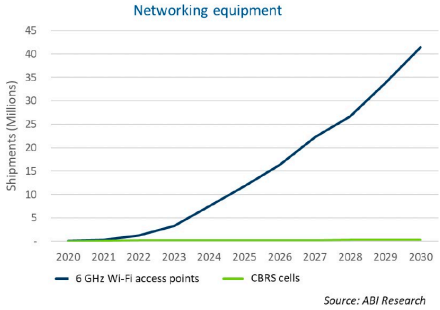
Your response

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?	*Is this response confidential? – N* Wi-Fi plays a critical role for the digital and green transition of society. Wi-Fi enables digital innovation by making high QoS connectivity available and affordable. As highlighted by Ofcom, the vast majority of internet traffic is delivered over Wi-Fi. Public stakeholders (including schools, universities, hospitals, libraries) as well as private stakeholders (commerce, offices) rely on Wi-Fi to digitise and improve their activity. Wi-Fi is also critical to digital innovation, in particular AR/VR. Innovative devices require high bandwidth, low latency, low power consumption connectivity to deliver current and innovative experiences. Wi-Fi is a key enabler of the Metaverse. Critically, the global Wi-Fi ecosystems supports the full 6 GHz band. Devices sold in the UK are currently software limited to only operate in the lower 6 GHz. Wi-Fi connectivity can be significantly improved by opening the 6425-7125 MHz band to Wi-Fi, at no additional economic or environment cost. Such measure would obviously generate significant consumer and business benefits. There is simply no alternative for the current and upcoming generations of Wi-Fi (Wi-Fi 6E, 7 and 8) to the 6 GHz band. Spectrum availability in the 6 GHz band will directly determine the performance of Wi-Fi connectivity in the UK, whereas the upper 6GHz band would only be one band among many for UK MNOs. As such, the impact of the unavailability of the upper 6 GHz would be much larger on Wi-Fi than it would be on mobile networks. Should hybrid sharing enable complementary local mobile capacity in addition to Wi-Fi, it may maximise the efficient use of spectrum. However, hybrid sharing should not unduly restrict Wi-Fi's access to the band. Wi-Fi is

	essential to maximising the societal, environmental and consumer and enterprise benefits in the band.
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?	*Is this response confidential? – N* Coleago Consulting Ltd for GSMA published in July 2021 a report on Estimating the mid-band spectrum needs in the 2025-2030 time frame, while Analysys-Mason published in June 2023 a report on Impact of additional mid-band spectrum on the carbon footprint of 5G mobile networks: the case of the upper 6GHz band. Both reports present the benefits related to opening the upper 6GHz band by focusing on dense urban areas. The Coleago report focuses on areas with population density ranging from 8000 to 31000 hab/km2, with a central focus on 15000 hab/km2, while Analysys-Mason focuses on a population density of 15000 hab/km2. The GSMA Intelligence June 2022 report on the Socioeconomic benefits of the 6GHz band is also focusing on urban areas. These reports suggest that mobile interest in the band is focused on very densely populated areas. Contribution ECC PT1(23)216r1 confirmed that the mobile industry expects outdoor to indoor loss of 26dB on average.
Question 2(b): Similarly, what are the priorities from the point of view of Wi-Fi deployments?	*Is this response confidential? – N* Wi-Fi spectrum requirements are also highest in densely populated areas. Wi-Fi Low Power Indoor (LPI) deployments in offices, universities or other large venues (e.g. Stadium) require a number of channels to provide consistent connectivity QoS. Per definition, Wi-Fi LPI requires access to spectrum indoor. Wi-Fi Very Low Power (VLP) delivers personal area connectivity. Wi-Fi VLP is particularly relevant for innovative applications such as AR/VR. The spectrum requirement for Wi-Fi VLP is also highest in densely populated areas, since VLP delivers personal area connectivity.
Question 3: What are your views on a modified AFC or SAS-type approach to enable hybrid	*Is this response confidential? – N*

sharing? What additional work do you think would be required?	Databases such as AFC and SAS can be a powerful tools to coordinate professional deployments, optimising the use of spectrum between such users. However, database approaches also trigger additional implementation costs including geolocation and service fees. Database mechanisms are justifiable for enterprise, professional and service providers' deployments but are not viable for mass market products. Senza Fili published in 2022 a paper on Sharing Access to the 6GHz band. CBRS is undeniably a successful implementation of database approaches, but nevertheless pales in comparison with licence exempt when it comes to enabling mass market scale, as illustrated in the Figure below extracted from the Senza Fili paper.  A database approach is especially not appropriate for AR/VR devices which may or may not have geolocation capabilities, face significant energy consumption and thermal restrictions and require low latency connectivity. Databases can enable improved spectrum use when the spectrum requirements of services are separated in geography or in time. Unfortunately, mobile and Wi-Fi spectrum requirements are highly correlated with significant overlap in both location and time. Ofcom example 1, in which London "Zone 1" would be prioritised for licensed mobile, is an excellent illustration of the significant drawbacks triggered by database for hybrid sharing. Under such a scheme, the list of stakeholders that would be prevented from deploying state of the art Wi-Fi solution in their premise include: • the Palace of Westminster, • 10 Downing Street, • the University of London,

	• the London School of Economics, • King's College, • the BBC Broadcasting House, • the entire city of London, • Ofcom's headquarters, • Meta's London offices (and others' offices). Beyond these examples, prioritising mobile access in London's "Zone 1" would also significantly restrict the access to the next generation immersive applications in London, as AR/VR headset would function sub-optimally due to the restriction in spectrum access. London's "Zone 1" is one of the geographical areas where the Wi-Fi spectrum demand in the UK is the highest, demonstrating that geographical separation is not a viable hybrid sharing approach. Meta recommends Ofcom to limit the consideration of database approaches to professional Wi-Fi deployments requiring protection from mobile networks.
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?	*Is this response confidential? – N* Wi-Fi and 5G NR-U already implement Listen-Before-Talk (LBT) mechanisms which enable spectrum sharing and efficient use of spectrum. Contribution ECC PT1(23)196r1 demonstrates that LBT would prevent RLAN located in very close proximity to 5G Base Stations from interfering such stations. However, such mechanisms would *also* prevent Wi-Fi from operating in the band should mobile networks be deployed at *high power*. *Reducing the maximum power* of mobile base station in combination with LBT features of Wi-Fi can enable hybrid sharing for Wi-Fi VLP, LPI and mobile networks. While such mechanism would not completely remove all cases of interference, they are likely to enable additional capacity for all systems. Considerations of additional or modified sensing mechanisms should be carefully assessed. The potential consumer and

	enterprise benefits in the 6GHz band are due to the broad availability and vast scale of the global Wi-Fi ecosystem. New sensing requirements would trigger delays and additional costs, leading to substantial loss of consumer and enterprise benefits. Ofcom should ensure that the benefits linked to additional sensing requirement are not dwarfed by the drawbacks of delayed availability of services and increased cost for consumers.
Question 5: What mechanisms could potentially enable device-to-device connectivity?	*Is this response confidential? – N* Device-to-device connectivity is critical to digital innovation, in particular to AR/VR. There is significant investment by industry to develop wearable AR devices that could potentially become the new foundation for human computer interaction. These AR/VR headsets are designed to be wearable all day long, may not support geolocation capabilities, and may not always be connected to the internet. As such, indoor requirement would be impractical for VLP devices. The benefits of 6GHz for AR/VR VLP devices is due to the availability of very wide channels, including 80 and 160 MHz channels, for latency sensitive high bandwidth and power constrained connectivity. The 5 GHz band does not provide an alternative to the 6 GHz band for VLP due to the limits in the support of wide channels. Leveraging the Wi-Fi sensing mechanism – in particular LBT – may provide adequate protection for mobile terminals and base stations, when taking into account that VLP devices operate at significantly lower power than mobile devices.
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?	*Is this response confidential? – N* Mobile networks could leverage 6 GHz medium power base stations for additional outdoor capacity in areas where the 3.4-3.8 GHz cells become congested.

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?	*Is this response confidential? – N* Splitting the band will drastically degrade the consumer and enterprise benefits. Both mobile and Wi-Fi devices can support the full 6 GHz band. Artificially restricting such devices to half of the bandwidth they can support would reduce the consumer benefits while the price of device and the associated environmental cost remain whole. For consumers and enterprise, it would mean paying full price for sub-performing devices. Massive MIMO is unlikely to provide significant benefits due to two reasons. The physical constraints on the size of antenna limit the beamwidth of AAS antennas in the 6GHz band. In mid-bands, a beam would typically be 20 to 30 degrees wide, triggering interference to a significant area. Furthermore, the interference reduction would reduce as the number of users increases, spreading the total power of the base station over the whole cell. The most promising hybrid sharing approach would be to limit the power of IMT deployment combined with leveraging the existing LBT features of Wi-Fi. This would enable immediate benefits as existing devices could be leveraged, maximising the benefits to consumers. More advanced sharing mechanisms may be considered over time for professional users.
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?	*Is this response confidential? – N* Allowing medium power IMT deployment is the most effective mechanism to enable indoor use for Wi-Fi and outdoor use for mobile. While LBT would not guarantee absence of interference, it significantly reduces the interference from RLAN to mobile networks. Absence of interference is not likely to be achieved under Hybrid Sharing. Avoiding interference requires severely restricting spectrum usage (i.e. geographical separation) or severely increasing the cost of technology (advanced synchronised systems). Adopting interference free operation as a pre-requisite

	leads to significant drawbacks in terms of consumer and enterprise benefits. Wi-Fi does not operate under the assumption of interference free operation. Nevertheless, Wi-Fi is the main internet connectivity mean, delivering both high quality of service, lower cost and lower power consumption. Hybrid Sharing is unlikely to be successful under the pre-supposition that Hybrid Sharing would deliver interference free operation. Hybrid sharing should balance additional spectrum access, additional interference and additional cost to devices, to deliver the optimal benefits to consumer and enterprises.
Question 8(b): Could there be a combination of technical adjustments such as power limits and other mechanisms (including databases or sensing mechanisms)?	*Is this response confidential? – N* A combination of reduced 5G Base Station power, LBT for LPI and VLP Wi-Fi and database approach for professional Wi-Fi deployments, is likely to bring the most benefits to consumers and enterprises. Contribution ECC PT1(23)196r1 suggests that IMT Base Station power should be reduced by 15 to 20 dB compared with ITU studies assumptions (Annex 4.4 to Document 5D/716).
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?	*Is this response confidential? – N* Coexistence of incumbent services with Wi-Fi LPI and VLP is obviously orders of magnitude easier than coexistence with mobile networks transmitting outdoor at much high EIRP above rooftop. Reducing the maximum power allowed for mobile networks by 15 to 20 dB not only enables hybrid sharing, it will also enable incumbent services such as point-to-point Fixed Services (FS) and Satellite Uplink (FSS) to maintain operation in the band.
Question 9(b): What are your views on the initial analysis we have conducted around hybrid sharing and coexistence with incumbents?	*Is this response confidential? – N* Ofcom's analysis of the interference from mobile networks to FSS assumes that the 6GHz upper band would be used for complementary 5G capacity. However, should the band be

	considered as a priority band for 6G services, it would require all incumbent services to vacate the band and would remove any opportunity for Wi-Fi to access the spectrum. International activity performed technical studies corresponding to a complementary and geographically limited 5G deployment. Yet, some stakeholders advocate for the band to be considered as the priority 6G band in Europe. Hybrid sharing is not possible with high power IMT base stations. Ofcom's support to higher mobile network power in international discussions directly promotes exclusive use of the band for mobile networks (as opposed to hybrid sharing) and band clearing of incumbent services. Should Ofcom decide to promote hybrid sharing, it should consequentially promote medium power mobile network regulation in the upper 6 GHz band.
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?	*Is this response confidential? – N*
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?	*Is this response confidential? – N* Hybrid sharing can provide benefits to consumer and enterprise if Ofcom defines a regulatory framework focusing on these objectives. One of the most critical objective for Ofcom should be to increase consumers welfare in the foreseeable future. Wi-Fi LPI and VLP WI-Fi 6E devices benefit from a global ecosystem, but UK citizens only get a fraction of their capacity due to their restricted operation in the lower 6 GHz band. Opening the upper 6 GHz band to global Wi-Fi LPI and VLP 6E devices would deliver significant connectivity benefits to UK consumers and enterprises, at no additional economic or environmental cost. Hybrid sharing should prioritise the opening of the upper 6 GHz band to VLP and LPI Wi-Fi 6E devices.

Question 11: Do you have any other comments to make on these proposals or on the future use of the upper 6 GHz band?	*Is this response confidential? – N* Wi-Fi is by far the dominant wireless technology for UK consumers to access the internet. Wi-Fi is the technology offering the most promise for digital innovation. Wi-Fi is the dominant technology for enterprises and the digital transformation of the UK economy. While UK consumers can already buy Wi-Fi 6E devices, they only benefit from a fraction of the benefits that such devices can deliver, due to the regulatory restriction to a fraction of the spectrum band that the devices can support. This directly triggers significant consumers drawbacks, both from an economic and environmental perspective. Hybrid sharing has the potential to bring additional benefits compared to opening the upper 6 GHz band exclusively to Wi-Fi. However, it will only generate benefits if it does not result in significant delays in the opening of the upper 6GHz band to Wi-Fi LPI and VLP devices.

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