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**DSA Submission to Ofcom's 5 GHz Proceeding**

**Introduction: The Consultation**

This consultation sets out Ofcom's proposals for increasing the amount of radio spectrum available for Wi-Fi in the 5 GHz band to deliver high speed wireless broadband for consumers. Ofcom proposes a three-step approach to further opening more of the 5 GHz band: 5725-5850 MHz in the short term; 5150-5350 MHz in the medium term; and 5350-5470 MHz in the long term.

As Ofcom notes, Wi-Fi is one of the UK's most important vehicles for communications, commerce and entertainment. Some 85 percent of the UK's 27 million households have a broadband connection. Virtually all of these households use Wi-Fi to provide the final link between their home broadband router and the various wireless devices in their homes.

The initial focus is to "open up a further 125 MHz of spectrum 5725 – 5850 MHz subject to establishing the correct technical sharing parameters to ensure the appropriate protection of other users of this sub-band." Ofcom notes that early results of studies suggest that sharing is feasible and achievable through UK-only policy changes.

Other possibilities for review include (1) re-examining the technical requirements such as those used to protect radar to ensure that they are fit for purpose; (2) remove outdoor restrictions to the 5150 – 5350 MHz range; and (3) retain the longer term objective of opening up spectrum if possible at 5350 – 5470 and 5850 – 5925 MHz.

**I. Overview**

DSA strongly favours improving spectrum access to users in the 5GHz band. While we support expanding the bands to be used in the future, ultimately the main challenge is the fully efficient use of spectrum. We believe that dynamic spectrum management should be included among the options presented overall in the consultation. Given the success of launching TVWS in the UK and a number of other leading countries, we encourage Ofcom to design its future spectrum policies around the dynamic spectrum management paradigm.

Global Internet traffic is expected to triple over the next 5 years, with the majority of this traffic coming from wireless devices such as smartphones and Internet of Things (IoT) devices. The wireless spectrum that enables this connectivity is already in short supply, and we are nearing the theoretical physical limits of what is possible to transfer on each hertz of spectrum. At this rate, demand for spectrum over the next decade will outstrip supply if the current licensing model is maintained. If the growth of connectivity is to continue, new models for allocating spectrum must be adopted.

The core DSA position rests on introducing dynamic spectrum management in pertinent bands. This would enable access to spectrum to be coordinated in real time (or near-real time), and the amount of spectrum adjusted depending on the service demand at any given moment, whilst taking into account geographic characteristics. Such dynamic thinking would allow for innovative sharing with different services across the sub-bands, ushering in considerable innovation.

The existing static models used for allocating spectrum are inherently inefficient. The current static licensing models assign the exclusive use of spectrum to a specific user for a fixed time period in a fixed geographic area. If the assigned user does not utilise the allocated spectrum, then its potential may be lost forever. Previously the only alternative to this was licence-exempt usage, where anyone can use the spectrum on a best-efforts basis. This system remains more than acceptable for many users and applications, and should become the case in the UK for the first time for the 5725-5850 MHz bands.

Where licence-exempt status is not feasible, at least in the short term, dynamic spectrum sharing would allow available spectrum to be used more efficiently than any existing static techniques. Dynamic spectrum sharing uses a combination of geo-location databases, access control technologies, and data analytics to allocate the available spectrum in the most efficient manner. Maximising the efficiency of the spectrum usage increases the value of this finite resource, lowers barriers to access in established markets, and fosters the growth of new niche ones.

In particular, the use of geo-location databases allows regulators to test and implement policies very quickly, thus massively lowering the cost of developing spectrum reforms. Additionally, the use of cognitive radios and access technologies will allow regulator to optimise the spectrum use locally, while the use of data analytics will allow the industry and users to evaluate market opportunities more thoroughly. TV White Spaces (TVWS) was the first important step for dynamic spectrum management, as it clearly showed that dynamic spectrum management can be successfully implemented paving the way for it to be used more widely in other spectrum bands. Dynamic spectrum management enables access to spectrum to be coordinated in real time (or near-real time) and the amount of spectrum can be adjusted depending on the service demand at any given moment whilst also taking into account geographic characteristics.

We believe that Ofcom should take a strong leading position about the opportunity to share spectrum. Ofcom should clearly state that where licence-exempt usage is not feasible, sharing should become the default way to access spectrum. If Ofcom does not remove any doubt by strongly signalling that dynamic access will be a key part of its policy regime moving forward, the industry will be unable to fully respond appropriately with new innovations in this space. Ofcom should consider spectrum sharing as a market-based approach that enables innovation; by definition, therefore, it is not possible to fully define what the market outcomes will be in advance of the changes in regulation.

In particular, we believe that radars and other uses that need to be protected should be handled by querying a geo-location database that provides the list of power limits to be enforced in the area on certain frequencies, through appropriate dynamic frequency selection (DFS) thresholds, or a combination of the two. Base stations (such as Wi-Fi routers) that cannot provide an approximate location or that cannot query the database will have a conservative spectrum availability. This approach would enable both legacy access technology and innovative new ones, while pushing the market towards a more efficient use of the spectrum.

In addition, we encourage Ofcom to being exploring whether there are spectrum sharing opportunities adjacent to the 5 GHz band (such as, for example, the 6 GHz band). Because this particular spectrum is immediately adjacent to the 5 GHz band, the radio technologies are similar. This could lead to the rapid expansion of larger unlicensed channels (e.g., 80 MHz and 160 MHz) that can be reliably accessed by unlicensed devices.

Finally, while the consultation is not technology-specific and uses the term Wi-Fi for different technologies, it also assumes that similar levels of politeness are implemented in all technologies. While Wi-Fi (IEEE 802.11) has always been designed for spectrum sharing, other technologies such as LTE only recently developed versions that require a listen-before-talk approach to operating in unlicensed spectrum. We encourage the regulator to make sure that all technologies that will share unlicensed spectrum will be required to fairly use the available spectrum.

**II. Responses to Questions**

Question 1

Do you agree with our proposal to prioritise consideration of the 5725-5850 MHz frequencies for Wi-Fi, subject to appropriate protections to other users, in particular satellite services?

DSA agrees that the 5725-5850 MHz range of frequencies should be prioritised for consideration. Ofcom clearly understands and articulates the reasons for moving first on the 5725-5850 MHz band, including the fact that it is the easiest path to more efficient spectrum utilization for licence-exempt uses. Any decision that expedites the process of keeping up with user needs would be welcome.

Other users, such as satellite services, should be amply protected. However, we would oppose simplistic coexistence solutions, such as harsh power restrictions, which will severely restrict the applications that could use the new range. In an era of proven dynamic spectrum access techniques, such blunt techniques are sub-optimal.

DSA believes that the 5150-5350 MHz and 5850-5925 MHz bands also would be good choices for early consideration. The US FCC has enabled outdoor use and increased transmit power in 5150-5250 MHz using simple antenna restrictions, we encourage Ofcom to consider similar action. The FCC also is currently testing ITS interference mitigation techniques in order to enable sharing in the 5850-5925 MHz band.

Question 2

Do you agree with our proposal to re-examine the requirement for DFS across the 5 GHz band, subject to appropriate protections to other users?

DSA strongly agrees with this proposal. DFS can be reviewed in the light of technology advancements such as dynamic spectrum management techniques. Current DFS rules were developed over ten years ago, and Wi-Fi technologies have advanced significantly during that time. Basing modified DFS rules on today's Wi-Fi and radars actually in use, could benefit all of the users in the DFS bands.

The protection measures needed to safeguard incumbent users should be redefined without the unnecessary inefficiency that the current measures introduce. Evidence gathered by various parties, including Ofcom itself, shows that the vast majority of DFS triggers are spurious. Further evidence gathered by Sky and by Ofcom illustrates the preference of access points for non-DFS channels and hence the unnecessarily inefficient use of spectrum that the protection mechanisms introduce.

DSA cautions against giving any consideration to limiting transmit power with future channel allocations on 5 GHz (such as 50 mW) because this will not provide any added value for Wi-Fi due to the limited range and speed. While it can be argued that this would reduce the likelihood of false DFS triggers, the value of severely power restricted allocations for wireless data transfer can be drawn from a concrete example: the channels 12 and 13 on 2.4 GHz are allowed to be used in the US with similarly limited channel power, and they are not used for Wi-Fi at all. The industry has not adopted them, as they cannot support any Wi-Fi use case.

Question 3

Do you think we should pursue the other options we have identified: opening up 5850-5925 MHz; outdoor Wi-Fi use at 5150-5350 MHz; and opening up the 'centre gap' at 5350-5470?

DSA encourages Ofcom to open up these new ranges with as few restrictions as possible. These bands would enable not only improvement in the quality of connections, but also provide wider channels, needed to support the demand for the higher throughput applications of the next five to ten years.

In particular, we encourage Ofcom to consider opening the 5850-5925 MHz band as soon as the sharing studies are concluded, and consider allowing outdoor use of the 5150-5250 MHz band as a priority action. Further, we encourage Ofcom to consider opening the 'centre gap,' 5350-5470 MHz, as soon as mitigation techniques have been identified to protect current incumbents in the band. Opening the band would greatly enhance the use of Wi-Fi for current and evolving applications (e.g. 4K video) that require wider channels (80 MHz and 160 MHz) to enhance consumer experience.

DSA also believes that Ofcom should also explore whether the 6 GHz bands could be shared as well.

Question 4

What are your views on the future growth in demand for Wi-Fi? In which use scenarios do you expect to see the greatest pressure for delivery of high quality Wi-Fi access? What evidence do you have to support your views?

All experts' forecasts agree that wireless traffic will grow massively in the next several years. As a consequence, we believe that as Wi-Fi demand will increase, it will become more and more important for the regulator to find be able to design future-proof solutions that can help meeting the demand of spectrum.

The Internet of Things (IoT) is likely to be one driver, as billions of devices will use the spectrum (both licensed and unlicensed) to connect to the Internet. While most of the IoT devices will generate only small amounts of traffic, others will be more data intensive and will therefore require more spectrum.

IoT will not be the only driver for the increase in spectrum demand. As predicted by Cisco, IP video traffic will be 82% of all consumer traffic by 2020. It is reasonable to assume that a good part of that traffic will be carried over in-home wireless networks, such as over Wi-Fi. In particular, providers such as Netflix already support UltraHD streaming to compatible TVs, and the consumer market has already introduced a number of portable devices that can play UltraHD videos. We therefore expect that in the next years it will become normal to stream UltraHD content wirelessly.

Research and analysis carried out by various bodies (Cisco et al) indicates that the growth of data on Wi-Fi networks will be larger than the expected increase on other mobile data networks (IMT). It should be noted that whereas these other networks have secured access to vast ranges of new, premium licensed spectrum, there has been little movement in access to unlicensed spectrum which device manufacturers are willing to adopt. Currently allocated license-exempt spectrum increasingly cannot sustain existing and near-future demand in a host of environments.

Opening large enough swaths of contiguous spectrum to enable additional 80 MHz and 160 MHz channels is important. There must be a sufficient number of these larger channels to enable reliable channel access before manufacturers build applications designed to take advantage of these wider bandwidths.

Question 5

Do you think technology improvements and densification of access points will be sufficient to meet demand or will there also be a need for more spectrum beyond that which we propose to make available? What evidence do you have to link between demand for data and demand for additional spectrum?

Given the forecast growth of demand for wireless data, DSA believes that more spectrum will be required to accommodate this growing demand. However, unless this new spectrum is used more efficiently, its full potential will not be achieved.

Wi-Fi is now the dominant Internet access technology. In fact, the ratio of usage of W-Fi to LTE is a staggering 15 to 1. At the same time, the Wi-Fi industry has an excellent track record for upgrading the standards and technology it uses. 802.11ac is already benefitting many consumers, while the upcoming 802.11ax standard will be a benchmark for efficiency, comparing well against the most efficient standards in use in other technologies. These new standards will undoubtedly help to satisfy consumer demand as they are introduced. However, the projected pace of growth in demand for mobile data will outstrip even these improvements. The rapid acceleration of demand of data over Wi-Fi will therefore require a commensurate increase in available spectrum for Wi-Fi.

As described above, there are a variety of sharing techniques available today, including dynamic spectrum access, which will enable adequate protection and foster robust sharing. For this reason, DSA believes that Ofcom should also look at adjacent bands with a fresh eye toward whether those bands could be shared. Because of its proximity to 5 GHz, DSA encourages Ofcom to explore under which conditions the 6 GHz band could be shared.

Question 6

What real life speed and quality of experience can consumers expect in practice from devices using the 5GHz spectrum as authorised in the UK now? What changes can we expect as the number of devices increases and technology improves? What difference in speeds and quality of experience would additional spectrum make?

Consumers are currently receiving high quality of service (QoS) from their devices using 5 GHz spectrum, especially in smaller channel configurations (e.g., 20 MHz, 40 MHz). However, there are clear concerns that the experience will deteriorate as the number of devices increases and the bandwidth needed for applications rises. Additionally, as applications requiring larger channels begin to proliferate (e.g., 80 MHz and 160 MHz), the limited number of channels will negatively affect QoS levels. Improvements in technology alone will not be sufficient to obviate occurrences of spectrum saturation.

Question 7

How important is contiguous spectrum? How wide should channels be to support future demand?

Wi-Fi has been designed and implemented to utilize non-contiguous spectrum blocks. However, contiguous spectrum is important for devices to achieve high throughput. Also, contiguous spectrum can also help to design high performance antennas and digital filters. Nevertheless, the more spectrum will be released, the more the demand will be met.

Getting access to contiguous spectrum helps in many ways: standards and applications that benefit from contiguous spectrum will be supported; the inefficiencies resulting from interference mitigation with adjacent bands are avoided; the densification of access points with wide bands can be better supported. It can, therefore, only help if spectrum allocated to Wi-Fi is as contiguous as possible. It is important for access points to have some flexibility in the channel width that they allocate. In the case of hot spots, the most prevalent use is for multiple sessions of basic web browsing such as information searches and emails.

In practice, 20 MHz channels are currently able to serve the majority of use cases. Wireless mesh implementations need more but 80 MHz is currently able to satisfy those very well. Looking to the future, we consider the 160 MHz channel width to be adequate for all foreseeable use cases with the further option of channel aggregation from various bands (including higher frequency spectrum for applications with limited range requirements) to meet any unforeseen demands that may arise. Wider channels are not only useful for delivering faster data rates, they also will lead to significant energy savings because devices will transmit data for much shorter periods of time.

Increasing the amount of spectrum available would mean that channel width restrictions are needed less and higher bandwidth applications can be supported. Wider channels can be used more freely in the home to support new, higher bandwidth applications that are becoming very popular such as Location Services using “time of flight.” These can benefit from wider channels, and a doubling in the bandwidth of the channel results in a proportionate improvement in location measurement accuracy.

Question 8

Do you believe we have correctly identified the incumbent services in 5150-5925 MHz which need to be taken into account in considering opening up more 5 GHz spectrum for Wi-Fi? Are there any other services which will need to be taken into account in future studies?

While Ofcom has identified certain incumbent services which require careful consideration, Ofcom should complete a thorough study of current and future incumbent uses of the spectrum, to ensure that protection measures are well-fitted to the actual situation

Question 9

What coexistence studies, measurement campaigns and mitigation techniques do you believe would be most effective for demonstrating coexistence between Wi-Fi and incumbent users?

The same methodology used for TVWS coexistence studies should be sufficient for all the technologies where it is proved that they can fairly share the spectrum. We encourage Ofcom to consider using geo-location databases for dynamically handling the coexistence and interference.

A mixture of theoretical studies and practical measurement campaigns will be required to test and select from the range of mitigation techniques available to safeguard incumbent users from harmful interference. We believe that dynamic spectrum access should be amongst the techniques considered because of its capability to provide protection only in places and at times when it is actually required. We urge Ofcom to place most emphasis on measurement campaigns that are based on testing the actual circumstances in which interference could occur so that a) mitigation can be based on real scenarios, and b) over-protection can be avoided.

Question 10

Do you intend to participate and provide technical material into the ITU and CEPT work? In what way?

DSA member companies are ready to assist in the provision of technical material to Ofcom, and to any technical body working on topics related to 5 GHz Wi-Fi.

Sincerely,

H. Nwana
Executive Director