Your response

Question	Your response
Question 1: Hybrid sharing could mean that the upper 6 GHz band will be used for mobile outdoors and Wi-Fi indoors. What are your views on the priorities for each of these two services, assuming that suitable coexistence mechanisms are developed?	GSOA has concerns about Ofcom's proposal for enabling licensed mobile outdoor users to access the upper 6 GHz band. Studies conducted in ITU-R during the WRC-23 study cycle based on parameters and assumptions agreed by WP5D have already shown excessive level of interference into FSS (Fixed Satellite Service) receivers. Similarly, previous ITU-R studies (Report ITU-R S.2367) showed very little potential for IMT operations while protecting FSS receivers (indoor use only, 10-15 dBm EIRP limit necessary). Previous studies conducted at CEPT level have demonstrated that sharing with unlicensed Wi-Fi indoor could be more feasible than sharing with IMT. There is a real issue about the feasibility of coexistence between outdoor IMT and FSS receivers, which would require significant constraints on IMT stations to ensure coexistence with FSS services. If Ofcom is to adopt and proceed with the proposal, there will need to be a significant constraint on IMT outdoor deployment in the upper 6 GHz in order to ensure the protection of FSS receivers. We propose therefore that Ofcom prioritises use of the upper 6 GHz band for Wi-Fi applications, which have much greater potential for sharing the band with FSS uplinks.
Question 2(a): Hybrid sharing could mean that the upper 6 GHz ban will be used for mobile in some locations, and Wi-Fi in others. We would like feedback on the priorities for each of these two services, assuming that suitable coexistence mechanisms are developed. From the point of view of mobile, is the upper 6 GHz band most useful to provide outdoor coverage, or indoor coverage? Is it most useful in urban areas, or in those base stations that are currently carrying more traffic, or some other split?	See response to question Q1, i.e., any outdoor IMT deployment would require significant constraints on both IMT power levels and density. It should be noted that in the context of WRC-23 agenda item 1.2, the IMT community has proposed that IMT would be deployed only in very limited parts of sub-urban and urban areas. Even with these assumptions, interference would exceed FSS uplink protection levels

Question 2(b): Similarly, what are the priorities from the point of view of Wi-Fi deployments?	In accordance with the Wi-Fi market prediction information from the Wi-Fi industry and the study assumptions made in ECC Report 302, 98% of Wi-Fi market is indoors. Therefore, focus of the Wi-Fi deployment should be on the indoor-only use.
Question 3: What are your views on a modified AFC or SAS-type approach to enable hybrid sharing? What additional work do you think would be required?	AFC implementation does not consider the risk of aggregate interference to FSS receivers. Similarly, SAS is concentrated on localized geographical coordination between Fixed Service, receiving satellite Earth stations and mobile usage. Therefore, additional mechanisms applicable without geographical limitation, such as EIRP limits, would be required to control the aggregate interference to FSS uplinks.
Question 4: How could existing access protocols and sensing mechanisms be leveraged (i.e., those in Wi-Fi or 5G NR-U) to enable hybrid sharing?	GSOA has no view on this Question.
Question 5: What mechanisms could potentially enable device-to-device connectivity?	GSOA has no view on this Question.
Question 6: If hybrid sharing is eventually adopted, and requires licensed mobile to operate at medium power, in what way would mobile networks use the upper 6 GHz band?	GSOA has no view on this Question.
Question 7: How would you suggest that the mechanisms presented here can be used, enhanced, or combined to enable hybrid sharing or are there any other mechanisms that would be suitable that we have not addressed?	GSOA would like to note that concentrating licensed mobile outdoor use into a narrower band, through bandwidth splitting between Wi-Fi and mobile use, could significantly increase the risk of unacceptable interference to FSS receivers by increasing the power spectral density in the smaller band available to each technology. Therefore, more stringent EIRP limits could be required than in the case that a single technology use is introduced throughout the whole 6425-7125 MHz band.
Question 8(a): Assuming the future of the band includes indoor use for Wi-Fi and outdoors use for mobile: How could this be achieved without creating or suffering interference?	Understanding this question relates only to interference between WiFi and mobile, GSOA has no view on this Question.
Question 8(b): Could there be a combination of technical adjustments such as power limits and other mechanisms (including databases or sensing mechanisms)?	GSOA is of the view that a database approach could be suitable for protecting FSS receive earth stations in the 6700-7075 MHz band, whereas sensing would not be feasible as the earth stations are only receiving in this band. As noted above, the database approach would need to be complemented by additional mechanisms to address aggregate interference of all terrestrial use to the FSS receiver, such as EIRP limits.

Question 9(a): We are interested in input about the importance of the upper 6 GHz band for its incumbent users, and on the potential impact of hybrid sharing of the band. What evidence do you have on whether incumbents are likely to coexist with hybrid sharing of the band with mobile and Wi-Fi? Are there unique advantages of the upper 6 GHz band for these uses?	Frequency band 6425-7075 MHz is used by FSS uplinks, by a range of applications, including telecommand links, and systems part of the App 30B plan. The band is also used for feeder uplinks, to support L-band MSS (Mobile Satellite Service) systems which support essential maritime and aeronautical communications. In the maritime community, services are provided for operational as well as for safety related communications, such as the International Maritime Organisation (IMO) Safety-of-Life At Sea (SOLAS) communications equipment requirements (including Global Maritime Distress and Safety System (GMDSS) requirements), which are mandatory for many vessels. In aviation, L-band MSS communications support the Aeronautical Mobile Satellite (Route) Service (AMS(R)S) and are important for ensuring flight safety. Additionally, 6700-7075 MHz band is used by non-GSO MSS feeder downlinks. Earth stations and gateways would receive interference from IMT Base Stations, unless protected by geographical separation e.g. by using a database approach. There should be a possibility to deploy new satellite earth stations. Regarding the potential impact of hybrid sharing of the band on the incumbent FSS service, unless the necessary constraints are applied to the IMT and WiFi stations, harmful interference would occur to the FSS service. Incumbent FSS receivers can only coexist with outdoor IMT deployment with significant constraints on IMT stations' radiated power and density of IMT deployment. Coexistence between FSS uplinks and Wi-Fi is potentially feasible, with constraints on WiFi powers, based on the precedent in lower 6 GHz. The evidence for this position is the studies done in ITU-R during WRC-23 study cycle based on parameters and assumptions agreed by WP5D have already shown excessive level of interference into FSS satellite receivers. Similarly, previous ITU-R studies (Report ITU-R S.2367) showed very little potential for IMT operations while protecting FSS receivers (indoor use only, 10-15 dBm EIRP limit necessary), while previous studies conducted at CEPT level have demonstrated that sharing with unlicensed Wi-Fi indoor could be more feasible than sharing with IMT. GSOA has conducted studies on the upper 6 GHz under AI 1.2 of the WRC-23, based on the ranges of parameters provided by WP5D and WP 4A and considering allowance for interference from Wi-Fi and FS, shows there would be excessive interference into FSS receivers (see table below) and there will need to be constraints

on IMT base station deployment. Given the interference is an aggregate from large numbers of interferers, and aggregate interference depends on IMT stations density, GSOA believes that conditions on IMT to protect FSS receiver should apply to both IMT base station radiated power and IMT deployment density.

Excess Interference above the protection criterion in dB

IMT deployment density	Global beam satellite coverage
Highest	21
Lowest	11

Based on the above results, GSOA believes the IMT base station average EIRP mask should be constrained by the exceedance depending on the deployment density of IMT base stations assumed. In order to ensure the protection of FSS receivers and give flexibility to IMT deployment, we propose two alternative approaches, "Approach 1" is to develop conditions based only on limits on IMT BS EIRP above the horizon (assuming the highest base station density provided by WP5D) and "Approach 2" applies a condition based on both IMT BS EIRP and a BS density limit based on the lowest density provided by WP5D. The average density of base stations operating in the territory of any administration, in any bandwidth of 100 MHz, not to exceed 0.0037 base stations per square kilometre. The constraint on IMT base stations that GSOA proposes is given below.

Vertical angle measurement window $\theta_L \leq \theta < \theta_H$ (vertical angle θ above horizon)	**Approach 1**
	Average e.i.r.p. limit (dBm/MHz) (Highest BS density level) **(NOTE 1,2, 3)**
$0° \leq \theta < 2°$	9.3
$2° \leq \theta < 5°$	2.0
$5° \leq \theta < 10°$	-0.7
$10° \leq \theta < 15°$	-4.3
$15° \leq \theta < 20°$	-6.4
$20° \leq \theta < 25°$	-8.4
$25° \leq \theta < 30°$	-10.1
$30° \leq \theta < 40°$	-11.8
$40° \leq \theta < 50°$	-14.2
$50° \leq \theta < 60°$	-16.5
$60° \leq \theta < 70°$	-18.6
$70° \leq \theta < 80°$	-21.3

	$80° \leq \theta \leq 90°$ | -23.4

NOTE 1**:** For this provision, the average e.i.r.p. is defined as the mean value of the e.i.r.p., with the averaging being performed:

– over horizontal angles between –180° to +180°, and the IMT base station beamforming in a specific direction within its steering range,

– over different beamforming directions within the IMT base station steering range, and

– over the specified vertical angle measurement window $\theta_L \leq \theta < \theta_H$.

NOTE 2: An IMT base station must comply with the specified limits on expected e.i.r.p. for all mechanical tilts with which it can be deployed.

NOTE 3: Testing for compliance shall be carried out with the following configurations:

- Base station transmitting with maximum power with all resource blocks occupied
- Base station e.i.r.p measured as the sum of both polarisations
- These limits shall be met for all base station antenna beams within the following vertical and horizontal scanning angles:
  - Suburban: horizontal scanning angle set to $\pm 65^0$ and vertical scanning angle set to 0^0 to -10^0
  - Urban: horizontal scanning angle set to $\pm 65^0$ and vertical scanning angle set to 0^0 to -30^0
- Beam scanning shall be done with evenly distributed angles within the above vertical and horizontal scanning ranges

If multiple beams may be formed simultaneously, testing shall be based on the worst case beam configuration.

Question 9(b): What are your views on the initial analysis we have conducted around hybrid sharing and coexistence with incumbents?	Regarding the initial analysis of Wi-Fi sharing with FSS receivers that Ofcom has conducted, GSOA concurs that coexistence may be feasible with low power indoor Wi-Fi. Regarding the Ofcom study to consider sharing between higher power licensed mobile and FSS satellite uplinks in the upper 6 GHz band, GSOA's view is that the study shows there is interference into FSS which exceeds the satellite protection criteria. The level of exceedance depends on the IMT base station density considered, i.e. D1 (a lower density) and D2 (a higher density). Figure 8 of the consultation document shows that with the higher base station density, interference exceeds the criterion for most elevation angles. In section 5.12 of the consultation document, Ofcom notes "*there is activity underway internationally to agree on base station antenna emission limits at elevations above the horizon, as a mitigation mechanism to ensure coexistence in case higher densities of base stations are deployed. If agreed internationally, it is likely that we will implement these or similar restrictions in the UK, if we were to enable high power licensed mobile in the upper 6 GHz band.*" GSOA understands this to be Ofcom's engagement in the development of IMT base station antenna emission limits at elevations above the horizon to be adopted in CEPT as an ECP for the upcoming WRC-23. In this engagement, Ofcom has made a number of revisions to the study previously provided to WP5D, and made a

number of assumptions, selected parameters, and scenarios, many of which are favourable to IMT and hence underestimate the interference risks.

GSOA would like to highlight the main concerns that we have regarding Ofcom's assumptions, parameters, and scenarios in the development of base station antenna emission limits. GSOA summarises its main concerns with the latest Ofcom study:

1. Ofcom is only considering the use of global beams in the FSS, which are less sensitive to interference than regional or spot beams. The rationale for this is that Ofcom's responsibility is only to protect FSS and it is up to other administrations to advocate for protection of any other more sensitive satellites. We disagree, considering that all administrations have a responsibility to provide adequate protection to current and planned satellite systems, irrespective of whether the systems are filed through the UK.
2. Ofcom's analysis only considered the least sensitive carrier parameters agreed in the ITU-R, while there are other more sensitive carrier parameters.
3. Ofcom, in its study, states that the assumptions, parameters, and scenarios are based on a realistic situation, and yet, the Ofcom study assumes IMT deployment only in ITU Region 1, excluding other regions such as Region 3. GSOA strongly believe that deployment in Region 3 should also be considered, especially as China became the first country in the world to identify the upper 6 GHz (6425-7025 MHz) for IMT in a revised version of its radio regulations which came into effect on 1 July 2023[1]. Also, other countries in Region 3 have expressed interest in IMT identification at the recent APG meeting, these are: *China, Bangladesh, Cambodia, Japan, Lao, Maldives, Myanmar, Pakistan, Philippines, Sri Lanka and Singapore.* Excluding R3 countries from IMT deployment is not realistic because even if the band is identified for IMT only in Region 1, there will be nothing to prevent Region 3 countries from deploying IMT when the equipment is available.
4. Ofcom is proposing Hybrid sharing (enabling both licensed mobile and Wi-Fi users to access the upper 6 GHz band). Some other countries have already decided to make this band available to Wi-Fi systems and some others to make this band available to IMT systems. When considering interference into FSS satellite receivers, the interference from both IMT and Wi-Fi, as well as other terrestrial services deployed globally should be considered. However, the Ofcom study makes no allowance for interference from Wi-Fi or the FS. Effectively this means that Ofcom considers that the upper 6 GHz band will be left empty in

[1] China first in the world to set upper 6 GHz band aside for 5G and 6G - PolicyTracker:

	other countries and areas where IMT is not deployed. This is not realistic. If IMT is not deployed in some countries, some other terrestrial technology will be deployed, which will contribute to the aggregate interference received. 5. Ofcom has adopted an antenna efficiency factor for the satellite antenna pattern, i.e., reduce the antenna gain pattern based on an assumed efficiency (e.g., if the efficiency of the antenna is 63%, reduce the pattern by 2dB). This is simply technically incorrect, since the antenna efficiency is already accounted for in the pattern, whether it is a measured pattern or based on an ITU Recommendation. 6. Ofcom has also adopted a Total Integrated Gain (TIG) factor, based on calculating the TIG of the antenna pattern (e.g. an ITU Recommendation) and reducing the antenna radiation pattern by 10log(TIG), on the assumption that the gain must integrate to 1. This is also technically incorrect. While it is of course true that the TIG cannot be >1, this doesn't affect the pattern close to the main lobe. In this region, the pattern is very close to the envelope pattern. Hence, a TIG factor is not applicable to a global beam. Based on the above 6 factors, GSOA considers that Ofcom's analysis has significantly underestimated the interference from licensed mobile systems to existing and planned FSS operations. Much more stringent power limits on IMT will be required than those currently proposed by Ofcom in the CEPT discussions.
Question 9(c): For any incumbent uses that you view as unlikely to be able to coexist, what alternatives are there? What are the barriers that might prevent those alternatives?	GSOA's study based on parameters, assumptions and scenarios provided by WP5D, show that there would be excessive interference from IMT deployment into FSS satellite receivers. Given the constraints required on IMT stations to ensure protection of FSS satellite receivers, GSOA's view is that it is unlikely for IMT to be able to coexist with FSS satellite receivers. On the other hand, Wi-Fi is shown to be able to coexist with incumbents, as confirmed by Ofcom's initial analysis. GSOA considers the band could be shared between FSS, Fixed Service and Wi-Fi. Any need for additional spectrum for licensed mobile systems can be accommodated through densification in existing mobile bands and through use of the mmWave bands, which remain largely unused.
Question 10: Do you have any other thoughts that you would like to share about hybrid sharing in the upper 6 GHz band, or about hybrid sharing more generally and its potential for applications in other bands?	Irrespective of the approach to sharing between WiFi and mobile, GSOA emphasizes the importance of appropriate protection measures for satellite use in the band.

Question 11: Do you have any other comments to make on these proposals or on the future use of the upper 6 GHz band?	In order to ensure the continued operation of the FSS service, the future use of the upper 6 GHz band should not include deployment of IMT stations. As evidence of the potential impact, there are real world examples where IMT base stations have caused interference to satellite receivers in other bands which have been reported to ITU: • India MSS satellite in 2.6 GHz band, approx. 3.5 dB degradation in 2019 where the signal analysis shows signature of LTE signal. • Inmarsat MSS satellite serving Europe in 2 GHz MSS band received interference from mobile base stations deployed in northern Europe – IMT equipment used for broadband access, interference experienced is many dBs above noise. In both cases, because of the level of interference, part of the satellite transponder cannot be used. Even though the ITU has been formally informed of the issue, this process has been largely ineffective to resolve the interference issue, once interference occurs. Therefore, given that that it is not feasible for IMT stations to coexist with incumbent FSS users, GSOA urges Ofcom and other administrations to consider other terrestrial technologies for this band, such as Wi-Fi, that are better suited to sharing with FSS.

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