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TECHNICAL REPORT

IMT cellular networks; Mobile/Fixed Communication Network (MFCN) in the frequency range 6 425 - 7 125 MHz

Reference

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Executive Summary

In Europe the frequency range 6 425 - 7 125 MHz is currently (October 2019) being mostly used for Fixed Services (FS) and Fixed Satellite Services (FSS) on a primary basis. While the ever-increasing user demand for mobile broadband is pushing industry, academia and regulatory bodies to search for new spectrum, the frequency range 6 425 - 7 125 MHz, it is seen as a possible contender to meet this demand.

Clause 6 includes the main technical specifications of the NR Base Station (BS) and NR mobile User Equipment (UE) which can potentially be incorporated for this frequency range.

The present document does not include the co-existence studies to analyse the risk of interference between incumbent services and the 5G NR technology, which can be the next step in the process of feasibility study.

Introduction

More than two and a half decades after the launch of GSM (2G), a new generation of mobile network technology is at our doorstep with the release of 5G New Radio (NR) technical specification by 3GPP™ (http://www.3gpp.org/DynaReport/38-series.htm). This transition from 4G (known as LTE and LTE-A) to 5G is also in line with the European Commission's vision for the Digital Single Market by 2025 [i.1].

In recent years, the demand for mobile broadband has increased exponentially. As per Ericsson Mobility Report, November 2018 [i.7], the mobile broadband subscriptions are growing at a rate of 15 % YoY (year-on-year), reaching 5,7 billion subscriptions. In Q3 2018 alone, LTE subscriptions increased by 200 million and now accounts for 58 % of the total subscriptions. The global mobile data traffic excluding traffic served by Wi-Fi® or WiMAX™ grew by a rate close to 79 % YoY in Q3 2018, fuelled primarily by high resolution video content. It also forecasts a staggering 8,9 billion mobile subscriptions (6,2 billion unique subscribers) including 1,5 billion 5G subscribers of Enhanced Mobile Broadband (eMBB) by 2023. The eMBB promises faster mobile broadband speed than its predecessor Mobile Broadband (MBB). One of the ways to achieve it is by using large blocks of spectrum which are rare to find in the lower part of the spectrum range (below 6 GHz).

The eMBB forms one of the primary pillars of 5G, the other two being Massive Machine-Type Communications (mMTC) and Ultra-Reliable and Low Latency Communications (URLLC). Considering this enormous user demand, the administrators and regulators are faced with the task of making room in the radio spectrum to adapt for all those new use cases. The radio spectrum is a limited resource, the future is to efficiently share the spectrum between different services, at the same time, keeping all the incumbent protected.

The International Telecommunication Union (ITU), in its Recommendation ITU-R M.2083-0 [i.4], has laid out the foundation and framework for the future development of International Mobile Telecommunication (IMT) 2020 and beyond. A snapshot of the three main pillars and the key capabilities of IMT 2020 and beyond as described in [i.4] are depicted in figures 0-1 and figures 0-2. ITU in its recommendation has also highlighted the importance of contiguous and wider bandwidth requirement to fulfil the need of users running high volume data applications on their smart devices.

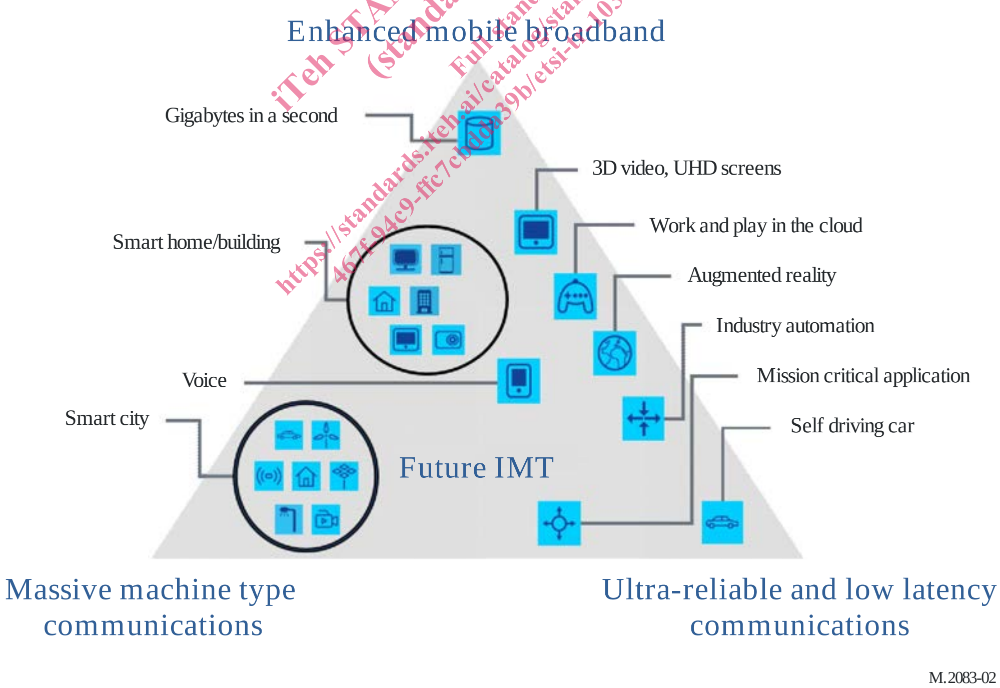

Figure 0-1: Usage scenarios of IMT for 2020 and beyond [i.4]

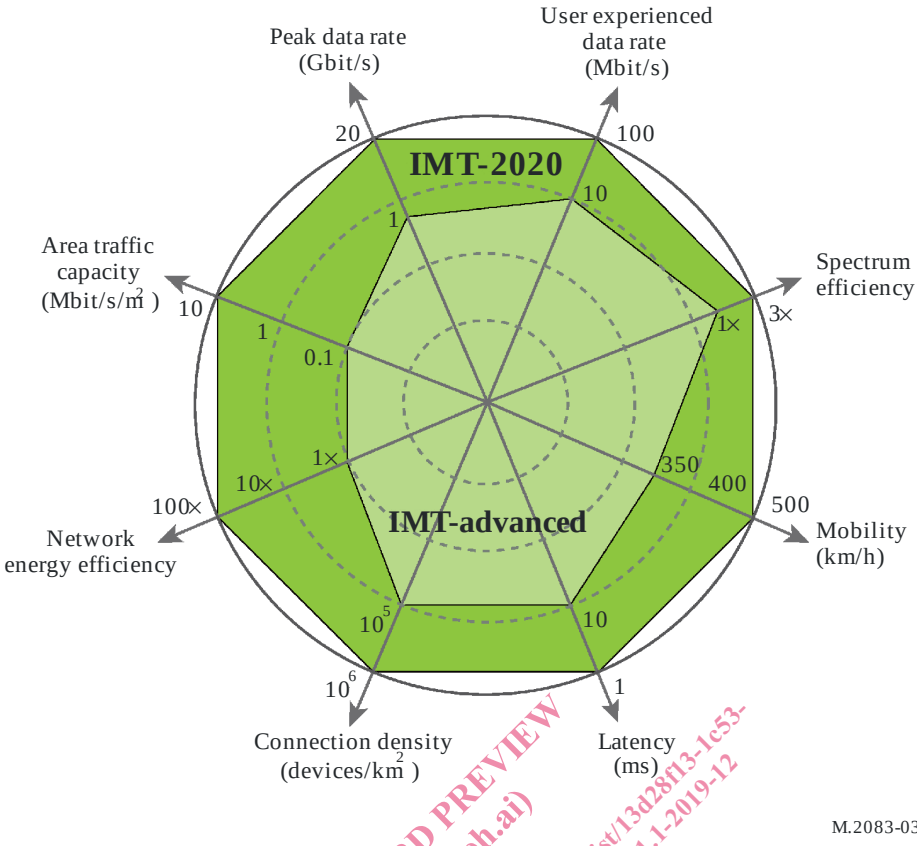

Figure 0-2: Enhancement of key capabilities from IMT-Advance to IMT-2020 [i.4]

The present document acknowledges the scarcity of the available spectrum and provides the justification for the need of additional spectrum for the Mobile/Fixed Communication Networks (MFCNs) including International Mobile Telecommunications (IMT) services in the frequency range 6 425 - 7 125 MHz.

1 Scope

The present document is about the possibility of sharing the frequency range 6 425 - 7 125 MHz between the incumbent services and MFCN (Mobile/Fixed Communication Network) services.

The present document provides the technical parameters of new entrant i.e. MFCN, current spectrum regulations, mitigation techniques and foreseen use cases and applications for the high data rate MFCN including IMT services in the frequency range 6 425 - 7 125 MHz.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] Connectivity for a European Gigabit Society.

NOTE: Available at https://ec.europa.eu/digital-single-market/en/policies/improving-connectivity-and-access.

[i.2] ECC Report 254: "Operational guidelines for spectrum sharing to support the implementation of the current ECC framework in the 3600-3800 MHz range".

[i.3] ITU-R Radio Regulations, Articles, Edition of 2016, Volume 1.

NOTE: Available at http://search.itu.int/history/HistoryDigitalCollectionDocLibrary/1.43.48.en.101.pdf.

[i.4] Recommendation ITU-R M.2083-0 (09/2015): "IMT Vision - Framework and overall objectives of the future development of IMT for 2020 and beyond".

[i.5] Recommendation ITU-R SM.329-12: "Unwanted emissions in the spurious domain". .

[i.6] Recommendation ITU-R SM.1541-6: "Unwanted emissions in the out-of-band domain".

[i.7] Ericsson Mobility Report November 2018.

NOTE: Available at https://www.ericsson.com/assets/local/mobility-report/documents/2018/ericsson-mobility-report-november-2018.pdf.

[i.8] Imperial College Business School: "How important are mobile broadband networks for global economic development?".

NOTE: Available at https://spiral.imperial.ac.uk/bitstream/10044/1/46208/2/Goodridge%202017-05.pdf.

[i.9] Nokia: "5G New Radio (NR) Physical Layer Overview and Performance".

NOTE: Available at http://ctw2018.ieee-ctw.org/files/2018/05/5G-NR-CTW-final.pdf.

[i.10] Huwey: "5G Spectrum Public Policy Position".

NOTE: Available at https://www.huawei.com/en/about-huawei/public-policy/5g-spectrum.

[i.11] ETSI TS 138 101-1: "5G; NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone (3GPP TS 38.101-1)".

[i.12] ETSI 138 104: "5G; NR; Base Station (BS) radio transmission and reception (3GPP TS 38.104)".

[i.13] 5G PPP: "5G PPP use cases and performance evaluation modeling" v1.0 - April 2016.

NOTE: Available at https://5g-ppp.eu/wp-content/uploads/2014/02/5G-PPP-use-cases-and-performance-evaluation-modeling_v1.0.pdf

[i.14] 3GPP RP-191523 (June 2019): "Status report for SI on RAN-centric data collection and utilization for LTE and NR".

[i.15] ETSI EN 301 908-24: "IMT cellular networks; Harmonised Standard for access to radio spectrum Part 24: New Radio (NR) Base Stations (BS)".

[i.16] ETSI TR 138 913 (15.0.0): "5G; Study on scenarios and requirements for next generation access technologies (3GPP TR 38.913 version 15.0.0 Release 15)".

[i.17] ERC Report 25: "The European table of frequency allocations and applications in the frequency range 8.3 kHz to 3000 GHz (ECA table)".

NOTE: Available at https://www.ecodocdb.dk/download/2ca5fcbd-4090/ERCREP025.pdf.

[i.18] GSMA: "The Mobile Economy 2018"..

NOTE: Available at https://www.gsma.com/mobileeconomy/wp-content/uploads/2018/05/The-Mobile-Economy-2018.pdf.

[i.19] ECC report 302: "Sharing and compatibility studies related to Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) in the frequency band 5925-6425 MHz".

NOTE: Available at https://www.ecodocdb.dk/download/cc03c766-35f8/ECC%20Report%20302.pdf.

[i.20] Recommendation ITU-R S.2367-0: "Sharing and compatibility between International Mobile Telecommunication systems and fixed-satellite service networks in the 5 850-6 425 MHz frequency range".

[i.21] Recommendation ITU-R F.2328-0: "Sharing and compatibility between international mobile telecommunication systems and fixed service systems in the 3 400-4 200 MHz frequency range".

[i.22] Recommendation ITU-R F.2326: "Sharing and compatibility study between indoor International Mobile Telecommunication small cells and fixed service stations in the 5 925-6 425 MHz frequency band".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

antenna connector: connector at the conducted interface of the *BS type 1-C*

BS type 1-C: NR base station operating at FR1 with requirements set consisting only of conducted requirements defined at individual *antenna connectors*

BS type 1-H: NR base station operating at FR1 with a requirement set consisting of conducted requirements defined at individual *TAB connectors* and OTA requirements defined at RIB

BS type 1-O: NR base station operating at FR1 with a requirement set consisting only of OTA requirements defined at the RIB

protection zone: geographical area (for a defined frequency range and time period) within which victim receivers will not be subject to harmful interference caused by interferer transmissions

radiated interface boundary: *operating band* specific radiated requirements reference where the radiated requirements apply

NOTE: For requirements based on EIRP/EIS, the *radiated interface boundary* is associated to the far-field region.

restriction zone: geographical area (normally applicable for a defined frequency range and time period) within which licensees are allowed to operate radio transmitters, under certain restrictive conditions (e.g. maximum e.i.r.p. limits and/or constraints on antenna parameters)

TAB connector: *transceiver array boundary* connector

3.2 Symbols

For the purposes of the present document, the following symbols apply:

Δf	Separation between the channel edge frequency and the nominal -3 dB point of the measuring filter closest to the carrier frequency
Δf_{max}	f_offset_{max} minus half of the bandwidth of the measuring filter
f_offset	Separation between the channel edge frequency and the centre of the measuring filter
f_offset_{max}	The offset to the frequency Δf_{OBUE} outside the downlink *operating band*
MHz	Mega-Hertz
N_{RB}	Transmission bandwidth configuration, expressed in resource blocks
PRated,c	Rated output power (per carrier)

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

3GPP	3rd Generation Partnership Project
AAS	Active Antenna System
ACLR	Adjacent Channel Leakage Power Ratio
ACS	Adjacent Channel Selectivity
BS	Base Station
BW	Bandwidth
CA	Carrier Aggregation
CEPT	European Conference of Postal and Telecommunication Administrations
DC	Dual Connectivity
ECC	Electronic Communication Committee
eMBB	Enhanced Mobile Broadband
ERC	Electronic Radiocommunication Committee
FR	Frequency Range
FS	Fixed Services
FSS	Fixed Satellite Services
GDP	Gross Domestic Product
GSM	Global System for Mobile Communication
GSMA	Global System for Mobile Communication Association
GSO	Geostationary orbit
HST	High Speed Train
IAB	Integrated Access Backhaul
IMT	International Mobile Telecommunication
ITU	International Telecommunications Union
LA	Local Area
LOS	Line-of-site
LTE	Long-Term Evolution

MBB	Mobile BroadBand
MCS	Modulation and Coding Scheme
MFCN	Mobile/Fixed Communication Network
MIMO	Multiple Input Multiple Output
mMTC	Massive Machine-Type Communication
MR	Medium Range
MTC	Machine-Type Communication
NGSO	Non-Geostationary orbit
NR	New Radio
OBUE	Operating Band Unwanted Emissions
OTA	Over-The-Air
PSD	Power spectral density
RAN	Radio Access Network
RAT	Radio Access Technology
RF	Radio Frequency
RIB	Radiated Interface Boundary
RSU	Roadside Unit
SCS	SubCarrier Spacing
SHF	Super High Frequency
TAB	Transceiver Array Boundary
TRP	Total Radiated Power
TX	Transmitter
UE	User Equipment
URLLC	Ultra-Reliable and Low Latency Communications
WA	Wide Area
YoY	Year-over-Year

4 Market Trend and Information

Mobile communication is one of the most significant technological developments in recent history. It has transformed the ways of communication, seek information, learn and develop, experience entertainment and to execute business. The number of mobile subscriptions is growing at 4 % Year-over-Year (YoY) and reached a figure of 7,9 billion in Q3 2018. Almost 79 % of those subscriptions were mobile broadband, accessing internet via mobile broadband technology (MBB) [i.7].

The mobile data traffic has also grown massively with 54 % Year-over-Year (YoY) growth, Q1 2017-2018. This growth is both due to the increase in mobile subscriptions and the increase in average data volume per subscription, which is driven by rising consumptions of video content at increasingly higher resolutions. The mobile video traffic is expected to grow at 45 % annually through 2023 and constitute 73 % of the overall mobile data traffic. It is also expected that by 2023, more than 20 % of the mobile data traffic will be carried by 5G networks while the major share would still be held by LTE/LTE-A [i.7].

The mobile broadband technology has bridged the digital gap between the Internet-connected and unconnected people, especially in the developing countries. It has become a major factor in driving economic and social change. The study done by Imperial College Business School [i.8], reveals a direct relation between mobile broadband penetration and the Gross Domestic Product (GDP), for every 10 % increase in the MBB there is a 0,6 % to 2,8 % rise in GDP.

According to The Mobile Economy 2018 by GSMA Intelligence [i.18]: "In 2017, mobile technologies and services generated 4,5 % of GDP globally, a contribution that amounted to $3,6 trillion of economic value added. By 2022, this contribution will reach $4,6 trillion, or 5 % of GDP". At the same time, mobile technology is also at the forefront of the economic development of the developing countries providing digital connectivity.

5 Frequency allocation

5.0 General

In this clause, the frequency allocation valid at the time of creation of the present document has been presented.