Vodafone Response to Ofcom Consultation: 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

1. Introduction

Vodafone welcomes the opportunity to comment on Ofcom's proposals for usage of the 6GHz band. As a provider of both fixed and mobile services, we are all too familiar with the competing demands to utilise the 6GHz band. Our enterprise customer base comprises many of the organisations that might seek to make usage of Wi-Fi technology utilising the 6GHz band, and our fixed consumer base is growing rapidly, comprising more than 1.5 million customers – all with Vodafone-provided Wi-Fi access points in their home. Conversely, as part of the approval process for a merger with Three, we are taking on legally binding commitments to aggressively deploy our spectrum stocks to support our joint mobile network, and are all-too aware that these are finite, with traffic demands still growing. In the centre, our Fixed Wireless Access capability makes use of both mobile technology in the wide area network, and Wi-Fi technology for delivery to end user devices. There can be little doubt that we are uniquely positioned to consider the question of how to address competing demand – we are not coming at this through the lens of equipment manufacturers with vested interest that spectrum policy promotes the usage of our products (mobile or Wi-Fi focussed), rather our interest is in delivering services for consumers - whether they're mobile or at home - in the most cost effective manner.

We therefore believe that Ofcom is right to examine how these competing demands can be met by sharing spectrum. We also believe it correct to examine whether the 6GHz band as a whole should be split between mobile and Wi-Fi technologies – noting, however, that Ofcom's proposals don't ask this question, but take it as a given that the lower part of the band be dedicated to Wi-Fi, and instead examine whether the remaining Upper 6GHz and be further split between Wi-Fi and mobile prioritisation.

Whilst we believe that the starting point should be the entirety of the Upper 6GHz being prioritised for mobile usage (with Wi-Fi infill where this isn't deployed), it is worth asking the question of whether the entirety of the Upper 6GHz should have mobile as a priority, or instead whether there is scope for there to be a split with some of the band being prioritised for Wi-Fi. However, as we set out in this response, we think it unlikely that a meaningful amount of spectrum can be prioritised for Wi-Fi, making such an approach problematic.

We believe that the mechanisms required to enable any granular level of prioritisation (e.g. in the same geographic area where there is likely to be competing demand via indoor/outdoor sharing) as particularly problematic to develop, standardise, test, manage and maintain.

We do not fundamentally see demand for more spectrum for Wi-Fi while we see clearer demand for mobile spectrum, and huge imbalance in risks if sufficient spectrum is not provided.

We are concerned that the analysis in the consultation examines the topic solely through a spectrum lens, hence omits analysis of the economic benefits that would be yielded from the competing demands.

2. Juxtaposition of licensing regimes

For 25 years, UK spectrum policy has favoured a market-driven approach to awarding rights to utilise spectrum. It is well-established economic theory that if spectrum is awarded via auction, the stakeholder with the highest economic value will be prepared to bid the highest amount to secure the rights to utilise that spectrum – economic spectrum efficiency is maximised. Modifications to this approach allow for the incorporation of social value – for example by the application of coverage obligations, or a baseline requirement for any licensee to adhere to ICNIRP safety requirements. Implicit within this market-driven approach is that Ofcom as regulator does not seek to position itself as arbiter of the most efficient or "best" technology – this is a decision that is left to the market to determine.

Conversely, there is a recognition within spectrum policy that in some cases there may either not be excess demand for spectrum, or if there is, then its impracticable for a large number of users to coordinate to express their economic value. Therefore, significant portions of spectrum have been set aside either as licence-exempt, or with a light-licensing regime where any fees are merely associated with the administrative overhead of managing licences.

There are scenarios where the two regimes collide – for example no spectrum licence is ever exclusive, so if the holder of a licence that was awarded via market mechanisms fails to use "their" spectrum in a given area, then it is open to Ofcom to issue a Local Access Licence to a third party to ensure efficiency of spectrum usage. PMSE licensing follows a similar theme.

What is important, however, is the hierarchy is maintained – unless there is compelling evidence of an inability to express spectrum value, those willing to pay for access to spectrum via market mechanisms are given "first dibs", with those who are not willing to pay able to make opportunistic usage if there is unused spectrum. We note that this approach is adopted in other regulatory jurisdictions, e.g. CBRS in the USA.

The proposals in the consultation turn this paradigm on its head. For any part of the Upper 6GHz that Ofcom determines should be "Wi-Fi priority", in effect Ofcom is saying "*yes we understand that there are stakeholders who are willing to pay for access to the spectrum, but we are instead going to make usage available free-of-charge to an alternative set of users".* This is a profound up-ending of spectrum policy – it may well be that Ofcom has concluded that there are a set of Wi-Fi users with collective value higher than would be expressed by bidders in an auction, but a) this is a reversion to a command/control model of spectrum management in Ofcom having reached that conclusion, and b) we see no evidence of an impact assessment in the consultation that seeks to establish the aggregate value of Wi-Fi usage in order that it can be contrasted with the likely value of mobile usage. As such, we have significant concerns of whether the proposals are compatible with Ofcom's statutory duties under the Wireless Telegraphy Act. For example, para 2(3)(b) states that Ofcom's actions must be "*Not such as to discriminate unduly against particular persons or against a particular description of persons*" – we would argue that providing free access to Wi-Fi users while charging mobile usage in the same band is incompatible with this.

Ofcom's starting point should be a market-based approach. It is reasonable to consider alternatives, but the bar to deviate from a market approach should be very high, especially given proven demand from the mobile industry for mid-band spectrum. Any setting aside of spectrum for licence-exempt purposes imposes an opportunity cost based on mobile industry valuations – Ofcom must produce clear evidence that the societal and economic value of Wi-Fi usage is higher than for mobile.

3. Demand for Wi-Fi and mobile

Through its mobile and fixed network operations in nine markets in Europe (including the UK), Vodafone feels it is well placed to assess the demands for mobile and Wi-Fi

Mobile Demand

Despite decreasing annual growth rates, Vodafone's mobile network traffic in Europe has over doubled in the past four years. Just over a year ago, Vodafone recorded its highest ever yearly increase in data across its networks in Europe. We forecast that even with the current trajectory of decreasing year-on-year growth *rates*, significant levels of *incremental* network traffic – a key metric for assessing network capacity requirements – will intensify the load on our networks across Europe in the forthcoming years.

When assessing traffic growth in the last year in particular, it is important to consider the implementation of measures designed to improve the efficiency of delivering data for video-based applications, which are key traffic generators in mobile networks. Vodafone announced a partnership with Meta last year resulting in a successful trial recording meaningful reductions in network traffic for Meta's applications delivered on Vodafone's UK network[1]. These optimisation measures were subsequently rolled out by Meta across Vodafone's networks in Europe. Care must therefore be taken in extrapolating a limited number of data points to suggest a stalling in the growth of mobile data. While Vodafone welcomes the continued implementation of video delivery optimisation mechanisms by all content access providers to maximise the efficient use of spectrum and infrastructure (including the adoption of new AV1 video coders), we are cautious that further measures are unlikely to provide the same incremental benefits in data reduction and this may impact network traffic growth rates going forward.

When considering additional spectrum requirements, it is also relevant to consider traffic growth on our busiest network sites (as opposed to focussing on overall network traffic) which do the 'heavy lifting' and typically require capacity expansions. For example, in Vodafone UK ✂% of sites carry around ✂% of the network data. Data growth on these sites in the last year was higher than the growth recorded across the network as a whole and more importantly the incremental traffic added on these sites represented ✂% of the total network data increase.

[1] Vodafone and Meta optimise short-form videos to improve network efficiency

Vodafone continues to expand it 5G networks in the UK and Europe and now provides 5G coverage in over 240 cities in Europe, with in excess of ✂ sites utilising high speed, high capacity 3.4GHz spectrum. In the UK over 60% of smartphones are now 5G capable and where deployed 3.4GHz spectrum currently carries over ✂% of network data. Data carriage by 3.4GHz is expected to further increase as 5G device penetration continues to increase and 5G stand-alone (5GSA) operation is provisioned more widely across our 5G networks

Another important consideration is the possibility of new mobile services enabled by technologies such as Gen AI, AR/XR, Cloud and network slicing. Gen AI in particular is already being used indirectly by various applications to influence or increase user engagement. However, its direct use in generating content for social media, entertainment, education, navigation etc. through AI-powered devices such as wearables including AI glasses (already available today) and their planned evolution to AR glasses, as well as in vehicles, cameras and drones - all of which heavily depend on reliable mobile communications for interactive content delivery and basic operation - could have a significant impact on network demand and traffic.

We also foresee growth in Fixed Wireless Access (FWA) services, especially with the "generation rent" preferring not to subscribe to conventional fixed services. Via Connected Nations, Vodafone provides information to Ofcom setting out ✂.

Therefore, 5G is delivering *'everything it said on the tin'* in terms of efficient network capacity and performance enhancement to consumers of mobile services. However, Vodafone's capacity modelling indicates urban 5G cells in some larger markets in Europe will begin to experience service-impacting capacity limitations towards the end of this decade which, absent of additional mid-band spectrum, rapidly extends over time across more urban areas.

As the only mid-band spectrum opportunity in this decade and likely beyond, the availability and deployment of the full Upper 6GHz spectrum band will therefore be critical to cost-efficiently maintain and evolve mobile network services capabilities to end customers. Vodafone's position is shared by principal mobile operators in Europe – we draw Ofcom's attention to the open letter signed by 12 CTOs setting out that the Upper 6GHz should be made available for mobile services without delay[2].

Wi-Fi Demand

Vodafone is a converged service operator, offering customers both mobile and fixed broadband solutions. Through its combined investments in fibre and cable TV networks, Vodafone has one of the largest footprints of next generation fixed access technology in Europe. We therefore take seriously the need to ensure we can meet the future traffic needs of our customers, across both fixed and mobile environments.

While we expect traffic to continue increasing across both our mobile and fixed networks (albeit at a slightly lower growth rate for fixed networks), we do not see the existing spectrum available for Wi-Fi in Europe (2.4GHz

[2] "Essential Action for Europe's mobile future", signed by the CTOs of A1 Group, BT, DTAG, KPN, Elisa, Orange, Proximus, Telefonica, Telia, TIM, United Group and Vodafone.

/ 5GHz / Lower 6GHz bands) as a limiting factor in achieving digital connectivity targets, and see considerably more opportunities to improve the performance and capacity of Wi-Fi solutions using existing bands available for this technology.

As an operator heavily utilising Wi-Fi technologies for our customers' services, we would like to provide the following observations supporting our position:

- Coverage – rather than capacity - is the key constraint for Wi-Fi performance in the home today. Routers deployed with boosters and extenders provide better coverage and performance. Without coverage enhancement features or methods, coverage will continue to be the key constraint for Wi-Fi performance in the home.
- This is supported by a comprehensive trial conducted to assess Wi-Fi performance in residential environments[3]. This trial confirms:
    - Coverage (not spectrum) is the key factor constraining Wi-Fi performance in the home and, when coverage is improved, performance improves significantly,
    - Existing Wi-Fi spectrum across 2.4GHz / 5GHz / Lower 6GHz bands is sufficient to meet digital connectivity targets of 1Gbps to the home, even in dense apartment blocks with high utilisation.
- Based on our planned FTTH technology deployments and system capacities, as well as future application requirements in the home, we see these can be fulfilled by Wi-Fi6E and Wi-Fi 7 using 2.4GHz, 5GHz and lower 6GHz spectrum
- It is of relevance to note that existing available Wi-Fi spectrum provides up to 11 80MHz channels, equivalent to 11 5G base stations in the home.
- Another constraint today is the widespread use of legacy Wi-Fi Access Points, which operate to pre-Wi-Fi 6 standards and deliver inferior performance. Wider adoption of the latest generation access points, as Vodafone is driving today, with more spectrally efficient features, has already shown to considerably improve performance. We expect the measures under the Telecoms Security Act to incentivise the replacement of CPE[4] which is no longer in security support will speed up this transition.
- New Wi-Fi-7 features[5] such as Multi-link Operation (MLO), 4K QAM, 16 Spatial Streams, Multiple RUs, Compressed Block Acks etc. further enhance spectral efficiency and provide lower latencies for Wi-Fi services on existing bands.

[3] Wi-Fi Indoor Connectivity Tests, Comtel, 19th European Spectrum Management Conference, Brussels, June 2024
[4] Telecommunications Security Code of Practice, in particular Measure 9.02
[5] Wi-Fi CERTIFIED 7 | Wi-Fi Alliance

- In Enterprise we see existing spectrum can be used with carefully designed and managed Wi-Fi networks through optimised placement of sufficient high-quality access points using latest generation technologies, to meet Wi-Fi demands in these environments.
- Alternative higher-frequency spectrum bands - better suited for short-range Wi-Fi communications - such as mmWave bands being considered for Wi-Fi-8, mean there are other spectrum options to expand Wi-Fi capacity in future if necessary. These bands are also better suited for high capacity, short range Wi-Fi environments such as factories, schools, venues and offices.

As a converged operator whose business heavily depends on both Wi-Fi and mobile services we have carefully assessed (and continually review) the need for the upper 6GHz band across both areas considering: current spectrum resources, future demands on both services, as well as alternatives, and see the balance of risks and socioeconomic benefits overwhelmingly in favour of mobile use of the band.

Following ongoing discussions with key stakeholders, policy makers and analysts on the need for additional spectrum for Wi-Fi in residential environments we now believe it is generally accepted there is no justification for more Wi-Fi spectrum in the home (aligned with Vodafone's consistent position also in its response to Ofcom's previous consultations[6]), with any residual requirement being in the enterprise or public-space domain.

Beyond the actual demand for spectrum, acknowledging Ofcom's desire to take a technology-neutral approach, it is incumbent on spectrum administrators to recognise the economic and technology environment within which users (both licensed and licence-exempt) consume spectrum. The UK mobile RAN market will shortly be a three-player one. It would be inappropriate if Ofcom were to structure awards such that market equilibrium is deliberately obstructed and an artificial dogfight for spectrum was created – or at the very least, it would be inappropriate to do this unless it could be established that the economic benefit created for the aggregate of unlicensed users outstripped the disbenefit of ramping up prices in the mobile market. There is some empirical evidence of impact, that Ofcom might seek to keep in mind:

- In the 3.4-3.8GHz band, the ideal for mobile operators was 100MHz of spectrum.
- In the UK, depending on whether one looks at the 2018 or 2021 auction price, approximately 400MHz of spectrum across a four-player market yielded spectrum values of £0.08/MHz/population.
- In Germany, the decision was taken to set aside 100MHz of spectrum for mobile private network usage, leaving 300MHz for mobile usage. Whilst not seeking to comment on the wisdom of this approach, we note that the clearing price for spectrum in this award was consequently £0.13/MHz/population.

[6] Vodafone response to Ofcom consultation on "Hybrid Sharing; enabling both licensed mobile and Wi-Fi users to access the upper 6GHz band", September 2023

There is no reason to suggest that networks utilising 3.4GHz spectrum are of higher economic worth in Germany than in the UK. The differences are solely down to supply & demand for the spectrum – if you limit supply, pricing will escalate. On a macro-economic basis this is a reasonable outcome if the value extracted by the alternate user is higher than the value lost to public mobile users by having to pay more for services (there's no magic money tree – ultimately anything paid at auction is recovered from consumers). However, returning to the Upper 6GHz, we do not believe that Ofcom has garnered any evidence to establish the relative economic value of mobile and Wi-Fi usage. Indeed, given Wi-Fi users are mobile users, a poorly thought-out split might result in consumers being given something free with one hand (that they had little use for in any case), and charged excessively by the other hand.

3GPP has embarked on developing a new radio access technology for 6G, targeting benefits in terms of spectral efficiency, energy efficiency and new service capabilities. First standards are expected by early 2029 with potential first deployments from 2030.

Larger channel bandwidths translate into not only better performance but better cost efficiency to support new or evolved higher bit-rate services and general network traffic growth. Our current estimates indicate the use of larger 200MHz channel bandwidths in the upper 6GHz band can provide up to ✂% better capacity cost efficiency (cost/GB) than 3.4GHz radio equipment today.

Vodafone has conducted initial field trials using prototype network equipment demonstrating the significant performance and capacity benefits, achieved across both outdoor and in particular indoor areas (where the majority of mobile network traffic is consumed), when deploying 200MHz channels in the upper 6GHz spectrum on existing macrocell sites[7].

While the upper 6GHz band may be used for 5G technologies, it represents the only spectrum opportunity to deploy 6G providing next generation performance levels and improvements in the cost of capacity which will be required in similar timescales – refarming other utilised bands can be enabled over time but would not provide the same immediate benefits.

In a three-player market, this suggests an 600MHz being required for mobile, with anything less than this likely to trigger aggressive bidding, which ultimately is to the detriment of consumers because it then starves winning bidders of the funds to actually deploy the spectrum. Further, the mobile operator that failed to secure 200MHz of spectrum would be faced with offering compromised capability, damaging the overall competitiveness of the mobile market that regulators have made great efforts to preserve.

Therefore, while we appreciate Ofcom's efforts in reaching a compromise by splitting the band, the combination of mobile technology standards and the shape of the UK market means that this split must make at least 600MHz available for priority mobile usage. Allowing for guard bands between technologies, we are sceptical that an additional 100MHz for Wi-Fi – yielding 600MHz in all – will render any benefit if the intention is to use 160/320MHz channels. Conversely, providing sufficient bandwidth to Wi-Fi to add an

[7] 6GHz Field Trials – Reference IMT Indoor Performance levels for standard power base stations operating in the 6GHz band, Contribution to ECC PT1 Meeting, ECC PT1 24 (033), Gronigen, 23-25th January 2024.

extra 320MHz channel would lead to artificial constraints in mobile spectrum, with the competitive consequences set out above. None of Ofcom's band split proposals provide 600MHz for mobile, instead proposing a minimum additional 160MHz or a preferred additional 320MHz of spectrum is provided to Wi-Fi for additional 160/320MHz Wi-Fi channels[8] leaving 540MHz and 380MHz for mobile, respectively (excluding guard bands). Something has to give and returning to our observations in Section Two of this response, it would be remarkable if the sector that was prepared to pay for spectrum usage was sidelined in favour of one seeking free-of-charge access.

None of this implies that Wi-Fi users could never benefit from an extra 320MHz channel – an approach of "mobile priority" instead means that solely in an environment where all three mobile networks had deployed then this wouldn't be possible. In areas where one or more of the licensees hadn't deployed, opportunistic usage would be possible.

Ofcom states they have "seen evidence" which may justify the need for additional Wi-Fi channels, however no supporting information is provided – as an operator using Wi-Fi to offer services to consumers we welcome further engagement with Ofcom on this point.

However, even secondary usage by Wi-Fi would require the use and deployment of suitable database access management or cross-technology sensing mechanisms by the technologies (Wi-Fi or any other licence-exempt technology) using the band on a secondary basis. Cross technology sensing mechanisms which attempt to allow secondary use on a granular basis in the same geographic area would need to be developed across different specification groups with harmonised standards, and ongoing conformance and compliance testing. Even if fully implemented we have strong concerns around their efficacy, particularly in weaker signal areas, which could still result in interference to mobile networks. There is also a concern around secondary usage by Wi-Fi (or other licence-exempt technologies) in adjacent bands potentially impacting the operation of mobile in the channel it is prioritised to use. This could result in additional restrictions or constraints in the use of the band, to facilitate any secondary use in co-channel or adjacent channel scenarios, which otherwise would not have been included if the band was authorized for exclusive use e.g. reduced operational powers levels.

Therefore, to ensure high quality mobile services Vodafone believes mobile spectrum should be allocated exclusively on a licensed basis in a given area – this reduces complexity and maximises performance for end users (of both technologies) and avoids increased development costs and ecosystem fragmentation. As outlined in our previous responses to Ofcom on hybrid sharing, given it has been stated by Vodafone (and other MNOs) that the focus of upper 6GHz band deployments for mobile are urban environments, this would still allow geographic sharing through Wi-Fi use in areas where the band is licensed for by mobile operators

[8] An additional 160MHz of spectrum would provide a total of 8 x 80MHz or 4x160MHz or 2x320MHz channels in combination with the lower 6GHz band. An additional 320MHz of spectrum would provide 10 x 80MHz or 5x160MHz or 2x320MHz plus 1 x 160Mhz channels in combination with the lower 6GHz band.

but is unused. This is this a more pragmatic and effective approach only requiring Wi-Fi equipment to query a geo-location database to determine whether it is permitted to use the band in a specific location.

4. Early usage by Wi-Fi

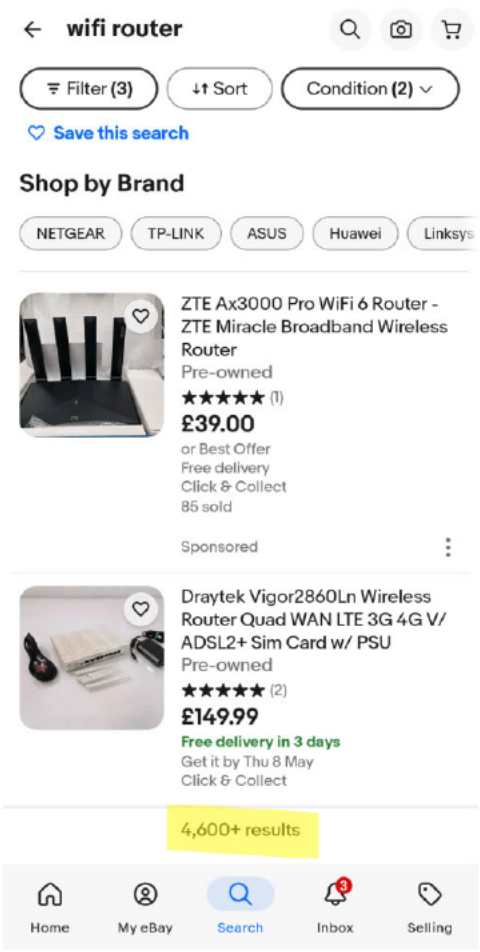
Ofcom has been cheerleader for opportunistic sharing of the band, i.e. in Wi-Fi-priority areas there could be mobile deployment where nobody has implemented Wi-Fi, and conversely in mobile-priority areas, then Wi-Fi could be utilised if no mobile infrastructure is deployed. Conceptually it is a seemingly logical extension to say that because there is currently no mobile usage – no award of mobile spectrum has been made – then it would be efficient to permit Wi-Fi to use the band until this occurs. However, this idea is fraught with difficulty, and we cannot support the proposals as framed by Ofcom – which would create an opportunistic landgrab for the spectrum that would be impossible for Ofcom to unpick.

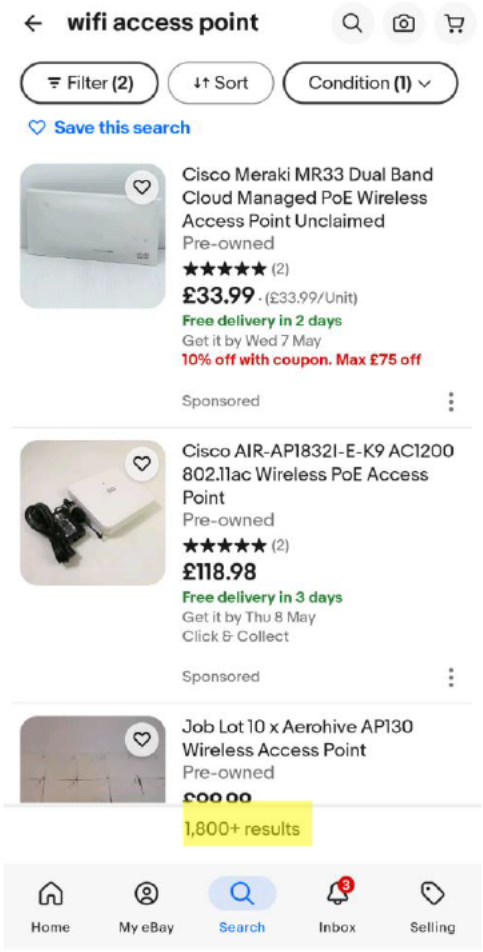
It is impossible for Wi-Fi equipment to comply with standards that have not yet been defined at a European/international level, so the only conclusion can be that the proposal is instead to deploy equipment designed for markets that have made the whole 6GHz band available for Wi-Fi usage, with a view to modifying or replacing this kit when mobile is subsequently deployed.

This risks users making a land grab for the spectrum, using it not based on need, but instead based on securing first-mover advantage. There would be no incentive to use spectrum efficiently, and every incentive to spread out as much as possible with a view to securing squatters' rights.

At para 5.40, it is asserted with no evidence whatsoever that only a software upgrade will likely be needed to support the future (undefined) sharing standard. Ofcom cannot know that this is possible, cannot enforce that vendors would make this hypothetical software release available, and certainly cannot enforce that end users who have deployed non-compliant kit will go to the trouble of deploying a software upgrade that would worsen their equipment's capability – Ofcom are creating an economic negative externality. As the equipment will be licence exempt, there will be no means of tracing it (other than when it interferes with mobile networks – which puts the onus on mobile spectrum licensees to clear up a mess of Ofcom's making, and could leave the Baldock team overwhelmed).

There is also a suggestion that Wi-Fi equipment replacement cycles will deal with the task of removing non-compliant equipment. This is fanciful. Even if Wi-Fi access points were regularly replaced – they're not – then such a proposition implies that redundant equipment is recycled/destroyed. However, there is a thriving market in second-hand equipment – for example a search on eBay yields 4600 used Wi-Fi routers for sale by UK sellers, with a further 1800 listed as Wi-Fi access points. In reality, when any early adopters upgrade to compliant kit (**if** they upgrade to compliant kit), the non-compliant kit will hang around in the secondary market for years to come as early-adopters seek to recover the significant cost of equipment capable of supporting the whole 6GHz band.





Extensive studies conducted by Vodafone and other key industry stakeholders, as part of ECC PT1 work item PT1_50[9] have outlined the many complex and severe interference scenarios which can be expected impacting *both* mobile *and* Wi-Fi devices when using the upper 6GHz band in the same area[10]. For example, one joint study conducted by Vodafone and Ericsson[11] was able to easily show, even with best-case isolation assumptions, a single indoor Wi-Fi Access Point operating within 50m of an outdoor base station can significantly desensitise its uplink receiver resulting in a performance degradation for all mobile devices connected to the base station. This was not a unique or isolated scenario, the study outlined other severe interference scenarios which can readily occur.

[9] "Feasibility and sharing studies on the potential shared use of the 6425-7125 MHz frequency band between MFCN and Wireless Access Systems including Radio Local Area Networks (WAS/RLAN)"
[10] Draft ECC Report 366, ECC - Tools & Services - Services - ECC Consultation
[11] ECC PT1(24) 053, "6GHz Sharing", ECC PT1 Meeting #77, 23-25 January 2024 – Groningen, Netherlands.

UK/Ofcom has actively participated in ECC PT1 Work Item PT1_50 and carefully scrutinised all studies including those of Vodafone. Therefore, we cannot understand why, when presented with this evidence from many studies, Ofcom would propose immediate uncoordinated/uncontrolled access to the upper 6GHz band by Wi-Fi devices when clearly this would severely risk the subsequent operation of both mobile and Wi-Fi services. By allowing unfettered access, the most probable outcome of Ofcom's proposals will be to render the "mobile priority" bands contaminated to the point of being potentially unusable. It is a reckless approach.

Ofcom might argue that the risk of this outcome is justified in the guise of not leaving the spectrum lying fallow for an interim period. However, this is wrong – there is no need to take such a risk. As we set out in Section Three, there is no compelling need for Wi-Fi usage of the Upper 6GHz band in domestic settings and current usage of the lower 6GHz band is very small with less than ✂% of our customer devices connected to Wi-Fi 6E routers being 6GHz capable. Any logic that does underpin the usage of the Upper 6GHz potentially applies to specific industrial applications and commercial high footfall applications such as stadia and shopping centres – for the avoidance of doubt we consider that a poor technology choice, but it is not for us to dictate technology choice any more than it is for Ofcom. Ofcom has readily available licensing models which would allow deployment of Wi-Fi infrastructure for such applications without making the access points licence-exempt. For example:

1. Ofcom could issue time-bound Shared Access Licences for the band, particularly now that the online licensing platform has been developed to simplify this process, or
2. Ofcom could expand the Fixed Wireless access regime to cover the band. With this approach, users would secure a licence to use the band, then be required to register each deployment.

With either approach, the terminal exemptions themselves could be extended to cover the whole of the 6GHz band, it would just mean that Ofcom kept control of the degree of access point rollout. Critically, Ofcom would have a list of deployments so that when "mobile priority" bands were introduced, existing deployments could be addressed & licences revoked as necessary.

With the latter approach in particular, the pricing model is such that it would not be a barrier to deployment for high-end residential consumers, should we be incorrect in our assessment of there being little demand.

Further, we note that by adopting such light-licensing approaches, Ofcom could also facilitate early adoption of the band by mobile operators – the licensing regime should be technology-neutral.

We cannot understand why Ofcom has not taken this approach and urge you to reconsider. The licence-exempt approach advocated in the consultation will inevitably lead to an allocation of the Upper 6GHz for Wi-Fi via the back door.

5. Answers to Questions

Q1. 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

We do not have any interest in deploying such equipment, and also have significant concerns around the negative impact higher power outdoor Wi-Fi (or other licence-exempt RLANs) may have on our existing and future lower power indoor Wi-Fi services in the lower 6GHz band.

We would welcome reviewing any studies Ofcom has conducted in assessing any impact ahead of any decision it may take as well as elaborating further on the demand they see for high power outdoor Wi-Fi (or other licence-exempt RLAN) services.

Q2: Are you interested in providing or developing AFC databases for use in the Lower 6 GHz band in the UK?

Q3: Do you have any views on the operational considerations of setting up and running AFC databases?

We do not have any interest in providing or developing AFC databases for usage in the Lower 6GHz band.

We query whether the UK is of sufficient size to justify the provision of multiple competing AFC databases, or alternatively whether it may be better for Ofcom to award a franchise to provide the capability.

Q4: 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?

As indicated in our response to Question 1 we have no interest and see no demand for higher power outdoor Wi-Fi and have strong concerns around the negative impact higher power outdoor Wi-Fi (or other licence-exempt RLANs) may have on our existing and future lower power indoor Wi-Fi services in the lower 6GHz band.

There appears to be some confusion in the wording of the consultation, with the text of para 4.39 suggesting adopting the FCC *process*, whereas this subsequent question – with language of not re-running the process – being more suggestive of *outcome* of the FCC process being adopted.

We are somewhat surprised that Ofcom is proposing to copy/paste regulatory decisions made in other jurisdictions rather than providing its own regulatory oversight. Whilst it may be appropriate to draw on the process adopted by the FCC, we would expect Ofcom to operate its own approval process in order to meet its statutory duties under the Wireless Telegraphy Act. We question what Ofcom would do if the outcome of

a third-party regulatory decision was subsequently proven to be flawed, and Ofcom had adopted that outcome without its own due diligence.

Q5. 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.

Please see response to Question 1.

Q6: Do you have any comments on our proposal to use a "phased" approach, or on the alternative to wait for European harmonisation?

We favour alignment with a European approach – in common with every other individual European country, the UK is not a sufficiently large market to plough its own furrow on equipment standards.

We acknowledge that there may be merit in adopting an interim solution if to do so both facilitated short term spectrum efficiency and did not present an impediment to adoption of international standards in the medium/long term. However, the proposal to allow interim usage of the spectrum on a licence-exempt basis does not meet these criteria – it risks contaminating the band with usage that Ofcom cannot track, indeed the squatters' rights argument means that such usage will actually be incentivised. So, in facilitating spectrum usage for perhaps one or two years, Ofcom risks economically valuable usage of the band for perhaps decades to come.

Ofcom might argue that this is of low risk – we absolutely disagree – but the presence of a zero-risk approach, i.e. light licensing as described in Section Four of this response means that there is no reason to go down this path.

In any case, with only ✂% of devices connected to our routers currently utilising the Lower 6GHz band, we do not see any immediate need or merit in allocating more spectrum to Wi-Fi. We welcome further clarification from Ofcom on where it sees any immediate need for more Wi-Fi spectrum. As also outlined in Section Four any specific immediate need should addressed through licensing using established frameworks Ofcom has put in place. – practicably for the user base where there is any demand, this won't be restrictive, and usage can be carefully controlled.

In the event that Ofcom does proceed, then any licence-exemption for access points must be restricted to usage at a fixed location – for example should Wi-Fi access points in vehicles utilise the Upper 6GHz band, this would entirely contaminate the band as it would be impossible to locate them, and almost certainly impossible to upgrade them to compliant sharing approaches.

Q7. Do you have any comments on the above suggestion to manage any "legacy" Wi-Fi devices, or alternative suggestions?

As described in Section Four, controlling the distribution and use of "legacy" Wi-Fi equipment after it has been deployed is virtually impossible, meaning any subsequent use by mobile would result in potentially significant and uncontrolled interference to both systems.

As also outlined in Section Four and the response to Question 3 above, any specific immediate need (which we do not see) should addressed through licensing using established frameworks Ofcom has put in place.

Q8. 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.

As we set out in Section Two, Vodafone is a major converged service operator, offering customers in Europe both mobile and fixed broadband solutions. Through our combined investments in fibre and cable TV networks, Vodafone has one of the largest footprints of next generation fixed access technology in Europe. Vodafone and other major converged service operators are the key providers of Wi-Fi services to customers across residential and enterprise locations and we do not see the need for additional Wi-Fi spectrum for the reasons explained in Section Two. We welcome further discussions with Ofcom on where they believe or see a need for an additional 320MHz of spectrum for Wi-Fi (as indicated in the consultation).

However, it is wholly wrong to examine the needs of only one sector, when the decision of how much spectrum to designate as "Wi-Fi first" vs "Mobile first" is inherently a balancing act between the competing demands. As described in Section Three, a three-player mobile market points to the need for 600MHz of spectrum – anything less will have a competitive impact on the mobile market, which should form the foundation of Ofcom's analysis. Any decision on the amount of spectrum that is designated as priority for each application must be examined through the lens of the long-established market-based approach to spectrum management. In order to prioritise Wi-Fi above the needs of stakeholders who are willing to demonstrate value via market means, it is incumbent on Ofcom to provide compelling evidence that the value accrued by unlicensed users would outstrip the market value that the mobile industry would be prepared to pay.

Q9. Do you have any comments on our plan for a "phase 1" when Wi-Fi will be introduced?

Please see our response to Question 6.

Q10. 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?

We are concerned with this approach for the following reasons

1. These seeded devices would not comply with the harmonised technical conditions for use of the upper 6GHz band which will be developed in CEPT (under mandate from the European Commission)
2. Client devices can still act as hot-spots for other devices therefore these devices would not support cross-technology or other mechanisms which would be required to support secondary usage

Q11. Do you have any comments on our plan for a "phase 2" when commercial mobile will be introduced?

We understand Ofcom's preferred plan for "Phase 2" is a prioritised bands split where between 160MHz and 400MHz of additional spectrum is allocated and prioritised for Wi-Fi in the upper 6GHz band leaving a maximum (excluding guard bands) of 300MHz to 540MHz "prioritised" for mobile.

As explained in detail in Section Two:

- Firstly, we see no clear need or justification for allocating additional spectrum to Wi-Fi (on top of the spectrum already allocated in the lower 6GHz band) – in particular the need for an additional 320MHz for which Ofcom state they have seen evidence.
- Secondly as the only remaining mid-band spectrum opportunity in this decade and likely well into the next, the proposed spectrum splits will significantly impact future competitive mobile services to consumers in the UK including 6G deployments.
- Thirdly with respect to mobile priority usage we believe there are significant risks and challenges with this approach, impacting both technologies.

Awarding licences for spectrum will maximise the capabilities of that spectrum for use by mobile network operators and in turn provide reliable high-quality mobile services to UK consumers.

Notwithstanding these concerns around Ofcom plans for "Phase 2" we believe any decision on the use of the band should be harmonised across Europe to maximise the benefits in using the band and any decision should not be made until an ETSI harmonised standard for the upper 6GHz band is available.

For Phase 2 Vodafone would also like to clarify what mechanisms or processes are assumed for mobile to access spectrum prioritised for Wi-Fi, in line with clause 5.10 of the consultation *"... Each set of users (Wi-Fi and Mobile) would be able to access the others priority portion where it would not cause interference, i.e., it was aware that the other application was not present in the area*".

Ofcom have also included the possibility of mobile use of the adjacent 7125-7250MHz band which is included in Agenda item 1.7 for WRC-27. Studies are ongoing as part of the WRC-27 process but it's clear there appear to be some challenges around co-existence with incumbent satellite services, which could restrict its use for mobile services. Suitable guard bands with adjacent bands/services would also be required. Vodafone therefore requests Ofcom delay any decision it may take on splitting the upper 6GHz band until there is better clarity on its potential use for mobile services and harmonised support from national administrations and regions going into WRC-27, including the availability of products ecosystems to enable its use.

We do agree with Ofcom's reservations about the second sharing option it proposes around an "indoor/outdoor split" based on significant limitations on mobile power levels. Mobile network operators have clearly indicated the limitations and challenges with this approach[12] meaning the band cannot be effectively used for mobile network services and only suitable for short range, hot spot coverage scenarios at best. These challenges and limitations centre around three fundamental areas:

1. Most mobile usage and resource utilisation is indoors, therefore there is little opportunity for capacity offload (a key requirement for operators) if coverage is constrained to "outdoor only" locations.
2. Mobile service availability and reliability – a fundamental characteristic of mobile services to consumers - cannot be maintained across outdoor and indoor areas, including when transitioning between them, due to coverage limitations and interference with indoor Wi-Fi systems.
3. Deployment of coverage enhancement solutions.: in a competitive service environment operators may be compelled to address any coverage gaps through the deployment of (or upgrade of existing) coverage enhancement solutions such as small cells, indoor pico-cells, repeaters etc. This would reduce any attempted isolation between indoor and outdoor areas impacting both mobile and Wi-Fi services. Any extensive deployment of these coverage enhancement solutions could result in the same level of coverage that would have been achieved if power levels were not restricted. It would also represent a significant economic burden and therefore business risk to operators which could impact market structures and the future availability of competitive mobile services to consumers

It is also important to note the proposed power level for attempting to create an indoor/outdoor split (58dBm/100MHz) is nearly 20 dB lower than the maximum power level of 3.4GHz deployments today, and in effect a higher reduction if considering additional propagation losses. While undoubtedly impacting indoor coverage this will also naturally impact outdoor coverage and capacity (as demonstrated by many studies).

Therefore, we do not consider the Ofcom's second sharing option ("Indoor/outdoor split") as viable or feasible for mobile networks and would dispute it may even be classed as "sharing".

Q12. 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.

As explained in Section Two we believe at least 600MHz (excluding guard bands) is required for mobile applications – anything less has the potential to impact competition between mobile network operators.

Q13. Do you have any evidence or views about the geographical extent of mobile networks' likely deployment in Upper 6 GHz?

Across our networks in Europe, we plan to deploy the band in dense traffic areas primarily cities for capacity expansion and 6G introduction, mimicking our 5G macrocell network roll-out using 3.4GHz. However, under the Network Commitment that will be embedded into Vodafone's licence following the merger with 3UK, we will be mandated to deploy 3.4GHz at ✂mast sites, of which ✂ are rural so inherently would be outside of the high-density areas (in reality a significant portion of the remaining ✂ urban masts would fall outside those areas too). Therefore, if this rollout is mirrored in the 6GHz band, the high./low density area approach used for mm-wave wouldn't work., or at the least, Ofcom's licensing system would be stressed by the volume of applications from mobile network operators for deployment outside high density areas.

Q14. Do you have any comments on our proposed phased approach to authorisation of both Wi-Fi and mobile in the Upper 6 GHz band?

As set out in Section Three we fundamentally disagree with Phase 1 ("Initial Wi-Fi Access") authorising low power indoor Wi-Fi across the whole band on a licence exempt basis, and as described in Section Two and summarised in response to Question 11 above we disagree with Ofcom's plan's for Phase 2.

Q15. 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?

As outlined in Section Two we do not see any demand for additional Wi-Fi spectrum in the upper 6GHz band in any form. However, portable devices are particularly problematic and should certainly be excluded from any exemption.

[12] ECC PT1(24) CG6GHz055, "Challenges and Limitations of Outdoor-only MFCN Scenarios, Vodafone Group, BT, DT, Orange, Telefonica, Telia, TIM,11th-12th Nov 24, Edinburgh

Q16. 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?

Q17. Do you have any comments on the proposed technical conditions?

Please refer to our responses to Questions 6, 7 and 10.

Q18. Do you have any comments on the proposed VNS draft?

As indicated in our response to Question 6 and detailed in Section Four we see no need for additional Wi-Fi spectrum in the upper 6GHz band.

Q19. Do you have any suggestions for an appropriate mechanism for enhanced sensing, or comments on the proposed solution above?

Mixing and matching different technologies (developed across different specification groups) within the same band increases development costs, operational complexity, and introduces ecosystem uncertainty/fragmentation as well inherent performance limitations/degradations (for both technologies). These factors ultimately impact the efficient use of the spectrum and services that can be delivered over it (by operators) to consumers

Q20. 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.

We respect incumbent services operating in any band and if co-channel services are introduced appropriate protection mechanisms need to be put in place.

Compatibility and coexistence requirements with all incumbent spectrum users in the Upper 6GHz band, and both mobile ("WBB/ECS") and Wi-Fi (and more generally WAS/RLANs) will be addressed by the EC mandate under Task 1. We therefore consider that whilst Ofcom is potentially correct to limit usage in 6650-6675.2MHz; it is best to await European-level decisions before authorising any usage.

Q21. Do you agree with our assessment of Wi-Fi coexistence with existing users of the band? If not, please provide details.

Please see response to Question 20.

Q22. 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?

We believe that because of the considerations set out in our response to Question 13, it is inappropriate to limit consideration to being solely in/around high-density areas– in reality only ultra-rural deployments can be considered to have long term security of tenure.

We understand that there are approximately 800 licences in circulation, of which around half are awarded to BT, who should have fair incentives to move them.

We understand that the typical cost of moving frequencies – subject to suitable alternatives being available -- is ~£✂.. Ofcom could facilitate migration by giving a holiday on the fees for links migrated to alternate bands post-migration – indeed Ofcom could provide the holiday for 10 years from now, in order to incentivise early release.

Q23. 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 6GHz band?

See response to Question 20.

While we appreciate a maximum permitted power level may be required in some areas to ensure co-existence with incumbent services operating in the same area it is important to note the quoted 73 dBm/100MHz in Clause 5.20 is a reference commonly used in studies and not a specified maximum (which should be ubiquitously applied). Coexistence with any incumbent service should be considered on a case-by-case basis including all options available to effectively and efficiently manage the coexistence e.g. exclusion zones, specific tilt and azimuth settings, transmitter heights etc. including potential migration of the service.

Vodafone has already trialled prototype mobile network equipment operating in the upper 6GHz band with a maximum EIRP of 79dBm and expects next generation equipment will be able to operate at over 80dBm EIRP. As demonstrated through our 6GHz trials[6] and through ongoing studies in PT1 any reduction in power level from around 80dBm to 73dBm will have a significant impact on mobile network capacity and coverage. Therefore, any specified maximum power level(s) should be careful considered and set through proper analysis ensuring both co-existence while maximising the efficient use of spectrum.

Q24. Do you have any other comments on our policy proposals or any of the issues raised in this document?

We must reiterate our strong objection to what Ofcom refers to as "Phase 1 – Initial Wi-Fi Access" i.e. pre-authorising low power indoor Wi-Fi across the whole upper 6GHz band on a licence exempt basis. As well as there being no justification, benefit or reason in this approach for any Wi-Fi services, it effectively precludes

the use of the band for mobile service and therefore cannot be considered as “sharing”. We strongly urge Ofcom not to proceed with “Phase 1”.

Vodafone UK
May 2025