Expanding access to the 6 GHz band for mobile and Wi-Fi services

Proposals for AFC in Lower 6 GHz and mobile / Wi-Fi sharing in Upper 6 GHz

Qualcomm Response

Qualcomm is pleased to respond to Ofcom's Consultation on "Expanding access to the 6 GHz band for commercial mobile and Wi-Fi services."

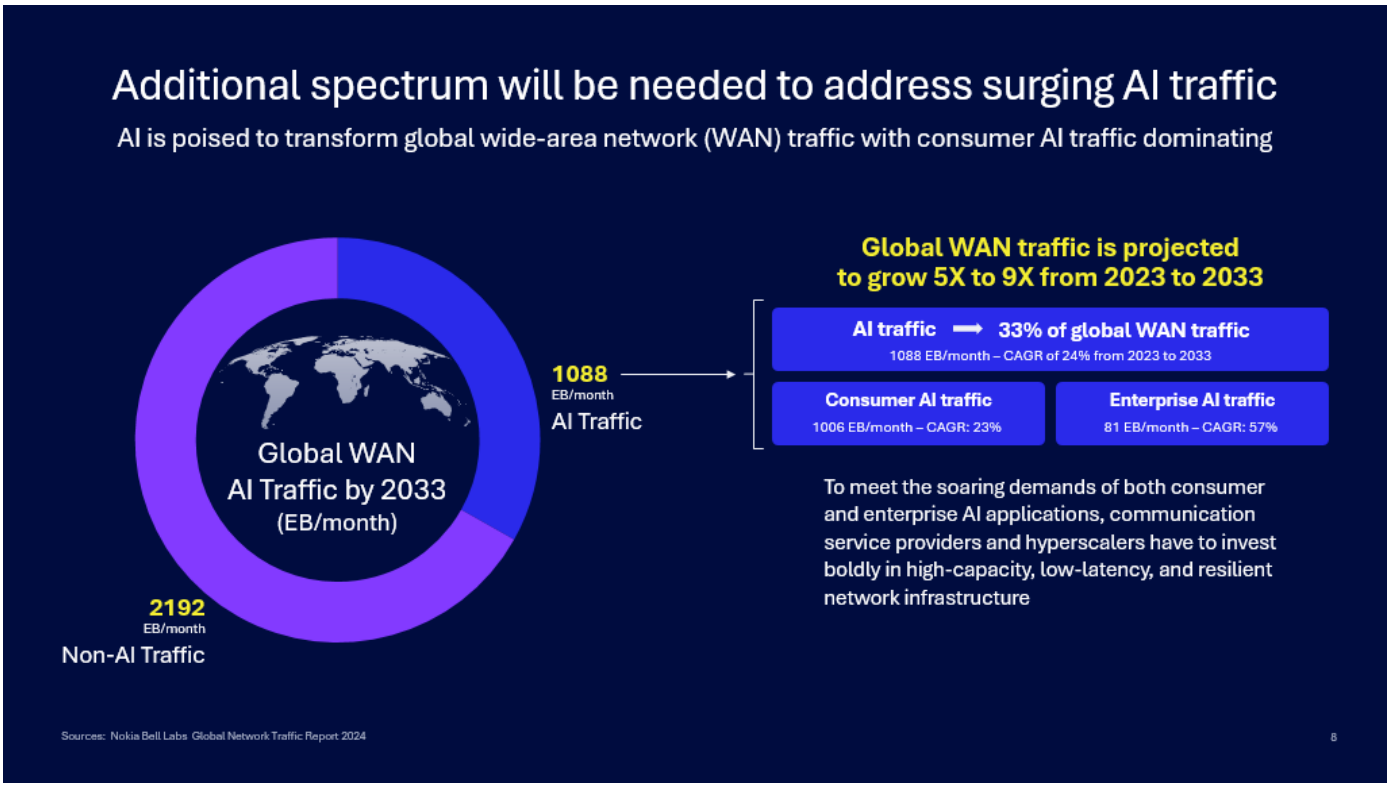
As a leading provider of both mobile and Wi-Fi technologies, Qualcomm has a unique viewpoint on the 6 GHz band. Qualcomm was the driving force behind 3G, 4G, and 5G, and is now leading the development of 6G to be deployed throughout the world later this decade. At the same time, Qualcomm is at the forefront of Wi-Fi innovation and is the world's leading provider of chipsets that support Wi-Fi operations in license-exempt spectrum.[1] Qualcomm also has been deeply involved in the development of innovative spectrum sharing frameworks and technologies aimed at enabling improved spectrum utilization across diverse frequency bands. For example, in March 2024, Qualcomm was awarded by DSIT a funded project to study sharing and co-existence between Wi-Fi and Mobile (5G) in the upper 6 GHz spectrum band (U6 GHz from 6425 to 7125 MHz) in the UK.

As we march toward 2030 and the 6G-enabled communications infrastructure, the relentless demand for wireless data will continue to reshape the connectivity landscape. Wireless connectivity has become the backbone of global digital transformation. The proliferation of smartphones, laptops, tablets, Internet of Things (IoT) devices and connected vehicles — each supported by wireless broadband — has driven a massive surge in data consumption. It is expected that by 2030, global mobile data traffic will quadruple, reaching a staggering 465 exabytes per month, with a compound annual growth rate (CAGR) of 23%[2] from 2023. This surge is powered by key trends such as the continued proliferation of 5G networks, enhanced video streaming quality, as well as the rise of extended reality (XR), cloud gaming, and the increasing

[1] Qualcomm's Wi-Fi chipsets operate in the 2.4 GHz band, the 5 GHz U-NII bands and in 6 GHz bands (in the lower 500 MHz from 5.925-6.425 GHz and in the entire 1200 MHz from 5.925-7.125 GHz)

[2] GSMA. (2024). The Mobile Economy 2024. Retrieved on Dec 2, 2024 from: https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-economy/.

usefulness and prevalence of AI-driven applications and services. AI is reshaping data flows, with global wide-area network (WAN) traffic projected to grow five to nine times from 2023 to 2033. By then, AI is estimated to account for a whopping 33% of all WAN traffic[3].



As the world moves from 5G to 6G, the capabilities of mobile networks will be improved, and new 6G capabilities, applications, and services will be added. 6G will address, at its foundational level, energy efficiency and environmental sustainability needs and incorporate technology enablers that extend the platform capability beyond connectivity. In the 6G era, capabilities such as RF sensing, Machine Learning/Artificial Intelligence ("ML/AI") and compute will merge with enhanced communication capabilities and foster ubiquitous access to use cases such as immersive multisensory devices, supporting Digital Twins and collaborative robotic applications, among other innovations. 6G is being designed from the ground up to be more energy efficient and more cost-efficient, allowing mobile network operators to maximize their return on investment ("ROI")[4] to support rapid network buildout and timely introduction of 6G capabilities. With a focus on reducing capital and operating expenditure, 6G will improve network efficiency while driving down network costs.

[3] Nokia. (2024). Global network traffic report. Retrieved on Dec 2, 2024 from: https://onestore.nokia.com/asset/213660.

[4] For instance, according to a report by GSMA, "20% of operators rate energy efficiency as the No.1 attribute to prioritize in 6G networks from a business standpoint." See GSMA Intelligence, The Next Generation of Operator Sustainability: Greener Edge and Open RAN at 6 (Sep. 2023).

Meeting these continually increasing demands requires a well-orchestrated strategy to secure new IMT spectrum and optimize existing mobile bands. 6G will use a combination of frequency resources in the low, mid and high band spectrum to meet coverage and enhanced capacity requirements, to provide improved performance and serve new and emerging use cases. The success of 6G, with commercial deployments expected to start in 2030 (or earlier), hinges on the timely availability of new mid-band spectrum with wide channels of 200-400 MHz.

In this context, Ofcom's consultation is timely and critical to UK's mobile success as the U6 GHz is the only feasible spectrum opportunity to launch 6G in the UK within this timeframe. The availability of the entire U6 GHz band for 6G use without undue restrictions or harmful interference from unlicensed devices is vital for the successful introduction of 6G, and making the entire band available for mobile services is a key prerequisite to maintain UK's competitiveness and ambitions to place it ahead of, or at least in line with, leading markets, like the U.S., China, Brazil, India, and the rest of Europe.

It is for this reason that Ofcom's proposal to allow Wi-Fi operations in the U6GHz band through a so called "phased" approach is concerning. Contrary to Ofcom's stated goals of: (1) providing both license-exempt and mobile industries with certainty, (2) enabling investment in faster and better-quality mobile and Wi-Fi services, and (3) providing Ofcom with flexibility to respond to demand uncertainties, Ofcom's proposed "phased" approach will compromise each of these goals and should be abandoned.

Allowing LPI devices in the U6 GHz band -- without a well-defined and successfully demonstrated and implemented sharing mechanism in place beforehand -- will significantly compromise the usefulness of the band for 6G mobile use, resulting in greatly delayed deployment of 6G technology in the UK. The proposed phased approach would remove a key driver for Wi-Fi industry players to work collaboratively with the mobile industry on sharing mechanisms, as there would be little incentive to do so. Thus, there would be a serious risk of one industry sector dictating access to the band at the expense of another. This would delay and ultimately limit the benefits of 6G mobile connectivity to UK citizens and consumers.

With regard to the lower 6 GHz band where LPI devices presently operate, Qualcomm supports enabling indoor/outdoor standard power Wi-Fi deployments using an Automated Frequency Coordination ("AFC") system. Qualcomm has been instrumental in advancing the expansion of Wi-Fi into the 6 GHz band, collaborating closely with regulatory bodies to develop and implement an AFC system, a spectrum sharing mechanism designed for sharing between incumbent fixed service links and license-exempt devices in the 6 GHz spectrum. Qualcomm's AFC system is approved for commercial operations in the US and Canada, the two countries with AFC enabling regulations in place. Qualcomm received the world's first AFC system certification from ISED Canada in August 2023,[5] and it was among the first group of entities that received FCC authorization of its AFC system in early 2024 in the U.S.[6] This underscores Qualcomm's dedication to advancing wireless technology and ensuring efficient spectrum utilization. The efforts in this area are aimed at unlocking the full potential of the Lower 6 GHz band for various applications and driving innovation in the wireless industry. Qualcomm looks forward to working with Ofcom to enable AFC system

[5] https://www.qualcomm.com/news/releases/2023/08/qualcomm-designated-as-world-s-first-approved-automated-frequenc

[6] FCC Public Notice, OET Announces Approval of Seven 6 GHz Band Automated Frequency Coordination Systems For Commercial Operation (rel. Feb. 23, 2024) DA 24-166.

operations in the U.K. in the Lower 6 GHz band to support standard power indoor and outdoor power outdoor connectivity in license-exempt spectrum.

In summary:

- 6G will be deployed by the end of this decade, and it will provide an order of magnitude improvement over 5G and will be needed to ensure a seamless level of connectivity for the tens of millions of smartphones, tablets, laptops, vehicles, and drones to enable continued progress and economic growth in the UK.

- The U6 GHz band will be the anchor band for 6G in most of the world, and Ofcom should ensure that the UK is able to deploy reliable full-power mobile operations in that band both indoors and outdoors. Therefore, Ofcom should make available the entire U6 GHz band for 6G, as there is no other wide bandwidth mid-band spectrum in the UK that mobile deployments can use for wide channel 6G operations indoors and outdoors.

- Ofcom should refrain from introducing low power indoor Wi-Fi deployments in the U6 GHz band through the proposed phased approach without an established sharing mechanism in place because doing so will "pollute" the band and limit the success of 6G services in the UK.

- Allowing unlicensed LPI operations in U6 GHz without a well-defined and demonstrably effective sharing mechanism – to ensure priority and protection of licensed mobile operations indoors and outdoors – will detrimentally impact the successful deployment of mobile operations in U6 GHz. Thus, Ofcom should not move forward to authorizing LPI operations in the U6 GHz band unless and until those operations credibly demonstrate no harmful interference to mobile operations.

- To enable licensed and license-exempt sharing in the U6 GHz band, extensive work on multiple fronts is necessary. This includes standardization work involving both Wi-Fi and MNO stakeholders, followed by regulatory proceedings to implement regulations that enable successful sharing, and a compliance testing program that ensures mobile operations are not subject to harmful interference from Wi-Fi. This process will take several years to complete, at a minimum.

- Today, there are sufficient spectrum resources for Wi-Fi networks. The current license-exempt allocation of the 2.4 GHz band, 5 GHz band and lower 6 GHz band offer adequate spectrum resources for the deployment of Wi-Fi networks. Moreover, there are other spectrum bands that can possibly be opened for indoor unlicensed use in the future in Europe, which is where there is the greatest need for additional Wi-Fi spectrum. Indeed, it is easier to open license-exempt bands for indoor use to sharing with incumbent systems that operate exclusively outdoors.

- Should Ofcom decide to permit license-exempt operations in the U6 GHz band at some future point in time, it should only do so after license-exempt equipment is able to reliably detect and vacate the band and defer to active mobile operations in the vicinity.

Please find below Qualcomm's answers to the questions in the consultation.

1. What interest do you have in deploying outdoor or standard power Wi-Fi or other license-exempt RLANs in the Lower 6 GHz band? Please provide details of the types of expected deployments.

Qualcomm has a strong interest in enabling standard power Wi-Fi deployments in the Lower 6 GHz band. With 19.5 billion Wi-Fi devices in use today[7] and more than 20 years of standards development, Wi-Fi is one of technology's greatest success stories. Constantly evolving to support new use cases and devices, it has permeated all aspects of our lives to become an essential connectivity means at home, at work and in public across the globe.

Qualcomm Technologies was among a group of technology leaders recognizing the importance of additional license-exempt spectrum to fuel continued growth for Wi-Fi and worked with the FCC on developing regulation for the 6GHz band, culminating in the FCC's April 2020 Order opening 6 GHz spectrum for Wi-Fi. In the years since FCC milestone ruling, several regulators and policy makers in different countries have followed in opening up 6 GHz spectrum for license-exempt use.

While many countries have allowed low-power operation with the Low Power Indoor (LPI) and Very Low Power (VLP) operating classes, some countries have enabled a higher-performance, longer-range version of 6 GHz operation with the Standard Power (SP) operating class. This operating class unlocks new use cases and provides significant benefits for consumer and enterprise deployments.

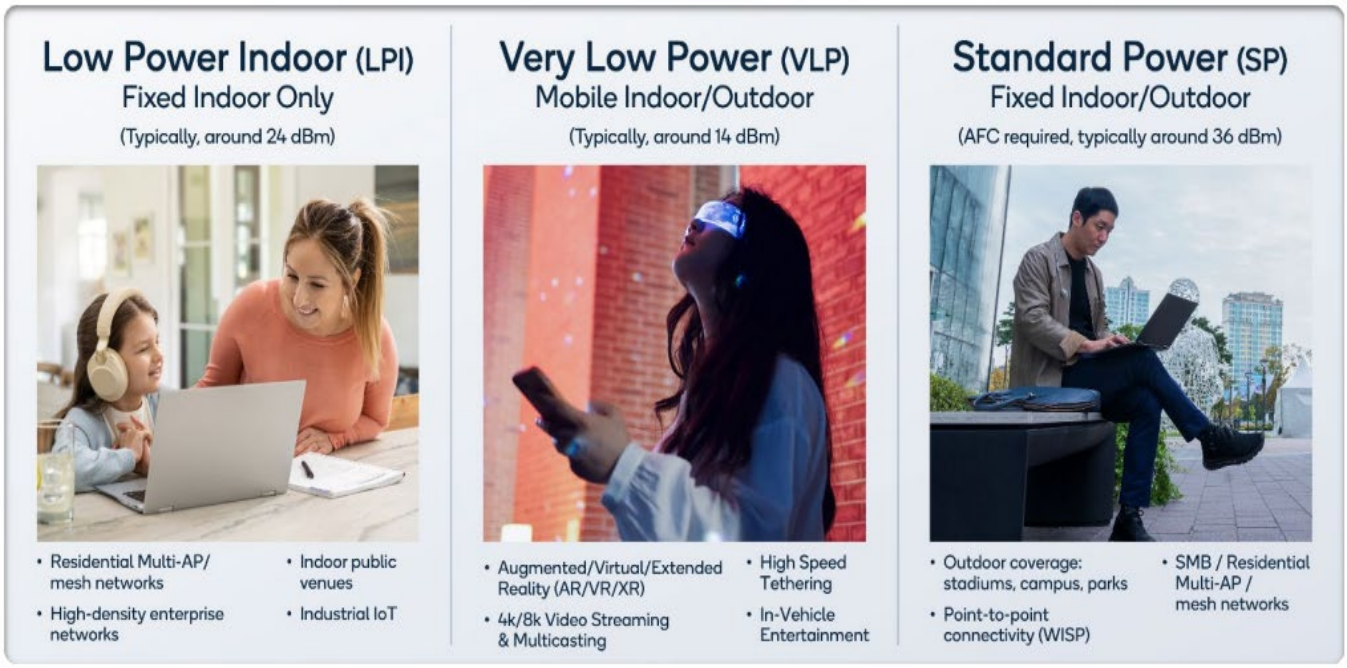


Figure 1: Typical regulatory operating classes for 6GHz band license-exempt operation

[7] IDC Worldwide Wi-Fi Technology Forecast, 2023-2027, #USS0019923, March 2023

Qualcomm supports enabling indoor / outdoor standard power Wi-Fi deployments in the Lower 6 GHz band in the UK, particularly for high-density urban areas, enterprise environments, and outdoor use cases where higher power is needed. Qualcomm has been instrumental in advancing the expansion of Wi-Fi into the lower 6 GHz band, collaborating closely with regulatory bodies to develop and implement AFC, a flexible spectrum sharing mechanism designed for sharing with incumbent fixed point-to-point systems in 6 GHz spectrum. Qualcomm notably became the world's first AFC system operator approved for commercial operation when ISED Canada approved Qualcomm's AFC system in August 2023.[8] Qualcomm's commitment to deploying Wi-Fi in the Lower 6 GHz band is driven by the potential to unlock new use cases and provide significant benefits across various sectors.

Expected types of Standard Power Wi-Fi deployments in the UK are summarized below.

1. **Outdoor Deployments**:
    - **Wireless Internet Service Providers (WISPs)**: Utilizing the Lower 6 GHz band to provide broadband access in rural and underserved areas.
    - **Campus Networks**: Enhancing connectivity across large campuses, such as universities and corporate complexes.
    - **Municipal Networks**: Supporting public Wi-Fi initiatives in cities and towns to provide residents and visitors with reliable internet access.

[8] See Qualcomm Press Note, Qualcomm Designated as World's First Approved Automated Frequency Coordination System Administrator for Superior Wi-Fi Experiences (Aug. 22, 2023).

2. **Industrial and Enterprise Deployments**:
    - **Manufacturing and Industrial Settings**: Deploying robust Wi-Fi networks in factories and industrial sites to support automation and IoT applications.
    - **Outdoor Event Venues**: Providing high-capacity Wi-Fi coverage for large outdoor events, such as concerts and sports events.
3. **Residential Deployments**:
    - **Enhanced Home Wi-Fi**: Offering higher power, longer-range Wi-Fi solutions for residential users, improving connectivity throughout homes and even extending to outdoor areas like gardens and patios.

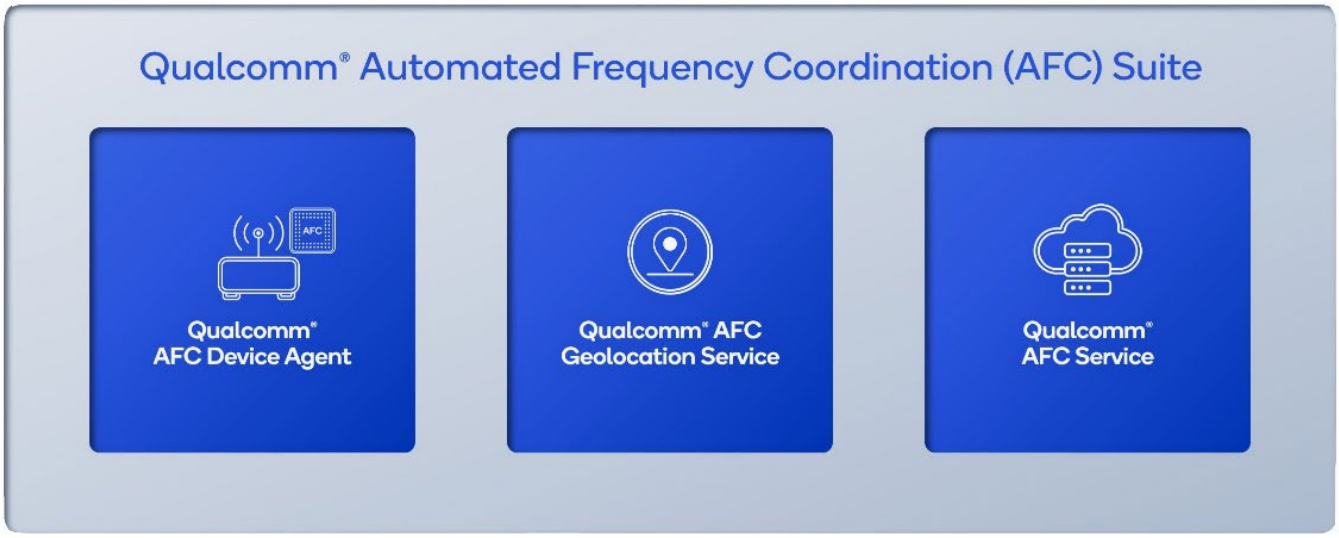
2. Are you interested in providing or developing AFC databases for use in the Lower 6 GHz band in the UK?

Qualcomm has a strong interest in developing an Automated Frequency Coordination (AFC) database in the UK to allow for standard power license-exempt operations in the Lower 6 GHz band.

Qualcomm has developed and has been authorized to provide AFC solutions in the U.S. and Canada. The AFC system will protect licensed incumbents in the lower 6 GHz band by ensuring that no single license-exempt interference source increases the noise at the fixed receiver to a level of harmful interference, which will be determined using information each fixed service licensee is required to provide to Ofcom in its license application. The AFC system will use the information associated with each fixed link in conjunction with a robust propagation model to ensure no license-exempt operations are activated that exceed a specified interference threshold at any incumbent licensee's receiver.

3. Do you have any views on the operational considerations of setting up and running AFC databases?

The operational considerations for AFC databases include ensuring accurate geolocation of new standard power license-exempt devices to prevent interference with incumbent fixed links and satellite earth stations. Qualcomm's AFC system integrates a geolocation service that enhances accuracy without the need for GPS hardware in access points, thereby simplifying deployments. The system also supports regular frequency re-validation and interference management protocols to enable effective coexistence.



The Qualcomm AFC Solution is a complete end-to-end offering built to enable 6 GHz Wi-Fi Standard Power operation. The Qualcomm AFC Solution supports location-based power optimizations for 6 GHz transmissions, is designed to enable standard Wi-Fi power levels to be used in access points and devices indoors and outdoors to deliver higher performance and longer range while protecting existing incumbent users of the band.

Qualcomm AFC Solution's turnkey, cost-effective and scalable implementation encompasses an access point agent and cloud system utilizing standards-defined interfaces to support interoperability across network deployments leveraging 6 GHz operation, including Wi-Fi 6E, Wi-Fi 7, and beyond. It is available for customer device integration today across Qualcomm® Networking Pro Series and Qualcomm® Immersive Home platforms to span residential, broadband operator and enterprise market segments.

Qualcomm looks forward to engaging with Ofcom and providing additional information and support as required.

4. Do you have any views on how we should manage the approval process for AFC databases and, in particular, whether we should rely on parts of the FCC process rather than requiring the whole process to be re-run in the UK?

Given the existing regulatory frameworks, the UK could benefit from leveraging aspects of the FCC's AFC approval process, including public trials and laboratory testing, to streamline adoption while adapting to local regulatory conditions. Qualcomm's AFC Suite has already been approved for operation in the United States and Canada and could be adapted to meet the UK's specific requirements. Therefore, we support an approval process which focuses on the UK specific changes (e.g., UK incumbent database) while adopting general AFC topics like security, standardization for AFC implementation, and propagation modeling, each of which already have been thoroughly tested in the US and Canada.

Indeed, ISED Canada's and the FCC's approvals of the Qualcomm AFC Service mark the culmination of a significant journey in developing and introducing this innovative and future-proof spectrum sharing mechanism, ultimately enhancing connectivity experiences for Wi-Fi 6E and Wi-Fi 7. This milestone also

paves the way for the expansion of AFC and AFC-like systems into other regions, where numerous countries and regulatory agencies, such as CEPT (European Conference of Postal and Telecommunications Administration), and more, have shown interest. Qualcomm Technologies is actively engaged with regulators worldwide and is prepared to scale operations as AFC-enabled spectrum sharing gains traction globally.

5. Please provide any other comments on our proposals for extending access to standard power Wi-Fi and outdoor use.

Extending access to standard power Wi-Fi and outdoor use under AFC control is a logical step forward. Standard power Wi-Fi at 36 dBm would provide greater flexibility and expanded coverage while ensuring that incumbent users are adequately protected. Qualcomm supports an approach that prioritizes spectrum efficiency and minimizes administrative burdens.

However, we note that contrary to the language in paragraph 4.12 of the consultation, AFC functionality is not device-dependent; it is software-controlled and device power levels can adjust to the appropriate operating rules for a given operational mode, be it Very Low Power, Low Power Indoor, or Standard Power license-exempt operations under the control of an AFC system.

6. Do you have any comments on our proposal to use a "phased" approach, or on the alternative to wait for European harmonization?

Qualcomm respectfully disagrees with the proposed "phased" approach, where low power indoor Wi-Fi use on a license-exempt basis is introduced across the entire U6 GHz band "as quickly as possible," while introduction of mobile operations would come later. Qualcomm cautions Ofcom against inadvertently adopting a de-facto co-channel sharing environment in the band, which will compromise the viability of the band for future mobile deployments.

Qualcomm has been working closely with the UK Department for Science, Innovation and Technology (DSIT) through a sandbox project to explore sharing opportunities between licensed IMT and unlicensed RLANs in the U6 GHz band. The objective of this technically challenging work effort has been to assess the costs and benefits of the sharing solutions, i.e., implementation cost and performance impact from an interference perspective versus performance improvements through sharing, and the regulatory mechanisms that may help achieve the country's desired goals. The sandbox project highlighted that co-channel spectrum sharing between IMT and Wi-Fi may lead to a significant degradation of both technologies when Wi-Fi deployment is close to 5G UE (User Equipment). Technical solutions like cross-technology signaling (XTS) by 5G Base stations and UEs though technically feasible, present also significant challenges:

- XTS must be standardized, harmonized and compliance tested as a pre-condition for deployment which creates a longer timeline for deployment. Standardization will be challenging because:
    - 3GPP would need to define how to transmit specific Wi-Fi waveform in the relevant band.

- 3GPP work will have to be followed up by work in ETSI TFES and ETSI BRAN - testing and conformance, with associated conformance tests to be developed by ETSI, will also be needed

- XTS functionality would also have to be implemented globally to enable device roaming into these European bands – this will add cost and complexity.

- XTS functionality will have to be included in all WAS/RLAN equipment intended for Europe – this will require specific certification and importation rules for such devices.

The observations provided above emphasize that defining, standardizing and commercially implementing a sound sharing solution between IMT and Wi-Fi is a complex process with a massive amount of technical details to be dealt with. This process will require regulators and stakeholders from both industries to work collaboratively and in good faith for more than a few years as well as making available significant resources. While Qualcomm has invested substantially in this effort, it does not appear that many other stakeholders are interested in investing resources and time in enabling co-channel sharing.

Thus, Ofcom should not allow license-exempt equipment to enter the upper 6 GHz band before the necessary standardization, regulation, and compliance testing frameworks are in place. Early entrance of Wi-Fi equipment would disincentivize cooperation from the Wi-Fi community and investment from the IMT ecosystem and likely result in the failure of spectrum sharing between the two ecosystems and the inability to deploy 6G later this decade when the rest of the world will deploy.

Given that we are less than five years away from initial 6G deployments and there is not a consensus view on co-channel sharing in the Upper 6 GHz band, Qualcomm believes it is critically important that countries prioritize the need for 6G spectrum and identify the upper 6 GHz band for mobile operations, especially since Wi-Fi 7 has spectrum allocations in the lower 6 GHz band and 5 GHz bands that can support multi-gigabit speeds.

Finally, Qualcomm recommends that Ofcom does not make decisions in isolation from the rest of Europe and encourages Ofcom to collaborate and engage with the rest of Europe in the harmonization process. Sharing of U6 with RLAN in Europe also risks fragmenting the global U6 ecosystem, with further damage to sector sustainability.

7. Do you have any comments on the above suggestion to manage any "legacy" Wi-Fi devices, or alternative suggestions?

Qualcomm shares Ofcom's views on the risks from first generation Upper 6 GHz "legacy" Wi-Fi devices. If Wi-Fi devices are permitted to operate in the U6 GHz band in the near future, and at a later time Ofcom decides to allocate the band for 6G operations, a large number of Wi-Fi devices will have already been deployed and this will cause interference to mobile operations. It will not be practical and in a number of cases even possible to ensure the removal of these "legacy" devices from operation, as their location will be unknown, especially for devices sold to retail consumers. For enterprise customers which work with companies, while these companies might have the opportunity to register the devices, or the deployments, they will have to continue to be responsible for updating the devices for an unspecified amount of time. This scenario creates a different set of risks, including but not limited to companies going

out of business, withdrawing from the market, to name just a few. This might lead to installed devices remaining in operation with no incentive to have them updated or replaced.

Ofcom suggests devices could consult a simple database periodically to be advised on which bands to operate. Ofcom's suggestion is in effect a simplified version of an AFC that would not require location information but would still need development including the definition of appropriate rules for its operation, selection of the entity that would operate it and further, it would require that the device certification allows for this solution in the UK.

This demonstrates that what would appear to be an easy solution would be in fact more burdensome for the Wi-Fi companies and still would not alleviate the risks identified. Even to the extent that enterprise Wi-Fi operations might be willing to undertake this effort, the risk becomes more pronounced with retail devices, where consumers do not update the device, and keep it in operation for the longest time without knowledge or awareness of the changed regulatory environment.

Therefore, Ofcom's proposed measures would not be adequate to protect investment from the IMT ecosystem players and will effectively make the Upper 6 GHz band a Wi-Fi band.

8. Do you have a view on the amount of spectrum that should be prioritized for Wi-Fi under the prioritized spectrum split option?

Qualcomm urges Ofcom to refrain from prioritizing any quantity of spectrum in the upper 6 GHz band for Wi-Fi. UK has spectrum for license-exempt operations with 2.4 GHz band, the 5 GHz band, and the lower 6 GHz band (500 MHz) that can support multi-gigabit speeds and satisfy current needs. These bands allow for multi-gigabit performance in residential settings, high-density public environments, and in enterprise settings. Qualcomm's tri-band Wi-Fi chips (2.4, 5, and lower 6 GHz) are deployed in each of these settings. Current allocations should suffice for the short and medium term and there is no demonstrated need for new license-exempt spectrum at this time. License-exempt operations, which typically occur indoors can use other spectrum bands that today support services that – unlike IMT – occur only outdoors.

When looking at international markets, Qualcomm acknowledges that the US, Canada, Argentina, Saudi Arabia and South Korea have assigned or are moving towards assigning both lower and upper 6 GHz bands to Wi-Fi. However, China, India, Brazil, Hong Kong, UAE as well as most African countries have assigned or plan to assign this band for mobile services, and these countries account for over 80% of world population.[9] Also, in South America countries like Brazil, Mexico, and Chile have reversed the initial decisions to provide the entire 1200 MHz for Wi-Fi, and now plan to open the U6 GHz for IMT and other Latin American countries considering a similar decision. In Southeast Asia, countries like Sri Lanka, Indonesia, Thailand, Bangladesh, and Cambodia have also added the U6 GHz in their IMT spectrum release roadmaps. Globally, there is a solid foundation for mobile ecosystem development in U6 GHz.

Qualcomm recommends Ofcom align its decision on U6 GHz to the EU and not make a final decision on what to adopt in the UK until the outcome of European harmonization becomes clearer. Sharing of U6 with R-LAN in Europe also risks fragmenting the global U6 ecosystem, with further damage to sector sustainability.

[9] https://www.gsma.com/connectivity-for-good/spectrum/gsma_resources/spectrum-policy-trends-2025/

9. Do you have any comments on our plan for a "phase 1" when Wi-Fi will be introduced?

As noted above, any Wi-Fi operations in the U6 GHz band, even if it is an indoor/outdoor split as Ofcom proposes, will compromise the viability of the band for future mobile operations, especially if such operations are introduced first and without a viable sharing mechanism in place.

As mentioned in the response to question 13, Qualcomm R&D has demonstrated that 6G systems using 8 GHz band can provide the same coverage indoors (and outdoors) that 5G systems provide today using 3 GHz spectrum – an impressive achievement that runs counter to the narrative that the Upper 6 GHz spectrum band is "poor for indoor coverage."

Enabling interference-free mobile operations indoors is critically important to the successful rollout of 6G operations because most mobile communications sessions begin or end indoors. The Energy Detection ("ED") level Wi-Fi uses today is -72 dBm/20 MHz, which means Wi-Fi will transmit in a channel when no foreign signals above -72 dBm/20MHz are detected. Mobile phones and other devices that use mobile connectivity routinely communicate at levels as low as -105 dBm/MHz and even lower. Operations at these low levels occur today at the edge of cellular coverage and deep inside of buildings.

Ensuring successful coexistence between Wi-Fi and mobile operations in the same geographical location without detrimental impacts to both technologies would not be possible unless spectrum sharing techniques are developed, standardized, implemented in regulations and test procedures. Unlicensed equipment would also have to be properly tested for compliance prior to any deployments. The ECC report developed by CEPT PT1 and now under public consultation has reached the same conclusion.

The draft conclusions in the ECC Report indicate that "MFCN downlink throughput would be reduced to zero in around 49% of locations within the coverage area of the MFCN where a WAS/RLAN is transmitting continuously within 10 m of an MFCN UE which is receiving at the same time (up from 12% of locations when no WAS/RLAN interference was present)." and "shared use between MFCN with full power and WAS/RLAN LPI operating on the same channel is not possible without negative consequences for WAS/RLAN spectrum access and user experience." This would be a disastrous outcome. Mobile network operations are not designed to cope with bursty interference caused by Wi-Fi traffic; indeed, it is notable that this aspect was not analyzed in the CEPT studies.

Should Ofcom decide to allow Wi-Fi in the band (this is not Qualcomm's preferred option), it is imperative that Low Power Indoor (LPI) unlicensed use should not be permitted unless and until it is conclusively demonstrated that such unlicensed use does not materially impact IMT operations, both indoors and outdoors. Allowing any deployment of LPI without a robust sharing mechanism will significantly degrade the usefulness of the band for IMT. As a result, mobile network operators may avoid using the band, which would inhibit the deployment of 6G technology in the UK.

10. One variation on "phase 1" would be to only authorize Wi-Fi in client devices to "seed" the market. Would you have any views on this, or suggestions for other variations?

As Ofcom acknowledges in the consultation, this option has no measurable benefit. As future decisions on the spectrum use of the U6 GHz may necessitate additional requirements such as specific OOBE requirements for client devices, allowing client devices early should not be considered.

11. Do you have any comments on our plan for a "phase 2" when mobile will be introduced?

Qualcomm respectfully disagrees with Ofcom's assumption (as stated in paragraph 5.53) that "the physical characteristics of the Upper 6GHz band make it particularly well suited for providing additional capacity in parts of the mobile network where traffic is very high, rather expanding coverage" paving the road for a mmW type of approach for the introduction of mobile in this band.

Very similar to the 3.5 GHz band being the primary band for 5G deployments in Europe, we foresee the Upper 6 GHz band to be the primary band for 6G. It not only supports high capacity but can achieve wide-area coverage, especially in urban and dense environments using the same deployment infrastructure as that used for 5G in the 3.5 GHz band. As described in the response to Question 13 below, research has shown that with the new innovative 6G technologies, bands like 6GHz can achieve wide-are coverage, transforming the U6 GHz band to a coverage band for 6G and the primary band for 6G deployments. Hence, Qualcomm believes that U6 GHz should be awarded under similar licensing conditions to the 3.5 GHz in the UK to enable broad 6G coverage.

12. Do you have a view on the amount of spectrum that should be prioritized for mobile under the prioritized spectrum split option?

As noted above, Qualcomm believes that the entire upper 6 GHz band should be made available for mobile use without undue restrictions and become the home of the next generation of wireless technology. The U6 GHz is the only feasible spectrum opportunity to launch wide-area 6G in the UK and in Europe at the end of this decade, as Europe has opposed identification of additional IMT resources in the range 7.250 – 8.400 MHz at WRC-23. It's notable that this range could possibly be extended by additional 125 MHz in the 7.125 – 7.250 GHz (under sturdy for WRC-27).

U6 GHz spectrum responds to capacity and coverage needs for 6G immersive communications usage scenarios and helps reducing CapEx by enabling the reuse of existing base stations sites. Without wide-area, wide-bandwidth channels for 6G mobile systems (e.g., 200 to 400 MHz-wide), such as those available in the Upper 6 GHz band, 6G systems will be unable to provide comparable multi-Gigabit speeds to large numbers of mobile users outdoors and in other locations where mobile systems are the only source of connectivity. U6 GHz as a primary 6G band will facilitate larger blocks sizes compared to those available in current harmonized bands. This would be particularly beneficial for targeted new 6G services that require larger bandwidth. Furthermore, on the basis of this spectrum being made available, new usages not initially targeted when developing the technology roadmap could emerge triggered either by new technology opportunities or by evolving MNOs' strategies.

Furthermore, the EU and its Member States have allocated €11 billion to 6G research and development programs[10], but access to the entire upper 6 GHz spectrum band is key to ensuring the successful deployment of these technologies. Making the upper 6GHz available for initial 6G launch is also critical, because coordinated timing for a launch of 6G services does not appear practical at EU level in the current harmonized bands due to technology neutrality and operators' migration plans for switching to enhanced technologies. Timing of 6G launch will depend on mobile operator's strategy, availability of spectrum resources and expiration dates of existing authorizations. Therefore, the availability of an additional spectrum band such as U6 GHz could facilitate coordinated timing for 6G launch.

It is important to note the following:

[10] https://connecteurope.org/insights/reports/state-digital-communications-2022

- Segmenting the upper 6GHz spectrum will result in compromising IMT use cases, especially considering 6G adoption by the end of the decade, because of smaller bandwidths available for the operators
- Segmentation will create artificial spectrum scarcity resulting in expensive spectrum auctions - telecom Industry was drained already by expensive spectrum auctions (EUR 24.7 billion for pioneer bands in 2022 and expected to reach about 35 billion euros for 5G[11])
- Segmentation will drive up the costs of the transmitted traffic unit (EUR/G Byte)

Thus, Qualcomm would like to encourage Ofcom to:

- Make available the entire upper 6GHz band (6425 – 7125 MHz) for full power macro base station deployments and without undue regulatory restrictions to mobile
- Extending the upper 6GHz band with additional 125 MHz in the 7125 – 7250 MHz range (through WRC-27 process)
- make available at least 200 MHz of contiguous spectrum per MNO in upper mid bands in the range 6425 – 7250 MHz

13. Do you have any evidence or views about the geographical extent of mobile networks' likely deployment in the Upper 6 GHz?

Qualcomm's 6G R&D has been focusing on numerous innovative technological solutions, including implementing next generation Giga-MIMO technology that will provide wider coverage using the same network deployment architecture akin to that available in the lower 3 GHz band. For example, the Giga-MIMO technology will increase the number of antenna elements from 192 for typical 3.5 GHz systems to 1024 (or more) for 6G U6 GHz base stations, resulting in higher antenna gain without increasing power consumption. Uplink waveform switching allows devices to operate their power amplifiers closer to maximum output. Higher power device classes, up to 29 dBm (+6 dB from typical 3.5 GHz devices), and more antennas on devices (e.g., 4 antennas instead of 2 at 3.5 GHz, leading to +3 dB enhancement) are also being developed. As a result, 6G network deployments will be more cost-efficient, allowing for more universal connectivity at affordable prices.

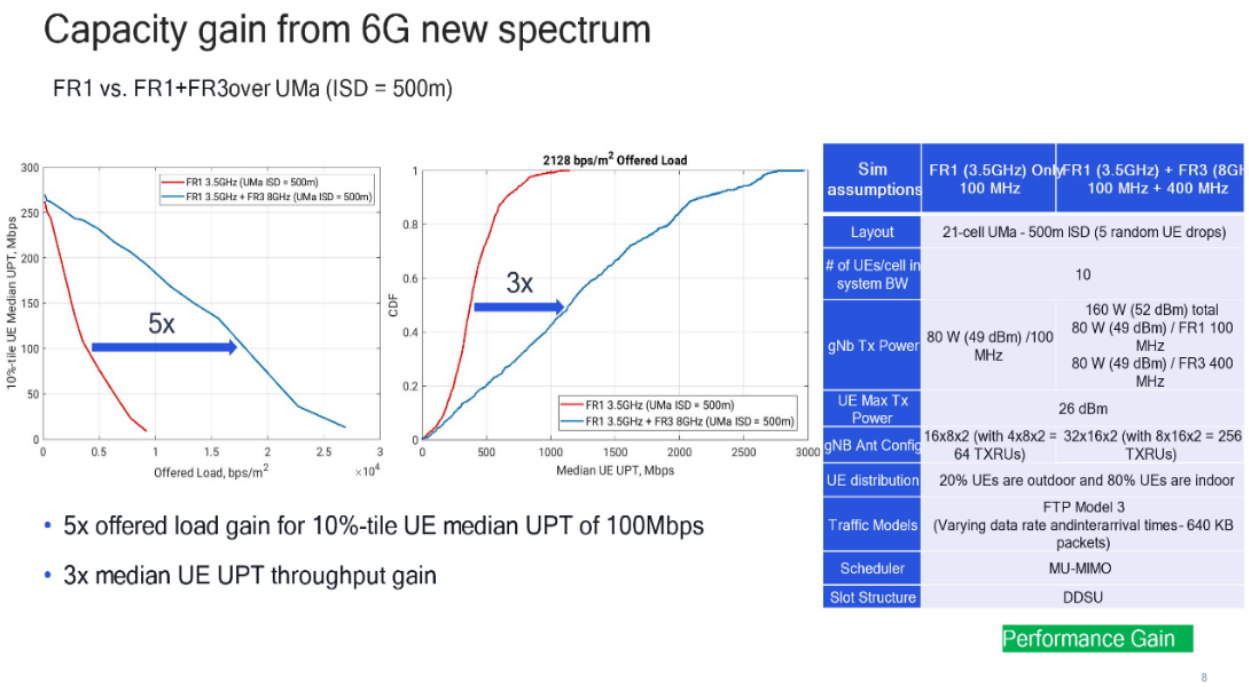
At MWC 2025, Qualcomm demonstrated that 6G systems using the 8 GHz band (a band above the U6 GHz with more challenging propagation characteristics) can provide comparable performance and coverage (indoors and outdoors) to that of 5G systems using 3.5 GHz spectrum.[12] The capacity gain and coverage using 8 GHz are shown in the below slide. Thus, Qualcomm respectfully disagrees with Ofcom's statement that the Upper 6 GHz spectrum band is "poor for indoor coverage."[13] Moreover, in challenging scenarios, like deep indoors, carrier aggregation can extend service by combining U6 GHz band carriers with those from lower frequency bands. Energy-efficient materials, such as frequency-selective surfaces, are also

[11] https://www.vodafone.com/news/public-policy/open-letter-european-telecom-companies-6ghz-spectrum

[12] https://www.qualcomm.com/news/onq/2025/02/mwc-barcelona-2025-tech-advancing-us-to-next-era-of-wireless-connectivity

[13] See Ofcom Consultation at page 7. Qualcomm agrees with Ericsson, Three and Vodafone statements in the responses to the July 2023 Consultation "that the Upper 6 GHz band could achieve similar coverage to the 3.4–3.8 GHz band (using higher radiated powers)." See Ofcom Consultation at 7.

being considered. Thermal-efficient buildings also can feature designs that reduce losses at 6 GHz compared to the C-band, including windows with target frequency selectivity.



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14. Do you have any comments on our proposed phased approach to authorization of both Wi-Fi and mobile in the Upper 6 GHz band?

As noted above, Qualcomm is concerned that Ofcom's phased approach proposal will compromise Ofcom's ability to designate at a later time the U6 GHz band for commercial mobile especially since this band will be instrumental to the deployment of 6G. The proposed phased approach will result in effectively "polluting" the band with numerous license-exempt devices that cannot be located once they are set in operation, cannot be shut down unless the user shuts them down and cannot be otherwise controlled. This "incumbent" status that license-exempt devices will 'de facto' obtain will compromise the adoption and deployment of next generation wireless systems that have been targeting this band as its primary band and will place the UK in a disadvantageous position.

Any phased approach without appropriate sharing mechanisms will in effect predetermine the future of wireless cellular technologies in the UK. Even more, a phased approach will disincentivize the wi-fi industry from collectively working with the IMT industry to assess and agree on a sharing mechanism.

15. Do you have any comments on our proposal to not include very low power portable devices in the Upper 6 GHz band at this stage, but to keep this under review?

Qualcomm agrees with Ofcom's proposal to refrain from authorizing very low power portable devices in the upper 6 GHz, for the same reasons listed in the answer for question 14.

16. Do you have any comments on our proposal to authorize the use of low-power indoor Wi-Fi access points and client devices to use 6425–7125 MHz?

As commented above in the responses to previous questions, Qualcomm is not supportive of the phased approach that introduces Wi-Fi use in the upper band 6GHz band in the near future and potential IMT technology in the future.

17. Do you have any comments on the proposed technical conditions?

Qualcomm does not support Ofcom's proposal to authorize low power indoor Wi-Fi use on a license-exempt basis across the entire Upper 6 GHz band and proposes to align with the harmonized technical conditions that will be developed by CEPT, once they become available.

18. Do you have any comments on the proposed VNS draft?

No comment

19. Do you have any suggestions for an appropriate mechanism for enhanced sensing, or comments on the proposed solution above?

Qualcomm had been working closely with the UK Department for Science, Innovation and Technology (DSIT) evaluating suitable sensing mechanisms for the co-channel deployments between IMT and Wi-Fi. If properly designed, standardized, tested and enforced, cross-technology signaling (XTS) transmitted by Mobile base station and UE can enhance Wi-Fi sensing capabilities and reduce potential for interference between two technologies. Utilization of Wi-Fi waveform based XTS design simplifies detection and makes it technically feasible to trigger suitable interference avoidance mechanisms, such as Wi-Fi vacating the channels where interference with Mobile service may occur.

20. Do you agree with our proposal to restrict Wi-Fi from transmitting in the 6650-6675.2 MHz band to protect the radio astronomy service? Please provide any technical evidence to support your view.

Qualcomm does not support Ofcom's proposal to allow Wi-Fi equipment anywhere in the U6 GHz band.

21. Do you agree with our assessment of Wi-Fi coexistence with existing users of the band? If not, please provide details.

Qualcomm agrees with Ofcom's assessment that low power indoor Wi-Fi likely will not cause interference to existing users of the band.

22. Do you have any evidence about the costs to operators of moving fixed links in and around "high density" areas (such as urban centers) to other bands?

Qualcomm agrees with Ofcom that the benefit to citizens and consumers of using U6 GHz for mobile in high density areas is likely to be greater than that of fixed links, and therefore a relocation of these links is highly recommended to avoid interference. Qualcomm believes that 6G deployment of the U6GHz band should not be limited to high density areas thus fixed links outside high-density areas should also be considered for relocation. Qualcomm does not have adequate information about the costs of relocation of fixed links

23. Do you have any comments on our initial assessment of our likely approach to coexistence between future mobile use and current users in the Upper 6 GHz band?

At this point in time, on a preliminary basis, Qualcomm agrees with Ofcom's initial assessment of the possible coexistence between mobile use and current incumbent operations in the Upper 6 GHz band.

Qualcomm agrees with Ofcom's assessment that it is unlikely that fixed links could be protected from interference from mobile base stations without causing significant interference, making relocation of the fixed links necessary.

24. Do you have any other comments on our policy proposals or any of the issues raised in this document?

Qualcomm notes that 6G research and standardization activities are accelerating globally. 3GPP has already started the process of 6G standardization with its Workshop in March 2025, which focused on proposals for the Radio Access Network (RAN), including the physical and media access control (PHY/MAC) layers, other protocol levels and system architecture aspects. 3GPP is scheduled to undertake study items at the RAN Plenary-level, that will address use cases, requirements and KPIs, and on the study group level, which will focus on how the requirements will be met technically and corresponding evaluation methodologies before the end of the year.

At the same time, Ofcom's proposed band sharing scenario is likely to result in a sub-optimal regime where the upper 6GHz band will be polluted by low power Wi-Fi devices making an otherwise prime spectrum band undesirable (and probably not as valuable) for mobile operators for their 6G deployments. Allowing opportunistic Wi-Fi use of the entire band will compromise the desirability of the U6 GHz band by commercial mobile services, inadvertently impacting mobile networks capability to meet future customer needs. As a result, it will deprive mobile operators of using this new upper mid-band spectrum that will be deployed elsewhere around the globe as the primary band for 6G.