Enabling opportunities for innovation

Shared access to spectrum supporting mobile technology

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Kindly address comments or questions to: [✂].

1. Introduction

Ofcom proposes to encourage innovative uses of radio spectrum by proposing spectrum sharing mechanisms to take advantage of unused "white space" spectrum at 3.8-4.2 GHz, revisions to the 1800 MHz shared band and a new 2390-2400 MHz shared band. In all cases, the bands would be designated for mobile use. For all three bands, Ofcom proposes a lightweight first-come, first served licencing regime in two categories: a low power licence allowing unlimited deployment of base stations within a 50 metre radius circle, and a medium power licence on a per base station basis that is limited to rural locations only at this time.

Ofcom proposes these rules in furtherance of its goal of facilitating access to spectrum for Internet of Things applications, improved coverage, and in encouraging diverse interests and new business models in the mobile ecosystem. The consultation document also notes that this proposed regime lays a strong foundation for future Dynamic Spectrum Access tools that could further support innovative uses of the bands.

Cisco endorses the policy goals of this consultation in that spectrum sharing can put more radio spectrum to work, and if regulations are properly designed, enable multiple business models and interests to utilize mobile technologies in innovative ways. We are also excited to see Ofcom laying the groundwork for future dynamic access sharing models, which we believe are important to deliver the full benefits of spectrum to consumers as demand for spectrum continues to rise.

That said, there are two areas of discussion in the consultation document that we believe are overly optimistic with respect to likely outcomes, including one where we believe Ofcom needs to radically change course for the moment. First, Cisco believes Ofcom needs to put on hold its plan to open 2390-2400 MHz to mobile use, as the success of the plan is far too dependent on licence-exempt receiver standards that have not been forthcoming and on analysis that fails to take into account the current generation of Wi-Fi equipment in the market. Second, Cisco urges Ofcom to consider modifications, described below, that would make the 3.6-3.8 GHz band more conducive to new investment, while ensuring incumbent systems and uses remain in the band.

2. 2390-2400 MHz should not be authorized for mobile use at this time

As Cisco understands the consultation, Ofcom is proposing to authorize mobile use of

2390-2400 MHz directly adjacent to the licence-exempt band at 2400 MHz. The consultation asserts that interference can be for the most part eliminated under the following conditions: (1) base stations would be limited to a maximum of 250 mW EIRP (or 24 dBm) per carrier per sector; (2) up to 23 dBm for terminal stations (stated as a TRP limit for mobile or nomadic terminals and an EIRP limit for fixed or installed terminals; and (3) possible medium power base stations at 42 dBm per carrier per sector, if Ofcom can be assured that this category of transmitters will not cause harmful interference to other existing uses in the band.

As the consultation notes, there is likely to be an impact to adjacent unlicensed use, and in particular Wi-Fi use, in the 2400 MHz band. However, the consultation document states that "previous studies" show that the impact to Wi-Fi would be small, because a series of circumstances would need to be simultaneously present in order for Wi-Fi signals to be degraded:

- the Wi-Fi signal is very weak, operating at its minimum signal levels; and
- *the Wi-Fi equipment does not have sufficiently good filters to reject signals from the adjacent mobile band*; and
- mobile handsets use 2390-2400 MHz; and
- mobile handsets transmit at near full power of +23 dBm; and
- the mobile handset is particularly close to the Wi-Fi receiver, i.e. less than one metre away.

Similar concerns are raised with respect to Assistive Listening Devices. The consultation document then categories the risk of interference as "low," finding that that the likely risk of interference comes primarily from handsets, which it says would not be powered above 10 dBm indoors *when coverage is provided by indoor base stations*. The consultation also finds that it is "unlikely" that a Wi-Fi receiver will be in sustained proximity to a mobile handset, and that the contention-based Wi-Fi protocol is robust in the face of interference.

Cisco urges Ofcom to put its plan to open 2390-2400 MHz to mobile use on hold, pending further study. There are several reasons why this should be done. As an initial matter, the previous tests were conducted using Wi-Fi technology that does not represent the technology that is being placed in the market beginning in 2019 and beyond, namely Wi-Fi 6 (aka IEEE 802.11ax). Wi Fi 6 is a substantially different version of Wi Fi relative to the IEEE 802.11n equipment that was used in the tests. Relative to

its predecessor technologies, Wi-Fi 6 uses broader channels, makes far greater use of Multi-user MIMO antenna technology, and its signals travel farther than previous generations. Conclusions about the impact of adjacent operations have not taken into account this generation of technology, and the results are likely to be different.

Second, Wi-Fi operating on Channel 1 (centred on 2412 MHz) will be affected by anything above -62 dBm per 20 MHz. It appears from the consultation that if a 24 dBm base station is located indoors at 2390-2400 MHz, that means interference will substantially degrade Wi-Fi operations on Channel 1 at up to 3 meters. That is a very real issue for residential and commercial users, where a base station could be near any number of Wi-Fi equipped devices.

Finally, Ofcom cannot rely on non-existent receiver standards. Despite the best of intentions, licence-exempt receiver standards are not yet a reality in Europe. Moreover, even if they were a reality in 2019, their existence would have no impact on the millions of licence-exempt devices in the market today.

Cisco does not believe the "additional measures" called out in the consultation are enough to overcome the impediments identified above. Advising users to separate low power base stations and Wi-Fi access points might work for large enterprises staffed with IT professionals, but is unlikely to have much impact in any other deployment scenario. Moreover, there is no European standard at this time to address licence-exempt receiver filtering. Coordination for medium powered stations is helpful, but in the first instance would not stop degradation to Channel 1 in the 2400 MHz band. For example, personal hot spots on mobile phones can be used anywhere to wirelessly tether another Wi-Fi device, such as a laptop or tablet. Coordination cannot predict the geolocation of this type of use case. In addition, the fact that Wi-Fi utilizes a contention-based protocol to overcome interference is not particularly helpful when trying to manage adjacent channel transmissions from synchronous mobile devices because Wi-Fi "listens before talk" and will defer so long as it perceives its channel is occupied. The strength of LBT is predominantly in managing transmissions with other LBT devices, and not in managing transmissions with other types of systems.

Finally, it is worth stating that the 2.4 GHz band remains the essential band for Wi-Fi globally. It is the one band that, no matter where you are in the world, works. While countries have made improvements to expand 5 GHz allocations, those allocations are

not yet consistent globally. Impairing access to the roughly 80 megahertz of access that Wi-Fi uses in the 2.4 GHz band is therefore an enormous problem for the licence-exempt ecosystem by degrading access to the basic band that licence-exempt devices use worldwide.

This is not a small problem for the United Kingdom. Like every other nation, Wi-Fi is the wireless workhorse of the Internet, and that will only continue in the 5G era ahead. Cisco predicts fixed/Wi-Fi IP traffic in the UK will reach 7.0 exabytes per month by 2022, up from 2.6 exabytes per month in 2017. With overall IP traffic growing, the fixed Wi-Fi portion will represent 50- 51% of total IP traffic during this period. In contrast, the UK's mobile data amounted to 3% of total IP traffic in 2017, and will be 6% of total IP traffic by 2022. Meanwhile, the use of Wi-Fi to offload mobile data from devices equipped with both Wi-Fi and cellular connectivity will increase from 66% of traffic from these devices in 2017 to 71% of traffic from these devices in 2022. These numbers should be top of mind for Ofcom before it takes a decision to open the adjacent band at 2390-2400 MHz to mobile use.

3. The Consultation's proposals for 3.8-4.2 GHz are strong, but would benefit from modification

Cisco finds significant merit in the proposal to utilize white spaces at 3.8-4.2 GHz. As discussed in the consultation document, the band is currently underutilized. Putting the spectrum more fully to work would no doubt be helpful in meeting rising demand for wireless services, and in particular to address the needs of enterprises as well as commercial services that address government needs. The proposal is also highly consistent with the Future Telecoms Infrastructure Review.[1] That Review specifically called out how new spectrum sharing models could support new business models, and gave "private 4G LTE/5G networks" in support of the industrial Internet of Things, automation and robotics, as a key example.

In Cisco's view, there are several details in the proposal that in particular will make the band especially attractive to new use: proposed power levels, low power area licensing,

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/779226/SSP_Consultation_-_Publication_Version__2_.pdf

equal priority licensing, and flexible eligibility and use. We discuss these aspects first, before turning to suggested modifications to the proposal.

Proposed power levels, in particular the low power license at 24 dBm for base stations and 23 dBm for terminals, are well matched for use in a variety of Internet of Things applications especially in enterprise use cases. In addition, the proposal allows area licencing, which enables the licensee to elect to deploy as many transmitters at its site as needed under one licence authorization. This gives the licensee needed flexibility to address diverse manufacturing, healthcare, retail, education, logistics and other business cases, where network topologies might differ.

Medium power licenses of up to 42 dBm are also useful in outdoor deployments for Internet of Things – in particular agriculture, educational campuses, and a variety of enterprises where work is performed outdoors (e.g., mining, certain logistics operations, ports). This will enable the creation of outdoor small cells for coverage.

Also of importance is the proposal that, once licensed, the licensees would have the same priority as other types of incumbents in the band – namely first in time rights against harmful interference. This provision ensures that those making an investment in network, particularly for deterministic use cases (e.g., industrial Internet or equipment automation) can be assured of a return on investment from the wireless network they provision.

As the consultation implicitly recognizes, flexibility in terms of licence eligibility and use cases is critical. Specifically, this band can create certainty for use cases where an enterprise/industrial user needs to control and manage the radio spectrum without reliance on an external party, while also providing opportunities for service providers to offer capabilities “as a service”. This will not only lead to additional innovation in how the spectrum will be used, but also can support applications that must perform to an extremely high quality of service and availability level without encountering harmful RF interference. They also provide necessary flexibility in some important industrial and business situations where safety, security and/or other regulatory issues pose important constraints. In Cisco’s view, demand exists for new, more robust private wireless networks to address business-critical, mission-critical, and enterprise/industrial automation use that is projected to have significant economic benefits for the national economy. Whether this is called the “Industrial IoT,” the “next industrial revolution” or “Industry 4.0,” empowering enterprise processes with wireless transmission of data is becoming a critical piece of national economic strategy for competitiveness throughout

the world. In Cisco's experience, certain governmental users have similar requirements to non-governmental users on service quality and availability, and thus could benefit from this flexible approach as well.

We also note that ensuring that licensing fees remain reasonable and licence processing remains simple and straightforward will help to support a wide range of innovative uses in the band.

While there is much to appreciate in the proposal, there are some suggested modifications that might be considered to ensure the band produces the results that are intended by Ofcom. First, in any kind of lightly-licenced regime, it is important to put in place incentives to ensure efficient and equitable use of spectrum, e.g., to avoid having a few entities claim all the spectrum that is being made available, simply because they are aware of the new rules when many of the prospective users are not. There are a variety of ways to reduce this likelihood, such as the suggestion in the Consultation to require licencees to provide information about their build outs and systems to Ofcom. Presumably this can be automated in some way to ensure that Ofcom has actionable data on the band and licensee activities. However, the proposal to put licensees on five year's notice that their license will be reclaimed seems excessive in the case of a licencee who has not built out its network. That would simply ensure that spectrum would lie fallow for five additional years after "notice" has been given. Cisco urges Ofcom to think through this issue, including whether to impose a definite licence term, or possibly differentiating between a case of substantial use of radio spectrum, where lengthy notice might be appropriate, from a case where a licence has not been constructed.

The consultation document correctly states that incumbents and incumbent uses will continue to be welcome in the band. Cisco endorses this approach with the following suggestion. Ofcom should consider future repacking, particularly of satellite downlinks, and/or should consider a plan to place future satellite downlinks primarily in one section of the band if possible. This will ensure that terrestrial use, and in particular these low and medium power transmission licences, will be removed spectrally from satellite receive stations and reduce the risk of interference.

Finally, Cisco encourages that the final adoption of the approach for 3.8-4.2 GHz be as technology neutral as possible. For example, the consultation calls out a range of 3GPP technologies, but there are other non-3GPP technologies that might be useful in this band, including Wi-Fi. Moreover, the consultation calls out Time Division Duplex (TDD)

technology, but the technical rules are quite 3GPP centric, as to channel widths, frame structure, synchronous behaviour, etc. In this respect, we believe the rules are overly regulatory and may exclude certain technologies or future evolution of technology. At a minimum, alternative technologies should be allowed provided they do not cause harmful interference to geographically adjacent licensees.