BASIC DETAILS

Consultation title: Improving Spectrum Access for Wi-Fi – spectrum use in the 5 and 6Ghz bands

Representing (self or organisation/s): Cisco

Cisco's Response to Ofcom's Consultation Document

Improving spectrum access for Wi-Fi

Spectrum use in the 5 and 6 GHz bands

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This response contains no confidential information.

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1. Overview and Introduction

This filing is made on behalf of Cisco Systems, Inc. (Cisco), the global technology company. Cisco has had a presence in the UK for over 30 years. We serve a broad range of enterprise, telecoms and public sector customers of all sizes through our UK network of 4000 partner companies. We are committed to helping the UK achieve its digital ambitions whether through our technology offers, our innovation initiatives such as the Country Digital Acceleration program or through our skills work through Cisco's 300+ Network Academies in the UK.

Cisco strongly supports the proposal by Ofcom to open 5 925-6 425 MHz for Wi-Fi, including low power indoor equipment and very low power outdoor use.
Cisco also supports the proposal to remove Dynamic Frequency Selection (DFS) requirement from 5725-5850 MHz, because the technology is only necessary when the government concludes that Wi-Fi must avoid radar operations in this band, and to harmonize the rules in the United Kingdom with other nations.

As in the consultation document, Cisco will use the term "Wi-Fi" to refer to Radio Local Area Network (RLAN) technology, as Wi-Fi is the most common RLAN application in the market.

2. Opening access to 5 925-6 425 MHz will enable innovation, make more efficient use of 5 725-5 850 MHz, and respond to consumer demand

Ofcom correctly concludes that wireless connectivity, whether in the home or business, is an enabler of innovation. The enormous rise in the number of devices generates competitive innovation, further fueling the number of devices and driving new functionality. Cisco's 2020 Internet Report forecast for the UK[1] noted there will be just under 660 million connected devices in the UK by 2023, with the leading categories as follows:

Device Type	2018	2023
Machine to Machine modules	161m	401.1m
Smartphones	63.9m	78.2m
TVs	77.3m	108m
Laptops & Tablets	77.6m	71.1m

[1] https://www.cisco.com/c/en/us/solutions/executive-perspectives/annual-internet-report/air-highlights.html#

Innovation in device types, device functionality, and the applications riding on the connected devices is expected to continue. For example, application stores globally saw a record 204 billion application downloads in 2019, up 6% from 2018.[2] In the UK, Cisco is projecting 3.3 billion downloads of mobile applications by 2023.[3] Smart home technology is expected to grow at a 18% compound annual growth rate through 2026.[4]

But continued growth and innovation in devices and applications depends upon access to spectrum. Ofcom's consultation document, at page 4, presents the current view of channels available to Wi-Fi. It notes that as the number of devices and applications continues to grow, congestion on existing channels can cause the user experience to deteriorate. Greater latency and the inability to connect to Wi-Fi can quickly lead to consumer frustration.

To avoid congestion, additional non-overlapping channels are needed. While improvements in regulatory conditions associated with 5 GHz are welcome, they alone are not sufficient.

We therefore endorse Ofcom's view that 5 925-6 425 MHz is spectrum that could be utilized by Wi-Fi, and that reducing regulatory constraints on 5 725-5 850 MHz is desirable. Cisco further agrees that Wi-Fi in the 5 925-6 425 MHz band could successfully share with incumbents at power levels up to 250 mW indoor and 25 mW outdoor, and in the 5 725-5 850 MHz band at power levels of up to 200 mW and limited to indoor use. Together, these changes are a strong step in the direction of supporting the UK's wireless future. Cisco notes that in the United States, regulators are considering Wi-Fi spectrum up to 7 125 MHz, and we hope that in a future proceeding, regulators in the UK and elsewhere will consider opening the full band to Wi-Fi.

3. Current and future uses of Wi-Fi compel access to more channels

The UK is among the global leaders in emphasizing the importance of broadband connectivity to homes and businesses. Moreover, it has correctly put its policy focus on

[2] https://techcrunch.com/2020/01/15/app-stores-saw-record-204-billion-app-downloads-in-2019-consumer-spend-of-120-billion/

[3] https://www.cisco.com/c/en/us/solutions/executive-perspectives/annual-internet-report/air-highlights.html#

[4] https://www.marketwatch.com/press-release/smart-home-market-size-2026-by-technology-share-growth-regional-statistics-global-revenue-forecast-2018-2026-2019-09-11

improved wired connectivity. This is critical because broadband, whether fibre or coaxial cable, is rapidly evolving toward a multi-gigabit, symmetrical capability. This ensures that as the UK moves forward, its broadband connectivity to its citizens and businesses will support the widest array of use cases, including important applications in home health care and education. Cisco applauds this policy focus.

At the same time, it is important that the Wi-Fi router sitting at the end of the broadband connection not become a bottleneck to new applications being delivered over faster broadband links. Wi-Fi technology, and its market penetration, needs to stay ahead of capabilities being engineered into broadband fixed connections. Video, which represents the lion's share of IP traffic in the UK and globally, is a good example. In a short span of time, industry has transitioned from digital, to HD, Full HD, 4K, Ultra 4K and now, 8K, which was originally designed for commercial theaters but is beginning to transition to consumer products. Increasingly large file sizes are seen in downlink (consumption of entertainment) and uplink (video calling). And, there is no reason to believe that innovation in video technology will stop at 4K or 8K.

These issues are real, not hypothetical. Cisco forecasts that in the UK by 2023, over 17% of broadband connections will operate at speeds of 100 megabits per second.[5] Wi-Fi needs to increase its capability to stay ahead of these data consumption curves, and that means, as will be discussed below, more and wider channels.

Just as fixed broadband connectivity displays a cycle of continuous improvement, so too do mobile technologies. The transition from 4G to 5G has dominated this discussion, with speeds moving from theoretical maximums of 100 megabits per second to multi-gigabits per second. Wi-Fi's role in offloading traffic from a mobile device to Wi-Fi, and the fixed wireless network, also makes it essential for Wi-Fi to remain ahead of the 5G curve.

Enterprise use is growing, also. Much of that traffic ends up on corporate or industrial Wi-Fi networks. Virtually every business segment –retail, health care, education, manufacturing, logistics, sports, and more, relies on Wi-Fi for significant portions of its business process and/or to attract customers. For these segments, Wi-Fi has meant that workers and business processes can be wireless.

More fundamentally, Wi-Fi has also in many ways changed the value proposition for industries. For example, a fully equipped Wi-Fi connected stadium delivers a wholly different fan experience, allowing customers to immerse themselves in the action on the field, accessing game and season stats for players, and enables social media sharing of key events. Wi-Fi also changes the way in which fans interact with vendors, and how

[5] https://www.cisco.com/c/en/us/solutions/executive-perspectives/annual-internet-report/air-highlights.html#

the stadium and vendors interact with them. Stadium Wi-Fi enables real time delivery of coupons, food ordering, product orders, ticketing, re-ticketing and more. Stadium operators can deploy improved safety and security services, easily manage vendor venues and point of sale activities, and provide connectivity to news media as well as within their own organizations.[6] This transformation is being repeated again and again in different market sectors. It is, by any measure, a new ball game.

As broadband, 5G, and enterprise deployments of Wi-Fi continue to grow, demanding more from the Wi-Fi radio, industry has innovated to new and increasingly potent versions of Wi-Fi in order to meet demand. Today, as the consultation document notes, industry is shipping its sixth generation of Wi-Fi products, known as "Wi-Fi 6". This generation contains numerous innovations that enable efficient use of spectrum resources, and is engineered to manage the data loads that consumers are generating.[7]

One innovation relevant to policymakers is the use of wider bandwidths. Starting with Wi-Fi 5, and continuing into Wi-Fi 6, channel sizes can now be as large as 80 or 160 megahertz in width. These wide channels are particularly useful to manage large data files such as video, enabling transmission of data quickly over the air, thereby ensuring that the shared resource of Wi-Fi spectrum is available for other uses. But as the consultation document notes, the spectrum resources at 5 GHz are insufficient to deploy networks with multiple 80 or 160 MHz channels.

> Although new Wi-Fi standards may mitigate some spectrum challenges in the existing Wi-Fi bands, they are not a comprehensive solution….Congestion may be eased but it is not resolved in the long term.[8]

We agree. New contiguous spectrum must be found, such as the proposed allocation of 5925-6425 MHz.

[6] https://upshotstories.com/stories/how-aeg-uses-technology-to-create-the-best-experience-for-fans-and-partners

[7] https://www.cisco.com/c/en/us/solutions/enterprise-networks/802-11ax-solution/index.html?dtid=osscdc000283

[8] Consultation document at 12.

4. Opening spectrum for Wi-Fi in 5925-6425 MHz

Question 1: Do you have any comments on our proposal to open access to the 5925-6425 MHz band for license-exempt Wi-Fi use?

4.1 Channel plan and center frequencies

The consultation document, at page 14, presents a notional channel plan that begins at 5 935 MHz and ends at 6 415 MHz. Based on that notional channel plan, in Appendix A8, the appendix presents, as information, the Nominal Centre Frequency in megahertz of each 20 MHz wide channel between 5 935-6 415 MHz.[9] Cisco has no issue with a notional channel plan, provided that the channel plan is not in any way enshrined in rules to which industry must adhere. As Ofcom knows, the European standards body, ETSI, and more in particular its technical committee TC BRAN, is responsible for deliverables for Broadband radio Access Networks. ETSI TC BRAN is currently working on a harmonized standard (EN 303 687) for Wireless Access Systems (including Wi-Fi technologies) operating in this band, and it is far preferable for national rules to allow manufacturers to adhere to the harmonized standard. As the work BRAN is conducting is expected to yield a stable draft later this year, the lack of a completed standard should not be of concern with respect to Ofcom's ability to adopt a final decision in this consultation process.

In fact, based on current information, we expect that the channel plan in ETSI EN 303 687 will encompass all of 5 925-6 425 MHz, with nominal center frequencies (in MHz) as follows (for 20 MHz channels): 5935, 5955, 5975, 5995, 6115, 6135, 6155, 6175, 6195, 6215, 6235, 6255, 6275, 6295, 6315, 6335, 6355, 6375, 6395, 6415. Whatever is finally decided, the ETSI channel plan does not need to take adjacent channel interference into account, or whatever out of band emission requirements are ultimately adopted. It is simply a plan, in which channels at the edge may need to be notched or meet other requirements to protect adjacent use. Cisco therefore urges Ofcom to ensure that its final decision in this matter gives equipment manufacturers the ability to harmonize with ETSI standards for the channel plan and center frequencies.

Cisco also notes that since the consultation document was released, Working Group FM appears to have agreed to a European-wide allocation for Communications-Based Train Control (CBTC) from 5 925-5 935 MHz, even though many countries do not use CBTC and have no plans to do so. To the extent the UK has no plans to deploy CTBC technologies above 5 925 MHz it should be free to set its own rules for 5 925-5 935 MHz, including making it available for license-exempt devices.

[9] Consultation document at A8, page 64.

4.2 Demand

As discussed above, we completely agree with Ofcom's view that both demand and technological changes in response to demand are driving the need for 6 GHz spectrum availability.[10] We agree that:

- A large continuous block of spectrum in the 6 GHz band will allow for wide, non-overlapping channels to allow Wi-Fi to continue to serve its critical role in the broadband and mobile ecosystems.
- 6 GHz is ideal for this use as it is adjacent to existing Wi-Fi spectrum at 5 GHz to support rapid development of products (including router and antenna designs) and speed those products to market.
- The industry's latest and most efficient technology, Wi-Fi 6, would be deployed in the band from the outset, enabling the most efficient use of spectrum, which will be of particular benefit in congested environments, but will be beneficial to all users.

Cisco also agrees with Ofcom's assessment that regulatory bodies in Europe and the United States are moving forward with initiatives to open 6 GHz to Wi-Fi use, and that the UK is wise to consider similar measures, as its consumers stand to benefit from the economies of scale that will be realized from these regulatory modifications.[11]

Question 2: Do you have any comments on our proposed technical analysis of coexistence in the 5925-6425 MHz band?

4.3 Power levels

Cisco agrees with the consultation document's finding that sharing the 5 925-6 425 MHz band between incumbent users and Wi-Fi is feasible.[12] We further agree that the transmit power maximums and power spectral density limits proposed in the text and in Appendix A8 will allow Wi-Fi users to deploy networks that will yield the benefits that Ofcom seeks. We therefore agree that Ofcom should adopt final power rules as follows for 5 925-6 425 MHz:[13]

- 250mW EIRP maximum for indoor use

[10] Consultation at page 15.
[11] Consultation at page 16.
[12] Consultation at page 18 and Appendix A7 at page 56.
[13] Consultation at page 18 and Appendix A8 at page 64.

- 25 mW EIRP maximum for outdoor use
- Maximum mean EIRP density of 10 mW/MHz in any 1 MHz band

We believe that by imposing simple, easy to understand power rules to create a license-exempt underlay, Ofcom is providing a framework that is simple to enforce from an equipment homologation perspective, and that can be easily and rapidly implemented by industry.

The consultation document suggests, at footnote 11,[14] that if the CEPT process concludes with a power level of 200 mW EIRP, that Ofcom would consider revising its rules downward to align with CEPT. Cisco discourages Ofcom from committing to future actions based on contingencies. Like Ofcom, we believe 250 mW EIRP will promote innovation in the band, including both use cases and applications. It is important to allow this equipment to function at the maximum power level national conditions allow. For example, whole home coverage is far better facilitated at higher power levels than lower ones because the higher power allows signals to propagate through interior walls. In any event, Ofcom need not decide in this proceeding what it might do in the event of a future contingency. As a result, we recommend no commitment to "what if's" as part of the final decision in this consultation process.

4.4 Technical coexistence examination appears reasonable

The Consultation, at pages 17-18, summarizes the work done to obtain a power level that would protect incumbent users consisting of fixed links and satellite uses. As discussed, representative samples of fixed link geometries and RLAN deployments were evaluated using both a Monte Carlo approach, a Minimum Coupling Loss analysis to evaluate protection criteria, and a static analysis. Cisco agrees with the conclusions that:

- Fixed link interference is unlikely;
- RLAN EIRP levels are quite likely to be below maximums for the vast majority of the time;
- Fixed links in rural or open areas are not likely to experience interference to receivers; and
- Fixed links in populated areas are protected by clutter loss.[15]

Cisco further agrees that the various Ofcom studies demonstrate that introducing Wi-Fi into the 6 GHz band will not result in the long term interference criteria to fixed links to be exceeded.[16] We agree that to the extent the engineering studies show a risk of

[14] Consultation at footnote 11, pages 18-19.
[15] Consultation at Appendix A7 at page 57
[16] Consultation at Appendix A7 at page 41 and page 55.

interference, it is from a single device located near a fixed link receiver, and that by reducing power, the long term interference protection criteria is not exceeded. Moreover, we fundamentally agree that the most relevant analysis of whether spectrum sharing can be successful is long term interference analysis, and that the existence of "further mitigation for interference as a result of uplift in the fade margins used in the UK planning criteria" for fixed links strongly argues against further need to explore short-term interference analysis.[17] Demand for spectrum is becoming so strong that regulators need to focus first on the potential for harmful interference, and whether the introduction of new radios would change in a substantial way the risk of harmful interference. Where, as here, conditions of entry can be designed to mitigate against a significant rise in the risk of harmful interference, sharing should be allowed to proceed.

Cisco appreciates that the discussion in Appendix A7 specifically calls out where it aligns with Report 302 or other work ongoing in the relevant CEPT committees, and agrees that these parameters are generally reasonable. Specifically –

- The selection criteria for representative links is reasonable. (A7.22)
- The RLAN deployment example is reasonable (A7.26 and Table A7.3)
- The factors and values displayed in Table A7.6 "RLAN deployment topology: other factors to consider" are within a zone of reasonableness.

There are a couple of values selected for use in the studies that will result in highly conservative – and overprotective – results. The polarization mismatch of 1.5 dB is conservative.[18] Wi-Fi 6 equipment, based on IEEE 802.11ax has multiple spatial streams. As a result, the antennas have to be mis-aligned to each other in order to better process spatial streams. Industry has been suggesting a polarization mismatch of 3 dB.

Cisco also notes that, in picking a Building Entry Loss (BEL) factor of 12 dB, the consultation document acknowledges that this value is far more conservative than the ITU recommendation of 17 dB for traditional buildings and 32 dB for thermally efficient buildings.[19] In fact, in Cisco's view, this highly conservative BEL value selection is yet another reason why Ofcom need not concern itself with short term interference issues, as its engineering evaluations already deliver overprotective results.

Setting aside our disagreement with these overly conservative parameters, Cisco generally agrees that the studies support the finding that sharing is feasible and that the geometries in which harmful interference could occur are "negligible."[20]

[17] Consultation at Appendix A7 at page 43.
[18] Consultation at Appendix A7 at page 51.
[19] Consultation at Appendix A7 at page 56.
[20] Consultation at Appendix A7 ag page 60.

Cisco further supports the proposed updates to Interface Requirement 2030 with respect to the 5 925-6 425 MHz band, to the extent it is understood that the Nominal Centre Frequency values are non-binding and industry can utilize the output of ETSI BRAN.[21]

5. Making more efficient use of spectrum in the 5725-5850 MHz band

Question 3: Do you agree with our proposal to remove DFS requirements for indoor Wi-Fi up to 200 mW from the 5 725-5 850 MHz band?

The consultation document notes that, in the UK, 5 725-5 850 MHz is a band that currently requires the use of Dynamic Frequency Selection (DFS) technology to protect other users. The consultation notes that the DFS requirement may be impeding equipment manufacturer interest in the band, and that other jurisdictions around the world have no DFS rule for that spectrum. The consultation proposes that indoor Wi-Fi at a maximum power of 200 mW could safely utilize the band without creating a harmful risk of interference to pre-existing radars. On that basis, it proposes to eliminate the DFS requirement.

Cisco offers the following comments on the proposal.

First, we are always in favor of eliminating unnecessary regulation. Unnecessary regulation raises cost. Particularly for cost-sensitive or margin-sensitive products, higher cost can inhibit markets. From the conclusion that DFS is not needed should follow an action to eliminate the DFS requirement. We urge Ofcom to adopt the revised requirements for the band set forth in Appendix A8.

Second, Cisco believes that a major factor inhibiting use of 5 725-5 850 MHz in the UK is that the balance of European countries have not seen fit to open the band for RLAN use. We believe that this is a mistake on their part, and directly and through trade organizations have urged reform. But the truth is that most manufacturers in the industry are global in scale and will be looking to create product that can be sold throughout Europe. While the UK is no doubt taking a leadership position in making use

[21] Consultation at Appendix A8 at 64.

of this band more attractive, we caution that this improvement alone may not change the basic dynamic that has caused this band to be lightly used.[22]

Third, where DFS is needed to create a safe and stable radio environment in those countries where other users have superior spectrum rights, it should not be disparaged as a poor technology that provides a terrible user experience. In the enterprise market, for example, Cisco's robust implementation of DFS ensures that customers get the most access to all available spectrum (i.e., eliminates false positives), and thereby utilizes frequencies that do not result in channel changes. We acknowledge that the technology capabilities of an enterprise network can be vastly different from a consumer-grade device, but caution that the complaints of consumer manufacturers over the challenges that they face should not cause regulators to declare DFS technology bankrupt.

Fourth, DFS is a mechanism to protect radar operations, both civil (weather) radars and military radars. Knowing that meteorological radars in Europe have either concentrated their operations in the band 5 600 – 5 650 MHz or have moved into the band 5 350 – 5 470 MHz, we may conclude that only military radars might potentially still be using the band up to 5 850 MHz, but this is only the case in very few European countries. Therefore, countries not deploying military radars could safely open up 5 725 to 5 850 MHz without the need for Wi-Fi to activate DFS when operating in this band. This would improve the functionality of the Wi-Fi devices as otherwise an efficient DFS mechanism that also need to protect the Frequency Hopping military radars definitely will constrain Wi-Fi performance.

Fifth, indoor operation of Wi-Fi at 200 mW eirp without DFS within the band 5 725 to 5 850 MHz will not impose a higher risk than Short Range Devices which are currently allowed to operate in this band at 25 mW eirp outdoor and this across Europe via either the Commission Decision for SRDs or via the CEPT/ECC Recommendation for SRDs.

Cisco is also concerned about proposals for expanding DFS requirements to include detection of fast frequency hopping radars. Fast Frequency Hopping radars reduce the number of pulses at a given frequency before hopping to a different frequency. This makes the challenge of sensing and identifying the radar more difficult and, in some cases, impossible, to detect. If license-exempt equipment were forced to identify a radar pattern from a single or just a few pulses, then the equipment is much more likely

[22] We are encouraged to see notice of a consultation from the Czech Republic on this issue. "Announcement of CTU's intention to expand the frequency range intended for WAS/RLAN systems' usage to 5725-5850 MHz band," released 11 March 2020 at https://www.ctu.eu/announcement-ctus-intention-expand-frequency-range-intended-wasrlan-systems-usage-5725-5850-mhz-band

to respond to false detects across the band where the fast Frequency Hopping radar is operating, with the consequence of a loss of service.

6. Operations at 5 150-5 250 MHz

Question 4: Do you have any comments on other options that may be available for Wi-Fi and RLANS within the 5 150-5 250 MHz band?

The consultation document notes that regulation of outdoor Wi-Fi power levels, the low percentage of Wi-Fi devices used in outdoor environments, and a requirement for emissions masks could successfully be utilized to protect aggregate interference into satellite systems that share the band. Cisco agrees.

In addition to these device-based requirements, regulators in the US and Canada have called for registration or licensing of outdoor networks that comprise more than a specific number of access points. In the US, that was done as a transitional tool to allow firmware updates to equipment operating in other bands so that the US regulators would know who the largest operators would be.[23] In Canada, licensing has been limited to service providers, which has meant enterprises wanting to deploy outdoors at a larger scale cannot take advantage of the band.[24] Entities such as ports, mines, rail yards and more are not eligible for outdoor deployments. Should the UK choose to follow this path, Cisco would urge neutral rules that allow all to participate.

7. Conclusion

Cisco thanks Ofcom for the opportunity to comment on these proposed changes in its RLAN rules, and urges prompt adoption of the modifications as specified herein.

[23] 47 CFR Part 15.407 *(j) Operator Filing Requirement: Before deploying an aggregate total of more than one thousand outdoor access points within the 5.15-5.25 GHz band, parties must submit a letter to the Commission acknowledging that, should harmful interference to licensed services in this band occur, they will be required to take corrective action. Corrective actions may include reducing power, turning off devices, changing frequency bands, and/or further reducing power radiated in the vertical direction.*

[24] Decision on the Technical and Policy Framework for Radio Local Access Network Devices Operating in the 5150-5250 MHz Frequency Band, SMSE-013-17 (May 2017).