Introduction	Microsoft Corporation ('Microsoft') commends Ofcom for its call for public input on *UK preparations for the World Radiocommunication Conference 2023 (WRC-23)* and welcomes the opportunity to provide comments on this important subject. Microsoft's spectrum interests are complex and do not fall neatly into one category. Microsoft's cloud ingests data transmitted over various wireline and wireless technologies. Examples of wireline technologies are optical fibre, coaxial cable, and copper (still). With respect to wireless technologies, our cloud ingests data transmitted from mobile devices, nomadic devices (license-exempt devices connected wirelessly to a fixed access point), and fixed (satellite and terrestrial) wireless devices. Through Microsoft's Azure for Operators and Azure private Multi-Access Edge Compute (MEC) programs, we support 5G public and private (vertical) networks in certain frequency bands. Through Azure Orbital and Azure Space initiative, we support spectrum for Fixed Satellite Service, Earth Exploration Satellite Service, and Inter-Satellite Service in other frequency bands. And for the past two decades, based on how individual consumer and enterprise end user devices connect to our online services, Microsoft has been a strong advocate for license-exempt spectrum. Virtually all laptops and tablets include license-exempt Wi-Fi radios. With respect to mobile phones, virtually all include license-exempt radios, in addition to cellular radios operating in licensed frequency bands. A considerable amount of mobile data is offloaded over license-exempt spectrum rather than over licensed spectrum. We see IEEE 802.11 / Wi-Fi certified - and

	3GPP -based technologies as serving complementary roles, particularly in the enterprise.[1] Based on Wi-Fi industry studies, there is a clear need for additional license- exempt spectrum for Wireless Access Systems / Radio Local Area Networks (WAS/RLANs), of which Wi-Fi is an example. The only spectrum band globally that can meet the requirements for the next generation of Wi-Fi, Wi-Fi 7, is the full 6 GHz band (5 925-7 125 MHz). Thus, Microsoft's priority at WRC-23 is a "no change" for AI 1.2 with respect to the 6 425 – 7 025 MHz band in Region 1 and "no change" for 7 025 -7 125 MHz band in all three regions. We are also encouraging individual administrations in Region 1 to adopt rules permitting operation of license-exempt low-power indoor devices and very low power indoor/outdoor devices across the entire 6 425 to 7 125 MHz range under rules similar to those adopted by the EU for the 5 925-6 425 MHz band.

[1] Monica Paolini, "5G and Wi-Fi 6: Stronger together Two parallel paths to connect everybody and everything", Senza Fili Tech Brief, (September 2021). 5G and Wi-Fi 6: Stronger together (linkedin.com)

Your response

Question	Your response
Question 1: Do you agree with the prioritisation of the agenda items, as shown in Annex 5, and if not why?	Microsoft agrees with Ofcom that the high priority WRC-23 agenda items for the UK will be AI 1.1, AI 1.2, and AI 1.5.
Question 2: What are your views on the continued need to protect global aeronautical and maritime services, in the 4.8 – 4.99 GHz band, under this agenda item?	N/A
Question 3a: Do you agree that the UK interest in the bands 3 600-3 800 MHz and 3 300-3 400 MHz in Region 2 (North & South Americas) should be limited to any impacts on UK operational use in those areas?	Microsoft agrees with Ofcom that with respect to WRC-23 agenda items, the UK interests in the bands 3 600 - 3 800 MHz and 3 300 – 3 400 MHz in Region 2 should be limited to any impacts on UK operational use in those areas. As Ofcom is no doubt aware, there is an effort underway within the United States government to determine the feasibility of 5G operations sharing spectrum in the 3 100 – 3 450 MHz band with incumbent government users.
Question 3b: Do you agree that the UK should maintain its objections to changes to the regulatory environment for the band 3300-3400 MHz (in Region 1, Europe, Africa, Middle East), noting UK has interests in use of radar for both ground and airborne operations?	Microsoft recognizes that the 3 300-3 400 MHz band is used by NATO and that the UK has interests in use of radar for both ground and airborne operations. At the same time, as described above, there is an effort underway by a NATO country, the United States, to examine whether commercial 5G services can share the band with government (military) users. Ideally, the UK can keep an open mind on the potential of sharing the frequency range 3 300-3 400 MHz until more information about the possibility of sharing between these categories of users becomes available.

Question 3c: What is your view on the use of 6425-7025 & 7025-7125 MHz, and what evidence do you have to support this view? How does that inform your views on a IMT identification in these bands?	Microsoft recommends that the UK takes a 'no change' position with respect to the potential identification of the 6 425-7 125 MHz frequency band for IMT. Further, Microsoft recommends Ofcom initiate steps to make the entire 1200 MHz of the 6 GHz band (5 925-7 125 MHz) available for license-exempt use. Reasons that Ofcom should advance rules allowing license-exempt use across the entire 6 GHz band include: (1) <u>License-Exempt use across the entire 6 GHz band complements the Government's 2030 target for gigabit broadband to be available nationwide by preventing indoor capacity bottlenecks</u> Gigabit-capable broadband can be delivered to a structure by a range of technologies, including full-fibre connections and high-speed cable broadband. One of the things we collectively learned from working and learning from home during COVID is that it is not only the broadband speed to the structure (or network termination point) that matters, but also the speed from the internet connection to the multiple broadband devices operating indoors at the same time. This connection, usually over a handful of meters, is almost always over Wi-Fi. Sufficient indoor capacity is required to avoid bottlenecks and allow residents to fully take advantage of the UK's efforts to facilitate gigabit broadband capacity to every household. Even if 1 Gbps download speed becomes available to every UK household, it doesn't mean 1 Gbps will be available to each resident's user device operating indoors at a given moment if there is insufficient Wi-Fi capacity indoors. Thus, it is important for Ofcom to consider in tandem policies and actions that facilitate high-speed broadband to residences and high-speed broadband distributed to the devices within residences.

(2) Heightening Competition Between Broadband Access Technologies

For consumers, regardless of the broadband access and backhaul technologies used – fiber, coax cable, satellite, fixed wireless – adding a Wi-Fi radio at the end of the network results in a globally harmonized, high-bandwidth, more-energy efficient connection to a myriad of end user client devices. Any broadband access technology can connect to client devices over the last 10 meters using a high-bandwidth Wi-Fi connection. This includes mobile phones offloading data over an indoor Wi-Fi connection. With broadband providers using different access technologies, Wi-Fi allows for compatibility with most all end user devices and supports competition between and among different broadband providers.

In rural areas, Wi-Fi in combination with satellite and fixed wireless technologies can provide broadband in locations where it is too expensive to deploy optical fibre at the present time.

(3) Enabling Wi-Fi Channel Diversity Indoors Within Enterprises and High-Density Venues

All 1200 megahertz of the 6 GHz band needs to be made license-exempt to ensure that there is sufficient Wi-Fi channel diversity in enterprises and high-density deployments so that each device can operate at the IEEE 802.11 ax channel bandwidth limit – which is 160 MHz channels. If only 500 MHz is available (5 925-6 425 MHz), the frequency re-use pattern of a Wi-Fi network with seven cells will only allow each device to have a unique 40 MHz of spectrum. The seven cell Wi-Fi frequency reuse pattern is modeled after the seven-cell reuse pattern utilized in cellular macro cell deployments. Having only 500 MHz available for Wi-Fi will shortchange UK industries and place it at a competitive disadvantage with other parts of the world that are already using the entire 1200 MHz band for Wi-Fi.

(4) The Next Generation, Wi-Fi 7, is Based on 320 MHz Channels and Requires all 1200 MHz

While Wi-Fi 6 and Wi-Fi 6E standards allows for multiple 80 MHz and 160 MHz channels, the next generation of IEEE 802.11 technology under development for Wi-Fi 7 (IEEE 802.11be), will require the availability of the entire 5 925-7 125 MHz band to provide multiple 160 MHz and 320 MHz-wide channels.

The 500 megahertz of spectrum available for Wi-Fi in the 5 925-6 426 MHz band today will support only one 320 MHz channel and three 160 MHz channels. The availability of only one 320 MHz channel limits the future potential of Wi-Fi as there are no other spectrum bands that are suitable for larger-bandwidth license-exempt indoor Wi-Fi applications (e.g., can penetrate at least one interior wall).

(5) Wi-Fi spectrum in the 6 425-7 125 MHz band could benefit UK residents and UK businesses as soon as late 2024.

Today, there are a number of license-exempt low power indoor access points, subordinate devices (e.g., Wi-Fi 6E enabled TV receivers), and client devices certified in other parts of the world whose operations can span the entire 5 925-7 125 MHz band. As license- exempt operations, Wi-Fi devices must protect both fixed service and fixed satellite service operations in the 6 425-7 125 MHz band. This means that if the UK adopt rules similar to those adopted for the 5 925-6 425 MHz range based on the work underway in ECC project team SE-45, residents and enterprise users could benefit from this additional Wi-Fi capacity in the near term.

Alternatively, if the 6 425-7 125 MHz band is identified for IMT at WRC-23, it would eliminate the flexibility of UK regulators for making the 6 425-7 125 MHz range available for license-exempt use at a later time. An IMT identification sends a strong signal to

	national regulators that the band should be LICENSED and that the bands' incumbents need to be relocated to other spectrum bands. In the case of the 6 425-7 125 MHz band, if the band is auctioned for IMT, it will require fixed service, fixed satellite service, and other users of the band to be relocated. Beyond the disruption to these operations, it typically takes years for the national regulations and resulting actions to fully clear a band. It is not likely that 6 425-7 125 MHz would be available for IMT until around 2030. Presumably, 5G will be fully deployed by then and the world will be awaiting the rollout of 6G services. The use cases and corresponding spectrum needs for future 6G services are in a nascent stage. A 'no change' decision for the 6 425-7 125 MHz band in Region 1 supports UK broadband objectives. A decision to identify 6 425-7 125 MHz for IMT will effectively foreclose the possibility of 1200 MHz for Wi- Fi in the 6 GHz band. The notion that high- power IMT systems operating outdoors in the 6 425-7 125 MHz band can co-exist with low-power Wi-Fi systems operating indoors and very low power devices operating both indoors and outdoors is wishful thinking. WAS/RLAN devices are designed to share (co-channel) spectrum and employ a number of mechanisms and 'politeness' protocols for this purpose. 3GPP-based devices are not designed to share with WAS/RLAN devices on a co-channel basis. At the EIRP levels under consideration for 5G operations in the 6 425-7 125 MHz band, if 5G and Wi-Fi 6E (and future Wi-Fi 7) devices are operating co-channel in the same vicinity, the performance of the low power indoor Wi-Fi devices will be degraded. The same would hold true for very low power for Wi-Fi devices that are intended to operate both indoors and outdoors. While both 5G IMT and WAS/RAN devices are applications of the mobile service under the ITU Radio Regulations, at the national level,

	spectrum for 5G is licensed and WAS/RANs devices (e.g., Wi-Fi) are not (as licensing is a national matter). We are not aware of administrations where there are rules in place requiring licensed services to share spectrum with license-exempt devices, where the license-exempt devices are afforded any measure of protection.

Question 3d: What are your thoughts on the current UK view that IMT should not be identified in Region 2 in the band 10-10.5 GHz in order to ensure the protection of the globally operating EESS (active) systems and airborne & vessel mounted radars?	Microsoft believes that similar to the 3 300 - 3 400 MHz band, the UK should keep an open mind in regard to an IMT identification of the 10.0 -10.5 GHz band in Region 2. The 10 GHz band is not a NATO band, and other spectrum bands are shared between military and non-military users successfully. For example, the 5 250-5 350 MHz and 5 470-5 725 MHz bands require Dynamic Frequency Selection to protect military radars from receiving harmful interference from WAS/RLANs. Microsoft understands that there are earth monitoring satellites that are planned for the 10.0-10.4 GHz band (European Synthetic Aperture Radar - ESAP) and 10.6-10.7 GHz band (Copernicus Imaging Microwave Radiometer – CIMR). With respect to protecting CIMR, technical conditions can be placed on the IMT in the adjacent band. Maybe it is possible at this stage to explore whether ESAP can be located to another spectrum band
Question 4: Do you agree that, where no additional technical limitations are placed on mobile services, the UK can support an upgrading of the mobile allocation, in 3600 - 3800 MHz, from secondary to primary?	N/A
Question 5: What are your views on the development of regulatory conditions to facilitate deployment of high altitude IMT base stations in IMT identified bands below 2.7 GHz?	N/A
Question 6: Do you agree that a formal modification to the Radio Regulations is not needed for fixed service applications that use IMT technologies?	Microsoft agrees that a formal modification to the Radio Regulations is not needed for fixed service applications that use IMT technologies. The ITU-R has already established a framework in which IMT and other mobile technologies can be used to provide fixed wireless access, including broadband access, in frequencies allocated to the fixed service on a primary basis.

Question 7: What are you views on the proposed approach for 470-694 MHz, recognising the national decisions already in place and taken for DTT multiplex licensing in the band, and the additional and supplementary spectrum made available for UK PMSE usage?	Microsoft has long been a proponent of using license-exempt technologies in the TV White Spaces (TVWS) as one tool to help close the digital divide in unserved and underserved areas. TVWS by any other name is broadband over Fixed Wireless Access (FWA). Within administrations, TVWS regulations typically tie back to RR 4.4. TVWS radios have typically used the IEEE 802.22 standard or a variation of the IEEE 802.11 standard. Other radio access technology standards could also be used. Several years ago, Microsoft Research, located in Cambridge, conducted a demonstration project in the community (with Ofcom's approval) where it deployed license-exempt personal portable TVWS devices using 700 MHz IMT base stations borrowed from a U.S. mobile network operator that also had UK spectrum holdings. The personal / portable TVWS devices communicated with the base station using the 4G standard. From a technical standpoint, we can envision 5G systems providing FWA in the TVWS in unserved and underserved areas in the UK (and other parts of Region 1). The challenge we see in Region 1 is that there is no allocation for either the fixed or mobile service in the broadcast TV band. Therefore, our position is somewhat tangential to the question at hand. For our interests, we believe that a mobile allocation on a secondary basis would allow 5G FWA to operate in the broadband TV bands, while protecting incumbent broadcast services.
Question 8: What are your views on the need to establish an international regulatory environment that provides adequate protection of UK fixed links from earth stations in motion, in the band 12.75 – 13.25 GHz, which is also practicable from an enforcement/implementation perspective?	N/A

Question 9: Do you agree that the UK continues to support the maritime distance figure for ESIMs that work to non-geostationary satellites and to test the other conditions agreed at WRC-19 for ESIMs working to geostationary satellites to ascertain whether these remain appropriate for non-geostationary satellites?	N/A
Question 10: What are your views on whether an allocation to inter satellite links is necessary for existing satellite allocated bands and whether this would provide benefits internationally?	N/A
Question 11: What are your views on the need for additional satellite allocations in support of narrowband IoT "M2M" type applications, noting that there remains the continued use of PMSE for wireless cameras in the band 2010 – 2025 MHz?	N/A
Question 12: What are your views on the proposed approach to this agenda item concerning the fixed satellite service in 17.3-17.7 GHz in Region 2?	N/A
Question 13a: On Topic B, what are your views on the post milestone procedures for non-geostationary satellite systems?	N/A
Question 13b: On Topic L, what are your views on regulatory conditions for Telemetry, Tracking and Command (TT&C) for NGSO in-orbit servicing?	N/A
Question 13c: What are your views on the remaining topics currently listed for Agenda Item 7?	N/A

Question 14: Noting that any UK position will be developed only after the ITU Plenipotentiary Conference, do you have any comments relating to the use of Article 48 that may be addressed at WRC-23?	N/A
Question 15: What are your views on the need to establish an international regulatory environment for sub-orbital vehicles, which at the same time does not limit flexibility of spectrum options, and retains international safety considerations?	N/A
Question 16: Do agree that where the adjacent band compatibility issues are	N/A
addressed and ICAO coordination processes are not compromised, that the addition of an aeronautical satellite (AMS(R)S) allocation to the band can be supported?	
Question 17: Do agree that functions related to international aviation safety are a matter for ICAO? On this basis, and absent any contrary information from ICAO, should the UK support the development of an international spectrum regulatory framework for UA use of FSS that would support efficient use of spectrum?	N/A
Question 18: Recognising the recent diminishing industry interest in this item relating to possible modification of the aeronautical HF assignment plan, and the general lack of global interest, do you agree that UK move towards a No Change proposal under this agenda item?	N/A
Question 19: What are your views on the need for additional spectrum, specifically in the 15 and 22 GHz bands, for non-safety aeronautical use?	N/A

Question 20: What are your views on Agenda Item 1.11 and the proposed UK position to support modernisation of GMDSS?	N/A
Question 21: What are your views on the approach to the review of 1240-1300 MHz, recognising that discussions concerning future satellite navigational needs for the UK are a matter for Government?	N/A
Question 22: What are your views on a new spectrum allocation in the 40-50 MHz range to support and enhance	N/A
climate monitoring, such as, environmental shifts in ice sheets?	
Question 23: What are your views on upgrading the Space Research Service allocation, from secondary to primary, in the 14.8-15.35 GHz band?	N/A
Question 24: What are your views on the potential for defragmentation in this band to facilitate both EESS (passive) use and provide for larger contiguous blocks for fixed & mobile allocations?	N/A
Question 25: Do you agree that formal international recognition for Space Weather Sensors should be implemented in the Radio Regulations?	N/A
Question 26: What are your views on the limits proposed to protect EESS (passive) under Agenda Item 9.1 topic d) and do you have any views on which of these limits might be accommodated in the Radio Regulations and how?	N/A

Question 27: Do you agree that the formalised time reference in common global use, is not a matter of spectrum regulation?	N/A
Question 28: Do you have any comments concerning the Standing Agenda Items, where not covered elsewhere in this document?	N/A
Question 29: Do you have a view on any of the footnotes to which UK is a party?	N/A
Question 30: Are you aware of any specific issues, not covered elsewhere in this document, which are likely to be raised in this part of the Director's Report	N/A
and of which you think Ofcom should be aware?	
Question 31: Do you have any comments on Agenda Item 9.3 considering Resolution 80?	N/A
Question 32: What changes to the Radio Regulations have you identified that would benefit from action at a WRC and why? Do you have any proposals regarding UK positions for future WRC agenda items or suggestions for other agenda items, needing changes to the Radio Regulations, that you would wish to see addressed by a future WRC?	N/A
Question 33: What are your views on the use of IMT stations that use antennas that consists of an array of active elements, in bands shared with satellite services?	N/A

Please complete this form in full and return to wrc-23.respond@ofcom.org.uk.