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Decision to make Wireless Telegraphy Exemption Regulations 2017

Statement

Publication date: 13 July 2017

About this document

This document sets out Ofcom’s decision to make regulations that will allow Wi-Fi use in the 5.8 GHz band.

Wi-Fi currently uses spectrum in the 2.4 GHz and 5 GHz bands. This decision will allow access to an additional 125 MHz of spectrum in the 5.8 GHz band.

This document also confirms the technical conditions which manufacturers of equipment, such as smartphones, tablets and laptops, would have to comply with in order to benefit from licence exempt use of this spectrum.

Contents

Section 1

Executive summary

1.1 This document sets out our decision to make regulations that will extend the use of Wi-Fi to the 5725-5850 MHz band ("the 5.8 GHz band"), The Wireless Telegraphy (Exemption and Amendment) (Amendment) Regulations 2017.

1.2 This follows our recent Statutory Notice entitled "Notice of proposal to make Wireless Telegraphy Exemption Regulations 2017: Consultation on Regulations and proposed technical parameters" (the 'Notice') which we published on 9 March 2017.

1.3 In the Notice, we consulted on the draft Regulations and proposed technical parameters for Wi-Fi use in the 5.8 GHz band: a power limitation to 200 mW per channel, a ban on fixed outdoor use, and normal WAS/RLAN channel access and occupation rules. These proposed technical parameters were informed by our technical studies taking into account existing spectrum users and stakeholders responses to our May 2016 consultation.

1.4 We received 21 non-confidential responses and 3 confidential responses to the Notice. Some respondents commented on the policy decision to open the band to Wi-Fi while others provided specific feedback on the proposed technical parameters. We have reviewed these comments carefully. On the basis of the responses received, we did not consider it necessary to revisit our decision to make the 5.8 GHz band available for Wi-Fi. We also continue to consider that the technical parameters presented in the Notice strike an appropriate balance of maximising benefits to consumers of Wi-Fi services while avoiding negative impacts on other users.

1.5 We have therefore decided to proceed with making the Regulations as drafted in the Notice. The Regulations will come into force by 7 August 2017.

Section 2

Background

Introduction

2.1 Ofcom is responsible for authorising use of the radio spectrum and achieves this by granting wireless telegraphy licences under the Wireless Telegraphy Act 2006 (the 'WTA') and by making regulations exempting users of particular equipment from the requirement to hold such a licence. Under section 8(1) of the WTA, it is an offence to establish, install or use equipment to transmit without holding a licence granted by us, unless the use of such equipment is exempted.

2.2 On 9 March 2017, Ofcom published its Statement ("the March Statement")[1] setting out its decision to make the frequencies 5725-5870 MHz ("the 5.8 GHz band") available to consumers in the UK for Wi-Fi[2] usage, and to do so on a licence-exempt basis. Following further consultation on making proposed regulations to give effect to this decision (including the technical parameters which should apply)[3], this Statement sets out Ofcom's decision to make regulations ("the Regulations") set out in Annex 4.

The Legislative Framework and Notice

2.3 Under section 8(3) of the WTA, Ofcom may, by regulations, exempt operators of radio equipment from requiring a licence, either absolutely or subject to such terms, provisions and limitations as may be specified.

2.4 Under section 8(3B) of the WTA, any terms, provisions and limitations specified in the regulations must be:

- objectively justifiable in relation to the wireless telegraphy stations or wireless telegraphy apparatus to which they relate;
- not such as to discriminate unduly against particular persons or against a particular description of persons;
- proportionate to what they are intended to achieve; and
- transparent in relation to what they are intended to achieve.

2.5 Section 122 of the WTA sets out the statutory procedure for making regulations. Under sections 122(4) to (6), Ofcom is required to publish a notice of any proposal to make regulations. The notice must state that Ofcom proposes to make the regulations in question, must set out their general effect, specify an address from which a copy of the proposed regulations may be obtained and specify a time of at

[1] *Statement on improving spectrum access for consumers in the 5 GHz band and Notice of proposal to make Wireless Telegraphy Exemption Regulations 2017*, https://www.ofcom.org.uk/__data/assets/pdf_file/0027/98154/5p8-Regs.pdf

[2] We use the term "Wi-Fi" in this document to refer to a number of related technologies that could use the spectrum under similar conditions. The umbrella term for these types of technologies is Wireless Access Systems including Radio Local Area Networks (WAS/RLANs). We use "Wi-Fi" simply because it is a widely understood term.

[3] This Consultation formed part of the March Statement.

least one month before which any representations with respect to the proposal must be made to Ofcom.

2.6 In order to meet the statutory requirements, Ofcom published its "Notice of proposal to make Wireless Telegraphy Exemption Regulations 2017" (the 'Notice'), on 9 March 2017, as part of the March Statement. The Notice included a draft of The Wireless Telegraphy (Exemption and Amendment) (Amendment) Regulations 2017 and gave any person or party who wished to do so until 11 April 2017 to make representations.

2.7 The Regulations make reference to "IR 2030 – UK Interface Requirements 2030 Licence Exempt Short Range Devices" ("IR 2030"), which is a separate document that sets out the applicable technical parameters with which individuals must comply when operating equipment in the 5GHz band. We updated IR 2030 to include Wi-Fi use in the 5.8 GHz band and notified the revised version to the European Commission on 22 March 2017. During the three-month standstill period, we received one comment from the Italian administration which noted that the 5.8 GHz band is the subject of international sharing studies in relation to agenda item 1.16 of the next World Radiocommunication Conference (WRC-19). We did not receive any comments which led us to make changes to the version of IR 2030 notified to the Commission.

2.8 The Regulations will authorise, on a licence-exempt basis, the use of the 5.8 GHz band. Equipment will be able to operate in these frequencies on the basis that:

- it does not cause or contribute to any undue interference to any wireless telegraphy; and that
- such use complies with the interface requirements that form part IR 2030.

2.9 In addition to the legal requirements set out in the Regulations and IR 2030, Ofcom is also publishing a Voluntary National Specification ("VNS"), setting out guidance for 'notified bodies'[4] and manufacturers which might assist them in the development of new equipment in order to make the best use of the 5.8 GHz band. We notified this document to the European Commission along with IR 2030.

2.10 In Section 3 of this Statement, we set out the responses we received to the Notice, and Ofcom's decision in relation to the points raised. In Section 4, we set out the scope of the Regulations which will now be made. In Annexes 4 and 5, we set out the Regulations and amendments to IR 2030. The new VNS is published alongside this Statement as a separate document.

[4] A notified body is an organisation designated by an EU country to assess the conformity of certain products before being placed on the market. A list of notified bodies for Directive 2014/53/EU can be found here: http://ec.europa.eu/growth/tools databases/nando/index.cfm?fuseaction=directive.notifiedbody&dir_id=154428

Section 3

Responses to the Notice and Ofcom's decision

Introduction

3.1 This section outlines the comments that we received in response to the Notice published on 9 March 2017 and our responses to these. We received 21 non-confidential responses and 3 confidential responses to the Notice. The names of the non-confidential respondents are set out in Annex 1 and their responses are published on our website.

3.2 Most responses came from stakeholders with interests in Wi-Fi and road tolling. We also received responses from stakeholders with interests in fixed satellite service (FSS), fixed wireless access (FWA) and amateur use. Responses were mixed, with most stakeholders with interests in Wi-Fi broadly supporting the proposed regulations while asking for less restrictive technical parameters, and road tolling stakeholders expressing concern about interference from Wi-Fi to road tolling. Two responses from the satellite sector thought that we should wait for ongoing studies to be completed before proceeding with our proposals.

Stakeholders' comments on the Notice and Ofcom's response

3.3 In the Notice, we asked for comments on the drafting of the proposed regulations and comments on the proposed technical parameters.

3.4 None of the respondents commented on the drafting of the regulations (other than suggesting a change to technical parameters). Most respondents instead focused their responses on the policy decision to open up spectrum at 5725-5850 MHz for Wi-Fi. A number of respondents also provided specific suggestions and feedback on the proposed technical parameters.

3.5 Below, we discuss the main issues raised by each stakeholder sector, and provide our response to these points.

Respondents supporting Wi-Fi access in the 5.8 GHz band

3.6 The majority of respondents from the Wi-Fi sector supported and welcomed our proposals to open up the 5.8 GHz band for Wi-Fi. They noted significant growth in demand for Wi-Fi and cited studies supporting this[5]. BT and Ericsson additionally encouraged us to promote the use of the 5.8 GHz band for Wi-Fi in CEPT. Most of these respondents also encouraged Ofcom to actively work towards the medium and long-term goals highlighted in our March Statement, including enabling Wi-Fi access to the 5850-5925 MHz band and, additionally, 5925-6425 MHz.

3.7 Most Wi-Fi respondents thought that the technical parameters we proposed in the Notice were on the cautious side. Some of the respondents noted their acceptance of

[5] Including the Cisco Mobile Visual Networking Index (VNI) forecast (February 2017) and the Quotient Associates "Wi-Fi Spectrum Needs Study" (February 2017).

a cautious approach, while encouraging Ofcom to commit to reassessing these limits in the future. Others, including the Dynamic Spectrum Alliance, Microsoft and Sky, thought that the proposed technical parameters were overly conservative or restrictive.

3.8 Most Wi-Fi respondents thought that the proposed EIRP of 200mW was suitable for the indoor scenarios we had identified, but was too low for the full range of possible Wi-Fi scenarios. Some, including Cisco and Ruckus, thought that the limit was slightly too low; Cisco preferred an EIRP of 1W but suggested that 250mW would be better for indoor Wi-Fi networking and that devices could span an additional 160 MHz wide channel if operating at this power. Microsoft also suggested 1W. It noted concerns about protection of satellite use and suggested that this power level be kept under review and potentially lowered if the rest of Europe and Africa authorised Wi-Fi in the band, or that antenna power restrictions above a certain degree elevation could be used. Others, including the Dynamic Spectrum Alliance, Intel and the Wi-Fi Alliance, suggested an EIRP of 4W; the Dynamic Spectrum Alliance additionally noted that the US allows 4W indoors and outdoors with no reported coexistence issues.

3.9 Only a few Wi-Fi respondents responded specifically to the proposed restriction on fixed outdoor use. Ericsson thought this was a sensible compromise but asked for us to set a process and timeline for removal of the restriction. Microsoft thought that the outdoor restriction would limit the utility of the spectrum and the Dynamic Spectrum Alliance and Sky both thought the restriction was unnecessary. Cisco encouraged Ofcom to evaluate the use of an elevation mask for outdoor use.

3.10 On our proposals relating to Dynamic Frequency Selection (DFS)[6], we received mixed responses. Some respondents were supportive, noting our suggestion in the March Statement that we would keep the DFS requirements under review. A number of others thought that the DFS requirements would be a barrier to effective use of the spectrum and that we should consider alternative proposals now. For example, Sky called for a dynamic spectrum access (DSA)[7] based solution or radically revised rules for DFS. Ruckus and iWireless suggested that Ofcom should carry out research and field measurements once the band is in use for Wi-Fi to better understand the potential for interference to radars, with Ruckus recommending removal of the DFS requirements as soon as practically possible.

Ofcom's response

3.11 We agree that the technical parameters proposed in the Notice are on the cautious side. As explained in the Notice, our aim was to authorise the least restrictive conditions which were also appropriately cautious in relation to interference to other services, based on studies to date. We did not receive any additional evidence from Wi-Fi respondents that provided strong reason to revisit our coexistence analysis or set different technical parameters.

3.12 We presented coexistence analysis in Annex 6 of the Notice between Wi-Fi and the fixed satellite service (FSS) which underpinned our proposal to set a radiated power

[6] DFS is a radar coexistence mitigation technique. A device implementing DFS "listens" for radar pulses in the channel it is using and will vacate that channel and use a different channel if it "hears" a radar pulse.

[7] DSA techniques often use a geolocation database which will allow devices to use a channel only when there is no risk of interference to other nearby services.

limit of 200 mW EIRP. We also considered a radiated power limit of 1 W which we believed might be used for some outdoor Wi-Fi deployment scenarios. We were concerned that even if 1 W outdoor access points represented only a small proportion of the total Wi-Fi device population, this could make coexistence harder to demonstrate. Similarly, this risk would persist if we were to permit up to 4 W EIRP.

3.13 We believe that the 250 mW EIRP limit proposed by Cisco would permit services similar to the 200 mW EIRP limit in our technical regulations. In our conversations with Wi-Fi operators they emphasised that different power limits in different bands can cause problems when trying to provide consistent Wi-Fi coverage and service. We have, therefore, aligned the EIRP limit in our 5.8 GHz technical regulations with the existing 200 mW EIRP limit in the 5150-5350 MHz band. While we note that the US allows Wi-Fi use in 5725-5850 MHz at higher powers, we also note that there are different coexistence considerations in the US, including no FSS use of the band, and our coexistence analysis was based on the specific circumstances in the UK which is part of Region 1 where there is a primary allocation to the FSS.

3.14 An elevation mask might be an effective technical solution for coexistence with the FSS and there is a precedent for it in the UK 5.8 GHz broadband fixed wireless access (BFWA) regulations. However, there is currently no evidence that Wi-Fi can implement an elevation mask in the existing standards. This could change in the future, possibly through new standards to mandate an elevation mask or light-licensing for higher power, outdoor Wi-Fi access points.

3.15 As noted in the March Statement, we will continue to explore the medium and long term options set out in our consultation published in May 2016, 'Improving spectrum access for consumers in the 5 GHz band' (the 'May 2016 Consultation')[8] and March Statement, including the option to re-evaluate the technical requirements for DFS. In doing so we will take into account the responses we received to the May 2016 Consultation and to the Notice. We will also continue to monitor developments in other bands and to contribute to international studies aiming at extending spectrum access for Wi-Fi.

Respondents with concerns about coexistence with road tolling systems

3.16 We received eight responses from stakeholders with interests in road tolling. Three were from road toll operators in the UK and four were from organisations representing, or with interests in, the road tolling industry. Some of the respondents pointed out that they had not been aware of the May 2016 Consultation. All respondents from this sector expressed concern about the impact of Wi-Fi in the 5.8 GHz band on road tolling. They said that interference caused by Wi-Fi would impact journey times and have safety implications.

3.17 The European Association of Operators of Toll Road Infrastructures (ASECAP) noted the extensive use of the 5795-5815 MHz frequencies for road tolling across Europe. They said that Wi-Fi hotspots in vehicles deserve special attention from a radio regulation point of view, since vehicles cross borders. A confidential respondent made a similar point.

3.18 ASECAP and some other respondents suggested that the problem could be addressed by avoiding the 5795-5815 MHz frequency bands for Wi-Fi hotspots in

[8] https://www.ofcom.org.uk/__data/assets/pdf_file/0037/79777/improving-spectrum-access-consumers-5ghz.pdf

vehicles and mobile devices in “Wi-Fi hotspot mode” and limiting output power in the rest of the band to 25 mW. ASECAP cited tests in Spain which they had been involved with and which they said demonstrated that an output level of 200 mW creates significant interference with road charging transactions. We made further enquiries about these studies but were not able to obtain any further detail or report at this stage. Both ASECAP and a confidential respondent also cited a report published by CEPT (ECC Report 244) which they said concluded that Wi-Fi interferes with incumbent systems and that mitigation measures would need to be introduced.

3.19 Other respondents were concerned about the impact on the operational life of tags (also referred to as on-board units or ‘OBUs’) in cars. The British Standards Institute panel responsible for the standardisation of Intelligent Transport Systems technologies (BSI EPL/278) cited a 2006 Transport for London (TfL) trial that showed that tags in vehicles parked in areas receiving road tolling beacons (and therefore continuously active) could have an operational life of less than 7 days as opposed to 5-7 years. The concern was that interference from Wi-Fi could have a similar effect on road tolling tags.

3.20 Several respondents called on Ofcom to do further testing to better understand the impacts before going ahead with the regulations.

Ofcom’s response

3.21 We have identified seven road tolling locations across the UK which use 5.8 GHz systems: Dartford Crossing, Humber Bridge, M6 Toll, Mersey Tunnels, Severn Crossing, Tamar Bridge / Torpoint Ferry and the Tyne Tunnels. Mersey Gateway was also mentioned but we understand that this scheme will not use 5.8 GHz.

3.22 We have carefully considered the responses and note the concerns expressed by road tolling respondents. We continue to consider however that the risk of impact from Wi-Fi use in the 5.8 GHz band to road tolling systems in 5795-5815 MHz in the UK is low.

3.23 The Regulations will ban fixed outdoor use and are relatively low power (200 mW). We consider that interference from in-building use of Wi-Fi is unlikely because of the distances between tolling equipment and Wi-Fi equipment, and the attenuation caused by building walls. Most of the toll plazas at road tolling locations are located away from built-up areas, and the transmitters are generally located on gantries tilted down towards the road, which would also help to attenuate distant interference sources.

3.24 Road tolling stakeholders highlighted risks relating to in-vehicle use of Wi-Fi as their main concern. However, Wi-Fi devices fixed to vehicles are unlikely to need to use a radiated power of 200 mW EIRP because they only have to provide coverage within a vehicle. A radiated power of 25 mW EIRP, as currently authorised in European and domestic law[9] in the 5.8 GHz band, is likely to be sufficient. This existing 25 mW EIRP authorisation is also likely to be more attractive to vehicle manufacturers looking to install Wi-Fi access points in their vehicles because it does not require radar mitigation mechanisms (e.g. DFS) to be implemented in the 5.8 GHz band. We

[9] In particular, in Decision 2006/771/EC (as amended by Decision 2013/752/EU). This Decision has been implemented into UK law through the Wireless Telegraphy (Exemption and Amendment) Regulations 2010.

are aware from discussions with Wi-Fi manufacturers that DFS particularly struggles with high mobility scenarios such as vehicles because of the long (30 minute) channel non-occupancy period after a radar has been detected.

3.25 Some stakeholders also highlighted concerns about mobile devices used in hot-spot mode (operating in 5.8 GHz frequencies) causing interference to road tolling systems. We consider that the risk of interference from low power Wi-Fi mobile devices in hotspot mode to road tolling is likely to be very low.

3.26 We understand that hotspot mode in current mobile devices does not use frequencies that require DFS, and this is not likely to change in the foreseeable future. Manufacturers of mobile device components have explained to us that demonstrating DFS compliance for highly integrated mobile devices is currently impractical. They said that they expected that our proposed regulations would not be usable for mobile devices in either hotspot or peer-to-peer mode in the near future.

3.27 Even if they were to be used in the longer term, 5.8 GHz mobile hotspots would likely be low power and would, in our view, be less likely to cause interference than other existing uses of the band. We note that road tolling in the 5795-5815 MHz band already coexists with several other radio systems including short range devices (SRDs) and, as ASECAP noted in its response, is designed to be sufficiently robust against existing threats of interference. Our calculations show that mobile devices in Wi-Fi hotspot mode have a radiated power spectral density typically less than that of 5.8 GHz SRDs which could be used in vehicles. We present these calculations in Annex 3. Additionally, Wi-Fi uses “listen before talk”[10] in contrast to SRDs, which are not required to implement a polite channel sharing protocol.

3.28 We consider that ASECAP has interpreted ECC Report 244 too pessimistically. This report looks at simple minimum coupling loss (MCL) type scenarios for coexistence between Wi-Fi and road tolling which assume that Wi-Fi is transmitting at the maximum regulatory limit.

3.29 Real Wi-Fi devices do not continuously transmit and only access the radio channel when necessary. The length of time they access the channel will partially depend on the data loading of the Wi-Fi network as well as the activity of other users sharing the channel. Wi-Fi uses “listen before talk” and so will tend to “back off” and leave gaps between transmissions when it detects other users accessing the channel, even when heavily loaded.

3.30 ECC Report 244 shows that road tolling causes interference to Wi-Fi at a greater distance than the interference distance from Wi-Fi to road tolling. In most typical scenarios, the distance at which Wi-Fi might cause interference to road tolling is even lower because real Wi-Fi devices typically transmit at power levels much lower than the regulatory limit as we have already discussed.

3.31 In relation to concerns about impacts on the operational life of road tolling tags, we understand that the TfL report cited by BSI EPL/278 was focused on the impacts on battery life to vehicles parked within the communications zone of road tolling charge points in central London rather than other 5.8 GHz radio uses and it is therefore not

[10] Wi-Fi’s “listen before talk” is Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). This means that if a Wi-Fi device detects a co-channel user then it will wait a period of time before attempting to transmit again. This waiting period between attempts to access the channel increases exponentially to reduce the risk of collisions.

clear that the findings of this report can be extended to the impacts from other radio systems in the 5.8 GHz band. If this was in fact a problem, we expect that this would be true for other 5.8 GHz radio systems too, not just Wi-Fi use; for example, there is already a large amount of outdoor 5.8 GHz BFWA use for CCTV in central London. The ban on fixed outdoor use for Wi-Fi in 5.8 GHz would tend to mitigate the risk from Wi-Fi relative to other 5.8 GHz devices. We are therefore not persuaded that the proposal to make the 5.8 GHz band available for Wi-Fi use will have negative impacts on the operational life of road tolling tags.

3.32 In summary, while there is a theoretical risk of interference from Wi-Fi use in the 5.8 GHz band to road tolling systems in 5795-5815 MHz, we think that the risk of this occurring in reality is very low. Road tolling systems currently share the band with other users on a non-protection, non-interference basis and will continue to do so. Authorisation for Wi-Fi in-car use in the band already exists (at 25 mW) but we do not think this is an attractive band for in-car use at higher power levels (up to 200 mW), especially under the regulations published here which require use of DFS or equivalent technologies. We therefore do not think it is necessary to make changes to the proposed technical parameters to manage this risk.

Respondents with concerns about coexistence with FSS

3.33 We received two responses from the satellite sector, from EMEA Satellite Operators Association (ESOA) and the Global VSAT Forum (GVF). GVF noted that it coordinates closely with ESOA on all spectrum matters and fully endorsed their response.

3.34 Both respondents asked for assurances that spectrum required by the satellite industry for the continuation and growth of services would continue to be accessible. They said that the 5725-5850 MHz band is under discussion under WRC-19 Agenda Item 1.16 and that studies are on-going, including on the appropriate value for the limit on the maximum EIRP of Wi-Fi access points to protect FSS satellite receivers, and therefore that it was preferable to wait for the completion of these studies.

3.35 ESOA also thought that a 200 mW EIRP did not seem sufficiently stringent to protect FSS in the same band and suggested Ofcom should review the calculations and associated scenarios between Wi-Fi and FSS. In particular, ESOA highlighted the latest models[11] on building entry loss and clutter loss provided by WP3K/WP3M (22-29 March 2017) to WP5A[12]. In any case, ESOA welcomed the proposal to prohibit fixed outdoor use of Wi-Fi.

3.36 ESOA said that they believed that conservative modelling assumptions should be used because there is a great uncertainty in the number of future Wi-Fi devices which might be deployed and that it might be impossible to reverse any decision to make this band available for Wi-Fi. In particular, they said that the introduction of LTE-LAA might increase the total number of devices using the 5 GHz band. They also argued that ECC Report 244 had only taken into account Wi-Fi interference from EU countries but satellite footprints typically cover a larger area and so territories adjacent to the EU should have been taken into account too. In contrast, Wi-Fi stakeholders said we had been overly conservative in our analysis.

[11] P.[Clutter] (Doc. 3/53 rev 1) and P.[BEL] (Doc. 3/57 rev1) respectively
[12] Document 3K/TEMP/44

3.37 ESOA observed that Ofcom had not conducted a coexistence study between Wi-Fi use in 5725-5850 MHz and adjacent FSS use in 5850-5925 MHz. However, they supported the proposed centre frequency and channelling arrangements which ESOA observed would provide an effective 15 MHz guard band between the top Wi-Fi channel[13] and FSS operations above 5850 MHz.

3.38 Finally, both ESOA and GVF reiterated their opposition to options for Wi-Fi use in the 5850-5925 MHz and 5350-5470 MHz bands mentioned in our May 2016 consultation. ESOA added that the technical parameters proposed for the 5.8 GHz band should not be viewed as a precedent for parameters in these other bands, which are more extensively used for satellite services than the 5.8 GHz band.

Ofcom's response

3.39 We note the suggestion from ESOA that we should review the calculations and associated scenarios between Wi-Fi and FSS set out in our March Statement. We have assessed the new models provided by ITU Study Group 3 and we have found that this does not significantly change the coexistence assessment.

3.40 We consider that we took a conservative approach to the analysis, but we avoided compounding conservative assumptions in an unrealistic manner. We have considered a wide range of deployment scenarios in our studies and still consider that LTE-LAA is unlikely to significantly increase the overall 5 GHz device population. We have used geographic apportionment to take into account Wi-Fi interference from both EU countries and adjacent territories.

3.41 We did not model the adjacent coexistence scenario between Wi-Fi in 5725-5850 MHz and FSS above 5850 MHz, but we note that 5.8 GHz Wi-Fi is deployed in many countries in ITU Regions 2 and 3, including the USA and China, with no reported interference to adjacent FSS services. Furthermore, as ESOA observes, there is an effective 15 MHz guard band between the top Wi-Fi channel and FSS services above 5850 MHz.

3.42 We therefore consider that the analysis presented in Annex 6 of the March Statement is sufficient to provide us with confidence that the proposed UK technical parameters will pose little risk to the existing FSS in the 5.8 GHz band from use in the UK alone. In the case where other countries in ITU Region 1 were to open the 5.8 GHz band for Wi-Fi using the same technical parameters as the UK, we continue to consider that there is a low risk of interference to existing FSS, because our calculations took this scenario into account. We do not consider that the interference risk is sufficiently high to warrant waiting for the outcome of WRC-19 (and foregoing the benefits to consumers of increased Wi-Fi capacity in the interim period) before deciding to proceed with allowing Wi-Fi access in the band.

3.43 We additionally note the concerns raised by ESOA and GVF in relation to future access to spectrum for the satellite industry, and allowing Wi-Fi access to other bands used for FSS. Any future proposals to allow Wi-Fi access to other spectrum bands will be subject to consultation at the time. Key considerations will be our duty to secure optimal use of the spectrum and to ensure that new uses do not cause harmful interference to existing authorised uses.

[13] IEEE Channel 165 (5815-5835 MHz)

Other responses

3.44 We additionally received responses from the Radio Society of Great Britain (RSGB) and Juice Broadband, a fixed and wireless internet service provider.

3.45 The RSGB welcomed our proposed technical parameters and asked that they be properly enforced. Juice Broadband were concerned that opening up the band for Wi-Fi would result in a higher noise floor and less capacity, but said this could be tolerated if additional frequencies could be provided for fixed wireless access (FWA), including allowing FWA access to the 5795-5815 MHz frequencies currently used by road tolling.

Ofcom's response

3.46 We note Juice Broadband's concerns and suggestions regarding additional spectrum. As explained in our Statement, we consider that interference from Wi-Fi to BFWA is unlikely. We note that additional spectrum for BFWA is out of the scope of this document.

Ofcom's decision to make the Regulations

3.47 We have carefully reviewed and considered the comments from all respondents. For the reasons set out above, we did not consider it necessary to revisit our decision to make the 5.8 GHz band available for Wi-Fi or to make changes to the proposed technical parameters at this time.

3.48 As noted in our March Statement, our aim was to authorise Wi-Fi use of the 5.8 GHz band on the basis of technical conditions which were the least restrictive, but also appropriately cautious in relation to interference to other services, based on studies to date. For the reasons set out in this section, we continue to consider that the proposed technical parameters strike an appropriate balance of maximising benefits to consumers of Wi-Fi services while avoiding negative impacts on other users. Having carefully considered the views of respondents to the published Notice, we also consider that, in accordance with section 8(3B) of the WTA, the Regulations as drafted are objectively justifiable, not unduly discriminatory, proportionate and transparent.

3.49 We have therefore decided to proceed to make the Regulations as drafted in the Notice, with no amendments to the proposed technical conditions. We present the scope of the regulations in the following section.

Section 4

Scope of the Regulations

4.1 Following consideration of the responses as outlined in Section 3, we have decided to proceed with our proposal to make the Wireless Telegraphy (Exemption and Amendment) (Amendment) Regulations 2017 as drafted. The Regulations will come into force by 7 August 2017. We outline the final scope of the Regulations in this section.

The Wireless Telegraphy (Exemption and Amendment) (Amendment) Regulations 2017

4.2 Regulation 1 sets out the name of the Regulations and will make clear the date on which they are due to come into force.

4.3 Regulation 2(1) sets out that the Regulations will take effect by amending the Wireless Telegraphy (Exemption and Amendment) Regulations 2010 ("the 2010 Regulations").

4.4 Regulation 2(2) amends Regulation 5 of the 2010 Regulations by substituting the publication date of the relevant interface requirements ("IR 2030 – UK Interface Requirements 2030 Licence Exempt Short Range Devices") for a date in 2017. The updated version of IR 2030 includes new entries making provision for equipment to be used in the 5725-5850 MHz sub-band on the basis of the technical parameters specified (see Annex 5).

Annex 1

List of non-confidential respondents

ASECAP

BSI EPL/278

BT plc

Cisco

Dynamic Spectrum Alliance

Ericsson

ESOA

Global VSAT Forum

Intel Corporation

ITS UK

iWireless Solutions Ltd

Juice Broadband

Mersey Tunnels

Microsoft

Midland Expressway Ltd (M6toll)

Radio Society of Great Britain (RSGB)

Ruckus Wireless

Sky

Tamar Bridge and Torpoint Ferry Joint Committee

Wi-Fi Alliance

Wireless Broadband Alliance

Annex 2

Glossary of abbreviations

BFWA	Broadband Fixed Wireless Access. Radio link to the home or the office from a cell site or base station for the purpose of providing broadband internet access, replacing the traditional local loop.
CEPT	European Conference of Postal and Telecommunications Administrations
dB	Decibel. A notation for expressing a linear value in a logarithmic scale
dBm	The power in decibels (dB) of the measured power referenced to one milliwatt (mW).
DFS	Dynamic Frequency Selection. A system that makes Wi-FI routers change frequency when a radar using the same frequency is near.
DSA	Dynamic Spectrum Access. This is a technology for a variety of reconfigurable radio equipment allowing it to select the frequency on which it will operate at a given location and over a given period of time to optimise the use of available spectrum and avoid interference with other radios or other systems.
EIRP	Equivalent Isotropically Radiated Power. This is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain).
FSS	Fixed Satellite Service. Two-way communication links between earth stations, usually at fixed locations, and one or more satellites
FWA	Fixed Wireless Access. Radio link to the home or the office from a cell site or base station, replacing the traditional local loop.
GHz	Gigahertz. A unit of frequency of one billion cycles per second.
IR	Interface requirement. These documents provide a link between the requirements of the R&TTE Directive and how spectrum is used nationally for radio equipment.
ITU	International Telecommunications Union - Part of the United Nations with a membership of 193 countries and over 700 private-sector entities and academic institutions. ITU is headquartered in Geneva, Switzerland.
ITU Region	The International Telecommunication Union (ITU), in its International Radio Regulations, divides the world into three regions for the allocation of frequencies.
kHz	Kilohertz. A unit of frequency of one thousand cycles per second
MCL	Minimum coupling loss refers to the minimum distance loss including antenna gains between transmitter output and receiver input.
MHz	Megahertz. A unit of frequency of one million cycles per second.

mW	milliwatt. A derived unit of power in the International System of Units (SI). A milliwatt is one thousandth (1x10-3) of a Watt.
RLAN	Radio Local Area Network. A radio access system used to provide wireless access between computer devices. RLANs are intended to cover smaller geographic areas like homes, offices and to a certain extent buildings being adjacent to each other.
RTTT	Road Transport and Traffic Telematics. This term is used to describe the category of radio devices that are used in the field of road transport and intelligent transport systems (ITS), including for road tolling purposes
SRD	Short range device is a general term, applied to various radio devices designed to operate usually on a license exempt basis, over short range and at low power levels. This includes devices such as alarms, telemetry and telecommand devices, radio microphones, radio local area networks etc
VNS	Voluntary National Specification. In the absence of a relevant ETSI Harmonised Standard, a VNS can be employed nationally for equipment to demonstrate compliance with the R&TTE Directive.
WAS	Wireless Access Systems (WAS) are end-user radio connections to public or private core networks.
Wi-Fi	Commonly used to refer to wireless local area network (WLAN) technology, specifically that conforming to the IEEE 802.11 family of standards. Such systems typically use one or more access points connected to wired Ethernet networks which communicate with wireless network adapters in end devices such as PCs. It was originally developed to allow wireless extension of private LANs but is now also used as a general public access technology via access points known as "hotspots".

Annex 3

Coexistence with Road Tolling – Update

The spectral density of power radiated by mobile devices in Wi-Fi hotspot mode is typically lower than that of SRDs and far lower than that of road tolling

A3.1 Road tolling operates across the 5795-5815 MHz range, using four channels of 5 MHz bandwidth. We compare the radiated power of SRDs, Wi-Fi and RTTT referenced to the 5 MHz receiver bandwidth of road tolling in Figure A3.1 below. This shows that the spectral density of power radiated by Wi-Fi devices in mobile hotspot mode is typically lower than that of SRDs which are currently authorised in the 5.8 GHz band and far lower than that of road tolling.

A3.2 We populated Figure A3.1 using information from the road tolling ETSI standard[14] and typical characteristics for SRDs based on parameters given in ECC Report 101[15]. We also considered analogue video streaming for first person view (FPV) drone piloting because many of the stakeholders who responded to our May 2016 5 GHz strategy consultation[16] noted that they used the 5.8 GHz band for FPV.

A3.3 Wi-Fi device manufacturers have told us that the total radiated power of Wi-Fi mobile devices is fundamentally limited by their battery capacity and tends to be in the range 25 to 80 mW, depending on the form factor of the mobile device, and that this power is spread out over a minimum of 20 MHz and up to 160 MHz for Wi-Fi devices which support 802.11ac[17]. Laptops might be towards the higher end of this range of radiated power levels because they have a larger battery and larger more efficient and directional antennas, whilst mobile phones might be towards the lower end.

A3.4 The power spectral density of mobile devices in Wi-Fi hot spot mode is typically lower than that of existing 25 mW EIRP SRDs, even if the total radiated power is slightly higher. This is because Wi-Fi has a minimum bandwidth of 20 MHz whilst SRD regulations specify no minimum bandwidth. This means that the total power of an SRD could fall into the 5 MHz receiver bandwidth of the roadside tolling interrogator whilst only a maximum of a quarter of a Wi-Fi channel will ever be co-channel with a road tolling receiver.

[14] §5.3, " Road Transport and Traffic Telematics (RTTT); Dedicated Short Range Communication (DSRC) transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band; Part 1: General characteristics and test methods for Road Side Units (RSU) and On-Board Units (OBU)", ETSI EN 300 674 V1.2.1-1 (2004-08), http://www.etsi.org/deliver/etsi_en/300600_300699/30067401/01.02.01_60/en_30067401v010201p.pdf

[15] §3.4.1," COMPATIBILITY STUDIES IN THE BAND 5855– 5925 MHz BETWEEN INTELLIGENT TRANSPORT SYSTEMS (ITS) AND OTHER SYSTEMS", ECC Report 101, Bern, February 2007, http://www.erodocdb.dk/docs/doc98/official/pdf/ECCRep101.pdf

[16] "Improving spectrum access for consumers in the 5 GHz band", Ofcom, May 2016, https://www.ofcom.org.uk/__data/assets/pdf_file/0037/79777/improving-spectrum-access-consumers-5ghz.pdf

[17] Broadcom submission to the July 2015 SE24 meeting

Figure A3.1: The spectral density of power radiated by Wi-Fi devices in mobile hotspot mode is typically lower than that of SRDs which are currently authorised in the 5.8 GHz band and far lower than that of road tolling

System type	Transmitter description	**EIRP PSD** dBm / 5 MHz	Total EIRP dBm	System BW MHz
RTTT	roadside tolling interrogator	**33**	33	5
SRD	max. regulatory limit	**14**[a]	14	no min.
	typ. narrowband SRD	**14**[a]	14	0.25
	analogue video (e.g. for FPV)	**12**	14	8
	typ. wideband SRD	**8**	14	20
Wi-Fi	max. regulatory limit	**17**	23	20
	typ. laptop (high. bitrate)	**13**	19	20
	typ. mobile phone (high. bitrate)	**8**	14	20
	typ. laptop (v. high bitrate)	**4**	19	160
	typ. mobile phone (v. high bitrate)	**-1**	14	160

[a] We are considering the power falling co-channel with the road tolling receiver here, not strictly the PSD, so this value can never exceed the total radiated power of a single SRD (14 dBm EIRP).

Annex 4

The Regulations

A4.1 A sample copy of the Regulations is presented below for indicative purposes. The statutory instrument will be formally published on the government's legislation.gov.uk website in due course.

STATUTORY INSTRUMENTS

2017 No.

ELECTRONIC COMMUNICATIONS

The Wireless Telegraphy (Exemption and Amendment) (Amendment) Regulations 2017

Made - - - -	*13th July 2017*
Coming into force - -	*7th August 2017*

The Office of Communications ("OFCOM") make the following Regulations in exercise of the powers conferred by sections 8(3) and 122 of the Wireless Telegraphy Act 2006([18]) (the "Act").

Before making these Regulations, OFCOM have given notice of their proposal to do so in accordance with section 122(4)(a) of the Act, published notice of their proposal in accordance with section 122(4)(b) of the Act, and have considered the representations made to them before the time specified in the notice in accordance with section 122(4)(c) of the Act.

Citation and commencement

1.—(1) These Regulations may be cited as the Wireless Telegraphy (Exemption and Amendment) (Amendment) Regulations 2017 and shall come into force on 7th August 2017.

Amendment of the Wireless Telegraphy (Exemption and Amendment) Regulations 2010

2.—(1) The Wireless Telegraphy (Exemption and Amendment) Regulations 2010([19]) shall be amended in accordance with the following provisions of these Regulations.

(2) In regulation 5 (short range devices), for ""IR 2030—UK Interface Requirements 2030 Licence Exempt Short Range Devices", published by OFCOM in June 2014", substitute ""IR 2030—UK Interface Requirements 2030 Licence Exempt Short Range Devices", published by OFCOM in July 2017".

Philip Marnick
Group Director of Spectrum Group
13th July 2017 For and by the authority of the Office of Communications

([18]) 2006 c.36; sections 8(3), 12 and 122 were extended to the Bailiwick of Guernsey by article 2 of the Wireless Telegraphy (Guernsey) Order 2006 (S.I. 2006/3325); to the Bailiwick of Jersey by article 2 of the Wireless Telegraphy (Jersey) Order 2006 (S.I. 2006/3324); and to the Isle of Man by article 2 of the Wireless Telegraphy (Isle of Man) Order 2007 (S.I. 2007/278).
([19]) S.I. 2010/2512 as amended by S.I. 2011/3035, S.I. 2013/1253, and S.I. 2014/1484.

EXPLANATORY NOTE

(This note is not part of the Regulations)

These Regulations amend the Wireless Telegraphy (Exemption and Amendment) Regulations 2010 (S.I. 2010/2512 as amended by S.I. 2011/3035, S.I. 2013/1253, and S.I. 2014/1484).

These Regulations extend the exemption for establishing, installing and using short-range devices. A copy of IR 2030—UK Interface Requirements 2030 Licence Exempt Short Range Devices, published by OFCOM in July 2017, can be found on OFCOM's website at www.ofcom.org.uk.

A full regulatory impact assessment of the effect that these Regulations will have on the costs to business is available to the public from the Office of Communication's ("OFCOM") Library at Riverside House, 2A Southwark Bridge Road, London, SE1 9HA (Tel: 020 7981 3000) and on OFCOM's website at www.ofcom.org.uk. Copies of this assessment have also been placed in the library of the House of Commons.

Annex 5

Updates to Interface Requirement 2030

A5.1 We present below the final version of the modified section of Interface Requirement 2030 (IR 2030), which will be referred to in the Regulations. The technical parameters set out in IR2030 will form part of the requirements with which individuals must comply when operating in the 5725-5850 MHz frequencies.

Interface Number/Notification number/Date	Normative Part								Informative Part
	Application	Comments to application	Frequency band	Comments to Frequency band	Transmit power / Power density	Comment to Transmit power / Power density	Channelling	Channel access and occupation rules	Reference
IR2030/8/2 2017/120/UK June 2017	Wireless Access Systems (WAS)	Aeronautical mobile use is not permitted. The apparatus may also be used airborne within an aircraft, only to establish a connection with a station or apparatus within the same aircraft.	5470-5730 MHz		Maximum mean e.i.r.p. of 1W and Maximum mean e.i.r.p. density of 50mW/MHz in any 1 MHz band			Techniques to access spectrum and mitigate interference that provide at least equivalent performance to the techniques described in harmonised standards adopted under Directive 2014/53/EU must be used.	Where the band 5470 – 5725 MHz is used, Dynamic Frequency Selection and Transmit Power Control are assumed to be implemented as specified in EN 301 893 EC Decision 2005/513/EC. Where the band 5725 – 5730 MHz is used, see footnote[20] for information. Nominal Centre Frequency (MHz) 5500, 5520, 5540, 5560, 5580, 5600, 5620, 5640, 5660, 5680, 5700, 5720

[20] Although a matter for users to determine, if Dynamic Frequency Selection and Transmit Power Control are implemented as elements of the techniques to access spectrum and mitigate interference referred to under 'Channel access and occupation rules', one possible approach may be to apply Dynamic Frequency Selection and Transmit Power Control as specified in EN 301 893 (applied to this band in the same way as applied to the 5150 – 5350 and 5470 – 5725 bands) and Dynamic Frequency Selection detection radar test signals as specified in EN 302 502 (as applied to WAS equipment).

IR2030/8/3 2017/120/UK June 2017	Wireless Access Systems (WAS)	Equipment must not form part of a fixed outdoors installation when operating in 5730 – 5850 MHz Aeronautical mobile use is not permitted. Equipment may be used airborne, within an aircraft, only to establish a connection with a station or apparatus within the same aircraft.	5725 – 5850 MHz		Maximum mean e.i.r.p of 200 mW and maximum mean e.i.r.p density of 10 mW/MHz in any 1 MHz band			Techniques to access spectrum and mitigate interference that provide at least equivalent performance to the techniques described in harmonised standards for the 5150 – 5350 MHz and 5470 – 5725 MHz bands adopted in accordance with EC Decision 2005/513/EC and Directive 2014/53/EU must be used.	See footnote[21] for information. Nominal Centre Frequency (MHz) 5745, 5765, 5785, 5805, 5825

[21] Although a matter for users to determine, if Dynamic Frequency Selection and Transmit Power Control are implemented as elements of the techniques to access spectrum and mitigate interference referred to under 'Channel access and occupation rules', one possible approach may be to apply Dynamic Frequency Selection and Transmit Power Control as specified in EN 301 893 (applied to this band in the same way as applied to the 5150 – 5350 and 5470 – 5725 bands), except with respect to Dynamic Frequency Selection detection radar test signals where Dynamic Frequency Selection detection radar test signals as specified in EN 302 502 (as applied to WAS equipment) may be applied.