Virgin Media O2 response to Ofcom consultation:

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

September 2023

Introduction

Virgin Media O2 ("VMO2") welcomes the opportunity to respond to Ofcom's consultation on Hybrid sharing: enabling both licensed mobile and Wi-Fi users to access the upper 6 GHz band[1]. As Ofcom noted in its most recent Update on the upper 6 GHz band[2], there is intense and competing industry interest in the use of the band. As a result, we understand Ofcom's rationale for examining potential sharing solutions, in the hope that they can maximise benefits for UK consumers and businesses and deliver efficient use of the spectrum.

The efficient use of spectrum

VMO2 strongly supports the principle of efficient use of spectrum. As a Mobile Network Operator ("MNO"), O2 has always sought to make efficient use of its spectrum holdings. We were the first to reuse our 2G spectrum for 3G, and since then we have extensively refarmed our 2G and 3G spectrum to enhance our 4G capacity to the maximum extent feasible, to deliver the greatest efficiency and benefits. We have worked hard to implement innovative solutions, including rebalancing different frequencies through refarming and deploying spectrum where it is most needed. We continue to embrace the newest generations of mobile standards, as well as adopting the latest developments in technology and equipment to extract maximum efficiency and ensure we deliver high-quality, reliable mobile services to our customers.

VMO2 is a converged operator

VMO2 launched in 2021, combining the UK's largest and most reliable mobile network (O2) with a fully gigabit broadband network (Virgin Media) where customers benefit from speeds five times faster than the national average. Our fixed network covers more than half the country and is being upgraded to full fibre to the premises, with completion in 2028. We are very much a converged operator and committed to ensuring our customers continue to benefit from both gigabit broadband connectivity (with a significant amount of our fixed traffic carried over Wi-Fi), as well as delivering high-quality mobile services, including through the roll out 5G, with the aim of ensuring its full benefits are realised.

As a converged operator, we have a clear interest in ensuring our customers receive the best services, both mobile and fixed (including when accessed over Wi-Fi), now and into the future. This means that we take a balanced approach to these services and we are incentivised to ensure that there is sufficient capacity available to meet the growth in demand for both.

The importance of sufficient spectrum for Wi-Fi use

To improve spectrum access for Wi-Fi in the UK, Ofcom has allocated 500 MHz in the lower 6 GHz band for use by Wi-Fi and other RLAN technologies. This almost doubled the amount of spectrum available for this use, adding to existing 2.4 GHz and 5 GHz spectrum. In addition, with a large amount

[1] https://www.ofcom.org.uk/__data/assets/pdf_file/0031/263776/condoc-upper-6ghz-review-june23-v2.pdf

[2] https://www.ofcom.org.uk/__data/assets/pdf_file/0028/248770/update-on-upper-6hz-band.pdf

of spectrum also available between 57-71 GHz, capable of supporting very high capacity and demands, there is no obvious shortage of spectrum for Wi-Fi use. This is a positive outcome, as it ensures that millions of fixed broadband customers in the UK will continue to benefit from high-quality connectivity, such as that provided by VMO2, when accessed through the use of Wi-Fi.

Given the amount of spectrum available for Wi-Fi use, our view is that enabling the upper 6 GHz band for Wi-Fi use risks taking an unbalanced approach, particularly when considering the scarcity of, and need for, additional mid-band spectrum for licensed mobile use, which is required to meet the continued growth in demand for mobile services.

The importance of the upper 6 GHz band for licensed mobile use

As we have set out in our responses to several Ofcom publications on spectrum matters in recent years, including Ofcom's Call For Input on 'UK Preparations for the World Radiocommunication Conference (WRC-23): UK Provisional views and positions for WRC-23', in the coming years (between 2025 and 2030) existing mid-band spectrum will be quickly absorbed by the well-evidenced demand for mobile services. MNOs face a future challenge in respect of their ability to meet this demand, especially in dense urban areas. As a result, additional mid-band spectrum will be required if they are to continue to provide high-quality 5G services and prevent congestion having a deteriorating impact on customers in key areas, such as the largest cities and towns across the UK.

MNOs have forecasted that between the period 2025 and 2030, existing capacity will become exhausted on a significant number of their sites. VMO2 has provided detailed evidence directly to Ofcom to support this. Absent appropriate action, a capacity crunch will start within two years.

In response to growing demand, MNOs recognise that a level of densification is required and plan to densify their networks as a way of increasing capacity in key areas. However, densification has practical and economic limits. MNOs will not be practically able to, nor commercially justify, densification on a mass scale, as it would involve very high costs not only in building large numbers of additional sites, but also from increased energy usage that would come with adding and running large numbers of additional cells, along with the associated environmental impact. These are all serious factors which are high on the agenda for VMO2.

The upper 6 GHz band offers an effective solution to the impending problem. As mid-band spectrum, it provides a good balance between capacity and coverage. If deployed on existing macro sites on a high-power basis in a similar way to 3.4-3.8 GHz spectrum, it can be used in an efficient way to meet the growth in demand across key towns and cities. It represents the only viable solution for MNOs to avoid congestion and provide high-quality mobile services across wide areas, where the deployment of mmWave spectrum and mass densification will not be technically or economically feasible.

The alternative is that the absence of timely access to the upper 6 GHz band for high-power licensed mobile use is likely to have a detrimental impact upon UK consumers and businesses, who currently enjoy good speeds and, as Ofcom reports, display high levels of satisfaction[3]. This would represent a

[3] For example, in Ofcom's recent Comparing Customer Service publication, https://www.ofcom.org.uk/__data/assets/pdf_file/0014/261500/comparing-customer-service-report-2023.pdf

failure to deliver the level of ambition and services that the UK will expect and leave it at a disadvantage relative to countries which prioritise spectrum allocation to licensed mobile use.

Given the importance of the band for high-power licensed mobile use, we are concerned by the fact that Ofcom has no timeline for its release, nor a commitment to support an identification of the band for IMT (International Mobile Communications) at the upcoming World Radiocommunication Conference (WRC-23). We are concerned that IMT identification of the band could be stalled by a push for it to be enabled for licence-exempt use. This could, at best, significantly delay the timeline at which it can become available for licensed mobile use, but also result in serious impact to 5G in the UK and the mobile connectivity that operators can deliver over the medium and longer term as well as limiting the benefits that the spectrum can deliver.

Hybrid sharing options between licensed mobile and Wi-Fi

We understand Ofcom's rationale for examining potential sharing solutions in the upper 6 GHz band in the hope that they can maximise benefits for consumers and businesses in the UK and deliver efficient use of the spectrum. However, the hybrid sharing options considered, and the mechanisms and measures identified as being likely to be required in order to deliver them, raise a number of concerns and may be challenging to implement successfully in the real world.

In the consultation, Ofcom presents two main options for hybrid sharing – an indoor/outdoor split which envisages Wi-Fi indoors and licensed mobile use outdoors, and geographical sharing, which would enable licensed mobile use in specific high-traffic locations, with Wi-Fi elsewhere. Whilst we see an element of logic in proposing such partitioning, we also see significant issues arising from it.

An indoor/outdoor split is unlikely to work with high-power licensed mobile, as mobile signals often exist indoors. While some buildings are constructed in a way that results in high building penetration loss, there are far more that are not and which see relatively high levels of mobile signal strength. Unlike mmWave, 6 GHz spectrum is expected to have reasonably good coverage properties and, as we have highlighted to Ofcom directly, trials have already reported good outdoor to indoor coverage.

In order to deliver a more optimal solution, Ofcom suggests that there may need to be technical constraints imposed including tighter power limits on licensed mobile. This is a significant concern for VMO2. As we have outlined, the upper 6 GHz band offers an effective solution to the issue of capacity exhaustion over a significant number of mobile sites, over wide areas. This is because the spectrum can be deployed on existing macro sites on a high-power basis in a similar way to 3.4-3.8 GHz spectrum is today, providing a highly efficient way to deliver capacity and performance across key towns and cities. If licensed mobile use in the upper 6 GHz band was restricted to medium power, as suggested in the consultation, it would artificially restrict the level of coverage that is able to be delivered. This would seriously impact the mobile business case for the band, making it unviable, and it would fail to deliver the benefits that the band is capable of.

When compared to an indoor/outdoor split, geographical sharing perhaps offers more potential. We note that Ofcom recently took a geographical approach to spectrum allocation in its consultation on

the release of mmWave spectrum, whereby it split the country into different high and low density areas on the basis that mmWave deployment by mobile operators is expected to be limited to a very small percentage of the UK landmass. However, whilst mmWave deployment is expected to be largely deployed at 'hotspots' in specific areas and it has limited coverage properties, the upper 6 GHz band is expected to be deployed more widely across key towns and cities, therefore any geographic restriction on the deployment of the band would need to be more relaxed in order to ensure that the business case for deployment is preserved and the benefits are not artificially limited.

Coexistence and interference management mechanisms

Co-channel sharing between Wi-Fi and licensed mobile is highly challenging to achieve from a technical standpoint. It is likely to result in significant interference impacting both services and their performance, to the extent that it would make it unviable. Wi-Fi and licensed mobile currently use different technical specifications that operate in very different ways, optimised for each technology and protection regime, therefore the systems are not currently harmonious. Furthermore, licensed mobile has a high level of control over its use of a spectrum band, whereas Wi-Fi equipment can't currently be controlled dynamically. This makes real-world sharing between the two technologies highly challenging on a co-channel basis where they are likely to be present in the same locations.

As Ofcom highlights at paragraph A7.3 in the consultation:

> *"Our analysis has shown that, without additional measures, interference to both services is likely, at least in some locations and at some times. Additional interference management mechanisms and mitigation techniques are therefore likely to be necessary to manage the sharing of resources between the two services to enable use of both mobile and Wi-Fi in the band."*

We agree with this statement. Hybrid sharing would require the use of advanced mechanisms to manage coexistence between Wi-Fi and mobile. Two such mechanisms that Ofcom considers (which might be used either independently, or in combination), are the use of managed databases to enable priority of use by either Wi-Fi or mobile over a particular geographic area where both services would be present, and the use of modified sensing and access protocols.

Databases may offer a potentially viable way of managing sharing between licensed mobile of Wi-Fi in the context of geographic sharing. However, as Ofcom identifies at paragraph 4.34 of the consultation, databases work on the basis of understanding the location of the users, however, geolocating indoor systems (such as Wi-Fi) can be difficult or impossible as GPS signals are not always available, particularly deep indoors.

There is limited evidence of the successful deployment of databases and significant work would be required in order for them to be implemented effectively. Ofcom, or possibly a third party, would need to develop and administer the database. Development, along with the maintenance and management of the database will involve costs, which are currently unknown, as is the answer to the question of who bears the cost and what impact they may have. Mobile operators would need to add the capability to query databases to their base stations, and development would be required to determine the parameters to be used in the database in order to protect Wi-Fi deployments. Whilst

mobile operators will already be providing information about their network deployments to the Regulator, this is not something that the Wi-Fi industry is used to doing. The introduction of databases would introduce a cost for Wi-Fi manufacturers, and they will need to change their standards and implement new ones in their devices in order to connect to it.

Automated Frequency Coordination ("AFC") and Spectrum Access Systems ("SAS") have not yet been implemented at scale with different technologies, we therefore believe that further testing is required to ensure 'unknowns' do not introduce further challenges.

In relation to sensing mechanisms and access protocols, we believe it would be sensible for Ofcom to monitor current implementations, particularly for their technical performance. However, the novel nature of the hybrid sharing approach will limit the direct applicability of existing mechanisms. As Ofcom identifies in the consultation, Wi-Fi currently decides when to transmit based on whether or not it detects other nearby users in the channel. However, it does not detect mobile signals in the same way as it detects other Wi-Fi signals. Therefore development of the current protocols would be required and subsequent changes will need to be successfully implemented in order to facilitate coexistence between Wi-Fi and licensed mobile.

In the United States, CBRS uses a network of sensors, but such a solution for the upper 6 GHz band needs to first test whether sensing techniques are adequate for 6 GHz spectrum (as CBRS exists around 3.5-3.7 GHz). While CBRS use is supported by a dedicated network of sensors, Ofcom appears to suggest reliance on implementing sensing technology into the devices utilising the upper 6 GHz spectrum. This would require macro cells and Wi-Fi access points to also act as sensing nodes. This will involve unknown costs and complexity and may compromise their performance and user experience, especially during busy hours.

Enhanced sensing mechanisms may offer a potentially viable way of mitigating interference to Wi-Fi which is operating indoors, in the same areas that mobile is operating outdoors. However this is still likely to be challenging where the mobile signal is still strong indoors and would require Wi-Fi to adjust accordingly in order to avoid degradation to both services.

The introduction of modified or new protocols in existing mechanisms to support hybrid sharing may affect network KPIs including latency. Other considerations such as automatic update of a shared database when new nodes are connected, may be preferable, but would need to be tested at scale across a wide geographical landscape and for edge cases.

Sensing mechanisms would need to detect when an outdoor mobile user connected to the upper 6 GHz spectrum moves indoors, and be forced to switch to another frequency or Wi-Fi. There is limited evidence existing mechanisms can do this reliably at scale. Dynamic Frequency Selection ("DFS") used in the 5 GHz band to manage Wi-Fi and radar signals has had limitations, including duration of detection and false positives of detecting radar signals. Any sensing mechanism for a hybrid approach would have to overcome similar limitations and concerns.

The importance of International harmonisation

We understand Ofcom's aim is to encourage the development of technology-based coexistence solutions such as managed databases and enhanced dynamic sensing. Ofcom identifies at paragraph 1.18 of the consultation, that any hybrid sharing mechanisms will likely need certain features and capabilities implemented in devices and/or network equipment for which International harmonisation is important to create economies of scale. VMO2 agrees that if any mechanism is to be viable it will need to be harmonised widely. However, achieving this will require a step change and commitment.

In summary

We understand Ofcom's reasoning behind exploring and seeking to develop an innovative approach to sharing between Wi-Fi and licensed mobile in the upper 6 GHz band. However we believe that hybrid sharing is likely to be challenging to deliver. It raises several questions and concerns including the impact of potential technical restrictions such as power limits on licensed mobile which could make the business case unviable, as well as the unknown cost and level of complexity involved in developing hardware and software, and the effectiveness of any solution and extent to which service performance may be compromised.

We are concerned that hybrid sharing could risk sterilisation of the upper 6 GHz band for wide area licensed mobile use, and could result in a failure to realise the full benefits of the band and ultimately fall short of the goal to deliver efficient use of the spectrum.

Alternative approaches

We note that in the consultation, Ofcom briefly touches upon alternative approaches. At paragraph 4.53 Ofcom says:

> "*Some stakeholders have suggested that the easiest way to accommodate licensed mobile and Wi-Fi use in the upper 6 GHz band would be by having two clear, separate assignments. This would mean, for example, that the first 160 MHz or 320 MHz channels in the upper 6 GHz band (from 6425 MHz upwards) would be assigned for licence exempt use, extending the available spectrum from the lower 6 GHz band for Wi-Fi. The remaining bandwidth would be assigned for licensed mobile use."*

And at paragraphs 4.54 and 4.55:

> *"In theory, this solution offers a simple way to support some level of additional capacity and new use cases for both Wi-Fi and licensed mobile. However, this option ignores the potential benefits of a hybrid approach as described in this document, as different parts of the band would be uniquely assigned to different uses."*
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> *"Once we have more developed proposals for hybrid sharing, we will be able to assess them against alternatives where Wi-Fi and mobile do not coexist in the same frequencies, including partitioning the band, or single use for either."*

VMO2 suggests that, given the challenges and concerns identified with the two main potential hybrid sharing options, Ofcom includes such alternative approaches to hybrid sharing within its detailed assessment work. This will enable it to develop a better understanding of the advantages and disadvantages of different approaches and options.