



# More Radio Spectrum for the Internet of Things

Consultation

Publication date: 10 September 2015

Closing Date for Responses: 12 November 2015

# About this document

## **Spectrum for the Internet of Things**

There appears to be demand for Machine-to-Machine (M2M) applications, especially in rural areas and hard to reach locations, that require connectivity over longer distances.

This document aims to encourage investment and innovation in the Internet of Things (IoT) using 10.1 MHz of spectrum within the 55-68 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz bands by using our existing licence products.

At the same time, we seek views on whether any changes to our existing licence products are necessary to promote innovative uses in these bands, especially for serving rural and remote locations.

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## Section 1

# Executive Summary

- 1.1 Use of VHF spectrum by the Internet of Things (IoT) community could deliver valuable new services for the benefit UK consumers and businesses.
- 1.2 We want to encourage IoT investment and innovation in particular at 55-68 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz. These frequencies could be used by Machine-to-Machine (M2M) applications to enable wireless operation over long distances. This will allow them to connect locations that can be hard to reach using the higher frequency bands already opened for the IoT.
- 1.3 IoT access to these VHF bands is already available through existing Ofcom licence products. However, we believe a popular misconception that our Business Radio (BR) licence products are for voice-only applications, not IoT, could be hindering investment and development.
- 1.4 We are seeking to address this misconception and create the right environment for innovation by identifying possible uses of these particular VHF bands. We believe they could be especially valuable for the following:
  - wirelessly connected ‘smart’ farming
  - coastal/maritime applications: fishing, fish farming, environmental sensing, shipping, boating
  - land/agriculture applications: agricultural equipment, crop management, livestock management; and
  - new energy sources.
- 1.5 We believe our existing BR licence products are well suited to IoT uses such as these because they are flexible, relatively in-expensive, simple to apply for, and may be used for data transmission. However, we seek stakeholder’s views on whether or not new licensing arrangements would be beneficial.
- 1.6 In summary, we are conducting our consultation in order to:
  - gain information from potential IoT users on the suitability of these bands and likely developments for remote and rural applications.
  - confirm our assessment that wider exploitation of the band by IoT can be accommodated without impacting on existing users of the band.
  - confirm whether our BR licence products are suited to the IoT or whether we should consider changing them. Here we seek views on both the current technical conditions placed on our BR licence products and wider questions on the most appropriate authorisation approach.

## Next steps

- 1.7 We invite comments on our proposals by 12<sup>th</sup> November 2015. We plan to publish a statement before the end of the year and to introduce any new arrangements shortly after.
- 1.8 If stakeholders think our licences need to change significantly, a further consultation may be needed before we publish a statement on how the bands can be used for new IoT services.

## Section 2

# Introduction and background

## Opportunity for greater use of VHF spectrum

- 2.1 There are already more than 40 million devices connected via the IoT in the UK alone. This is forecast to grow more than eight-fold by 2022, with hundreds of millions of devices carrying out more than a billion daily data transactions. Access to radio spectrum makes wireless connection of these devices possible.
- 2.2 We believe there are already valuable opportunities available for IoT to use VHF spectrum bands. However, we believe a popular misconception that our BR licence products are for voice-only applications, not IoT, could be hindering investment and development.
- 2.3 We are keen to address this misconception because we believe our BR licence products are appropriate for a wide range of IoT uses. This is because BR licences are flexible, simple to apply for, relatively in-expensive and can be used for data transmission.
- 2.4 Whilst the BR licence name might suggest their use is limited, this is not the case. Our BR licence products for the VHF range were liberalised in 2008 to make them more flexible. They now support a wide range of data services and uses.
- 2.5 Greater access to spectrum within the VHF range could open new opportunities for investment and innovation in the IoT sector for Machine-to-Machine (M2M) applications. We think this could bring significant benefits to citizens and consumers, especially those in remote and rural parts of the UK, through development of:
  - wirelessly connected ‘smart’ farming
  - coastal/maritime applications: fishing, fish farming, environmental sensing, shipping, boating
  - land/agriculture applications: agricultural equipment, crop management, livestock management and
  - new energy sources.
- 2.6 In addition to the above, spectrum within the VHF range could provide a means to deliver aspects of safety-related communications in rural areas.

## Related recent consultations

- 2.7 We have already made other spectrum bands available for the IoT. In 2014, we released the 870-876 MHz and 915-921 MHz bands for licence exempt devices. This was implemented through the Wireless Telegraphy (Exemption and

Amendment) (Amendment) Regulations 2014<sup>1</sup> that came into force on 27th June 2014 in accordance with the decision in our Statement published on 2 April 2014. This frequency spectrum is suitable for relatively short range M2M applications.

- 2.8 In January this year, we set out the steps we are taking to ensure the UK plays a leading role in developing the IoT<sup>2</sup>. This includes monitoring the demand for spectrum - the raw material that underpins wireless services - and identifying when (and what) additional spectrum is needed.

## Document structure

- 2.9 The remainder of this document is structured as follows:

- Section 3 provides information on how the VHF bands are currently used
- Section 4 explains how much VHF spectrum we think will be available for IoT services; why we think the VHF bands might be suited to agricultural and environmental applications in rural and remote locations; and provides some examples of what these applications might be
- Section 5 sets out the current licence conditions and discusses why we are consulting on possible changes to encourage greater IoT use
- Section 6 outlines our next steps.

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<sup>1</sup> See <http://www.legislation.gov.uk/ukxi/2014/1484/made/data.pdf>

<sup>2</sup> See <http://media.ofcom.org.uk/news/2015/iot-next-steps/>

**Section 3**

# How the VHF bands are currently used

3.1 In this section we provide information on how the VHF spectrum bands are currently used. Tables are provided for the VHF bands that show how different parts of these are used for different applications.

## 55.75-68 MHz

3.2 Figure 3.1 below summaries how the 55.75-68 MHz frequency range is used. The sub-bands highlighted in blue are those we are considering in this consultation.

47-68 MHz Met Office Wind Profiling Radar, South Uist, Hebrides															
53.75-55.75 MHz				55.75625-60.59375 MHz		60.75-62.75 MHz				62.75625-67.99375 MHz		67.75-67.8375 MHz			
PMSE	PMSE	PMSE	PMSE	Business Radio	Business Radio	PMSE	PMSE	PMSE	PMSE	Business Radio	Business Radio	PMSE	PMSE	PMSE	PMSE
Audio Distribution System	Programme Making and Special Events (Fixed Site)	Programme Making and Special Events (Link)	Programme Making and Special Events (Low Power)	Business Radio (Area Defined)	Business Radio (Technically Assigned)	Audio Distribution System	Programme Making and Special Events (Fixed Site)	Programme Making and Special Events (Link)	Programme Making and Special Events (Low Power)	Business Radio (Area Defined)	Business Radio (Technically Assigned)	Audio Distribution System	Programme Making and Special Events (Fixed Site)	Programme Making and Special Events (Link)	Programme Making and Special Events (Low Power)
				Subject of this consultation						Subject of this consultation					

**Figure 3.1 How VHF Band One is used**

### Business Radio

3.3 Referred to as Band One, the 55.75-68 MHz range<sup>3</sup> has been available for BR communications for many years.

3.4 Our information on the demand for spectrum licences in the 55.75-68 MHz range indicates that the bands 55.75625-60 MHz, 62.75625-64.8 MHz and 64.8875-66.2 MHz have never been used by the BR sector and still remain largely undeveloped.

<sup>3</sup> See Annex 6: <http://licensing.ofcom.org.uk/binaries/spectrum/business-radio/technical-information/tfac/ofw164.pdf>

## Other uses

### *Programme Making and Special Events*

- 3.5 A large part of the 55.75-68 MHz range is used for wireless Programme Making and Special Events (PMSE) services.
- 3.6 There is a range of PMSE licensees providing services including audio distribution (ADS) programme links and talk-back. The majority of the frequencies assigned for PMSE uses are short term (e.g. less than one month). There is one national assignment for BskyB, and the BBC has area and regional licences that are renewed annually.
- 3.7 The bands 55.75625-60 MHz, 62.75625-64.8 MHz and 64.8875-66.2 MHz have never been available for PMSE services.
- 3.8 In addition to BR and PMSE, the frequency range is used for Wind Profiling Radar (WPR) measurements, which are integral to the Met Office's weather observations. The UK is also a party to an international planning agreement for digital terrestrial television (DVB-T<sup>4</sup>).

### *Wind Profiler Radar*

- 3.9 The Met Office's 64 MHz stratosphere-troposphere wind profiler radar (WPR) was installed at its South Uist range meteorological station in the Hebrides in May 2003. The site is located at 57.353 N, 7.375 W at a height of 4 m above mean sea-level. In order to make measurements at various heights in the atmosphere the WPR points upwards with a beam angle of 15° from the vertical. It has a range of 500 m to 20.0 km.
- 3.10 We are not proposing to change the spectrum access arrangements for this installation.

### *Digital Video Broadcasting (DVB-T)*

- 3.11 The frequency range is harmonised in Europe<sup>5</sup> for DVB-T and the rules for using it are established internationally<sup>6</sup>. However, we do not licence spectrum for DVB-T in the 53.75-68 MHz range.

## International harmonisation and coordination

- 3.12 The broader 47-68 MHz frequency band is divided into three parts. The first, 47-54 MHz, is used for low power, short range simplex services. The second and third are a duplex pair, 54-61 MHz (mobile transmit) and 61-68 MHz (base

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<sup>4</sup> Terrestrial Digital Video Broadcasting (DVB-T).

<sup>5</sup> Wiesbaden 1995 (WI95), and Maastricht (MA02) Regional Agreements as revised in Constanta in 2007 (Co07), are applicable to the bands 47–68 MHz, 87.5–108 MHz, 174–230 MHz, 230–240 MHz and 1452–1492 MHz.

<sup>6</sup> [https://www.itu.int/ITU-D/tech/OLD\\_TND\\_WEBSITE/digital-broadcasting\\_OLD/kyiv/Presentations/doeven/ITU-DKyiv.pdf](https://www.itu.int/ITU-D/tech/OLD_TND_WEBSITE/digital-broadcasting_OLD/kyiv/Presentations/doeven/ITU-DKyiv.pdf)

transmit), and are designated for pan-European Land Mobile services according to CEPT Recommendation T/R 25-08<sup>7</sup>.

- 3.13 Because 47-68 MHz is used differently in France and the UK, a technical frequency co-ordination procedure has been agreed to manage country-to-country interference. This procedure is set out in a Memorandum of Understanding<sup>8</sup>. *Click on the in-text link to learn more about this [Band One MoU](#)*
- 3.14 The co-ordination procedure is based on the concept of preferential frequencies. The 47-54 MHz, 54-61 MHz and 61-68 MHz duplex frequency bands are apportioned as groups of frequencies which can be assigned in an equitable manner by both countries. Field strength thresholds<sup>9</sup> are applied inside each neighbouring country to protect the uses in each.

### **70.5-71.5 MHz and 80.0-81.5 MHz**

- 3.15 The 70.5-71.5 MHz and 80.0-81.5 MHz bands are within the 68.08125–87.49375 MHz range, which is called VHF Low Band<sup>10</sup>.
- 3.16 Until 2012 the 70.5-71.5 MHz and 80.0-81.5 MHz bands were used by the Emergency Services in the UK. In 2012 the communications needs of the Emergency services moved onto new communications networks and the band was given up, except in Scotland where 6 spot channels (70.5625MHz, 70.575MHz, 70.85MHz and 80.35MHz, 81.0MHz, 81.05MHz) have been retained.
- 3.17 Figures 3.2 and 3.3 below summarise how the relevant parts of VHF Low Band (70.5-72.3813 MHz and 76.80625-83.4875 MHz) are used and the services that are provided using them. The sub-bands highlighted in blue are those we are considering in this consultation.

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<sup>7</sup> See <http://www.erodocdb.dk/Docs/doc98/official/Pdf/Tr2508.pdf>

<sup>8</sup> See [http://licensing.ofcom.org.uk/binaries/spectrum/business-radio/technical-information/MoU\\_for\\_Band\\_1\\_between\\_the\\_1.pdf](http://licensing.ofcom.org.uk/binaries/spectrum/business-radio/technical-information/MoU_for_Band_1_between_the_1.pdf)

<sup>9</sup> For international coordination purposes a field strength threshold of 6 dB $\mu$ V/m at 10 metres above ground level at all points 80 km inside the neighbouring country has been established.

<sup>10</sup> See Annex 6: <http://licensing.ofcom.org.uk/binaries/spectrum/business-radio/technical-information/tfac/ofw164.pdf>

	Amateur Radio	Amateur	70 - 70.5 MHz
	Amateur Radio	Amateur	70 - 70.5 MHz
	Military, Amateur Radio (Full, Intermediate & Foundation Licence)	Amateur and Public Sector	70 - 70.5 MHz
70.5-71.5 MHz Subject of this consultation	(Area Defined)	Business Radio	70.5 - 72.7875 MHz
	(Technically Assigned)	Business Radio	70.5 - 72.7875 MHz
	(Suppliers Light)	Business Radio	72.3688 - 72.3813 MHz

Figure 3.2. How the 70.5-72.3813 MHz range within VHF Low Band is used

			76.80625 - 76.84375 MHz
Audio Distribution System	PMSE		
Programme Making and Special Events (Fixed Site)	PMSE		
Programme Making and Special Events (Link)	PMSE		
Programme Making and Special Events (Low Power)	PMSE		
Cordless Telephone Apparatus (CT1; extended CT1; CT2 and DECT)	Licence exempt		77.5125 - 77.55 MHz
Business Radio (Simple UK)	Business Radio		77.68125 - 77.69375 MHz
Military	Public sector		78 - 80 MHz
Audio Distribution System	PMSE		
Programme Making and Special Events (Fixed Site)	PMSE		78.18375 - 78.25875 MHz
Programme Making and Special Events (Link)	PMSE		
Programme Making and Special Events (Low Power)	PMSE		
<b>Subject of this consultation</b>	Business Radio/M2M		80.5 - 81.5 MHz
Business Radio (Area Defined)	Business Radio		81.5125 - 83.4875 MHz
Business Radio (Technically Assigned)	Business Radio		

Figure 3.3. How the 76.80625—83.4875 MHz range within VHF Low Band is used

### Private Mobile Radio/Business Radio

- 3.18 Like VHF Band One, much of the VHF Low Band has been available for BR communications for many years.
- 3.19 Our information on the demand for spectrum licences indicates that there is more interest in BR use in this range than the spectrum below 68 MHz. 80% of

the BR licences granted for both bands are for assignments in the 68.08125–87.49375 MHz frequency range.

- 3.20 Since restrictions on the 80.5-82.5 MHz band to protect radio astronomy observations were lifted in 2008<sup>11</sup> Business radio systems are no longer excluded from operating within 48 km of the radio astronomy site where these measurements were taken<sup>12</sup>.

## Other uses

### *Programme Making and Special Events*

- 3.21 The VHF Low Band is used for wireless PMSE services. There is a range of PMSE licensees providing services including audio distribution services, programme links and talk-back. The majority of the frequencies assigned for PMSE uses are short term (e.g. less than one month). Area and national use is available for major Broadcast production companies. The bands 70.5-71.5 MHz and 80.0-81.5 MHz are not used for PMSE services.

### *Military uses*

- 3.22 In addition to BR and PMSE, parts of the frequency range are also used for military radio communications.
- 3.23 Within the frequency band 20-108 MHz the common military tuning range is 30-87.5 MHz. The bands 70.5-71.5 MHz and 80.0-81.5 MHz are not harmonised military bands.

### *Amateur Radio*

- 3.24 Radio Amateurs have been permitted temporary access to the band since earlier this year to innovate and research narrowband broadcasting and voice communications. This temporary, innovative use is permitted in England, Wales and Northern Ireland. In Scotland Radio Amateur use of the band is not permitted. This is because the bandwidth required by Radio Amateurs for narrowband broadcasting could overlap channels retained by the Scottish Government.
- 3.25 Access to spectrum is authorised by varying individual Amateur Radio licences. This authorisation is valid for 12 months to holders of the Amateur Radio (Full) Licence holders only. A Special Research Permit is available for this purpose. See <http://licensing.ofcom.org.uk/binaries/spectrum/amateur-radio/apply-for-a-licence/ofw306.pdf>.
- 3.26 Amateur Radio use of the 70.5–71.5MHz band is not protected and must not cause interference to other, authorised, users of the spectrum.

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<sup>11</sup> See Recognised Spectrum Access as applied to Radio Astronomy, section 4. [http://stakeholders.ofcom.org.uk/binaries/consultations/ras/annexes/ras\\_radio\\_astronomy.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/ras/annexes/ras_radio_astronomy.pdf)

<sup>12</sup> This site was located in Cambridge (52° 10' 06" North 00° 02' 23" East)

- 3.27 Ofcom retains the right to withdraw the facility for temporary access to the band. If we decide to do this Ofcom we will not consult on this decision, but we will publish our intention 12 months prior to discontinuing this arrangement.
- 3.28 To date, we have received one request for temporary permit for a station in Northern Ireland.

#### *Government uses*

- 3.29 In Scotland access to 6 spot channels (70.5625MHz, 70.575MHz, 70.85MHz and 80.35MHz, 81.0MHz, 81.05MHz) has been retained by the Scottish Government. These channels cannot be assigned for other uses such as BR or IoT services.

#### **International coordination**

- 3.30 There are no international frequency coordination requirements for the VHF Low Band (68.08125–87.49375 MHz) that the UK is signatory to. *Click on the in-text link to learn more about international frequency coordination requirements* [OFW164, Annex 5](#)

## Section 4

# Use of VHF Spectrum for IoT

- 4.1 In this section we examine the demand for longer range spectrum for IoT and set out how much spectrum we think we could make available for IoT services using our existing BR licence products.
- 4.2 We also consider whether there is evidence that making the bands available to the IoT would mean that other uses of the VHF Low Band and VHF Band One might be adversely affected.

## Introduction

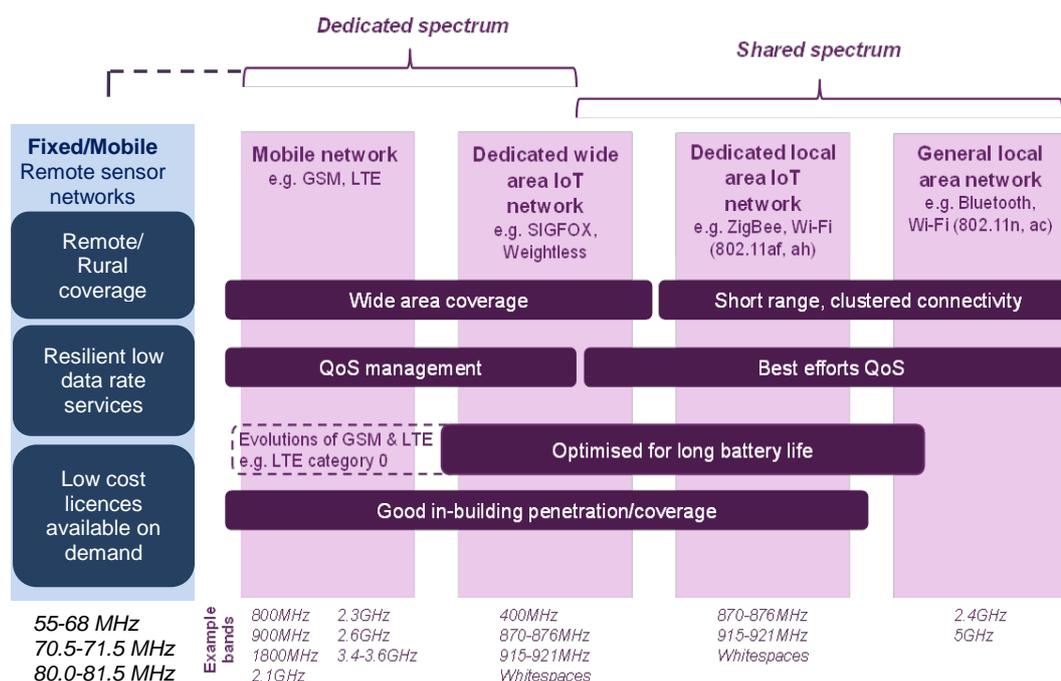
- 4.3 In our January 2015 statement “Promoting investment and innovation in the Internet of Things” we said that our existing initiatives, like making spectrum available in the 870/915 MHz bands and liberalising licence conditions for existing mobile bands, will help to meet much of the short to medium term spectrum demand for IoT services. We also recognised that, as the IoT sector develops, there may be a need for additional spectrum.
- 4.4 Our January 2015 statement also said that different spectrum and network solutions are likely to be needed to meet the different operational requirements of the range of IoT services. We provided an illustration of two broad approaches that might be used to meet the future needs of different types of IoT applications using shared and dedicated spectrum.

## Promoting investment and innovation in the IoT

- 4.5 Although the VHF bands identified may be well suited to IoT services where a resilient good quality of service is required, such as those used to manage and control national infrastructure, it is also likely that they will be suited to connecting M2M devices in locations that can be hard to reach using the higher frequency bands or where commercial mobile network coverage is not available.
- 4.6 M2M applications range from wirelessly connected sensors used for [‘smart farming](#), where fertilizer and water are automatically distributed across a farm to increase efficiency, to [intelligent traffic management](#) systems and [smart energy grids](#), which match power generated to consumers’ electricity needs. *Click on the in-text links above to learn more about these applications.*
- 4.7 Figure 4.1 below replicates our illustration<sup>13</sup> of two broad approaches that might be used to meet the future needs of different types of IoT services using shared and dedicated spectrum, but with the VHF spectrum added.

<sup>13</sup> See Section 1.14.2 figure 1.

(<http://stakeholders.ofcom.org.uk/binaries/consultations/iot/summary/iot-cfi.pdf>)



**Figure 4.1 Framework for considering spectrum requirements for the IoT**

## How much spectrum is being made available?

- 4.8 Although we currently have no evidence of how much VHF spectrum might be needed for M2M and none that suggests there is any immediate demand for it, we note Senaptic’s comment to our July 2014 Call for Inputs<sup>14</sup> that it would be happy to operate down to “low frequencies”.
- 4.9 We also note that our licence records show that several companies already use the VHF bands for M2M-like applications. For example, telemetry at VHF is used for monitoring and changing energy requirements in power networks and for rail transport operations.
- 4.10 Our licensing data confirms that 7.6 MHz of spectrum is clear and un-used in VHF Band One. Figure 4.2 below summarises what VHF spectrum in Band One is available now for new IoT services.

<sup>14</sup> See <http://stakeholders.ofcom.org.uk/consultations/iot/>

Lower band edge	Upper band edge	Bandwidth available	Availability
55.75625 MHz	60 MHz	4.24375 MHz	Available and un-assigned except for T&D uses
60.0 MHz	60.59375 MHz	0.59375 MHz	Not available. Assigned and in use.
62.75625 MHz	64.8 MHz	2.04375 MHz	Available and un-assigned except for T&D uses.
64.8875 MHz	66.2 MHz	1.3125 MHz	Available and un-assigned except for T&D uses.
<b>Total available</b>		<b>7.6 MHz</b>	

**Figure 4.2 Spectrum availability in VHF Band One**

- 4.11 The 70.5-71.5 MHz and 80.0-81.5 MHz bands are also available and could be assigned to new uses, including IoT services. Doing so would add a further 2.5 MHz of spectrum for these new uses. See figure 4.3 below.
- 4.12 6 spot (12.5kHz) channels have been retained by Scottish Government. These 6 channels (70.5625 MHz, 70.575 MHz, 70.85 MHz and 80.35 MHz, 81.0 MHz, 81.05 MHz) are not available in Scotland. Except for these 6 narrow band channels, 2.5 MHz of spectrum is available UK-wide in the 70.5-71.5 MHz band and 1.5 MHz of spectrum is available in the 80.0-81.5 MHz band.

Lower band edge	Upper band edge	Bandwidth available	Availability
70.5 MHz	71.5 MHz	1 MHz	Available and un-assigned except for T&D uses.  In Scotland access to 37.5 kHz has been retained by the Scottish Government.
80 MHz	81.5 MHz	1.5 MHz	Available and un-assigned except for T&D uses.
<b>Total available</b>		<b>2.5 MHz</b>	

**Figure 4.3 Spectrum availability in VHF Low Band**

## VHF suitability for IoT in rural and remote locations

- 4.13 In the VHF range below 90 MHz communications is usually restricted to a range of less than 160 km. This is because range is affected by the height of antennas, the effects of hills, mountains, buildings and vegetation<sup>15</sup>.
- 4.14 However, in some circumstances this range can be considerably larger than 160 km. The ionosphere can influence the propagation of radio signals particularly at frequencies below about 90 MHz<sup>16</sup>. In some circumstances communications may be possible for small percentages of the time at distances beyond 500 km<sup>17</sup>.
- 4.15 When the effects of hills, mountains, buildings and vegetation are taken into account, communications in the VHF range below 90 MHz is still possible over distances two to three times greater than the coverage offered by a cellular mobile (LTE) base station at 900 MHz<sup>18</sup>.
- 4.16 Another significant factor in any communications link is radio noise. This is because radio noise sets a limit to the performance of radio systems. Five main sources of radio noise are defined and characterised<sup>19</sup>, but at frequencies below 100 MHz man-made noise is dominant<sup>20</sup>. Typical levels of man-made noise have been measured for city, residential, rural and quiet rural environments<sup>21</sup>, but the man-made noise level in cities can be more than 100 times higher than that in quiet rural environments.
- 4.17 This means that connecting wireless IoT services together in remote and rural areas using the VHF range can be achieved using lower transmitter powers than those needed for the same range using the existing M2M bands above 800 MHz.
- 4.18 Ofcom carried out its own measurements of radio noise in 2009. We concentrated on urban areas, but we recognise that the noise levels in rural areas can also rise where power lines and industrial/farming processes are located.

## Rural wireless IoT

- 4.19 Agricultural businesses in the UK are faced with many problems that wireless can help address. For example, security of plant and livestock is a major concern; and renewables and other remote plant, such as drainage pumps and irrigators, all benefit from connectivity. But connecting devices together wirelessly in remote and rural areas is a challenge.

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<sup>15</sup> See for example CCIR Report 1145 [https://www.itu.int/dms\\_pub/itu-r/opb/rep/R-REP-P.1145-1990-PDF-E.pdf](https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-P.1145-1990-PDF-E.pdf)

<sup>16</sup> Sporadic-E ionization and tropospheric ducting. See for example <http://rsgb.org/main/get-started-in-amateur-radio/operating-your-new-station/vhfuhf-propagation/>

<sup>17</sup> See ITU-R Recommendation P.1546-2

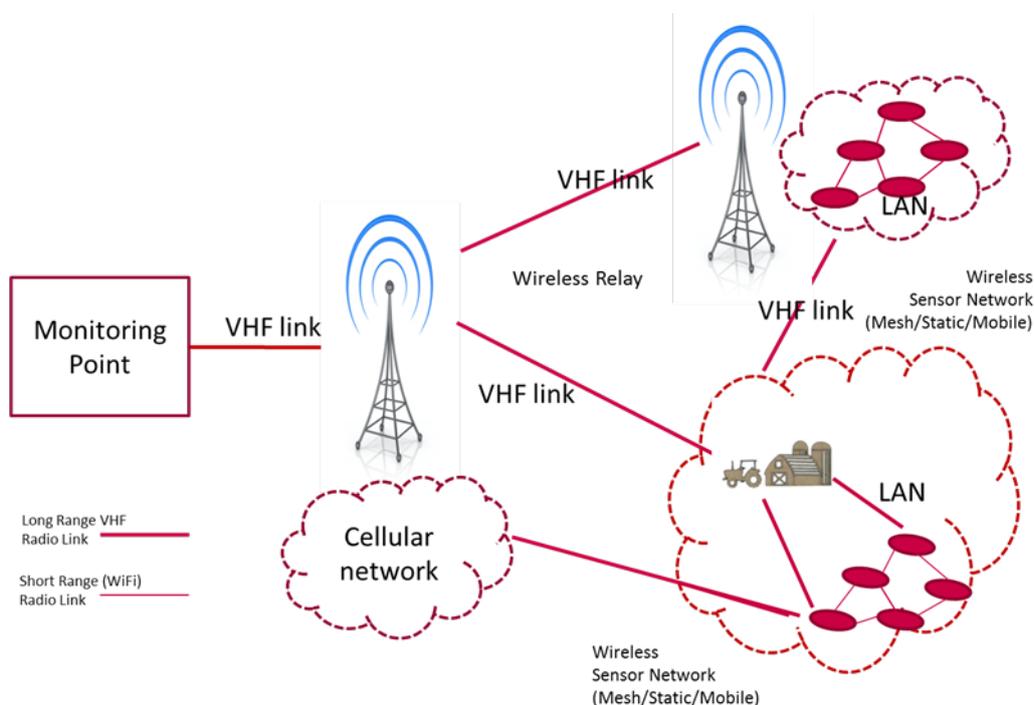
<sup>18</sup> See pp.269 “LTE for UMTS, Evolution to LTE-Advanced”, second edition. Edited by Harri Holma and Antti Toskala, Pub. Wiley. ISBN 978-0-470-66000-3

<sup>19</sup> See ITU-R Recommendation P.372-10

<sup>20</sup> Man-made noise is aggregated unintended radiation from electrical machinery, electrical and electronic equipment, power transmission lines, or from internal combustion engine ignition noise.

<sup>21</sup> See ITU-R Recommendation P.372-10 <https://www.itu.int/rec/R-REC-P.372-10-200910-S/en>

- 4.20 When considering the deployment of a network of sensors the distance between each of them is an important factor. How close to each other the sensors are determines how much power is required, which limits the range of the most power hungry module - the radio transmitter.
- 4.21 The cost of deployment can be the critical limiting factor for rural and remote users and communities. Cost can be reduced by extending coverage to improve network connectivity using higher transmission power, but this is not possible when transmitter powers are limited.
- 4.22 Figure 4.4 below illustrates one example of how it might be possible to connect local area networks (LANs) of sensor networks together using VHF spectrum as the resilient link. We note that the VHF spectrum could also be used for the sensors and not just for the link between LANs, but relatively large antenna sizes at VHF may not be practical for some sensor-to-sensor links.



**Figure 4.4. Connecting short range networks together**

### Question for stakeholders

Q1. Do you agree that the spectrum we have identified (in figures 4.2 and 4.3 above) is suitable for M2M applications for remote and rural locations?

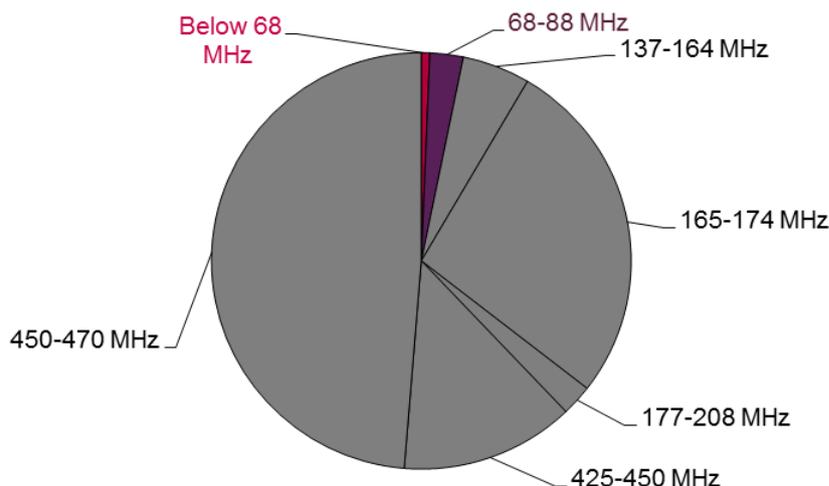
Please provide as much information as possible on likely applications.

### Spectrum demand

- 4.23 Because licences are already available to business radio users for the bands 55.75625-60 MHz, 62.75625-64.8 MHz and 64.8875-66.2 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz we have considered whether recent trends in demand for BR licences indicates that making these bands more accessible for IoT services could adversely affect existing BR licensees.

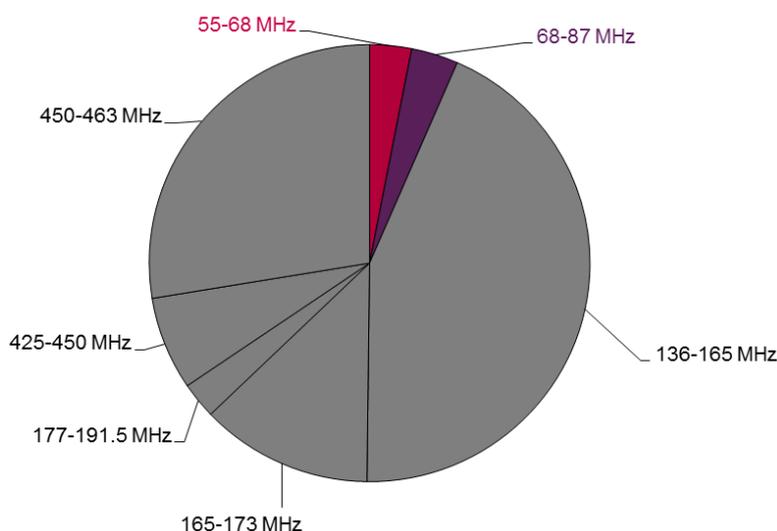
## Business Radio

- 4.24 Our information on the demand for BR spectrum licences indicates that the bands 55.75625-60 MHz, 62.75625-64.8 MHz and 64.8875-66.2 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz continue to attract little interest from the BR sector. They remain largely un-used.
- 4.25 Figure 4.5 below summarises the use for BR Technically Assigned licences by frequency band for May 2015. It shows that assignments for the 55.75-68 MHz and 68.08125–87.49375 MHz bands account for approximately 4% of the total demand.



**Figure 4.5 Number of BR Technically Assigned Assignments by band, May 2015**

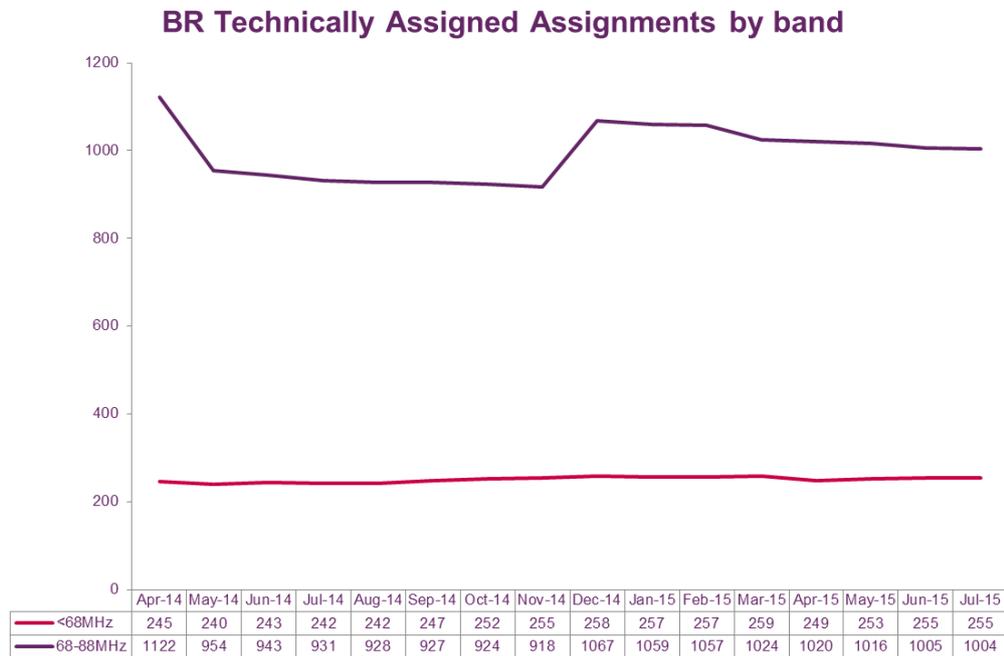
- 4.26 Figure 4.6 below summarises the demand for BR Area Defined licences by frequency band for May 2015.



**Figure 4.6 Number of BR Technically Assigned licences by band, May 2015**

- 4.27 Our licensing data confirms that the assignments for spectrum for BR applications in VHF Band One has declined (by approximately 10%) and the

demand for VHF Low Band BR licences has risen only slightly (by approximately 3%) since April 2014. This trend is shown in figure 4.7 below.



**Figure 4.7. Change in the number of BR licences granted for Band One and Low Band**

4.28 When all the VHF bands available to BR licensees are considered, it is Ofcom’s view that encouraging new IoT uses in the bands 55.75625-60 MHz, 62.75625-64.8 MHz and 64.8875-66.2 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz should still leave sufficient spectrum to meet demands for BR in the VHF range.

**PMSE**

- 4.29 An examination of our licence data shows that the bands 55.75625-60 MHz, 62.75625-64.8 MHz and 64.8875-66.2 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz are not used for Programme Making and Special Event (PMSE) services.
- 4.30 We are not proposing to change the licensing arrangements for the bands used for PMSE applications within VHF Low Band or within VHF Band One.

**Question for stakeholders**

Q2. Do you agree with our analysis that encouraging new IoT uses in the bands 55.75625-60 MHz, 62.75625-64.8 MHz and 64.8875-66.2 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz should still leave sufficient spectrum to meet demands for Business Radio in the VHF range?

## Section 5

# Licences for VHF IoT services

- 5.1 In this section we set out our consideration of the licensing regime for IoT services in the VHF bands. We discuss whether the existing BR licence regime is the most appropriate for IoT providers or whether we should introduce changes. Finally, we seek the views of stakeholders on the options for licensing going forward.

## BR Licence products

- 5.2 Our licence products for VHF bands already support a wide range of uses including data communications. Business users already use these bands to connect some types of telemetering and remote control devices together, for example.
- 5.3 There are two main types of licence available for business users, as discussed in the paragraphs which follow. The grey box below includes links to further details and to relevant application forms.

## Area Defined licences

- 5.4 The Area Defined licence class is used for licensees who require large geographical areas on a national or regional basis who operate networks and who require exclusive access to spectrum. Such networks are often of strategic and national importance, e.g. rail networks, utilities, distribution networks and transport networks.
- 5.5 Licences are issued on a first come-first serve basis. Depending on spectrum availability, these licences may be issued for either the whole of the UK, national areas (e.g. Scotland) or 50 km x 50 km national grid squares. The licensee is free to deploy radio equipment anywhere within the licensed geographical boundary as long as licence conditions are met.

## Technically Assigned Licences

- 5.6 This licence is a flexible licence that authorises the use of a wide variety of equipment. Licensees can choose from a wide range of frequencies and a wide range of coverage areas, from very small (e.g. in-building coverage) to very large (e.g. a county) and require a degree of protection from other users. Licences are issued on a first-come-first serve basis and access to the band requires a technical coordination process to ensure users can operate without causing interference to other users of the band.

### BR licence products available for use by Internet of Things

Three licence products are available. *Click on the in-text links below to learn more about these:*

- [Area Defined Licences](#): Frequency assignments are made in 50km<sup>2</sup> geographic squares aligned to the Ordnance Survey grid or for one or more Nations that make up the UK. A [Spectrum Leasing](#) clause may be added by request.
- [Technically Assigned Licences](#): Assignments are coordinated with existing users by us. We will use our spectrum management tools to do this.
- [Light Licences](#): There are three different sub-types of BRLight Licence, each of which has a pre-selected set of radio channels for each of the bands.

Our BR Online service enables users to apply for a range of licences for Business Radio uses. Details of what these licences cover is available in our [guidance notes](#).

You can use our Online Licensing Service to apply for any BR licence product quickly and easily by clicking on this link [Apply for a BR Licence](#).

You may [download a paper application form](#) from the Ofcom website.

## Our BR licence conditions

- 5.7 Table 5.1 below summarises the conditions associated with the current range of BR licence products and the conditions that apply to them<sup>22</sup>.
- 5.8 We seek the views of stakeholders on whether the conditions associated with BR licences or in any of the related documents (e.g. the relevant Interface Requirements) are as suitable as they can be for IoT uses in the 55.75-68 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz bands.

<sup>22</sup> Further information on BR licence classes can be found here: <https://licensing.ofcom.org.uk/binaries/spectrum/business-radio/guidance-for-licensees/LicensingPolicyManual.pdf>

**Table 5.1 Summary of conditions associated with the current range of BR licences**

Parameters	Licence class	Terms and conditions of our licence products
Channel bandwidth(s)	Area defined licence	Any channel bandwidth permitted, but typically single or dual channel based on 6.25 kHz, 12.5 kHz, 25 kHz
	Technically assigned licence	
Maximum transmit power limit	Area defined licence	IR 2044 applies <sup>23</sup>  Base stations: 100Watts <sup>24</sup> , 50Watts <sup>25</sup> , 25Watts <sup>26</sup> ERP  Mobile stations: 25Watts ERP for all channel bandwidths
	Technically assigned licence	<i>Simple Site Light</i>  The maximum permitted ERP power for base stations is 2 Watts with a maximum antenna height of 15m. The maximum permitted ERP power for mobile stations is 2 Watts, except for the 25 kHz bandwidth channels where the maximum permitted ERP power is 0.02 Watts.  <i>Simple UK Light</i>  The maximum permitted ERP power for mobile stations is 5 Watts ERP.  <i>Suppliers Light</i>  The maximum permitted ERP power for base stations is 10 Watts;  The maximum permitted ERP power for mobile stations is 25 Watts;  The maximum permitted base station antenna height above ground level is 20m.
Duplex type/separation	All licence products	Various duplex type/separation permitted e.g. 8.7125 MHz, 10 MHz, 13.5 MHz
Geographical coverage	Area defined licence	Frequency assignments are made in 50km <sup>2</sup> geographic squares aligned to the Ordnance Survey grid or for one or more Nations that make up the UK. (See Technical frequency Coordination Criteria <sup>27</sup> )  Each licensed grid square is subject to field strength limits at the boundary (-116 dBm/12.5 kHz).

<sup>23</sup> IR 2044: <http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-policy-area/spectrum-management/research-guidelines-tech-info/interface-requirements/ir20441.pdf>

<sup>24</sup> For 25kHz channel bandwidth

<sup>25</sup> For 12.5kHz channel bandwidth

<sup>26</sup> For 6.25kHz channel bandwidth

<sup>27</sup> <http://licensing.ofcom.org.uk/binaries/spectrum/business-radio/technical-information/tfac/ofw164.pdf>

Parameters	Licence class	Terms and conditions of our licence products
	Technically assigned licence	Determined from the parameters supplied at the time of application.
		<p><u>Simple Site Light</u></p> <p>This licence authorises the use of a radio system operating a base station and mobile stations within a small geographical area (typically 1 kilometre or less).</p> <p>This licence authorises the use of hand-portable or mobile radio equipment anywhere within the UK.</p> <p><u>Simple UK Light</u></p> <p>This licence authorises the use of hand-portable or mobile radio equipment anywhere within the UK.</p>
Other conditions	Area defined licence	Analogue or digital transmission permitted. IR 2044 applies <sup>28</sup>
	Technically assigned licence	Signalling Codes (CTCSS and DCS) for analogue systems or timeslots or Channel Access Codes for digital systems. IR 2044 applies <sup>29</sup> IR 2008 <sup>30</sup> technology permitted
		<p><u>Simple Site Light and Simple UK Light</u></p> <p>IR 2044 applies<sup>28</sup></p> <p>Base station use is not permitted.</p> <p><u>Suppliers Light</u></p> <p>IR 2044 applies<sup>28</sup></p> <p>This licence product is a specialist licence for Radio Suppliers.</p>

<sup>28</sup> IR 2044: <http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-policy-area/spectrum-management/research-guidelines-tech-info/interface-requirements/ir20441.pdf>

<sup>29</sup> IR 2044: <http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-policy-area/spectrum-management/research-guidelines-tech-info/interface-requirements/ir20441.pdf>

<sup>30</sup> IR 2008: <http://www.ofcom.org.uk/static/archive/ra/publication/interface/word-pdf/ir2008v1-2.pdf>

## Licence duration and cost

- 5.12 Information on the fees currently charged for the various business radio products available in this band are available at <https://licensing.ofcom.org.uk/binaries/spectrum/business-radio/forms/nonexcelguide.pdf>
- 5.13 A guidance note on fees can be found here <http://licensing.ofcom.org.uk/binaries/spectrum/business-radio/forms/nonexcelguide.pdf>
- 5.14 If you are planning a network (multi-site, multi-channel) then you may use our on-line fee calculator. This can be found here: [http://licensing.ofcom.org.uk/binaries/spectrum/business-radio/forms/BR\\_Calculator\\_ver\\_6\\_2.xls](http://licensing.ofcom.org.uk/binaries/spectrum/business-radio/forms/BR_Calculator_ver_6_2.xls)
- 5.15 In our March 2014 Statement Spectrum Pricing: A framework for setting cost based fees, we indicated our intention to review fees for business radio. That review is currently underway and will be subject to a separate consultation, which we intend to publish later this year.
- 5.16 Licences in the BR category are issued in perpetuity and continue in force until revoked by Ofcom or surrendered by the Licensee. Information on the terms and conditions of licences in this category can be found at <https://secure.ofcom.org.uk/busrad/terms>

## Options for authorising IoT at VHF

- 5.17 We believe that the current approach to authorising IoT in these bands is adequate. The three different licence products cater for a range of stakeholder requirements whilst ensuring interference is appropriately managed.
- 5.18 Users may share access to spectrum on a co-ordinated basis. They may do this through the Technically Assigned and Area Defined BR licence products. The Area Defined product gives licensees the ability to plan individual deployments without the need to co-ordinate each base station. Our light licence approach provides access to those who are prepared to share spectrum on an un-coordinated basis.
- 5.19 If stakeholders do not believe that the authorisation model currently in place is sufficiently flexible to meet their needs then we could consider other options. Other licence options for IoT using the 55.75-68 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz bands include:
- the choice between licence exemption or creation of a new licence type; and
  - the nature of the licensing regime, which can be divided into the following choices:
    - award spectrum exclusively for IoT through an award (i.e. block assignments);
    - dedicate spectrum for IoT but coordinate its use between users.
- 5.20 In the paragraphs below we assess each of these options in turn.

## Licence exemption vs licensed access?

- 5.21 If there was little or no risk of interference from deployments of IoT equipment then we could make its use licence exempt in a similar way to Wi-Fi. This would minimise the regulatory burden for users (as well as for Ofcom) and would be consistent with our duty to make spectrum use licence exempt wherever possible.
- 5.22 Licence exemption would provide spectrum access to all users and could facilitate a wide range of services. This approach is generally most appropriate for low power systems where there is a low risk of interference between users.
- 5.23 However, there are disadvantages to licence exemption. Firstly, licence exempt access to spectrum would be on a shared basis with no guaranteed level of service.
- 5.24 Secondly, any decision now to make IoT use licence exempt might be difficult to reverse if subsequent experience indicated that we needed instead to move to a licensed approach (e.g. in order to limit density of deployment or enable coordination between different networks). For example, it would be difficult for us to assess who had deployed IoT equipment or to have access to information about how many, and where they had been deployed.
- 5.25 We have therefore considered the advantages of licensed access. An individual approach to licensing would allow Ofcom to hold accurate and up to date information on the location of IoT equipment. This would help to us to coordinate IoT equipment so that it does not suffer inference from other authorised spectrum users, or cause interference itself.
- 5.26 It would be relatively easy to adapt authorisation arrangements - if justified in light of experience of the impact on other spectrum users - either to tighten conditions or to move to a more permissive regime.
- 5.27 A licensed approach is likely to be most suitable for high power<sup>31</sup> IoT use, such as providing long distance communications, because the risk of interference would be greater than for low power uses.
- 5.28 However, there are disadvantages to a licensing approach too. Depending on the number of stations, individual licensing of IoT equipment could be burdensome and potentially involve significant administrative costs. Moreover, it would take longer to implement and so delay IoT deployment to the detriment of innovation.
- 5.29 We seek the views of stakeholders on the most appropriate approach.

## Nature of a licensing regime

- 5.30 The issuing of licences for IoT use raises questions over the authorisation process, for example:
- how many licences should be issued, what licence conditions could apply and what geographical area should be covered?

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<sup>31</sup> EN 300 220 describes SRD as being up to 1/2 watt ERP

- how should licences be issued: first-come-first-served or by an award process? and
- what fee level should be charged e.g. cost based or Administrative Incentive Pricing (AIP)?

5.31 The factors we take into consideration when assessing fees have already been discussed in paragraphs (5.14 to 5.17) above. The paragraphs below note the main issues to consider in respect to limitations on licences and on an award process.

#### *Volume of licences and areas of coverage*

5.32 There may be a case for limiting the number of licences and/or limiting the density of deployment by individual licensees. Limitations of this nature would reduce the risk of interference that might arise. This could be done by:

- making only a limited number of licences available in an area (an area may be UK-wide, nationwide or region wide etc.) and/or
- limiting the number of deployments that can be made under a single licence e.g. by stipulating maximum IoT equipment density.

5.33 An area licence would authorise the licence holder to deploy IoT equipment in a given area without the need to inform Ofcom, subject to the conditions of that licence. One such condition could be an obligation on the licensee to keep accurate records of its IoT terminal locations and to provide this information to Ofcom on request.

5.34 The information could be used to investigate interference issues and to inform any future consideration of the authorisation regime. However, such an approach limits the number of users that could operate in an area and could lead to inefficient use in areas where licensees may not want to provide services.

5.35 The alternative would be to place no limit on the number of licences granted. Under such an unlimited, shared spectrum access approach, licences would be available on demand and all licensees would have equal rights to access spectrum in any part of the UK. As noted, this could lead to interference issues.

5.36 We seek the views of stakeholders on these issues.

#### *Award process*

5.37 If we were to limit the number of licences available, it is likely there would be more demand than supply. In those circumstances, we would need to establish a means of assigning the licences, either through a competitive award process such as an auction or 'beauty contest' or by some other means, such as a lottery.

5.38 It would be time consuming and costly to design and run a competitive award process. It could delay significantly the potential to roll out new services, and so hinder the development of new IoT services.

5.39 In contrast, a shared access approach in which network licences are available on demand could be implemented quickly.

## Questions for stakeholders

*Q3. Do you think the conditions associated with the current range of BR licences available now should change to facilitate new IoT services uses? If you do, what should these changes be?*

*Q4. Do you think we should create a new licence product specifically for IoT services?*

## Section 6

# Next steps

- 6.1 Following this consultation we will publish a statement. We expect to do this before the end of 2015.
- 6.2 It is possible that stakeholders will propose changes to our licences or even a new licence product. If they do, and we consider their ideas worth taking forward, we may need to conduct a further consultation. If this is the case, it is likely that any new arrangements for IoT services will be published by summer 2016.

## Annex 1

# Responding to this consultation

## How to respond

- A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 12<sup>th</sup> November 2014**.
- A1.2 Ofcom strongly prefers to receive responses using the online web form at <http://stakeholders.ofcom.org.uk/consultations/radio-spectrum-internet-of-things/> as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 3), to indicate whether or not there are confidentiality issues. This response coversheet is incorporated into the online web form questionnaire.
- A1.3 For larger consultation responses - particularly those with supporting charts, tables or other data - please email [Stephen.Jones@ofcom.org.uk](mailto:Stephen.Jones@ofcom.org.uk) attaching your response in Microsoft Word format, together with a consultation response coversheet.
- A1.4 Responses may alternatively be posted or faxed to the address below, marked with the title of the consultation.
- Stephen Jones  
Floor 3:105  
Spectrum Policy Group  
Riverside House  
2A Southwark Bridge Road  
London SE1 9HA
- Fax: 020 7981 3333
- A1.5 Note that we do not need a hard copy in addition to an electronic version. Ofcom will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.
- A1.6 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 4.1. It would also help if you can explain why you hold your views and how Ofcom's proposals would impact on you.

## Further information

- A1.7 If you want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact Stephen Jones on 020 7783 4524

## Confidentiality

- A1.8 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, [www.ofcom.org.uk](http://www.ofcom.org.uk), ideally on receipt. If you think your response should be kept confidential, can you please specify what part or whether

all of your response should be kept confidential, and specify why. Please also place such parts in a separate annex.

- A1.9 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and will try to respect this. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.
- A1.10 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's approach on intellectual property rights is explained further on its website at <http://www.ofcom.org.uk/terms-of-use/>

## Next steps

- A1.11 Following the end of the consultation period, Ofcom intends to publish a statement in December 2015.
- A1.12 Please note that you can register to receive free mail Updates alerting you to the publications of relevant Ofcom documents. For more details please see: <http://www.ofcom.org.uk/email-updates/>

## Ofcom's consultation processes

- A1.13 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information please see our consultation principles in Annex 2.
- A1.14 If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at [consult@ofcom.org.uk](mailto:consult@ofcom.org.uk) . We would particularly welcome thoughts on how Ofcom could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, who are less likely to give their opinions through a formal consultation.
- A1.15 If you would like to discuss these issues or Ofcom's consultation processes more generally you can alternatively contact Graham Howell, Secretary to the Corporation, who is Ofcom's consultation champion:

Graham Howell  
Ofcom  
Riverside House  
2a Southwark Bridge Road  
London SE1 9HA

Tel: 020 7981 3601

Email [Graham.Howell@ofcom.org.uk](mailto:Graham.Howell@ofcom.org.uk)

## Annex 2

# Ofcom's consultation principles

A2.1 Ofcom has published the following seven principles that it will follow for each public written consultation:

### Before the consultation

A2.2 Where possible, we will hold informal talks with people and organisations before announcing a big consultation to find out whether we are thinking in the right direction. If we do not have enough time to do this, we will hold an open meeting to explain our proposals shortly after announcing the consultation.

### During the consultation

A2.3 We will be clear about who we are consulting, why, on what questions and for how long.

A2.4 We will make the consultation document as short and simple as possible with a summary of no more than two pages. We will try to make it as easy as possible to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

A2.5 We will consult for up to 10 weeks depending on the potential impact of our proposals.

A2.6 A person within Ofcom will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. Ofcom's 'Consultation Champion' will also be the main person to contact with views on the way we run our consultations.

A2.7 If we are not able to follow one of these principles, we will explain why.

### After the consultation

A2.8 We think it is important for everyone interested in an issue to see the views of others during a consultation. We would usually publish all the responses we have received on our website. In our statement, we will give reasons for our decisions and will give an account of how the views of those concerned helped shape those decisions.

## Annex 3

# Consultation response cover sheet

- A3.1 In the interests of transparency and good regulatory practice, we will publish all consultation responses in full on our website, [www.ofcom.org.uk](http://www.ofcom.org.uk).
- A3.2 We have produced a coversheet for responses (see below) and would be very grateful if you could send one with your response (this is incorporated into the online web form if you respond in this way). This will speed up our processing of responses, and help to maintain confidentiality where appropriate.
- A3.3 The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore Ofcom would encourage respondents to complete their coversheet in a way that allows Ofcom to publish their responses upon receipt, rather than waiting until the consultation period has ended.
- A3.4 We strongly prefer to receive responses via the online web form which incorporates the coversheet. If you are responding via email, post or fax you can download an electronic copy of this coversheet in Word or RTF format from the ‘Consultations’ section of our website at <http://stakeholders.ofcom.org.uk/consultations/consultation-response-coversheet/>.
- A3.5 Please put any parts of your response you consider should be kept confidential in a separate annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your cover sheet only, so that we don’t have to edit your response.

**Cover sheet for response to an Ofcom consultation**

**BASIC DETAILS**

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

**CONFIDENTIALITY**

Please tick below what part of your response you consider is confidential, giving your reasons why

Nothing  Name/contact details/job title

Whole response  Organisation

Part of the response  If there is no separate annex, which parts?

If you want part of your response, your name or your organisation not to be published, can Ofcom still publish a reference to the contents of your response (including, for any confidential parts, a general summary that does not disclose the specific information or enable you to be identified)?

**DECLARATION**

I confirm that the correspondence supplied with this cover sheet is a formal consultation response that Ofcom can publish. However, in supplying this response, I understand that Ofcom may need to publish all responses, including those which are marked as confidential, in order to meet legal obligations. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

Ofcom seeks to publish responses on receipt. If your response is non-confidential (in whole or in part), and you would prefer us to publish your response only once the consultation has ended, please tick here.

Name

Signed (if hard copy)

## Annex 4

# Consultation questions

- A4.1 This document identifies VHF spectrum that could be used for M2M applications, particularly in remote and rural locations. We would like to know if stakeholders think conditions associated with our business radio licence products are suited to M2M applications in the 55.75-68 MHz, 70.5-71.5 MHz and 80-81.5 MHz bands or should we change these?

*Q1. Do you agree that the spectrum we have identified (in figures 4.2 and 4.3 above) is suitable for M2M applications for remote and rural locations?*

*Please provide as much information as possible on likely applications.*

*Q2. Do you agree with our analysis that encouraging new IoT uses in the bands 55.75625-60 MHz, 62.75625-64.8 MHz and 64.8875-66.2 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz should still leave sufficient spectrum to meet demands for Business Radio in the VHF range?*

*Q3. Do you think the conditions associated with the current range of BR licences available now should change to facilitate new IoT services uses? If you do, what should these changes be?*

*Q4. Do you think we should create a new licence product specifically for IoT services?*

## Annex 5

# Impact Assessment

## Introduction

- A5.1 The analysis presented in this section 4 represents an impact assessment, as defined in section 7 of the Communications Act 2003 (the Act).
- A5.2 You should send any comments on this impact assessment to us by the closing date for this consultation. We will consider all comments before deciding whether to implement our proposals.
- A5.3 Impact assessments provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policy-making. This is reflected in section 7 of the Act, which means that generally we have to carry out impact assessments where our proposals would be likely to have a significant effect on businesses or the general public, or when there is a major change in Ofcom's activities. However, as a matter of policy Ofcom is committed to carrying out and publishing impact assessments in relation to the great majority of our policy decisions. For further information about our approach to impact assessments, see the guidelines, Better policy-making: Ofcom's approach to impact assessment, which are on our website:  
[http://www.ofcom.org.uk/consult/policy\\_making/guidelines.pdf](http://www.ofcom.org.uk/consult/policy_making/guidelines.pdf)

## The citizen and/or consumer interest

- A5.4 We want to encourage IoT investment and innovation in particular at 55-68 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz. These particular frequencies could be used by M2M applications to enable wireless operation over long distances. This will enable them to connect locations that can be hard to reach using the higher frequency bands already opened for the IoT.
- A5.5 Greater access to spectrum within the VHF range could open new opportunities for investment and innovation in the IoT sector for M2M applications. We think this could bring significant benefits to citizens and consumers, especially those in remote and rural parts of the UK, through development of:
- wirelessly connected 'smart' farming
  - coastal/maritime applications: fishing, fish farming, environmental sensing, shipping, boating
  - land/agriculture applications: agricultural equipment, crop management, livestock management; and
  - new energy sources.
- A5.6 In addition to the above, spectrum within the VHF range could provide a means to deliver aspects of safety-related communications in rural areas.

## Ofcom's policy objective

- A5.7 In our January statement “Promoting investment and innovation in the Internet of Things”<sup>32</sup> we said that our existing initiatives, like making spectrum available in the 870/915MHz bands and liberalising licence conditions for existing mobile bands, will help to meet much of the short to medium term spectrum demand for IoT services.
- A5.8 We also said that different spectrum and network solutions are likely to be needed to meet the different operational requirements of the range of IoT services.
- A5.9 Our aim is to encourage investment and innovation in the IoT using 10.1 MHz of spectrum within the 55-68 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz bands by using our existing licence products.
- A5.10 We want to see M2M applications using spectrum in these VHF ranges to enable them to connect wirelessly over longer distances than at present. This will enable them to connect locations that can be hard to reach using the higher frequency bands we have already opened for the IoT.
- A5.11 If stakeholders support our proposals we anticipate that new IoT services should start to appear during 2016/17. We anticipate the demand for licences for the 55.75-68 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz bands will increase. However, we do not yet know how many licences are likely to be taken up.

### Options considered

- A5.12 Our existing BR licence products for the VHF band already support a wide range of business users from taxi companies and factories, to hospitals, care homes, industrial sites and transport operators.
- A5.13 One option is therefore to continue to offer this range of BR licences without change.
- A5.14 A second option is to create a more liberal licence product to encourage new innovative IoT services for consumers.
- A5.15 We have set out a range of possible changes to the conditions associated with BR licences or in any of the related documents (e.g. the relevant Interface Requirements) are suited to IoT services in the 55.75-68 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz bands
- A5.16 Other licence options for IoT services using the 55.75-68 MHz, 70.5-71.5 MHz and 80.0-81.5 MHz bands include:
- a new licence product dedicated to IoT services
  - exempting IoT services from individual licensing

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<sup>32</sup> See <http://stakeholders.ofcom.org.uk/consultations/iot/>

## Annex 7

# Glossary

- ADS** (Audio Distribution Service)      Equipment for transmitting audio content.
- BR** (Business Radio)      Use of radio for business purposes. Business radio users range from taxi companies and factories, to hospitals, care homes, industrial sites and transport operators.
- CCIR** (The Consultative Committee on International Radio)      Former technical advisory group within the International Telecommunications Union (ITU), that provided Recommendations, technical advice, and technical information related to the allocation and use of the radio spectrum.
- CEPT** (Conference of European Postal and Telecommunications Administrations)      CEPT is the European regional organisation dealing with postal and telecommunications issues.
- CTCSS** (Continuous Tone-Coded Squelch System)      A circuit that is used to reduce the annoyance of listening to other users on a shared two-way radio communications channel.
- dBm**      An abbreviation for the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW).
- dB $\mu$ V/m**      Radio signal field strength expressed in decibel-microvolts per meter.
- DCS** (Digital-Coded Squelch)      A digital replacement for CTCSS. DCS code is used in a group of radios to reduce the annoyance of listening to other users on a shared two-way radio communications channel.
- DVB-T** (Terrestrial Digital Video Broadcasting)      European-based consortium standard for the broadcast transmission of digital terrestrial television.
- E.R.P.** (Effective Radiated Power)      This is the product of the power supplied to the antenna and the antenna gain in a given direction.
- IoT** (Internet of things)      Refers to the interconnection [wirelessly] of uniquely identifiable embedded computing-like devices within the existing Internet infrastructure.
- IR** (Interface Requirements)      Published by Ofcom, these provide a link between the requirements of the R&TTE Directive and how spectrum is used nationally for radio equipment.
- ITU** (International Telecommunication Union)      The ITU is the United Nations specialized agency for information and communication technologies.
- ITU-R** (International Telecommunication Union Radiocommunication sector)      One of the three sectors (divisions or units) of the International Telecommunication Union (ITU) and is responsible for radio communication.
- ITU-R Recommendations**      The ITU-R Recommendations constitute a set of international technical standards developed by the Radiocommunication Sector (formerly CCIR) of the ITU.

**kHz** (Kilohertz) A measurement of frequency in the International System of Units (SI). It is defined as  $1 \times 10^3$  cycles per second.

**km** (Kilometre) A unit of length in the metric system, equal to one thousand metres (kilo-being the SI prefix).

**LAN** (Local Area Network) A computer network that spans a relatively small area.

**LTE** (Long term Evolution) A standard for wireless communication of high-speed data for mobile phones and data terminals.

**MHz** (Megahertz) A measurement of frequency in the International System of Units (SI). It is defined as  $1 \times 10^6$  cycles per second.

**MoU** (Memorandum of Understanding) A formal agreement between two or more parties.

**M2M** (Machine to Machine) Refers to technologies that allow both wireless and wired systems to communicate with other devices of the same type.

**PMR** (Private Mobile Radio) Radio communications systems which use portable, mobile, base station and dispatch console radios.

**PMSE** (Programme Making and Special Events) Equipment that is used to support broadcasting, news gathering, theatrical productions and special events.

**R&TTE Directive** (Radio and Telecommunications Equipment Directive) Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications equipment and the mutual recognition of their conformity.

**T&D** (Test and Development) This term is still used colloquially for a licence granted by Ofcom under the Non-Operational Development class of licence, for non-operational use of radio spectrum for innovative purposes.

**UK** United Kingdom

**VHF** (Very High Frequency) Spectrum between 30 MHz and 300 MHz.

**VHF Band One** Frequencies within the 55.75-68 MHz range

**VHF Low Band** Frequencies within the 68.08125–87.49375 MHz range

**WiFi** The name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections. Wi-Fi is a trademarked phrase for the standards IEEE 802.11x.

**WPR** (Wind Profiling Radar) A type of weather observing equipment that uses radar or sound waves to detect the wind speed and direction at various elevations above the ground.