Hewlett Packard
Enterprise

# Response to the Public Consultation on “Expanding access to the 6 GHz band for mobile and Wi-Fi services” issued by Ofcom UK on the 13th of February 2025

**7th May 2025**

# Introduction

Hewlett Packard Enterprise (HPE) appreciates the opportunity to respond to Ofcom's Public Consultation on "Expanding access to the 6 GHz band for mobile and Wi-Fi services" that was published on the 13th of February 2025.

HPE is a global technology leader focused on developing intelligent solutions that allow customers to capture, analyse and act upon data seamlessly from edge to cloud. Our edge to cloud vision is founded upon the GreenLake hybrid cloud platform which allows users to operate and securely manage data between their public and private clouds, on-premises infrastructure and edge solutions. Its Aruba Networking division is a global leader in Enterprise Network and Mobility Solutions and the world's second largest provider of Enterprise Class Wireless Access Points. In 2021, HPE Aruba Networking was the first company worldwide to commercially launch an enterprise-grade 6 GHz Wi-Fi Access Point. With the acquisition in June 2023 of Italy-based company Athonet, a leading provider of Private 5G network solutions, we further extended our managed connectivity, Secure Access Service Edge (SASE), and edge compute portfolios which enables us to address the private networking needs of both enterprises and telecom network operators even better.

We would like to stress that HPE does not favour any particular wireless technology, neither Wi-Fi nor IMT. As a leading provider of enterprise networking solutions, our main interest is to provide the best possible solution for our customers' connectivity needs. As far as the 6 GHz band (5925-7125 MHz) is concerned, we believe that the most efficient use of this band will be achieved by making it available for licence-exempt use in its entirety.

Below please find our response to Ofcom's questions.

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

*Response:*

We see considerable interest from our customers in outdoor and indoor standard power Wi-Fi, particularly for large public venues/sports stadiums, but also for a variety of other use cases including warehouses and logistics centres, large industrial sites, large retail spaces, campus coverage (corporate, higher education, healthcare facilities), community Wi-Fi, transportation hubs (train/bus stations), agriculture, and rural connectivity (FWA). A request we frequently receive from customers is to provide indoor APs with connectorized antennas; this would be particularly important for optimizing indoor coverage by SP APs.

If standard power Wi-Fi is to operate under the control of an automated frequency coordination (AFC) system, we encourage Ofcom to consider authorizing AFC operation in the entire 6 GHz band (5925 – 7125 MHz). In this way, standard power Wi-Fi use cases would benefit from a greater choice of channels. Furthermore, AFC could potentially be used to enable spectrum sharing with other fixed users in the Upper 6 GHz band. AFC-enabled Wi-Fi Access Points will be capable of operating across the full 6 GHz band.

AFC is currently supported on a range of HPE Aruba Access Points, including the following models:

- AP-634, AP-654 (Wi-Fi 6E Indoor)
- AP-674, AP-675, AP-677, AP-679 (Wi-Fi 6E Outdoor)
- AP-734, AP-754 (Wi-Fi 7 Indoor)

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

*Response:*

While our standard power Wi-Fi products operate under the control of an AFC database, HPE itself does not provide or develop AFC databases. However, we do closely cooperate with AFC database providers such as Federated Wireless. In case the UK will authorize SP Wi-Fi and AFC operation in the Lower 6 GHz band, we intend to jointly provide solutions for the UK market as quickly as possible. We note that HPE's standard power Wi-Fi products work with any certified AFC database that complies with the respective WinnForum/Wi-Fi Alliance standards.

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

*Response:*

To enable fast adoption of SP Wi-Fi plus AFC in the UK, regulatory and technical barriers to entry should be low. Hence, HPE encourages Ofcom to base its technical and regulatory framework on those implemented in the US and Canada (such as the FCC's rule on AFCs [47 CFR Part 15.407(k)(l)(m)], along with OET KDB 987594, and Canada's RSS 248). Being able to use existing technology which has already been field-tested and proven will make it easier for AFC operators and equipment providers to serve the UK market.

Ofcom will need to ensure the AFC provider can access and retrieve data concerning incumbent operations. While this information exists in its own incumbent database, Ofcom would need to assess if it is complete, accurate, and updated regularly. Ofcom should also review whether a daily query to the incumbent database will be necessary or whether the query period can be extended without compromising protection of incumbents.

**Question 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?**

*Response:*

We believe that in order to minimise implementation cost and accelerate availability of standard power Wi-Fi solutions in the UK, Ofcom should as closely as possible follow established processes such as those implemented by the FCC and ISED. This should accelerate the approval process for AFC operators that have already been certified by the US, Canadian, or other competent national regulatory authority.

AFC databases approved by Ofcom should comply with established standards (WInnForum, Wi-Fi Alliance) to enable swift deployment and ensure wide-ranging interoperability.

HPE recommends that Ofcom authorize multiple AFC operators, rather than limiting the market to a single provider. A multi-operator model promotes innovation, enhances competition, and mitigates risks associated with reliance on a single point of service.

**Question 5: Please provide any other comments on our proposals for extending access to standard power Wi-Fi and outdoor use, including the overall approach, any details on technical parameters and the running of the AFC databases in this band.**

*Response:*

We recommend that Ofcom include Simultaneous Composite Access Points (SCAPs) in its respective regulation. These devices which are capable of operating at both Low-Power Indoor (LPI) and Standard Power levels would use an AFC service for Standard Power operations and support all client device types (LPI, Standard Power, Very Low Power). While there is a large base of LPI-only clients in the field, an increasing number of clients can operate at Standard Power or both Low Power and Standard Power levels. Ofcom should therefore consider authorising the operation of SCAPs for indoor-only use. This would reduce installation and operating costs for end users by eliminating the need for installing separate LPI and Standard Power Access Points, or Access Points equipped with both LPI and Standard Power radios. Fewer radios will also reduce energy consumption and improve spectral efficiency by reducing the amount of beaconing and probe responses.

For SP indoor operation, we ask Ofcom to allow AFC systems to incorporate associated Building Entry Loss (BEL) in AFC operating parameter calculations.

Furthermore, we suggest that Ofcom allow for device antenna directionality to be taken into account by the AFC system for its channel and power availability calculations. This would be helpful for use cases such as point-to-point Fixed Wireless Access (FWA) or directional coverage of areas such as logistics facilities and stadiums.

HPE encourages Ofcom to swiftly proceed with launching a specific public consultation on the detailed implementation of AFC systems supporting SP Wi-Fi in the UK.

**Question 6: Do you have any comments on our proposal to use a "phased" approach, or on the alternative to wait for European harmonisation?**

*Response:*

HPE strongly supports Ofcom's below proposal for a phased approach:

- Phase 1: Authorising low power indoor (LPI) Wi-Fi in the whole of the Upper 6 GHz band as quickly as possible.
- Phase 2: Authorising mobile once the outcome of European harmonisation is clearer.

We encourage Ofcom to authorise LPI Wi-Fi operation in the 6425-7125 MHz band before the end of this year. Considering that currently installed 6 GHz enterprise Wi-Fi equipment is capable of operating across the full 6 GHz band, we ask Ofcom to put measures in place to minimise certification/re-certification efforts for such equipment when new firmware becomes available that enables operation in the Upper 6 GHz band.

We do not support the alternative approach, i.e., to wait for European harmonisation before authorising Wi-Fi and before authorising spectrum for mobile. Given the time frame of the European Commission's Mandate on the Upper 6 GHz band, a harmonized regulation for Europe is unlikely to enter into force before 2028. The subsequent implementation of the EC Decision by EU Member States can take up to another two years. This means that the Upper 6 GHz band would sit idle (not considering incumbents' continued use of the band) for several years while a fully-fledged 6 GHz Wi-Fi ecosystem is in place with

a wide range of products being ready to be deployed[1]. This delay would widen even further the competitiveness gap between the countries that already opened the full 6 GHz band for licence-exempt use and those who did not.

We share Ofcom's view that mobile should not be authorised in the band before the outcome of the European harmonisation process becomes clearer. Given the absence of credible use cases for public mobile networks in the Upper 6 GHz band, it is highly questionable whether any significant demand will arise by 2030 and beyond.

In this context, we would like to highlight that the use case targeted by the IMT industry rather obviously is not to provide additional capacity to mobile users in areas of congestion but to provide Fixed Wireless Access (FWA) in urban areas. As by 2030, close to 100 percent of these areas will be covered by fibre, FWA would be in competition with fibre and jeopardize the return on the enormous investments made for the fibre build-out. Furthermore, FWA would not be able to deliver downlink data rates and latencies comparable to those provided by fibre, as various field trials demonstrated. In the uplink direction, the performance disparity is even more pronounced, due to the limited transmit power of IMT user equipment (UE) which is at least 60 dB lower than that of the IMT base station (BS) and the higher signal attenuation (compared to the 3.5 GHz band) in the Upper 6 GHz band. In ECC PT1, some mobile network operators (MNOs) declared that they would not use the Upper 6 GHz band for the uplink. For small and medium enterprises and home office workers who require higher uplink data rates, FWA would not be a feasible solution.

Another very important aspect is that an FWA CPE will have to connect to a Wi-Fi router, either an external unit or, more commonly, an integrated one, to connect to the indoor network which typically comprises a variety of Wi-Fi devices. According to a 2023 survey conducted by Vodafone in several European countries including the UK, the average number of connected Wi-Fi devices in a home was 12[2]. It is expected that by 2027, more than 50 percent of UK homes will be smart homes[3] featuring a considerable number of connected devices, ranging from personal computers, smartphones, and tablets to audiovisual equipment to cameras, doorbells, lightbulbs, and sensors.

To fully exploit the performance delivered by fibre, such as multi-gigabit symmetrical data rates and very low latency, users need to be able to use the full 6 GHz band.

Because of the aforementioned limitations of the access network, FWA users' Internet experience would probably not be significantly impacted by having only the Lower 6 GHz band available for Wi-Fi. Hence, FWA operators (i.e., the big MNOs) would have an incentive to prevent Wi-Fi from getting access to a large part or all of the Upper 6 GHz band because this would effectively negate the competitive advantage of fibre.

[1] https://wifinowglobal.com: More than 5000 Wi-Fi device models with support for 6 GHz operation were announced or made available during 2021-2024
[2] https://www.vodafone.com/news/products/home-wi-fi-usage-increases-as-european-households-become-more-digital
[3] https://www.tnssolutions.co.uk/post/how-many-smart-homes-are-there-in-the-uk

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

*Response:*

HPE agrees with Ofcom's assessment that the risk of "legacy" Wi-Fi devices creating interference to mobile would be small and manageable. Wi-Fi clients only use channels they are authorized to by the AP they are connected to. Enterprise APs are centrally managed, their locations are known precisely (HPE's 6 GHz APs are self-locating in the 3D space with sub-1 metre precision), and their transmission characteristics can easily be updated according to operational or regulatory needs. Firmware updates are regularly provided by the manufacturer, either directly or via contracted system integrators. Consumer Wi-Fi gateways are typically provided and managed by the network operator/Internet service provider. In the UK, over 85% of broadband customers get their service from one of the big four providers: BT Group, Sky, Virgin Media, and TalkTalk[4]. Aftermarket devices can equally be identified by their user credentials, so that the locations of most, if not all Internet-connected Wi-Fi routers/gateways can be determined by the operators with reasonable precision.

Protocols for remote management of broadband customer premises equipment (CPE) that were developed by the Broadband Forum (BBF), such as TR-069/TR-181 and TR-369 have been widely implemented. The Wireless Broadband Alliance (WBA) developed an architecture for operator-managed Wi-Fi[5] which is based on the BBF standards mentioned above.

To prevent consumer Wi-Fi APs which cannot be directly accessed or controlled by an operator or manufacturer (e.g., APs that are not connected to the Internet), Ofcom could consider authorizing access to the Upper 6 GHz band only for devices that can be remotely configured by an operator.

**Question 8: Do you have a view on the amount of spectrum that should be prioritised for Wi-Fi under the prioritised spectrum split option? Please provide evidence for your view.**

*Response:*

Our ask to Ofcom is to allocate at least an additional 400 MHz of spectrum in the Upper 6 GHz band (i.e., 6425-6825 MHz) for Wi-Fi use as soon as possible and subsequently establish a regulatory framework allowing enterprises and other entities to obtain local licenses for operating Wi-Fi networks in the remaining part of the Upper 6 GHz band (6825-7125 MHz).

We will explain our reasoning below, but first we would like to provide some background information on the spectrum needs of Wi-Fi Enterprise Networks.

The vast majority of enterprises use the internet for various purposes such as communication, marketing, and sales[6]. Between 2016 and 2023, business internet traffic has increased fivefold[7] (we note that in addition to Internet traffic, enterprise networks can carry a considerable amount of Intranet traffic).

The evolution of enterprise Wi-Fi networks has been a dynamic journey marked by significant technological advancements and changing business needs. Initially, Wi-Fi networks were primarily used

[4] https://www.choose.co.uk/broadband/guide/market-share/
[5] https://wballiance.com/omwi-phase-2/
[6] https://www.jcchelp.com/how-many-businesses-use-the-internet/
[7] https://graphiant.com/reviving-the-business-internet-a-roadmap-to-restoration/

for basic internet connectivity, providing employees with wireless access to corporate resources. However, as technology progressed, so did the demands placed on enterprise Wi-Fi networks.

As the number of Wi-Fi-enabled devices proliferated and bandwidth-intensive applications became commonplace, enterprises began facing challenges related to network congestion and performance. Furthermore, the rise of the Internet of Things (IoT) and the influx of connected devices further necessitated enhancements to enterprise Wi-Fi networks.

Nowadays, enterprise Wi-Fi networks realize a large variety of use cases and applications. What all these use cases have in common is the ever-increasing need for bandwidth and capacity.

When we speak of enterprise networks, we are not just talking about factories, warehouses, and carpeted office spaces. The vast majority of enterprise networks are privately managed, but publicly accessible. They are universities, schools, concert venues, hospitals, airports, hotels, and malls. When you go to work or to school, when you go shopping, when you travel, when you go out on a date or take in a ballgame, you are on enterprise Wi-Fi. The viability of the consumer client Wi-Fi market depends on enterprise venues continuing to view Wi-Fi as an attractive investment.

Enterprise Wi-Fi networks are meticulously engineered to maximize availability and reliability and optimize performance parameters such as per-user throughput and latency. AP placement and RF characteristics are carefully tuned to minimize inter-cell interference and reduce the impact of interference from external sources.

With the introduction of Wi-Fi 6, Wi-Fi networks have become more deterministic which – in combination with the opening of the 6 GHz band – has significantly expanded the addressable market, particularly in industrial, medical, and other critical applications. It was not accidental that Wi-Fi 6E adoption was initially driven by enterprise usage.

Since the opening of the 5925-7125 MHz band for Wi-Fi in the United States and other countries, we have seen a surge in 6 GHz deployments by universities, large public venues (such as sport stadiums, concert halls, and conference centres), and major healthcare facilities.

While not all enterprise applications will need to use the full 6 GHz band, some of them do, as shown in the examples provided below. Large enterprise Wi-Fi networks which can comprise thousands of access points require significant investments which need to be protected, and those that fulfil operation-critical functions need to have reliable and predictable access to spectrum.

**Large public venues**

Large events, such as concerts, conferences and in particular sports events can draw tens of thousands of attendees who concurrently use Wi-Fi, transferring tens of Terabytes[8], at speeds of up to and exceeding one hundred Mbps per user. The amount of uplink traffic now frequently exceeds that of downlink traffic as spectators increasingly stream HD video to the cloud.

Until a few years ago, 20 MHz was the channel width of choice in high-density deployments. This was because per-user data rates were low and in terms of performance it was advantageous to have more lower-bandwidth channels than fewer larger bandwidth channels. This principle still holds true but with bandwidth and capacity needs growing dramatically, channel widths have increased to currently 40 MHz and 80 MHz and are expected to increase further to 160 MHz in the near to mid-term future. Enterprise Wi-Fi deployments have become much denser, with typical office designs implementing nine or more

[8] https://stadiumtechreport.com/feature/ohio-state-sets-new-top-wi-fi-mark-34-8-tb-at-michigan-game/

discrete channels and designs for large public venues such as arenas and convention centres utilizing as many as twenty-three and more distinct channels. In general terms, the coverage area for an enterprise indoor access point has decreased from ~500-1000 square metres in 2003, to ~250 square metres by 2010, to less than ~150 square metres today. It should be noted that Wi-Fi design for very large public venues is quite different than for a typical business environment and AP coverage areas are frequently smaller than 100 square metres.

An increase in capacity, i.e., per-user throughput can be achieved by using wider channels and/or densification. Densification, however, only works up to a certain point; just adding APs is not a solution because of co-channel inter-cell interference.

Unlike in the US, the permissible channel power in the CEPT area does not increase with channel width. As the noise floor increases with channel width, larger channel widths result in smaller cell sizes (for a given MCS/SNR) which enhances the need for more non-overlapping channels.

In a very dense deployment such as an indoor arena, there is typically one AP per 50-60 clients. As there is little to no RF spatial reuse inside indoor arena bowl areas, co-channel interference is a major issue. To minimize co-channel interference (CCI), the physical distance between same-channel cells must be sufficiently large; at the same time, cell size must be sufficiently small to maximize per-user throughput and minimize latency. The more non-overlapping channels are available, the better these requirements can be satisfied, as illustrated in Figure 1. While this image is a 2-dimensional representation, in a multi-storey building there will also be access points deployed on the floors above and/or below, and channel planning becomes a 3-dimensional effort.

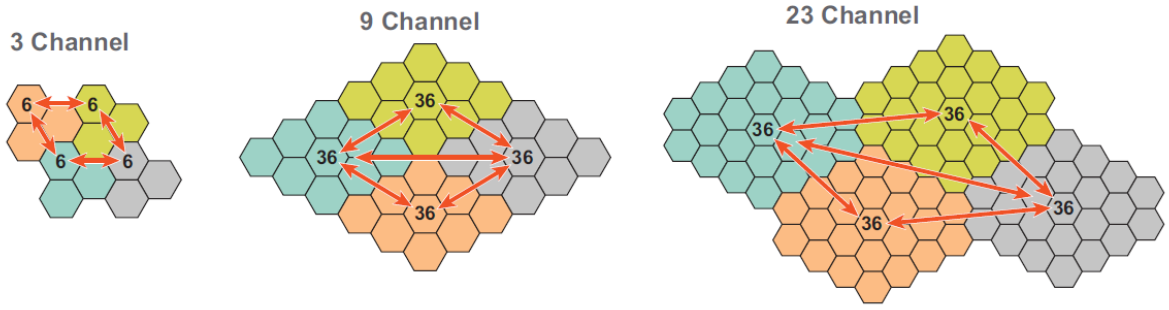


*Figure 1: Adding channels increases same-channel reuse distance*[9]

Depending on the size of the arena and the coverage strategy employed, it is normal to have anywhere from 5 to 25 APs on every channel[10].

For an indoor arena with 18,000 attendees such as the Chase Center in San Francisco, approximately 300 APs and a minimum of 15 non-overlapping channels are required. This is a conservative calculation which assumes 60 clients per AP and 20 APs per channel and does not consider all the other services that are provided in the Center via the Wi-Fi network. In real deployments, the maximum possible number of non-overlapping channels is used.

[9] Aruba Networks: *Very High-Density 802.11ac Networks, Engineering and Configuration Guide, Version 1.0*
[10] Aruba Networks: *Very High-Density 802.11ac Networks, Scenario 2: Large Indoor Arena, Version 1.0*

Ofcom proposes to open an additional 160-400 MHz of spectrum in the Upper 6 GHz band for Wi-Fi use which would increase the number of 80 MHz channels in the 6 GHz band to 8-11 (Table 1). (The figures in brackets denote the total number of 80 MHz channels available in the 5 GHz and 6 GHz bands combined).

| Spectrum option | Total amount of 6 GHz spectrum available for Wi-Fi | No. of 80 MHz channels |
|---|---|---|
| Lower band only | 500 MHz | 6 (11) |
| + 160 MHz | 660 MHz | 8 (13) |
| + 320 MHz | 820 MHz | 10 (15) |
| + 400 MHz | 900 MHz | 11 (16) |
| Full band | 1200 MHz | 14 (19) |

*Table 1: Number of available 80 MHz channels – Comparison of options*

For certain Wi-Fi use cases such as large public venues (LPVs) with very high user densities, 16 channels will not be sufficient, especially when planning for the future.

Let us take the following example:

Mobile clients typically do not support more than two spatial streams. Using MCS-11 in an 80 MHz channel requires a minimum SINR of -46 dBm and provides a physical layer data rate of 1.2 Gbps. Very dense Wi-Fi networks are typically dimensioned for 30 percent channel load, but we will be conservative here and assume a target channel load of 50 percent. Considering 10 percent protocol overhead, the capacity per channel (i.e., AP) is 540 Mbps.

Per user, an average bit rate of 5 Mbps is to be provided, so that each AP could feed 108 concurrent users per 80 MHz channel. Keep in mind that 5 Mbps is an average value and that peak demand can be significantly higher, mostly due to the growing number of attendees at large events who upload or stream live video to the Internet. A 4K video stream typically requires a bit rate between 35 and 45 Mbps[11]; in this example we choose a value of 40 Mbps. Assuming that at peak times 10 percent of users (i.e., 11 users per AP) stream 4K video, the required capacity is 440 Mbps, leaving only 100 Mbps for the remaining 97 attendees, or just about 1 Mbps per user (assuming channel load remains unchanged. A higher channel load means more packet collisions which would negatively affect overall performance).

By densifying and reducing the number of clients per AP to 60 (like in the Chase Center deployment), the peak capacity required for 4K video is 240 Mbps, leaving 300 Mbps for the remaining 54 clients, which approximately matches the targeted rate of 5 Mbps per client.

As mentioned above, CCI is critical in high-density environments. Therefore, the more non-overlapping channels are used, the larger the isolation between cells operating on the same channel and the lower the CCI.

If a sufficiently large number of 80 MHz-wide channels is not available, almost twice as many 40 MHz channels or four times as many 20 MHz channels have to be used to provide the same capacity.

Table 1 shows an example calculation of the number of channels needed and available in the full 6 GHz band and only the Lower 6 GHz band. In Table 2, the total numbers of channels available in the combined 5 GHz and 6 GHz bands are shown.

[11] https://support.google.com/youtube/answer/1722171?hl=en#zippy=%2Cbitrate

| Channel width [MHz] | 80 | 40 | 20 |
|---|---|---|---|
| Required no. of channels (full 6 GHz band) | 14 | 28 | 49 |
| Available no. of channels (full 6 GHz band) | 14 | 29 | 59 |
| Available no. of channels (lower 6 GHz band) | 6 | 12 | 24 |

*Table 2: Example of the number of channels required for high-density deployment vs. the number of channels available in the full 6 GHz band and the lower 6 GHz band*

| Channel width [MHz] | 80 | 40 | 20 |
|---|---|---|---|
| Required no. of channels (5 GHz and full 6 GHz band) | 19 | 37 | 66 |
| Available no. of channels (5 GHz and full 6 GHz band) | 19 | 40 | 81 |
| Available no. of channels (5 GHz and lower 6 GHz band) | 11 | 23 | 46 |

*Table 3: Example of the number of channels required for high-density deployment vs. the number of channels available in the combined 5 GHz and full 6 GHz band / lower 6 GHz band*

A high-density deployment needs a certain number of channels to fulfil the performance objectives. Where the full 6 GHz band is available, the objectives can be fulfilled using 80, 40, or – in theory - even 20 MHz wide channels[12]. The latter option, however, would not be feasible, neither economically (because of the large number of APs to be installed[13]) nor technically (high levels of CCI because of small AP spacing).

If only the Lower 6 GHz (and 5 GHz) bands are available, the performance targets cannot be achieved.

Large indoor arenas[14] such as the Principality Stadium in Cardiff (Wales) can accommodate about 80,000 attendees. At major football matches in the US, more than 60 percent of attendees concurrently used Wi-Fi[15]. In the exemplary case of the Principality Stadium there could be approximately 48,000 persons concurrently using Wi-Fi for uploading or downloading content. With 60 clients per AP, the Principality Stadium would need to be equipped with 800 APs. With 19 usable 80 MHz channels, there would be 42 APs per channel, considerably more than the "typical" 25 APs per channel which means that even if the full 6 GHz band were available, providing the targeted capacity would be challenging.

Each high-density deployment is unique which makes it very difficult, if not impossible to produce a generic formula that gives a certain configuration for a certain performance objective. Depending on the venue, APs will be placed under seats or in handrails which allows very fine-grained coverage or under ceilings which provides for wider coverage but increases CCI, or combinations of the different solutions.

**Education**

In 2022, the University of Michigan (UMich) deployed a new Wi-Fi network comprising more than 16,000 Wi-Fi 6E access points. With greater capacity in the 6 GHz band and wider channels up to 160 MHz, download speeds of up to 750 Mbps and enough bandwidth to support 70,000 concurrent Wi-Fi

[12] The calculation for 40 and 20 MHz wide channels considers that for the same cell size as with 80 MHz channels, MCS 12 and 13, resp. could be used, resulting in higher channel capacity.
[13] Deploying multi-radio APs capable of simultaneously receiving and transmitting in multiple bands could reduce the total number of APs, albeit at an additional cost.
[14] Arenas equipped with retractable roofs such as the Principality Stadium are considered indoor locations here.
[15] https://stadiumtechreport.com/feature/ohio-state-sets-new-top-wi-fi-mark-34-8-tb-at-michigan-game/

connections, Wi-Fi 6E brought new capabilities to students, faculty, and staff. UMich facilities include very large classrooms that accommodate up to 500 students at a time, and utilizing AR/VR for teaching a large number of students concurrently requires an adequate number on non-overlapping and sufficiently wide Wi-Fi channels. Another design requirement was that all personal devices should at least be able to receive an HD-quality video stream even at the busiest times and in the most densely populated areas.

An HPE Aruba Networking customer, a major European university whose name we cannot disclose here made the following statement:

"*We would greatly benefit from the upper 6 GHz band due to the density of clients and the corresponding access points. We are increasingly going mobile, which means all students are working solely on Wi-Fi, and now colleagues also follow a 'Wi-Fi first' policy. Due to the high density of access points we currently have, we experience channel overlap in many places.*

*There are also times when students need to download large files simultaneously, such as VM ISOs or similar. To address this, we have provided additional AP density, but this naturally leads to some overlap in certain areas. Naturally, large file downloads with 30+ students on 1 or 2 APs with a 20 MHz channel will take some time.*

*With extra bandwidth on the 6 GHz band, we could deploy more flexibly in the future, using wider channels instead of 20 MHz*".

To further illustrate the issue with wider channels in a higher education setting, consider the images below from Hamina Wireless, a Finnish company specializing in wireless design and troubleshooting.[16]

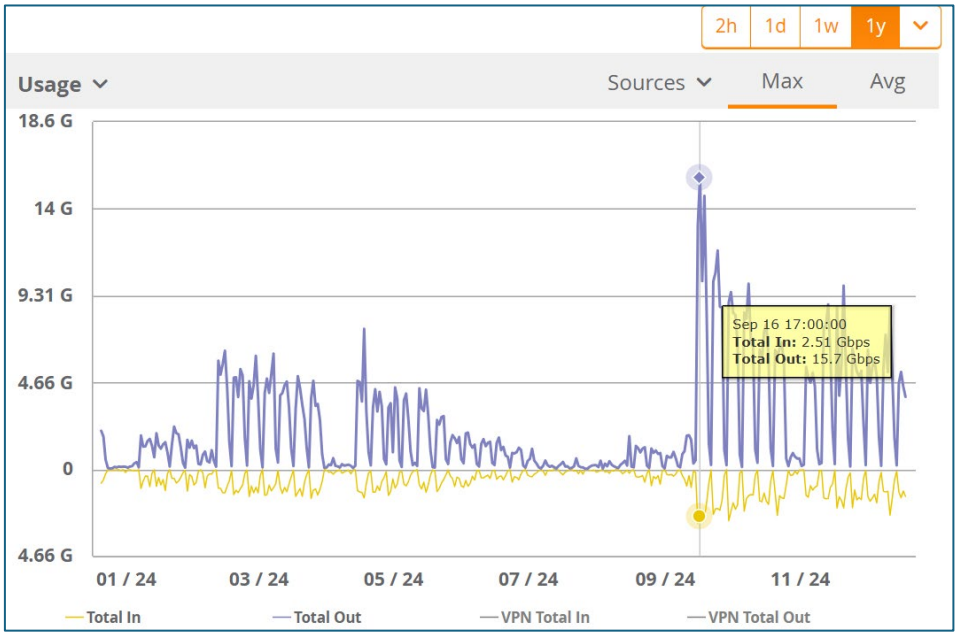


*Figure 2: Belgian University – Wi-Fi Demand Surge as Semester Begins*

[16] https://www.hamina.com/

They represent the 6 GHz Wi-Fi co-channel interference that would be experienced in an actual university academic building (an engineering building at a polytechnic university) seeking to deploy 80 MHz wide channels under two scenarios, the first utilizing the Full 6 GHz band and the second utilizing only the Lower 6 GHz band. Forty-two access points are deployed to cover the 6290 $m^2$ interior space of the building, conforming with the 150 $m^2$ per access point density limit.

With the Full 6 GHz band available (fourteen 80 MHz wide channels), 100% of the university building is "clean" in terms of the interference environment. The 6 GHz channel assignments are noted in the third bubble below each of the access points (the blue circles with the radio nodes).


*Figure 3: University Building Wi-Fi Interference (Fourteen 80 MHz Channels, full 6 GHz Band)*

Hamina shows a very different result when only the Lower 6 GHz band is available (six 80 MHz wide channels). Only 45% of the building is now considered "clean", while 48% would have significant interference and 7% is deemed outright "dirty". This is because with only six channels to assign across the forty-two access points, the increased frequency reuse results in heavy interference.

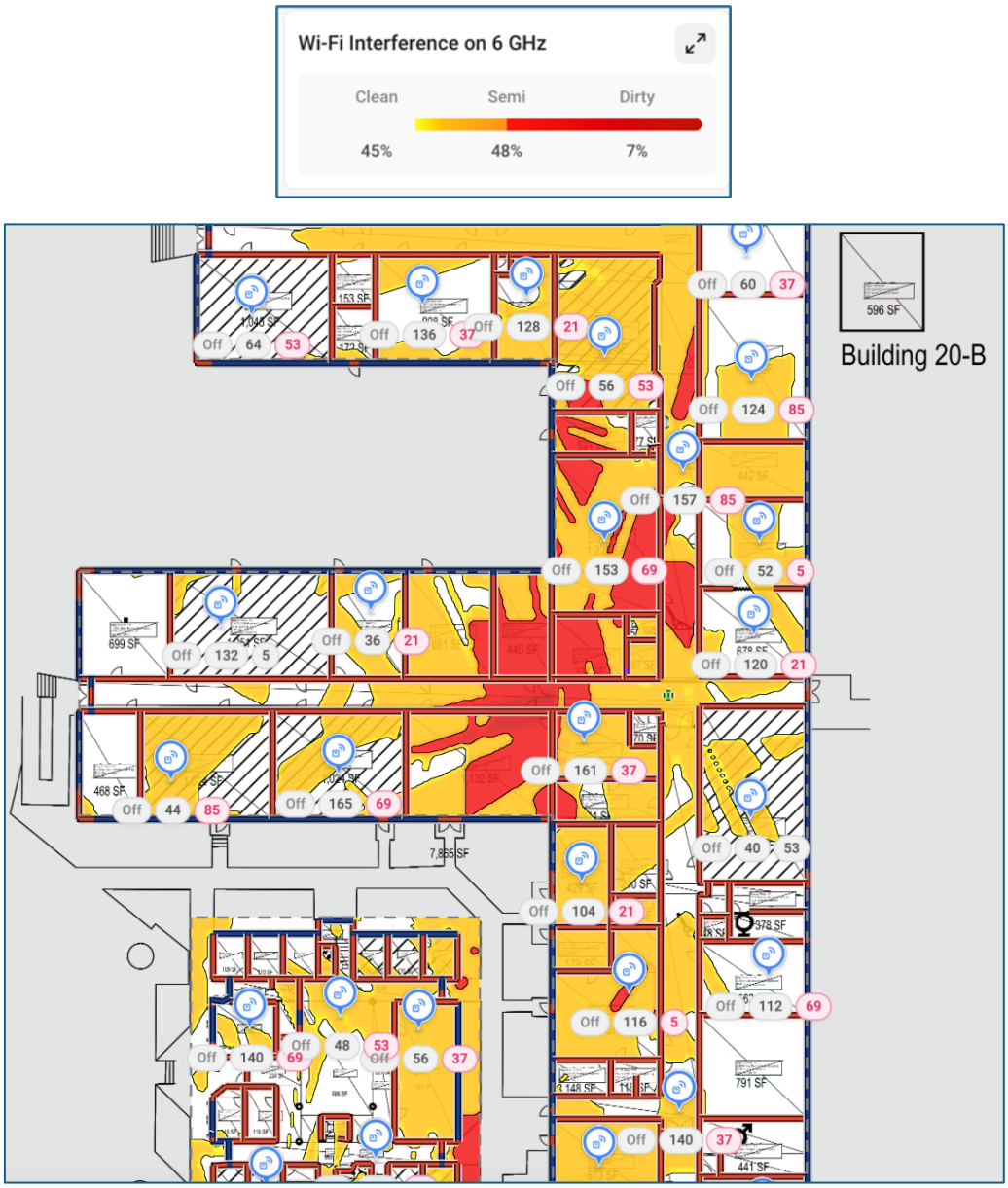


*Figure 4: University Building Wi-Fi Interference (Six 80 MHz Channels, lower 6 GHz Band only)*

Wi-Fi will not operate effectively in such a high interference environment, with interference leading to packet loss and retransmissions, which in turn results in lower data rates, which creates even more contention for transmit time, causing a self-reinforcing negative feedback loop. The conclusion is that Gigabit connectivity will remain out of reach for Europe's students until the full 6 GHz band becomes available for Wi-Fi use.

**Healthcare**

Sidra Medicine (https://www.sidra.org), one of Qatar's leading hospitals increasingly relies on digital solutions to enhance patient care, optimize operational efficiency, and facilitate smooth communication and collaboration among its healthcare professionals. Sidra uses Wi-Fi extensively for over 160 different applications, ranging from Electronic Health Records access and management and advanced diagnostics, over logistics handled automatically by automated guided vehicles, critical environmental monitoring, and intelligent building management, to enhanced medical team communications. To be able to satisfy the ever-growing demand for Wi-Fi capacity, the hospital densified its Wi-Fi Network by increasing the number of access points from 1,500 to 3,000 and upgraded to 6 GHz operation. Now that

the limit for densification is reached, Sidra requires the full 6 GHz band to be able to fully exploit the capability of its network to deliver the additional capacity required during the next seven to ten years.

In July 2024, Ramathibodi Hospital Bangkok gave a demonstration of 6 GHz Wi-Fi enabling the use of AR/VR for medical applications[17]. A comparison was made between using only the three 160 MHz channels available in the Lower 6 GHz band versus the seven channels available in the full 6 GHz band. The results of this demonstration[18] underscored the criticality of the full 6 GHz band for maintaining an optimal user experience under high network loads.

**Office environment**

The images below represent the 6 GHz co-channel interference (CCI) situation on one floor of a multi-storey office building in Lyon, France and were generated during the deployment validation process.

The first image represents the overall 6 GHz CCI situation when sufficient channels are available. In this case, twelve separate channels were available and eleven were deployed on this floor (Chs 5, 13, 21, 29, 37, 45, 53, 69, 77, 85, 93 – denoted in the light blue ovals). The channels were assigned to the fifteen access points providing coverage on this floor (the dark blue circles and single orange circle). There are only a few locations where CCI is noticeable and would slightly degrade performance (the yellow and orange shading).

Keep in mind that there are also access points deployed on the floors below and above this one, and their channels must also be assigned in such a way as to minimize the CCI impacts shown here. In fact, the twelfth available channel (Ch 61) is deployed towards the centre of the floor above, which is why it is not utilized on this floor.

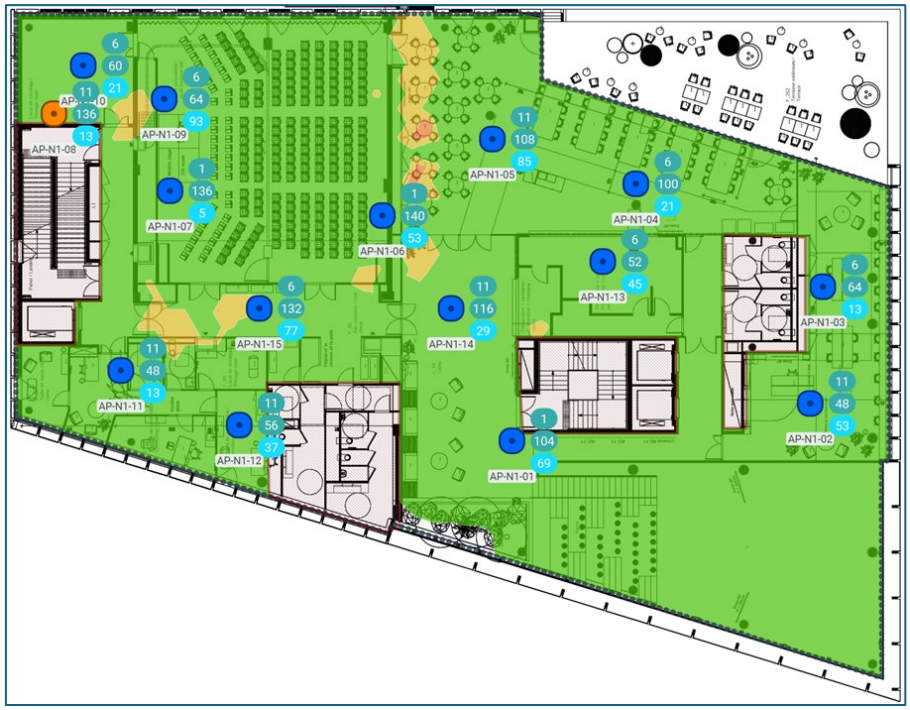


*Figure 5: 6 GHz Interference in Office Building – Lyon, France (Twelve 80 MHz Channels, full 6 GHz Band)*

[17] https://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-and-ramathibodi-hospital-demonstrate-advanced-6-ghz-healthcare

[18] https://youtu.be/OpsOoL0mxaA

The CCI environment is much different when only six channels are available, which is the current situation for 80 MHz wide channels in Europe, where only the lower 480 MHz is allocated for licence-exempt use. In this case, the six channels (Ch 5, 21, 37, 53, 69, 85) are deployed across the same fifteen access points. Even using sophisticated radio resource management (RRM) algorithms to optimize the placement of the access points and channel assignments, the proximity of access points operating on the same channel results in the very high CCI shown in yellow, orange, and red below.


*Figure 6: 6 GHz Interference in Office Building – Lyon, France (Six 80 MHz Channels, lower 6 GHz Band only)*

This level of interference is not viable for a business network, and ultimately the decision was taken to utilize a larger number of narrower channels, meaning that for the businesses in this building the EU's Gigabit target could not be fulfilled. The French network engineer for the Wi-Fi deployment noted that *"more spectrum on the 6 GHz band would allow us to deploy a CCI-free network in this band and benefit from wider [80 MHz] channels at the same time."*[19]

Choosing the European Parliament building for an example, Hamina Wireless recently published a video[20] highlighting the negative consequences a lack of 6 GHz Wi-Fi spectrum can have for connectivity in dense office environments.

**Additional demand aspects**

The growing demand for Wi-Fi spectrum is also driven by businesses and public institutions increasingly replacing their wired infrastructure by wireless. Again, UMich is a prominent example. The University reported that by having the full-band 6 GHz available for providing very high-speed Wi-Fi connectivity, it was able to reduce the number of wired ports and switches across the campus. Almost 80,000 wired ports were removed or reduced which saved several thousand switches. Besides saving on hardware

[19] https://networkjon.wordpress.com/2024/11/05/we-need-more-6ghz-spectrum-in-the-eu/
[20] https://www.linkedin.com/posts/jussikiviniemi_the-eu-needs-more-wi-fi-to-illustrate-this-activity-7316458027400814592-Mvm3/?rcm%3DACoAAAAhudEBZsUZmT4AnkVwBZP-go36uqaPEqY&sa=D&source=calendar&usd=2&usg=AOvVaw3x19UAdqrsZn7mMbZfBdns

costs, fewer switches also means less electronic waste, less power consumption and less heat generated which greatly helped with UMich's overall sustainability goals[21].

Another technical development which will require a considerable of spectrum is Wi-Fi enabled location-based services which are becoming increasingly important not only in large arenas and conference centres but also in retail and logistics. Utilizing 320 MHz wide channels, the future IEEE 802.11bk standard will enable location services with a precision of less than 10 centimetres[22].

**Residential/consumer Wi-Fi**

While HPE Is not active in the consumer Wi-Fi market, we would like to point to the 2024 study on Wi-Fi spectrum requirements in the residential domain conducted by Plum Consulting[23]. The study found that with the five 160 MHz channels (or eleven 80 MHz channels) that are available for Wi-Fi services in the combined 5 GHz and 6 GHz bands. gigabit connectivity will only be achievable in around 50-60% of residential building area. To ensure whole-building coverage, a minimum of ten 160 MHz channels would be necessary, implying that both the 5710-5875 MHz sub-band and the Upper 6 GHz band would need to be made available in Europe.

We trust that Ofcom's decisions about allocating spectrum in the Upper 6 GHz band will be based on facts and consider actual demand and user benefits. In the UK, fixed networks carry more than 96% of data traffic, this is almost twenty-nine times the amount of data carried by mobile networks[24]. Allocating a substantial amount of the Upper 6 GHz band to IMT would increase the existing imbalance between the amount of data transferred and the amount of spectrum expended even further in favour of IMT.

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

*Response:*

HPE strongly supports Ofcom's proposal to authorize low power indoor (LPI) Wi-Fi operation in the 6425-7125 MHz band in Phase 1. We encourage Ofcom to launch Phase 1 as quickly as possible, ideally before the end of this year.

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

*Response:*

To be able to use the additional capacity made available by the Upper 6 GHz band, it will be essential that operation of 6 GHz-capable access points is authorised, as well. Therefore, we encourage Ofcom to authorise operation of 6 GHz-capable LPI access points from the beginning, under the same conditions as those applicable for the 5925-6425 MHz band. We believe that authorising AP operation will have a stimulating effect on demand and supply of 6 GHz-capable Wi-Fi clients which will result in even greater choice and lower prices. By April 2025, more than 5,000 Wi-Fi products were able to operate in the 6 GHz band[25].

[21] https://edtechmagazine.com/higher/article/2022/04/how-university-michigan-upgraded-next-generation-wi-fi-access-points
[22] https://blogs.arubanetworks.com/solutions/wi-fi-location-based-services-how-did-we-get-here/
[23] Plum Consulting, Wi-Fi® Spectrum Requirements, 18 March 2024
[24] Ofcom Connected Nations UK Report 2024 (Published 5 December 2024)
[25] https://wifinowglobal.com/news-and-blog/massive-market-adoption-5000-wi-fi-devices-now-support-6-ghz-1230-support-wi-fi-7-intel-says/

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

*Response:*

We agree with Ofcom's proposal to wait with introducing mobile to the upper part of the Upper 6 GHz band until the situation of European harmonisation becomes clearer. By 2030, when Phase 2 could be launched, it will also be clearer whether a 6 GHz mobile ecosystem has developed and whether there is any actual demand for additional spectrum for mobile services.

In case part of the Upper 6 GHz band will be prioritised for mobile, businesses and institutions (and any other user) operating Wi-Fi networks in the Upper 6 GHz band will need sufficient time to react to the new spectrum requirements. Given the typical timescales between a regulatory decision, the subsequent assignment of spectrum, and the eventual network build-out, we do not expect the Wi-Fi transition will delay IMT rollout.

We also recommend that, during Phase 2, Ofcom carry out further study work and/or trials of potential future sharing methods and mechanisms that could enable enterprise and industrial networks using Wi-Fi in the Upper 6 GHz band to continue providing critical services at certain venues and locations within the spectrum prioritised for IMT operations.

**Question 12: Do you have a view on the amount of spectrum that should be prioritised for mobile under the prioritised spectrum split option? Please provide evidence for your view.**

*Response:*

In the face of low mobile usage (in 2024, mobile accounted for a mere 3.4% of total data usage in the UK[24]) and decreasing mobile traffic growth, we do not see a need for allocating additional spectrum in the Upper 6 GHz band for public mobile networks in the near and medium term.

We do see a high potential for future deployment of local private mobile networks; however, we believe that the 3.8-4.2 GHz band available in the UK is best suited for this purpose.

Furthermore, there is ample mobile spectrum in the millimetre wave (mmWave) bands which can be used to provide high-capacity wireless connectivity, particularly for the FWA use case envisaged by the IMT industry. Below is a list of quotes from an IMT vendor's publication[26] that highlights the benefits of mmWave for FWA:

- *mmWave can be used almost anywhere – urban, suburban and rural areas – without the need for costly network densification.*
- *5G mmWave coverage is surprisingly robust and doesn't necessarily require significantly higher cell densities compared to the existing cell grid.*
- *5G mmWave can cover distances of more than 10 km in the right rural environment.*
- *mmWave FWA can now be used in non-line-of-sight (NLOS) conditions if the CPE has very high-gain antennas, especially when combined with a 360° field of view.*

Another vendor[27] states the following:

[26] https://www.nokia.com/about-us/newsroom/articles/busting-the-myths-around-mmwave-fixed-wireless-access-fwa/
[27] https://www.ericsson.com/en/reports-and-papers/further-insights/leveraging-the-potential-of-5g-millimeter-wave

- *Enhanced fixed wireless access is another growing source of revenue potential. Deploying dedicated sites for mobile broadband with the new available spectrum is quickly becoming an achievable business case, exploiting the high capacity and low latency characteristics of 5G mmWave and fixed wireless access.*
- *As fixed wireless access can be highly demanding of capacity resources, 5G mmWave is an attractive choice for supplying the required capacity with 400MHz-800MHz of spectrum.*
- *Fixed wireless access installations can provide a cost-effective way to deliver fiber-like internet speeds wirelessly over 5G mmWave to homes and business everywhere – from urban to rural communities*.

Following a recent field trial in the UK, representatives of the mobile industry praised the potential of 5G mmWave Fixed Wireless Access for home broadband, and to eliminate mobile network congestion in busy locations[28].

In the United States, mobile operator Verizon declared mmWave to be key to its FWA strategy[29]. Quote: "*Millimeter wave spectrum is well-suited for FWA, especially for MDUs, because it offers more bandwidth than mid-band spectrum. Fixed wireless access subscribers typically consume more data than mobile broadband subscribers, and their data usage can spike simultaneously at certain times of the day*".

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

*Response:*

Given the absence of convincing use cases and spectrum needs assessments for public mobile networks, it is very difficult to estimate the geographical extent of mobile networks' deployment in the Upper 6 GHz band.

The initial assumption, also shared by Ofcom (see Section 2.18), had been that 6 GHz IMT would be deployed in a few urban locations where mobile users were facing capacity bottlenecks, for instance at railway stations during peak times.

In the meantime, however, it has become obvious that the real use case for IMT in the Upper 6 GHz band is Fixed Wireless Access (FWA) in urban and suburban areas. Due to its intrinsically lower cost, the mobile industry views FWA as a viable competitor to FTTH and a means to increase sagging mobile ARPU levels. By design, FWA will deliver lower performance than FTTH, particularly in the uplink direction. Remarkably, the mobile industry stated they intend to use the Upper 6 GHz band for the downlink only which will make the service even more asymmetric. To connect indoor users and their networks to the internet, IMT FWA CPE will have to provide Wi-Fi connectivity. With its WAN performance being limited, having only the Lower 6 GHz band available for Wi-Fi may be sufficient for an IMT FWA CPE to perform to its capability. At the same time, the competitive advantage of fibre is negated because the FTTH ONT cannot extend the full symmetric fibre performance to the user as its Wi-Fi interface cannot use the full 6 GHz band. As already pointed out in our response to Question 6, this entails significant disadvantages for businesses and professionals working from home or other out of office locations.

[28] https://www.datacenterdynamics.com/en/news/vodafone-qualcomm-and-ericsson-complete-5g-mmwave-trials-in-uk/
[29] https://www.fierce-network.com/wireless/millimeter-wave-key-verizons-fwa-das-strategies

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

*Response:*

Most of the premises on which our enterprise customers operate Wi-Fi networks are located in urban and dense urban areas. To be able to continue operating their Wi-Fi networks which may be using the entire Upper 6 GHz band by the time mobile becomes authorised, we would expect Ofcom to put regulatory tools in place that enable uninterrupted operation of these networks.

In the interest of an efficient use of spectrum, mobile licensees should not be given access to the same spectrum block across all high-density areas, should IMT be introduced into the band. Spectrum blocks in each high-density area should be awarded separately.

**Question 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?**

*Response:*

We have no objection to Ofcom's proposal to not include very low power portable devices in the Upper 6 GHz band at this stage.

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

*Response:*

HPE strongly supports Ofcom's proposal to authorise the use of low-power indoor Wi-Fi access points and client devices in the 6425–7125 MHz band. We encourage Ofcom to implement this authorisation as quickly as possible, preferably before the end of this year. This would allow our customers to significantly enhance the functionality and maximize the value of their existing 6 GHz Wi-Fi infrastructure. [✂]

**Question 17: Do you have any comments on the proposed technical conditions?**

*Response:*

Generally speaking, HPE agrees with the technical conditions proposed by Ofcom.

In case a prioritised band split approach should be pursued, operational conditions in the portion of spectrum prioritised for Wi-Fi should be identical to those in the Lower 6 GHz band, including the contention-based protocols.

We strongly recommend that Ofcom not mandate contention-based (polite) coexistence mechanisms/protocols that deviate from those already specified in the Wi-Fi standards and implemented in Wi-Fi equipment, since this could lead to a UK-centric solution.

In our view it is important that the regulatory treatment of client devices in the Upper 6 GHz band remains consistent with that in the Lower 6 GHz band, since any necessary complexity can be managed by the access points.

We also encourage Ofcom to collaborate with industry to explore a range of sharing mechanisms that can support diverse use cases while ensuring compliance with regulatory requirements.

**Question 18: Do you have any comments on the proposed VNS draft?**

*Response:*

HPE appreciates Ofcom's proposal for a UK Voluntary National Specification (VNS). We recommend Ofcom actively participate in the work on the 6 GHz standard EN 303 687 conducted by ETSI TC BRAN to ensure that the respective 320 MHz channel plans are aligned. Current Draft EN 303 687 v1.1.6 contains a channel plan which is different from the options shown in Fig. A3.1 of the Ofcom consultation document.

Furthermore, we would like to point out that Draft EN 303 687 v1.1.6 contains a provision for the use of dedicated antennas on 6 GHz equipment. A dedicated antenna is defined as an "antenna external to the equipment, using an antenna connector with a cable or a waveguide and which has been designed or developed for one or more specific types of equipment". We recommend that in a new VNS, Ofcom considers authorizing the use of external antennas for 6 GHz enterprise access points for indoor and outdoor use.

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

*Response:*

HPE is sceptical about the need for introducing an enhanced sensing mechanism but not categorically opposing it, provided that it makes spectrum sharing more efficient and that implementation of this mechanism does not increase Wi-Fi product cost, delays the introduction of new products, or reduces system performance. We would like to point out that in the 5 GHz bands in which DFS must be applied, Wi-Fi performance can be negatively affected because of false positives.

In case sensing capabilities should be mandated, we recommend that these capabilities can reside either within the individual Access Point (which would typically be the case for a consumer device) or within the network management system (which would typically be the case for enterprise networks).

We believe that reliable alternative approaches may exist that do not require sensing, e.g., geolocation in combination with remote management of Wi-Fi gateways/routers (see our response to Question 7). We recommend Ofcom evaluate also these alternatives when entering Phase 2.

**Question 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.**

*Response:*

We acknowledge that radio astronomy is an important service which must be protected. We agree with Ofcom's proposal to restrict Wi-Fi from transmitting in the 6650-6675.2 MHz band during the initial phase of opening the Upper 6 GHz band for Wi-Fi use. At a later stage, Ofcom may want to consider the use of AFC to protect radio astronomy sites whilst enabling use of the 6650-6675.2 MHz band by Wi-Fi where possible.

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

*Response:*

We agree with Ofcom's assessment of Wi-Fi coexistence with existing users of the band. Numerous sharing studies conducted by CEPT and other bodies have demonstrated that Wi-Fi can share the Upper 6 GHz bands with incumbent users.

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

*Response:*

HPE does not have expertise in this field. However, we are aware of cost calculations made by other parties. Ofcom may wish to consult a 2023 report by the Czech Republic on the cost of clearing fixed links in the Upper 6 GHz band[30] and a 2020 report on the cost of clearing the 3.7 GHz band in the United States produced by RKF Engineering[31].

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

*Response:*

Concerning the coexistence of mobile with fixed satellite we would like to point out that the expected E.I.R.P. mask agreed at WRC-23 was calculated on the basis of a certain maximum number of mobile base stations deployed within a satellite's coverage area. As the deployment assumptions made in current coexistence studies conducted by CEPT are significantly different from those made at WRC-23, Ofcom should not include this mask in the technical licence conditions for mobile before verifying its validity under the updated deployment assumptions.

Similarly, the WRC-23 assumption for the proportion of antennas placed below rooftop is not valid if usage of the existing 3.5 GHz grid is assumed where most antennas are placed above rooftop. Furthermore, IMT base station transmit power (e.i.r.p.) levels demanded by the IMT industry are significantly higher than those assumed in the studies for WRC-23.

As FWA appears to be a major use case for IMT in the Upper 6 GHz band (see our responses to Questions 6,12, and 14) it must be noted that this use case was neither considered at WRC-23 nor has it been studied in CEPT.

The assumption that all IMT user equipment (UE) will be located on ground level at a height of 1.5 metres is highly unrealistic. According to the IMT industry, 60-80 percent of mobile traffic occurs indoors. Consequently, the assumptions of spatial distribution of IMT UE need to be modified to reflect the building height distribution (as applied in the case of Wi-Fi).

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

*Response:*

We would like to comment on the statement made in Paragraph 2.6 of the consultation document that "Both Wi-Fi and mobile have access to roughly 1150 MHz of spectrum". While this is not factually

[30] The report can be downloaded here: https://ctu.gov.cz/studie-ke-spektru, English executive summary on pages 9-10.

[31] https://docs.fcc.gov/public/attachments/DA-20-802A2.docx

incorrect, it must be noted that in the case of Wi-Fi, 360 MHz of these 1150 MHz, i.e., approximately 30% of the total amount of spectrum currently available for Wi-Fi in the UK, are subject to dynamic frequency selection (DFS) restrictions. These restrictions affect a significant amount of spectrum and not just "some channels" (see Paragraph 2.11 of the consultation document).

We also noticed contradicting statements regarding the nature of Wi-Fi operation which we believe should be corrected. Several references are made to potentially "exclusive" use of the Upper 6 GHz band by Wi-Fi or IMT. HPE would like to stress that unlike IMT, Wi-Fi does not use spectrum exclusively. This is acknowledged in Paragraph 2.6: "*All of the bands available for Wi-Fi are shared with other users, whereas the commercial mobile bands tend to only be available to whichever operator holds the licence*".

Finally, HPE would once again like to express its appreciation for Ofcom's pro-active and pragmatic proposals to authorize outdoor and standard power Wi-Fi plus AFC in the Lower 6 GHz band and make additional spectrum available for Wi-Fi use in the Upper 6 GHz band.

We hope to see positive policy decisions by Ofcom later this year, and we are looking forward to responding to specific consultations when they get published.

Wi-Fi is and will remain essential for running our customers' networks reliably and in a cost-effective way, and by making the full 6 GHz band available for Wi-Fi, Ofcom will enable UK businesses to remain competitive in the short, medium, and long-term.