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Strategic Review of UHF Band 1 and Band 2

410 MHz to 470 MHz

Statement

Publication date: 25 May 2017

About this document

This document sets out the changes we are making to the way spectrum in the 410 MHz to 450 MHz (UHF Band 1) and 450 MHz to 470 MHz (UHF Band 2) bands is managed to better address the requirements of current and future users.

The spectrum in this range is attractive to users as it has good in-building penetration as well as coverage. These bands already deliver important benefits to UK citizens and consumers, including robust and immediate communications for businesses, Emergency Services, and Programme Making and Special Events.

Our policy decisions are to make a number of changes to the Business Radio Technical Frequency Assignment Criteria; to add additional channels to Business Radio Simple UK and Business Radio Simple Site licences; and to make access to this spectrum more uniform by reconfiguring the channel plan to more common duplex spacings. The aim of these changes is to create a framework for managing this spectrum for the next ten years.

This statement also confirms our decision to maintain the existing band configuration for UHF 2, and not seek to align it with the configuration used in continental Europe.

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Section 1

Executive Summary

1.1 This document sets out the changes we are making to ensure that management of the spectrum bands 410 MHz to 450 MHz (UHF Band 1) and 450 MHz to 470 MHz (UHF Band 2) can meet the future needs of existing and new users and applications.

1.2 These bands are used by a wide range of parties, including Ministry of Defence (MOD), Emergency Services (ES) and civil users referred to as Business Radio (BR). BR provides services to many industry sectors, for example transport, security, manufacturing and Utilities (water, gas and electricity industries). The bands also support Programme Making and Special Events (PMSE), maritime and aeronautical sectors, Amateur Radio and licence exempt (LE) use (including short range devices).

1.3 In December 2016, we published our Consultation on the strategic review of UHF Band 1 and Band 2, which set out our assessment of future spectrum demand in these bands and put forward proposals we considered would provide the spectrum management framework to meet this demand. Some proposals, i.e. increased sharing between BR licensees and changes to planning thresholds, also apply to other spectrum bands used by BR.

1.4 Stakeholders were broadly supportive of our proposals. Therefore, after consideration of responses, we have decided to implement the policy proposals we set out in the consultation. These are:

- Add additional channels to Business Radio Simple UK and Business Radio Simple Site licences to recognise the demand for these licence products;
- Changes to the Business Radio Technical Frequency Assignment Criteria. This includes increasing the sharing factor[1] from two to four (with an initial increase to a sharing factor of three) for Technically Assigned licences, and increasing the planning thresholds with respect to the noise floor for the bands 55.75 MHz to 68.0 MHz (VHF Band 1) and 68 MHz to 87.5 MHz (VHF Low Band); and
- Channel plan reconfiguration to a rationalised set of more common duplex spacings to defragment the bands to release additional spectrum capacity for use.

1.5 We also confirm our decision to maintain the existing band configuration for UHF 2, and not seek to align it with the configuration used in continental Europe. In the 2016 Consultation, we set out our view that aligning UHF 2 would be a major intervention and would cause significant cost and disruption to all users of the band, most of whom would receive limited, if any, benefits from alignment. We have concluded that it is not necessary or proportionate to change the band configuration as there is insufficient evidence to suggest that the benefit would outweigh the costs.

[1] The sharing factor relates to the number of users sharing a channel within the same geographical area

Section 2

Introduction

2.1 Following our December Consultation, '*Strategic Review of UHF Band 1 and Band 2 410 to 470* MHz' (the 2016 Consultation)[2], this Statement sets out the changes we are making to ensure that management of the spectrum bands 410 MHz to 450 MHz (UHF Band 1) and 450 MHz to 470 MHz (UHF Band 2) can meet the future needs of existing and new users and applications.

2.2 The aim of the review was to build on our sectoral analysis and establish a long-term spectrum management strategy for civil use of the UHF spectrum at 410 MHz to 470 MHz. We will continue to monitor trends in demand and think this strategy provides a flexible framework for how we manage and licence this spectrum for the next ten years.

2.3 In reaching the conclusions set out in this Statement we have had regard to, and acted in accordance with, our statutory duties, including our duty to secure the optimal use of the radio spectrum.

Background and aims

2.4 UHF 1 and 2 are busy, heavily populated bands that already deliver important benefits to UK citizens and consumers. The spectrum in this range is attractive to users as it has good in-building penetration as well as coverage. Business Radio (BR) is the most significant civil user of the bands, of which Private Mobile Radio (PMR) is the most common type of use.

2.5 We currently have approximately 40,000 BR licences issued for use in these bands, of which 20,000 are Light Licences (Simple UK, Simple Site and Suppliers Light licences) and 18,000 coordinated licences (Technically Assigned and Area Defined). Within the coordinated licences there are approximately 10,000 licensees with 32,000 assignments. In addition, there is also licence exempt use in the sub band 458.5 MHz - 459.5 MHz.

2.6 Current users of the bands include:

UHF 1 (410 MHz – 450 MHz)

Primarily used by the Ministry of Defence. Other users in the band include Arqiva and the Emergency Services (ES) (both using 2 x 2 MHz), Business Radio (BR), Amateur Radio (secondary use between 430 MHz to 440 MHz), Programme Making and Special Events (PMSE) and Licence Exempt (LE) devices.[3]

Military use places a number of constraints on other spectrum users of the band, including geographical limitations, which limit civil use to specific areas

[2] https://www.ofcom.org.uk/__data/assets/pdf_file/0033/95991/Strategic-Review-of-UHF-Band-1-and-Band-2-410-to-470-MHz.pdf

[3] The spectrum for Licence Exempt devices in UHF 1 is harmonised across Europe

around conurbations.[4]

UHF 2 (450 MHz – 470 MHz)

Contains many different types of users including mission and safety critical services. Users include BR, PMSE, scanning telemetry, ES and Licence Exempt devices.[5] There are also long standing international allocations for maritime (on board ships communications sharing the telemetry bands).

2.7 This review does not consider any changes to spectrum management for scanning telemetry, PMSE, Amateur Radio, or UHF Maritime allocations.

Consultation

2.8 In the 2016 Consultation, we set out our analysis of current and future use of UHF Band 1 and Band 2 and proposals which we believed would enable us to more effectively manage the bands to meet these future challenges. Our proposals focussed on providing certainty for businesses, individuals and public sector users who rely on this spectrum; to allow the bands to be used more intensively and efficiently; and set a framework for managing this spectrum for the next ten years.

2.9 The Consultation focussed on three elements: trends in demand for current and new services; risk of continental interference; and potential access to Public Sector spectrum for Business Radio use.

2.10 Regarding the trends for current and future use, we identified a moderate overall growth for services currently using the band, with voice remaining the dominant application for BR and some users seeing increasing use of data services; potential for increased use for Internet of Things (IoT) and Machine-to-Machine (M2M) type applications from both new and current users; some interest in wideband services / private broadband communications networks for businesses; and an increasing risk of congestion.

2.11 Our assessment of the risk of continental interference, based on comments received from stakeholders, interference and spectrum monitoring reports from affected stakeholders and our own monitoring and analysis, is that the risk of continental interference is mainly confined to the east and south east of the UK during periods of atmospheric lifts causing anomalous propagation events.

2.12 We also proposed that access to more Public Sector spectrum will have a positive impact on our ability to implement our policy proposals. This is expected in the bands 380 MHz to 385 MHz paired with 390 MHz to 395 MHz and 406.2 MHz to 430 MHz frequency ranges, and to the 4 MHz of non-contiguous spectrum in UHF Band 2 (which we expect to see made available due to the decrease in Emergency Services use).

2.13 We proposed that it would be appropriate and proportionate to take action to ensure efficient use of UHF spectrum. We identified three policy proposals to address these spectrum management challenges. These are:

[4] UK Frequency Allocation Table, Annex C
https://www.ofcom.org.uk/__data/assets/pdf_file/0021/36228/ukfat_2013.pdf

[5] The Licence Exempt spectrum in UHF 2 (458.5 – 459.5) is a UK only allocation for short range devices

- Add additional channels to Business Radio Simple UK and Business Radio Simple Site licences to recognise and enhance the appeal of these licence products as an alternative to coordinated licences;

- Changes to the Business Radio Technical Frequency Assignment Criteria, specifically an increase in the sharing factor for Technically Assigned licences from two to four with an initial increase to three and changes to the planning criteria in VHF Band 1 and VHF Low Band; and

- Channel plan reconfiguration to a rationalised set of more common duplex spacing to defragment the bands to release additional spectrum capacity for use.

2.14 To maximise the potential benefits of this spectrum and to ensure our spectrum management approach is consistent across all BR bands, some of the above proposals apply to spectrum outside UHF 1 and 2. The proposed increase in sharing factor will apply to Technically Assigned licences in all spectrum bands used by BR. In VHF Band I (55.75 MHz to 68.0 MHz) and VHF Low Band (68 MHz to 87.5 MHz) only we proposed to adopt a higher noise floor in the planning criteria. Table 1 summarises the policy proposals and which bands they apply to.

Table 1 - Policy options and impacted frequency bands and licence products

Policy Proposal	Licence Products Impacted	VHF Band I (55.75 to 68.0 MHz)	VHF Low Band (68.0 to 87.5 MHz)	VHF Mid Band (138.0 to 165.04 MHz)	VHF High Band (165.04 to 173.09 MHz)	Band III (177.21 to 207.49 MHz)	UHF 1 (410 to 450 MHz)	UHF 2 (450 to 470 MHz)
Addition of spectrum to BR Light Licence	Simple Site (BR) Simple UK (BR)							✓
Increase in sharing factor from 2 to 4 (initially 3)	Technically Assigned (BR)	✓	✓	✓	✓	✓	✓	✓
Increase noise floor for planning thresholds	Technically Assigned (BR) Area Defined (BR)	✓	✓					
Changes to spectrum allocations to reduce number of duplex spacings	Technically Assigned (BR) Area Defined (BR)						✓	✓

2.15 We considered these policy proposals would help meet future demand for spectrum and provide a flexible spectrum management framework to respond to new uses and applications. Changes to our assignment criteria and possible access to additional spectrum would help to address issues of congestion, particularly in urban areas

such as London, where demand continues to grow and where we already reject a small, but growing, percentage of licence applications.

2.16 We also said that our preliminary view was that configuring the channelling arrangement of UHF Band 2 to align with continental Europe was not justified or necessary and that such a large-scale intervention would not be proportionate as the cost and disruption to all UHF Band 2 users would outweigh the benefits to a small proportion of the sector

2.17 We received 24 responses to the Consultation, of which one was confidential. They were broadly supportive of our assessment and policy proposals.

2.18 This statement sets out our conclusions on our strategy in light of stakeholder responses. It also sets out our next steps and plans for implementing our policy decisions.

Ofcom's specific duties and powers related to spectrum management

2.19 Ofcom's responsibilities for spectrum management are set out primarily in two Acts of Parliament which confer on Ofcom specific duties and powers in respect of spectrum (and the other sectors we regulate): the Communications Act 2003 (the '2003 Act') and the Wireless Telegraphy Act 2006 (the 'WT Act').[6]

2.20 Our principal duties under the 2003 Act are to further the interests of citizens and consumers, where appropriate by promoting competition. In doing so, we are also required (among other things) to secure the optimal use of spectrum.

2.21 In carrying out our spectrum functions, we have a duty under section 3 of the WT Act to have regard in particular to: (i) the extent to which the spectrum is available for use or further use for wireless telegraphy, (ii) the demand for use of that spectrum for wireless telegraphy and (iii) the demand that is likely to arise in future for the use of that spectrum for wireless telegraphy. We also have a duty to have regard to the desirability of promoting: (i) the efficient management and use of the spectrum for wireless telegraphy, (ii) the economic and other benefits that may arise from the use of wireless telegraphy, (iii) the development of innovative services and (iv) competition in the provision of electronic communications services.

2.22 This document sets out the decisions we have taken in accordance with these statutory duties.

Structure of this document

2.23 In this Statement we outline the comments received and any issues raised in response to the Consultation questions. We first address responses in relation to our analysis in Section 3 and then address issues raised regarding our policy proposals in Section 4.

2.24 The rest of this document is structured as follows:

[6] The European Common Regulatory Framework for electronic communications (in particular, the Framework Directive and the Authorisation Directive) sets the broad legal framework for how spectrum use should be authorised and managed in the UK and aims to harmonise the regulation of electronic communications networks and services throughout the European Union.

- In Section 3 we set out our assessment alongside a summary of our consideration of consultation responses
- In Section 4 we set out our policy decisions alongside a summary of our consideration of consultation responses
- In Section 5 we set out our next steps.

Section 3

Our assessment and summary of responses

Overview of responses

3.1 We received 24 responses to the consultation. One response was fully confidential. The full text on non-confidential responses can be found on our website.[7] Annex 1 provides a list of respondents (non-confidential).

3.2 Responses to our Consultation were broadly supportive of both our analysis and policy proposals. Where stakeholders have disagreed, or expressed a different view we have summarised this and provided our response.

3.3 We note the response from The British Entertainment Radio Industry Group (BEIRG) responded in relation to PMSE, but, as stated in the Consultation, this review does not consider spectrum allocated to PMSE use (as recognised by BEIRG in its response).

Responses to our analysis

3.4 In the Consultation, we asked a number of questions to seek views on whether stakeholders agreed with our assessment of trends in future demand, continental interference and that spectrum being considered under the Public Sector Spectrum Release (PSSR) programme could help address the industry's future spectrum needs. The Consultation questions on our analysis were:

Question 1: Do you agree with our assessment of the trends in current and future demand in the band?

Question 2: Do you agree with our assessment that the risk of continental interference is limited to the east and south east of the UK during periods of atmospheric lifts?

Question 3: Do you agree with our assessment that these bands could enable the implementation of our UHF policy proposals? Are there any additional uses you think we should consider if this spectrum becomes available for use?

Trends in future demand

3.5 When formulating our policy proposals for how best to manage this spectrum, we first sought to identify the trends in current and future use. In identifying these trends, we collated information from stakeholders and industry more widely. This included gathering information directly from stakeholders via meetings and from responses to our Call for Input published in December 2014[8], and two online surveys to BR licence holders. The surveys were sent to approximately 20,000 licensees, and we received

[7] https://www.ofcom.org.uk/consultations-and-statements/category-1/strategic-review-of-uhf-band-1-and-band-2

[8] https://www.ofcom.org.uk/consultations-and-statements/category-1/420-470-mhz

2,285 responses. In addition, we noted the Radio Spectrum Policy Group (RSPG)[9] report on Strategic Sectoral Spectrum Needs.[10]

3.6 We also carried out a review of international developments to gain a better understanding of trends, developments and potential future uses of the 400 MHz range across Europe.

3.7 We noted the following trends:

- Moderate overall growth for services currently using the band, with voice remaining the dominant application for BR and some users seeing increasing use of data services;
- potential for increased use for IoT / M2M type applications from both new and current users;
- some interest in wideband services / private broadband communications networks for businesses; and
- Increasing risk of congestion.

3.8 None of the responses disagreed with our assessment that there is an increasing risk of congestion in urban hot-spots, or that there is currently congestion in London. Motorola agreed that year on year growth in BR demand is causing congestion. Our policy proposals and any additional spectrum released or made available for further sharing as part of the PSSR programme, will help to address this issue.

3.9 Respondents generally agreed with our assessment of moderate overall growth with regards to voice and data services.

3.10 Regarding use of the band by Utilities, SSE said we underestimated the growth in data usage required by the Utilities sector, and that we did not sufficiently consider its increasing demand for UHF spectrum. The Joint Radio Company Ltd (JRC) and Wilkinson Helsby partnership (WHP) stated that Utilities require an additional 2 x 3 MHz within the 380 MHz to 470 MHz Band for smart grids. These responses noted that increased low carbon electricity generation, for example from distributed wind and solar power generation, will need increased communications infrastructure for monitoring and control. Western Power Distribution also noted the increase in the number of embedded generation systems connected to the electricity distribution network which has led to an increase in the amount of data acquired for supervisory management and remote network control.

3.11 JRC noted in its response the immediate need to move to increased data rates for 9.6 kbit/s in a 12.5 kHz channel to 64 kbit/s in 25 kHz in some applications and, when considering alternative technologies, the possibility to have upload data rates of 154 kbit/s in a 50 kHz channel.

3.12 We highlight that under our current authorisation mechanism it is possible to assign and license channel bandwidths greater than 12.5 kHz (subject to spectrum

[9] The RSPG is a high-level advisory group that assists the European Commission in the development of radio spectrum policy.
[10] RSPG Report on Strategic Sectoral Spectrum Needs https://circabc.europa.eu/d/d/workspace/SpacesStore/f15d622c-183f-44d4-8412-19f2335a714d/RSPG13-540rev2_RSPG%20Report%20on%20Sectoral%20needs.pdf

availability), therefore it is possible to accommodate larger bandwidths already. As noted in the Consultation, access to additional spectrum for civil use as a result of PSSR and the rationalisation of Emergency Services spectrum, will enable us to more easily provide appropriate channels.

3.13 We acknowledge that the Utilities sector has an increasing communications requirement and that this is important to maintaining critical national infrastructure, and that the 400 MHz spectrum band has benefits for addressing some of the communication needs. However, as noted by JRC, different parts of the electricity generation and distribution network have varying requirements, for example once per day reporting (or on a change of state e.g. a switch) compared to obtaining real time values in millisecond periods over a wide area.

3.14 We therefore remain of the view that there are other options for meeting the increasing communications needs through a variety of fixed and wireless technologies, including a range of applications such as fixed links, commercial cellular networks (M2M applications) and Short Range Devices using existing harmonised spectrum.

3.15 We understand the importance of the Utilities sector to the UK and will continue to monitor developments and work with the industry to better understand their communications requirement and options for how this can be met.

3.16 We acknowledged in our consultation the potential for increased use in the bands for IoT/ M2M type applications. One respondent, Scottish Government Emergency Responder Telecommunications ('Scottish Government'), said that we had underestimated IoT use. BT stated that the growth in M2M will see increasing demand for data connections at 410 MHz to 470 MHz.

3.17 The Federation of Communication Services (FCS) said in its response that that M2M communications has been a part of BR operations for many years in the form of telemetry solutions, but did note there is some level of increased application for these types of systems. FCS highlighted that from the perspective of its membership, M2M is "very much business as usual".

3.18 Other comments did not directly address the potential increase in demand for IoT/M2M but tended to focus on spectrum availability in UHF Bands 1 and 2 to support IoT/M2M, for example, RACOM suggested that making simplex channels available with a bandwidth greater than 25 kHz would generate increased interest in the bands for IoT/M2M.

3.19 In our Statement, published in March 2016, on making more radio spectrum available for the IoT[11] (which also covers M2M) we said that our existing BR licence products can be used to support these services and applications, are simple to apply for, relatively inexpensive and suited to a wide range of uses including narrow band, low data rate IoT services and M2M applications. In addition, as noted above, subject to available spectrum, we can license wider bandwidths as required in order to accommodate IoT/M2M.

3.20 We are of the view that growth in M2M and IoT in UHF Band 1 and 2 forms part of the trend for increasing demand for low data rate applications (as noted in the Consultation) and that our current spectrum management already supports this use. As noted in our 2016 Statement on IoT, there is no requirement to change the BR

[11] https://www.ofcom.org.uk/__data/assets/pdf_file/0029/78563/vhf-iot-statement.pdf

licence conditions in order to support M2M and IoT use, and would update the licences and guidance material to make it clear that the BR licence is appropriate for these applications.

3.21 Regarding our analysis of the demand for wideband and broadband services, respondents largely agreed with our assessment that there is only limited interest in private wideband and broadband communications networks for businesses. Responses, from Nordisk Mobiltelefon International ('Nordisk') and AINMT advocated a national LTE network allocated to a national operator. Both respondents suggested that this national network could be used to support several end user solutions such as M2M, Push-to-Talk (PTT), telephony and internet services, and hence improve spectrum efficiency. AINMT, who deploy LTE 450 networks in a number of other countries, suggested that deploying a national network would bring many benefits to the UK, including providing ubiquitous geographic coverage.

3.22 AINMT highlighted in their response that standardisation of LTE 450 (Band 31) at 3GPP makes this possible and harmonisation of aspects of the band in Europe is currently being studied by CEPT. Our understanding of the work within CEPT is that the basis of the Decision is to allow for national choice in what technologies are implemented in UHF Band 2.

3.23 AINMT also references the National Infrastructure Report which states that "Government and Ofcom should develop a meaningful set of metrics that represent the coverage people actually receive and use these to determine a mobile Universal Service Obligation so that consumers can access essential services where they are needed."[12] AINMT takes the view that LTE 450 is critical to achieving this level of coverage. Ofcom is currently taking a number of steps to improve coverage in the UK. We plan to do this by ensuring existing coverage obligations are met and introducing targeted new obligations where appropriate, including when making the 700 MHz band available[13]. Other measures include the development of new rules to allow the use of licence exempt mobile repeaters to help consumers improve coverage in the home.

3.24 We reviewed support for using 450 MHz to 470 MHz for mobile data as part of our Mobile Data Strategy in 2014[14], and in the update published in June 2016.[15] In the statement we noted that there was relatively limited interest expressed by stakeholders in the prospect of using this band for LTE for public mobile networks, and deprioritised the band in our 2016 update. Also, the Aegis Report commissioned by Ofcom in 2014 confirmed that there is limited evidence of demand for public mobile services in the band (such as LTE 450) as a means to improve rural coverage.

3.25 Airwave and WHP both agreed that there is some interest in private wideband and broadband networks, but highlighted that spectrum availability in UHF Band 1 and 2 is insufficient to support national systems. However, WHP added that this cannot be interpreted as indicating no additional future requirement for services. Similarly, FCS acknowledged that higher speed data traffic is expected to grow but, due to the

[12] 'Connected Future' https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/577906/CONNECTED_FUTURE_ACCESSIBLE.pdf

[13] We have decided to make valuable spectrum between 694 and 790 MHz (the 700 MHz band) available for mobile data services

[14] https://www.ofcom.org.uk/__data/assets/pdf_file/0027/58347/Mobile-Data-Strategy-statement.pdf

[15] https://www.ofcom.org.uk/consultations-and-statements/category-1/mobile-data-strategy#

complexities in the band, a different frequency range would need to be identified to carry those communications.

3.26 Responses in relation to our assessment of spectrum demand for wideband and broadband services broadly support our view as set out in the Consultation that there is some interest for private wideband and broadband communications network for businesses, but the level of demand is uncertain.

3.27 Except for the responses from Nordisk and AINMT, no other response indicated a need for a national LTE network. As AINMT notes, the situation in the UK is different to other European countries with respect to the density of use of UHF Band 1 and 2 by the BR and other sectors, that have indicated they prefer privately owned networks for security and resilience. In addition, we do not consider there is sufficient evidence to justify the cost of re-planning and migrating incumbent users to alternative spectrum in order to accommodate a national LTE network.

3.28 However, we consider that our approach to spectrum management in this band going forward is flexible enough to accommodate localised, private networks if the need arises, whilst also ensuring the ongoing and future requirements of incumbent users. We will continue to monitor demand for wideband/broadband services.

3.29 One confidential response suggested there is likely to be a small but growing demand for spectrum for space services in the 449.75 MHz - 450.25 MHz frequency range. We fully support the use of this band for space science and do not consider that our proposals limit the use of this spectrum by the space sector.

Our conclusion on trends in future demand

3.30 Responses to our Consultation broadly agreed with our assessment of future demand for current and new applications, and we see no evidence to revise our position as set out in our Consultation. We consider M2M and IoT use as being part of increasing demand for low data rate applications and, as noted above, our licensing process already accommodates such applications, for example scanning telemetry. In our 2016 Statement on IoT we confirmed that spectrum used by BR could support IoT and M2M.

3.31 Several respondents commented that spectrum sharing of some data services and voice communications is not possible due to the duty cycle of transmissions of these data services. We consider this later in this Statement.

3.32 With regard to comments received relating to increasing communication needs for Utilities we see no evidence to revise our position as set out in our Consultation, i.e. that there are other options for communications, and that an exclusive designation of spectrum is not necessary. However, we are mindful of the changes taking place, particularly for electricity generation and distribution, and will work closely with stakeholders to better understand their requirements and how they might best be met.

3.33 In response to comments received on making spectrum available for a UK wide LTE network our conclusion is that no evidence to support such a requirement. In response to our Mobile Data Strategy consultation, the 2014 Call for Input on UHF Band 1 and 2[16] and the 2016 Consultation the majority view shows that there is limited interest in wideband Public Mobile Radio or Public Access Mobile Radio that

[16] https://www.ofcom.org.uk/__data/assets/pdf_file/0020/47414/420-470-mhz.pdf

would justify the cost and disruption to the incumbent users of the band. However, we will continue to monitor the situation and any significant market developments in this area, both in the UK and across Europe.

Continental interference

3.34 The effect of continental interference in UHF Band 2 has previously been highlighted as an issue for some stakeholders, especially those located in the east and south east of the UK.

3.35 In the UK, our duplex configuration of UHF Band 2 is opposite to that used in continental Europe i.e. our base stations receive in the high part of the band which corresponds to the base station transmit in continental Europe. As base stations are often sited on high ground or buildings this can increase the risk of interference. One of the key reasons we wanted to better understand the impact of continental interference on users of the band, was to inform our policy considerations on whether to reconfigure UHF Band 2 to align with the arrangement in Europe.

3.36 To gather evidence on continental interference, we deployed a series of monitoring stations along the east coast from Fife to Colchester, monitoring both UHF Band 1 and Band 2. Our spectrum monitoring assessment found that cases of increased signal levels are infrequent and occur when atmospheric conditions give rise to anomalous propagation effects such as 'ducting'. In the Consultation, we set out our view that such interference is generally only a concern to users on the eastern side of the UK during times of enhanced propagation due to atmospheric lifts, and users can take steps to mitigate the risk of continental interference.

3.37 Responses to the consultation generally agreed with this assessment that continental interference was limited to the east and south east during periods of atmospheric lifts.

3.38 The Telecommunications Association of the UK Water Industry (TAUWI) agreed with our assessment but noted that when interference does occur, it can cause significant disruption to their monitoring stations. JRC also commented that continental interference may not be a significant issue for conventional BR applications, e.g. push to talk voice communications, but for Utilities operating 24/7 communications failures may have an operational impact.

3.39 WHP Telecoms agreed with our analysis, but noted the risk that the scale of interference (both in frequency and extent) may be masked because users are not reporting instances to Ofcom. Our view is that this is unlikely given our ongoing engagement with stakeholders, and our own assessment of continental interference. Comptons stated that the whole of the UK could suffer under particularly "high" lift conditions, but did not note any specific incidents, and we are not aware of such instances.

3.40 JRC suggested that Ofcom should also consider the intermittent interference sources from Ireland to the west of the UK and Northern Ireland, and that it may be helpful for Utilities to operate in similar bands north and south of the border and to co-ordinate directly.

3.41 We have not received any reports of interference from Ireland, and have not seen any evidence that this is the case. The duplex arrangement is the same in the UK and Ireland for both UHF Band 1 and Band 2, therefore the risk of interference is not increased in the west of the UK in UHF Band 2 as it is in the east. Spectrum

assignments in the band are carried out in accordance with the coordination agreement with Ireland which we believe is sufficient to protect users' operations.

3.42 Airwave disagreed with our assessment of continental interference, and stated that there is potential for interference from future UHF Band 1 wideband systems in Ireland or Isle of Man affecting the Wales/Western Scotland and possibly Devon/Cornwall coastal areas.

3.43 In response to the comments from Airwave we do not think these are material. The Consultation addressed continental interference in UHF Band 2 as the risk of interference is greater due to the duplex arrangement being opposite to that in Europe. UHF Band 1 is not similarly affected and spectrum use is coordinated between the UK and Ireland as a matter of course. In addition, we are not aware that there is a demand for wideband systems in Ireland or the Isle of Man in UHF Band 1. It is also noted that Ofcom carries out spectrum licensing duties for the Isle of Man in UHF Band 1 and 2, so requests for wideband systems would be assessed through our technical licensing tools to ensure no interference would be caused to existing users in mainland UK.

3.44 In the Consultation, we also outlined that assignments in the band are coordinated in accordance with the Harmonised Calculation Method (HCM), which specifies the interference thresholds which must not be exceeded. These thresholds are calculated for 10% of time which is used to account for anomalous propagation effects. This means that a coordinated continental transmission may cause interference into a UK system for 36 days per year and still meet the HCM agreement.

3.45 Western Power Distribution said they do not consider the HCM coordination thresholds are sufficient to adequately protect their services. Western Power Distribution argued that the agreed HCM thresholds could impact on their regulatory commitments to OFGEM's quality of service guarantees. In addition, JRC suggested that coordination for broadband systems should be for 1% time, not 10% time. JRC suggested that this would reduce the interference issues to the east and south-east of England.

Our conclusion on continental interference

3.46 Respondents to the consultation broadly agreed with our assessment that continental interference is mainly confined to the south and east of the UK during certain periods of weather leading to atmospheric lifts. We note the comments that the impact of such interference is more significant for some users such as Utilities. As noted above, we expect to have further engagement with the Utility sector to discuss their future communication requirements.

3.47 The HCM Agreement gives a criterion for determining whether the propagation curves for 1% or 10% time should be applied for coordination for continuous and non-continuous carrier signals. CEPT Recommendation T/R 25-08[17] recommends, in certain circumstances, that the 1% time curves should be used for digital systems, for example to better protect analogue systems.

3.48 We note the comments received from stakeholders regarding the HCM. In response, we will review the coordination process to determine whether the current approach is

[17] Planning criteria and coordination of frequencies for land mobile systems in the range 29.7- 470 MHz

appropriate, recognising that coordination also applies to UK assignments affecting our continental neighbours.

Access to Public Sector Spectrum

3.49 The Public Sector Spectrum Release (PSSR) programme has identified parts of the UHF spectrum between 380 MHz to 430 MHz to investigate for the possibility of granting further civil access. The bands are:

- 406.2 MHz to 430 MHz[18]. This band is currently used by a range of civil and public sector stakeholders, including the Ministry of Defence, Emergency Services, PMSE, Business Radio and the Radio Astronomy Service.[19]

- 380 MHz to 385 MHz paired with 390 to 395 MHz (380 MHz/390 MHz bands). These bands are currently licensed to Airwave to provide communications for Emergency Services using Terrestrial Trunked Radio (TETRA) in England, Scotland and Wales.[20] Airwave's licence comes to an end in December 2020.

3.50 For the 406.2 MHz to 430 MHz band we noted in the Consultation the potential for increased sharing between civil and military users. For the 380 MHz to 385 MHz paired with 390 MHz to 395 MHz bands we stated that making the spectrum available for continued emergency services and public safety uses would ensure compatibility with the ongoing military requirement and have a positive impact on our ability to implement our UHF 1 and 2 policy proposals. We asked stakeholders for their views on this, and what applications could make use of this spectrum.

3.51 Respondents were generally supportive of our view that these bands could enable the implementation of our proposals, and agreed that access to the spectrum would be a benefit to the Business Radio sector.

3.52 Several responses outlined possible uses for these bands.

- The FCS noted the increasing use of polling data stations and suggested this spectrum could be reserved for this use, thereby making it easier to share 'voice only' channels in other parts of the UHF band. FCS also suggested that the civil/military sharing arrangement within UHF Band 1 should be reviewed in order to maximise the utility of the band.

- BT suggested that the spectrum could be used for new M2M communication technologies.

- Nordisk responded that but it would be more efficient to have larger blocks used by a national operator. AINMT agreed access to this spectrum would enable

[18] 406 to 406.1 MHz is limited to low power satellite emergency position-indicating beacons. Resolution 205 (Rev.WRC-15) protects these systems and requests administrations not to make new frequency assignments within the frequency bands 405.9 to 406.0 MHz and 406.1 to 406.2 MHz to mobile and fixed services.

[19] 406.1-410 MHz allocated to Radio Astronomy and subject to footnote 5.149 of the ITU Radio Regulations which "urge administrations to take all practicable steps to protect the radio astronomy service from harmful interference"

[20] TETRA or Terrestrial Trunked Radio – is a European (ETSI) standard that can support mission critical communications.

greater flexibility for 380 MHz to 470 MHz and this wider opportunity should be considered.

- From the Utilities, TAUWI noted that priority should be given to Critical National Infrastructure stakeholders, the JRC noted a requirement for 2x3 MHz for smart metering and suggested that 380 MHz/390 MHz frequency range would be a good candidate for these.

3.53 A number of respondents (Comptons, Airwave and Motorola) expressed the view that the 380 MHz/390 MHz band may still be required to support Emergency Services TETRA use beyond 2020 due to potential delays in the Emergency Services Network (ESN). As we set out in the Consultation, we are not assuming immediate access to this band for civil use, and timings of availability will form part of our ongoing discussion with the MOD and Emergency Services.

Our conclusion on Public Sector Spectrum Release

3.54 Respondents agreed with our view that access to spectrum made available through PSSR would enable us to implement our policy proposals. Some respondents suggested possible uses for the bands and we will feed these responses into our ongoing discussions with the MOD and other Government leads as part of the Public Sector Spectrum Release programme.

Section 4

Our policy decisions and a summary of our responses

Policy Decisions

4.1 In the Consultation we put forward a number of proposals that we consider will provide the spectrum management framework to meet the trends in demand that we identified.

4.2 In this section we address stakeholder responses to these policy proposals and set out our decisions. Responses were generally supportive of our proposals, and we have decided to:

- Add additional channels to Business Radio Simple UK and Business Radio Simple Site licences to recognise the demand for these licence products;
- Make changes to the Business Radio Technical Frequency Assignment Criteria. This includes increasing the sharing factor[21] from two to four (with an initial increase to a sharing factor of three) for Technically Assigned licences, and increasing the planning thresholds with respect to the noise floor for the bands 55.75 MHz to 68.0 MHz (VHF Band 1) and 68 MHz to 87.5 MHz (VHF Low Band); and
- Channel plan reconfiguration to a rationalised set of more common duplex spacings to defragment the bands to release additional spectrum capacity for use.

4.3 Some policies, i.e. increased sharing for Technically Assigned licences and changes to planning thresholds, also relate to other spectrum bands used by BR.

4.4 In the Consultation, we also considered the question of band alignment and set out the rationale for why we did not consider that it was justified.

Band Alignment

4.5 The duplex arrangement for the band in the UK is opposite to that in continental Europe i.e. in the UK base stations transmit on the low spectrum side of the channel and mobiles transmit on the high spectrum side, whereas on the continent the opposite is the case with base stations transmitting high and mobiles transmitting low. This difference in duplex arrangement leads to an increased risk of continental interference, particularly into base station receivers, particularly to users in the south and east of the UK.

4.6 Since 2002 there have been several initiatives exploring whether we should reconfigure UHF Band 2 to align with the arrangement in Europe. We summarised these in the 2016 Consultation.

[21] The sharing factor relates to the number of users sharing a channel within the same geographical area

4.7 In our Consultation we set out our view that aligning UHF Band 2 with continental Europe was not required. We asked respondents if they agreed with our conclusion.

Question 4: Do you agree with our conclusion that aligning UHF Band 2 with continental Europe is not required?

4.8 The majority of respondents to this question agreed with our proposal not to align UHF 2, including one individual response, one confidential response, the Scottish Government, Nominet, The JRC, BT, Motorola, TAUWI and FCS.

4.9 A number of respondents disagreed with our proposal, and said that they consider band alignment is necessary. AINMT suggested that by not aligning the UK would find it difficult to deploy new LTE technologies in the band. However, as noted above, we have concluded that there is only limited interest for broadband services in this band and therefore do not see this as a justifiable benefit when set against the disruption and cost to users of the band.

4.10 Western Power Distribution said it believes band alignment is required, citing its experience of interference from the Continent at its southern and eastern sites, but noted that costs are a concern. WHP Telecoms also said that alignment is essential, but acknowledged that it is unlikely to be achievable due to the complexities and risk of doing so. Comptons also disagreed with our proposal, but did state that alignment would not solve all the issues.

Our decision on alignment of UHF 2

4.11 The majority of responses to our Consultation agreed with our proposal that alignment of UHF Band 2 is not required. Of those that disagreed it was recognised that the costs and disruption to users in the band would make alignment challenging and did not provide any evidence that the benefits of alignment would outweigh these costs. As noted in the consultation users can take steps to mitigate the risk of continental interference to minimise incoming interference. Users could also consider using different technologies and frequency bands for their communication needs.

4.12 The main purpose of alignment (as noted in the Consultation) was to mitigate the risk of continental interference, which, as agreed by stakeholders in their response to our assessment of continental interference, is mainly a concern for some users in the south and east of the UK.

4.13 After consideration of the responses we have decided to maintain the existing band plan for UHF 2, and not seek to align it with continental Europe. We will not consider this issue again unless there is a significant and material change to the spectrum environment which would necessitate regulatory intervention. Our horizon scan of the band does not indicate any changes which would require such an intervention.

Add additional channels to Simple UK and Simple Site licences

4.14 In the Consultation, we proposed to add up to 10 × 12.5 kHz channels to the Simple UK and Simple Site licences from the UK only licence exempt 458.5 MHz to 459.5 MHz band, and to create up to six duplex channels in the Simple Site licence by pairing six of these new channels with spectrum released by the Emergency Services in UHF Band 2.

4.15 We asked respondents whether they agreed with adding additional channels from the 458.5 MHz to 459.5 MHz to the Simple UK and Simple Site licences, and whether they agreed with our assessment that risk of interference is low.

Question 5: Do you agree with our proposal to add additional channels to the Simple UK and Simple Site licence products from spectrum within the 458.5 to 459.5 MHz band?

Question 6: Do you agree with our assessment that the risk of interference between Simple UK and Simple Site use and licence exempt short range devices in the 458.5 to 459.5 MHz band is low, and that any interference can be mitigated by users changing channels?

4.16 The majority of respondents either had no comment or agreed with our proposal to add additional channels to Simple UK and Simple Site licences, including: two individual responses, one confidential response, Comptons, Maxxwave, Scottish Government, BT, Motorola, the FCS and JRC.

4.17 Only one response, from TAUWI, directly opposed this proposal. They outlined that the water industry makes significant use of telemetry and tele-control equipment operating in the 458.5 MHz to 458.95 MHz licence exempt band with more than 3500 links in operation. Members of TAUWI responded that the current band is already congested and allowing additional use for Simple UK and Simple Site licences would make this congestion worse.

4.18 TAUWI also disagreed with our proposal that interference could be mitigated by users changing channels. They note that telemetry and tele-command equipment is, in many instances, installed in remote, rural areas which would require staff to travel out to site, confirm the reason for the system failure is due to interference and manually change the operating channel of the equipment. TAUWI suggests that a more robust approach is required by Ofcom, for example allocating additional licensed channels to the Utilities sector.

4.19 In response to the question on adding additional channels to the Simple UK and Simple Site licences, WHP stated that additional spectrum should be limited to more spectrally efficient systems, for example digital systems providing opportunity for lower channel bandwidths. Our view is that proposing a maximum bandwidth of 12.5 kHz balances spectrum efficiency with our policy of being technology neutral.

Our decision on adding additional channels to the Simple UK and Simple Site licences

4.20 After consideration of responses, we have decided to implement our proposal and add additional channels to the Simple UK and Simple Site licences.

4.21 In the Consultation, we acknowledged that there is a risk of interference between Simple Site and UK users and short range, licence exempt devices, but we considered this risk to be low as the use profiles of these user groups is likely to be different.

4.22 TAUWI disagreed with our assessment and suggested that the risk of interference is greater than we suggested. However, we disagree with TAUWI's view for the following reasons:

- TAUWI notes in their response that telemetry and tele-command equipment is, in many instances, installed in remote, rural areas. Our view is that use of channels in the 458.5 MHz to 459.5 MHz band by Simple UK and Simple Site licensees will likely be in areas away from these remote locations i.e. the use profile will be different between these user groups;

- If the spectrum is congested due to current use, new Simple licence users will find it difficult to find a usable channel in this band and will therefore likely tune to a different channel; and

- We are only considering sharing a proportion of channels in the licence exempt band which will leave a significant portion of the band solely for use by telemetry and telecommand.

4.23 In addition to the above we also note that there are alternative spectrum options for telemetry and telecommand systems. As previously stated, there is no restriction on type of use or technology within the standard BR licensing regime, therefore M2M (or telemetry and telecommand) can be licensed in spectrum allocated to Land Mobile use and, given that many locations are in remote and rural areas, spectrum availability should not be constrained. In addition, other alternatives could be considered, for example, it could be possible to operate within the 470 MHz to 790 MHz band[22] under the TV White Space framework where operational parameters are provided by a dynamic spectrum access database.[23]

4.24 In our Consultation, we proposed that we would add up to 20 × 12.5 kHz channels (across both Simple Site and Simple UK) using spectrum within the range 458.5 MHz to 458.95 MHz and/or interleave 12.5 kHz channels between the 25 kHz channels in the upper part of the band, i.e. 459.1 MHz to 459.5 MHz for the Simple Site licence only. We would also provide up to six channels from spectrum released by the Emergency Services to be used as base station frequencies to provide UHF duplex pairs for the Simple Site licence.

4.25 We noted in the Consultation that allowing up to twenty channels of the 458.5 to 458.95 MHz band to be shared with the Simple Site and Simple UK licences is only a proportion of the spectrum available for licence exempt short range devices. In response to TAUWI's comments on the extensive use of the band by the water industry we have considered the number of channels to make available. In order to reduce the impact to the water industry we have decided to limit the number of shared 12.5 kHz channels in the 458.5 MHz to 458.95 MHz band to 10, with six being included on the Simple Site licence and four on the Simple UK licence. In addition we have decided to include 6 × 12.5 kHz channels from spectrum released by the Emergency Services to be used as base station frequencies in the Simple Site licence.

4.26 The channels and technical parameters are summarised in Table 2 for the Simple Site licence and Table 3 for the Simple UK licence.

[22] Until May 2020 when the band 694 to 790 MHz is cleared for new mobile data services
[23] See "TV white space: manually configurable white space devices" at https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences#

Table 2 - Technical parameters for Simple Site licences

Frequency (MHz)	Maximum bandwidth (kHz)	Mobile ERP (Watts)	Base station ERP (Watts)	Base station antenna height (m)
451.5125	12.5	n/a (base station only)	2	15
451.525				
451.5375				
451.55				
451.5625				
451.775				
458.5125	12.5	2	n/a (mobile use only)	n/a
458.525				
458.5375				
458.55				
458.5625				
458.775				

Table 3 - Technical parameters for Simple UK licences

Frequency (MHz)	Maximum bandwidth (kHz)	Mobile ERP (Watts)
458.7875	12.5	2
458.8		
458.8125		
458.825		

Changes to the Technical Frequency Assignment Criteria (TFAC)

4.27 The TFAC document details the technical and propagation modelling criteria and the process we take when assigning a frequency for the Business Radio Technically Assigned and Business Radio Area Defined licence products.

4.28 In the Consultation, we proposed a number of changes to the BR assignment process. These were:

- To increase the sharing criterion from two to four (with an initial increase to a sharing factor of three) for Technically Assigned licences; and

- Increase the frequency planning thresholds with respect to the noise floor for VHF Band 1 and VHF Low Band.

4.29 We consider these changes will both improve the way assignments are made and help to address the increases in demand that has resulted in congestion and rejected licence applications. We asked respondents:

Question 7: Do you agree with the proposal to initially increase the sharing criterion from two to three, and, subject to further analysis, move to four in the longer term?

Question 8: Do you agree with our proposal to change the planning levels we use in our modelling by reducing both the RSL and unwanted levels by 12 dB for VHF Band 1 and VHF Low band?

Increase sharing

4.30 We implemented the current frequency assignment model for the BR technically assigned licence product in 2008. This assignment model works by offering an exclusive or shared channel to the user, subject to the requirement and spectrum availability in the chosen geographical area. The sharing criterion is currently defined on the basis of allowing two equivalent PMR co-channel, co-located systems (assuming they have equal technical parameters and radio coverage).

4.31 In the Consultation, we proposed to increase the sharing criterion from two to three, and, subject to further analysis, move to four in the longer term. The expected benefits of increasing the sharing level to three would yield (in a best case scenario) a 50% increase in spectrum capacity.

4.32 There was broad agreement from respondents to the proposal, including from Comptons, Motorola, Maxxwave, the Scottish Government, Nominet and the FCS, who said that they consider this to be an important policy change.

4.33 No respondents disagreed with this proposal, but some highlighted that it can be difficult for voice and data applications to share, as some data applications are 'always on' and dominate use of the channel. Western Power Distribution and FCS suggested that separate voice and data channels should be considered, allowing higher sharing factors between voice users, with data users having exclusive channels.

4.34 Motorola expressed a general concern about further increasing the sharing factor, and said we should review our results on the initial move to three, before further increasing the sharing factor. We will carry out some additional work to assess the potential impact on users and to consider how this could be mitigated. Nominet responded that we should set out a more definite timetable for reviewing whether it is possible to advance the sharing criterion from three to four.

Our decision on increasing the sharing factor

4.35 We have decided to increase the sharing factor from two to four with an initial increase to three. We recognise there could be possible incompatibilities between sharing voice and some types of data communications on a single channel, as noted in some of the responses received. We will monitor the situation following

implementation of the initial increase to three and include this in our analysis and preparations for the introduction to increasing the sharing to four. As set out in the Consultation, we are planning to undertake some further analysis to gain a better understanding of how existing users are utilising the channels and the typical transmit patterns in the time domain. We plan to do this with a view to establishing categories of use, this is likely to be achieved by defining whether the channel is being used for voice, 'voice-like' data or data.

4.36 In addition, we are also considering changes to our application and assignment process to capture and record data use. We do not think that it would be an efficient use of spectrum to reserve channels for voice or data as suggested by some respondents, however, it may be possible to amend the licence application process so that data users are issued an exclusive assignment (assuming an available channel) and will be restricted on sharing a channel with another local user. This may require a change to the licence in order to regulate different types of use. We would consult on any proposals we develop.

Increase in planning thresholds with respect to the noise floor for VHF Band 1 and VHF Low Band

4.37 Radio noise from different sources introduce a certain unwanted background RF level at the input stage of any receiver which the wanted signal has to overcome for successful reception i.e. the wanted signal needs to be higher than the noise level in order to ensure reception. This is known as the signal to noise ratio. The noise floor varies across different frequency bands and is greater at lower frequencies.

4.38 In our current planning criteria, we assume a wanted radio service can be received using a typical Receiver Sensitivity Level (RSL) of –104 dBm / 12.5 kHz, and then apply a signal to interference plus noise ratio (SINR) of 12 dB. This means that unwanted signals are modelled at –116 dBm / 12.5 kHz.

4.39 In the Consultation, we proposed increasing the frequency planning thresholds in VHF Band 1 (55.75 to 68 MHz) and VHF Low band (68 to 87.5 MHz) by 12 dB. This results in an increase in wanted signal level to -92 dBm/12.5 kHz, and the unwanted signals to -104 dBm/12.5 kHz.

4.40 The majority of respondents either agreed with our proposal or had no comment. One response suggested that the higher noise floor in the VHF band is a result of electromagnetic compatibility (EMC) regulations not being adhered to or enforced. The response added that the underlying cause of noise should be addressed rather than increase the planning thresholds.

4.41 Maxxwave strongly agreed with the proposal, and called the existing thresholds "*completely unworkable*" requiring a user to protect a theoretical noise floor that doesn't exist. JRC, TAUWI, FCS, RACOM, Motorola, Scottish Government and two confidential responses also agreed with the proposal. Motorola also suggested that we review the thresholds for VHF Mid and High Band, but no stakeholder indicated an issue with the noise floor for these bands.

4.42 The MOD said that it understood the rationale behind the proposed changed, but has concerns around the potential noise increases in other bands, including those used by the MOD, as a result of the changes. It requested that Ofcom regularly review these changes to ensure that other users of VHF spectrum are not hindered in their use. We do not think that there is a significant risk to other users of the band but will monitor the results of the change in response to MOD's comments.

Our decision on increasing the planning thresholds with respect to the noise floor for VHF Band 1 and VHF Low Band

4.43 We have decided to implement our proposal to increase the planning levels we use in our modelling by increasing both the RSL and unwanted levels by 12 dB for VHF Band 1 and VHF Low band to a Receiver Sensitivity Level of -92 dBm / 12.5 kHz and an unwanted level of –104 dBm / 12.5 kHz.

4.44 We do not agree with the suggestion that the higher noise floor in VHF Band 1 and VHF Low Band is due to EMC regulations not being observed or enforced. It is widely understood that the noise floor is greater in lower frequency bands, for example as described in the International Telecommunication Recommendation P.372 which provides information on the background levels of radio-frequency noise in the frequency range from 0.1 Hz to 100 GHz. Our view, therefore, is that it is reasonable to adjust the planning thresholds to reflect this difference in noise level in VHF Band 1 and VHF Low Band.

Channel Plan reconfiguration to more common duplex spacings

4.45 The Business Radio channel plans in UHF Band 1 and UHF Band 2 have evolved over many years resulting in a large number of different duplex spacings. As mentioned previously, we have made the decision not to reconfigure the band to align fully with CEPT TR-25/0826 (10 MHz duplex spacing). However, we think a number of benefits could be gained from more uniform duplex spacings.

4.46 There are currently 17 different duplex splits in UHF 1 and 2, the majority of which exist for legacy reasons and are no longer in operational use. We think this can be reduced to 5 common duplex splits (currently 90% of assignments use these splits). Internally this will reduce the administrative burden of managing the spectrum, and externally will allow equipment manufacturers and users to standardise on more common duplex splits, reducing the need to customise equipment. We asked respondents the following question

Question 9: Do you agree with our assessment that moving towards more common duplex spacings will increase spectrum efficiency?

4.47 The majority of respondents either agreed with our assessment or had no comment.

4.48 Motorola expressed concern that licensees may be burdened with additional costs. JRC suggested that migration costs could be minimised by incorporating changes into regular maintenance cycles over an extended period of time thereby reducing time spent on site.

4.49 WHP agreed that moving to more common duplex spacings would improve spectrum efficiency, but suggested that implementing the changes would be difficult given the current level of use of the band. In addition they raised concerns regarding the potential for increased interference and disruption, especially to mission critical systems.

4.50 AINMT suggested that moving to more common duplex spacings should be combined with aligning UHF Band 2 with continental Europe. We have addressed alignment in Section 3 and do not consider it further here.

4.51 Nordisk agreed with our assessment, but said it may be even more feasible to introduce and encourage TDD types of applications in regions and parts of the

spectrum where this is feasible. We assume this relates to wideband/broadband use which we have discussed in Section 3 and concluded that there is little demand for wideband/broadband use in this band.

Our decision on moving to more common duplex spacings

4.52 We have decided to move to fewer, more common duplex spacings in our channel plans for both UHF Band 1 and Band 2. Table 4 summarises the changes we plan to make.

Table 4 – Revised duplex spacings

Band	Frequency Band	Single Frequency Channels Available	Dual Frequency Channels Available	Dual Frequency splits to be retained	Dual Frequency splits to be removed
UHF1	425.00625 – 449.49375 MHz	Yes	Yes	14.5 MHz 20.5 MHz	5.3875 MHz 17.0 MHz 17.15 MHz 17.41875 MHz 17.64375 MHz 17.65625 MHz 17.70625 MHz 17.71875 MHz 17.74375 MHz 17.78125 MHz
UHF2	453.00625 – 466.0625 MHz	Yes	Yes	5.5 MHz 6.5 MHz 7.0 MHz	5.3 MHz 5.65 MHz

4.53 Our intention is to make these changes over a longer period of time to allow for users' equipment replacement cycles and to utilise any additional spectrum from PSSR releases or increased sharing opportunities. We will aim to minimise the disruption and cost to stakeholders by working with them on a case by case basis, as far as possible, to align changes to their channelling arrangements with normal equipment replacement cycles.

Longer Term changes to the way we manage spectrum

4.54 As part of the Strategic Review, we also identified three areas in which we plan to undertake further work in order to understand how our management of the spectrum can generate greater efficiencies.

Improvements to the modelling of on-site/campus type systems

4.55 On-site/campus type systems (which include systems with mobiles operating up to 5 km from the base station) make up around 59% of the current technically assigned licences. Demand for these systems has been increasing in recent years. However, our current assignment process is not optimised for these short-range applications which leads to a reduction in spectrum efficiency.

4.56 We will undertake research to assess whether the current propagation model (ITU-R Recommendation P.1546) is still the most efficient in predicting the radio coverage for assignments that have a service area of less than 1km, or whether an alternative

propagation model would produce a more accurate prediction therefore allowing a greater number of assignments within a geographical area. As part of the assessment Ofcom will consider whether to tailor our approach and use a particular propagation model for a particular band or to continue with a unified approach across all bands.

Efficiency of digital PMR

4.57 In its report on Strategic Sectoral Spectrum Needs the RSPG noted that current spectrum efficiency for analogue PMR is one channel in 25 kHz or 12.5 kHz, while new digital technologies provide a two-fold to four-fold increase to 6.25 kHz equivalent spectrum efficiency such as the technologies standardised in ETSI, e.g. TETRA, Digital Mobile Radio (DMR) and dPMR.

4.58 Through engagement with stakeholders and the results of our questionnaires we can see that analogue technology is still important to many users, but digital use is growing. As the market increasingly transitions to digital technologies we will look at how this could promote efficient spectrum use but have no proposals at this time. We will continue to monitor the sector and gather information from manufacturers and users to see if, in future, the requirement for analogue systems naturally declines leading to an opportunity to benefit from the efficiency of digital PMR.

Incorporating use of monitoring data into assignment process

4.59 Making frequency assignments using modelling of a shared environment has limitations, for example, the model cannot know the utilisation of a particular assignment. In these cases, it would be beneficial to incorporate real world feedback into the assignment process.

4.60 We consider that there is merit in investigating whether spectrum occupancy data received from the monitoring stations we have located throughout the UK could be used to improve our assignment process. Identifying unused capacity could help us to increase spectrum efficiency. In its response, Nominet said that it encouraged us to integrate real word feedback into the application process. We plan to undertake some further work to investigate how we could capture and analyse the data and incorporate this into the assignment process

Improving stakeholder guidance around sharing

4.61 We acknowledged in the Consultation, that our proposal to increase the sharing factor (which in this Statement we have confirmed) is complex, and that we could help stakeholders understand this by improving our guidance and information.

4.62 We set out three proposed activities for improving stakeholder guidance, and asked respondents whether they agreed.

Question 10: Do you agree with our proposed activities for improving stakeholder guidance? Are there further steps you think Ofcom could take to ensure stakeholders and licensees can make an informed decision when considering their licensing needs

Table 5: Table showing proposed activities for improving stakeholder guidance

Proposed activity	Next steps

Improving definition of sharing in context of the assignment model.	Develop clearer and simpler guidance in both the application forms and the TFAC to help manage the expectations of licensees. This may involve changing the current terminology used in the application forms to better reflect phrases more commonly used by licensees.
Improve processes to address complaints of interference in relation to sharing.	Provide licensees and our Spectrum Assurance teams with clearer guidance on how to manage complaints of interference in relation to sharing, including a checklist for licensees who believe they are experiencing intolerable levels of interference. Identify the most appropriate regulatory tool to ensure that all licensees who are using systems on shared channels are operating fairly in conjunction with other users, and that mitigations are available when users are not operating fairly.
Providing more information on congestion through use of measuring application rejections by geographical area.	Investigate whether it is feasible to expand the way application rejections are recorded to produce a heat map showing where the areas of the UK that are most likely to result in Technically Assigned application rejections and provide more detailed guidance to applicants to optimise the opportunity for gaining access to spectrum in that area. This will also be supported and facilitated by the implementation of the other policy options identified in this review.

4.63 All respondents either agreed with our proposal or had no comment. Some respondents provided suggestions for consideration.

4.64 The FCS noted that many of the problems relating to the use of data mixed with voice communications on the same channel could be avoided if the guidance was more clear, and suggested that improving guidance on this is important in light of increasing the sharing factor for Technically Assigned licences.

Our decision on improved stakeholder guidance

4.65 We will take forward our proposal to update and improve the information and guidance we provide. We thank stakeholders for their suggestions and will look to incorporate these as best we can. As discussed previously, we are also assessing whether it is possible to amend the licence application process so that data users are issued an exclusive assignment (assuming an available channel) and would restricted on sharing.

Other policy proposals

4.66 As part of the Consultation, we also asked stakeholders if they considered there were any other policy options which they felt would make use of UHF 1 and 2 more efficient.

4.67 Airwave and RACOM both responded that Ofcom should make wider channels available in UHF 1 and 2 in order to deliver higher data through puts that cannot be served by 12.5 kHz or 25 kHz channels.

4.68 In response we would like to remind stakeholders that there is no restriction in terms of bandwidth we can license (assuming available spectrum). Licence fees are dependent on bandwidth, with the smallest unit being 6.25 kHz. Wider bandwidths are calculated based on multiples of 6.25 kHz which correspondingly increases the licence fee. Theoretically there is no limit to the size of bandwidth that can be licensed. We therefore consider that licensees are already able to access wider channel sizes where required, subject to spectrum availability.

4.69 In response to the suggestion to mandate the use of 6.25 kHz channels, our policy is to be, as far as possible, technology and application neutral. It is also noted that while some BR sectors could utilise 6.25 kHz efficiency technologies, other services, as suggested by Airwave, RACOM and the utility companies, require larger bandwidths. Currently, therefore, we do not consider mandating or limiting spectrum use to 6.25 kHz or 6.25 kHz equivalent technologies.

4.70 One individual suggested that future policy decisions should include data from more comprehensive measurement and real-world monitoring results. In addition, further guidance on the use of PMR446 was requested.

4.71 As noted previously we will carry out further analysis, including spectrum monitoring, before moving to a sharing factor of four. We are also exploring how we can incorporate spectrum occupancy data received from the monitoring stations we have located throughout the UK to improve our assignment process. In relation to further guidance on PMR446, we will review and update all our guidance information we provide on Business Radio. However, we would like to remind stakeholders that they can contact Ofcom at any time for information on licensing and our spectrum management approach.

4.72 JRC suggested mandating down-fire antennas for on-site systems within dense urban areas. Maxxwave suggested limiting the maximum ERP for mobile use to 4 Watts to limit the use of the UHF bands for wide area services which they consider prevents greater use of a channel by more, short-range users.

4.73 Our assignment algorithm already includes different antenna types and distribution methods within the modelling parameters. As noted in the Consultation we are looking at options to improve the accuracy of our assignment process, particularly for on-site/campus type systems by including a simplified coordination/modelling method applied to short ranges, or a change in propagation model to one which includes algorithms specifically adapted to short range propagation. Mandating the use of any particular technology, including antenna type, is contrary to our policy on technology neutrality.

4.74 In response to the comment from Maxxwave regarding limiting the ERP of mobile use to 4 Watts, we note that the licence fee reflects the coverage of use of a channel, i.e. larger coverage attracts a greater licence fee. We feel, therefore, that users who have a demand for wide are coverage will value this accordingly.

4.75 Other responses to this question reiterated previous comments by stakeholders, for example spectrum requirements for Utilities, and these have been addressed elsewhere in the Statement.

Section 5

Next Steps

5.1 Having made our decisions as set out in this Statement we have identified a number of actions that we need to take. As previously outlined some of these will be over an extended period, for example working to reduce the number of different duplex arrangements in UHF Band 1 and Band 2, whereas others we expect to implement in a shorter timescale.

Add channels to the Simple Site and Simple UK licences

5.2 We have identified the channels to be added to the Simple Site and Simple UK licences. This change will require a variation of the licences for all licensees which will be carried out in accordance with Section 169 of the Communications Act 2003. This will require us to notify all licensees (of these licence types) of the variation and allow time for licensees to make representation about the proposal.

5.3 We will update the licence schedule to include the additional channels and this will be available to download via the online licensing portal once the notification period has ended. We will advise licensees of the relevant date in the notice of variation.

Changes to our assignment process

5.4 We will update MASTS (mobile assignment technical system) to increase the sharing factor for shared Technically Assigned licences to three. We will also update the assignment tool with the revised spectrum planning thresholds in VHF Band 1 and VHF Low Band. We expect to make these changes by the end of this financial year.

5.5 Area Defined licences contain a reference to the power spectral density limit at the geographic boundary of the service area of -116 dBm/12.5 kHz. As this threshold will be increased to -104 dBm/12.5 kHz we will need to vary VHF Band 1 and VHF Low Band Area Defined licences to reflect the change. As for the Simple Site and Simple UK variation this will be carried out in accordance with Section 169 of the Communications Act 2003.

5.6 In response to stakeholders' comments relating to the potential difficulty of data and voice services sharing the same channel we will explore how we can more efficiently monitor and manage these different uses. As noted in Section 4, one option may be to change our application process to inform whether the use is for data or voice so that sharing is avoided between these services.

5.7 As part of updating the assignment process we will look to reduce the number of active channel plans, i.e. reduce the number of duplex spacings. As outlined previously, we will do this over an extended period of time and work with stakeholders in order to minimise disruption.

5.8 In addition to the above we will also examine the benefit of updating the propagation model within the assignment planning tool, particularly around modelling short range on-site/campus systems.

Update to guidance information

5.9 We will review the current information available to stakeholders relating to Business Radio and update to reflect the changes we are making. In particular, we will provide further information on sharing and explore options to provide more detail on areas of congestion.

5.10 In addition to the above we will also update our guidance information to clarify that the Business Radio can support M2M and IoT services.

Stakeholder engagement

5.11 As noted previously we acknowledge the comments received from the Utilities sector in relation to the growing requirement for communications. In order to better understand the drivers and the options to meet these communication requirements we will engage directly with relevant stakeholders, including Government and the energy regulators.

5.12 We will continue to engage with MOD and the PSSR project team to share our consultation findings, and agree next steps on investigations into increased sharing and access to the 406.2 MHz to 430 MHz as well as the 380 MHz to 385 MHz paired with 390 MHz to 395 MHz bands.

Annex 1

Consultation responses

A1.1 A total of 24 responses were received to this consultation, of which 1 was completely confidential.

A1.2 Organisations that submitted non-confidential responses are listed below:

- AINMT
- Airwave
- British Entertainment Industry Radio Group
- BT
- Comptons
- Federation of Communication Services
- Joint Radio Company
- Maxxwave
- Ministry of Defence
- Motorola
- Nominet
- Nordisk Mobiltelefon International AB, (Sweden)
- Racom
- Scottish Government Emergency Responder Telecommunications
- Scottish and Southern Electricity Networks (SSE)
- TAUWI
- Western Power Distribution
- Wilkinson Helsby Partnership