Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title: *Improving spectrum access for Wi-Fi - Spectrum use in the 5 and 6 GHz bands*

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

As an Enterprise wireless LAN architect, I welcome the proposal to open access to the 5925-6425 MHz band. This will provide a valuable national resource to help meet the growing demands for RLAN connectivity across all sectors of industry and society.

DFS Considerations

The widespread adoption of existing spectrum provision in the 5GHz band has been significantly impeded by the DFS restrictions imposed on the majority of channels across that band. The major challenge has not been avoidance of “real” radar systems, but rather the (disruptive) false-positive events that are inadvertently generated by various sources, including RLAN access points and clients themselves. Many vendors who supply RLAN solutions have struggled to provide equipment that performs reliably and is not subject to false-positive DFS trigger events, together with their ensuing service disruption. Some equipment providers have even gone as far as not supporting DFS channels to mitigate the issue. For modern RLAN networks, particularly when considering real-time services such and voice and video conferencing, this is not an acceptable situation. Each time a DFS event occurs, RLAN service is interrupted, and disruption of real-time services occurs.

Similarly, for service providers attempting to use mesh solutions in domestic environments, the instability of backhaul connections that use DFS channels provides a poor implementation option. This limits implementation choices and ensures that highly inefficient solutions are provided using a single 80MHz channel for both backhaul and client connections. This single non-DFS channel (bonded channels 36-48), tends to be used by the vast majority of service providers, so that the majority of networks in any given venue or area are contending for airtime on the same area of spectrum, reducing the aggregate throughout available for those networks. This can be verified by visiting any busy transport hub, shopping mall or residential street and observing the distribution of RLANs across the 5GHz spectrum using a simple wireless scanner tool.

The introduction of the new 6GHz spectrum will provide huge benefits as RLANs may be operated across many more channels that are free of the impediments of DFS support. This will allow a wider variety of channels to be used by 6GHz RLANs, reducing network contention and providing higher potential throughput for all networks, even in areas with many neighbouring networks. I believe this will provide a significant economic benefit to the UK through improved efficiencies that can potentially be realized, if this spectrum is used in a “considerate” manner.

Enterprise Environments

Many large modern office buildings tend to employ a structural design that is open plan on each floor, with perhaps an open atrium area connecting floors that allows unfettered RF leakage between floors.

A large number of organizations within these offices have also moved to a “wireless first” strategy for network access connectivity for network users.

RLAN capacity in these environments is directly related to the opportunities for the re-use of spectrum. In Enterprise networks, many access points will be deployed, using unique channels where

possible to reduce contention of neighbouring coverage cells. However, the number of access points required is often far in excess of the number of unique channels available, therefore channels need to be re-used across a floor or building. Access points re-using channels need to be sufficiently isolated from others on the same channel, to avoid contention between access points (and their clients) on the same channel. Given the open physical nature of the office structures discussed, the opportunities for spectrum re-use with low levels of contention are very limited. This has a negative impact on overall network aggregate throughput that can be achieved. The introduction of additional spectrum in the 6GHz band will provide very significant benefits for these environments, allowing the opportunity for much greater distances between devices using the same spectrum, hence reducing contention effects and increasing achievable aggregate throughput. This is a huge benefit in terms of improved productivity, particularly when considering large Enterprise organizations that will generally struggle with these design challenges.

A second significant benefit of the new 6GHz spectrum in Enterprise environments may be realized in terms of client roaming improvements. Currently, mobile client devices that need to roam to a new access point use a variety of techniques to determine the next suitable wireless access point to which they should roam. A fast roaming decision and execution is critical when considering clients that support real-time services such as voice; any roaming delays will cause poor perceived call quality and even connectivity issues.

Clients devices may use active scanning methods, using ad-hoc probe requests to nearby access points to determine suitable roam targets. Alternatively, they may also use slower, passive scanning methods, through listening for periodic network beacons, to identify roam targets. However, this second method is often too slow for the requirements of real-time services.

Due to the regulatory restrictions of DFS channels, client devices have significant restrictions when performing active scans across DFS channels (i.e. they *generally* may not actively scan DFS channels as required). This means they often rely on passive scanning, making DFS channels sub-optimal for real-time traffic when clients need to roam. The introduction of new channels on 6GHz, that do not use DFS, will be a welcome enhancement for real-time services, allowing active scanning (if required) on all channels. (Note: *there are some challenges around scanning the high number of channels that will be provided on 6GHz, but in conjunction with mechanisms such as 802.11k, there is likely to still be a net benefit through the opportunity for active scanning*)

Service Provider Concerns

One area of concern when considering the benefits and use of new spectrum, is around large-scale service providers, particularly in the domestic and SME markets.

Experience shows that they typically rely on the provision of the highest possible Wi-Fi physical connection rates by their RLAN equipment as a major part of their marketing strategy. It is not unusual to see claims around “Gigabit Wi-Fi”, which is derived from the use of an 80MHz channel with the provision of a CPE device that uses 3 spatial streams to provide a theoretical 1.3Gbps physical connection rate on 5GHz. In reality, this physical rate is not achievable by the vast majority of client devices, which may use 2 or less spatial streams, so cannot achieve the advertised gigabit connection speeds. When considering the half-duplex nature of RLANs and the restrictions of many domestic DSL services, these claims around providing the “fastest” Wi-Fi available are fanciful at best when considering the real-world throughput rates achieved. However, the use of un-necessarily wide channel widths to support fanciful marketing claims has a detrimental impact on neighbouring RLAN services.

From a technical perspective, as seen in the Enterprise space, wider channel widths are often not required to provide the required services. Instead, they fulfil the dual purpose of supporting “bigger, faster” marketing claims and attempting to overcome the poor RF design approaches used by service providers and/or their domestic customers.

Given the welcome arrival of additional spectrum, I would like to see a “duty of care” responsibility for spectral conservation placed upon service providers to ensure that this new national resource is used wisely to maximise the benefit for all sectors of the UK.

If service providers are allowed to consume the entire new spectrum allocation by using the theoretical 3 x 160Mhz channels available on 6GHz purely to support their marketing claims, rather than having solid technical reason for using them, then we will be in a similar position again as we are on 5GHz. Neighbouring networks that potentially only use 20, 40 or 80MHz channels (as is typical in Enterprise environments) will again be un-necessarily contending for airtime and potentially suffer un-necessary performance degradation.

If service providers were encouraged to move to a model of better-designed RLANs, they could benefit both their customers and other spectrum users through improved performance and reduced spectral consumption. They need to move from a raw connection-rate focused model, that tries to overcome the current shortfalls in performance through the use of highest possible connection speeds, to a model of improved design quality and reliability through good RF design. As long as “speed” is their measure of a “good” RLAN, then the cycle of consuming all available spectrum for marketing purposes will continue, with the resulting impact on UK business that need to share this valuable, finite resource. A burden of both spectral conservation and spectral stewardship needs to be placed upon large-scale service providers to ensure that this new, valuable national commodity can provide the maximum benefit to the UK economy.

For applications where 160MHz width channels are technically justified (which does not include the vast majority of services that will run across 6GHz RLANs), power and mode of operation restrictions should apply to limit their spectral impact. As far as I am aware, the primary use-case of 160MHz channels is in VR/AR applications, which require the very low latency provided by very high bandwidth. However, these are typically short-range, client device, peer to peer connections. It would be useful if devices using 160MHz channels were limited to a lower maximum transmission power that that proposed for the 6GHz band (e.g. 25mW) to limit impact on neighbouring networks.

Limiting network access devices (e.g. CPE and wireless access point devices) to use only up to 80MHz channel widths on the new 6GHz band would also provide a valuable protection against deliberate or inadvertent occupation of large swathes of the new spectrum in any local area.

802.11ax on 6GHz

Finally, it appears that the 6GHz band will, initially, only be used by RLAN devices that conform to the IEEE 802.11ax draft standard amendment. This is excellent news, as it removes the burden of backwards compatibility support that has caused historical inefficiencies on both the 2.4GHz and 5GHz bands.

The opening of a new band for RLAN use is a very infrequent opportunity and we need to maximise the value we obtain from this new resource, I would like to suggest that Ofcom engage with the IEEE and explore possibilities for the removal or optimization of legacy PHY headers that are part of the existing draft 802.11ax standard, which was originally designed to support both the 2.4 and 5GHz bands, and their legacy protocols. As this is a one-time opportunity to optimize the efficiency of the protocol before 6GHz becomes available, I believe this should be pursued rigorously with the IEEE and perhaps the Wi-Fi Alliance. Future standards could be burdened with any inefficiencies we leave in now for many tens of years to come, with possible legacy elements that have no technical merit.

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

I would like to see limitations on the use of 160MHz channels as outlined in my response to question 1 to protect the new band from un-necessary burdens that have no technical basis and may primarily be used to support marketing efforts.

I would also like to see transmit power level restrictions placed on 160MHz channel widths to limit their impact on other spectrum users.

Question 3: Do you agree with our proposal to remove DFS requirements for indoor Wi-Fi up to 200mW from the 5725-5850 MHz band?

This would a very welcome enhancement that would allow similar use of the higher end of the 5GHz band that is enjoyed in the USA. Having access to 8 non-DFS channels will provide significant opportunities to both Enterprise and service provider networks. The opportunities for Enterprise networks to more reliably support real-time service such as voice will be particularly significant. In simple terms, it provides a 100% uplift in spectrum that can be used more reliably in 5GHz by RLANs through the removal of DFS restrictions.

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

As outlined in previous responses, DFS restrictions have been a significant technical burden when designing and providing RLANs on 5GHz.

I'm sure many RLAN providers and equipment vendors would welcome the removal of DFS restrictions for all channels across the 5GHz band, when considering indoor use. This would encourage a significant uptake of a broader range of channels across the band and provide an additional effective spectrum boost for indoor networks.