ESOA response to the RÚ public consultation on Future use of radio frequencies (incl. in 1500 MHz, 3.6 GHz, 10 GHz, 26 GHz)

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Introduction

As a trade association, the EMEA Satellite Operator's Association (ESOA) welcomes the opportunity to provide responses to the Slovak regulator, the RÚ, on its public consultation on future use of radio frequencies and their possible allocation for 5G.[1]

ESOA is a non-profit organisation established with the objective of serving and promoting the common interests of the satellite industry in the Europe, Middle East and Africa (EMEA) region, and leads a coordinated and impactful response to the global challenges and opportunities the commercial satellite communications sector faces. The Association today represents the interests of 30 members, including satellite operators who deliver information and communication services across the globe, as well as EMEA space industry stakeholders and insurance brokers.[2]

Satellite-enabled services have enriched the daily life of millions of people around the globe for decades, by broadcasting news and events worldwide, by cost-effectively extending the reach of terrestrial networks, and by connecting remote places on land, at sea and in the air that could not otherwise be connected by terrestrial options. Today, satellite communications provide both direct connectivity and an invisible and resilient overlay for terrestrial networks. Together, we help connect millions of people, devices and things for the institutions, businesses and citizens of modern societies.

ESOA understands that the objective of the RÚ consultation is now to evaluate IMT interest in deploying 5G technologies in some of the 5G pioneer spectrum identified by the European Union (3400-3800 MHz and 26 GHz) plus in the 1500 MHz and 10 GHz (10150-10650 MHz) bands.

[1] Available from: https://www.teleoff.gov.sk/konzultacie/

[2] See www.esoa.net

Satellite role in 5G

5G is not a standalone terrestrial solution. It is most definitely the result of adding different services to provide the most effective connectivity to the up raising use cases, as was acknowledged in the 2019 ITU Report on the integration of satellite systems in next generation technologies.[3] In its latest report on 5G via Satellite: Impacts, Demand and Revenue Potential (October 2020), Northern Sky Research NSR forecasts that 5G will generate $21 Billion in 2019-2029 cumulative Capacity Revenue for the satellite communications sector alone.

Satellite will play an important role in the global 5G ecosystem, by helping to extend the reach and resilience of 5G networks, as well as providing connectivity for IoT, M2M, media services, connected transport networks and many other services. In doing so, satellite will also ensure 5G-type services will benefit a maximum of citizens and are not be limited to serving urban areas. ESOA is convinced that in order to realise a viable 5G ecosystem and ubiquitous coverage, the integration of satellites into 5G networks at an early stage will be critical to make it seamless and realise the EU vision for the 'Gigabit Society'.

The role of satellite in 5G has been well recognized and explained by the Electronic Communications Committee of the CEPT in its report dated 18 May 2018 entitled Satellites in 5G which presents the main use cases of 5G by satellite already made possible with numerous high-throughput satellites (HTS) today in operation.[4] Satellite operators are also involved in the work of 3GPP, the international body that provides a framework in which 5G standards are being developed, specifically supporting the 2 work items dedicated to ensuring satellite integration into the 5G ecosystem.[5]

For more information on the exact role of satellite in 5G, ESOA invites the RÚ to review the very comprehensive White Paper on Satellite, an Integral Part of the 5G Ecosystem,[6] which ESOA recently updated.

Importance of Global Harmonisation

ESOA invites the RÚ to give due consideration to the need of taking a global harmonised approach to the allocation of radio spectrum for 5G. An impressive amount of bandwidth totalling 14.25 GHz of harmonized spectrum in mmWave band frequencies above 24 GHz has been identified for IMT-Advanced

[3] See https://www.itu.int/en/ITU-R/space/workshops/2019-SatSymp/PublishingImages/Pages/Programme/R-REP-M.2460-2019-PDF-E.pdf

[4] See https://www.ecodocdb.dk/download/e1f5f839-ba17/ECCRep280.pdf

[5] See 3GPP TR 38.811 v0.3.0 *Study on New Radio (NR) to support non terrestrial networks (Release 15)" and 3GPP TR 22.822 "Technical Specification Group Services and System Aspects; Study on using Satellite Access in 5G* Stage 1 (Release 16)

[6] https://www.esoa.net/5g

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by the ITU at WRC-19. This comes in addition to large amounts of spectrum made available to IMT in low and mid-bands.

In this context, ESOA is submitting the attached specific comments on proposals to use the 1500 MHz, 3.6 GHz, 10 GHz, 26 GHz bands where there are various allocations to the Mobile Satellite Service (MSS), Fixed Satellite Service (FSS) and Broadcasting Satellite Service (BSS). In addition, ESOA wishes to insist on the need to preserve satellite access to the 27.5-29.5 GHz (so-called 28 GHz) band.

A. Concerning the 1500 MHz band (1427-1518 MHz)

ESOA is not able to provide information to answer all the specific questions addressed by the RÚ in its Public Discussion Document[7] but would like to highlight the need for careful consideration of compatibility measures with respect to mobile satellite systems operating in the adjacent band 1518-1559 MHz, if the RÚ decides to make the 1500 MHz band available.

The band 1518-1559 MHz is used by several GSO MSS operators, including Inmarsat, to provide vital communication services to ships, aircraft and land mobile users. MSS systems in this frequency band are used for mission-critical voice and data services, including mandatory safety-of-life communications, for the maritime and aviation communities around the globe. Thus, care needs to be taken so that new Mobile/Fixed Communications Networks (MFCN) systems do not cause interference to those MSS operations in the Slovak Republic.

The CEPT has developed two important Reports on the issue of adjacent band compatibility with the MSS: ECC Report 263 [8] and ECC Report 299.[9] Report 263 establishes in-band and out-of-band EIRP limits for mobile base stations based on protection of land mobile earth stations, and notes that additional protection measures may be necessary at ports and airports.

Question n°6.5: Do you think that the RÚ should apply restrictions when building base unit stations in the 1500 MHz frequency band near airports in order to avoid interference operation of a satellite service operating in the frequency band above 1518 MHz?

ECC Report 299 determines that additional protection measures are indeed necessary to protect MSS operations at ports, airports and some inland waterways where vital MSS operations are in use on ships and aircraft. ECC Report 299 also provides a methodology to protect those operations based on power flux density ("PFD") limits to be met by mobile base stations deployed in and near to those locations.

[7] From: https://www.teleoff.gov.sk/data/files/49800_2020_11_04_verejna-diskusia_1500-mhz_final.pdf

[8] *Adjacent band compatibility studies between IMT operating in the frequency band 1492-1518 MHz and the MSS operating in the frequency band 1518-1525 MHz* from: https://docdb.cept.org/document/967

[9] *Measures to address potential blocking of MES operating in bands adjacent to 1518 MHz (including 1525-1559 MHz) at sea, ports and airports* from: https://docdb.cept.org/document/9066

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The protection measures described in ECC Report 299 would require RÚ to determine the airports where L-band MSS services are in operation and to establish PFD limits to be met by the mobile operators. This will require constraints on the base stations operating in the uppermost part of the 1500 MHz band only, i.e. 1492-1517 MHz, but would not require any such constraints on base stations operating in 1427-1492 MHz.

Refraining from authorisation of mobile broadband systems in the band 1492-1517 MHz will ensure that all MSS operations in Slovakia, including land mobile use, will be able to continue without significant risk of interference, without requiring the RÚ to apply additional protection measure related to protection of MSS operations. In this regard, it should be noted that some other European countries have proposed to initially auction only the centre part of the 1500 MHz band: 1452-1492 MHz. Examples of such countries are Germany, the Netherlands, Malta and France.

ECC Report 299 recommends PFD limits in two phases, with the timing of the transition to be determined by administrations, based on expected deployment of next generation satellite earth stations on board ships or aircrafts. RÚ should note that both ICAO (civil aviation) and IMO (maritime) have proposed that the "phase 1" period should be commensurate with the natural replacement cycle of aircraft terminals and maritime terminals, which is typically 20-25 years. In the event that the RÚ decided to proceed with authorisation of mobile broadband systems in the band 1492-1517 MHz, ESOA would recommend that the phase 1 limits are applied to airports in Slovakia for at least 15 years, at which point the limits could be reviewed for possible transition to the phase 2 limits.

B. Concerning the 3400-3800 MHz band

Even though the 3400-3800 GHz (so-called 3.6 GHz) band is now labelled as a "5G" band and part of the three 5G pioneer bands identified by the EU, ESOA wishes to underline the fact that in accordance with the EC Decision on this band (2008/411/EC as amended), the use of the band for terrestrial electronic communication services has to remain "*Without prejudice to the protection and continued operation of other existing use in this band*".[10] Also, the Radio Spectrum Policy Group (RSPG) of the European Commission in their 2nd opinion on 5G networks (RSPG18-005) have encouraged national regulators to find a proper balance between the benefits of allowing 5G use and keeping access to satellite operators in the 3.6 GHz band.[11]

Today, more than 190 geostationary satellites operate in the C-band, providing essential services to a multitude of consumers globally. European satellite operators have invested large sums of money in

[10] See Article 1 of EU Decision 2019/235 available from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019D0235&from=EN

[11] "European Administrations should ensure the proper balance between the benefits of allowing 5G use and keeping access to satellite operators in this frequency band. Administrations should consider how to use the toolkit taking into account specific national situations while at the same time facilitating practical deployment of 5G networks in this band" - from A2.1.4 of https://circabc.europa.eu/sd/a/fe1a3338-b751-43e3-9ed8-a5632f051d1f/RSPG18-005final-2nd_opinion_on_5G.pdf

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developing Fixed-Satellite Service (FSS) communications platforms and networks in the whole C-band 3400-4200 MHz. With continued investments, satellite operators are constantly working to further improve and expand the reach of these services. For example, some customers such as GiTy (Czech Republic) and Hungaro DigiTel Plc (Hungary) within the region use C band services.

The satellite earth stations operations will need to continue at 3.6 GHz and above 3800 MHz and coordination and coexistence arrangements will have to be found in consultation with neighbouring administrations to accommodate any new 5G systems. ESOA's ultimate objective is to ensure that all satellite services operating in the C-band downlink in Europe are fully protected while, at the same time, not placing overly restrictive limitations on 5G deployment that would inhibit it from achieving its full potential.

It is also important to note that the 3400-3800 GHz band is heavily used for FSS earth stations in other parts of the world, which will effectively prevent internationally harmonised use of this band for 5G; and the satellite industry depends on continued access to the 3400-3800 MHz spectrum globally for existing and future satellite deployments due to continued demand for existing and new services. Due to the critical nature of the C-band satellite teleport facilities, even more important than the economic value is the societal impact of the continued C-band satellite services to both commercial customers and critical communications users around the world.

Massive MIMO technology will be a key and necessary component to enable 5G networks. When used in terrestrial 5G deployments and radio network management, it could allow for higher overall base station EIRP levels while limiting power levels in the direction of FSS earth stations, for example, by creating nulls in antenna patterns in specific directions or by preventing beams from pointing in the direction of the FSS earth stations.

There are several ways of ensuring an adequate protection of FSS earth stations and links using frequencies beyond 3800 MHz, some of which are interference mitigation techniques recommended to be applied for the coordination between IMT stations and FSS earth stations:

- Improve the receive technique characteristics of LNA/LNB, such as adding an additional filter
- Install shielding net around the earth station
- Avoid installing IMT-2020(5G) base stations in the main lobe of earth station antenna
- Adjust the maximum radiation direction
- Reduce the IMT-2020(5G) maximum output power
- Use geographical separation based on I/N protection criteria from ITU REC 1432

ITU-R Reports M.2109 and S.2368, provide studies to assess the technical feasibility of deploying IMT systems in the 3 400-4200 MHz and 4500-4800 MHz band used by FSS. These reports clearly state that to provide protection of the FSS receive earth stations, some separation distance relative to the stations of the terrestrial mobile network is required. However the magnitude of this separation distance depends on the parameters of the networks and the deployment of the two services.

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ECC Report 254[12] provides guidance on enabling administrations to protect incumbent use of the band with exclusion zones, whilst also facilitating its use by new entrants.

The conjunction of IMT station's emissions and FSS earth station LNA (low noise amplifier)/LNB (low-noise block down converter)'s overload are key factors for inter-band and intra-band interferences, as explained below.

1. Interference from IMT station's unwanted emissions:
    a. Given that FSS earth station's input signal strength is always at very low power level, unwanted emissions generated by IMT base station can cause interference to the reception of FSS earth station operating in IMT system's adjacent band
2. LNA/LNB overload:
    a. FSS Earth station's LNAs and LNBs are optimized for receiving very low power level of satellite signal and have a very high sensitivity
    b. IMT signal's strength is always at much higher power level, so it can severely affect the LNA/LNB and drive it out of its dynamic range to where it works at a non-linear behaviour

One thing is very clear: improving the radio performance of FSS earth stations and IMT base stations is proved to be one of the most effective way to avoid interference. The OOBE levels specified in 3GPP standards do not protect FSS signals in adjacent bands. Using a guard band around 3800 MHz and imposing strict OOBE limits on 5G are therefore necessary. Table 1, below, summarizes some of the tools which can be deployed by mobile network operators on a localized, case-by-case, basis to ensure the interference to FSS stations is at or below the OOBE threshold level.

	Mobile Network Operator Tools to Reduce OOBE
1	Using Multiple-Input Multiple-Output (MIMO) technology to null the radiation pattern in the direction of earth stations.
2	Lowering the transmit power levels for the base station or user equipment.
3	Force user equipment to roam to non-C-Band frequencies near FSS earth stations.
4	Deploying microcells near FSS earth stations which have lower transmit powers.
5	Install better transmit OOBE mask for select base stations near FSS earth stations.

Table 1: MNO Tools to Reduce OOBE

This leads ESOA to have the following comments:

1. ESOA believes that a guard band of *at least* 50 MHz is required to effectively ensure protection of FSS operations at 3800-4200 MHz from adjacent high powered terrestrial 5G transmissions at 3.6 GHz when used in conjunction with a purpose-designed filter to be fitted on FSS earth stations, noting that other countries are implementing similar protection.[13] It should be noted that the implementation of a guard band does not mean that these frequencies cannot be used at all by

[12] ECC Report 254 on *Operational guidelines for spectrum sharing to support the implementation of the current ECC framework in the 3600-3800 MHz range*, approved 18 November 2016

[13] **Germany** has reserved the 3700-3800 MHz band to private local networks which power and deployment characteristics are strictly limited, whist The **Netherlands** and **Luxembourg** have established a guard band in 3750-3800 MHz.

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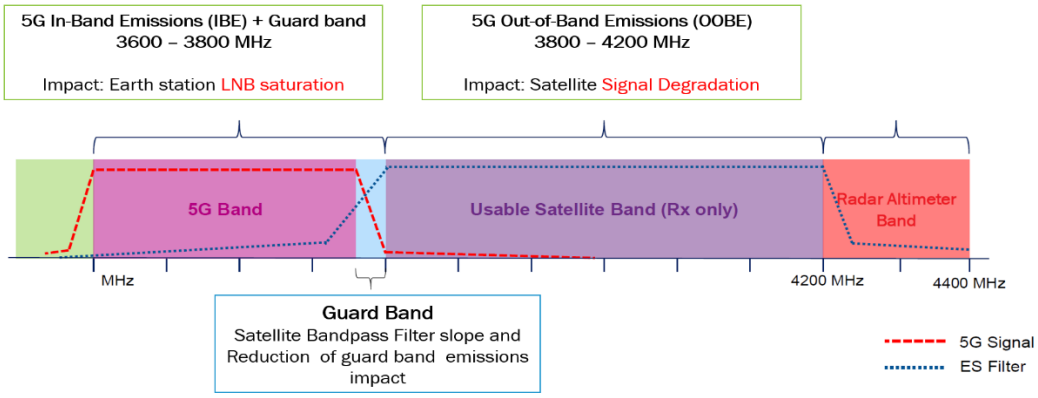
MFCN networks, but their use would need to be subject to the same restrictions as for co-frequency operations.

Below is an example of how FSS services within the 3800-4200 MHz would be impacted by unwanted signals of MFCN networks operating in the adjacent band, that justifies such measures.



Impact on Satellite Spectrum

2. ESOA also recommends that the RÚ requires adoption of a Block Edge Mask (BEM) for protection of FSS earth stations above 3800 MHz in their proposed regulations/ licences to MFCN operators, noting that such BEM should be in accordance with the in-band limits proposed - i.e. 9 dB below the BEM of the CEPT Decision ECC/DEC(11)06 and of the corresponding EU Decision 2019/ 235, consistent with the applicable 3GPP BEM.

C. Concerning the 10 GHz band

ESOA is concerned with the potential impact of introducing 5G services in the 10 GHz (10.15-10.65 GHz) band on satellite operations in the Fixed Satellite Service (FSS) and Broadcasting Satellite Service (BSS) Ku-bands 10.7-11.7, 11.7-12.5 and 12.5-12.75 GHz. As the RÚ is aware, the entire Ku-band spectrum in 10.7-12.75 GHz is used for satellite services throughout Europe including in Slovakia, notably for the provision of direct broadcast satellite services (DTH) (e.g. Skylink in Slovakia), cable distribution, as well as for data services (VSATs), aeronautical and maritime services, and satellite broadband services. (see diagrams below). Given the large amounts of spectrum already identified for IMT-2020 by WRC-19, in which 5G is only now being deployed, it is unclear whether any additional spectrum in the 10 GHz range is required for any near-term 5G requirements.

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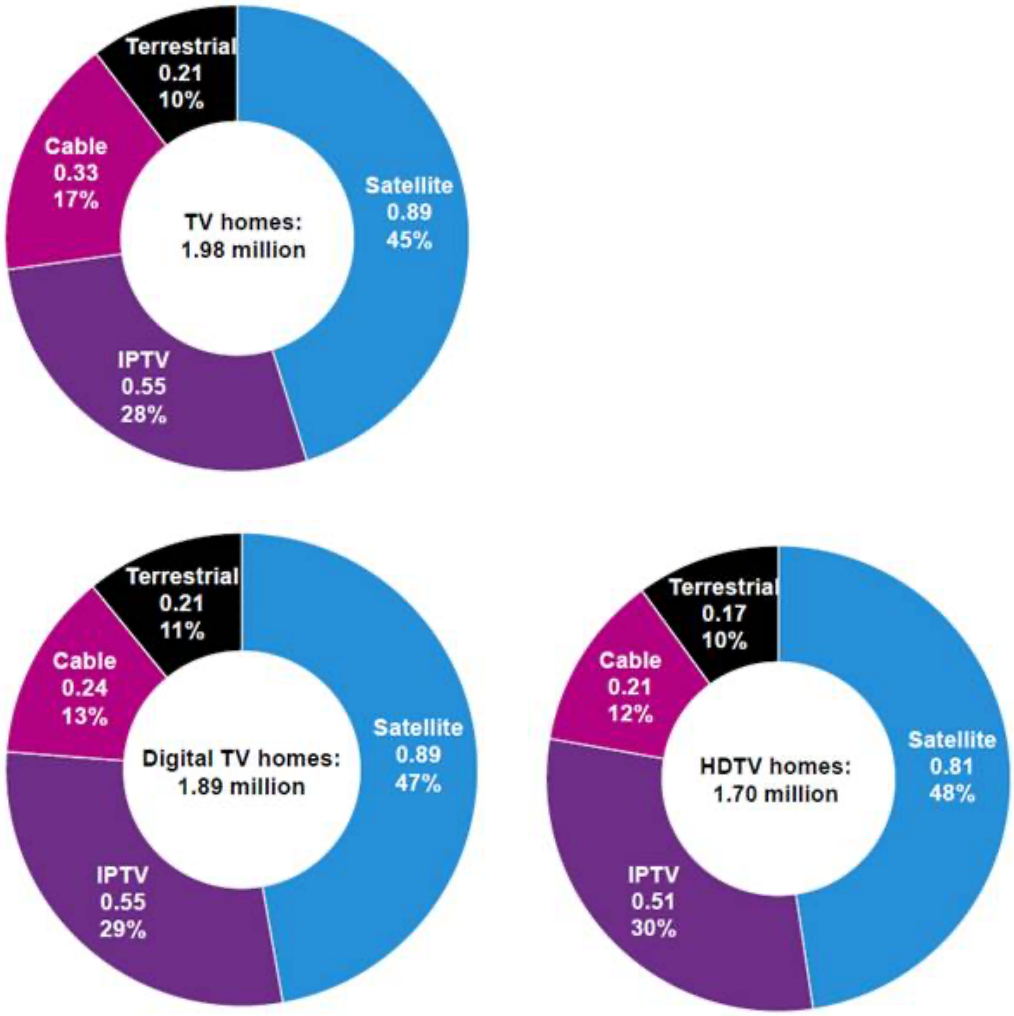

Slovakia TV market, end 2019 (SES Satellite Monitor)

In any event, it is important to recognise that not only are satellite services in frequencies immediately adjacent to the 10 GHz band at risk of being affected, but potentially services in higher frequencies, depending on satellite receiver performance and the levels of the spurious emissions from the IMT side. Significant additional technical studies would be required to ensure that the adjacent band effects are fully understood and that appropriate in-band and adjacent band protection measures are implemented to protect the extensive satellite services in 10.7-12.75 GH band.

D. Concerning the 26 GHz band

WRC-19 identified the frequency band 24.25-27.5 GHz (so-called 26 GHz) for IMT, subject to specific conditions (Resolution 242 (WRC-19)). ESOA fully understands the interest of the 26 GHz band for the mobile industry, and in particular to deploy 5G in dense urban areas. This band provides more than 3 GHz of contiguous spectrum for the Mobile industry. Most recently, Qualcomm has reached an amazing level

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of connectivity performance by testing their new 5G IMT chips, with data rates topping 8 Gbps in using the 26 GHz band.[14]

ESOA understands that in Slovakia, "26 GHz frequencies are expected to be assigned after July 7, 2021."[15] It is important to keep in mind that the Fixed Satellite Service (FSS) has a 600 MHz allocation in the 24.65-25.25 GHz band. The EU Decision 2019/784 on this regard states: *"space and satellite [FSS] services should be appropriately protected against interference from terrestrial wireless broadband electronic communications services. They also need prospects for further development."* Article 3 of the Decision explicitly thus instructs that *"Member States shall ensure (…) that the [5G] terrestrial systems (…) appropriately protect"* satellite services, and Article 5 adds that "*subject to market demand, Member States shall ensure, that the continued deployment of [satellite] earth stations is made possible."*

ESOA also reminds the RÚ that *"the technical conditions provided in CEPT Report 68[16] for the use of the 26 GHz frequency band are based on the assumption of an authorisation regime based exclusively on individual rights of use, which is also conducive to ensuring appropriate co-existence with current band usage. Any other authorisation framework such as general authorisation or a combined individual/general authorisation regime would require additional technical conditions in order to ensure appropriate coexistence of terrestrial systems capable of providing wireless broadband electronic communications services with other services in the band, in particular taking due account of continued deployment of FSS, EESS and SRS earth stations."* (quote from the 2019 EC Decision)

ESOA further notes that ECC PT1 delivered a new draft ECC Recommendation (20)01 on "Guidelines to support the introduction of 5G while ensuring, in a proportionate way, the use of existing and planned FSS transmitting earth stations in the frequency band 24.65-25.25 GHz and the possibility for future deployment of these earth stations." [17]

ESOA would further welcome the RÚ to guarantee that IMT license holders in the 26 GHz band have base stations that do not transmit above the horizon. As the 2019 EU Decision states: "*Coexistence between terrestrial wireless broadband electronic communications services (including 5G) and satellite receivers in the FSS and ISS, including EDRS, is currently feasible, subject to technical conditions that address the antenna elevation of wireless broadband base stations.*" It is to be noted that 5G base stations in these frequencies will leverage smart antennas which adapt their emission characteristic to the location of the end users. This presents a specific risk as antenna panels, irrespective of their physical down tilt, could start transmission with the main beam above the horizon through beamforming. Such cases are very

[14] See https://www.telecompaper.com/news/elisa-nokia-and-qualcomm-reach-8-gbps-in-trial-on-commercial-5g-network-in-finland--1362327

[15] From http://5gobservatory.eu/wp-content/uploads/2020/10/90013-5G-Observatory-Quarterly-report-9-V2.pdf

[16] CEPT Report 68 on *Harmonised technical conditions for the 24.25-27.5 GHz ('26 GHz') frequency band*, also named "Report B"

[17] See: https://www.cept.org/ecc/groups/ecc/ecc-pt1/client/meeting-documents/file-history/?fid=56630

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realistic, for example a lamppost-mounted base station transmitting to an end user located on the top floor of a building. This kind of scenario would most likely result in significant interference to FSS.

Finally, ESOA recommends the RU to apply, in accordance with *resolves 2.2* of Resolution 242 (WRC-19), regulatory conditions that require MFCN base stations that would operate an e.i.r.p. per beam exceeding 30 dB(W/200 MHz) to be prohibited from pointing their antenna beams upward at the geostationary satellite orbit and maintain a minimum separation angle of ≥ ±7.5 degrees. In addition, as a minimum, 5G stations should also be required to comply with out-of-band domain emission limits in the frequencies above 27.5 GHz as described in Recommendations ITU-R SM.1541-6 and ITU-R SM.329. In the case of ITU-R SM.329, the category B limits should apply.

E. Concerning the 28 GHz Band

ESOA is pleased the RÚ is not considering the 28 GHz band for IMT. In line with WRC-15 and WRC-19 outcomes, Europe and the CEPT have taken an unambiguous position against the use of the 28 GHz band for terrestrial 5G mobile systems and have instead harmonised this band for broadband satellite and ESIM applications. WRC-15 decided *not* to consider the 28 GHz band as candidate spectrum for IMT (5G) under WRC-19. The CEPT also issued a 5G Roadmap that explicitly noted: "… ***Europe has harmonised the 27.5-29.5 GHz band for broadband satellite and is supportive of the worldwide use of this band for ESIM. This band is therefore not available for 5G***."[18] In addition, the Radio Spectrum Policy Group (RSPG) in its Opinion on WRC-19 clearly indicated: "The RSPG recommends that the European Commission propose an EU position to the Council **opposing** any consideration of the 27.5 - 29.5 GHz band under Agenda item 1.13 [of WRC-19]."[19]

The 28 GHz band, in which the European satellite industry has invested tens of billions of dollars for the design, manufacture and launch of HTS and VHTS satellites, is being, and will increasingly be, used for a wide portfolio of services across the world, including satellite consumer broadband services (e.g. Eutelsat's Tooway service), as well as for the operation of Earth Stations On Mobile Platforms (ESOMPs) that are already being deployed in European territories. Connectivity is thus provided to ships, aircraft and land vehicles, using GSO and non-GSO networks of the Fixed Satellite Service (FSS). Indeed, the conditions under which the FSS may operate in the 28 GHz band are well established under ECC Decisions (05)01, (13)01, and 15(04) of the CEPT, which have all been implemented by Slovakia.[20]

Conclusion

ESOA thanks the RÚ for this opportunity to comment on their spectrum plans. ESOA will be very pleased to respond to any question the RÚ may have in relation to our comments.

[18] See Action B.3 in https://cept.org/Documents/ecc/45004/ecc-18-104-annex-17_cept-roadmap-5g

[19] See https://circabc.europa.eu/sd/a/7ab8a6bb-f59a-434f-9b66-606b5a8067ce/RSPG18-023final-Opinion_WRC19-for_public_consultation.pdf

[20] See from https://docdb.cept.org/document/384, https://docdb.cept.org/document/447, https://docdb.cept.org/document/439

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