-1492 MHz • 1 x 40 MHz SDL	40 MHz SDL	01.01.2020 – 31.12.2034
2600 MHz	2530-2570 MHz / 2650-2690 MHz • 2 x 40 MHz FDD	80 MHz FDD	01.01.2020 – 31.12. 2029
3400-3800 MHz	• 90 MHz TDD	90 MHz TDD	01.01.2020 – 31.12.2025
3400-3800 MHz	3400-3800 MHz • 400 MHz TDD	400 MHz TDD	01.01.2026 – 31.12.2035

Frequencies available in the above-mentioned frequency bands will be allotted exclusively for use at national level.

7.3. Purpose of awarding the available spectrum; technology neutrality

The purpose of using the spectrum envisaged by the awarding procedure is ensuring wireless access for providing public broadband MFCN networks and services at national level, based on the WAPECS (*Wireless Access Policy for Electronic Communications Services*) concept, which promotes the flexibility of radio spectrum use in terms of neutrality of the technologies and of electronic communications services within the European Union.

The area of providing the wireless access network and the geographic market relevant for the provision of broadband electronic communications services is the territory of Romania.

The frequencies for which usage rights are to be awarded in the bands 700 MHz, 800 MHz, 1500 MHz, 2600 MHz and 3400-3800 MHz will be technology neutral, in accordance with the provisions of the relevant EC Decisions:

- Commission Implementing Decision (EU) 2016/687 on the harmonisation of the 694-790 MHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services and for flexible national use in the Union;
- Commission Decision no. 2010/267/EU on harmonised technical conditions of use in the 790-862 MHz frequency band for terrestrial systems capable of providing electronic communications services in the European Union (TRA-ECS);
- Commission Implementing Decision (EU) 2015/750 on the harmonisation of the 1452-1492 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Union, amended by Commission Implementing Decision (EU) 2018/661;
- Commission Decision 2008/477/EC on the harmonisation of the 2500-2690 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community (TRA-ECS), amended by Commission Decision 2009/740/EC;
- Commission Decision 2008/411/EC on the harmonisation of the 3400 - 3800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community, amended by Commission Implementing Decision 2014/276/EU. (The European Commission has recently adopted a new Draft Decision

amending Commission Decision 2008/411/EC, to be published in the Official Journal of the European Union. This Position Paper aims at implementing the newly updated Commission Decision 2008/411/EC).

Any technologies available for terrestrial systems capable of providing broadband wireless electronic communications services that comply with the harmonized technical conditions (spectrum masks and technical parameters) established by the European Commission Decisions applicable to each of the frequency bands may be used.

7.4. Frequency arrangement in the 694-790 MHz band

The harmonised frequency arrangement for MFCN networks in the 694-790 MHz band, according to Commission Implementing Decision (EU) 2016/687 is flexible and includes:

- a) a paired frequency arrangement (2x30 MHz FDD):
 - the 703-733 MHz and 758-788 MHz sub-bands will be used in frequency division duplex mode (FDD);
 - the 703-733 MHz sub-band will be used for terminal station emission (uplink);
 - the 758-788 MHz sub-band will be used for base station emission (downlink);
 - the duplex spacing is 55 MHz;
 - the allotted block sizes shall be in multiple of 5 MHz.
- b) an unpaired - optional - frequency arrangement (supplemental downlink – SDL):
 - the 738-753 MHz sub-band will be used additionally for the base station emission (for the downlink only);
 - the allotted block sizes shall be in multiple of 5 MHz.

The 753-758 MHz sub-band will be reserved for the emission of base stations of the PPDR systems operating in the FDD 698-703 MHz/753-758 MHz sub-bands.

The block edge masks for a 5 MHz block in the 694-790 MHz band to be observed are those defined in Sections B and C of the Annex to Decision 2016/687/EU.

The frequency arrangement layout for the 700 MHz band harmonized at European level is set out in Annex 1 to Decision ECC/DEC/(15)01 on the harmonised technical conditions for mobile/fixed communications networks (MFCN) in the 694-790 MHz band and is represented below.

All the six 2x5 MHz (FDD) blocks and the three 5 MHz (SDL) blocks will be available for MFCN networks.

Figure 7

Harmonised frequency arrangement in the 694 – 790 MHz band, in 5 MHz blocks

694 - 703	703 - 708	708 - 713	713 - 718	718 - 723	723 - 728	728 - 733	733 - 738	738 - 743	743 - 748	748 - 753	753 - 758	758 - 763	763 - 768	768 - 773	773 - 778	778 - 783	783 - 788	788 - 791
Guard band	5 MHz (1)	5 MHz (2)	5 MHz (3)	5 MHz (4)	5 MHz (5)	5 MHz (6)		5 MHz (1)	5 MHz (2)	5 MHz (3)		5 MHz (1)	5 MHz (2)	5 MHz (3)	5 MHz (4)	5 MHz (5)	5 MHz (6)	Guard band
9 MHz	Uplink 30 MHz (6 blocks of 5 MHz) FDD						5 MHz	SDL (A) 15 MHz			5 MHz	Downlink 30 MHz (6 blocks of 5 MHz) FDD						3 MHz

7.5. Frequency arrangement in the 790-862 MHz band

The frequency arrangement in the 790-862 MHz band, in accordance with Decision 2010/267/EU, is presented below:

- the 790-791 MHz sub-band is kept as a guard band as to the adjacent band and will not be used;
- the operation mode in the 790-862 MHz band is Frequency Division Duplex (FDD);
- the sub-band 791-821 MHz is used for base station emission (downlink);
- the sub-band 832-862 MHz is used for terminal station emission (uplink);
- the duplex spacing is 41 MHz;
- the allotted blocks sizes shall be multiple of 5 MHz.

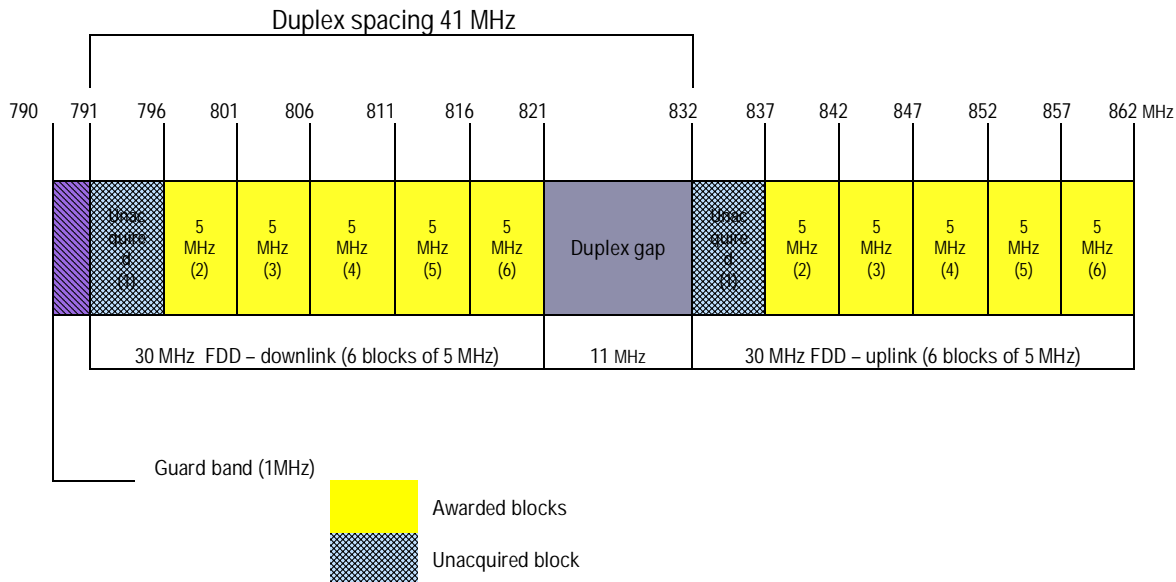
The block-edge mask (BEM) for a 5 MHz block in the 790-862 MHz band defined in the Annex to Decision 2010/267/EC shall be observed.

The layout for the 800 MHz band frequency arrangement harmonized at European level is set out in Annex 1 to Decision ECC/DEC/(09)03 on harmonized technical conditions for systems operating in the 790-862 MHz band and is further represented below.

The figure below also highlights the 5 MHz blocks awarded, and the block unacquired in the 2012 auction and available for allotment to MFCN networks.

Figure 8

Harmonised frequency arrangement in the 790-862 MHz band, by 5 MHz blocks



7.6. Frequency arrangement in the 1452-1492 MHz band

The harmonised frequency arrangement in the 1452-1492 MHz band, in accordance with the provisions of Commission Implementing Decision (EU) 2015/750 amended by Commission Implementing Decision (EU) 2018/661, is as follows:

- the usage the 1452-1492 MHz band is limited to base station emission (downlink);
- the allotted block sizes in the 1452-1492 MHz band will be multiple of 5 MHz.

The base station emission must comply with the harmonized technical conditions on block edge masks contained in Section B of the Annex to the Commission Implementing Decision 2015/750/EU amended by Commission Implementing Decision (EU) 2018/661.

The layout of the 1452-1492 MHz frequency band arrangement harmonized at European level is set out in Annex 1 to ECC/DEC/(13)03 Decision and is presented below.

Figure 9

Harmonised frequency arrangement in the 1452-1492 MHz band for SDL,
by 5 MHz blocks

52-1457	1457-1462	1462-1467	1467-1472	1472-1477	1477-1482	1482-1487	1487-1492
5 MHz (1)	5 MHz (2)	5 MHz (3)	5 MHz (4)	5 MHz (5)	5 MHz (6)	5 MHz (7)	5 MHz (8)
SDL (base station emission) 40 MHz (8 blocks of 5 MHz)							

All the eight 5 MHz blocks are available for awarding for MFCN SDL networks.

7.7. Frequency arrangement in the 2500-2690 MHz band

The frequency arrangement in the 2500-2690 MHz band, in accordance with Decision 2008/477/EC, is the following:

- the 2500-2570 MHz/2620-2690 MHz sub-bands are intended for Frequency Division Duplex (FDD) operation mode;
- the 2500-2570 MHz sub-band is used for terminal station emission and base station reception (uplink);
- the 2620-2690 MHz sub-band is used for base station emission and terminal station reception (downlink);
- the duplex spacing is 120 MHz;
- the 2570-2620 MHz sub-band is intended for Time Division Duplex (TDD) operation mode;
- the allotted blocks shall be multiple of 5 MHz.

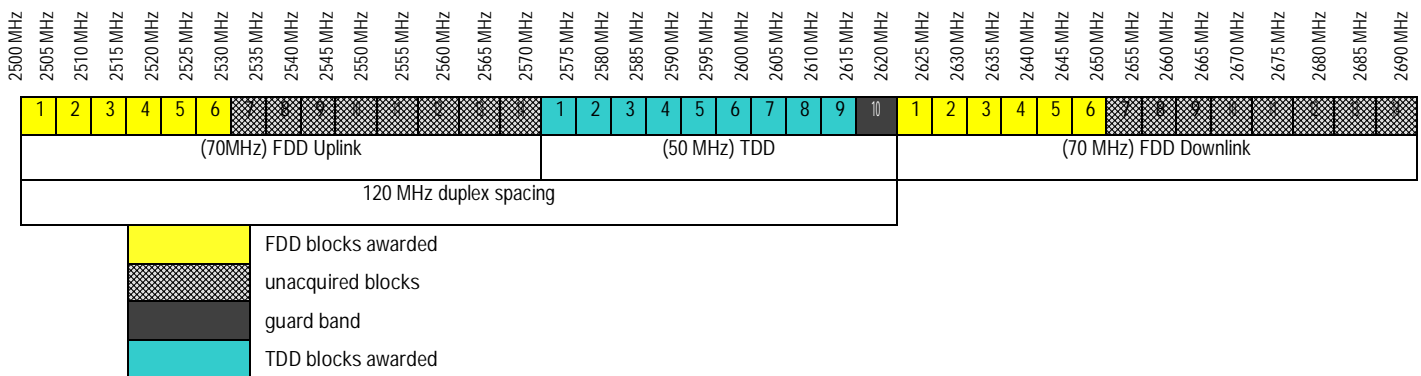
For the use of the FDD 2650-2690 MHz sub-band, the conditions for unrestricted blocks shall be applied to all 5 MHz FDD blocks. The block edge mask of a 5 MHz block for unrestricted blocks: Maximum EIRP = 61 dBm/5 MHz.

The layout for European harmonized frequency arrangement in the band 2600 MHz is set out in Decision ECC/DEC/(05)05 on harmonised utilization of spectrum for Mobile/Fixed Communications Networks (MFCN) operating in the 2500-2690 MHz band and is represented in the figure below.

The diagram also highlights the 5 MHz blocks awarded and the blocks remaining unacquired in the 2012 auction.

Figure 10

Harmonised frequency arrangement in the 2500 – 2690 MHz band, in 5 MHz blocks



7.8. Frequency arrangements in the 3400-3800 MHz band and associated provisions

7.8.1. Current usage status of the 3400-3800 MHz band

The use of this frequency band in Romania is currently regulated by CEPT Decision ECC/DEC/(11)06 on harmonised frequency arrangements and least restrictive technical conditions (LRTC) for mobile/fixed communications networks (MFCN) operating in the band 3400-3800 MHz, adopted on 09 November 2011 amended on 14 March 2014.

At EU level, the relevant regulation in force is Commission Implementing Decision 2014/276/EU amending Decision 2008/411/EC on the harmonisation of the 3400 - 3800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community.

This decision allows both frequency arrangement options (based on FDD or TDD technology) in the 3400-3600 MHz band, and only the TDD arrangement in the 3600-3800 MHz band.

The 3400-3800 MHz band is currently used in line with the provisions of the Strategy for the 3400-3800 MHz band. Thus, in Romania, the channel arrangement in force in the 3400-3600 MHz band is FDD and in the band 3600-3800 MHz there is a TDD channel arrangement.

Terrestrial electronic communications systems using the 3400-3800 MHz band are those which comply with:

- the provisions of the Strategy for the 3400-3800 MHz band as regards the channel arrangements valid in the 3400-3600 MHz and 3600-3800 MHz bands,
- the block edge masks (BEM) as for the allocated block, set out in the Annex to the Commission Decision 2008/411/EC amended by Commission Implementing Decision 2014/276/EU.

Any available technology that complies with the Strategy on the usage of the 3400-3800 MHz band and with the technical conditions stipulated in the above-mentioned decisions may be used.

According to the above-mentioned regulations, the FDD arrangement in the 3400-3600 MHz band consists of 2x5 MHz duplex channels. Larger radio channels can also be used by joining adjacent 2x5 MHz channels.

Sub-bands 3410-3490 MHz / 3510-3590 MHz are available for use, the useful bandwidth of the respective spectrum being 2x80 MHz (16 duplex channels of 2x5 MHz).

The duplex spacing is 100 MHz. The duplex gap is 20 MHz (3490-3510 MHz) and the two side guard bands are 10 MHz (3400-3410 MHz and 3590-3600 MHz).

Base station (downlink) emissions are in the upper sub-band while subscriber terminal (uplink) emissions are in the lower sub-band.

According to the above-mentioned regulations, the TDD arrangement in the 3600-3800 MHz band consists of 5 MHz channels. Larger radio channels can also be used by joining adjacent 5 MHz channels.

The entire 3600-3800 MHz band is available for use, the useful bandwidth of the band being 200 MHz (40 unpaired 5 MHz channels), since the TDD arrangement within this frequency band does not require a duplex gap and side guard bands as to the adjacent - lower and upper - bands, according to CEPT Decision ECC/DEC/(11)06 (2014 edition) and to Commission Implementing Decision 2014/276/UE.

The alternative channelling scheme in the 3400-3600 MHz band currently available in Romania is the one presented in Annex 2 of Decision ECC/DEC/(11)06 (2014 edition) and in Chapter III section 2.5/2.5.1 of the Public consultation document developed by ANCOM in 2017.

The channel arrangement scheme in the 3600-3800 MHz band currently available in Romania and harmonized at European level is the one presented in Annex 3 of Decision ECC/DEC/(11)06 (2014 edition) and in Chapter III section 2.5/2.5.2 of the Public consultation document developed by ANCOM in 2017.

In the 3400-3800 MHz band, the usage rights are in force enable only the provision of national public electronic communications networks.

The current usage status of this band, following the results of the 2015 selection procedure and the subsequent transfer of usage rights, is presented below:

a) in the 3400-3600 MHz band, two operators hold allocations, under national licences, until 31 December 2025, as follows:

- one operator holds 2x20 MHz (four duplex adjacent channels of 2x5 MHz),
- another operator holds 2x35 MHz (two duplex adjacent channels of 2x5 MHz – adjacent to those held by the first operator – and, separately, five more duplex adjacent channels of 2x5 MHz).

b) in the 3600-3800 MHz band:

- three operators hold allotments, under national licences, until 31 December 2025, as follows:
 - one operator holds 45 MHz (nine unpaired adjacent channels of 5 MHz),
 - two other operators hold 50 MHz each (each of them holds ten unpaired adjacent channels of 5 MHz).
- government networks use 55 MHz (11 unpaired adjacent channels of 5 MHz), until 31 December 2025.

All the licences have been granted for the provision of public MFCN networks and electronic communications services at national level. The licences have been issued with the observance of the principles of technological neutrality as regards both the service provided, and the technology used for MFCN applications.

The status of the so far unawarded and of the currently available spectrum is presented below:

a) in the 3400-3600 MHz band, the following unadjacent bands are available:

- 2x10 MHz (two duplex adjacent channels of 2x5 MHz),
- 2x15 MHz (three duplex adjacent channels of 2x5 MHz),

b) in the 3600-3800 MHz band there is no spectrum available.

At present, there are no licences containing frequency assignments in the fixed satellite service in this frequency band, on a national level.

7.8.2. Future usage of the 3400-3800 MHz band

Considering the applications relevant for this position paper, at CEPT level, for the entire 3400-3800 MHz band, Decision ECC/DEC/(11)06 on harmonised frequency arrangements and least restrictive technical conditions for mobile/fixed communications networks (MFCN) operating in the band 3400-3800 MHz, adopted on 09 December 2011 and amended (for the second time) on 26 October 2018.

At EU level, a new draft EC decision amending Decision 2008/411/EC has been finalized. This draft decision has been adopted and will be published by the EC in the near future. It also amends the annex to the initial decision, which contains technical provisions for the use of the above-mentioned band.

The most important change is that the TDD channelling is mandatory in the whole 3400-3800 MHz band, with an implementation deadline of 31 December 2020, as mentioned above.

Therefore, subsequent measures must be taken to implement the two (CEPT and EU) regulations, the latter being mandatory to be applied by Romania in its national legislation, following the obligations assumed by our country, as an EU Member State.

The TDD arrangement in the 3400-3800 MHz band will consist of channels with a bandwidth of 5 MHz. Larger radio channels can also be used by joining adjacent 5 MHz channels.

The entire 3400-3800 MHz band is available for use, the useful bandwidth of the respective band reaching even 400 MHz (80 unpaired 5 MHz channels), since the TDD arrangement does not require a middle guard band and side guard bands, as to the adjacent - lower and upper - bands, are not provided for this band, according to Decision ECC/DEC/(11)06 (2018 edition) and the new draft EC Decision on the 3400-3800 MHz band.

The scheme of the 3400-3800 MHz channelling arrangement currently in force at European level is set out in Annex 1 to ECC/DEC/(11)06 Decision (2018 edition).

ANCOM recognizes the primary allocation of the 3.4-3.8 GHz both for the fixed and for the mobile services, for MFCN networks on the one hand and for the fixed-satellite (space-to-Earth) service on the other hand. However, given the limited development of satellite applications on the territory of Romania (according to the data currently held by ANCOM), the Authority will act towards protecting the operation of satellite communications equipment (receiving signals from satellites in the respective band) only to the extent:

1) the Authority receives written complaints, in accordance with the relevant regulations in force, on harmful interference produced by MFCN networks on satellite communications equipment,

2) the users or beneficiaries of the applications in the fixed-satellite service request the issuance of the frequency usage license for the frequency assignments of the satellite receiver equipment in the 3.4-3.8 GHz band (the Authority does not charge a spectrum usage fee for any reception frequencies, irrespective of the radiocommunication service where they are allocated).

7.8.3. Specific implementation measures in the 3400-3800 MHz band

With a view to meeting our country's obligations as an EU Member State, while ensuring the predictability of the regulatory environment, this Position Paper establishes that the channel arrangement in the 3400-3800 MHz band in Romania will be exclusively TDD, starting from 1 January 2020.

The Authority has set this deadline taking into account, on the one hand, the need to implement, within the required terms, the harmonization regulations adopted by the EC on the use of radio spectrum in the EU and, on the other, the need to grant a transitional period necessary to reorganize the 3400-3600 MHz band following the transition from the FDD arrangement to the TDD arrangement, thus enabling the two affected operators to properly reorganize their own

frequency assignments and to implement the necessary changes in the operation of their networks, while ensuring the continuity of service delivery to their end-users.

Therefore, the 3400-3600 MHz and 3600-3800 MHz bands will become equivalent from the point of view of the usage rules and applicable technical regulations. Therefore, they will be treated as one in terms of radio spectrum management, including during the transition period, starting from 2019.

As a consequence of the implementation of this measure, 2019 will be a transition period, meaning that Authority action will be needed in 2019 for the reorganization of the 3400-3600 MHz band to ensure the transition from the FDD arrangement to the TDD arrangement and the completion of this reorganization process until 31 December 2019 (taking into account that from 1 January 2020 new usage rights will enter into force as a result of the selection procedure).

Under the competitive selection procedure for the awarding of usage rights in several frequency bands, including in the spectrum unawarded in the 3400-3800 MHz band, for the provision of public broadband and public electronic communications services, two types of usage rights will be awarded in the 3400-3800 MHz band:

- a) six-year rights, with sub-band allotments in the unawarded portions within the 3400-3800 MHz band (under the conditions set out below), from 1 January 2020 to 31 December 2025;
- b) ten-year rights, with sub-band allotments that may be situated anywhere in the 3400-3800 MHz band, from 1 January 2026 to 31 December 2035.

The spectrum amount unawarded in the 3400-3800 MHz band, to be auctioned off in the above-mentioned selection procedure for acquiring the rights referred to in a) will result, once the reorganization operation has been completed, within the networks of the two operators holding licenses in force in the 3400-3600 MHz band. The result of the process of refarming this band will consist of a contiguous (the least fragmented possible) sub-band or sub-bands containing unpaired 5 MHz channels, situated within the 3400-3800 MHz band and totalling 90 MHz.

7.8.4. Authority's steps regarding the 3400-3800 MHz band

Following the publication of the new draft Decision adopted by the EC with a view to amending Decision 2008/411/EC on the harmonization of the 3400-3800 MHz band for terrestrial systems capable of providing electronic communications services within the Community, ANCOM will start consultations with operators holding frequency usage licenses in the 3400-3600 MHz band.

The purpose of the consultations is to identify new sub-bands of radio frequencies (TDD) to be allotted to the two operators by converting the sub-band allotments (FDD) currently held by them.

Then, at the initiative of the respective license holders or, as the case may be, at the Authority's initiative (pursuant to the provisions of Art. 24(3), indent c) of GEO no. 111/2011), ANCOM will amend accordingly the licenses of the two operators, by including the new (TDD) sub-band allotments valid from 1 January 2020, thus replacing the currently (FDD) allotted sub-bands. In this respect, ANCOM will apply the provisions of Art. 24(4) of GEO no. 111/2011.

During 2019, as a result of the process of refarming the 3400-3600 MHz band and considering the need to ensure the continuity of the service delivery to end-users, the obligations of operators currently operating networks in this frequency band on meeting the development conditions contained in the licenses, shall be suspended.

In 2019, ANCOM will undertake the necessary steps to organize the competitive selection procedure with a view to awarding usage rights in several frequency bands, including the 3400-3800 MHz band, for the provision of public broadband electronic communications networks and services, with the aim of optimally carrying out this process.

Thus, among other things, ANCOM will elaborate and adopt ANCOM President's decision on setting out the rules for the selection procedure, as well as the Terms of Reference for the selection procedure, which will contain in detail all the technical and administrative elements regarding the selection procedure.

Aspects regarding the minimum spectrum requirements with a view to properly ensuring the provision of broadband wireless communications, service coverage obligations, as well as the timetable for the selection procedure, will be analysed and established in consultation with the stakeholders, when preparing the technical and administrative documentation for conducting the selection procedure.

ANCOM will run and complete the selection procedure before the end of 2019.

Licenses will be issued to the winners who have obtained usage rights in the 3400-3800 MHz band upon full payment to the state budget of amounts representing the cumulative amount of license fees for all the rights of use acquired in this band, the payment being carried out before the end of 2019.

In the first part of 2020, but no later than 31 March 2020, ANCOM will amend, under the provisions of Art. 24(3), indent c) of GEO no. 111/2011, all the licenses in force on 31 December 2019 in the 3400-3800 MHz band, in order to update the technical and operational conditions contained therein, in accordance with the provisions of the draft EC Decision amending Decision 2008/411/EC on the harmonization of the 3400-3800 MHz frequency band for terrestrial systems capable of providing electronic communications services within the Community. In this respect, ANCOM will apply the provisions of Art.24(4) of GEO no. 111/2011. Moreover, on this occasion, in order to ensure non-discriminatory treatment for all operators operating networks in the 3400-3800 MHz band and the efficient and effective use of the frequency spectrum awarded by licence, ANCOM will include in all the above-mentioned licenses obligations regarding the network development, redefined in accordance with the technical documentation of the selection procedure.

Thus, the above-mentioned draft decision will be properly implemented, ensuring also the required transition period, for all operators holding licenses in the 3400-3800 MHz band to make the necessary changes within the networks they operate in this frequency band.

7.9. Channelling arrangements in the 24.25-27.5 GHz and related provisions

7.9.1. Current usage status in the 24.25-27.5 GHz band

Currently, in Romania, the 24.25 - 24.5 GHz band is free of permanent assignments and there are no radio channel arrangements available for this band in our country.

There are, however, license-exempted applications that can legitimately use this band (with the strict observance of the technical interface specifications that are relevant to each application type) as outlined in the previous chapter. However, the use of radio spectrum by such applications is generally temporary, occasional and random. Additionally, applications exempted from licensing do not enjoy radio protection, having a secondary usage status.

In Romania, the 26.5-27.5 GHz frequency band is also free of permanent assignments granted by the Authority under a license for the use of radio frequencies. That is, there are no non-governmental permanent assignments in this band (which however has a shared usage status, G(A)/NG). There are no radio channel arrangements available for this band in our country.

The 24.5-26.5 GHz band is currently used in line with the *Strategy on the usage of 24.5-26.5 GHz band*, a document developed, consulted with stakeholders and published by ANCOM on its website, here: http://www.ancom.org.ro/uploads/links_files/Pozitie_benzi_24_26_GHz.pdf.

Currently, in the band 24.5-26.5 GHz, the channel arrangement in force in Romania is that in Annex B of CEPT Recommendation T/R 13-02. According to this arrangement, the bandwidth of

the 24.5-26.5 GHz band comprises 8 duplex 2x112 MHz channels or 16 duplex 2x56 MHz channels, or 32 duplex 2x28 MHz or 64 duplex 2x14 MHz or 128 duplex 2x7 MHz or 256 duplex 2x3.5 MHz channels, totalling 2x896 MHz, which is the total useful capacity of the band.

There are 49 MHz side guard bands in the lower band, and 47 MHz side guard bands in the higher band, as well as a 112 MHz duplex gap (the sub-band 25445 - 25557 MHz).

As shown in the first chapter, there are currently three public operators holding licences for allotments in 2x112 MHz sub-bands, designed to provide high/medium capacity traffic resulting from access networks operated by the respective operators in various bands and using various technologies. One of the three licenses existing in this band is valid until July 2021 and the other two until December 2021.

The three 2x112 MHz duplex channels are allotted at national level, on a primary but non-exclusive basis, for fixed links.

Furthermore, until December 2021, one frequency assignment for a cross-border radio link in the upper band is still in force.

There are currently no licenses that contain frequency assignments at national level, in the fixed-satellite service or in other satellite communications services in this frequency band.

7.9.2. Future usage of the 24.25-27.5 GHz band

As far as the relevant applications for this position paper are concerned, CEPT Decision ECC/DEC/(18)06 on harmonized technical conditions for Mobile/Fixed Networks (MFCN) in the 24.25-27.5 GHz frequency band is currently in force for the whole band, the decision having been adopted on 6 July 2018 and amended on 26 October 2018.

The channel arrangement established by this decision is TDD and consists of channels with a bandwidth of 200 MHz.

The channel arrangement scheme currently in force at European level in the 24.25-27.5 GHz radio is available in Annex 1 to Decision ECC/DEC/(18)06.

As shown in the previous chapter, a draft EC decision is being prepared at the level of the European Commission on the harmonization of the use of the 24.25-27.5 GHz frequency band for the provision of public electronic communications networks and services in the Community, and it is expected to be adopted and published by the EC later this year.

Moreover, the 24.25-27.5 GHz band is being analysed during the current study cycle of the ITU-R due to its inclusion in Resolution 238 (WRC-15), which is covered by item 1.13 on the agenda of the WRC-19.

Furthermore, most of the strictly technical regulations regarding the future usage of this band are still being developed and/or finalized at CEPT level.

Taking into consideration the above-mentioned and the fact that the deadline for making available at least 1 GHz in the 24.25-27.5 GHz band for broadband communications networks is 31 December 2020 - with the possibility of extending this deadline in cases where re-farming the respective band and migrating existing uses to other bands raises difficulties - the Authority deems it premature to award usage rights in this band during 2019.

Other objective elements may be mentioned in support of this conclusion, such as:

- the fact that the upper 1GHz sub-band has shared G(A)/NG usage status and there are insufficient elements to make the release of this band by the MoD predictable);
- the existence of a significant number of radio links operating in the 24.5-26.5 GHz band, for which a viable migration solution needs to be identified, if necessary (the relevant technical regulation is still at an early stage), thus triggering significant difficulties during this process.

In this context, we mention that the analysis process for the frequency band 24.25-27.5 GHz will be resumed after the WRC-19 results have materialized.

At that point, all the elements necessary for making pertinent decisions for an efficient reorganization of the uses in the above-mentioned band will be available for consideration and the Authority will be able to provide the optimal conditions for the actual - if necessary - migration of the existing uses to another frequency band, observing the principles of efficient and rational spectrum management and while ensuring the continuity of service provision.

However, taking into account the need to ensure the predictability of the regulatory act and the transparency of the consultation with all stakeholders, ANCOM deems it necessary to start informing the operators holding licences in the 24.5-26.5 GHz band that, although they may still request frequency assignments for radio links based on the priority and non-exclusive allotments included in the licenses, the validity of licenses currently in force in this band will not be extended beyond 2021, by way of exception from the generally applicable rule in the ANCOM President's decision no. 353/2015 on the procedure for granting rights of use for radio frequencies.

ANCOM recognizes the primary allocation of sub-bands in the 24.25 - 27.5 GHz band for applications both in the fixed-satellite (Earth-to-space) and in the space research service (space-to-Earth).

ANCOM will grant licences for Earth stations in the fixed-satellite service (Earth-to-space) at the justified request of some interested entities. However, given the limited development of satellite applications on the territory of Romania (according to the data currently held by ANCOM), the Authority will act towards protecting the operation of satellite communications equipment (receiving signals from satellites in the respective band) only to the extent:

- 1) the Authority receives written complaints, in accordance with the relevant regulations in force, on harmful interference produced by MFCN networks on satellite communications equipment,

- 2) the users or beneficiaries of the applications in the fixed-satellite service request the issuance of the frequency usage license for the frequency assignments of the satellite receiver equipment in this frequency GHz band (the Authority does not charge a spectrum usage fee for any reception frequencies, irrespective of the radiocommunication service where they are allocated).

We also specify that the Earth exploration-satellite service (space-to-Earth) has a primary status at international level and a secondary status at European level, therefore requests for frequency assignments within this radiocommunication service will be treated according to priority rules regarding the secondary radiocommunication services.

7.9.3. Specific implementation measures in the 24.25-27.5 GHz band

Taking into account the arguments raised in section 7.9.2 and especially the fact that most of the CEPT technical regulations as well as the draft EC decision applicable to this frequency band have not been completed yet, the analysis regarding the refarming in this frequency band and the granting of frequency usage rights for the purpose of providing broadband communications in the 24.25-27.5 GHz band will be resumed after the completion of the WRC-19 and the implementation of the results of this World Conference regarding item 1.13 on its agenda (which directly regards this frequency band).

In this context, the draft EC decision on the harmonized use of the 24.25-27.5 GHz band within the Community will be implemented in Romania by means of another position paper, to be developed following the adoption and publication of the respective draft EC decision.

The validity of frequency usage licenses for radio links in the fixed service in force in the 24.5-26.5 GHz band will not be extended beyond 2021.

Based on the needs arising in the process of reorganization of the 24.5-26.5 GHz band and on the possible migration of existing uses to other frequency bands, in the future position paper

for the frequency band 24.25 - 27.5 GHz ANCOM will present all necessary details with regard to the migration of frequency assignments for radio links, including as regards the target frequency bands envisaged for the migration of these assignments.

Currently, for exploratory purposes, ANCOM is analysing the bands 27.5 - 29.5 GHz and 31.8 - 33.4 GHz. The final decision will depend on the applicable technical regulations in force at the respective moment and on the WRC-19 results.

7.9.4. Authority's steps regarding the 24.25-27.5 GHz band

ANCOM will support Romania's interests in the international debates taking place at the level of the European bodies (CEPT and the European Commission) as well as at the ITU level (meetings of the ITU-R study groups, CPM meeting and the World Radiocommunication Conference of 2019), with respect to the regulation and use of the 24.25-27.5 GHz frequency band.

Subsequent to the WRC-19, ANCOM will resume its analysis on the reorganization of the above-mentioned band and on awarding frequency usage rights for the provisions of broadband communications in this band. In this reflection process, ANCOM will include any other very high frequency bands designated for IMT systems at WRC-19.

During 2020, ANCOM will develop a position paper awarding frequency usage rights for the provision of broadband communications systems in the 24.25-27.5 GHz band and, if necessary, in other very high frequency bands designated for IMT-2020 systems at the ITU level. This position document will also implement the future EC Decision on this frequency band.

In the second half of 2020, ANCOM will organize and carry out a selection procedure for awarding frequency usage rights in the 24.25-27.5 GHz band and - based on the favourable conclusions thereon in the process of internal analysis and consultation with the stakeholders - in other very high frequency bands to be designated at the ITU level for IMT-2020 systems.

7.10. The need for spectrum portfolios containing a mix of frequencies above and below 1 GHz

Access to appropriate frequency resources is essential for the provision of broadband mobile communications networks and services at national level. The spectrum portfolio held by a provider of such networks and services has a great impact on the quality of the data services that can be provided and on the number of users that can be served. The number of macro-sites installed is also an important factor.

A larger number of sites can be deployed to increase capacity, as an alternative to using a larger amount of spectrum. However, the higher the demand for traffic, the more sites will be needed to reach the required capacity, which is less feasible in terms of practical and financial viability. Therefore, the spectrum portfolio of a service provider at national level will have a significant impact on capacity as well as on the quality of the services it can offer. If the portfolio does not include the appropriate frequency spectrum mix, such as frequencies below 1 GHz, the quality of the services will be limited. In addition, if the portfolio contains a small amount of spectrum, limitations in the network capacity may occur.

Given the high costs involved in ensuring access (even if shared) to a broadband network at national level, the operators need to have a spectrum portfolio sufficiently broad to provide the capacity to gain a customer base large enough to make the investment profitable. This is in line with the fact that in most countries the mobile communications industry is characterized by a small number of network providers (typically three or four providers) at national level.

The quality of the network and the frequency spectrum used by a broadband mobile network operator at national level determines:

- the speed of data services (Mbps) that users can benefit from;
- network capacity (number of users that the network can support);
- wider coverage (percentage of the country's territory, i.e. percentage of the population benefiting from mobile broadband services);
- the coverage penetration (indoor penetration of the coverage considering attenuation due to walls and other structural elements).

The timely availability of adequate and sufficient spectrum is a key element for the development of high-performance electronic communications networks capable of meeting the requirements regarding very high data capacity and speed, very low latency (real time communication) and high availability.

In order to invest appropriately and successfully develop their mobile broadband and 5G mobile networks in the future, operators should be able to ensure a suitable mix and amount of spectrum in all three types of bands: low (<1 GHz), medium (between 1 GHz and 6 GHz), and high (> 6 GHz).

The frequency spectrum in the 1500 MHz, 2600 MHz, and 3400-3800 MHz bands is a valuable resource for ensuring the capacity to provide high-speed data communications services to a large number of users simultaneously.

The frequency spectrum below 1 GHz offers advantages compared to higher frequencies in terms of coverage, allowing a significantly wider geographic coverage compared to the coverage that higher frequency bands can provide using the same number of sites, (as radio waves at lower frequencies propagate over longer distances). The use of the spectrum below 1 GHz also tends to provide substantially better signal quality and higher speeds of data transfer to the user, while indoors, than those enabled by using higher frequencies because radio waves at lower frequencies penetrate solid objects better.

Therefore, the frequency spectrum in the 700 MHz and 800 MHz bands is an important resource for the efficient provision of mobile broadband services in sparsely populated (rural) areas. This spectrum is appropriate for providing large coverage with such services at national level and for improving indoor coverage.

Mixing the frequency spectrum below 1 GHz with that above 1 GHz allows the potential of the two spectrum categories to be combined to efficiently deploy networks capable of delivering broadband mobile communications at national level, while being able to meet the significant demand for traffic in urban centres.

ANCOM deems that, for a national broadband mobile networks and services provider to be a credible competitor in the provision of high-quality data services, an appropriate spectrum portfolio is needed, which should meet the following requirements:

- an overall spectrum portfolio suitable for the use of 4G and 5G technologies, to enable the provision of high-quality data services, and in a sufficient amount to cover the fixed costs for the installation and operation of a network for the provision of mobile communications services at national level;
- the spectrum portfolio should include frequencies below 1 GHz for the operator to be able to provide high quality data services over wide areas, and especially indoors.

Simultaneous spectrum awarding both in frequency bands below 1 GHz (700 MHz, 800 MHz) and above 1 GHz (1500 MHz, 2600 MHz, 3400-3800 MHz) by means of a combined procedure is an opportunity to obtain combined spectrum portfolios, suitable to ensure the availability of mobile broadband services at national level, both in densely populated and commercially attractive urban areas and in less densely populated urban areas or in rural areas, to the benefit of citizens and consumers across Romania.

7.11. Design and presentation of frequency blocks

The spectrum resources to be awarded in the available frequency bands will be organized into abstract frequency blocks (generic blocks), by different categories - according to their equivalence in terms of use (FDD, TDD or SDL), the date from which they are actually available, the validity period of the usage rights, the advantages they offer in terms of technical performance, the technical restrictions on usage resulting from cross-border or domestic coordination on the use of frequencies, for the purpose of avoiding harmful interference or specific obligations associated with the frequency blocks. The frequency blocks designed according to the criteria above will be herein referred to as *blocks*.

The main factors relevant for designing spectrum blocks are:

- a) block organization - band plans;
- b) size of each block in a given category;
- c) number of generic block categories;
- d) block contiguity.

Spectrum blocks having the specified position in the band will be considered as concrete blocks within the selection procedure.

7.11.1. Design of the frequency blocks in the 700 MHz band

a) The 700 MHz band plan

The frequency spectrum available in the 700 MHz band consists of 2x30 MHz for FDD use and 15 MHz for SDL use, as illustrated in Figure 7 of Section 7.4.

The band plan complies with Commission Implementing Decision (EU) 2016/687 and Decision ECC/DEC/(15)01 on the harmonised technical conditions for mobile/fixed communications networks (MFCN) in the band 694-790 MHz.

The frequency block 753-758 MHz in the 738-758 MHz band (SDL) will not be subject to the procedure of awarding frequency use rights in the 700 MHz band.

b) Size of blocks in the 700 MHz band

The blocks awarded in the 700 MHz band will be sized as multiples of 5 MHz, in accordance with the with Commission Implementing Decision (EU) 2016/687. This allows flexibility for the licence holder to aggregate 2x5 MHz blocks in order to obtain larger bandwidth frequency blocks, based on the spectrum requirements of its own business model and on the technology envisaged (e.g.: 2x5 MHz, 2x10 MHz, 2x15 MHz etc.)

Therefore, ANCOM proposes that the frequency blocks in the 700 MHz band to be subject to the selection procedure should have a 2x5 MHz bandwidth in the bands 703-733 MHz/758-788 MHz (FDD) and 1x5 MHz in the 738-753 MHz band (SDL).

c) Generic block categories in the 700 MHz band

As at this stage, ANCOM does not have all the information necessary for setting the technical conditions to be applied for the use of frequencies in the 700 MHz band to ensure coexistence with other uses in neighbouring countries. Therefore, all the 5 MHz blocks in the 700 MHz band will be considered as similarly affected/unaffected by any technical issues regarding coexistence with uses in neighbouring countries in the 694-790 MHz band.

Under these circumstances, the 700 MHz FDD band (703-733 MHz/758-788 MHz) will be organized into 6 generic equivalent blocks of 2x5 MHz, belonging to the same category, marked A. Blocks in this category will be marked A1, A2, A3, A4, A5, A6 and will be listed identically in the selection procedure.

The 700 MHz SDL band (738-753 MHz) will be organized into 3 generic equivalent blocks of 1x5 MHz, belonging to the same category, marked B. The blocks in this category will be marked B1, B2, B3 and will be listed identically in the selection procedure.

By the date of launching the procedure for the awarding of frequency usage rights, ANCOM will have carried out further technical activities to establish the technical conditions associated with the use of frequencies in the 700 MHz band, following frequency coordination with neighbouring countries.

If the coordination activities result in different technical restrictions for certain frequency blocks, with a major impact on the use of these frequencies on the territory of Romania, the respective blocks will be included in a distinct category and will be listed differently in the selection.

d) Block contiguity in the 700 MHz band

Within a given band, spectrum blocks for which a license holder has usage rights may be contiguous or fragmented. Holding contiguous spectrum blocks presents a real advantage as it offers operators the opportunity to obtain and use larger bandwidth radio channels.

Large bandwidth channels are needed to achieve the highest performance that the latest mobile broadband technologies or future 5G technologies can offer.

In view of these considerations, ANCOM's approach is to ensure the contiguity of the blocks acquired by each winner, in each band.

The 700 MHz band plan, highlighting generic blocks in categories A and B, is illustrated in the figure below:

Fig. 13

The 694-790 MHz frequency band plan

694 -	703 -	708 -	713 -	718 -	723 -	728 -	733 -	738 -	743 -	748 -	753 -	758 -	763 -	768 -	773 -	778 -	783 -	788 -
703	708	713	718	723	728	733	738	743	748	753	758	763	768	773	778	783	788	791
Guard band	A1	A2	A3	A4	A5	A6		B1	B2	B3		A1	A2	A3	A4	A5	A6	Guard band
9 MHz	Uplink						5 MHz	SDL (A)			5 MHz	Downlink						3 MHz
	30 MHz (6 blocks of 5 MHz) FDD							15 MHz				30 MHz (6 blocks of 5 MHz) FDD						

7.11.2. Design of frequency blocks in the 800 MHz band

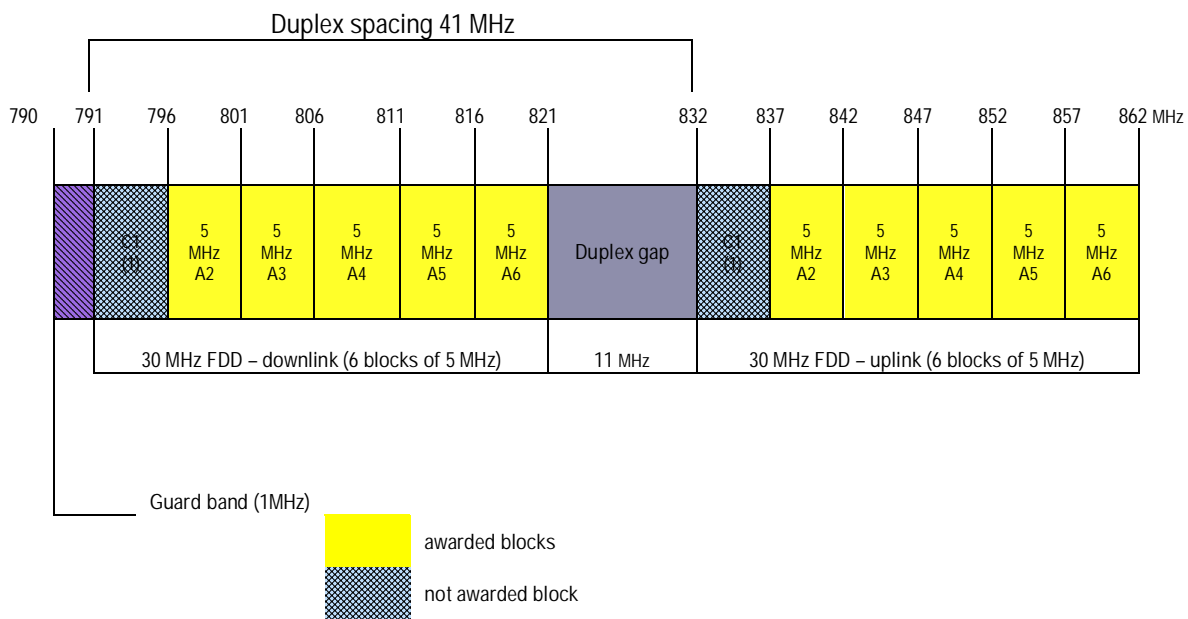
In the 800 MHz band only one 2x5 MHz block is available in the 791-821 MHz/832-862 MHz FDD bands, respectively the first block of the harmonized frequency plan according to Decision 2010/267/EU, corresponding to the 791-796 MHz/832-837 MHz frequency sub-bands.

The 821-832 MHz sub-band band situated between the FDD paired bands, which is the duplex gap between the uplink and downlink frequencies, will not be subject to the procedure for awarding frequency usage rights in the 800 MHz band.

The block available in the 800 MHz band will be considered a concrete block (with a specified position in the band) in the selection procedure and will be part of category C, being marked C1.

The figure below illustrates the 800 MHz band plan, distinctly marking the available concrete block.

Fig. 14
The 790-862 MHz frequency band plan



7.11.3. Design of frequency blocks in the 1500 MHz band

a) The 1500 MHz frequency band plan

The frequency resources available in the 1500 MHz band total 40 MHz unpaired, corresponding to the 1452-1492 MHz band, for SDL use (exclusively for MFCN-SDL).

The 1500 MHz band plan will comply with the harmonized frequency arrangement set out by Commission Implementing Decision (EU) 2015/750 amended by Commission Implementing Decision no. (EU) 2018/661 and by ECC Decision (13)03 on the harmonized use of the 1452-1492 MHz band for the supplemental downlink of mobile/fixed communications networks (MFCN - SDL).

b) Size of blocks in the 1500 MHz band

The blocks in the 1452-1492 MHz sub-band to be subject to the selection procedure will span 1x5 MHz. The use of such blocks has the advantage of allowing flexibility to the selection procedure participants as regards the options of using channels with different bandwidths and of gaining larger bandwidths in order to provide additional downlink capacity, as needed. The use of larger bandwidth channels for the downlink from the base station to the mobile terminal station contributes to improving the capability of mobile broadband networks to meet the growing downlink traffic demand and is an effective mechanism for treating the mobile data traffic growth asymmetry between the downlink and the uplink.

c) Categories of generic blocks in the 1500 MHz band

As at this stage, ANCOM does not have all the information necessary for setting the technical conditions/limitations on the use of frequencies in the 1500 MHz band to ensure coexistence with other uses in neighbouring countries. Therefore, all the 5 MHz blocks in the 1452-1492 MHz band will be considered as similarly affected by any technical issues regarding coexistence with uses in neighbouring countries in this band.

Under these circumstances, the 1452-1492 MHz (SDL) band will be organized into 8 generic equivalent blocks of 1x5 MHz, belonging to the same category, marked D. Blocks in this category will be marked D1, D2, D3, D4, D5, D6 and will be listed identically in the selection procedure.

By the date of launching the procedure for awarding frequency usage rights, ANCOM will have carried out further technical activities to establish the technical conditions associated with the use of frequencies in the 1500 MHz band, following frequency coordination with neighbouring countries.

If the coordination activities result in different technical restrictions for certain frequency blocks, with a major impact on the use of these frequencies on the territory of Romania, the respective blocks will be included in a distinct category and will be listed differently in the selection.

d) Contiguity of blocks in the 1500 MHz band

Holding contiguous spectrum blocks presents a real advantage as it offers operators the opportunity to obtain larger bandwidths that allows the usage of larger bandwidth frequency channels required for achieving the performance promised by next generation 5G technologies.

In view of these considerations, ANCOM's approach is to ensure the contiguity of the blocks acquired by each winner, in the 1500 MHz band.

The 1500 MHz band plan, highlighting generic blocks in category D, is illustrated in the figure below:

Fig. 15

The frequency band plan in the SDL 1452-1492 MHz band

1452-1457	1457-1462	1462-1467	1467-1472	1472-1477	1477-1482	1482-1487	1487-1492
D1	D2	D3	D4	D5	D6	D7	D8
SDL (base station emission) 40 MHz (8 blocks of 5 MHz)							

7.11.4. Design of frequency blocks in the 2600 MHz band

a) The 2600 MHz frequency band plan

The frequency resources available in the 2600 MHz band total 80 MHz (2x40 MHz), corresponding to the 2530-2570 MHz/2650-2690 MHz sub-bands, for flexible FDD use.

ANCOM proposes a frequency band plan with FDD bands situated according to the harmonized frequency arrangement presented in section 7.7, which observes the provisions of both Commission Decision 2008/477/EC amended by Commission Decision 2009/740/EC, and of Decision ECC/DEC/(05)05 and of the relevant standards on the technologies available for this band.

b) Size of blocks in the 2600 MHz band

ANCOM proposes that the blocks subject to the selection procedure in the paired sub-bands 2530-2570 MHz/2650-2690 MHz should be 2x5 MHz. The use of such blocks has the advantage of allowing flexibility to the selection procedure participants as regards the options of using channels with different bandwidths (2x5 MHz, 2x10 MHz, 2x15 MHz or 2x20 MHz) and of aggregating 2x5 MHz channels in order to provide larger bandwidth channels, based on the requirements of the technology envisaged for implementation.

c) Categories of generic blocks in the 2600 MHz band

ANCOM considers that all available FDD lots in the 2600 MHz band are equivalent in terms of the technical usage conditions and limitations and can be treated as generic batches belonging to the same category.

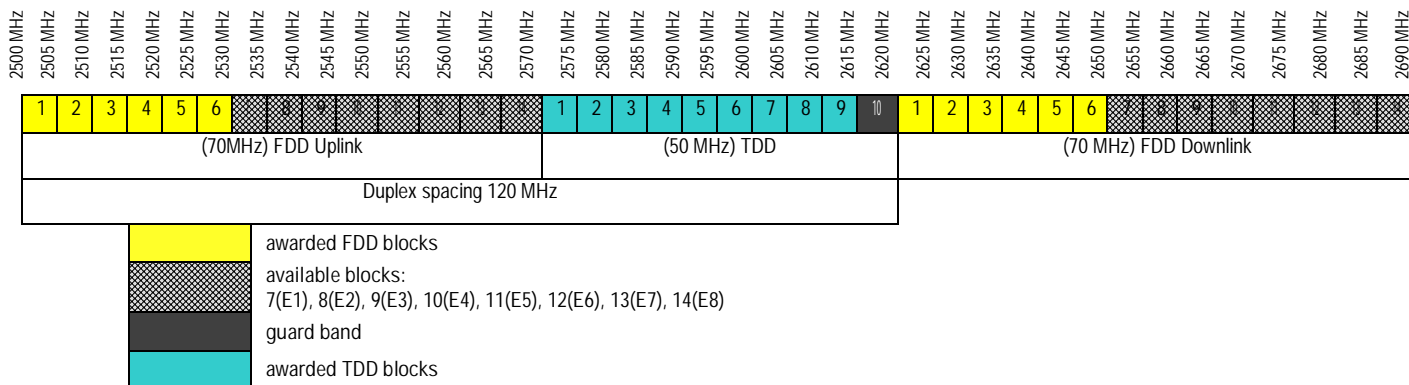
Therefore, the 8 FDD paired 2x5MHz blocks in the 2530-2570 MHz/2650-2690 MHz sub-bands, will be assigned to one category - E. The blocks will be marked E1, E2, E3, E4, E5, E6, E7, E8 and will be listed identically in the selection procedure.

d) Contiguity of blocks in the 2600 MHz band

With a view to ensuring the advantages of holding contiguous spectrum blocks, ANCOM's approach is to ensure the contiguity of the blocks acquired by each winner, in the 2600 MHz band.

The 2600 MHz band plan, highlighting generic blocks in category E, is illustrated in the figure below:

Fig. 16
The frequency band plan in the 2500-2690 MHz band



7.11.5. Design of short-term frequency blocks in the 3400-3800 MHz band

With a view to awarding valid rights for the period 01.01.2020 - 31.12.2025, only the available frequency sub-bands resulting from the 3400-3800 MHz band reorganization will be subject to the selection procedure (i.e. a total amount of 90 MHz - equivalent to 18 unpaired 5 MHz channels).

Short-term validity blocks that will be the subject of the selection procedure in the 3400-3800 MHz band will have a bandwidth of 5 MHz each, therefore the 18 radio channels will be as many frequency blocks.

This ensures the necessary flexibility for the bidders to acquire variable frequency sub-bands in order to accommodate radio channels with different bandwidths or, if necessary, to extend the spectrum resources already held in the respective band.

ANCOM considers that all the blocks in the 3400-3800 MHz band are equivalent in terms of the technical usage conditions and they can be treated as generic blocks belonging to the same category (as it happened in the selection procedure conducted in 2015 in this frequency band, the only difference compared to 2015 - when there were two channel arrangements - is that there will be one channel arrangement for the whole band).

The Authority will ensure that the spectrum blocks won by each bidder following the auction are concatenated and included in a single frequency sub-band. Where appropriate, this frequency sub-band should in turn be adjacent to the other sub-bands already awarded to the bidder (if the respective bidder has already obtained a license to provide MFCN public networks in the respective band), thus avoiding the excessive fragmentation of the band.

Although the refarming the 3400-3600 MHz band will begin immediately after the publication of the new draft EC Decision in the 3400-3800 MHz band, this process will continue after the adoption of this position paper.

The existence of several scenarios for the reorganization of allotments in the respective frequency band significantly impedes the process of accurately identifying spectrum blocks in this case.

Therefore, further details in this regard will be specified in the Terms of Reference of the selection procedure.

7.11.6. Design of long-term frequency blocks in the 3400-3800 MHz band

With a view to awarding valid usage rights for the period 01.01.2026 - 31.12.2035, the whole 3400-3800 MHz band will be subject to the selection procedure (i.e. a total amount of 80 unpaired 5 MHz channels).

Long-term validity blocks will have a bandwidth of 5 MHz each, therefore the 80 frequency channels in the 3400-3800 MHz band will be as many frequency blocks in this year's selection procedure.

This ensures the necessary flexibility for the bidders to acquire frequency sub-bands large enough to accommodate frequency channels of different aggregated bandwidth (including for an operator that has not held usage rights in the respective band before).

ANCOM considers that all the blocks in the 3400-3800 MHz band are equivalent in terms of the technical usage conditions and they can be treated as generic blocks belonging to the same category (as it happened in the selection procedure conducted in 2015 in this frequency band, the only difference compared to 2015 - when there were two channel arrangements - is that there will be one channel arrangement for the whole band).

The Authority will ensure that the spectrum blocks won by each bidder following the auction are concatenated and included in a single frequency sub-band.

7.11.7. Design of frequency blocks in the 700 MHz, 800 MHz, 1500 MHz, 2600 MHz, and 3400-3800 MHz bands

Considering the above-mentioned, the frequency spectrum available in these bands will be organised as follows:

Category	Frequency band	Block bandwidth	No. of blocks
A	700 MHz FDD	2 x 5 MHz	6
B	700 MHz SDL	1 x 5 MHz	3
C	800 MHz FDD	2 x 5 MHz	1
D	1500 MHz SDL	1 x 5 MHz	8
E	2600 MHz FDD	2 x 5 MHz	8
F	3400-3800 MHz TDD, in the short run	5 MHz	18
G	3400-3800 MHz TDD, in the long run	5 MHz	80

The tables below give a snapshot on the distribution of the available frequency spectrum by categories and on the frequency block layout in each category:

1. 700 MHz

Frequency band	Category	Block mark	Block bandwidth	Frequency - from to (uplink / downlink)	Validity period
703-733/758-788 MHz FDD	A	A1	2 x 5 MHz	703.0 – 708.0 MHz/ 758.0 – 763.0 MHz	01.01.2020 - 31.12.2034
		A2	2 x 5 MHz	708.0 – 713.0 MHz/ 763.0 – 768.0 MHz	01.01.2020 - 31.12.2034
		A3	2 x 5 MHz	713.0 – 718.0 MHz/ 768.0 – 773.0 MHz	01.01.2020 - 31.12.2034
		A4	2 x 5 MHz	718.0 – 723.0 MHz/ 773.0 – 778.0 MHz	01.01.2020 - 31.12.2034
		A5	2 x 5 MHz	723.0 – 728.0 MHz/ 778.0 – 783.0 MHz	01.01.2020 - 31.12.2034
		A6	2 x 5 MHz	728.0 – 733.0 MHz/ 783.0 – 788.0 MHz	01.01.2020 - 31.12.2034

Frequency band	Category	Block mark	Block bandwidth	Frequency - from to (downlink)	Validity period
738-753 MHz SDL	B	B1	1 x 5 MHz	738.0 – 743.0 MHz	01.01.2020 - 31.12.2034
		B2	1 x 5 MHz	743.0 – 748.0 MHz	01.01.2020 - 31.12.2034
		B3	1 x 5 MHz	748.0 – 753.0 MHz	01.01.2020 - 31.12.2034

2. 800 MHz

Frequency band	Category	Block mark	Block	Frequency - from	Validity period
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			bandwidth to	
				(uplink / downlink)	
791-821/832-862 MHz	C	C1	2 x 5 MHz	791.0 - 796.0 MHz/ 832.0 - 837.0 MHz	01.01.2020 – 31.12.2029

3. 1500 MHz

Frequency band	Category	Block mark	Block bandwidth	Frequency - from to (downlink)	Validity period
1452-1492 MHz	D	D1	1 x 5 MHz	1452 – 1457 MHz	01.01.2020 – 31.12.2034
		D2	1 x 5 MHz	1457 – 1462 MHz	01.01.2020 – 31.12.2034
		D3	1 x 5 MHz	1462 – 1467 MHz	01.01.2020 – 31.12.2034
		D4	1 x 5 MHz	1467 – 1472 MHz	01.01.2020 – 31.12.2034
		D5	1 x 5 MHz	1472 – 1477 MHz	01.01.2020 – 31.12.2034
		D6	1 x 5 MHz	1477 – 1482 MHz	01.01.2020 – 31.12.2034
		D7	1 x 5 MHz	1482 – 1487 MHz	01.01.2020 – 31.12.2034
		D8	1 x 5 MHz	1487 – 1492 MHz	01.01.2020 – 31.12.2034

4. 2600 MHz FDD

Frequency band	Category	Block mark	Block bandwidth	Frequency - from to (uplink / downlink)	Validity period
2500 – 2570 / 2620 – 2690 MHz	E	E1	2 x 5 MHz	2530.0 – 2535.0 MHz/ 2650.0 – 2655.0 MHz	01.01.2020 – 31.12.2029
		E2	2 x 5 MHz	2535.0 – 2540.0 MHz/ 2655.0 – 2660.0 MHz	01.01.2020 – 31.12.2029
		E3	2 x 5 MHz	2540.0 – 2545.0 MHz/ 2660.0 – 2665.0 MHz	01.01.2020 – 31.12.2029
		E4	2 x 5 MHz	2545.0 – 2550.0 MHz/ 2665.0 – 2670.0 MHz	01.01.2020 – 31.12.2029
		E5	2 x 5 MHz	2550.0 – 2555.0 MHz/ 2670.0 – 2675.0 MHz	01.01.2020 – 31.12.2029
		E6	2 x 5 MHz	2555.0 – 2560.0 MHz/ 2675.0 – 2680.0 MHz	01.01.2020 – 31.12.2029
		E7	2 x 5 MHz	2560.0 – 2565.0 MHz/ 2680.0 – 2685.0 MHz	01.01.2020 – 31.12.2029
		E8	2 x 5 MHz	2565.0 – 2570.0 MHz/ 2685.0 – 2690.0 MHz	01.01.2020 – 31.12.2029

5. 3400-3800 MHz TDD

The blocks in the F and G categories will be identified in the frequency band at the moment of drawing up the Terms of Reference, considering the specifications in section 7.11.5.

8. Principles of awarding frequency usage rights

For the optimal allotment of the frequency spectrum resource with a view to meeting the objectives set out in Chapter 3, ANCOM considers that the spectrum usage rights in the 700 MHz, 800 MHz, 1500 MHz, 2600 MHz and 3400-3800 MHz bands must be awarded in accordance with the following principles:

- prevent an artificial frequency spectrum shortage induced by regulation and by the partial awarding of spectrum usage rights;
- ensure the necessary and sufficient spectrum resources and the optimal technical conditions for the provision of competitive public broadband mobile electronic communications networks and services at national level;
- optimize the use of the radio spectrum intended for the provision of broadband mobile communications services through the conjoint management of frequency bands with different usage capability and characteristics;
- ensure the conditions for access to the frequency spectrum resource in compliance with the principle of technology and service neutrality;
- apply the selection procedure for awarding frequency usage rights where the spectrum available is insufficient to meet all the requests, the number of spectrum usage rights being limited;
- the selection procedure must be objective, open, non-discriminatory, transparent and ensure fair competition;
- ensure the conditions for solving potential competition-related issues arising from uneven frequency allotments for broadband mobile communications networks;
- ensure the conditions of access to the frequency spectrum resource leading to its efficient allotment;
- allow for flexibility in the choice of radio spectrum solutions, in line with the business models of the operators and with the technologies used;
- establish a set of minimum frequency usage conditions/requirements to ensure the efficient use of the frequency spectrum resources for the purpose for which have been awarded;
- ensure radio coexistence with other systems using the same frequency bands in neighbouring countries or with other radiocommunications systems operating the same band or adjacent frequency bands.

9. Requirements and limitations regarding the award of spectrum usage rights

With a view to promoting competition in the market for mobile broadband services in Romania, ANCOM considers that there must be at least four providers of public broadband networks and mobile broadband services in the market at national level and that it is necessary to provide the premises that, following the selection procedure, at least four operators should hold the minimum spectrum portfolios necessary to be credible providers of such networks and services.

As shown in section 7.10 above, ANCOM deems that - for a national broadband mobile networks and services provider to be a credible competitor in the provision of high-quality data services - an appropriate spectrum portfolio is needed, which should meet the following requirements:

- an overall spectrum portfolio suitable for the use of 4G and 5G technologies, to enable the provision of high-quality data services, and in a sufficient amount to cover the fixed costs for the installation and operation of a network for the provision of mobile communications services at national level;
- the spectrum portfolio should include frequencies below 1 GHz for the operator to be able to provide high quality data services over wide areas, and especially indoors.

In order to provide the premises for achieving these objectives, several measures can be implemented in the selection procedure for awarding spectrum usage rights, such as:

- limit the amount of spectrum below 1 GHz that an operator can obtain following participation in the selection procedure, by imposing a spectrum cap on the total amount of frequency resources that may be held by an operator in the spectrum below 1 GHz, including the amount of spectrum it already holds in the bands below 1 GHz (800 MHz and 900 MHz);
- define the minimum essential spectrum packages necessary to guarantee the deployment of public networks capable of providing high-quality mobile data communications services at national level and the fact that the awarded spectrum will allow the holders of usage to become credible providers of such networks and services;
- possibly imposing spectrum caps on the total amount of frequencies an operator may hold for the provision of broadband mobile networks and services.

9.1. Spectrum caps

Since the frequency amount available in the FDD bands below sub 1 GHz is limited, totalling only 2x35 MHz, i.e. 7 blocks of 2x5 MHz for at least four operators, there is a high risk that anti-competitive effects arise for this frequency spectrum category.

Limiting the maximum amount of spectrum an operator may hold below 1 GHz, including the amount of spectrum already held in the 800 MHz and 900 MHz bands, is aimed at avoiding the risk of failure in promoting long-term competition by preventing anticompetitive results of the selection procedure, such as a small number of operators (smaller than the number of current holders of a licence for the provision of broadband mobile communications) acquiring a large amount of spectrum below 1 GHz, or a disproportionate distribution of spectrum resources among operators.

Imposing spectrum caps below 1 GHz provides the premises for:

- fair access to spectrum resources below 1 GHz, more appropriate to cover rural areas, which implies lower costs for infrastructure development;
- encouraging efficient investment in infrastructure;
- promoting a sustainable competition based on fair access to the radio spectrum resource;
- spectrum access in the bands below 1 GHz, and possibly a new entrant on the market.

Since the spectrum below 1 GHz offers advantages in terms of the efficiency of radio coverage compared to spectrum above 1 GHz, and given the low amount of spectrum available in the frequency bands below 1 GHz, in order to prevent anticompetitive results such as excessive concentration or disproportionate spectrum portfolios below 1 GHz, in the 2012 selection procedure ANCOM imposed spectrum caps in the spectrum below 1 GHz.

Thus, in the 2012 selection procedure for awarding frequency use rights in the 800 MHz, 900 MHz, 1800 MHz and 2600 MHz bands, the following limitations were imposed on the maximum spectrum amounts for which a bidder could acquire usage rights in the bands below 1 GHz following the selection procedure, for the period 06.04.2014-05.04.2029:

a) the total maximum amount of spectrum in the 800 MHz and 900 MHz bands (cumulated) for which a bidder could hold usage rights following the selection procedure, for the period 06.04.2014 - 05.04.2029, was 2 x 20 MHz;

b) the total maximum amount of spectrum in the 800 MHz band for which a bidder could hold usage rights following the selection procedure, for the period 06.04.2014-05.04.2029, was 2 x 10 MHz;

c) the total maximum amount of spectrum in the 900 MHz band for which a bidder could hold usage rights following the selection procedure, for the period 06.04.2014 - 05.04.2029, was 2 x 10 MHz.

With a view to ensuring adequate spectrum portfolios for all operators providing broadband mobile communications networks and services, ANCOM proposes to limit the amount of spectrum held by an operator in FDD bands below 1 GHz to a maximum of 2 x 30 MHz, including the amount of spectrum held in the 800 MHz and 900 MHz bands. This limitation will apply only to the stage of primary rounds and implies that no bidder can obtain, following the completion of primary rounds, more than 2 x 30 MHz in the FDD spectrum below 1 GHz (including the frequencies already held in the 800 MHz and 900 MHz bands).

In the event of organizing a stage of additional rounds, if FDD frequency blocks remain not acquired in the 700 MHz and 800 MHz bands after the primary rounds, the above spectrum caps rule will no longer be applied.

Taking into account that a very small amount of spectrum is available for SDL use in the 700 MHz band – i.e. only 15 MHz - ANCOM will not impose caps on the maximum amount of spectrum an operator can obtain in the 700 MHz SDL band, since such a limitation would lead to a potential inefficient use of the spectrum, given the specificity of SDL usage in these frequencies.

ANCOM, however, analyses the opportunity to limit the maximum amount of spectrum that an operator can obtain in the 700 MHz and 1500 MHz bands, cumulatively, for SDL use.

Furthermore, in order to avoid the accumulation of spectrum by a small number of operators, ANCOM will consider the opportunity to impose a limit also on the maximum amount of total spectrum that an operator can hold for the provision of broadband mobile communications networks and services, including the frequency spectrum that operators can obtain in the bands to be awarded through the selection procedure and the spectrum already held in the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2600 MHz and 3400-3800 MHz bands.

9.2. Allotment of concrete frequency blocks

The first stage of the selection procedure will reveal the winners and the number of generic blocks in each category to be received by each of them, without specifying the blocks of actual frequencies to be awarded.

The concrete frequency blocks will be allotted, respectively the abstract frequency blocks in each category will be distributed among the winners at a later stage of the selection procedure.

All the winners designated at the end of the first stage of the selection procedure that have obtained multiple blocks of abstract frequencies in one frequency band are guaranteed to obtain contiguous spectrum blocks in that band.

The actual allotment of concrete frequency blocks will be explained in the selection procedure documentation.

The following criteria shall be considered in the allotment of concrete frequency blocks:

a) Coherent allotment of the frequency spectrum

With a view to the efficient spectrum use for broadband technologies, the frequency resources will be allotted in such a way that contiguous frequency blocks with a width corresponding to an integer multiple of 2 x 5 MHz (FDD) or to an integer multiple of 5 MHz (TDD/SDL) should be ensured.

b) Restrictions on the use of concrete frequency blocks for reasons concerning harmful interference

The use of certain concrete frequency blocks can be restricted due to existing applications in the same band or in adjacent bands. In this respect, the following situations must be considered:

- Potential restrictions for avoiding harmful interference on other uses

Some usage restrictions may be imposed for certain concrete spectrum blocks, to ensure coexistence with other uses in the same band or in adjacent bands on the territory of Romania or of neighbouring countries (TV broadcasting, aeronautical radionavigation, aeronautical telemetry, etc.) and to avoid harmful interference that may be caused to these uses by MFCN networks. In this respect, the use of some frequency blocks may be restricted in certain geographical areas, for reasons of protecting existing uses from harmful interference. In such cases, the restrictions will be specified in the documentation of the selection procedure.

- Potential restrictions for avoiding interference caused by other uses

Some usage restrictions may be imposed for certain concrete spectrum blocks, to avoid harmful interference that may be caused by other uses in the same band or in adjacent bands (e.g. uses in neighbouring countries for different systems in other radiocommunications services: broadcasting, aeronautical radionavigation systems, etc.). Therefore, the use of frequency blocks may be restricted in certain geographical areas, in order to prevent any harmful interference on MFCN networks. In these cases, the restrictions will be specified in the documentation of the selection procedure.

10. Conditions for using the frequency spectrum in the 700 MHz, 800 MHz, 1500 MHz, 2600 MHz, 3400-3800 MHz bands (licence conditions)

With a view to meeting the objectives of promoting the growing penetration of broadband mobile services, competition on the market for such services and the efficient use, free of harmful interference, of the spectrum allocated for this purpose, a set of minimum usage conditions must be provided, including service coverage obligations and technical conditions to ensure coexistence with other applications in the same band or in adjacent bands, as well as with applications existing in the same band in neighbouring countries.

The minimum usage conditions for the frequency spectrum in the 700 MHz, 800 MHz, 1500 MHz, 2600 MHz and 3400-3800 MHz bands will be set by ANCOM prior to the launch of the selection procedure and will be part of the documentation for conducting the selection procedure, including the terms and conditions for awarding frequency usage licenses (Terms of Reference).

10.1. Requirements regarding coverage with broadband mobile communications services

The provision of obligations in the awarded licenses is a well-established practice in order to promote legitimate public interests.

In 2010, the Digital Agenda for Europe defined the following connectivity targets to be achieved in the European Union by 2020: universal availability of broadband communications services with a data transfer speed of at least 30 Mbps and access to speeds of at least 100 Mbps for at least 50% of households, to anticipate future competitiveness needs.

In the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - *Connectivity for a Competitive Digital Single Market: Towards a European Gigabit Society*, the European Commission considers that, while basic broadband (at a rate of at least 2 Mbps) is already available to every European citizen, mainly provided by existing infrastructures, however it is no longer sufficient to ensure continued digital transformation.

While the 2010 connectivity targets remain valid until 2020, the Commission proposes a strategic target to be achieved by 2025: ensuring that all households in the Union, in rural and urban areas, have access to Internet connections with a data rate of at least 100 Mbps, connections which could then be upgraded to Gbps speeds.

Another strategic objective proposed by the Commission in the above-mentioned document is that all urban areas and all major land transport routes²⁵ should have uninterrupted 5G coverage by 2025.

In the previous selection procedures, ANCOM provided requirements and included minimum obligations the subsequently issued licenses as regards service coverage and network access.

The Terms of Reference of the competitive selection procedure for awarding frequency usage rights in the 800 MHz, 900 MHz, 1800 MHz and 2600 MHz bands organised in 2012 provided separate coverage obligations for the licenses awarded in the frequency bands below 1 GHz and respectively for those in the frequency bands above 1 GHz, with the validity period 06.04.2014 - 05.04.2029.

(See section 3.3.1 of the Terms of Reference, a document available here:

http://www.ancom.org.ro/en/uploads/links_files/Caiet_de_sarcini_procedura_multibanda_800_900_1800_2600_2_07_2012_en.pdf).

In ANCOM's view, the development and growing penetration of broadband mobile communications at national level requires using frequencies in the spectrum provided by the combined selection procedure in the 700 MHz, 800 MHz, 1500 MHz, 2600 MHz and 3400-3800 MHz bands, so as to provide competitive mobile communications services through the most advanced technologies available (LTE or future 5G technologies).

Therefore, the license holders' obligation regarding coverage with broadband mobile communications services will be defined based on the percentage of the population in need of mobile access to high-speed electronic communications services, specific to 4G/5G technologies, provided in a consistent manner across the entire area covered.

ANCOM deems that, in order to reach the target of achieving national coverage with mobile next generation mobile communications services, it is necessary to impose the minimum required regulation, i.e. the Authority should define coverage obligations with respect to broadband mobile communications services, which will be specified in the frequency usage licenses awarded to the winners of the selection procedure.

Coverage obligations associated with the frequency usage rights will be set at a later stage and will be included in the Terms of Reference of the selection procedure.

Future coverage obligations of license holders will also consider the strategic objectives proposed in the draft *5G Strategy for Romania*²⁶, which was under public consultation between 21.11.2018 and 21.12.2018.

10.2. Requirements regarding the provision of emergency communications services

The need for emergency communications includes a multitude of scenarios, ranging from minor incidents such as road accidents to major incidents such as terrorist attacks and natural disasters. Thus, the requirements regarding emergency communications can be classified into the following categories:

- communications from authorities/organizations to individuals (e.g. the System for alerting and warning the citizens in emergency situations RO-ALERT);
- communication between authorities/organizations (e.g. PPDR networks and services and, subsequently, broadband PPDR);
- communication of citizens with authorities/organizations (e.g. The Single National System for 112 Emergency Calls, e-call).

²⁵ According to the definition in: http://ec.europa.eu/eurostat/statisticsexplained/index.php/European_cities_%E2%80%93_the_EU-OECD_functional_urban_area_definition

²⁶ http://www.ancom.org.ro/uploads/forms_files/Strategia_5G_pentru_Romania1542734913.pdf

In accordance with the Commission Recommendation 2003/558/EC (notified by document no. C(2003)2657), radiocommunications for public protection and disaster response (PPDR) are radio applications used for public safety, security and defence used by national authorities or relevant operators responding to the relevant national needs regarding public safety and security including in emergency situations.

The main broadband services needed to carry out the activities of institutions with PPDR attributions are, among others, voice and video transmissions, database interrogations, sensor monitoring and file transfer. Due to the quality parameters that are superior to today's broadband mobile communications systems, the services listed above can be provided through 5G technologies that provide high data transfer rates as well as mechanisms for prioritization, pre-emption and configuration of the quality parameters of various types of services.

With a view to meeting both today's BB-PPDR communications needs and the foreseen ones, the networks and services implemented need to be able to support improved data and multimedia transmission capabilities, increased data rates and capacities, as well as widely differing requirements in terms of capacity, availability and resilience.

Having regard to these objectives, the licenses to be awarded will have special associated requirements concerning coverage and access, aimed at achieving the objectives pursued by the institutions of the National Defence, Public Order and National Security System:

1. prioritization, pre-emption, service classes, national roaming, access to the 5G network of the communications and PPDR services integrator;
 2. technical conditions for interconnection with the RO-ALERT system and transmission of warning messages through all cells using the frequencies to be auctioned off;
 3. transmission - free of charge - of emergency calls and of their associated location information to The Single National System for 112 Emergency Calls (SNUAU).
1. The rights holders in frequency bands for 5G technology services will pursue the following requirements in relation with the designated PPDR communications and services integrator:
 - a) implementation within the 5G network of the possibility of providing service classes and access to the 5G network for the national PPDR communications integrator;
 - b) the possibility to ensure, and granting priority to, the services destined for the beneficiary of the national PPDR communications integrator. Priority is understood as the service feature that enables the prioritization of a user, application, traffic flow, or individual packet over the rest of the operator's customers, in setting up a data session and processing the respective session;
 - c) possibility of ensuring pre-emption in the provision of PPDR services. Pre-emption is understood as the service feature that enables priority allocation of communication resources to the respective service beneficiaries, even if - during periods of network congestion - this allocation of resources is may be also performed by closing active sessions for other operator's customers.

A more detailed technical description is provided in the 3GPP Technical Specifications (TS):

- TS 22.280 Mission Critical Services Common Requirements;
 - TS 23.379 Mission Critical Push To Talk call control; Protocol Specifications;
 - TS 23.281 Functional architecture and information flows to support Mission Critical Video (MCVideo);
 - TS 23.282 Functional architecture and information flows to support Mission Critical Data (MCData).
- d) the possibility of providing services for PPDR communications beneficiaries, under national roaming conditions, upon the negotiation in good faith and following the conclusion of national roaming agreements with other holders of frequency usage licenses for the provision of public electronic communications networks.

- “national roaming” – is the facility granted to a subscriber to use a mobile handset or other mobile electronic communications device on the territory of Romania when he/she is outside the coverage area of the subscriber’s network, due to the conclusion of agreements between the network operator to which he/she subscribes and the other mobile network operators in Romania;
- “national roaming agreement” – is an access agreement whereby another holder of a frequency usage licence for the provision of public mobile electronic communications networks and publicly available services makes available facilities or services required for providing electronic communications services at mobile locations outside the geographical area covered by one’s own network.

2. Operators will be responsible for ensuring the technical conditions necessary for the interconnection of the RO-ALERT system with their own infrastructure.

Interconnection between the RO-ALERT system and the operators' networks will be achieved in at least two points, in order to ensure the geographical redundancy of the RO-ALERT system. In the event of a change in one of the RO-ALERT installation sites, the operators, at the request of the communications integrator, will have to make the interconnection of their own networks with the RO-ALERT system at the new site.

Each of the operators will additionally provide a Layer 2 link between the RO-ALERT System sites via their own infrastructure, with a transfer capacity of at least 1 Mbps, to provide system redundancy.

Operators will ensure the distribution of Cell Broadcast messages to all their network elements and to all functional cells in their own networks through the controller elements within these networks.

Cell Broadcast messages will be distributed by operators across all the cells within their own networks, in all the available technologies.

3. Holders of frequency usage rights will ensure that emergency calls are transmitted free of charge and that their location information is provided to the SNUAU.

Holders of frequency usage rights will also have the obligation to negotiate, in good faith, and to conclude national roaming agreements with the PPDR communications and services integrator, with a view to providing access to the 112 emergency number for other holders of frequency usage licenses for the provision of public electronic communications networks.

National roaming agreements shall be concluded within a reasonable term from the date of entry into force of the licenses and shall be valid for their entire validity period.

10.3. Technical conditions for frequency usage in the 700 MHz, 800 MHz, 1500 MHz, 2600 MHz, 3400-3800 MHz bands

10.3.1. Technical conditions for frequency usage in the 700 MHz band

a) Concerning the frequencies in the 700 MHz band, the provisions of the latest versions of the following EC decisions, and CEPT/ECC decisions, recommendations and reports will apply:

- Commission Implementing Decision 2016/687/EU on the harmonisation of the 694-790 MHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services and for flexible national use in the Union;
- ECC Decision ECC/DEC/(15)01 on the harmonized technical conditions for mobile/fixed communications networks (MFCN) in the band 694-790 MHz including a paired

channelling arrangement (2x30 MHz FDD) and an unpaired channelling arrangement (supplementary downlink), approved on 6 March 2015;

- Report CEPT 53: Report A from CEPT to the European Commission in response the EC Mandate “to develop harmonised technical conditions for the 694-790 MHz ('700 MHz') frequency band in the Union for the provision of wireless broadband and other uses in support of EU spectrum policy objectives”, approved on 28 November 2014 by ECC;
- Report CEPT 60: Report B from CEPT to the European Commission in response the EC Mandate “to develop harmonised technical conditions for the 694-790 MHz ('700 MHz') frequency band in the Union for the provision of wireless broadband and other uses in support of EU spectrum policy objectives”, approved on 1 March 2016 by ECC;
- Report CEPT 29: Report from CEPT to the European Commission in response to the Mandate on “Technical considerations regarding harmonisation options for the digital dividend in the European Union” - “Guideline on cross border coordination issues between mobile services in one country and broadcasting services in another country” (Adoption of methodology) (Final report of 26 June 2009).

b) Technical conditions for frequency usage in the 700 MHz band in border areas

Concerning the usage of radio frequencies in the 700 MHz band in border areas, the provisions of the following bilateral technical agreements are applicable:

- *“Technical arrangement on the use of the 694-790 MHz frequency band for terrestrial systems in the border areas of Romania and Ukraine, concluded in Bucharest, in October 2015”;*
- *“Technical Agreement between the national authorities for the management of frequencies of Austria, Croatia, Hungary, Romania, The Slovak Republic and Slovenia on border coordination for terrestrial systems capable of providing electronic communications services and national options in the 700 MHz frequency band, concluded in Budapest, on 15 February 2018”.*

Where no bilateral agreements were concluded with the neighbouring countries, the provisions of No. 5.312A and 5.317A of Art. 5 of RR-ITU and the relevant provisions of ECC Recommendation ECC/REC/(15)01 on Cross-border coordination for mobile/fixed communications networks (MFCN) in the frequency bands: 694-790 MHz, 1452-1492 MHz, 3400-3600 MHz and 3600-3800 MHz (approved on 13 February 2015, amended on 5 February 2016).

The technical conditions for frequency usage in the 700 MHz band will be detailed in the Terms of Reference of the selection procedure for awarding frequency usage rights in this band.

10.3.2. Technical conditions for frequency usage in the 800 MHz band

a) Concerning the frequencies in the 800 MHz band, the provisions of the latest versions of the following EC decisions, and CEPT/ECC decisions, recommendations and reports will apply:

- Commission Decision 2010/267/EU on harmonised technical conditions of use in the 790-862 MHz frequency band for terrestrial systems capable of providing electronic communications services in the European Union;
- ECC/DEC/(09)03 on harmonised conditions for mobile/fixed communications networks (MFCN) operating in the band 790 - 862 MHz;
- CEPT Report 030: Identification of common and minimal (least restrictive) technical conditions for 790 - 862 MHz (the digital dividend) in the European Union;
- CEPT Report 031: Frequency (channelling) arrangement for the 790-962 MHz band;
- CEPT Report 019: Least restrictive technical conditions for WAPECS bands;

b) Technical conditions for frequency usage in the 800 MHz band in border areas:

Concerning the usage of radio frequencies in the 791-821 MHz/832-862 MHz bands in border areas, the provisions of the following bilateral technical agreements are applicable:

- *"Technical Agreement between the telecommunications administrations of Romania and Ukraine on the coordination of the use of the 790-862 MHz frequency band by mobile radiocommunications networks with radio navigation and fixed services, concluded at Geneva in February 2012"*;
- *"Technical Agreement between the telecommunications administrations of Romania and Ukraine on the coordination of DVB-T frequency assignments in the 470-790 MHz band and the technical criteria for the coordination of the broadcasting service in Ukraine in the 790-862 MHz band with the land mobile service in Romania, concluded in Geneva in February 2012"*;
- *"Technical Agreement between the national authorities for the management of frequencies of Austria, Croatia, Hungary, Romania, Serbia, The Slovak Republic and Slovenia on border coordination for terrestrial systems capable of providing electronic communications services in the 790-862 MHz frequency band, concluded in Budapest, on 14 February 2018"*.

In the absence of bilateral agreements with the neighbouring countries, the provisions of No. 5.316B and 5.317A of Article 5 of the ITU Radio Regulations and Recommendation ECC/REC/(11)04 on cross-border coordination for Mobile/Fixed Communications Networks (MFCN) in the frequency band 790-862 MHz (amended on 3 February 2017), as well as CEPT Report on Technical considerations regarding harmonisation options for the Digital Dividend in the European Union - "Guideline on cross border coordination issues between mobile services in one country and broadcasting services in another country" shall apply.

The technical conditions for frequency usage in the 800 MHz band will be detailed in the Terms of Reference of the selection procedure for awarding frequency usage rights in this band.

10.3.3. Technical conditions for frequency usage in the 1500 MHz band

- a) Concerning the frequencies in the 1500 MHz band, the provisions of the latest versions of the following EC decisions, and CEPT/ECC decisions, recommendations and reports will apply:
- Commission Implementing Decision (EU) 2015/750 on the harmonisation of the 1452-1492 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Union, amended by Commission Implementing Decision (EU) 2018/661;
 - Decision ECC/DEC/(13)03 on the harmonized use of the 1452-1492 MHz band for the supplemental downlink of mobile/fixed communications networks (MFCN - SDL), approved in November 2013, amended in March 2018;
 - ECC Report 202: Out-of-Band emission limits for Mobile/Fixed Communication Networks (MFCN) Supplemental Downlink (SDL) operating in the 1452-1492 MHz band (September 2013);
 - ECC Report 227: Compatibility Studies for Mobile/Fixed Communication Networks (MFCN) Supplemental Downlink (SDL) operating in the 1452-1492 MHz band (approved in January 2015);
 - ECC Report 269: Least restrictive technical conditions for Mobile/Fixed Communications Networks in 1427-1518 MHz. Approved 17 November 2017, corrected on 2 March 2018);
 - CEPT Report 054 – Report from CEPT to the European Commission in response to the Mandate "To develop harmonised technical conditions in the 1452-1492 band for

wireless broadband electronic communications services in the EU" (approved by ECC on 28 November 2014).

b) Technical conditions for frequency usage in the 1500 MHz band in border areas:

Concerning the usage of radio frequencies in the 1452-1492 MHz bands in border areas, the provisions of the following bilateral technical agreement are applicable:

- *"Technical Agreement between the national authorities for the management of frequencies of Austria, Croatia, Hungary, Romania, The Slovak Republic and Slovenia on border coordination for terrestrial systems capable of providing electronic communications services in the 1452-1492 MHz frequency band, concluded in Budapest, on 14 February 2018".*

In the absence of bilateral agreements with the neighbouring countries, the provisions of No. 5.342 of Article 5 of the ITU Radio Regulations and the relevant provisions of Recommendation ECC/REC/(15)01 on cross-border coordination for Mobile/Fixed Communications Networks (MFCN) in the frequency bands 694-790 MHz, 1452-1492 MHz, 3400-3600 MHz and 3600-3800 MHz (approved on 13 February 2015, amended on 5 February 2016) shall apply.

The technical conditions for frequency usage in the 1500 MHz band will be detailed in the Terms of Reference of the selection procedure for awarding frequency usage rights in this band.

10.3.4. Technical conditions for frequency usage in the 2600 MHz band

a) Concerning the frequencies in the 2600 MHz band, the provisions of the latest versions of the following EC decisions, and CEPT/ECC decisions, recommendations and reports will apply:

- Commission Decision 2008/477/EC on the harmonisation of the 2500 - 2690 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community, amended by Commission Decision 2009/740/EC;
- ECC/DEC/(05)05 on the harmonised utilization of spectrum for Mobile/Fixed Communications Networks (MFCN) operating in the 2500-2690 MHz band (approved on 18 March 2005, amended on 3 July 2015);
- ECC Report 045: Sharing and adjacent band compatibility between UMTS/IMT-2000 in the band 2500-2690 MHz and other services (February 2004);
- ECC Report 119: Coexistence between mobile systems in the 2.6 GHz frequency band at the FDD/TDD boundary (June 2008);
- CEPT Report 019: Report from CEPT to the European Commission in response to EC Mandate "to develop least restrictive technical conditions for frequency bands addressed in the context of WAPECS" (approved on December 2007, reviewed in October 2008).

a) Coordination and use of radio frequencies in the 2600 MHz in border areas:

For the use of radio frequencies in the 2500-2570 MHz/2620-2690 MHz bands in the border areas, the provisions of the following bilateral technical agreement shall apply:

- *"Technical arrangement between the national authorities for the management of frequencies of Hungary and Romania concerning the coordination in border areas for terrestrial systems capable of providing electronic communications services in the 2500-2690 MHz band, concluded in 2013".*

In the absence of bilateral or multilateral agreements with the neighbouring countries, the provisions of No. 5.384 of Article 5 of the ITU Radio Regulations and the relevant provisions of

Recommendation ECC/REC/(11)05 on cross-border coordination for Mobile/Fixed Communications Networks (MFCN) in the frequency band 2500-2690 MHz (approved on 26 May 2011, amended on 3 February 2017) shall apply.

The technical conditions for frequency usage in the 2600 MHz band will be detailed in the Terms of Reference of the selection procedure for awarding frequency usage rights in this band.

10.3.5. Technical conditions for frequency usage in the 3400-3800 MHz band

The technical regulations applicable to the 3400-3800 MHz frequency band were previously detailed under Chapter 5 of section 5.2.5.

The detailed technical conditions for the use of frequencies in the 3400-3800 MHz band will be described in the specification that will form the basis of the selection procedure for the granting of frequency use rights in this band.

Concerning the use of the frequency spectrum in border areas in the band concerned, we mention that there are no bilateral or multilateral technical agreements concluded with the national radio frequency management authorities in the neighbouring countries at present.

ANCOM's efforts in this regard are ongoing, such draft agreements being under consideration, for the time being only with the authorities of Hungary and the Republic of Moldova. Romania is analysing the possibility of joining a multilateral technical agreement in the 3400-3800 MHz band already signed by several European states (including Hungary and Serbia). Hungary and Romania intend to extend the debate on this issue to include the authority in Ukraine but talks on this topic are at an early stage.

Where no bilateral or multilateral agreements have been concluded with the neighbouring countries on the operation of MFCN networks in the 3400-3600 MHz band in border areas, the provisions of No. 5.430A of Art. 5 of RR-ITU apply.

Where no bilateral or multilateral agreements have been concluded with the neighbouring countries on the operation of MFCN networks in the 3600-3800 MHz band in border areas, the general provisions of Art. 5 of RR-ITU on the operation of radiocommunication services on a secondary basis will apply.

In both cases - where the neighbouring countries reach consensus thereon - the relevant provisions of ECC Recommendation ECC/REC/(15)01 on Cross-border coordination for mobile/fixed communications networks (MFCN) in the frequency bands: 694-790 MHz, 1452-1492 MHz, 3400-3600 MHz and 3600-3800 MHz (approved on 13 February 2015, amended on 5 February 2016) shall apply.

10.4. Validity period of frequency usage rights

ANCOM intends to grant the rights to use radio frequencies in the 700 MHz and 1500 MHz bands for a period of validity of 15 years with effect from 01.01.2020 (see Section 7.2 *Frequency spectrum available*).

As regards the frequency usage rights in the 800 MHz and 2600 MHz bands, ANCOM proposes to award them for a 10-year validity period, with effect from 01.01.2020 (see section 7.2 *Frequency spectrum available*). Setting a 10-year validity period takes into account the Authority's intention to align the expiry date of the frequency usage rights to be awarded in the 800 MHz and 2600 MHz bands with the expiry date of the licenses already issued in those bands, the validity of which is intended to be extended until 31.12.2029.

For the frequencies to be made available in 2019 in the 3400-3800 MHz band, ANCOM proposes to grant usage rights for a 6-year validity period, starting 01 January 2020 (see Section

7.8.4), in order to align the expiry date of these rights with the expiry date of the rights already awarded in the 3400-3600 MHz and 3600-3800 MHz bands, so that the entire 3400-3800 MHz band should become fully available as of 01 January 2026.

ANCOM will award new usage rights for the entire 3400-3800 MHz band for a 10-year validity period, starting from 01 January 2026.

11. The procedure for awarding frequency usage rights in the 700 MHz, 800 MHz, 1500 MHz, 2600 MHz, 3400-3800 MHz bands

Deciding on the selection procedure for awarding frequency usage rights in the 700 MHz, 800 MHz, 1500 MHz, 2500-2690 MHz and 3400-4800 MHz bands plays an extremely important role in achieving the desired results of the selection.

Taking into account the objectives of the strategy for awarding frequency usage rights in the bands for the provision of public broadband mobile electronic communications and services, as stated in Chapter 3, as well as the principles for awarding frequency usage rights that need to be observed for the purpose of optimal allocation of the spectrum resource, as stated in Chapter 8, ANCOCOM deems that the optimal selection procedure for awarding frequency usage rights that sets the premises for the fulfilment of the undertaken objectives, while observing the principles of efficient management of the spectrum resource, is the competitive selection procedure, also referred to as "auction".

The competitive bidding procedure is the procedure whereby the right to use radio frequencies is awarded to the winner of an auction as a result of offering a maximum bid value for the spectrum resources auctioned off, starting from a reserve price, while ensuring the fulfilment of pre-qualification technical, administrative or financial criteria, as applicable.

The advantages of such a procedure are the following:

- it can lead to more effective outcomes than other mechanisms for awarding spectrum usage rights;
- under the conditions of effective competition, it provides the premises for optimal use of the radio spectrum resource, and it is more likely to lead to awarding spectrum resources to those users who value it most;
- it allows flexibility in spectrum allotment, according to bidder options;
- if well designed and organized, it sets the premises for a fair and objective selection procedure, which meets the requirements for openness, non-discrimination and transparency;
- it is more transparent and robust in case of challenges than the comparative selection procedure

The auction procedure also has a set of disadvantages, such as:

- it is more difficult to organize an auction, it needs to be very carefully planned and managed and it calls for well-informed bidders;
- it can financially disadvantage weaker or newer market players and it can therefore prevent the development of more spectrum-efficient or more innovative applications;
- competition may be ineffective if market conditions suddenly deteriorate or there is significant disproportion among bidders;
- there is a risk of market failure if there are many spectrum users who must deal with high transaction costs to compete in an auction.

Having analysed the advantages and disadvantages of the tender procedure, ANCOCOM has concluded that the benefits that this procedure may entail are more important than the associated risks and decided that frequency usage rights available in the 694-790 MHz, 790- 862 MHz, 1452-1492 MHz, 2500-2690 MHz and 3400-3800 MHz are to be awarded by auction.

In order to maximize efficiency, the auction should be designed to meet the following requirements:

- a) include practical provisions in pursuit of the objective on promoting competition, while ensuring a balance of all the other factors set out below;
- b) allow the bidders' flexibility to bid for the spectrum bundles they value;
- c) remove the risks that the bidders acquire insufficient spectrum to satisfy their own needs or that frequency blocks be allotted in such a way that they are not contiguous enough to be exploited effectively;
- d) facilitate the reduction of uncertainty as to the overall value of the spectrum, through access to information relevant for spectrum evaluation by bidders;
- e) encourage bidders to bid for the spectrum they are interested in, to leave aside the frequency resources they do not want to acquire; design the auction so as to create incentives for bids to reflect the real value that bidders are willing to offer for the frequencies they intend to obtain in order to ensure that the winning bids reflect a real assessment;
- f) reduce the opportunities for bidding misbehaviour: the auction rules and procedure should prevent participants from implementing a bidding strategy that aimed at excluding other participants from acquiring spectrum resources or from attempting to obtain smaller amounts of spectrum than those tailored for effective usage in order to pay a significantly lower price;
- g) reduce participation barriers as much as possible: the auction rules must not unreasonably impede the participation of any category of applicants, by allowing both small-sized and large-sized (well-established) participants to take part in the selection procedure, which implies that bidding must be relatively simple, and it should involve low costs and low risk for participants;
- h) the auction design should be easy to carry out: the level of complexity of the bidding process should be not so great as to become impractical to be implemented in the auction software program or in the regulations required to produce legal effects in awarding the rights; an auction design too complex to be understood by the participants should also be avoided, so that they could participate in the auction without the risk of making mistakes due to lack of knowledge of the tender procedure and rules.

11.1. The competitive selection procedure

With a view to setting the optimum auction mechanism and the actual auction procedure, ANCOM intends to launch consultation with all the stakeholders, offering them the opportunity to bring useful input to designing an auction as efficient as possible.

Moreover, ANCOM will provide assistance to the interested parties by preparing a mock auction prior to the launch of the actual selection procedure.

For granting spectrum use rights in the 800 MHz, 900 MHz, 1800 MHz and 2600 MHz bands, in 2012, ANCOM applied a competitive selection procedure consisting of a stage of clock auction primary rounds, followed by one or two additional sealed bidding rounds for the blocks still not awarded in the primary rounds and one sealed bidding round for awarding concrete blocks within each block category for the previous stages' winners of generic blocks.

Clock auction:

- iterative bidding procedure, in multiple rounds, where multiple abstract (generic) spectrum blocks are auctioned out simultaneously, by various categories, at pre-set prices announced by the organizer at the beginning of each round;
- within each round, participants submit bids indicating the number of generic blocks they want to acquire in each category, at the price set for that category in that round;

- the price is gradually rising from one round to another, for the block categories where demand exceeds the offer;
- the process is repeated until the demand no longer exceeds the offer for any block categories;
- allows package bidding for spectrum licences;
- ensures the flexibility of participants to submit bids for different spectrum combinations, across multiple bands;
- participants can change the distribution of bids for the various blocks, each round, in compliance with an activity rule designed to stimulate participation during the auction and discourage speculative play;
- leads to the participants' jointly finding the price that reflects the market value;
- determines the number of generic blocks obtained by winners in each category;
- may be followed by a sealed bid auction stage whereby the concrete spectrum blocks are established for each of the winners of the clock auction stage.

The actual auction was preceded by a qualification stage, during which – upon assessment of the initial application of block frequencies within each category – the following decisions could have been taken:

- a) organize the auction stage starting with the primary rounds, if the aggregate demand had exceeded the number of blocks available under the selection procedure, in at least one category;
- b) organize the auction stage starting with the additional round/rounds, if the aggregate demand had not exceeded the number of blocks available under the selection procedure in any category, so blocks for which there was no demand would have remained unacquired;
- c) organize the bidding round only, if the aggregate demand had not exceeded the number of blocks available under the selection procedure in any category, so no blocks for which there was no demand would have remained unacquired.

In the primary rounds of the auction stage (main stage), the bidders competed to obtain abstract frequency blocks within one or more spectrum block categories (spectrum packages), specifying the number of generic blocks they wanted to acquire in each of the available block categories.

All bids in the main stage were submitted for full frequency block packages. Generic blocks in all categories were auctioned out simultaneously, which allowed spectrum bundle bidding, blocks within a category being scored with the same number of eligibility points and being substitutable during the auction.

The maximum amount of spectrum that a bidder could acquire was limited by the total number of eligibility points available to each bidder and by the restrictions and conditions applicable in the selection procedure.

The primary rounds were intended to determine the winning bids, respectively the winning bidders and the spectrum package acquired by each of them, as well as the reserve prices the winners had to pay for the respective package.

Where – following the submission of initial bids or following the primary rounds - abstract frequency blocks remained unacquired, ANCOM could decide to hold an additional bidding round, and if and after it some blocks remained unacquired, it could decide to organize a second additional round.

After the additional round/rounds, the winning bids for the blocks unacquired in the primary rounds, respectively the winning bidders, as well as the reserve prices of the winning bids - which the bidders had to pay - were determined.

Primary and additional round/rounds were aimed at determining the winning bidders and the number of generic blocks they acquired in each block category.

After the primary and additional rounds stage, an assignment round was carried out to determine the individual position of the abstract blocks obtained by each winner in the previous stage, within each frequency band, i.e. the assignment of the concrete frequency blocks.

ANCOM proposes applying a competitive selection procedure similar to the one organised in 2012, with a view to awarding frequency usage rights for the available frequencies in the 694-790 MHz, 790-862 MHz, 1452-1492 MHz, 2500-2690 MHz and 3400-3800 MHz bands.

The selection procedure will be regulated by ANCOM President's Decision and will be detailed in the Terms of Reference of the selection procedure.

11.2. Reserve price (minimum licence fee)/frequency block

The auction starting prices for each frequency block configured according to the procedure for awarding frequency usage rights in the above-mentioned bands, regulated by ANCOM President's decision, will be determined based on the minimum fees established by the law for awarding frequency usage licences in the respective bands.

12. Action plan

With a view to achieving the objectives proposed in this Position Paper on awarding frequency usage rights in the above-mentioned bands, in 2019, ANCOM plans to carry out the following frequency spectrum management activities:

No.	Action	Deadline
1.	Review the National Table of Frequency Allocations and adopt the updated version	30 March 2019
2.	Measures for refarming the 3400-3600 MHz band (issue the amended licences to the providers currently operating public MFCN networks and provide broadband electronic communications services in this band)	30 April 2019
3.	Finalize the coordination agreements with Ukraine on the use of DTT ²⁷	30 April 2019
4.	Finalize the conclusion of bilateral agreements with the neighbouring countries on cross-border coordination of frequency use for MFCN networks ²⁸	30 April 2019
5.	Conduct a campaign for monitoring the radio spectrum in the frequency bands to be auctioned out and provide a report on the status of the radio signals identified on the territory of Romania in these bands, coming from the territory of foreign states ²⁹	30 April 2019
6.	Draw up and publish the documentation required for the organisation of the selection procedure (draft decision on the organisation of the selection procedure, Draft Terms of Reference – initial version)	31 May 2019
7.	Public consultation on the documentation and receiving comments	30 June 2019
8.	Summary of comments and organisation of the Consultative Council	25 July 2019
9.	Adopt the decision on organising the selection procedure and other necessary normative acts, and consolidate the final version of the Terms of Reference (establish the conditions for awarding frequency usage rights) ³⁰	31 July 2019

²⁷ Action for which an earlier deadline needs to be set than that provided in the "National roadmap for the allotment and future use of the 470-790 MHz frequency band", published on ANCOM's website.

²⁸ Action for which an earlier deadline needs to be set than that provided in the "National roadmap for the allotment and future use of the 470-790 MHz frequency band", published on ANCOM's website.

²⁹ Action for which an earlier deadline needs to be set than that provided in the "National roadmap for the allotment and future use of the 470-790 MHz frequency band", published on ANCOM's website.

³⁰ In accordance with the "National roadmap for the allotment and future use of the 470-790 MHz frequency band", published on ANCOM's website

10.	Conduct the selection procedure for awarding the frequency usage rights in the other frequency bands 700 MHz, 800 MHz, 1500 MHz, 2600 MHz, 3400-3800 MHz ³¹	31 October 2019
11.	Issue frequency usage rights in the above-mentioned frequency bands	15 December 2019

Note: This Position Paper also includes other frequency management measures covering the 3400-3800 MHz and 24.25-27.5 GHz frequency bands, which are not directly linked to the 2019 selection procedure, and for which deadlines are to be found in the relevant chapters (see Sections 7.8.4 and 7.9.4 in this respect).

³¹ Action for which an earlier deadline needs to be set than that provided in the *"National roadmap for the allotment and future use of the 470-790 MHz frequency band"*, published on ANCOM's website.