Response of Cisco Systems, Inc. to Ofcom's Consultation Document

Hybrid sharing: enabling both licensed mobile and Wi-Fi users to access the upper 6 GHz band

15 September 2023

This response contains no confidential information.

Introduction

Cisco Systems, Inc. (Cisco) is a San Jose, California, U.S.A. based company that is the leading provider of IP-based networking technologies in the world. Cisco has a significant UK presence, with approximately 3,500 in-country sales, service, and research and development staff working with thousands of enterprise customers and partners. Our company is a major vendor of telecommunications equipment and services to Mobile Network Operator (MNO) customers in the UK and around the world and has made significant investments in various UK Government-backed 5G projects over the past few years. Cisco is also the leading vendor of enterprise-grade Wi-Fi in the world.

As a vendor to both MNOs and enterprise Wi-Fi users, Cisco applauds Ofcom's holistic approach to spectrum policy. In the last 20 years, wireless communications have become an essential part of every aspect of daily life. That importance is only expected to grow over the next decade. As the consultation notes, however, increasing demand for wireless communications has created corresponding challenges in identifying appropriate spectrum to achieve national wireless objectives. That process inevitably results in hard choices regarding the best use of any given band.

One such disputed spectrum band is the upper 6 GHz band (6425-7125 MHz). In a recent consultation,[1] Ofcom properly determined that a "no change" position regarding a possible identification of the band for International Mobile Telecommunications (IMT) at this year's World Radiocommunication Conference (WRC-23) would provide the UK with maximum flexibility in its choices for the band going forward. Cisco strongly supports Ofcom's decision because, while IMT (hereinafter referred to as "mobile") services may require more spectrum at some point, licence-exempt operations need access to the upper 6 GHz band now. Licence-exempt technologies like Wi-Fi are vital to the UK's economic and social success but existing spectrum resources are insufficient to meet the growing demand for Wi-Fi-based applications and advanced use cases.

Cisco supports Ofcom's consideration of the future possibility of a hybrid approach to the upper 6 GHz band. But we encourage the agency to begin its analysis by assessing the need for such a solution, taking account of the potential costs and benefits of any intra-sharing arrangement between mobile and licence-exempt WAS(RLAN) use, as well as any associated costs to existing incumbent operations. As the consultation recognizes, achieving mobile operations in the upper 6 GHz band on either a shared or exclusive basis will likely prove a significant challenge. While a coexistence arrangement may be possible, it may be of limited utility for mobile operations because of the restrictions necessary to protect licence-exempt and incumbent service operations.

These challenges should not rule out consideration of a hybrid approach, but while it analyses these complicated issues, Ofcom should authorize licence-exempt WAS(RLAN) use throughout the band with similar usage and technical restrictions to those already adopted for the lower 6 GHz band in the UK. This would immediately help end users and not threaten existing incumbent operations. Doing so will allow UK businesses and consumers to realize the full benefit of advanced technologies using Wi-Fi, including AR/VR, haptic technology, and 8K video. Delaying action to seek a perfect compromise between mobile and licence-exempt operations, however, will only place the UK at a disadvantage in an increasingly competitive world, as some innovative technologies and/or devices may not be made available due to a perceived lack of the spectrum necessary to achieve high Quality of Service (QoS) in congested environments.

[1] Ofcom, "Update on the Upper 6 GHz Band" at 9 (6 December 2022) ("Ofcom 6GHz Decision").

***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?*

Cisco believes that all communications technologies have a role to play in achieving our goal of securely connecting everything to make anything possible. As part of that commitment, we fully support the UK's Wireless Infrastructure Strategy, including the goal of achieving 4G coverage for 95 percent of the population and standalone 5G coverage over all populated areas by 2030.[2] Likewise, we strongly support the UK's goal of delivering gigabit broadband to 85 percent of UK households by 2025.[3] As discussed below, most of that broadband traffic will eventually travel across Wi-Fi. In our view, mobile wireless and licence-exempt technologies like Wi-Fi have complementary roles in enabling digital innovation across communications service providers, enterprises, the public sector, and various verticals in the UK.

We agree with Ofcom that mobile excels in outdoor communication. More broadly, enterprises may rely on mobile networks for large coverage areas (which are often outdoors) where high-speed mobile handoffs must take place without major latency impacts, and for certain applications and prioritized communications. 5G service has also had some success delivering fixed broadband services.

But as Ofcom has recognized, the same enterprises relying on mobile networks for aspects of their operations generally rely on Wi-Fi once their data enters a building. Wi-Fi is the technology of choice for most local area, low-power broadband networks. It is relied on nearly everywhere—homes and offices, universities, hospitals, sports and entertainment venues, factories and other industrial settings—for high-speed, inexpensive indoor wireless connectivity. Wi-Fi is by far the most common form of indoor wireless connectivity. Fixed infrastructure networks deliver more than 95 percent of all European internet traffic, and over 90 percent of that traffic is relayed via Wi-Fi once it enters a building.[4]

In addition, as Ofcom also recognizes, Wi-Fi is often used to provide broadband services within a moving vehicle, and newer versions of Wi-Fi technology "may enable improved mobility or other new outdoor use cases."[5] (We further discuss the role of outdoor Wi-Fi in our response to Question 2(b) below.) With that in mind, if Ofcom seeks to pursue coexistence in the upper 6 GHz band between outdoor mobile and indoor licence-exempt operations, it must balance any potential gains against the potential loss of those outdoor licence-exempt opportunities.

***Question 2**: Hybrid sharing could mean that the upper 6 GHz band 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.*

a) 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?

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[2] *See* UK Wireless Infrastructure Strategy, Policy Paper (11 April 2023), *available at* https://www.gov.uk/government/publications/uk-wireless-infrastructure-strategy/uk-wireless-infrastructure-strategy#chapter-5--realising-the-full-benefits-of-5g-and-advanced-wireless-connectivity.

[3] Secretary of State for Levelling Up, Housing and Communities, "Levelling Up the United Kingdom" (2 February 2022), *available at* https://www.gov.uk/government/publications/levelling-up-the-united-kingdom.

[4] Dynamic Spectrum Alliance, "How Do Europeans Connect to the internet" (2022) (How Do Europeans Connect to the internet), *available at* http://dynamicspectrumalliance.org/wp-content/uploads/2022/06/DSA-WhitePaper-How-do-Europeans-connect-to-the-Internet.pdf.

[5] *See* Ofcom 6GHz Decision.

Assuming that potential interference to incumbents could be avoided, the upper 6 GHz band likely would be most useful for outdoor-to-outdoor mobile operations in congested urban areas. Because of the band's technical characteristics, transmissions in the upper 6 GHz band will most easily travel over shorter distances.[6] As a 2022 study said, "the [mobile] application of 6 GHz cells is most likely to be found in urban areas," and would be "mainly for specific congested outdoor locations in urban areas…."[7] That conclusion is consistent with statements from the wireless industry, which in 2020 described the 6 GHz band as "offer[ing] a good combination of propagation and coverage for cities."[8]

By contrast, and as the studies discussed in this consultation suggest, the upper 6 GHz band is not as well-suited for outdoor-to-indoor mobile connectivity. This is in line with other studies that conclude the 6 GHz band has less favourable propagation conditions for outdoor-to-indoor connectivity.[9] Indeed, Ofcom's analysis shows that even outdoor cell sites using the 3.4-3.8 GHz band can only provide sporadic and inefficient indoor coverage.[10]

In addition, as Ofcom suggests, mobile transmissions using the upper 6 GHz band may require higher power levels to penetrate double-paned windows without significant signal loss.[11] According to a recent study, allocating the upper 6 GHz band for exclusive mobile use would lead to 16% higher energy consumption overall, as compared to permitting Wi-Fi operations in the band.[12] As the authors state:

> This translates to an additional 2230 million kWh of energy consumption per month and based on the estimated future energy mix, an additional 3.2 megatons of CO2 emissions per year (which corresponds to 4-6% of the current CO2 emissions by the complete ICT sector in Europe).[13]

Such an outcome would presumably run counter to the UK's sustainability goals. To achieve the UK's legally binding target of Net Zero emissions by 2050, all industrial sectors, including communications,

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[6] *See e.g.,* Hana Anandira, "Deutsche Telekom Claims Record 6GHz Trial," Mobile World Live (22 Sept. 2023) ("[Deutsche Telekom] pushed 6 GHz as a likely candidate for urban deployments due to the short distances it can cover."; "Deutsche Telekom stated that the 6 GHz antenna delivered data rates of around 11 Gb/s with its 3.6 GHz around 1 GB/s over a 100 metre distance.") (emphasis added)), *available at* https://www.mobileworldlive.com/featured-content/top-three/deutsche-telekom-claims-record-6ghz-trial/ eutsche Telekom claims record 6GHz trial - Mobile World Live.

[7] LS Telecom et al., "Socio-Economic Benefits of IMT Versus RLAN in the 6425-7125 MHz band in Europe" at 17 (7 June 7 2022) (LS Telecom Study), *available at* http://dynamicspectrumalliance.org/wp-content/uploads/2022/06/DSA-Report-6425-7125-MHz-EU-Study.pdf.

[8] Coleago Consulting Ltd, "IMT spectrum demand – estimating the mid-bands spectrum needs in the 2025-2030 timeframe" at 5 (emphasis added) (14 Dec. 2020), *available at* https://www.coleago.com/app/uploads/2021/01/Demand-for-IMT-spectrum-Coleago-14-Dec-2020.pdf.

[9] *See, e,g.,* Policy Impact Partners and Dynamic Spectrum Alliance, "How to Realise the Full Potential of 6 GHz Spectrum: A White Paper," Figure 13 (September 2021), *available at* https://6ghz.info/wp-content/uploads/2022/02/6GHz-EMEA_White-Paper_Sept21-EN.pdf.

[10] Ofcom Consultation at 14-15 & Figure 2.

[11] *See* Ofcom Consultation at 14 ("Whilst it is clearly important for mobile networks to provide good indoor coverage from their outdoor base stations, the upper 6 GHz band may not be the best band for this purpose because the level of indoor coverage achieved may be relatively modest, particularly in thermally efficient buildings.").

[12] Ing Peter Koon, Ilsa Godlovitch, and Dr. Thomas Plückebaum, WIK Consult, "Sustainability Benefits of 6 GHz Spectrum Policy" at 35 (31 July 2023), *available at* https://www.wi-fi.org/system/files/SustainabilityBenefitsof6GHzSpectrumPolicy202307.pdf.

[13] *Id.*

must improve their energy efficiency.[14] Thus, before allowing outdoor-to-indoor mobile operations in the upper 6 GHz band, Ofcom should carefully consider the impact on energy usage, and by extension, climate change, that would result from such a decision.

b) Similarly, what are the priorities from the point of view of Wi-Fi deployments?

As explained above, Wi-Fi is the technology of choice for indoor wireless operations. Any failure to address the substantial growth in indoor Wi-Fi operations would have a major impact on virtually all broadband connectivity. Moreover, many businesses and consumers also rely on Wi-Fi for outdoor operations. People expect seamless Wi-Fi connections wherever they go. Thus, Wi-Fi is used outdoors in mobile vehicles (e.g., airplanes, cruise ships), often connected to mobile wireless or satellite backhaul. Wi-Fi is also frequently used for outdoor use cases like municipal Wi-Fi, campus networks, sports venues, industrial sites, and broadband service.

The US FCC recognized the importance of outdoor Wi-Fi in its rules governing the 6 GHz band by allocating more than 800 MHz of the 1200 MHz in the 6 GHz band to standard power operations, which may take place outdoors in coordination with an Automated Frequency Coordination (AFC) database. In the United States, once the FCC standard power rules for the 6 GHz band are finalized, Cisco plans to take advantage of the outdoor Wi-Fi opportunity with state-of-the-art devices and services focusing on industrial and campus Wi-Fi uses.[15] As a recent blog stated, "[s]mooth operations require reliable wireless connectivity at the factory, into the warehouse, and across loading docks and ports. Machines need reliable, high bandwidth connectivity as businesses increase automation and connect more assets like autonomous robots and AGVs [Automated Guided Vehicles]."[16]

Outdoor Wi-Fi can also help bridge the digital divide. Cisco is currently working with network engineers and students at the University of Illinois Chicago to extend campus Wi-Fi service to the surrounding majority-Latino neighbourhood, which significantly lags behind nearby communities in terms of broadband access.[17] This student-led project is taking advantage of the school's planned Wi-Fi 6 upgrade effort "to provide point-to-multipoint and point-to-point Wi-Fi mesh solutions to extend the school's backbone wireless capabilities, leveraging the location of specific buildings in the Pilsen neighborhood."[18]

***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?*

The consultation suggests that hybrid sharing could allow the upper 6 GHz band to be made available for high-volume mobile use in heavily trafficked areas, while allowing Wi-Fi to use the spectrum elsewhere,

[14] *See, e.g.*, HM Government, "Net Zero Strategy: Build Back Greener" at 78 (October 2021) (targeting industry sector carbon emissions for 63-78% reduction by 2035 from 1990 levels), *available at* https://www.gov.uk/government/publications/net-zero-strategy.

[15] *See* Vikas Butaney, "Cisco announces first outdoor Wi-Fi 6E ready access point and enhancements for industrial remote operations," (24 May 2022), *available at* https://blogs.cisco.com/internet-of-things/cisco-extends-industrial-iot-portfolio-to-bring-reliable-wireless-connectivity-and-enable-remote-operations-anywhere.

[16] *Id.*

[17] Erika Gimbel, "How University Wi-Fi Networks Better Digital Equity in Surrounding Communities," EdTech (1 September 2023), *available at* https://edtechmagazine.com/higher/article/2023/09/how-university-wi-fi-networks-better-digital-equity-surrounding-communities.

[18] *Id.*

or where mobile signals cannot reach.[19] As an initial matter, there is some evidence that high-volume mobile traffic patterns may overlap with those of other high-volume internet traffic. An April 2022 report from Three UK found that mobile usage on its network peaked in the evening during Champions League football matches, as many consumers streamed matches over their mobile data connections.[20] Relatedly, Sundays are now the busiest single day for mobile data usage on Three UK's network.[21] These are generally the same peak times as other internet traffic[22], most of which traverses Wi-Fi networks. These potential competing demands for spectrum capacity may create difficulties with sharing in urban areas, which have high levels of population density even after business hours and on weekends.

Nevertheless, we support Ofcom's inquiry into whether some form of sharing in the band may be possible.[23] In reviewing potential database requirements for licence-exempt operations, however, we encourage Ofcom to consider the potential costs of those restrictions. While licence-exempt spectrum may be used without regulatory fees, such use still has significant associated costs. Databases cost money to create, maintain and operate. Software must be written, and chipsets designed and manufactured. Moreover, once a technical solution is created, equipment manufacturers must purchase licenses and enter into other business arrangements with database administrators, among others. These costs are passed along to end users and raise the cost not only of the underlying technology but the use cases relying upon it.

With this in mind, we urge Ofcom to consider the economic efficiency of database requirements for licence-exempt operations in the upper 6 GHz band. As noted above, broadband traffic over mobile networks is a relatively small share of overall internet traffic compared with licence exempt. Ultimately, a simpler approach to coexistence may provide the most consumer benefit. For example, Ofcom might begin with authorizing licence-exempt operations – including 5G NR-U -- in the upper 6 GHz band on an indoor-only basis, then authorizing mobile operations in the band on an outdoor-only basis, with appropriate restrictions to protect incumbents and licence-exempt deployments, particularly for enterprise.

Sharing on private networks might also be worth consideration. Enterprises already construct and support their own networks using both 5G and Wi-Fi technologies.[24] Ofcom should investigate whether enterprises might operate their private networks with Wi-Fi and 5G sharing the upper 6 GHz band. Such networks have much greater awareness of client location and may be able to manage their operations

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[19] Ofcom Consultation at 17-18 ("we believe that hybrid sharing could allow MNOs to increase capacity using the upper 6 GHz band in specific busy areas, whilst also allowing Wi-Fi to use the spectrum elsewhere, or in places where upper 6 GHz spectrum deployed on MNOs outdoor sites does not reach (for example, in indoor and deep indoor locations, especially within premises built with thermally efficient materials with higher building entry losses).").

[20] *See* Three UK, "Mobile Britain 2022" (2022) *available at* https://drive.google.com/file/d/1AIwRGSFaAF2nRNxYu6KGqoKGByDjiUJc/view.

[21] *Id.*

[22] *See, e.g.,* Lisa Iscrupe, "Report: Wednesday is the best weekday for fast internet speeds," allconnect (2 May 2023), *available at* https://www.allconnect.com/blog/best-and-worst-times-to-be-online ("Worst day for download and upload speeds: Sunday"); Austin Aguirre, "Why Your Internet Slows Down at Night and How to Fix It," HighSpeedInternet.com (22 May 2023), *available at* https://www.highspeedinternet.com/resources/why-does-my-internet-slow-down-at-night.

[23] Ofcom Consultation at 27-33.

[24] It has been Cisco's experience that "[e]very opportunity, and every problem we've solved [using Private 5G], has required Wi-Fi and 5G to work hand-in-hand." James Blackman, "Just-In-Time Cisco Warns Against Private 5G Silos," RCR Wireless News (23 Mar. 2023), https://www.rcrwireless.com/20230323/private-networks/just-in-timecisco-talks-wi-fi-style-5g-and-danger-of-another-network-silo.

to use the most efficient technology for a given situation while avoiding interference to other transmissions.

***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?*

As the consultation notes,[25] coexistence protocols already exist for mobile operations and Wi-Fi. Specifically, mobile operators can utilize licence-exempt spectrum via 5G New Radio Licence exempt (5G NR-U), which is an evolution of 4G LTE License Assisted Access (LAA). Both 5G NR-U and LAA utilize the listen-before-talk (LBT) protocol to share licence-exempt spectrum with other operations like Wi-Fi.

We agree that 5G NR-U could be used with no need for modification to implement a "level playing field" between Wi-Fi and mobile in the upper 6 GHz band. That coexistence, however, must be on truly equal terms to maximize consumer benefits. If one technology becomes dominant, then coexistence will become impossible.

Most importantly, we note that the LBT protocol assumes that all competing devices operate at similar power levels. Thus, any leveraging of LBT or similar approaches to enable hybrid sharing must reflect that assumption and not advantage one service over the other. While the standards differ from the UK, there is some evidence in the United States that truly equal coexistence in licence-exempt operations can be difficult to achieve, even using well-established coexistence protocols.[26] Assuming that such coexistence could be achieved, however, making the upper 6 GHz band available for licence-exempt use now would permit MNOs to utilize the spectrum via the 5G NR-U protocol and relieve some of their capacity restrictions.

[Questions 5-7: No response]

***Question 8:** Assuming the future of the band includes indoor use for Wi-Fi and outdoors use for mobile:*

a) *how could this be achieved without creating or suffering interference?*
b) *could there be a combination of technical adjustments such as power limits and other mechanisms (including databases or sensing mechanisms)?*

Coexistence between mobile and Wi-Fi in the upper 6 GHz band is theoretically possible, with Wi-Fi operations taking place indoors and mobile operating on an outdoor-only basis. As noted earlier, moreover, the LAA and 5G-NRU protocols may be useful models for such coexistence. But before discussing any coexistence approach, it is important to assess the current and future spectrum needs of the two technologies.

[25] Ofcom Consultation at 31.

[26] *See* Vanlin Sathya, Muhammad Iqbal Rochman, and Monisha Ghosh, University of Chicago, "Hidden-Nodes in Coexisting LAA & Wi-FI: a Measurement Study of Real Deployments" (March 2021), *available at* https://arxiv.org/pdf/2103.15591.pdf ("Our experiments lead to the conclusion that in a hidden node scenario with LAA, Wi-Fi experiences a performance degradation that is more severe than that experienced by LAA, thus indicating a need to develop more advanced protocols for existence between LAA and Wi-Fi."); Guarang Naik, Jum-Min (Jerry) Park, Department of Electrical and Computer Engineering, Virginia Tech, "Coexistence of Wi-Fi 6E and 5G NR-U: Can We Do Better in the 6 GHz Bands?" (Dec. 2020) (finding that new features of Wi-Fi 6E and 5G NR-U, along with the greenfield status of the 6 GHz band should allow for easier coexistence between those technologies than Wi-Fi and LAA, but noting that their study "ignore[s] the exposed node problem … which is known to contribute negatively to the overall system performance."), *available at* https://winser.ece.vt.edu/wp-content/uploads/2020/12/Infocom_2021_WiFi6__5G-NR-U.pdf.

Ofcom has previously stated that "MNOs have a number of options to address future demand for data, including through more extensive deployment of existing spectrum, making use of planned spectrum releases (including mm Wave); investment in technology upgrades to increase the amount of data that can be carried over a given amount of spectrum; and increasing the number of sites in areas where additional capacity is needed (network densification)."[27] We recognize that each of these factors presents technical and economic challenges for MNOs, but licence-exempt spectrum faces a more imminent spectrum crunch with far fewer options. The average European household now has 17 connected devices,[28] and that number continues to increase. Those devices connect inside the home via Wi-Fi – not mobile or Ethernet[29] According to research firm IDC, there will be 19.5 billion Wi-Fi devices in use globally by the end of 2023.[30] Moreover, consumers are not only using more devices but are using those devices for applications that require greater spectrum resources, like AR/VR and high-definition streaming.

The ITU last allocated spectrum for license-exempt operations more than 20 years ago. Wi-Fi traffic now doubles every 3 years, to the point that the existing 2.4 GHz and 5 GHz Wi-Fi bands have become congested, putting at risk the UK's technological leadership and its citizens' ability to take advantage of their high-speed fibre connections.[31] Indeed, without additional license-exempt spectrum, service quality will soon begin to suffer[32], affecting nearly every aspect of internet traffic, including future traffic on mobile networks.

Cisco applauds the UK's allocation of the lower 6 GHz band for licence exempt use. But 500 MHz of license-exempt spectrum will not allow the UK to take full advantage of the capabilities of the newest generations of Wi-Fi, which can support channel sizes of up to 320 MHz. Densely populated areas like central London may have hundreds of Wi-Fi networks per square kilometre, with dozens of networks operating in close proximity. As data demand continues to rise, these densely deployed Wi-Fi networks will need channel diversity to optimize operation and avoid congestion. With access to only 500 MHz

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[27] Ofcom 6GHz Decision at 14 (citing "Ofcom's Future Approach to Mobile Markets and Spectrum" (6 December 2022), *available at* https://www.ofcom.org.uk/__data/assets/pdf_file/0036/248769/conclusions-mobile-spectrum-demand-and-markets.pdf).

[28] *See, e.g.,* John Foetsier, "Smart Home : Apple is the Fastest-Growing Connected Device Company," Forbes (31 August 2022), *available at* https://www.forbes.com/sites/johnkoetsier/2022/08/31/smart-home-apple-is-the-fastest-growing-connected-device-company/?sh=d501aa07dd48.

[29] Simon Sherrington, Analysys Mason, "Operators and Vendors Need to Plan for More Conservative Mobile Data Growth in the Near Future" at 2-3, 4 (1 August 2023) ("Within the home – even when they have unlimited mobile data packages – users don't tend to switch to their mobile networks. They typically continue to use devices connected to their home fixed broadband and Wi-Fi for extended TV viewing.); ("Eventually, metaverse use cases could involve vast numbers of customers, with cloud processing of fully immersive environments and services requiring very low latency and very high bandwidth. However, most of the usage will take place indoors where a combination of fibre and Wi-Fi seems much more suited to the service requirements."), *available at* https://www.analysysmason.com/research/content/articles/cellular-data-traffic-rdnt0/.

[30] https://www.wi-fi.org/beacon/the-beacon/wi-fi-by-the-numbers-technology-momentum-in-2023.

[31] Dynamic Spectrum Alliance, "Lessons from the Assia Report on 'Wi-Fi and Broadband Data'" (October 2021), *available at* http://dynamicspectrumalliance.org/wp-content/uploads/2021/11/Lessons-from-the-Assia-Report-on-Wi-Fi-and-Broadband-Data.pdf. Nearly 20.8 million UK households – 70 percent of all UK homes -- can now access gigabit-capable broadband. *See* https://www.uswitch.com/broadband/studies/broadband-statistics/.

[32] *See* John Cioffi, ASSIA, "State of Wi-Fi Reporting – DSA 2021 Global Summit" (8 June 2021), *available at* https://dynamicspectrumalliance.org/wp-content/uploads/2021/06/2021-DSA-Summit_Spectrum-Value_John-M.-Cioffi.pdf.

additional spectrum, however, these networks will be stuck at 40 MHz channel sizes (state of the art in 2006) for enterprise networks that use a 7-channel reuse pattern.

Limiting licence-exempt networks to only the lower 500 MHz of the 6 GHz band while Ofcom undertakes the complex process of developing a hybrid approach will result in constraints like those that currently exist in 5 GHz. Users will not get effective use of the wider channels available in the latest Wi-Fi iterations, particularly in dense deployments, and will not be able to fully support next-generation technologies at scale like AR/VR and 8K video streaming. Enterprise grade wireless networks can currently support real-time voice and video, which require latencies of about 100 ms. AR/VR have much tighter requirements, however, with latency requirements approaching 10 ms. As such, availability of the full 6 GHz band is not just about improving the Wi-Fi experience today, but also about enabling and supporting the applications of tomorrow.

With these factors in mind, as Ofcom considers hybrid approaches to the upper 6 GHz band, Cisco urges the agency to act now to address the needs of licence-exempt operations by authorizing licence-exempt operations throughout the upper 6GHz band. UK consumers and businesses depend on licence-exempt connectivity everywhere, all the time, whether the underlying broadband connection is fixed, mobile, or satellite. They do so because licence-exempt technologies like Wi-Fi are ubiquitous, reliable, and inexpensive.

Once it has authorized licence-exempt operations in the upper 6 GHz band, including 5G NR-U, Ofcom should then consider how mobile operations might coexist in the band. As the consultation observes, indoor Wi-Fi access points and outdoor mobile base stations may have some coexistence issues at standard power levels.[33] And as noted below, mobile operations outdoors at high power levels present similar potential interference issues to incumbent fixed links and Fixed Satellite Service (FSS) operations. Ofcom therefore could seek input on the restrictions on mobile operations necessary to protect both incumbents and licence-exempt operations. The agency could use tools like digital twins to model potential interference scenarios.[34] This process should allow Ofcom to decide the best way to achieve the economic and social benefits of mobile operations in the upper 6 GHz band while protecting other operations in the band.

Question 9: *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.*

- *a) 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?*
- *b) What are your views on the initial analysis we have conducted around hybrid sharing and coexistence with incumbents?*
- *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?*

[33] Ofcom Consultation at 57 ("Our initial findings show that indoor Wi-Fi access points (or client devices) may not be able to detect low-level signals from outdoor mobile base stations. In this case, the listen-before-talk protocol may incorrectly assume that the channel is clear and the access point may start transmitting, potentially causing interference to any nearby mobile handsets receiving data from the base station.").

[34] *See, e.g.,* Program for IEEE RFID 2022 Workshop on Digital Spectrum Twinning (17-19 May 2022), *available at* http://2022.ieeerfid.org/files/2022/05/Program-for-IEEE-RFID-2022-Workshop-on-Digital-Spectral-Twinning-1.pdf.

As Ofcom has previously stated, licence-exempt operations are well-suited to coexist with the current incumbent operations in the upper 6 GHz band.[35] Wi-Fi and other licence-exempt uses primarily operate indoors at lower power than mobile services, reducing the likelihood of interference to incumbent operations like fixed links or FSS operations. As such, Wi-Fi operations in the upper 6 GHz band would require relatively little change to incumbent operations, such as relocation or restrictions on spectrum use. Moreover, even outdoor, higher-power licence-exempt operations should be possible through sharing mechanisms like AFC systems.

We agree with Ofcom that "coexistence between fixed links and licensed mobile base stations deployed outdoors is likely to be a challenge."[36] These challenges would likely persist in any coexistence scenario because, as the analysis provided by Ofcom of mobile/FS coexistence in London shows, the urban areas with the greatest need for added mobile spectrum capacity may also be areas with critically important fixed links.[37] Indeed, Ofcom's analysis of mobile/FS co-existence for London shows sharing between current FS operations and mobile appears near impossible. More generally, as Ofcom states, "if the upper 6 GHz band were to be deployed on these [high traffic macro] sites at higher power, about half of the fixed links in the UK could potentially suffer some interference."[38]

Similarly, whilst sharing between mobile and FSS operations may be possible, Ofcom's analysis shows that mobile network densities would have to "remain relatively low."[39] Thus, whilst it is worthwhile to consider allowing both licence-exempt and mobile operations in the upper 6 GHz band, it is possible that the benefits associated with such mobile operations may be limited.

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?*

Question 11: *Do you have any other comments to make on these proposals or on the future use of the upper 6 GHz band?*

As explained above, Cisco supports Ofcom's consideration of hybrid sharing in the upper 6 GHz band. We acknowledge that MNOs may need more spectrum resources to reach the UK's wireless infrastructure goals, and that a sharing approach may be possible in the upper 6 GHz band. But we strongly urge Ofcom not to delay authorization of licence-exempt operations in the upper 6 GHz band during this consideration. Licence-exempt technologies like Wi-Fi have a clear and growing need for additional spectrum now and making the upper 6 GHz band available is critical to the UK's technological and economic development.

[35] *See, e.g.,* Ofcom Consultation at 5 ("Use of low power Wi-Fi indoors is much less likely [than mobile] to pose a risk of harmful interference to incumbent services.").

[36] Ofcom Consultation at 5.

[37] Ofcom 6 GHz Decision at 5 ("Fixed links in the band are distributed across the UK. For instance, financial services high-frequency trading links are mainly concentrated around London."). *Compare* Ofcom Consultation Figure 3 with Ofcom 6 GHz Decision Figure 2.1.

[38] Ofcom Consultation at 37.

[39] Ofcom Consultation at 38. *See also* Ofcom 6 GHz Decision at 47 ("On-going studies in ITU-R Working Party 5D suggest separation distances [between FSS and mobile operations] of around 10km to more than 100km might be needed, depending on the assumptions used in the studies.").