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| **The 4th Meeting of the APT Conference Preparatory Group for WRC-19 (APG19-4)** | **APG19-4/INF-08** |
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Ericsson (Thailand) Limited, Ericsson Vietnam Co., Ltd.,

Intel Microelectronics (Thailand) Limited, Nokia Pte Ltd., Qualcomm International and Samsung Electronics Co., Limited[[1]](#footnote-1)

**GSA Views on WRC-19 AI 1.13**

1. **Positions for the AI 1.13 bands**

**GSA supports the identification of new spectrum globally for IMT (5G NR) under WRC-19 Agenda Item 1.13.**

**GSA strongly supports the identification of the 24.25-27.5 GHz and 37-43.5 GHz frequency ranges for IMT with the highest priority.**

With large spectrum bandwidth available in these two frequency ranges, they will enable various 5G NR applications of very high data rates and low latency for indoor and outdoor scenarios, e.g. 5G eMBB and URLLC applications to be deployed at hotspots in metropolitan areas and/or for industrial usage. GSA is of the view that in order to provide full 5G NR capabilities, a minimum of 1 GHz of contiguous bandwidth per network is needed in the 26 and 40 GHz frequency ranges.

A number of Administrations are considering licensing spectrum within these ranges by 2020 while some countries have done so already. Several bands from these ranges have been specified within 3GPP Release 15 (Rel-15) and products and ecosystems supporting different portions of these frequency ranges are available since 2018. These two frequency ranges are expected to be the early 5G millimeter wave bands globally.

**GSA agrees with NOC for 31.8-33.4 GHz.**

The spectrum bandwidth in this frequency band is limited, and there are challenges in sharing with incumbent and adjacent passive services. It is preferred to use this band for microwave backhaul under the Fixed Service (FS) allocation.

**GSA supports consideration of an identification for IMT in the ranges 45.5-50.2 GHz and 50.4-52.6 GHz.**

The frequency range 47.2-48.2 GHz is already allowed for fixed and mobile applications and is anticipated to be used for 5G NR in the USA which will stimulate market demand in other countries and regions. The frequency range of 50.4-52.6 GHz may have challenges from sharing with passive services on both sides of the band and the limited bandwidth.

1. **Key Considerations for CPM Text**

**2.1 Unwanted emission limit in the 24.25-27.5 GHz band**

The frequency band of 23.6-24.0 GHz is allocated to EESS (passive) globally, and a number of studies have been carried out in ITU-R Task Group 5/1 to determine the technical conditions for protection/compatibility of passive services in 23.6-24.0 GHz, leading to a range of 5G unwanted emission levels that would be necessary to protect the EESS (passive). While some of the studies were performed on all sensors in Recommendation ITU-R RS.1861 operating in the 23.6-24.0 GHz frequency band, the results summary in draft CPM report (section 2/1.13/3.2.1.2) are based on the most sensitive and restrictive Sensor F3.

The differences in the results are due to differences in the assumptions for aspects such as:

1. Antenna patterns
2. Apportionment of interference between services
3. IMT station densities
4. Interpretation of EESS (passive) protection criteria
5. Multi-operator factor
6. Margins (not applied in all studies)

Related to the last point on margins, it is a very important aspect that should be taken into account when the regulatory limit for 5G unwanted emissions is defined. Margins are necessary to manage the measurement uncertainties, variation in the production and deployment of 5G equipment, and temperature fluctuations and ageing. It is not realistic to assume that all devices emit exactly according to the given protection level (especially when this level is not allowed to be exceeded). So in practice, to ensure that this level is not exceeded, products need to be manufactured well below the limit which then results in an additional protection margin beyond the specified level thereby reducing the interference even further.

The African Telecommunications Union (ATU) recently adopted an African preliminary position which specifies the IMT-2020 unwanted emission levels within the following ranges:

* BS: -32 to -37 dB(W/200 MHz)
* UE: -28 to -30 dB(W/200 MHz)

The Arab Spectrum Management Group (ASMG) at its 24th meeting in Amman, Jordan in December 2018, decided to support no strict measures and restrictions on the use of IMT in 26 GHz band, with possibility of a new ITU-R Recommendation to include the following values of OOBE limits to the band 23.6-24 GHz from the BSs and UEs operating in the band 24.25-27.5 GHz, in case of need for these additional measures as appropriate:

* BS: -32  dB(W/200 MHz)
* UE: - 28 dB(W/200 MHz)

CEPT has decided in ECC Decision 18(06) [2018-10-26] on restrictions as stringent as -42 dB(W/200 MHz) for unwanted emissions from 5G BS. These unwanted emission limits are not workable for the IMT industry. This will seriously hamper the performance of network and in practice, can make a large part of the 26 GHz band unusable. 3GPP has been studying the feasibility of meeting more stringent unwanted emission limits than their baseline requirement. Preliminary results from these studies indicate that, for example, with an emissions limit for base stations of -37 dB(W/200 MHz) there would be a substantial impact on performance, throughput and costs of 5G networks and services in the 26 GHz band. This would also require a large frequency separation of around 1 - 1.5 GHz between the mobile transmissions and the EESS (passive) band, resulting in the lower part of the 26 GHz band not being usable for outdoor 5G base stations. While advances in technology and filter design may improve over time it is still anticipated that a significant guard band will be required for outdoor 5G deployments with such stringent requirements such as -42 dB(W/200 MHz).

In addition, US will likely auction the 24 GHz (24.25-24.45 & 24.75-25.25 GHz) in early 2019, which goes down to 24.25 GHz with same EESS(p) issue and the current limit considered by FCC is -13 dBm/MHz, i.e. -20 dB(W/200 MHz), which is 22 dB more relaxed than CEPT. Auction is expected to happen with this relaxed limit. The FCC will later on, if necessary, consider through notice and comments whether any modification of their current out-of-band limits may be needed. Even if they change the limit, it may not be as stringent as CEPT. Also in Korea, the limit for the 28 GHz band (26.5-29.5 GHz) is same as in FCC (-13 dBm/MHz).

Although there is clearly a need to protect EESS (passive) operations in 23.6-24 GHz, it is important not to over-protect EESS in such a way that would unnecessarily restrict 5G networks and services. GSA notes that most studies indicated that a value in the range -32 to -37 dB(W/200 MHz) is sufficient, and is supported by compatibility study results from both administrations and industry.

**The GSA suggest to the APT Administrations that the following IMT unwanted emission limits shall be the most restrictive values needed to protect the EESS (passive) service in the 23.6-24.0 GHz frequency band (see Annex for detailed calculation):**

* **BS: -33.5 dB(W/200 MHz)**
* **UE: -29.7 dB(W/200 MHz)**

**2.2 IMT and FSS (Earth-to-space)/ISS in the 24.25-27.5 GHz and 42.5-43.5 GHz bands**

In Region 3, the frequency bands 24.65-25.25 GHz and 27-27.5 GHz and 42.5-43.5 GHz are allocated to FSS (Earth-to-space), and the frequency bands 24.45-24.75 GHz and 25.25-27.5 GHz are allocated to ISS.

Sharing studies between IMT and FSS/ISS in the 26 and 40 GHz bands, conducted as part of the work of TG 5/1, give clarity on co-existence between these services. These studies show there is a sufficient protection margin between the level of emissions that would be expected from a 5G network and the level that could potentially cause interference to FSS/ISS space stations, see section 2/1.13/3.2.1.3 and 3.2.1.4 and 3.2.4.1 in draft CPM report.

For the 26 GHz band, for the case of aggregate long-term interference from IMT stations into FSS space stations in a geostationary orbit, results showed that the calculated I/N ranged from -40.62 dB to -19 dB for the baseline case, all below the protection criteria agreed by WP 4A. When considering short term interference, all studies provided results that showed maximum I/N values ranging from -28.3 dB to -15.8 dB for the baseline case, which again satisfy the agreed short-term protection criteria. Similar results are found in study results concerning the 42.5-43.5 GHz band. For the 26 GHz band, for the case of aggregate interference from IMT stations into ISS, results showed that the calculated I/N ranged from -35dB to -22.2dB for the baseline case, all below the protect criterion agreed by WP 7B .

Despite this, certain conditions are nevertheless being proposed which include an EIRP mask (based on elevation angle), an TRP limit per base station, and/or antenna tilting limits. Any such conditions would have a negative impact on the deployment, operation and performance of 5G networks and services. They are not required given that results of baseline studies show sufficient margins.

The imposition of a strict EIRP mask, TRP limits and/or electrical and mechanical tilting limitations on IMT-2020 base station would be unnecessary and impractical, and would further restrict the development and implementation of 5G in the 26 GHz and 40 GHz bands. In an IMT-2020 network, beamforming will be used to direct the main beam from a base station in the direction of each user equipment (UE) to be served, and a restriction on emissions at positive elevation angles is likely to be impractical to implement. The vast majority of UEs will be located below the height of the base station to which they are connected, and hence elevation angles greater than 0° will be atypical and are unlikely to have any significant impact on interference into other services. Imposition of an EIRP mask would place unnecessary constraints on a 5G network operator's ability to provide 5G services in an efficient and effective manner and raise costs of connectivity for consumers.

It should also be noted that almost all of the sharing studies that have been conducted on the potential interference from 5G networks into satellite space station receivers indicate that there is a significant margin between the level of interference calculated and level that could potentially cause interference at the satellite receiver.

**GSA is of the view that there is no technical justification for incorporating any regulatory provisions related to technical conditions, i.e. EIRP mask, TRP limits, epfd and/or electrical and mechanical tilting limitations on IMT-2020 base stations, for identification of the bands 24.25-27.5 GHz and 42.5-43.5 GHz in the Radio Regulation.**

In addition, IMT is the victim of interference from FSS earth stations in these two bands, but **no conditions to ensure the co-existence between the FSS transmitting earth stations and IMT receiving base stations and terminals operating within frequency bands of 24.25-27.5 GHz and 42.5-43.5 GHz are needed to be specified in Radio Regulation,** including development of any ITU-R Recommendation, as this is a matter for the national authority**.**

**2.3 Unwanted emission level in the 40 GHz band**

The frequency band 36-37 GHz is allocated on a primary basis to both EESS (passive) and the MS and FS with coexistence conditions currently addressed in Resolution 752 (WRC-07). The unwanted emission level of −13 dB(m/MHz), i.e. −43 dB(W/MHz), for an IMT station, which is equivalent to −13 dBW/GHz in the frequency band 36-37 GHz, satisfies the conditions described in Resolution 752 (WRC-07) (where the sharing criteria for stations in the mobile service is −10 dBW) to coexist with the EESS (passive). From this perspective, **there is no need to define additional OOBE limit for IMT systems operating in the frequency band 37-43.5 GHz to ensure coexistence with the EESS (passive) systems operating in the frequency band 36-37 GHz**.

In addition, passive services in the frequency band 36-37 GHz share the band with active MS and FS, so the frequency band 36-37 GHz is not a pure passive band and is not listed in Footnote **5.340**. Thus, EESS (passive) observations in this frequency band already currently have to accept a certain level of interference and that situation would not change through the use of the 37-43.5 GHz band by IMT systems.

**Therefore, GSA is of the opinion that it is not appropriate to include this frequency band 36-37 GHz in any revision to Resolution 750 (Rev.WRC-15)**.

**2.4 Identification of tuning range of 37-43.5 GHz band to IMT**

Leading Administrations, including some of the world’s largest markets, have or are planning to assign spectrum licenses within the 37-43.5 GHz frequency range for 5G. For example, the United States of America made the 37-40 GHz frequency range available for mobile broadband use. In Europe, the Radio Spectrum Policy Group has announced that 40.5-43.5 GHz is one of the second stage mm-wave 5G bands in recognition of “a tuning range for equipment from 37-43.5 GHz. The potential of this tuning range would be for different regions to be able to identify the most appropriate frequencies to be used for 5G.”

The harmonization of spectrum for mobile broadband provide benefits to consumers and businesses through economies of scale and global roaming. Yet harmonization of exact frequency bands for mobile broadband has becoming increasingly difficult over time as governments are unable to make spectrum available in the exact same frequency bands due to different existing uses and priorities. Fortunately, the benefits of harmonization can still be achieved today over “radio tuning ranges”. Which means, standards are already under development for the 37-40 GHz frequency range which can readily be extended to enable devices to operate in unpaired blocks in any portion of the entire 37-43.5 GHz frequency range.

Therefore, a global IMT identification of 37-43.5 GHz would allow each country/region to assign spectrum for 5G consistent with their domestic use and priorities, while still facilitating the benefits of economies of scale for businesses and consumers.

Recently, CEPT has agreed that “Whilst CEPT will not propose identification and has no intention of using 37-40.5 GHz for IMT, CEPT recognises that the frequency range 37-43.5 GHz has strong potential to become a 5G tuning range, facilitating harmonisation of equipment. CEPT is focusing on the top part of the range (40.5-43.5 GHz) while other countries outside of CEPT could focus on other parts of the range. In this respect, CEPT would not oppose a global IMT identification for the full 37-43.5 GHz range”. ATU has also recently decided to support the IMT identification of the whole 37-43.5 GHz range.

**GSA view is thus that in light of the ITU-R studies showing feasibility of sharing and the benefits of international harmonization while allowing regulators the flexibility to assign spectrum within this range for domestic use as appropriate, it is recommended that APT Administrations should support an IMT identification across the entire 37-43.5 GHz frequency range as well as upgrading the secondary allocation for the Mobile Service to a co-primary allocation in the range 40.5-42.5 GHz.**

1. **Positions for CPM Text**

**3.1 26 GHz (24.25-27.5 GHz)**

GSA supports a new IMT footnote for the 26 GHz range such as:

**5.A113b** The frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Resolution **750 (Rev.WRC-19)** applies.   (WRC‑19)

The GSA supports the following methods and conditions for the band 24.25-27.5 GHz:

* Method A2, Alternative 2: identification to terrestrial component of IMT in 24.25-27.5 GHz (in the mobile service), including allocation of the band 24.25-25.25 GHz to the mobile service (except aeronautical mobile) on a primary basis in Regions 1 and 2.
* Condition A2a: Option 1 – Resolution 750 (Rev. WRC-19) in Table 1-1.

Resolution 750 (Rev. WRC-15) Table 1-1 to be updated with the unwanted emission levels as below which are adequate to ensure the compatibility with EESS (passive) in the adjacent band at 23.6-24 GHz.

* + - IMT-2020 BS: -33.5 dB(W/200 MHz)
		- IMT-2020 UE: -29.7 dB(W/200 MHz)

For all other conditions, no action is necessary due to results of sharing and compatibility studies. In detail, the following is applied:

* Condition A2b: Option 3 – no condition necessary
* Condition A2c: Option 4 – no condition necessary
* Condition A2d: Option 4 – no condition necessary
* Condition A2e: Option 9 – no condition necessary
* Condition A2f: Option 3 – no condition necessary
* Condition A2g: Option 4 – no condition necessary

**3.2 32 GHz (31.8-33.4 GHz)**

There is only the NOC Method in CPM text.

GSA agrees with the Method B1 (NOC) for the band 31.8-33.4 GHz.

**3.3 40 GHz range (37-43.5 GHz)**

While there are three sub-segments to the 40 GHz range, this should be treated in its entirety as a wider tuning range in order to support global harmonisation. In order to create a harmonised global band, a single footnote covering the frequency range should be created which covers the full range at 37-43.5 GHz should thus be supported.

GSA supports creation of a new IMT footnote for the 40 GHz range along the following lines:

**5.B113X**The frequency band 37-43.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations.   (WRC‑19)

**3.3.1 37-40.5 GHz**

GSA supports:

* Method C2, Alternative 2: identification to terrestrial component of IMT in 37-40.5 GHz (in the mobile service)

For the conditions associated with this band, no action is necessary due to results of sharing and compatibility studies. In detail, the following is applied:

* Condition C2a: Option 4 – no condition necessary
* Condition C2b: Option 6 – no condition necessary
* Condition C2c: Option 3 – no condition necessary
* Condition C2d: Option 2 – no condition necessary
* Condition C2e: Option 3 – no condition necessary

**3.3.2 40.5-42.5 GHz**

GSA supports:

* Method D2, Alternative 2: identification to terrestrial component of IMT in 40.5-42.5 GHz (in the mobile service), including upgrade of the existing secondary allocation to the MS in the frequency band 40.5-42.5 GHz to a primary allocation.

For the conditions associated with this band, no action is necessary due to results of sharing and compatibility studies. In detail, the following is applied:

* Condition D2a: Option 5 – no condition necessary
* Condition D2b: Option 3 – no condition necessary
* Condition D2c: Option 3 – no condition necessary

**3.3.3 42.5-43.5 GHz**

The GSA supports:

* Method E2, Alternative 2: identification to terrestrial component of IMT in 42.5-43.5 GHz (in the mobile service)

For the conditions associated with this band, no action is necessary due to results of sharing and compatibility studies. In detail, the following is applied:

* Condition E2a: Option 7 – no condition necessary
* Condition E2b: Option 3 – no condition necessary
* Condition E2c: Option 4 – no condition necessary

**3.4 50 GHz range (45.5-52.6 GHz)**

**3.4.1 45.5-47 GHz**

The GSA supports:

* Method F2, Alternative 2: identification to terrestrial component of IMT in 45.5-47 GHz (in the mobile service)

While no studies were done yet for this band, it is noted that the allocations in this band are same as in the band 66-71 GHz and the results for this should be applicable for the sharing studies with ISS and MSS.

In addition, the following is applied:

* Condition F2a: TBD
* Condition F2b: Option 3 – no condition necessary

**3.4.2 47-47.2 GHz**

The GSA supports:

* Method G2, Alternative 2: identification to terrestrial component of IMT in 47-47.2 GHz (in the mobile service)

The following is applied:

* Condition G2a: TBD
* Condition G2b: Option 3 – no condition necessary

**3.4.3 47.2-50.2 GHz**

The GSA supports:

* Method H2, Alternative 2: identification to terrestrial component of IMT in 47.2-50.2 GHz (in the mobile service)
* Condition H2a: Option 3.

For the other conditions associated with this band, no action is necessary due to results of sharing and compatibility studies. In detail, the following is applied:

* Condition H2b: Option 8 – no condition necessary
* Condition H2c: Option 3 – no condition necessary
* Condition H2d: Option 4 – no condition necessary

**3.4.4 50.4-52.6 GHz**

The GSA supports:

* Method I2, Alternative 2: identification to terrestrial component of IMT in 50.4-52.6 GHz (in the mobile service)
* Condition I2a: Option 2 Resolution 750 (Rev. WRC-19) in Table 1-1, taking into account RR No. 5.340.1.

For the other conditions associated with this band, no action is necessary due to results of sharing and compatibility studies. In detail, the following is applied:

* Condition I2a: Option 3 – no condition necessary
* Condition I2b: Option 7 – no condition necessary
* Condition I2c: Option 4 – no condition necessary

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**ANNEX**

**Detailed calculation of the protection limit for EESS below 24 GHz**

The study L within section 2/1.13/3.2.1.2 of draft CPM report shows the levels of interference exceedance for Sensor F3 (applying the apportionment value of 3 dB of the EESS (passive) protection criteria) are 11 to 15.7 dB (variation due to normalized/not normalized and percentage of distribution 50% to 99%), and the required levels of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) are -31 to ‑36 dB(W/200 MHz) for UE and -35 to ‑39 dB (W/200 MHz) for BS, in case of using a beamformed antenna model in the unwanted emission domain.

Applying different assumptions will get different levels of interference exceedance and the required levels of unwanted emissions. When considering not-normalized, 0dB apportionment and 99% percentage of distribution, the required levels of unwanted emissions are -30.7 dB (W/200MHz) for UE and -34.5 dB (W/200MHz) for BS.

To go from these “normalized” results, it is suggested that the technical conditions for protection of passive services in 23.6 – 24.0 GHz should be based on the following key assumptions:

* Percentage level: 95% (1 dB relaxation in comparison with 99%)
* Interference apportionment: 2dB
* Antenna performance in 23.6 – 24.0 GHz is better modeled by beamforming than by the single element method. Antenna normalization factor of 2dB should be included.
* Multi-operator factor: 2 dB
* Corrections should be included for the margins necessary to manage variation in the production of equipment and to meet stipulated requirements at all times. Production and other margins: Most studies assume that IMT unwanted emission is identical to given unwanted/spurious emission mask. It is not realistic to assume that all devices emit exactly according to the given protection level (especially when this level is not allowed to be exceeded). Any design must therefore include margins to cover for at least ageing, temperature dependence, measurement uncertainties and production variations. One study contains an analysis of non-worst case unwanted emission, assuming a margin of 3 dB for ageing/temperature/measurement uncertainties and a production spread of 2 dB standard deviation for a 95% production yield. This provides a relaxation of ~6dB for required emission limit.

The protection limits are thus obtained by adding to the “normalized” values above the antenna normalization, apportionment and multi-operator factors (2 + 2 + 2 = 6 dB), and by subtracting the correction factors for percentage level, margins and averaging (1 + 6 = 7 dB).

This provides -33.5 dBW/200 MHz for the base stations and -29.7 dBW/200 MHz for the terminals.

1. This document has been discussed and agreed by GSA (Global mobile Suppliers Association, https://gsacom.com/), whose members include Ericsson, Huawei, Intel, Nokia, Qualcomm and Samsung. [↑](#footnote-ref-1)