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GSOA response to draft RSPG Opinion - The development of 6G and possible implications for spectrum needs and guidance on the rollout of future wireless broadband network

GSOA is the only global non-profit association of the entire satellite ecosystem that brings members together and serves as the premier platform for worldwide collaboration. As the only CEO-driven satellite association in the world, GSOA takes the lead in addressing global challenges, seizing opportunities, and providing a unified voice for the satellite industry. Our vision is to help policymakers improve the state of the world by continuously bridging digital, education, health, social, gender and economic divides across diverse geographies and across mature and developing economies.

The satellite industry is going through a phase of unprecedented growth and innovation with total annual investment going up from US$300 million in 2012 to more than US$10 billion in 2022, according to McKinsey.[1]

The fast-paced development of the satellite industry has been evidenced by the large-scale implementation of non-GSO systems, the design and launch of a new-generation of very high-capacity GSO satellites, progressive integration of NTN and Terrestrial in 5G and future 6G solutions, industrial IoT and satellite direct to cellular communications, to name but a few. As a result, the number of satellite broadband users globally is set to grow to at least 500 million people by 2030.[2] These innovation and progress will have a direct impact into the inclusiveness and quality of life of all citizens, including in Europe and its neighbouring regions.

GSOA welcomes the draft RSPG Opinion on identifying spectrum needs for 6G at such an early stage and is pleased to provide its views on it and on the important role of satellites in bringing increased connectivity to Europe and globally.

1. Recognises that 5G implementation is ongoing in the primary and pioneer bands identified for 5G.

Satellite is now part of the 5G ecosystem and already contributes to its deployment by extensively and more efficiently using its spectrum allocations.[3] Therefore, as the RPSG and European regulators take important decisions on the use of frequency bands, the important needs of the satellite industry and demands from users across Europe need to be considered.

Specifically, the RSPG Opinion states that the 26 GHz band is subject to different timings and implementations in Member States and that the roll-out of 5G in the band has been slow even in those Member States that have made this band available to the market. GSOA finds it remarkable that despite the growing spectrum needs of the industry 4.0 and verticals for local very high-capacity connectivity, the use of 26 GHz and 40.5-43.5 GHz have remained extremely limited. GSOA expects that 5G further development and 6G uptake will go together benefiting from these existing spectrum resources for future applications.

[1] A different space race: Raising capital and accelerating space investment | McKinsey
[2] The Socio-Economic Value of Satellite Communications
[3] 5G Americas, "Update on 5G Non-Terrestrial Networks Briefing Paper", July 2023. Available at: https://www.5gamericas.org/update-on-5g-non-terrestrial-networks/

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The low number of 26 GHz assignments and limited interest in using it in Europe seem to indicate that for now, there is no heavy demand for additional spectrum to respond to high-capacity needs.

3. Recognises the increasing needs for vertical and local spectrum.

The RSPG Opinion refers to the ongoing work to develop harmonised technical conditions for low and medium power terrestrial wireless broadband in accordance with the European Commission Mandate to CEPT on shared use of the 3.8-4.2 GHz frequency band for local-area network connectivity, as a response to the strong demand for mid-band spectrum for vertical and local use[4].

GSOA and its members have been actively participating and contributing to these discussions in CEPT ECC PT1 and FM60 and are extremely concerned with the constant attempts from the mobile industry to extend 5G macro-cell use also to the 3.8-4.2 GHz frequency band. Such considerations are completely contrary to the original aim of the EU Commission to enable vertical and local mobile use on a shared basis. They also jeopardize critical Fixed Satellite Service (FSS) use in the band, not to mention the radio altimeters operating in the adjacent band.

The EC Mandate is very clear with respect to incumbent services in the band, as it *"invites CEPT to assess the technical feasibility of the shared use of the 3.8-4.2 GHz frequency band by terrestrial wireless broadband systems providing local-area network connectivity with focus on vertical users and other terrestrial wireless use cases and, on that basis, deliver harmonised technical conditions for the shared use of the band. Those harmonised technical conditions should in particular ensure the protection and the possibility of future evolution and development of incumbent spectrum users in this band (notably receiving satellite earth stations in the fixed satellite service and terrestrial fixed links) and the coexistence with spectrum users in adjacent bands (such as radio altimeters on board aircraft operating in the 4.2-4.4 GHz frequency band)."*

The RSPG Opinion also mentions the 42 GHz band (40.5 - 43.5 GHz) as a possible extension to the 26 GHz band to enable local access to spectrum, including for verticals, with market demands expected to increase in the future. In Region 1, the frequency band 40.5-42.5 GHz is allocated for FSS downlinks and the frequency band 42.5-43.5 GHz for FSS uplinks. Indeed, higher frequency bands in Q / V-bands (37.5-52.4 GHz), have more available bandwidth compared to the widely-used Ku-band (10.7-14.8 GHz) and Ka-band (17.3-31 GHz). ITU Resolution 243 (WRC-19) addresses the conditions of deployment of IMT in the 42 GHz band. In CEPT, ECC Decision 23(01) and ECC Recommendation 22(01) address the use of these bands by satellite systems, while ECC Decision (22)06 provide harmonised technical conditions for MFCN in these bands. Also, ECC Recommendation 22(02) provides guidelines on compatibility between satellite operations below 40.5 GHz and MFCN operations above 40.5 GHz. Existing and future satellite operations in this 37.5-43.5 GHz range should thus be properly taken into account.

Accordingly, satellite operators around the globe have started to experiment this 42 GHz band on their satellites in view to further deploy high-capacity gateways and other individual earth stations that provide essential connectivity to users. GSOA is therefore asking the RSPG to confirm and preserve satellite access to this 42 GHz spectrum to meet growing connectivity demand.

[4] EC, Mandate to CEPT on technical conditions regarding the shared use of the 3.8-4.2 GHz frequency band for terrestrial wireless broadband systems providing local-area network connectivity in the Union, Dec. 2021. Available from: https://ec.europa.eu/newsroom/dae/redirection/document/82230

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4. **Recognises, further to RSPG Opinion 21-024, that, prior to the introduction of 6G, additional capacity needs for mobile networks may arise on the national level during this decade. These do not require additional EU harmonisation and can be met at a national level either by firstly using the current spectrum more efficiently (e.g. by densifying the network) or introducing additional spectrum for terrestrial mobile broadband.**

GSOA supports the RSPG Opinion that mobile networks must extensively and efficiently use already identified IMT spectrum. It is very important to avoid spectrum warehousing since spectrum is a finite resource. There is no need for additional harmonized IMT spectrum, considering that nearly 2 GHz of low/mid bands has been made available for IMT before WRC-19 and more than 17 GHz of mmWave bands at WRC-19.[5] Based on the use cases envisaged so far for 6G, the already existing mmWave IMT spectrum is perfectly suited for 6G terrestrial mobile systems. While there are yet some challenges for the mobile industry to overcome in the mmWave spectrum - such as low propagation, the need for high power levels, and the lower reliability of connection - solving these challenges can offer benefits in obtaining large continuous spectrum at relatively low cost and enjoying already globally harmonized frequencies for economies of scales, without jeopardising other wireless industries[3]. Therefore, GSOA strongly opposes to calls from the mobile manufacturers to identify further IMT spectrum in 7-24 GHz range of frequencies.[6]

Additionally, with sunset of 2G and 3G and eventually 4G mobile technologies in various bands below 4 GHz, spectrum will be freed for future generations of the mobile technologies in all different EU Member States in accordance with national objectives. For now, there has been very little discussion on how the mobile industry plans to use these bands in the future. We urge the RSPG to focus on the frequency bands already available to the mobile industry to support those 6G terrestrial use cases for which mmWave bands may not be suitable for, as opposed to looking at new allocations or IMT identifications for 6G. If these bands are not suitable for implementation of terrestrial 6G, there should be a harmonised European approach to open access to these bands to other technologies, such as satellite, once the existing mobile licenses expire.[7]

7. **Recognises the role of and need for non-terrestrial networks to support 6G development further current initiatives on 5G. Non-terrestrial networks could become an important additional connectivity layer to terrestrial connectivity services, e.g. to provide coverage in underserved areas, provide global connectivity to logistics and transport, support disaster relief and serve as a fallback layer or backhaul for terrestrial networks.**

Satellite systems are part of non-terrestrial networks (NTNs), and 3GPP Release 18 is key to pave the way to further integrate satellite communications into the 5G/6G ecosystem. Innovation in the satellite industry enables both GSO networks and non-GSO systems to contribute to 6G for coverage, resilience, security, energy-efficiency/sustainability.[8] Satellites also play a critical role in multicasting vast amounts of HD videos and data.

Satellites will be essential in providing immersive communications that satisfy international efforts to tackle digital inequity and achieve sustainable growth. There are three main roles for satellites in 6G. First, the global coverage of satellites will expand the reach of 6G to all sensors and devices that

[5] Plum Report: Examining the current assignment and usage of mobile spectrum – GSOA – Global Satellite Operator's Association (gsoasatellite.com)
[6] GSA presentation - CEPT 6G Workshop - June 2023 20.00.pptx (live.com)
[7] Plum Report: Examining the current assignment and usage of mobile spectrum – GSOA – Global Satellite Operator's Association (gsoasatellite.com)
[8] GSMA and ESA Partner on Satcom/Terrestrial Convergence - Via Satellite (satellitetoday.com)

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transmit and receive data for immersive applications.[9] Rather than merely having a supplemental role in network connectivity, satellites in 6G will facilitate globally interconnected devices that are accessible by anyone, anywhere, at any time. Such connectivity ensures that sensory experiences do not fall short of providing immersive, real-time communications.

Second, satellites promote sustainable 6G network growth and facilitate projects that aim to further ecologically sound progress.[10] As terrestrial networks become difficult to construct in many localities, carbon costs associated with the projects increase. By having solar-powered satellites centrally part of 6G network architectures, carbon costs by terrestrial network expansion can be nullified by satellite connectivity in the same area.[11] Additionally, the global nature of climate change requires devices and sensors to be globally connected such that meaningful monitoring efforts can ensue. NTNs must be fully integrated into terrestrial networks (TNs) to achieve this reality.

Lastly, satellites will establish resilient 6G networks that protect connectivity requirements when TNs succumb to disasters.[12] For example, climate change continues to showcase the failure of TNs when natural disasters occur.[13] Additionally, anthropogenic disasters - particularly warfare - illustrate how TNs can rapidly devolve into military targets for cyber-attacks.[14] Under traditional structures that treat NTNs as supplemental, continuous 6G service cannot be reinstated - especially since 6G places greater demands on networks. In contrast, three-dimensional network architectures - accomplished by fully integrating NTNs and TNs—can ensure service is agile to these unexpected events and connectivity with users remains seamless.

In order for a truly integrated 6G to become reality in the future, the existing spectrum used by satellite systems and satellite access to even more spectrum (incl. Q/V bands) need to be secured.

8. **Recognises that a proactive position is essential for supporting the development and deployment of 6G. This includes further work by RSPG on early recognition of spectrum needs, so that the initial launch and operation of 6G networks/services can start in 2030. In due time, this early recognition of spectrum needs should be based on a proper evaluation of coverage and capacity needs for 6G use cases and usages scenarios (…) RSPG will consider in 2024 or later a 6G spectrum roadmap.**

Experience of the past (notably to identify 5G spectrum needs) has shown the need to evaluate the actual spectrum needs of *all* wireless technologies very carefully, based on well-identified case studies and credible business opportunities. With 6G mobile terrestrial systems still in early research phase and the IMT-2030 standard expected to be completely defined only by 2030, such evaluation is practically impossible today, and lack of reliable technical characteristics would make any sharing studies at this point premature increasing the risk of protracted debates when discussing sharing conditions for different services.
As seen above there has been little demand for spectrum in the mmWave frequencies for high speed and low latency 5G technologies. Considering that the current requirements for 6G technology are still

[9] Satellite Communications and their role in enabling 6G – GSOA – Global Satellite Operator's Association (gsoasatellite.com)
[10] Sustainable Satellite Communications in the 6G Era: A European View for Multilayer Systems and Space Safety | IEEE Journals & Magazine | IEEE Xplore
[11] GLOBAL SATELLITE OPERATORS ASSOCIATION, *supra footnote 9,* page 4
[12] Maurilio Matracia et al., IEEE OPEN J. OF THE COMMC'NS. SOC'Y, PAGES 1177-1178 (2022) from: Post-Disaster Communications: Enabling Technologies, Architectures, and Open Challenges | IEEE Journals & Magazine | IEEE Xplore
[13] FAIR TECH INSTITUTE, THE ROLE OF SATELLITE COMMUNICATIONS IN DISASTER MANAGEMENT, PAGE 18 (2022) from: The-Role-of-Satellite-Communications-in-Disaster-Management.pdf (accesspartnership.com)
[14] NATO - Topic: NATO's approach to space

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very uncertain and subject to further study, it is likely that any future demand for large bandwidths could be accommodated by the mmWave bands already identified for IMT.

Mobile equipment manufacturers claim that additional 500-750 MHz of spectrum for each operator is required for 6G network rollout[15], which would lead to requirements of over 2 GHz of additional IMT spectrum in most Member States. This would not be feasible in the 7-24 GHz frequency band noting the amount and variety of existing and future use as well as the congestion in these bands. Instead, as discussed previously, the unused mmWave bands with existing IMT identification will have to be utilized.

With the increase in spectrum refarming for example in IMT bands used for 2G, 3G and 4G in bands below 5 GHz, and the availability of large existing bandwidths at mmWave, regulatory bodies and ITU study groups should be cautious about recommending future WRCs to identify significantly large additional bandwidths for IMT. While most services – e.g. satellite service and fixed service – are used to sharing spectrum with each other's, an identification for terrestrial IMT generally prevents use of the same frequency bands by other international services – such as science (including for climate), broadcast, or satellite.

The EU decision-makers should also ensure that fostering new technologies will not deepen the digital divide. As a reminder, many rural and remote areas of Europe still do not benefit from a high-quality, always-on 4G level of connectivity. The digital future of Europe relies on ensuring that all technologies can contribute to delivering for the wellbeing of society. At this stage, it is critical not to put existing services that contribute to essential connectivity of people, SMEs, or institutions at risk. Additionally, mobility services, that are increasingly dependent on satellite technologies, should remain in the focus of the RSPG. There is not a single technology that alone can cater for evolving connectivity needs of European citizens, therefore only by finding a balanced approach which preserves access to spectrum for variety of technologies can Europe really strive towards a network of networks that truly benefits citizens in all Member States.

Finally, when discussing the 6G spectrum roadmap, all TN (terrestrial) and NTN technologies are becoming critical components of 6G. NTN technologies, and satellite in particular, will serve as a basic element of 6G communications and adequate spectrum resources (including existing allocations) must be available for NTN to meet Europe's goals for 5G and 6G.

9. Recommends to the European Commission, taking into account RSPG recommendations, with the help of Member States, to work towards a strategy, involving all active stakeholders (research institutes, manufacturers, MNOs, spectrum users' associations, etc.), to facilitate the timely launch of 6G services across the EU.

GSOA fully supports the ambition of the RSPG and urges the RSPG and its members to ensure that *all* connectivity players (not only MNOs) are fully considered when Europe decides on the allocation of spectrum resources for 6G. Only in counting on the new, advanced satellite systems, will Europe achieve its connectivity goals and retain its international leadership in TN and NTN innovative technologies.

[15] Huawei Technologies Sweden AB, LM Ericsson, Nokia Corporation, Qualcomm, ZTE France SASU, "IMT-2030 (6G) Spectrum needs and candidate bands", PTA#8 April 2023. Available at: https://www.cept.org/Documents/cpg-pta/77266/pta-23-047_imt-2030-6g-spectrum-needs-and-candidate-bands