Information & Communication Technologies Authority

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DECISION OF 15 APRIL 2021 ON THE OPENING OF THE 2 500 – 2690 MHZ AND 3 400 – 3 600 MHZ FREQUENCY BANDS FOR OPERATION OF IMT NETWORKS, INCLUDING 5G

15 April 2021

1.0 BACKGROUND

5G is the 5th generation of wireless networks, a significant evolution of the 4G LTE networks. 5G has been designed to meet the very large growth in data and connectivity of today's modern society, the Internet of things (IoT) with billions of connected devices and tomorrow's innovations. The 5G wireless network enables high-speed data transmission with ultra-low latency.

In 2005, the ICT Authority made the 2 500 – 2 690 MHz and 3 400 – 3 600 MHz frequency bands available for the operation of Broadband Fixed Wireless Access Systems. Following this allocation the ICT Authority granted licences and assigned spectrum within the 3.5 GHz frequency band for the operation of Wi-Max systems. These Wi Max systems are no longer in operation and the spectrum assigned has since been relinquished.

Currently 40 MHz spectrum within the 2 570–2 620 MHz sub-band is allocated to one mobile operator for the operation of IMT (4G LTE) network.

Due to their favourable properties, such as radio wave propagation and available bandwidth, the frequency bands 2 500 – 2 690 MHz and 3 400-3600 MHz may be considered be the primary spectrum bands for the introduction of 5G systems based on Time Division Duplex mode.

The technical parameters and limits for operation within these frequency bands are being reviewed and specified in this Decision so as to enable the operation of terrestrial IMT Systems including 5G New Radio (5G NR).

2.0 DECISION ON THE INTRODUCTION OF IMT SERVICES IN THE 3 400 – 3 600 MHZ FREQUENCY BAND

The ICT Authority,

Considering that,

a) The International Telecommunications Union (ITU) World Radiocommunication Conference 2015 (WRC-15) has allocated the 3 400 – 3 600 MHz frequency band to the Mobile, except Aeronautical Mobile Service on a Primary basis in addition to the fixed and fixed satellite (space-to-Earth) services;
b) The World Radiocommunication Conference 2015 (WRC-15) has identified this frequency band for International Mobile Telecommunications (IMT);
c) The ICT Authority has adopted a technology neutral approach and supports the deployment of mobile technologies that can technically co-exist within the international regionally harmonised mobile bands;
d) The ICT Authority supports an equitable access to spectrum for all mobile operators with a view to create a level playing field;

e) The 3 600 – 4 200 MHz frequency band is allocated to the Fixed Satellite Service for Space to Earth Communication;
f) VSAT Earth Stations are being operated in 3 600 – 4 200 MHz frequency band by several operators, including by the Civil Aviation Department;
g) There is a need to protect the operation of these VSAT Earth stations.

Decides that,

h) The frequency bands 3 400 – 3 600 MHz be made available to licensed Public Land Mobile Network (PLMN) Operators for operation of terrestrial IMT systems, including 5G New Radio;
i) The duplex mode of operation shall be time division duplex (TDD);
j) The assigned block sizes shall be in multiples of 5 MHz. The lower frequency limit of an assigned block shall be aligned with or spaced at multiples of 5 MHz from the lower band edge of 3 400 MHz;
k) Synchronised operations as defined at Annex 1 and described at Annex 5 shall be the only authorised mode of operation within the 3 400 – 3 600 MHz frequency band;
l) Operators shall comply with the technical parameters and standardisation requirements as specified in Annex 2 and Annex 4 of this document;
m) Operators may be required to undertake frequency coordination with any relevant Earth Station in view of protecting same;
n) that each operator bears its own costs for the purposes of implementing the above Decision;

2.0 DECISION ON THE INTRODUCTION OF IMT SERVICES IN THE 2 500 – 2 690 MHZ FREQUENCY BAND

The ICT Authority,

Considering that,

a) The 2 500 – 2690 MHz frequency band is allocated to the Mobile, except aeronautical mobile, and Fixed services on a primary basis;
b) The World Radiocommunication Conference 2015 (WRC-15) has identified this frequency band for International Mobile Telecommunications (IMT);
c) The 2 500 – 2690 MHz frequency band had initially been allocated for the operation of both FDD and TDD Broadband Wireless Access systems;
d) The FDD sub bands have remained unused since the allocation of the 2 500 – 2 690 MHz band to Broadband Wireless Access services in May 2005;

e) There is a need to convert the FDD portion of the 2 500 – 2 690 MHz band to TDD operation to enable carrier aggregation with other IMT frequencies;

f) The ICT Authority has adopted a technology neutral approach and supports the deployment of mobile technologies that can technically co-exist within the international regionally harmonised mobile bands;

g) The ICT Authority supports an equitable access to spectrum for all mobile operators with a view to create a level playing field;

Decides that,

a) The frequency band 2 500 – 2 690 MHz be made available to licensed Public Land Mobile Network (PLMN) Operators for operation of terrestrial IMT systems, including 5G New Radio;

b) the duplex mode of operation shall be time division duplex (TDD);

c) The assigned block sizes shall be in multiples of 5 MHz. The lower frequency limit of an assigned block shall be aligned with or spaced at multiples of 5 MHz from the lower band edge of 2 500 MHz;

d) Synchronised operations as defined at Annex 1 and described at Annex 5, shall be the only authorised mode of operation within the 2 500 – 2 690 MHz frequency band;

e) Operators shall comply with the technical parameters and standardisation requirements as specified in Annex 3 and Annex 4 of this document for the operation of IMT-2020 networks;

f) Notwithstanding decides (e) above, existing LTE networks operating in the 2 500 – 2690 MHz frequency bands shall continue operating in accordance with existing LTE / LTE Advanced standards and continue complying with LTE Standards, as published by ETSI, in particular EN 301908-1, EN 301908-13, EN 301908-14, and EN 301908-11 .Emtel Ltd shall shift the operation of its existing LTE / LTE-Advanced network to the 2 650 – 2 690 MHz band. Furthermore, the 40 MHz of spectrum currently being used to operate a LTE / LTE-Advanced network shall be surrendered to the ICT Authority upon any future switch off of the said LTE / LTE-Advanced network.

g) that each operator bears its own costs for the purposes of implementing the above Decision;

ANNEX 1 – DEFINITIONS

Active antenna systems (AAS) means a base station and an antenna system where the amplitude and/or phase between antenna elements is continually adjusted resulting in an antenna pattern that varies in response to short term changes in the radio environment. This excludes long-term beam shaping such as fixed electrical down tilt. In AAS base stations the antenna system is integrated as part of the base station system or product.

Synchronised operation means operation of two or more different time division duplex (TDD) networks, where simultaneous uplink (UL) and downlink (DL) transmissions do not occur, that is at any given moment in time either all networks transmit in downlink or all networks transmit in uplink. This requires the alignment of all DL and UL transmissions for all TDD networks involved as well as synchronising the beginning of the frame across all networks

Total radiated power (TRP) is a measure of how much power a composite antenna radiates. It equals the total conducted power input into the antenna array system less any losses in the antenna array system. TRP means the integral of the power transmitted in different directions over the entire radiation sphere as shown in the formula:

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

where P(θ,ϕ) is the power radiated by an antenna array system in direction (θ,ϕ) given by the formula:

$$P(\vartheta, \varphi) = P_{Tx} g(\vartheta, \varphi)$$

where P_{Tx} denotes the conducted power (measured in Watts), which is input to the array system, and g(θ,ϕ) denotes the array systems directional gain along the (θ, ϕ) direction.

ANNEX 2 - TECHNICAL PARAMETERS FOR OPERATION OF IMT SYSTEMS IN THE 3 400 - 3 600 MHz FREQUENY BAND

The following technical parameters for base stations called block edge mask (BEM) are an essential component of conditions necessary to ensure coexistence between neighbouring networks, in the absence of bilateral or multilateral agreements between operators of such neighbouring networks. Less stringent technical parameters, if agreed among the operators of such networks, may also be used.

The BEM consists of several elements given in Table A2.1. The in-block power limit is applied to a block owned by an operator. The baseline power limit, designed to protect the spectrum of other operators, the transitional region power limit, enabling filter roll-off from the in-block to the baseline power limit. The additional baseline power limit is an out-of-band power limit which is used either for the protection of radar operation below 3 400 MHz or for the protection of fixed satellite services (FSS) above 3 600 MHz.

BEM element	**Definition**
In-block	Refers to a block for which the BEM is derived.
Baseline	Spectrum within 3 400-3 600 MHz used for IMT operation, with the exception of the block assigned to the operator and the corresponding transitional regions.
Transitional region	Spectrum within 0 to 10 MHz below and 0 to 10 MHz above the block assigned to the operator. The transitional regions do not apply below 3 400 MHz or above 3 600 MHz.
Additional baseline	Spectrum below 3 400 MHz and above 3 600 MHz.

Table A2.1

Power limits for operation of Base Stations in the 3 400 – 3 600 MHz frequency band are given in Table A2.2[1].

BEM element	**Frequency Range**	**Power Limits (TRP)**
In-block	Block assigned to the operator	None
Transitional Region	–5 to 0 MHz offset from lower block edge or 0 to 5 MHz offset from upper block edge	Min($P_{Max'}$ – 40, 16) dBm/ (5 MHz) per cell (*) (**)
Transitional Region	–10 to –5 MHz offset from lower block edge or 5 to 10 MHz offset from upper block edge	Min($P_{Max'}$ – 43, 12) dBm/ (5 MHz) per cell (*) (**)
Baseline	Below –10 MHz offset from lower block edge Above 10 MHz offset from upper block edge within the 3 400 - 3 600 MHz band	Min($P_{Max'}$ – 43, 1) dBm/(5 MHz) per cell (*) (**)

[1] Adapted from EUROPEAN COMMISSION IMPLEMENTING DECISION (EU) 2019/235 of 24 January 2019

Additional Baseline	Below 3 400 MHz	– 52 dBm/MHz per cell
Additional Baseline	3 600 – 3 605 MHz	Min($P_{Max'}$ – 40, 16) dBm/(5 MHz) per cell(*)(**)
	3 605 – 3 610 MHz	Min($P_{Max'}$ – 43, 12) dBm/(5 MHz) per cell(*)(**)
	3 610 – 3 640 MHz	Min($P_{Max'}$ – 43, 1) dBm/(5 MHz) per cell(*)(**)
	Above 3 640 MHz	– 14 dBm/(5 MHz) per cell(**)

Table A2.2

(*) $P_{Max'}$ is the maximum mean carrier power in dBm for the base station measured as TRP per carrier in a given cell.
(**) In a multi-sector base station, the radiated power limit applies to each one of the individual sectors.

Explanatory note to Table A2.2 In the specific case of femto base stations, power control shall be applied to minimize interference to adjacent channels. The requirement on power control for femto base stations results from the need to reduce interference from equipment that may be deployed by consumers and may thus not be coordinated with surrounding networks.

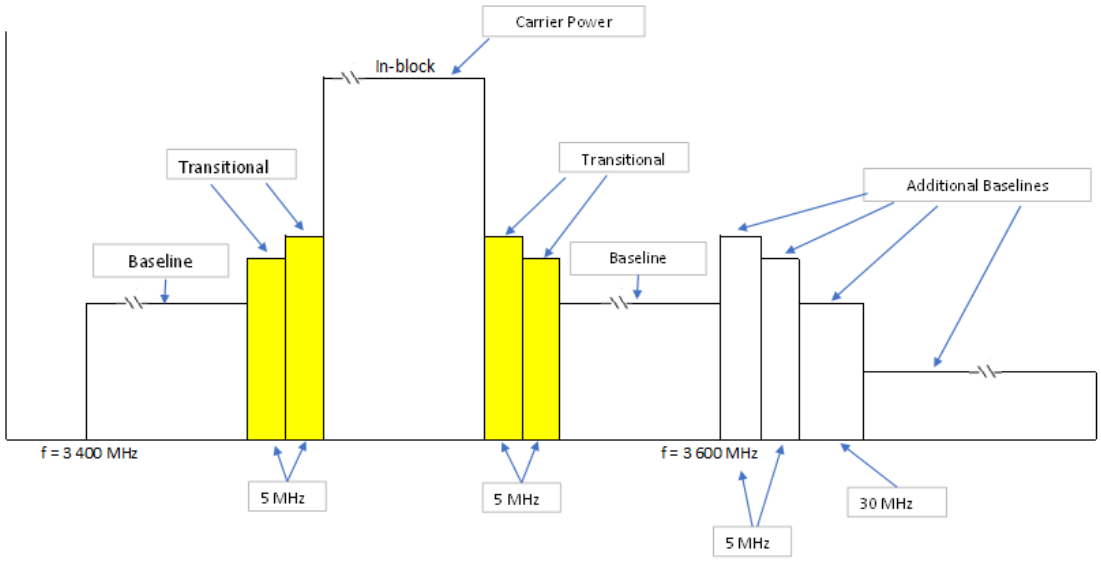

Figure 1 – Power limits for operation within the 3 400 – 3 600 MHz frequency band

Power limits for operation of Terminal Stations in the 3 400 – 3 600 MHz frequency band are given in Table A2.3[2].

BEM ELEMENT	**POWER LIMIT**
Maximum in-block power	28 dBm TRP

Table A2.3

[2] Adapted from EUROPEAN COMMISSION IMPLEMENTING DECISION (EU) 2019/235 of 24 January 2019

ANNEX 3 - TECHNICAL PARAMETERS FOR OPERATION OF IMT SYSTEMS IN THE 2500 - 2 690 MHz FREQUENY BAND

The following technical parameters for base stations called block edge mask (BEM) are an essential component of conditions necessary to ensure coexistence between neighbouring networks, in the absence of bilateral or multilateral agreements between operators of such neighbouring networks. Less stringent technical parameters, if agreed among the operators of such networks, may also be used.

The BEM consists of several elements given in Table A3.1. The in-block power limit is applied to a block owned by an operator. The baseline power limit, designed to protect the spectrum of other operators within the 2.6 GHz frequency band, the transitional region power limit, enabling filter roll-off from the in-block to the baseline power limit. The additional baseline power limit is an out-of-block power limit which is used for the protection of the radio astronomy service (RAS) stations in the adjacent frequency band 2 690 – 2 700 MHz.

BEM element	**Definition**
In-block	Refers to a block for which the BEM is derived.
Baseline	Spectrum within 2 500 – 2 690 MHz used for IMT operation, with the exception of the block assigned to the operator and the corresponding transitional regions.
Transitional region	Spectrum within 0 to 5 MHz below and 0 to 5 MHz above the block assigned to the operator. The transitional regions do not apply below 2 500 MHz or above 2 690 MHz.
Additional baseline	Spectrum between 2 690 – 2 700 MHz.

Table A3.1

Power limits for operation of Base Stations in the 2 500 – 2 690 MHz frequency band are given in Table A3.2[3].

BEM element	**Frequency Range**	**Power Limits (TRP) per cell (*)**
In-block	Block assigned to the operator	None
Transitional Region	–5 to 0 MHz offset from lower block edge or 0 to 5 MHz offset from upper block edge	+ 16 dBm/5 MHz (**)
Baseline	TDD blocks synchronised with the TDD block under consideration within the 2 500 – 2 690 MHz band	+ 5 dBm/MHz (**)
Additional Baseline	2 690 – 2 700 MHz	+ 3 dBm/10 MHz

Table A3.2

(*) In a multi-sector base station, the radiated power limit applies to each one of the individual sectors.

[3] Adapted from EUROPEAN COMMISSION IMPLEMENTING DECISION (EU) 2020/636 of 8 May 2020

(**) This limit is based on the assumption that the emissions come from a macro base station. It should be noted that small-area wireless access points (small cells) may be deployed at lower heights and thus closer to terminal stations, which can result in higher levels of interference if this power limit is used.

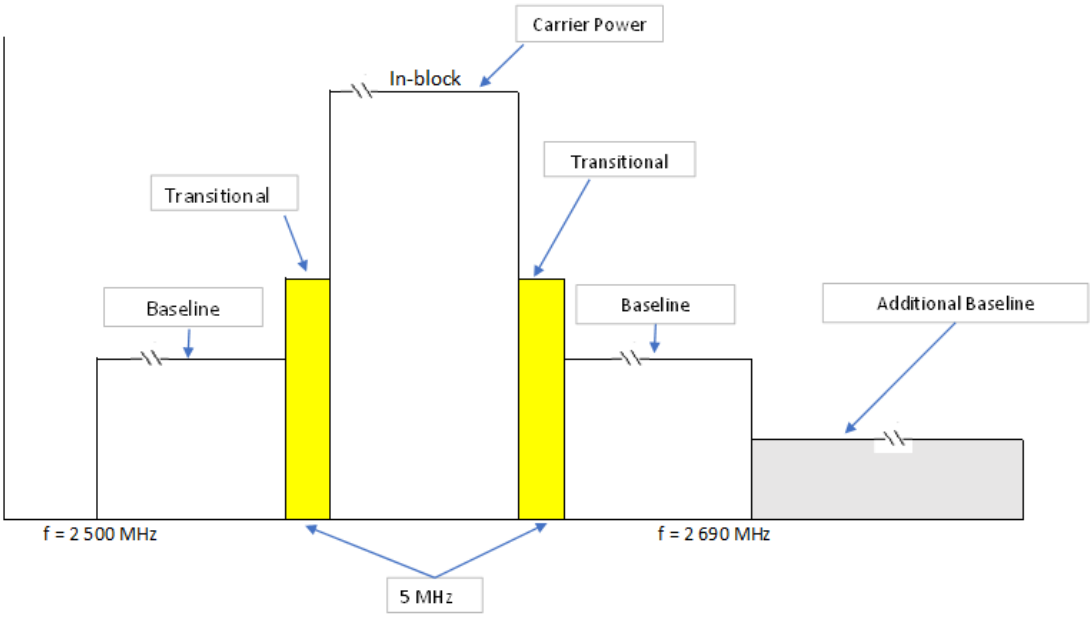

Figure 2

Power limits for operation of Terminal Stations in the 2 500 – 2 690 MHz frequency band are given in Table A3.3[4].

BEM element	**Maximum mean EIRP limit (including Automatic Transmitter Power Control range)**	**Maximum mean TRP limit (including Automatic Transmitter Power Control range)**
In-block	+ 35 dBm/5 MHz	+ 31 dBm/5 MHz

Table A3.3

Note: EIRP should be used for fixed or installed terminal stations and the TRP should be used for the mobile or nomadic terminal stations.

[4] Adapted from EUROPEAN COMMISSION IMPLEMENTING DECISION (EU) 2020/636 of 8 May 2020

ANNEX 4 - STANDARDISATION REQUIREMENTS FOR 5G NR

The base stations and terminal stations shall be in compliance with the 3GPP and ETSI specifications standards as specified in Table A4.1 below.

Base Station Equipment	**Terminal Station Equipment**
3GPP TS 38.104	ETSI EN 301 908-25
3GPP TS 38.113	ETSI EN 301 489-1
3GPP TS38.141-1	ETSI EN 301 489-52
3GPP TS 38.141-2	
3GPP TS 38.817-02	
ETSI EN 301 489-1	
ETSI EN 301 489-50	

Table A4.1

ANNEX 5 - INTER-OPERATOR SYNCHRONISATION

In order to deploy synchronised TDD mobile networks in a multi-operator context (without guard bands), agreement among all operators in a frequency band, needs to be reached on:

- A common phase clock reference (e.g. UTC) and accuracy/performance constraints, either using their own equipment to provide the clock, or sharing the same phase/time clock infrastructure;

- A compatible frame structure (including TDD UL/DL ratio) in order to avoid uplink/downlink overlapping;

- A commitment not to interfere with each other as any synchronisation issue of one operator may impact the network of the others (e.g. reliability of the reference clock and protection mechanism have to be ensured and/or procedure when losing this reference clock has to be defined);

- The terms and conditions where cross-operator synchronisation must apply and/or may not be required

- How to update the above parameters and terms and conditions.

The ICT Authority recommends that operators use the Electronic Communications Committee (ECC) Report Rep 216 as a guide to draw up their own synchronisation agreement. In case no agreement is reached, among operators the ICT Authority may intervene so that an acceptable agreement may be reached in a timely manner.