



Review of the Spectrum  
Management Approach in the 71-  
76 GHz and 81-86 GHz bands  
Consultation on the future management approach for  
the 70 / 80 GHz bands

Consultation

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Closing Date for Responses: 14 October 2013



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## Section 1

# Summary

- 1.1 This consultation proposes changes to the management and authorisation approach within the 71 – 76 GHz and 81 – 86 GHz (“70 / 80GHz”) bands. The 70/80 GHz spectrum has been used in the UK for Fixed Service applications since 2007 and offers access to 2 x 4.75 GHz of bandwidth and the ability to deploy fixed link applications with very high capacity capabilities that are not supported in the lower microwave bands (e.g. 1 Gbit/s and above).
- 1.2 At present a self coordinated licensing approach is used to authorise use in these bands and while the spectrum has been available in the UK for the past six years it is still a relatively new band in terms of technology and deployment development, when compared with the lower frequency bands used for fixed links.
- 1.3 Under the self coordinated licensing approach licensees have responsibility to coordinate new links with existing deployments in the band. The approach enables the use of this spectrum in a highly flexible way for point to point links, including mobile backhaul. This flexibility has enabled the spectrum to be used and developed in innovative ways over the past six years with the band seeing a rapid increase in link registrations and interest over the past year, particularly from the enterprise user community. However, the Spectrum Review, completed last year, identified that there was a perception among some stakeholders that the current self coordinated approach at 70 / 80 GHz does not offer the certainty that is required for the high availability (99.99% - 99.999%) applications, specifically in relation to the support of 4G networks.
- 1.4 The changes we are proposing are designed to provide a balance between the different user communities and sufficient interference management assurance for those stakeholders wishing to deploy high availability (e.g. 99.99% availability and above) backhaul for 4G network services. The review forms a major work item in Ofcom’s 2013/14 annual plan.
- 1.5 The proposals for consultation involve a mixed management approach for the bands, essentially segmenting the available spectrum into two paired blocks which:
  - a) Preserves the current self coordinated licensed authorisation model in the higher portion of the spectrum band for stakeholders that wish to continue to exploit this very flexible regulatory environment and;
  - b) Extends the existing Ofcom coordinated fixed link licence product into the lower portion of this band, offering the same coordinated and interference managed access as available in other lower frequency bands available for fixed links.
- 1.6 The proposed new spectrum plan for management of the band is provided below with the following allocations:
  - **Ofcom coordinated approach:** 2 x 2 GHz
  - **Guard band:** 2 x 250 MHz
  - **Self coordinated approach:** 2 x 2.5 GHz



- 1.7 Our proposals include measures to adapt to future demand evolution in light of actual deployments made over the next few years. They also allow for ‘grandfathering’ arrangements for existing self coordinated links that fall within the new Ofcom proposed coordinated spectrum.
- 1.8 We welcome stakeholder feedback to this consultation document. The deadline to submit responses to us is 5 pm on 14 October 2013. We expect to release a Statement on this consultation in December 2013 having taken into account stakeholder responses to our proposals.

## Section 2

# Introduction

## About this Consultation

- 2.1 This consultation sets out Ofcom's proposals to change the way in which the spectrum between 71-76 GHz and 81 – 86 GHz is managed in the UK following on from Ofcom's Spectrum Review<sup>1</sup> work last year.
- 2.2 The 70/80GHz bands are currently available in the UK and used for point to point fixed links under the self coordinated licence type.
- 2.3 The Spectrum Review conducted by Ofcom last year considered the management of spectrum that is used by fixed point to point links covering a range of frequency bands between 1.4 GHz and 86 GHz. The review identified a number of key priorities of which the need to review the future management of the 70 / 80 GHz spectrum was most urgent due to the changing nature of demand for this spectrum and recognising the bands as potentially important for the deployment of high capacity, high availability 4G backhaul.
- 2.4 At present a self coordinated licensing approach is used to authorise use in these bands. Under this approach licensees have responsibility to coordinate new links with existing deployments in the band. The approach enables the use of this spectrum in a highly flexible way for point to point links, including mobile backhaul. However the Spectrum Review identified that there was a perception among some stakeholders that the current self coordinated approach at 70 / 80 GHz does not offer the certainty that is required for the high availability (99.99% - 99.999%) applications used to support 4G networks.
- 2.5 This consultation considers the regulatory approaches best suited to provide the most efficient and appropriate authorisation arrangements for all users of the band, taking into account the needs of both existing and potential new uses.
- 2.6 In this document we detail the different approaches that Ofcom has considered for the future management of this spectrum. We then set out our proposals for band. Our analysis has been informed by an extensive stakeholder engagement exercise conducted prior to this consultation. We are now formally consulting on our proposals as set out in this document.

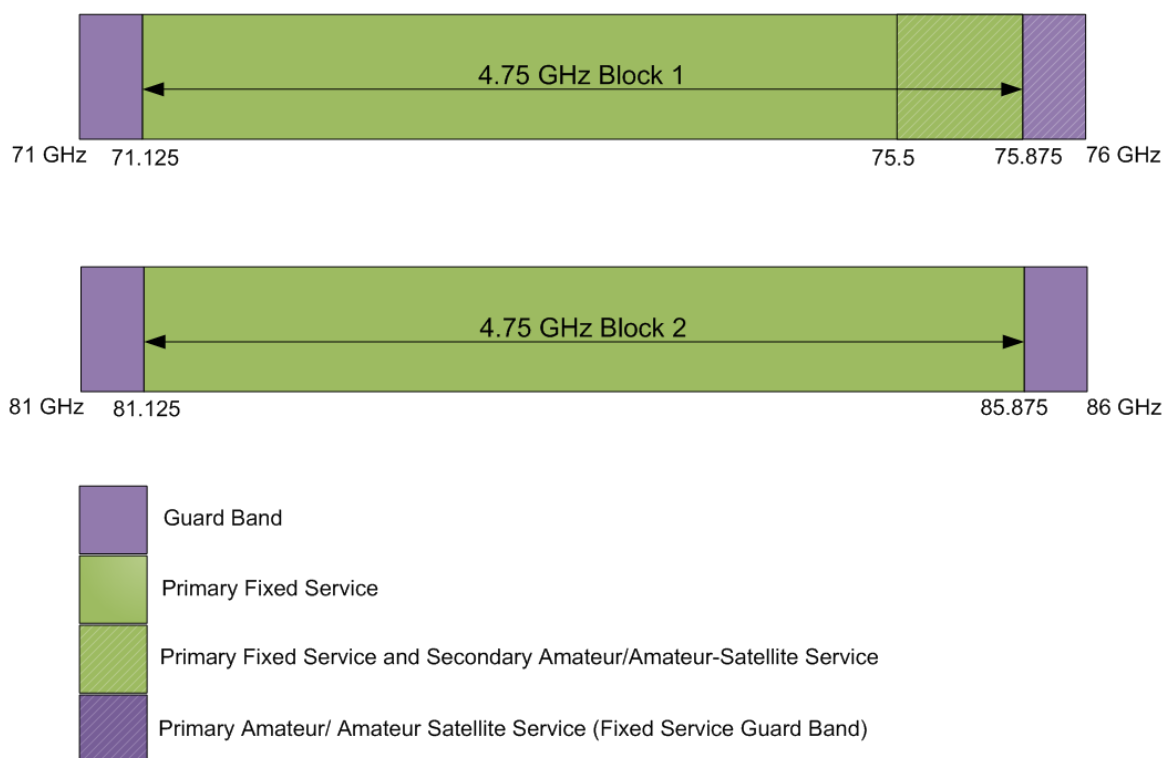
## The Spectrum under Review

- 2.7 The spectrum available in the bands allocated to the Fixed Service<sup>2</sup> currently provides access to 2 equal blocks of 4.75 GHz in each sub-band with a 125 MHz guard band at the end of each block as shown in figure 1.

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<sup>1</sup> <http://stakeholders.ofcom.org.uk/consultations/spectrum-review/>

<sup>2</sup> Radio Regulations 1.20 definition of *fixed service*: A radiocommunications service between two specified fixed points.



**Figure 1: Spectrum Under Review**

## **Statutory Framework - Promoting Optimal Use of the 70 / 80 GHz Bands**

- 2.8 The following paragraphs set out Ofcom key principles regarding spectrum management that were followed during the development of our proposals in this consultation document.
- 2.9 Section 3(1) of the Communications Act provides that our principal duties in carrying out our functions are:
- to further the interests of citizens in relation to communication matters; and
  - to further the interest of consumers in relevant markets, where appropriate, by promoting competition.
- 2.10 Directly relevant to spectrum management, Ofcom is required to secure the optimal use for wireless telegraphy of electro-magnetic spectrum. While in carrying out our spectrum management duties Ofcom must have particular regard to the different needs and interests of all persons who wish to make use of spectrum.
- 2.11 In performing our duties, Ofcom must have regard to the principles under which regulatory activities should be transparent, accountable, proportionate and consistent and targeted only at cases in which action is needed.
- 2.12 In the UK, Ofcom is responsible for the authorisation of civil use of the radio spectrum and achieve this by granting wireless telegraphy licences under the Wireless Telegraphy Act 2006 (the “WT Act”) and by making Regulations exempting users of particular equipment from the requirement to hold such a licence. Under

section 8(1) of the WT Act, it is an offence to install or use apparatus without holding a licence granted by Ofcom. Section 8(3) enables Ofcom to make regulations exempting apparatus from the requirement to hold a licence under section 8(1) either absolutely or subject to such terms, provisions and limitations as may be specified. Under section 8(4) of the WT Act, Ofcom must make regulations to exempt equipment if it is unlikely to cause undue interference. For these purposes, interference with wireless telegraphy is not to be regarded as undue unless it is also harmful.

2.13 In carrying out our radio spectrum functions, we must have particular regard to:

- availability of spectrum for use, or further use, for wireless telegraphy; and
- current and likely future demand for the use of the spectrum for wireless telegraphy.

2.14 And to the desirability of promoting:

- efficient management and use of the spectrum available for wireless telegraphy;
- economic and other benefits arising from the use of wireless telegraphy;
- development of innovative services; and competition in the provision of electronic communications services

## Additional Considerations

2.15 In development our proposals for this band we have also taken into account the following additional considerations:

- **Current use and approach.** As detailed in section 3, the 70 / 80 GHz has been available since 2007, however, it is still a relatively 'new' band, in terms of technology and deployment development, when compared with other bands available for fixed links.
- **Requirement associated with future demand:** As detailed in section 4, the Spectrum Review conclusions and the views expressed during this review are taken into account in considering our current proposals.
- **Stability and regulatory certainty:** During the Spectrum Review stakeholders gave a consistent message that due to the nature of the requirements and investment needed in meeting them, fixed link spectrum users require a stable regulatory environment in which they have a high degree of certainty about future access to spectrum. This was a key consideration for a very large proportion of spectrum users and manufacturers.

## Impact Analysis

2.16 The analysis presented in this document represents an impact assessment, as defined in section 7 of the Communications Act 2003<sup>3</sup> (the Act).

2.17 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

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<sup>3</sup> [www.opsi.gov.uk/acts/acts2003/pdf/ukpga\\_20030021\\_en.pdf](http://www.opsi.gov.uk/acts/acts2003/pdf/ukpga_20030021_en.pdf)



practice policy-making. This consultation sets out the potential impacts for stakeholders and the reasons we are making proposals for the future management of the 70 / 80 GHz spectrum.

- 2.18 Ofcom is separately required by statute to assess the potential impact of all our functions, policies, projects and practices on equality. Equality Impact Assessments (EIAs) also assist us in making sure that we are meeting our principal duty of furthering the interests of citizens and consumers regardless of their background or identity. We do not consider the impact of the proposals in this consultation to be to the detriment of any group within society.

## **Structure of this Document**

- 2.19 In the subsequent sections of this document we detail the current management approach and use within the band. We also give an overview of the Spectrum Review highlighting the key messages and issues drawn from that review that specifically impact the 70 / 80 GHz spectrum. By considering specific factors that need to be taken into account for this review, we identify and assess the approaches considered following the pre-consultation stakeholder engagement exercise. We make specific proposals on which we are consulting on for the future changes to the management of 70 / 80 GHz spectrum in the UK. We finally provide an overview of how we intend to implement these proposals and what this will mean in particular for existing users of this band.

## Section 3

# The current management approach at 70 / 80 GHz and use of spectrum for fixed links

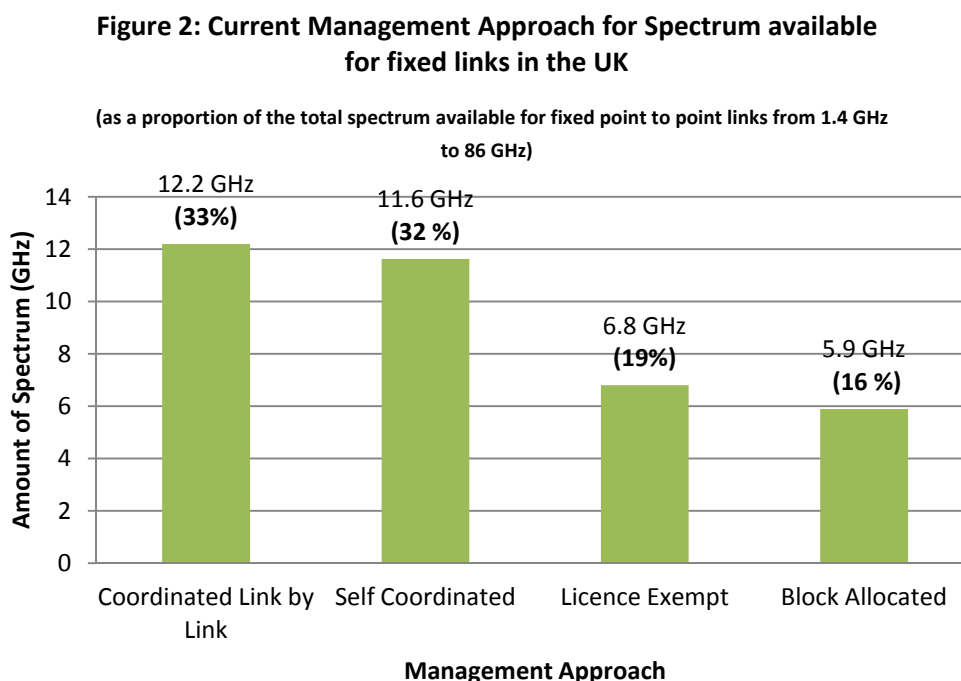
3.1 In this section we provide general background on the management of fixed link services in the UK before looking in detail at current arrangements in the 70 / 80 GHz bands.

## Management of Fixed Link Services in the UK

3.2 Approximately 37 GHz of spectrum is available in the UK for fixed terrestrial point to point links. This includes a wide variety of bands ranging from 1.4 GHz to 86 GHz. The manner in which use in each band is authorised is distinguished between:

- Ofcom coordinated: this spectrum is licensed and technically coordinated on a link by link basis and managed by Ofcom. We set the technical assignment criteria in consultation with stakeholders and we use this to coordinate the links to prevent interference. All of these fixed link bands consist of a pair of sub-bands which are used, respectively, for the 'go' and 'return' transmission paths (i.e. a frequency division duplex (FDD) arrangement). There is around 12 GHz of spectrum in this category spread across fourteen separate bands between 1.4 GHz and 55 GHz. Bands between 1.4 GHz and 38 GHz have significant use with the largest deployment at 38 GHz. The 52 GHz and 55 GHz bands remain unused.
- Self coordinated licensed: individual licences are issued by Ofcom, but the licensees themselves have responsibility for assigning and coordinating their links. Ofcom does not specify the channel arrangements in these bands and licensees have flexibility and the freedom to choose the channel size. In the 65 GHz, 70 GHz and 80 GHz bands, a self coordinated approach applies and this is described in detail later in this section. There is around 12 GHz of spectrum in this 'light' licensed category at 64-66 GHz, 71-76 GHz and 81-86 GHz. This includes the light licensed 5.8 GHz band where self coordination does not apply.
- Licence Exempt: users of licence exempt spectrum must comply with general conditions intended to prevent or minimise interference, but there is no requirement for users to coordinate between each other or to notify Ofcom of planned use. There is around 7 GHz of licence exempt spectrum available in the 57 - 64 GHz band which benefits from high atmospheric oxygen absorption and so allows intensive short hop frequency reuse.
- Block allocated / Awarded spectrum: around 6 GHz of spectrum which is suitable for fixed links use is licensed to and managed by 3<sup>rd</sup> parties. The largest part of this was acquired by licensees through the "10-40 GHz" auction that took place in 2008; other blocks in the 28 GHz band were acquired through an earlier auction in 2000. In addition, there is a UK wide licence for two large blocks of spectrum in part of the 4 GHz band. The licensees have wide discretion over the management of the spectrum in question.

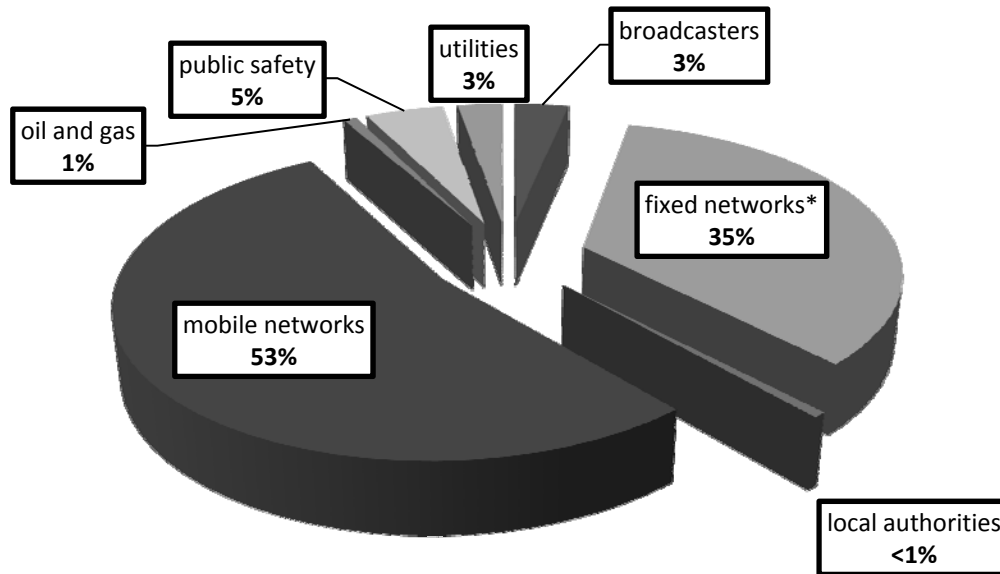
3.3 Figure 2 below shows the proportionate split amongst the management approaches.



### Current use of fixed link bands in the UK

3.4 As indicated by the Spectrum Review, Fixed point to point links are used by a variety of industry sectors. Figure 3, gives an approximate distribution of the user types within the bands which are coordinated on a link by link basis by Ofcom. The user types are based on the core business activity of the licensee. It can be seen that the predominant application is within mobile networks (for backhaul). In practice, the analysis understates the predominance of mobile network applications as many of the links assigned to fixed network operators are used to provide outsourced services to the mobile network operators. The Spectrum Review indicated that more than 80% of fixed links in use in the UK are for the provision on mobile backhaul predominantly for 3G.

**Figure 3: Approximate distribution of fixed link use by user types**



\* The majority of links licensed to fixed network licensees are used for mobile backhaul

- 3.5 The use of the spectrum in these bands (55 GHz and below) for mobile backhaul applications is limited to smaller channel sizes with a maximum channel size of 56 MHz currently available to stakeholders via Ofcom's frequency assignment service<sup>4</sup>. While the technology in these conventional microwave bands has advanced over time, in recent years there has been a general trend in utilising larger channels to increase link capacity. The demand for higher data rates poses challenges in specific parts of the network regarding the suitability of conventional microwave spectrum. Typically, a 56 MHz channel can deliver around 311 Mbit/s<sup>5</sup> when using one signal polarisation whereas at 70 / 80 GHz, larger channel sizes are supported where a data-rate of 2.8 Gbit/s<sup>6</sup> can be achieved in a 500 MHz channel for example. This makes spectrum at 70 / 80 GHz attractive for high capacity 4G backhaul applications.

## Current Use and Management Approach at 71-76 GHz and 81-86 GHz

- 3.6 The spectrum between 71-76 GHz and 81-86 GHz is allocated to the Fixed Service on an international basis in the ITU<sup>7</sup> Radio Regulations. Recognising the emerging interest in the use of this spectrum for broadband point to point Fixed Service applications, Ofcom published a consultation in May 2006 on making spectrum available in the 70 / 80 GHz bands<sup>8</sup>.
- 3.7 Following the May 2006 consultation, we detailed in our Statement of November 2006 the regulatory rules and management approach and opened the 70 / 80 GHz

<sup>4</sup> Ofcom is planning to offer frequency assignments in 110 and 112 MHz channels

<sup>5</sup> OfW 446 Technical Frequency Assignment Criteria for Fixed Point-to-Point Radio Services with Digital Modulation

<sup>6</sup> Final Draft ETSI EN 302 217-2-2 v2.1.0 (2013-04)

<sup>7</sup> International Telecommunications Union

<sup>8</sup> <http://stakeholders.ofcom.org.uk/consultations/71-86ghz/>

bands for licensing in March 2007 on a self coordinated basis. The approach allows for high levels of flexibility and quick authorisation and, it is generally recognised that this has enabled the market to develop and innovate during this time. More detail on the current arrangements is set out below.

- 3.8 In opening the band in 2007, we indicated that the self coordinated approach was a new and innovative approach to authorising this type of use and that we would review the arrangements should the need arise in the future.
- 3.9 As indicated by stakeholders during this review spectrum in the 70 / 80 GHz range is of particular interest now due to a combination of the following:
- **Properties of the spectrum:** A large amount of spectrum is available in this band to deliver very high capacity data along a single radio path relative to conventional microwave spectrum. Based on information provided to us typical channel sizes required for emerging use at 70 / 80 GHz are over 17<sup>9</sup> times larger than those typical in conventional microwave spectrum for fixed links creating the capability to transfer very high data rates of 1 Gbit/s and above. The spectrum is above the oxygen absorption curve at 60 GHz and link lengths possible at 70 / 80 GHz are similar to some conventional fixed links at 38 GHz.
  - **Equipment innovation:** Equipment available for this spectrum has evolved significantly. It delivers high data rates (1 Gbit/s and above) in comparison conventional microwave spectrum, and also offers small equipment sizes features that offer additional reliability e.g. adaptive modulation, use of smaller channel sizes, advanced modulation techniques, low latency, low power consumption. All of which make the 70 / 80 GHz bands attractive additional choice by operators for backhaul.
  - **Network evolution from 3G to 4G and beyond with the need for reliable high capacity data:** network evolution to deliver 4G mobile services has placed a greater requirement for increasing capacity to support the demand for high capacity mobile data. Macro layer requirements of 1 Gbit/s and above, which can be challenging in conventional microwave bands can effectively be delivered by using 70 / 80 GHz spectrum where the fibre alternative is not available or is not a cost effective solution.

## The Self Coordinated Approach

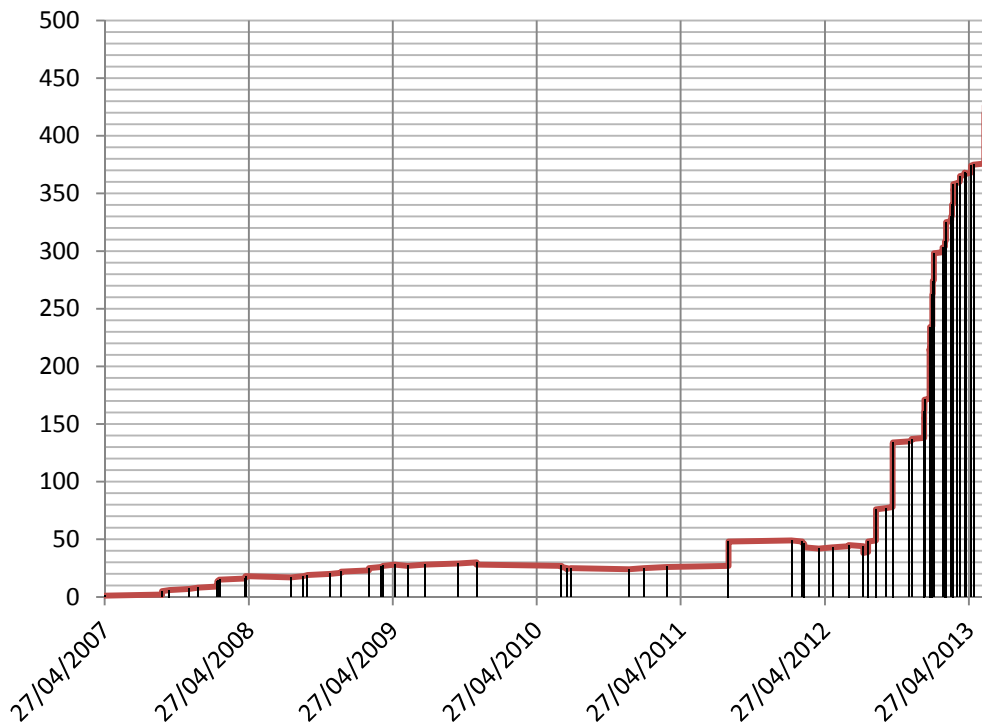
- 3.10 As described above, the current regulatory approach for 70 / 80 GHz has been designed to offer flexibility to the licensee. The key elements of the approach are:
- Ofcom has made available the self coordinated licence type Wireless Telegraphy Act licence which permits licensees to use links in the band subject to the prior coordination and registration of each link.
  - Links must be registered in public register (the Wireless telegraphy Register) containing information on all link deployment in the band.
  - Links can only be registered if the licensee has assessed that their deployment will not cause undue interference to existing users of the band.

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<sup>9</sup> Assumed typical fixed link channel of 28 MHz and based on information provided by stakeholders, typical 70 / 80 GHz channel planned for use for emerging applications is 500 MHz

- 3.11 If an interference case is reported to Ofcom, we would investigate this and issues regarding priority of access would be resolved by affording priority to the link registered on the earliest date. In practice we would hope that any issues could be resolved by further coordination between licensees.
- 3.12 The licensing and link registration process is currently under a largely manual arrangement. The approach enabled Ofcom to open the band in a timely manner in 2007 and has remained in place to date. In this consultation we are seeking views on the type of improvements the current self coordinated approach would benefit from.
- 3.13 The 70 / 80 GHz spectrum is currently used for fixed point to point links. To date, the applications dominating the market are for enterprise solutions e.g. Campuses (businesses, health, education); Security (CCTV); Computing (distributed servers / storage, cloud computing, LAN extension), last mile connectivity to replace fibre and for high frequency trading (a specialist application in support of the financial markets where low latency is a key consideration). Technology is also now rapidly evolving for use in this band with the availability of high capacity / lower bandwidth equipment and with reducing equipment costs.
- 3.14 There are currently over 500 links registered within the bands. The graph<sup>10</sup> (figure 4) below shows the number of registrations since the spectrum was made available in the UK and it can be observed that there has been a significant increase in registration of links in the bands since the second half of 2012.

**Figure 4: 70 / 80 GHz total registrations (extract 27/6/2013)**



<sup>10</sup> Note that all 70 / 80 GHz analysis in this consultation is based on data extracted from the 70 / 80 GHz section of the Wireless Telegraphy register on 27 June 2013.

## Section 4

# Stakeholder Feedback on 70 / 80 GHz

4.1 In this section we summarise relevant feedback received during the wider Spectrum Review and the subsequent stakeholder engagement process in relation to the 70/80 GHz bands.

## The 2012 Strategic Review of Spectrum used by Fixed Links

4.2 In 2012 Ofcom decided to undertake a strategic review of frequency bands used by fixed links as evidence was starting to emerge that demand for some of these spectrum bands may change significantly over the next 5 to 10 years. We wanted to understand the nature and timing of these changes so that we could ensure that spectrum resources were available on terms which best reflect the needs of users. The main purpose of the spectrum review was been to help inform the development of our strategy at three levels;

- i) Allocation decisions to do with which services should have access to which bands, and on what terms, particularly in the context of Ofcom's involvement with international decision making bodies;
- ii) UK band management strategy, including the extent to which Ofcom should delegate spectrum management to third parties as opposed to Ofcom managing these bands;
- iii) Development and innovation in licence products offered in the bands which Ofcom continues to manage (such as the application of pricing and design of licence products).

4.3 A full copy of the Spectrum Review Update on Key Messages and Next Steps<sup>11</sup> can be found on the Ofcom website.

## Relevant Stakeholder Messages from the Spectrum Review

4.4 The dominant use of the Ofcom managed spectrum currently used by fixed links is for the provision of backhaul within mobile networks, accounting for more than 80% of the current fixed link licence base. There was widespread stakeholder recognition that this use is likely to undergo significant change over the next few years, particularly as 4G networks are established to meet a rapid growth in demand for mobile data capacity. While many stakeholders expect rollout of fibre to continue, there was a clear view, widely held, that wireless backhaul will continue to play an important and significant role. We noted that many stakeholders foresee an increasing use of wireless links in dense urban areas to serve high capacity small cell backhaul to mobile base stations where wireless connectivity enables rapid initial deployment and subsequent flexibility which fibre may not be able to match. The very large capacity demands of such cells, and small scale topology, is expected by many to increase demand for higher frequency bands in preference to the lower bands (e.g. 26 GHz) which have until recently been subject to greatest demand.

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<sup>11</sup> <http://stakeholders.ofcom.org.uk/consultations/spectrum-review/update/>

- 4.5 The millimetre wave bands above 60 GHz, in particular, which are currently available on a self coordinated basis, were identified by some as particularly suitable for high capacity, short range applications within mobile networks. The Spectrum Review reported a high level of interest in the potential use of the 71-76 GHz and 81-86 GHz bands for the provision of backhaul in new 4G networks.
- 4.6 The Spectrum Review also concluded that the overall the balance of management approaches did not require further change. In particular, there was no further demand indicated for additional licence exempt spectrum for the fixed link sector.
- 4.7 The most important area of requested change related to the licensing of the 71-76 GHz and 81-86 GHz bands; the urgency and importance of this issue being connected with the observations above that the bands have a key role to play in the provision of high capacity backhaul required for 4G mobile networks.
- 4.8 Some mobile network operators and their equipment suppliers reported that the current self coordinated management regime for this band does not provide them with the level of confidence and protection that they believe is required for high availability applications. They felt that operator led coordination in shared bands could lead to extended dispute resolution discussions. On this basis some argued that Ofcom should more actively manage these bands.
- 4.9 The issues raised and views expressed from Spectrum Review by potential users and some vendors included:
- A perceived threat of interference with the current self coordinated approach and the requirement for them to directly coordinate with competitors which is currently hindering stakeholders that require high availability fixed links from accessing the band;
  - A view that interference should be centrally managed on a coordinated basis or block allocated for self use;
  - A concern that there is not enough coordinated spectrum suitable for backhaul available in the higher bands;
  - An expected increase in demand expected to cater for 4G mobile backhaul which will require access to high capacity fixed links (1 Gbit/s and above) towards the end of 2013;
  - That technology has advanced significantly over the last few years to allow large capacity (1 Gbit/s and above) capabilities using higher order modulation coupled with lower bandwidth requirements. Equipment cost is reducing and there is significant interest in using the band.
- 4.10 Following on from the Spectrum Review, Ofcom began work on the review of the 71-76 GHz and 81-86 GHz bands as the highest priority emerging from that review.

### **Subsequent Stakeholder Feedback.**

- 4.11 In developing the proposals set out in this consultation we have conducted an extensive programme of engagement with a wide range of stakeholders. Stakeholders included existing users / licensees of the band, future users of the band and vendors of 70 / 80 GHz equipment. In addition we have also utilised the Fixed Wireless Industry Liaison Forum (FWILF) on 30<sup>th</sup> November 2012 and 7<sup>th</sup> June 2013



to update stakeholders and discuss ideas. We have also carried out our own analysis and this has enabled us to identify a number of possible approaches that are discussed further in section 5.

4.12 Stakeholder discussions focussed on the deployment environment that is expected when using 70 / 80 GHz for 4G backhaul and for other applications as well as on the technical characteristics of these links. We were also interested in understanding stakeholder views on the spectrum management approaches and associated regulatory and technical issues. The discussion points covered the following issues:

- **Type of deployment expected:** Understanding the types of deployment scenarios in which 70 / 80 GHz spectrum would be used by fixed links was an important area for us to examine in consideration of our options. We were particularly interested in whether 4G backhaul applications would require 70 / 80 GHz for the “small cell” and / or the “macro cell” environment as well as other applications that might utilise this spectrum in the future. We were interested to understand what “small cell backhaul” meant in practice for stakeholders and whether 70 / 80 GHz links would be required at street level and within the clutter.
- **Characteristics and planning of fixed links:** We wanted to understand the proportion of the network that would be facilitated by links at street level, the antenna technology associated with these links (specifically beam width and size i.e. the “form factor”) to help us understand how this would impact certain aspects of planning and coordination. The method of planning street level links was of particular interest in relation to the criteria that would form the basis of such planning and how the approach would deliver the desired quality of service requirements. We sought information on maximum capacity of each link anticipated for each deployment scenario expected, minimum and maximum channel bandwidth requirements, typical link lengths envisaged and propagation availability requirements in the environments concerned. Regarding availability we wanted to understand how these compare with conventional microwave links and whether 99.999% “5 nines” would still be a requirement or whether lower availabilities around 99.9% would be acceptable. Another area of interest to us was how the network topography would be supported – this is detailed below.
- **Growth in numbers and demand:** Demand is an important aspect of our consideration and we sought information in relation to numbers of links anticipated and the time period over which these links would be deployed with specific emphasis on the roll out plans over the next 1-2 yrs. We were particularly interested in forming a realistic understanding of demand for specific applications for both the enterprise and backhaul market. The enterprise market currently dominates the use of the 70 / 80 GHz bands in the UK and we wanted to understand the needs of this market especially where stakeholders have fully operational links. In relation to access to the spectrum for new uses, we wanted to explore the timescale on which these would seek to access the spectrum and, hence, the potential implications for implementing any changes to current access arrangements.
- **Why the 70 / 80 GHz bands were the spectrum of choice for 4G backhaul over other bands available:** In reviewing change of management approaches we wanted to explore the specific reasons that made 70 / 80 GHz a candidate for 4G backhaul. Specifically we were interested in understanding whether or not spectrum in the 52 GHz and 55 GHz bands (which are currently available and coordinated by Ofcom for fixed links) were being considered for the types of applications envisaged and the associated rationale.

- **Channel arrangements:** The European Conference of Postal and Telecommunications Administrations (CEPT) has specified recommended channel arrangements for the 70 / 80 GHz bands in CEPT Recommendation ECC/REC/(05)07. These channels arrangements cover various options including single band and cross band duplex for Frequency Division Duplex (FDD) applications and channel slots for Time Division Duplex (TDD) applications. In planning the spectrum we wanted to know the type of duplex arrangements which would be required for FDD applications and in particular whether TDD applications would be used for 4G backhaul solutions. While Ofcom does not currently implement a channel arrangement for this band, we asked stakeholders for their views on this subject and on whether Ofcom should consider implementing the CEPT channel arrangement in the UK.
- **Evolution in 70 / 80 GHz equipment:** When the 70 / 80 GHz bands were made available in the UK, the 1<sup>st</sup> generation equipment implemented lower order (e.g. 2 state) modulation schemes which require wide channels to provide high data rates. Equipment has since evolved to enable higher order modulation schemes using smaller channel sizes. In consideration of the possible approaches and noting that both 1<sup>st</sup> and 2<sup>nd</sup> generation equipment is currently used at 70 / 80GHz today, it is important to take into consideration the type of equipment planned to be used and how this will likely develop in the future.
- **Other applications envisaged:** Although the discussion points focussed on 4G backhaul as the primary driver for the review, we wanted to understand the importance of 70 / 80 GHz for other applications (present and future). For example there has been a significant and sudden increase in the use of 70 / 80 GHz for high frequency trading applications.
- **The current management approach:** We were interested in detailed discussions on the extent to which the current self coordinated approach meets the needs of current licensees. The current approach has not yet been developed beyond the initial implementation which was always envisaged as a temporary solution to enable use of the band to get under way. Accordingly, we were interested in how the self coordinated approach could be improved and in whether such improvements could alleviate those concerns that might inhibit future deployments (e.g. for 4G backhaul).
- **Ofcom's coordinated approach:** During the Spectrum Review, views indicated that the process at 70 / 80 GHz could follow the management approach that Ofcom applies in the conventional microwave spectrum within the 1.4 GHz - 55 GHz range. We wanted to discuss the views of stakeholders that proposed extending this approach to 70 / 80 GHz. We were also interested in their views regarding propagation at these frequency bands and how they envisaged assignment planning would use existing propagation models. Other points covered the process of handling large numbers of links and batch processing for 70 / 80 GHz links as well as licence fees. We also wanted to explore thinking on how Ofcom should consider coordination within the street level environment as part of the assignment process.

4.13 As part of the engagement exercise we also discussed with stakeholders a number of possible future approaches for the management of the 70 / 80 GHz bands. These are summarised in in the following sub sections along with the feedback we received in relation to each approach.

## Key Messages from Stakeholders Regarding Existing and Future use of the 70 / 80 GHz Bands

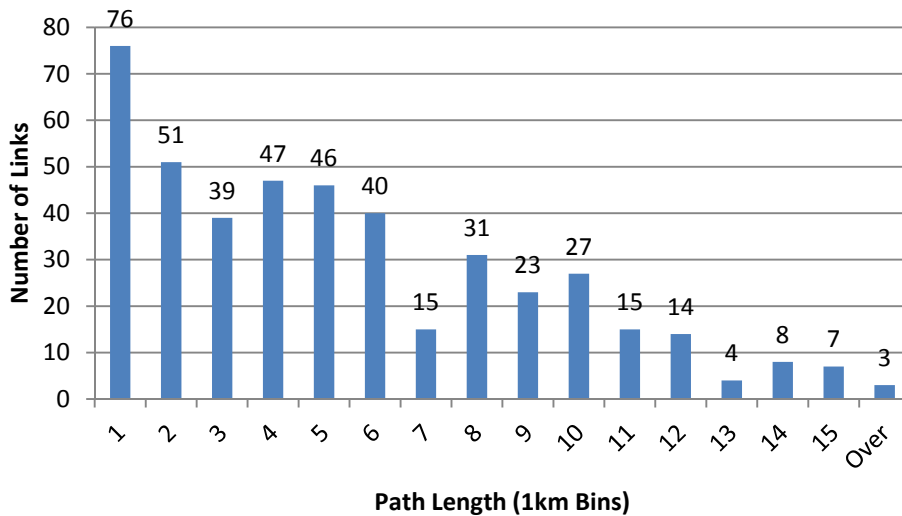
- 4.14 This section summarises the main messages from the wide ranging discussions held with stakeholders. We are grateful to all those that contributed to this process.
- 4.15 We summarise the feedback with reference to the two main market segments that have an interest in the 70 / 80 GHz bands, given that these appear to have different demands for the type of authorisation regime:
- **Enterprise:** this market dominates the existing use of the 70/80 GHz bands. It is also suggested by some stakeholders that, given the wide range of applications within this market sector (as detailed in section 3), this market will continue to increase rapidly such that it might continue to dominate the use of the band.
  - **Backhaul:** demand from mobile service providers to support the delivery of 4G mobile broadband access to customers.

### Enterprise

- 4.16 Enterprise applications currently dominate use of the bands and according to several stakeholders' feedback are likely to continue to grow as a significant market at 70 / 80 GHz. This is reflected by the volume of recent registrations for links as shown in section 3. Links are mainly used between high sites (buildings or towers) to roof level although some are occasionally used at street level, however most stakeholders indicated a preference for and have extensively used 60 GHz for street level deployment as the highly directional 70 / 80 GHz links are not suitable for deployment on structures which have some inherent movement.
- 4.17 The key messages from stakeholders delivering services for the enterprise market with links operating at 70 / 80 GHz were that:
- i) The self coordinated approach works well for them.
  - ii) They valued the flexibility of the approach. The self coordinated approach with its minimal planning and assignment rules provides flexibility for the licensee to register and deploy links to suit their requirements, whether this be FDD, TDD systems etc. The approach has also facilitated innovation within this market.
  - iii) A low link registration fee is valued because it avoids a barrier to accessing the spectrum and enables smaller companies to provide a high capacity data delivery service using this band.
  - iv) The self coordinated approach enables fast and easy access to the spectrum.
- 4.18 There were however, mixed views on the management approach from licensees registering links for high frequency trading where some preferred the self coordinated approach to the extent that the same licensee should be permitted to register self interfering links to enable them to make sensible judgements based on customer preferences and usability of channels when the link is deployed. This is particularly the case when links are used as multiple hops between two points requiring connection. While others deploying links for this application felt that an Ofcom coordinated approach was more appropriate.

- 4.19 These stakeholders highlighted that some aspects of the self coordinated approach could be improved such as mandatory build out requirements to prevent hoarding of paths. We cover improvements to the current approach in section 5. In relation to interference management, stakeholders reported that they used the register to perform interference checks to ensure the protection of links on the register and that in areas of dense use, no interference cases had arisen. Furthermore some stakeholders felt it would be beneficial to mandate the CEPT channel plan in the UK to facilitate easier and quicker coordination discussions.
- 4.20 Stakeholders also commented on the choice of equipment available to them. It was reported that there has been significant vendor innovation over the recent period that has enabled more affordable equipment in these bands and this has partly been enabled by the regulatory process for flexible, quick, easy and cost effective access to the band in the UK.
- 4.21 There seemed to be a variance in the length of links that would be expected for these bands and the link lengths appear to depend on the specific enterprise application i.e. although most links tend to be below 5 km, there are a significant number of registrations above this length, indicating that high availability (given the propagation characteristics in these bands) is not a key priority. Our analysis of link lengths on the register is shown in the distribution below:

**Figure 5: 70 / 80 GHz Path Length Distribution (register extract 27/6/13)**



- 4.22 This market also makes use of both TDD and FDD solutions and feedback suggests that requirements for both solutions should continue to be facilitated.

**Backhaul**

- 4.23 Stakeholders indicated that 70 / 80 GHz links would ideally be utilised and provided real value at the macro layer of the mobile network and therefore links are expected to be deployed above the clutter on roof tops and buildings and towers, similar to 38 GHz links in the UK, rather than in the street level environment. Several stakeholders reported that the main backhaul use will be to support the delivery of 4G mobile broadband services where very high capacity transmission (greater than 1Gbit/s per node) will be required. This, as stakeholders pointed out, is possible using 70 / 80 GHz spectrum as a single radio

link can deliver capacities which are not easily possible in the conventional microwave bands.

4.24 Stakeholders referred to the challenges posed at 70 / 80 GHz in relation the street level environment were:

- **Minimum Antenna Gain:** The current antenna size is governed by the standards that specify high minimum antenna gain requirements in this band (38 dBi in the ETSI<sup>12</sup> Standard for this spectrum) which require larger antennas (when compared to those at 60 GHz) making it difficult to conceal equipment and meet planning regulations in the street level environment.
- **Narrow Beam Width:** Associated with the nature of the spectrum and the minimum antenna gain requirements, very narrow beams are produced at 70 / 80 GHz. While this facilitates a minimal interference risk environment and assists with link coordination, link alignment with such narrow beams is much more challenging with respect to the swaying associated with street furniture such as lamp posts.
- **Propagation Environment:** To facilitate the required quality of service / availability of the links in the street level environment, coordination is difficult due to the dynamic nature of the environment (due to moving obstacles, vegetation growth etc) and the impact of different types of material on radio signal propagation.

4.25 In addition feedback from several operators and vendors was that the 57 – 64 GHz band (the “60GHz Band”) is the preferred spectrum for small cell backhaul within the clutter due to the smaller equipment size / form factors and the high atmospheric gas attenuation (oxygen absorption up to 15 dB/km) which naturally facilitates an uncoordinated approach. This spectrum is already available within the UK under a licence exempt regime and the above issues impacting the 70 / 80 GHz bands are reported as manageable making the 60 GHz spectrum a serious contender for street level use where high availability planning was indicated as not as essential as in the macro level environment. In addition to the 60GHz band for use within the clutter several stakeholders highlighted that they were also considering the 64 – 66 GHz band (the “65 GHz band”) for this purpose since this was managed via the self coordinated approach and gave, in their view, the most optimal solution i.e. a self coordinated environment coupled with small equipment form factors.

4.26 Several stakeholders indicated that the availability requirement for 4G backhaul links was a minimum of 99.99%, typically 99.995% and above to 99.999% with link lengths less than 5 km with the majority mainly falling within the 0.5 km to 3 km range.

4.27 Regarding the need for protection against undue interference and management of the interference environment, several stakeholders made the following points highlighting the issues that, from their perspective, made the self coordinated approach less attractive as an option for mobile backhaul:

- **No single coordination authority:** A perceived increase in risk of interference where a small percentage of licensees may potentially not exercise the necessary due diligence to self coordinate. This risk was considered unacceptable by stakeholders for links deployed in the macro layer where significant amounts of backhaul traffic would be carried and the impact a link

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<sup>12</sup> European Telecommunications Standards Institute

failure could have on the service provided to large numbers of mobile users i.e. the impact from the service and reputational perspective. For this reason stakeholders indicated a preference for a common set of frequency assignment and interference management criteria that would apply to all deployments.

- **Dispute resolution:** There were concerns that the current approach could lead to complex and time consuming dispute resolution procedures should interference occur.
  - **High density deployment:** The current process works well as the relative density of deployment is low. There were concerns that as usage of the band grows, the coordination burden could become extensive and complex, in particular when large numbers/batches of links are registered.
- 4.28 Several stakeholders highlighted similar points from the perspective of the backhaul market in relation to the advantages of 70 / 80 GHz over other spectrum available for fixed links. With a requirement for high capacity 4G backhaul applications delivering 1 Gbit/s and above, the wireless option, in their view, currently can only be delivered rapidly with 70 / 80 GHz fixed links. From the views expressed it was indicated that it is challenging to achieve such high data rates in the channels available in conventional microwave spectrum and there is not sufficiently large channel sizes in the 52 GHz and 55 GHz bands, nor was there an awareness of suitable equipment available in these bands. Our discussions with stakeholders also revealed that many were not aware of the coordinated spectrum currently available in the 52 GHz and 55 GHz bands.
- 4.29 Deployment expectations varied but the earliest requirement for backhaul deployment of significance was indicated as towards the end of 2013 with an increased requirement in subsequent years.
- 4.30 In relation to the channel plan configurations the availability of FDD cross band duplex following the CEPT channel plan was indicated as a preference. We were informed that single band duplexing was not currently used nor foreseen in the future due to the difficulties in facilitating the smaller duplexing that would be required and in addition that there was no evidence of interest expressed in such use. Typical channel bandwidths indicated were 500 MHz and 250 MHz and in terms of future expectations this may increase with vendor innovation. We noted that there is also development of equipment to be facilitated in smaller channel bandwidths and this has been accommodated by the most recent revision to the CEPT channel plan which has now implemented the possibility of 125 MHz and 62.5 MHz channels as subdivisions of the 250 MHz channels.

### Equipment Evolution

- 4.31 Stakeholders reported that 70 / 80 GHz equipment is evolving to 2<sup>nd</sup> generation which supports the delivery of Gbit/s capacity over single paths. While the 1<sup>st</sup> generation equipment can generate comparable data rates, the use of more advanced modulation techniques by 2<sup>nd</sup> generation equipment enables this capacity using smaller channel sizes and also supports adaptive modulation to enhance the transmission efficiency for 70 / 80 GHz links. Stakeholders from the vendor community referred to continued innovation in these bands and this is reflected as indicated above in the recent revision to the CEPT channel plan to facilitate smaller channel sizes to deliver high capacity backhaul. Other features of 2<sup>nd</sup> generation equipment reported by vendors include advanced clock synchronisation techniques,

network management features to enable reliable networks and reduced operator total cost of ownership due to efficiencies in equipment design.

### Other Issues Raised

- 4.32 Stakeholders also identified a number of more general issues surrounding the management of the bands including:
- Improvements to the self coordinated approach i.e. that the current implementation of the self coordinated approach would benefit from review.
  - Propagation models; highlighting that the current propagation models implemented in the lower bands may not be optimised for the higher (above 60GHz) bands.

## Summary of Feedback and Implications for Future Management of Band

- 4.33 Overall feedback from stakeholders points to the increasing use of this spectrum and the value of the 70 / 80 GHz spectrum to deliver a variety of applications including an emerging requirement for significantly higher data rate links such as those for 4G backhaul. Stakeholder stressed that currently available microwave spectrum cannot deliver for specific backhaul network topology at the macro level where fibre is not a viable option. This is in combination the maturing equipment market at 70 / 80 GHz. Stakeholders refer to equipment innovation and the availability of associated network management services similar to that for conventional microwave spectrum which makes this spectrum a viable option for backhaul provision.
- 4.34 Feedback indicated that the two broad market segments identified, enterprise and backhaul, have different requirements from a spectrum management and authorisation regime. In summary, the enterprise market generally valued the flexibility and low barrier to entry provided by a self coordinated regime. The backhaul market placed the highest importance in ensuring that the risk of interference was reduced as far as possible, and identified the issue as a barrier to their utilisation of the band.
- 4.35 In the following section consider how the possible management approaches for the band meet the needs of the two market segments and set out our proposals for the band.

#### *Question 1:*

*Do you have any additional information to provide to that presented in this consultation that you believe Ofcom should consider? If so please provide clearly evidenced views. Are there any other issues that you believe Ofcom should have considered?*

## Section 5

# Proposals for the Future Management of the 70 / 80 GHz bands

5.1 In this section we consider and assess approaches for the future management of this band. Each identified approach is examined from the perspective of its suitability for the requirements of the enterprise and backhaul market segments. We then set out our proposals for how this spectrum should be managed in the future.

## Possible Approaches for Assigning Licences in the 70 / 80 GHz bands

5.2 There are three possible approaches that we could take towards management of the 70 / 80 GHz bands:

- **Self coordinated approach:** This is the approach that is currently used for the band. Users must plan their own links with cognisance of existing registered links in the band. In the event of interference, priority of access is given to link with the earliest registration date.
- **Ofcom coordinated approach:** This approach would involve Ofcom planning, assigning and authorising each link in the band prior to its operation. The approach would effectively represent an extension of our current fixed link licence product to the 70 / 80 GHz bands.
- **“Block allocation” approach (Award of licences for frequency ranges):** Under this approach licences would be made available such that each covers a sizeable frequency range within the 70 / 80 GHz bands on a UK wide basis. These licences would be awarded through a competitive process, such as an auction.

5.3 Although we could select one approach on its own to manage the band, it would also be possible to segment the band and create a mixed management approach. For example one approach could be accommodated in the lower part of the band, and another approach in the higher part of the band. Indeed, all three approaches could, in principle, be accommodated in the available bandwidth if we split it into three segments.

The following paragraphs describe each of these approaches in a little more detail.

### Self Coordinated Approach

5.4 The key elements of this approach are as follows:

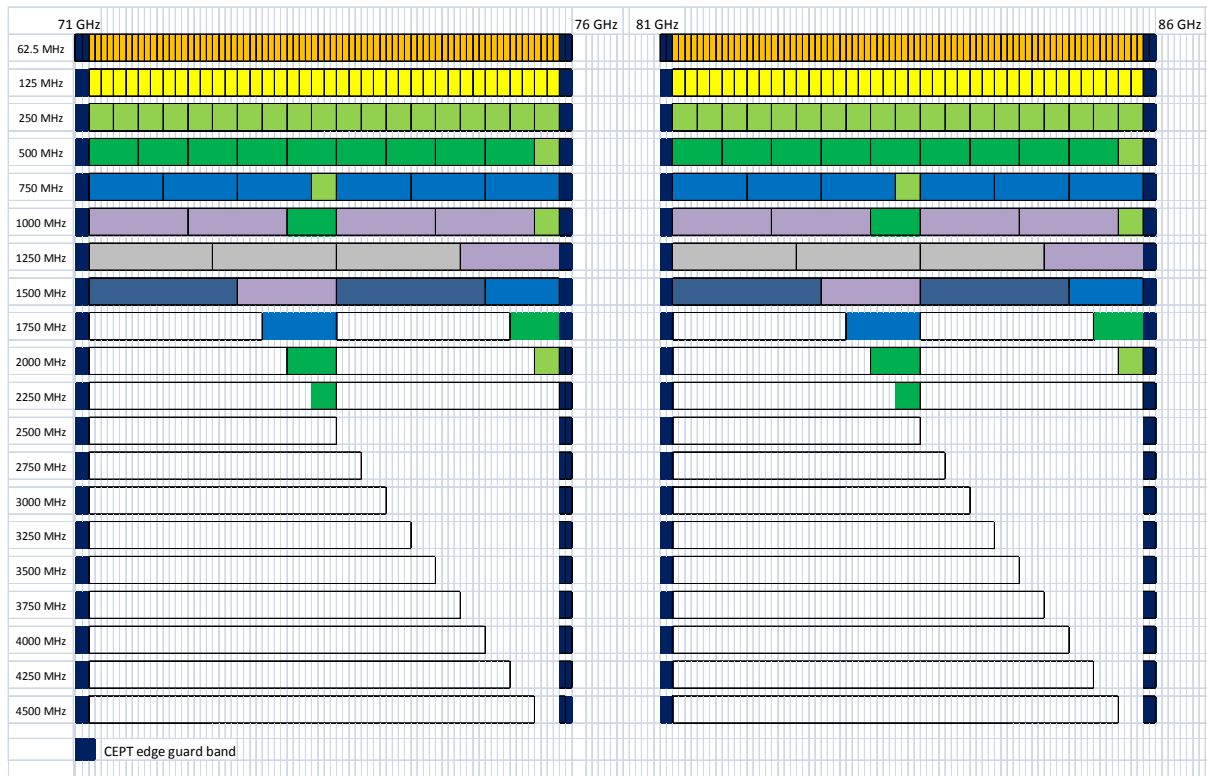
- Ofcom makes available a Wireless Telegraphy Act licence which permits licensees to use links in the band subject to the prior registration of each link.
- Links must be registered in a public register (the Wireless telegraphy Register) containing information on all link deployment in the band.



- Links should only be registered if the licensee has assessed that their deployment will not cause undue interference to existing users of the band. In addition, the licensee must deploy equipment that conforms with the technical parameters it has registered (e.g. the registration becomes invalid if a link is registered with a larger bandwidth than is actually deployed)
  - Should a licensee experience interference, issues relating to priority of access would be resolved by affording priority to the link registered in the register on the earliest date. In practice we would hope that any issues could be resolved by further coordination between licensees.
- 5.5 The approach affords a great deal of flexibility to licensees as regards to the planning criteria used to plan deployments and the very rapid authorisation of links. The spectrum has now been available in the UK under this approach for over 6 years and it is generally recognised that this has enabled the market to develop and innovate during this time. We do not currently mandate a channel plan.
- 5.6 We recognise that the approach introduced in 2007 was novel. At that time we identified that it may be sensible to review the approach and the details of our implementation once stakeholders had gained experience of it. Later in this section we seek views on a variety of issues concerning the current self coordinated approach.
- 5.7 Clearly, if we decided to continue with the self coordination approach there would be no lead time for putting our decision into effect; we would simply continue with the current approach (although it might take time to amend aspects of the current arrangements if this consultation concluded that there was value in such amendments being made).

### **Ofcom Coordinated Approach**

- 5.8 Under this approach we would technically assign and authorise each link prior to use as we do in many other fixed link bands.
- 5.9 Ofcom would set the technical assignment criteria used in the assignment process to coordinate between links and prevent interference. In annex 4 we explain our proposals for the assignment approach we would use in this band. As the exploitation of these very high frequencies for fixed links is a relatively recent innovation there are no established propagation models available and certain phenomena may require further study (e.g. signal attenuation due to precipitation). Consequently, in order to deliver a sensible assignment approach we have made a number of technical judgments as set out in the annex.
- 5.10 Under the coordinated approach it would be our intention to implement the channel plan as specified in CEPT Recommendation ECC/REC/(05)07. Specifically we would use the cross band duplex arrangement which pairs the coordinated sub-bands as shown in figure 6.



**Figure 6: CEPT Recommendation (ECC/REC/(05)07) cross band duplex channel arrangements**

- 5.11 Later in this consultation we set out proposals for a mixed approach to the management of the band. This would restrict the scope of Ofcom coordinated assignments to a segment of the band, although an amended version of the above channel plan would still apply within this segment.
- 5.12 If management of (some or all of) the band was transferred to a coordinated model, then existing links (that have already been registered under the current self coordinated approach) would be permitted to continue operation under their current characteristics; they would also be taken into account when making new link assignments under the Ofcom coordinated approach.
- 5.13 The implementation of the Ofcom coordinated approach would involve an extension of the existing fixed link assignment tools to this new band with some limited modifications. For this reason, and in light of some preparatory work that we have carried out on a precautionary basis, we believe that it would be possible for this approach to be brought into operation shortly after a decision is made following this Consultation.

**Block Allocation Approach**

- 5.14 Under this approach, licences would be made available that each covers a sizeable frequency range within the 70 / 80 GHz bands on a UK wide basis. These licences would be awarded through a competitive process, such as an auction. For example, four blocks could be auctioned, each of just over 2 x 1 GHz.
- 5.15 The licences on offer could be individual licences, i.e. each winner of a licence would be the single authorised user of a dedicated frequency range following the

award. Alternatively, we could award concurrent licences, where a limited number of winning bidders are awarded licences that authorise use in the same frequency range, with these concurrent licensees having obligations to engage in technical coordination amongst themselves so as to manage the risks of interference. It would be possible to mix these licences, with one block being awarded on a concurrent licence basis to a number of defined users and with other blocks being awarded as dedicated licences to single users.

- 5.16 This approach would take longer to deliver than the other two approaches, In particular, experience suggests that it would take a minimum of a year to design, plan and deliver an auction of this type from the point at which a decision was made to go down this path. This timeframe takes account of the need to consult on the details of the auction design, consult on and make auction regulations etc. Indeed, it could take longer than a year from the point of a decision on band management approach if the auction design needed to be more complicated or if contentious issues arose during the consultation process.

### Stakeholder Views on Approaches

- 5.17 We discussed the above approaches with stakeholders during the stakeholder engagement exercise discussed in section 4. A significant majority of stakeholders with an interest in using 70 / 80 GHz indicated a preference for either:
- the Ofcom managed approach, where the main concern is to have a “guarantee” of very high availability, notably for 4G backhaul for the RAN macro layer above urban clutter or;
  - the self coordinated approach that we currently have in place for this band where stakeholders from the enterprise market segment place more weight on the value of flexibility and on the low licence fee than on the “guarantee” of very high availability.
- 5.18 Although stakeholders tended to prefer one or other of these two approaches for their own deployments (with the preference depending on the market segment into which they fell), there was, in general, an acceptance of the idea of a mixed management approach in which the band is segmented between the “Ofcom coordinated” and “self coordinated” approaches. This acceptance reflected an acknowledgement of the different requirements of different applications. A number of stakeholders also expressed a view that, if the access arrangements could support both market segments, then this could increase the overall volume of demand for equipment at 70 / 80 GHz and so reduce the cost of this equipment.
- 5.19 The majority of stakeholders who expressed a view on the matter indicated that they opposed the block allocation approach as, in their view, this would limit access to the spectrum for the wider group of stakeholders in the future. However, one stakeholder indicated that it did favour the block allocation approach (with the award of individual, dedicated licenses). It considered that this approach would provide greater flexibility for the licensee with particular reference to the ability to plan a network at street level; that it would enable the licensee to achieve better interference management by having clear boundary conditions with adjacent users and that it would remove the risk associated with new co-frequency links being authorised that belong to other users (which could, in its view, create problems under this deployment scenario). However, this particular stakeholder did not indicate concrete plans to make deployments in this band (in contrast, those stakeholders that use the

band currently, or have concrete plans to do so shortly, favoured one or other of the first two approaches).

## Assessment of Approaches

- 5.20 When assessing the relative merits of each of the above approaches we need to take account of the different needs of the enterprise and backhaul market segments. An analysis of the strengths and weaknesses of each approach for the different market sectors is set out at table 1 below.
- 5.21 The analysis suggests that the **enterprise market** sector is best supported by the self coordinated approach for the following reasons;
- This approach enables the high levels of flexibility regarding technology and planning criteria sought by this market sector. Although most deployments are above building clutter, this flexibility becomes even more relevant for those deployments that are made below building clutter. The registration process supports rapid network deployment. Stakeholders in this sector have highlighted that the approach now has a proven record of supporting innovation in this sector's use of the band.
  - The coordinated approach would introduce technical restrictions in terms of channel configurations and planning criteria that were viewed as unnecessarily restrictive to meet the needs of the enterprise market. The requirement for Ofcom to plan and assign links would also add an overhead to current stakeholder planning and registration processes.
  - The award of spectrum blocks is unlikely to support the needs of this market sector. It is likely that this market sector would face significant coordination challenges in seeking to engage in an award process (something which would be untried with this stakeholder group). Most of these stakeholders have spectrum access requirements that are quite localised (as opposed to looking for spectrum access on a UK wide basis) and would need to collaborate in putting together bids for UK wide licences. Moreover, whilst the sector is immature, it is diverse and growing fast: new users that sought access to the spectrum after an auction was held could find it hard to gain access (they would probably need to seek spectrum leasing arrangements with the winners of the auctioned licence blocks, but it is not clear that the winners would be interested in developing a leasing business alongside their own use of the spectrum). In addition, the exclusive block allocated award approach would lead to a subdivision of the band into a number of blocks of perhaps 2 x 1GHz or so in size; this would make it very difficult to deploy bandwidths in excess in 1 GHz (noting that existing registrations by the enterprise sector range up to 2.5GHz in size) as this would require coordinated leasing deals to be struck with two or more block licensees. Taken together, these considerations would create a significant risk of blunting innovation in the 70 / 80 GHz bands by this wide enterprise market segment, noting that that there are no other bands currently available which support the high bandwidths they require.
- 5.22 Our analysis suggests that the 4G **backhaul market** could be supported by either the Ofcom coordinated or block allocation approaches.
- The Ofcom coordinated approach would provide confidence in the ability to maintain the very high availability sought by this market segment for 4G macro cell backhaul in cases where wireless links are preferred to fibre for this application (or where fibre links are not available).

- The block allocation approach would clearly enable the licensee to retain full control over its own in-band interference environment and a mobile operator interested in using this band for 4G backhaul would be well placed to win a competitive award for these blocks.
- In contrast, the self coordinated approach does not provide stakeholders with the necessary confidence over levels for the high availability levels required for deployment of links in a network macro layer. They perceive the lack of ex-ante checks on link deployment by a “band manager” as creating risk, and highlight that the approach and its attendant dispute resolution process is relatively untried for the large scale deployments on which they would be relying.

5.23 In weighing up the relative merits for the backhaul market of the Ofcom coordinated and block allocation approaches we need to consider both:

- The impact on spectrum efficiency of the lead time taken to make the new authorisation approach available; and
- The implications for spectrum efficiency in the longer term once the new authorisation approach is in place.

5.24 On the first point, we are aware that at least one mobile operator plans to start deployment in the band in support of 4G roll-out later this year for macro layer deployments. Subject to the outcome of this consultation, it would be feasible for the Ofcom coordinated approach to be in place on a timescale that is broadly consistent with this. In contrast, it seems unlikely that a block allocation award could be completed much before end 2014 (and it could take longer to complete). Given the rapid timetable for 4G deployment, it seems likely that the much longer lead time for the block allocation approach would prevent the operator from using the 70 / 80 GHz bands in support of a significant proportion of its planned 4G deployment. This could represent a sub-optimal use of spectrum, the effects of which might extend beyond the next few years (i.e. even after the new block allocations were awarded).

5.25 Turning to the longer term efficiency considerations (i.e. aside from the implementation lead time issue above):

- The block allocation approach would clearly provide the mobile operators with significant flexibility to manage their own deployments and would avoid the transaction costs that are inherent to the Ofcom coordinated approach. It could also offer certain advantages if this band were to become important for small cell backhaul in deployments within building clutter since Ofcom’s current assignment models are not optimised for these circumstances and network providers are better able to make choices as regard quality requirements. However, as noted in section 4, most stakeholders indicated that they were considering the 57-64 GHz licence exempt band (rather than the 70 / 80 GHz bands) for these types of deployment scenario.
- On the other hand, there could be a significant risk of inefficient spectrum use if several mobile operators sought their own, dedicated allocation that was large enough to accommodate its own deployment needs (e.g., 2 x 1 GHz each). This size of block allocation could squeeze access to this spectrum for other users whilst leading to much lighter use of each allocated block itself (the point here is that it might be technically possible for mobile operators to deploy a significant

number of links at the same frequencies if there is suitable coordination between them, thereby leading to a more efficient use of spectrum; this possibility would be lost if each operator deployed in their own spectrum exclusively). This risk to spectrum efficiency would be reduced, however, if several operators accessed the same spectrum block under concurrent licences where they took responsibility for coordination amongst themselves.

- 5.26 Taking the above factors into account, we consider that the Ofcom coordinated approach represents the most appropriate way forward for meeting the requirements of the 4G backhaul market in the immediate future, particularly in light of the implementation lead time issue. This need not, however, preclude the possibility of some or the entire spectrum (covered by the Ofcom coordinated approach) being made available at a later date under a block allocation approach via an overlay auction (in which assignments that exist at the date of the auction retain their spectrum access rights). However, any consideration of an overlay auction of this type would best be left until we have a clearer picture of the way in which the use of the band is developing.

**Table 1: Analysis of different approaches**

<b>Option</b>	<b>Enterprise Users</b>	<b>Backhaul</b>
<b>Approach 1: Self coordinated</b>	<ul style="list-style-type: none"> <li>+Strong support of self coordinated model from the enterprise community</li> <li>+It offers flexibility in terms of choice of technical criteria and supports a wide range of network topology and a range of different applications. Flexibility over equipment choice and supports rapidly evolving technology.</li> <li>+FDD and TDD both supported.</li> <li>+Licensees are able to cooperate and coordinate to achieve a mutually acceptable interference managed environment.</li> <li>+Low barriers to entry due to simple process speed of link registration and low licence fee.</li> <li>- Interference and dispute resolution is relatively untried.</li> </ul>	<ul style="list-style-type: none"> <li>-Stakeholders see the need for very high levels of availability, for macro layer deployments in particular, and do not feel that this is adequately supported by the self coordinated model because of the absence of defined planning criteria.</li> <li>- Absence of a single authority to manage the planning, to assess against criteria set and that gives prior approval to deployment.</li> <li>-The untried enforcement and dispute resolution may create unacceptable delays to use of links.</li> <li>-The current implementation is viewed as creating operational issues for large scale registrations</li> <li>+Some stakeholders felt that the self coordinated approach would be suitable for links within the clutter because of lower availability requirements and the additional flexibility offered.</li> </ul>
<b>Approach 2: Ofcom coordinated</b>	<ul style="list-style-type: none"> <li>-Most current users feel that the coordinated approach would restrict their flexibility over planning criteria and technology.</li> <li>-Currently only FDD use</li> </ul>	<ul style="list-style-type: none"> <li>+Stakeholders are confident in the approach as a tried and tested approach to support macro level deployment.</li> <li>+Common interference</li> </ul>

	<p>permitted. Enterprise market requires access to both TDD and FDD solutions</p> <p>-Stakeholder concerns that there is a higher barrier to entry in terms of licence fee and application process.</p> <p>-Processing times could restrict speed network deployment</p>	<p>management approach applies to all links which validates each link prior to authorisation.</p> <p>+Lower risk of coordination failure due to management by a single authority and reduced coordination overhead for licensee.</p> <p>+Proven operational process to support large network rollout.</p> <p>-Approach would not support efficient spectrum management for links within the clutter although current stakeholder plans are for macro level deployment.</p>
<p><b>Approach 3: Award of licences for frequency ranges rather than addition of links to a licence schedule (“Block allocation”)</b></p>	<p>-Strong opposition to the award model from enterprise stakeholders.</p> <p>-There is a lack of stakeholder readiness in the enterprise community to engage with the auction processes,</p> <p>-For an exclusive block allocation award model the spectrum would need to be segmented and separated into block sizes which could create impractical subdivisions as a consequence of which the benefits of the wide frequency range would be compromised.</p> <p>-An area based award model would not match stakeholder requirements which are for specific links.</p> <p>-A cooperative based award model was opposed as stakeholder questioned the willingness or ability of stakeholders to successfully cooperate amongst themselves</p> <p>-Potential for increased transaction costs for potential users and licensees, which could make the spectrum unavailable to the enterprise market and small businesses.</p>	<p>-Likely delivery timescales for an award process would not support the stakeholder requirements for access to the spectrum as soon as possible.</p> <p>+The award process could facilitate increased flexibility in planning.</p> <p>+There might be a case for block allocation to support smaller cell / within the clutter deployments as coordination is not as effective within the clutter because of the dynamic propagation environment and the lack of established approaches to model the impact of clutter to the radio signals at 70 / 80 GHz.</p> <p>+Block allocation removes the burden to coordinate with other users and provides greater flexibility of use for the licensee.</p> <p>-Challenges associated with determining appropriate the size of block</p> <p>-Cooperative/ shared access model is untested in practice which could create additional risk.</p>

## Balancing the Interests of Different User Communities.

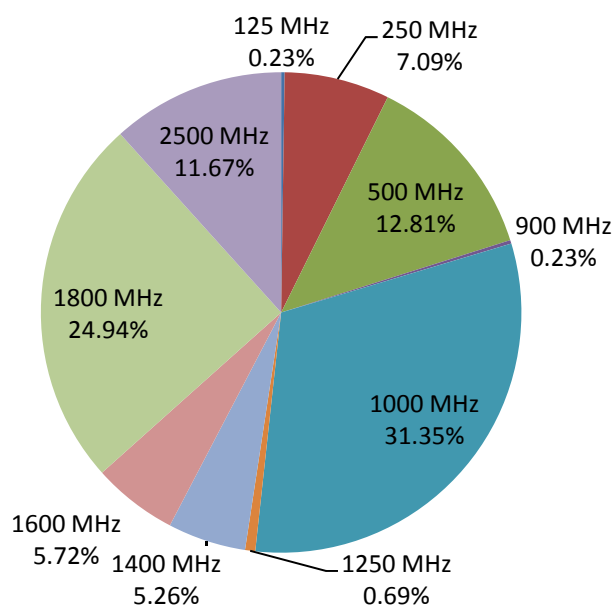
- 5.27 In light of the above analysis, it is clear that opting for *either* the self coordinated approach *or* for the Ofcom coordinated approach across the entire band would run the risk of excluding one or other market segment from accessing the band in the way that best meets its needs. Moreover, stakeholders have highlighted to us that the demands from both groups are likely to grow over the coming years and that the final pattern of use, and the technologies employed, in this band will not mature for some time. Accordingly, it would seem very undesirable to have to opt for one approach for the band; and if we sought to do so, there could be a significant risk that the decision turned out to have been suboptimal once usage requirements matured.
- 5.28 This analysis points towards the use of a **mixed approach** in which a portion of the available spectrum is made available under each authorisation approach, provided that the needs of the different user communities can be met from the available spectrum without compromising the overall utility of the band. The analysis also suggests that there would be value in retaining some flexibility to adjust the balance between the two authorisation approaches in light of experience, given the way the spectrum is exploited in practice.
- 5.29 We therefore set out below:
- Some analysis of whether there is likely to be enough spectrum to support both Ofcom coordinated and self coordinated management regimes simultaneously without the overall utility of the band being compromised;
  - The size of guard band that might be required to act as a buffer between an Ofcom coordinated block and a self coordinated block;
  - the implications for segmentation of the 70 / 80 GHz bands as between the Ofcom coordinated and self coordinated management regimes; and
  - The scope to retain some flexibility to adjust the balance between these approaches in light of experience over how the use of the band develops.

### Spectrum Requirements under a mixed approach

- 5.30 In establishing the needs of each market segment we have been guided by the following factors:
- For the enterprise community we have considered the current nature of deployments and the input we have received from stakeholders on technology development.
  - For the backhaul community we have been guided by the input we have received on likely channel sizes and network topology for planned deployments.
- 5.31 In considering the spectrum requirements from the enterprise community / self coordinated approach we have reviewed the channel bandwidth of registered links. This is shown in the chart below.



**Figure 7: Bandwidth Distribution within 71-76GHz and 81-86 GHz bands  
(Register extract 27 June 2013)**



- 5.32 Based on this data, the maximum channel size registered is 2.5 GHz although the majority of links have channels of smaller size.
- 5.33 Recent technology trends have indicated the move towards second generation equipment that is able to deliver higher data rates, in particular increasing the transmission efficiency per channel, with expectations to further improve this in the future. We refer to the recent CEPT revisions to the 70 / 80 GHz channel arrangement (ECC/REC/(05)07) to introduce smaller channel sizes as an indication of further innovation in the band to deliver high capacity using smaller channels.
- 5.34 The spectrum utilised under the self coordinated approach is used for both TDD and FDD applications and duplex use is always across the 70 GHz and 80 GHz bands rather than within each sub-band.
- 5.35 These considerations suggest that 2 x 2.5 GHz in an FDD configuration would provide access to adequate spectrum to support the majority of requirements from the enterprise communication for high data rate links. We recognise that the CEPT channel plan supports a maximum channel bandwidth of 4.5 GHz and that at the time of publication one link has been registered that utilises a 4.5 GHz channel (the maximum possible under the CEPT channel arrangement).
- 5.36 In considering the spectrum requirements for the 4G backhaul segment (under an Ofcom coordinated approach our starting point has been the stakeholder input on the typical channel sizes envisaged for backhaul applications. This has indicated that typical channel sizes required will be 250 MHz and 500 MHz.
- 5.37 The total spectrum demand for coordinated fixed links is driven by density of deployment particularly at key sites. From the information we have gathered there is a significant degree of uncertainty regarding this demand in the medium to long term. In determining the minimum spectrum demand we consider that it would be sensible to allow some level of frequency diversity at a single site and that to deliver this, a minimum of 2x1 GHz bandwidth (i.e. two paired 500 MHz channels) would be necessary. We consider that access to 2x2 GHz (four paired 500 MHz channels)

would provide additional frequency diversity to support most deployment scenarios across a number of operators.

### Guard Band Requirement

5.38 If there was no frequency gap between the proposed blocks under the two authorisation regimes then there is a possibility that new registrations that are made right up against the boundary in the self coordinated block might reduce the quality of service of a 4G backhaul link that was assigned up against the boundary in the Ofcom coordinated block. We are therefore proposing to take practical interference mitigation measures between the two approaches by introducing a guard band of 250 MHz. This separation bandwidth is twice the size of the band edge guard band. We are seeking views in this consultation on the size of guard band proposed.

### Implications for Band Segmentation

5.39 The above suggests that both the self coordinated and coordinated approach could be supported within the available spectrum and that the segmentation necessary to facilitate such an arrangement should not disproportionately impact the utility of the spectrum to either market segment when weighed against the benefits of maintaining both authorisation approaches. With both authorisation approaches available licensees would be free to choose the licence type that best meets their needs.

5.40 A proposed segmentation plan is provided below with the following allocation:

- **Ofcom coordinated approach:** 2 x 2 GHz
- **Guard band:** 2 x 250 MHz
- **Self coordinated approach:** 2 x 2.5 GHz



**Figure 8: Proposed segmentation**

### Flexibility to Adjust the Balance of Management Approaches

5.41 We recognise that the use of the band is at a very immature stage and that there is significant uncertainty over the levels and nature of future demand. Accordingly, there will be value in retaining some degree of flexibility over the allocation of the band between these two approaches. We consider the main degrees of flexibility in table 2 below.

5.42 As a general observation, we note that it would be relatively straightforward (in implementation terms) to expand the proportion of the band allocated to the Ofcom coordinated approach whilst reducing the proportion of the band allocated to the self coordinated approach. This is because, when making new assignments in the expanded Ofcom coordinated segment, we would be able to take account of self coordinated links (that exist at the time the change was made). In contrast, when considering a rebalancing that allocates more of the band to the self coordinated approach, it could be more challenging to ensure continued protection to existing Ofcom coordinated links (to the very high level of availability expected by these licensees). This is because users could register new links (in the expanded self coordination portion of the band) that are near to existing coordinated links without having to be approved through the Ofcom coordination tools. Because of this implicit asymmetry, we are proposing to adopt an assignment approach in the Ofcom coordinated portion of the band that would allow us to test the need for the additional channels to be assigned in excess of 1 GHz. In particular, we plan to use an assignment algorithm which allocates channels progressively from the bottom of the band. The algorithm will be able to make assignments automatically within the first 1 GHz of spectrum; but it would require an active intervention by Ofcom, as the assignment manager, to open up the second tranche of 1 GHz within the assignment tool and so make the full 2 x 2 GHz available for assignment. In this way, we will be alerted if and when a request is made that would push above the initial 1GHz threshold for automatic assignment. It may well be appropriate to assign and licence the link as requested. However, this approach would allow us to examine the position before doing so.

**Table 2: Possible responses for responding to changes in pattern of demand**

Issue	Approach
<b>User demand creates pressure to allocate more resource to self coordinated solution.</b>	<p>From introduction of the coordinated solution we plan to use an assignment algorithm which allocates channels progressively from the bottom of the band, and does so automatically up to 1 GHz of spectrum. It would require an active intervention by Ofcom as the assignment manager to allow further assignments beyond 1 GHz and up to the maximum 2 GHz allocated for this approach. If demand for Ofcom coordinated links has not exceeded the 1 GHz threshold at a time when demand for self coordinated links is placing real pressure on its 2 x 2.5GHz allocation, then this approach would make it possible to reallocate some of the unused Ofcom coordinated block to the self coordination approach in any future reallocation decision.</p> <p>In addition, we note that the 64-66GHz band provides additional capacity for self coordinated links (this band is already available on the same self coordinated approach as for the 70 / 80GHz bands although its use has not yet been developed)</p>
<b>User demand creates pressure to allocate more resource to coordinated solution.</b>	<p>If user demand creates pressure to exceed the initial 1 GHz threshold referred to above, then Ofcom can release access to the additional channels set aside for Ofcom coordinated links, having first assessed that there is a reasonable requirement that cannot be met in the initial 1 GHz allocation (e.g. by minor modification of an assignment request that can still meet user</p>

Issue	Approach
	<p>requirements).</p> <p>If there was demand for more than 2 x 2 GHz to make available under the Ofcom coordinated approach, it would be possible to change the overall allocations so as to increase the Ofcom coordinated portion and reduce the self coordinated portion. This would be possible since we are developing an effective “grandfathering” arrangement which will manage the interference risks to self coordinated links from new coordinated links as part of an initial implementation. However, before making such a change we would clearly need to reassess the evolving demands of both market segments.</p>
<p><b>Equipment bandwidth increases.</b></p>	<p>We believe the segmented band plan proposed will support the next evolution to even higher capacity systems (2.5 – 10 Gbit/s) where channel sizes up to 2 GHz may be necessary. The feedback we have received indicates that 500 MHz and 250 MHz channels are what are required for mobile backhaul at present (which can be comfortably accommodated in the proposed segmented band plan). However, we will use this consultation to validate our current understanding of technology evolution, noting that very wide band equipment (in excess of 2.5 GHz) will not be possible under the proposed mixed approach.</p>
<p><b>Network topography changes requiring planning within the clutter.</b></p>	<p>Our current understanding is that stakeholders will deploy above clutter in the macro layer (i.e. not the small / micro cell environment). However, one stakeholder expressed some concerns about the ability of our proposed approach to handle possible future requirements for planning 70 / 80 GHz links below and within a cluttered environment.</p> <p>As noted above, our discussions with most other stakeholders have indicated that 57 – 64 GHz is the preferred spectrum for small cell backhaul within the clutter due to the smaller equipment size / form factors and the high atmospheric gas attenuation (oxygen absorption up to 15 dB/km) that this band offers. The 57-64 GHz spectrum is already available within the UK under a licence exempt regime as for the 70 / 80GHz bands at present.</p> <p>Nonetheless, we intend to examine future assignment tools/approaches in relation to issues around coordination at 70 / 80 GHz</p>

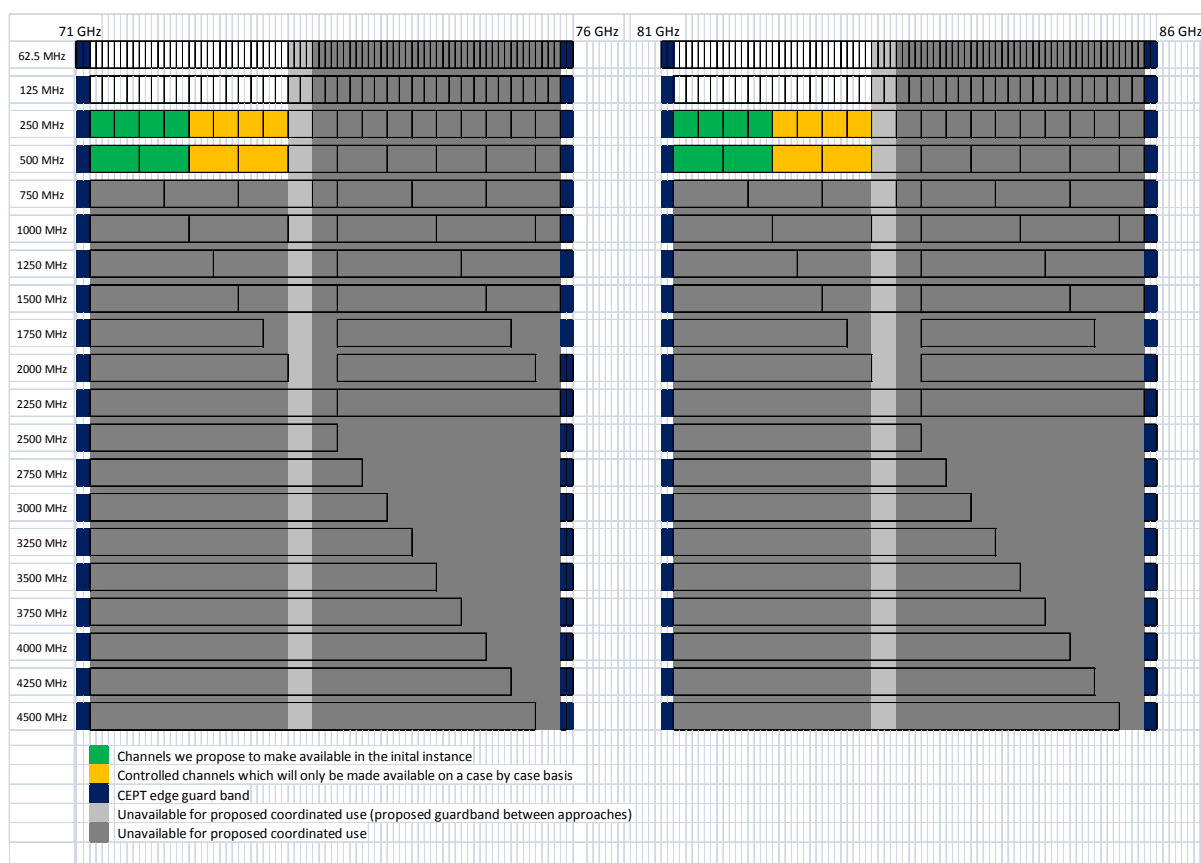
5.43 As noted above, the option of pursuing an overlay auction (perhaps for concurrent licensees) will remain open as an option if experience suggests that this might promote optimal use of (part of) the band at some point in the future.

## Proposed Channel Plan for Coordinated Block

5.44 We are proposing a detailed plan for the coordinated block in accordance with the cross band CEPT channel arrangement (ECC/REC/(05)07) is shown below where in the initial instance we propose to make the following channels available:

- 4 paired 250 MHz channels and
- 2 paired 500 MHz channels,

5.45 As explained above, we will assess the need for increasing the number of the above channels (e.g. up to 4 paired 500 MHz channels) as use of the band develops. Similarly, we will assess the need for larger channel sizes in the coordinated block as use of the band develops. The channel diagram is shown in figure 9 below. Channels that are greyed out will not be made available until clear need has been demonstrated. However paired channels smaller than 250 MHz (8 paired 125 MHz and 16 paired 62.5 MHz) will be made available when relevant standards have been agreed.



**Figure 9: Channel diagram showing channels in green that would initially be made available in the proposed coordinated block**

5.46 In implementing this approach we would propose to extend and modify the use of our UK current fixed link frequency assignment approach (for current spectrum managed by Ofcom for fixed links) to cover 70 / 80 GHz spectrum. There are a number of challenges in implementing this approach, for example propagation modelling at these very high frequencies. Annex 4 provides an explanation of our proposed technical implementation.

5.47 The interim licence fees for this spectrum are set out in later in this section.

## Management of the Self Coordinated Block

5.48 Ofcom is proposing to retain the self coordinated approach in the 2 x 2.5 GHz of paired spectrum in the upper half of each block with the existing rules continuing to apply as now. In particular:

- Subject to consultation responses, we are not proposing to constrain assignments so that they must fit a channel plan in this part of the band.
- The existing fee structure should remain in place for now (although self coordinated links, like all fixed link licence products, will be subject to the forthcoming Fixed Link Fee Review).
- We will continue to maintain a publicly available register of fixed links.

5.49 We are, nevertheless, keen to seek views through this consultation on whether the self coordinated approach could be improved. The following specific issues were raised by some of the current users of the band during the stakeholder engagement exercise:

- Some stakeholders suggested the introduction of the CEPT channel plan within the self coordinated block in order to ease coordination assessments between licensees. While Ofcom is not currently minded to mandate the use of a channel plan, we are seeking views on whether there would be a benefit in doing so that would outweigh the cost of losing the current flexibility.
- All registered technical link parameters are made publicly available on the 70 / 80 GHz section of the Wireless Telegraphy Register to facilitate coordination. Some stakeholders mentioned that it could help to have additional parameters such as polarisation and receiver sensitivity levels recorded as well. We are seeking views on whether stakeholders want additional parameters to be recorded so as to help with interference assessments.

5.50 We also welcome suggestions on any other aspects of the current licensing and registration process which could be improved.

5.51 During the stakeholder engagement exercise, there seemed to be some uncertainty about how the enforcement and dispute resolution process would work should an interference case arise. The key factor to bear in mind is that the date of registration of links establishes their priority. In other words, if one link causes interference to another link in a way that cannot be resolved through collaboration between the parties, then the link which has the later date of registration recorded in the published Ofcom spreadsheet must be altered (or, in the limit, de-commissioned) so as to remove the interference. We would strongly encourage the relevant parties to seek a solution without recourse to Ofcom, taking account of the registration dates of their respective links. However, should an interference incident be reported, Ofcom may investigate and, depending on its findings, could remove from the register the link with the later registration date (i.e. withdraw its authorisation).

5.52 An important consideration with respect to the proposals in this consultation relates to the management of existing self coordinated links that fall within or overlap with the frequency ranges that we propose to allocate to the Ofcom coordinated approach. Existing licensed / registered links would be permitted to continue to

operate. An overview of how these links will be taken into account is contained in Annex 4.

## Licence Fee Proposals

- 5.53 We are planning to begin a review of fees for fixed links before the end of this financial year. This Fixed Links Fees Review will cover all spectrum that is managed by Ofcom for fixed links and will include the 70 / 80 GHz bands. However, the new spectrum management arrangements covered in this consultation will come into effect before the Fixed Links Fee Review is concluded. Accordingly, we will need to have fee rates in place for the 70 / 80GHz products during an interim period (until the results of the Fixed Links Fee Review come into effect). The fee rate proposals below should therefore be seen in light of the need to create a pragmatic interim approach.
- 5.54 The existing fee structure for access to the spectrum on a self coordinated basis involves a £50 licence fee (which includes the first link registered in the first year of the licence) and then a £50 annual fee per link registered thereafter. In view of the impending Fixed Links Fee Review, it does not make sense to carry out a separate review of the existing fee structure for the self coordinated links now as part of this consultation process.
- 5.55 However, we consider that it would not be appropriate to set the same flat rate fee of £50 per link for the proposed new coordinated approach. Although we recognise this is only one of a number of potential solutions, there is an argument for a more incentive based approach to fees in this case as:
- The supply of spectrum has been reduced by this proposal: both from splitting the band and introducing coordination of high availability links.
  - Future demand could be quite substantive given the proposed use for backhaul to support deployment for mobile networks. As a consequence there is the possibility that this could lead to some congestion in the band in future as its use matures.
- 5.56 These considerations suggest that a more appropriate approach towards interim charging of the coordinated product would be to base it on our existing fixed link products that follow the same coordinated approach. However we feel that it is not appropriate to extend our existing fees algorithm to determine the fee since direct linkage and extrapolation of the current AIP fees applicable for fixed point to point links in Ofcom managed spectrum would not result in a sensible fee structure for access to the 70 / 80 GHz bands.
- 5.57 Instead we believe a pragmatic approach would be to derive an interim fee (in advance of the Fixed Link Fee Review) based on the current fee rate for the average link value in the 38 GHz band. We consider that the 38 GHz band is a reasonable basis for deriving interim fees as this is the nearest band (in frequency terms) to the 70 / 80 GHz bands that is currently managed by Ofcom and is extensively used (it is the most popular fixed link band in the Ofcom managed fixed link spectrum with around 8000 links currently licensed). We have derived the proposed fee on the following basis:
- Identified the average link fee at 38 GHz.
  - Applied the average 38 GHz link fee to a typical channel expected to be used for emerging uses in the 70 / 80 GHz bands (i.e.500 MHz).

- Pro-rated the resulting fee rate for a 500 MHz channel in the 70 / 80 GHz bands for other channel bandwidths.
- Set a minimum fee by applying the pro-rated price (to the nearest £100) at 125 MHz to all channel sizes below 250 MHz.

5.58 Making the fee dependent on channel width is an important aspect of the proposal as it should help to promote transmission efficiency: in particular, licensees should have an appropriate incentive to use smaller channel widths where these can meet their requirements (e.g. using equipment with higher order modulation).

5.59 The proposed fee levels for Ofcom coordinated links in the 70 / 80 GHz bands are therefore as follows:

Channel Size ranges (MHz)	Pro-rated Interim Fee
<250	£100
250	£225
500	£450

5.60 Although we are not proposing the introduction of channel sizes larger than 500 MHz in the coordinated block, should we decide to make these available based on market demand prior to the Fixed Link Fee Review, pro-rated fees will apply to larger channels based on the 500 MHz fee.

5.61 International discussions have also considered the subdivision of the 250 MHz channel into 125 MHz and 62.5 MHz. The revised CEPT channel plan (ECC/Recommendation (05)07) has now been adopted to facilitate these smaller channels and, following subsequent development of ETSI standards, Ofcom intends to make these smaller channels available. Should this be required before the Fixed Links review of fees, Ofcom proposes that a minimum fee of £100 to be applied to all channel bandwidths below 250 MHz that will be made available by Ofcom for the links in the coordinated part of the band.

## Summary of Proposals

5.62 The table below provides a summary of the proposals on which we are consulting:

**Table 3: Summary of Proposals**

Proposal	Detail
<b>We are proposing a mixed solution where separate frequency allotments are made to the self coordinated and coordinated licence types.</b>	<p>Our proposal for the distribution of the available spectrum is set out in the above sub sections.</p> <p>In summary this would involve:</p> <ul style="list-style-type: none"> <li>• The band 71.125 – 73.125 GHz and 81.125 – 83.125 GHz would be made available for a coordinated licensing approach. Although initially only the first 1 GHz of spectrum would be available for automatic assignment. Active</li> </ul>



Proposal	Detail
	<p>intervention will be made by Ofcom if channels are required in the second 1GHz tranche within this 2 x 2 GHz block.</p> <ul style="list-style-type: none"> <li>• The band 73.375 – 75.875 GHz and 83.375 – 85.875 GHz would remain available to the self coordinated licence type.</li> <li>• We are proposing a guard band of 250 MHz in each block at 73.125-73.375 GHz and 83.125-83.375 GHz as a practical measure to avoid co channel interference between the two approaches and minimise adjacent channel interference.</li> </ul>
<p><b>For the coordinated approach only the first 2 x 1 GHz of spectrum would initially be available for assignment on an automatic basis via our assignment tools. The further 1GHz (of the 2GHz total) could be made available after consideration of relevant assignment requests.</b></p>	<p>71.125-72.125 GHz paired with 81.125- 82.125 GHz</p> <p>Channels available for automatic assignment in the first instance:                  2x 500 MHz                  4x 250 MHz                  8 x 125 MHz (when standards are complete)                  16 x 62.5 GHz ( when standards are complete)</p>
<p><b>We propose to facilitate the introduction of a coordinated approach to the band by effectively extending our existing FWS Licence product to the band.</b></p>	<p>We would propose to introduce a channel plan based upon the CEPT model.</p> <p>The technical assignment criteria for the band would be based on our existing approach to other bands appropriately modified to reflect the frequency band. Details are provided in Annex 4.</p> <p>An interim fee rate is proposed as detailed in the above sub sections.</p>
<p><b>Registered links can continue to operate in spectrum no longer available to the self coordinated approach and will be taken into account in our assignment analysis. However, no new self coordinated link registrations will be permitted in the coordinated portion of the band.</b></p>	<p>Existing self coordinated links registered before 21<sup>st</sup> August will be permitted to continue operation and will be accounted for should they overlap or fall within the proposed coordinated block.</p>
<p><b>No specific changes are proposed to the self coordinated</b></p>	

Proposal	Detail
<b>licensing approach but we seek views as to how current arrangements could be enhanced.</b>	

*Question 2:*

*a) Do you agree with our proposals to offer a mixed solution that allows stakeholders to choose between the currently available self coordinated authorisation approach and a new Ofcom coordinated approach for the band?*

*b) Do you agree with the segmented band plan with the split of 2 x 2 GHz and 2 x 2.5 GHz for Ofcom coordinated and self coordinated approaches respectively?*

*c) Is the guard band size of 250 MHz considered appropriate between the two approaches?*

*Question 3:*

*a) For the Ofcom coordinated part of the band, do you agree with the proposal to make available channels of 500 MHz and 250 MHz (with smaller channels being made available when the standards are completed) and to make these channels available in up to 1 GHz bandwidth in the first instance?*

*b) Is there a requirement for channel sizes greater than 500 MHz in the coordinated block? Please submit evidence to support your view.*

*Question 4:*

*a) Are there any aspects of the current self coordinated licensing and link registration process that could benefit from improvements? Please provide specific information and reasons for how your suggestions would improve the process.*

*b) Should Ofcom consider mandating the CEPT channel plan, ECC/REC/(05)07 for the self coordinated block? Explain clearly the reasons to support your view.*

*c) Are the technical parameters shown on the register sufficient to enable self coordination? Should Ofcom consider presenting additional parameters on the register? If so, which parameters and why?*

## Section 6

# Existing and New Self Coordinated Licensees

6.1 In this section we explain the impact of the proposals presented in this consultation document to existing holders of 70 / 80 GHz licences and the process of licence variation that we are undertaking alongside this consultation and how this will impact the registration of new links from the date of this consultation. We also inform of the additional territories covered by new self coordinated licences.

## Impact on existing licensees

### Existing Registrations up to 21<sup>st</sup> August 2013 and Registrations from 21<sup>st</sup> August 2013

6.2 As set out in Section 5, we propose to allow existing registered links (i.e. the links registered prior to 21<sup>st</sup> August 2013) to continue to operate in the band even where they are not in alignment with the proposed new arrangements for the band. Those existing registrations that fall within the proposed coordinated block would then be taken into account in our technical assignment processes for the band to ensure that the interference environment to and from these links can be managed appropriately. In order to achieve this, a data preparation exercise, as referred to below, would need to be undertaken.

6.3 Although existing registered links will be able to continue operating in the band, it makes sense to limit the number of links which would turn out to be out of alignment with the proposed new arrangements for the band, pending a decision on these proposed new arrangements. Therefore, for the duration of this consultation process we will not accept new self coordinated link registrations (i.e. links from the 21<sup>st</sup> August 2013) which are not consistent with proposed new arrangement. Link registrations in the proposed self coordinated portion of the band can, of course, continue to be registered in the normal way. We have written to all impacted licensees setting out arrangements during the consultation period.

6.4 If Ofcom decides to implement its proposals for 70 / 80 GHz bands it will be necessary to vary and reissue current licences under the proposed new arrangements. To do this Ofcom must give at least one months notice to licence holders within which to make representations about the proposed variation. Licences have the statutory right to make representations to Ofcom and Ofcom must consider the comments received before taking a final decision on whether to make these changes. Ofcom must decide whether to proceed with the variation within one month and notify the licence holder of the final decision on variation within one week of making that decision.

As this process could unnecessarily delay access to the band for some stakeholders we have decided to commence the formal variation process immediately to avoid unnecessary delay to the implementation of our proposals should we decide, after consultation, to proceed with them. We have written to all licences setting out our proposals for existing licences and giving formal notice of proposed licence variation.

## **Data Preparation**

- 6.5 Ofcom's proposals require that a coordinated solution takes account of existing fixed link deployments registered under the self coordinated regime. Existing self coordinated links with occupied bandwidth that falls within or overlaps with the proposed coordinated block will be subject to Ofcom's frequency assignment procedures under a coordinated solution. These self coordinated links would need to be modelled in the radio interference environment so that they are protected from future coordinated links. We provide further details on data preparation in annex 4 and we have been in contact with existing licensees where this has been necessary.

## **Authorisation in the Channel Islands and Isle of Man**

- 6.6 During this review we have also received interest in the deployment of 70 / 80 GHz links in the Channel Islands. We have therefore consulted and received confirmation from the regulatory authorities of the Channel Islands and Isle of Man to extend the authorisation of 70 / 80 GHz to these territories. From the date of publication of this consultation, new self coordinated licensees can now deploy 70 / 80 GHz links in the Channel Islands and Isle of Man.

## Section 7

# Consultation Questions

### Question 1:

*Do you have any additional information to provide to that presented in this Consultation that you believe Ofcom should consider? If so please provide clearly evidenced views. Are there any other issues that you believe Ofcom should have considered?*

### Question 2:

*a) Do you agree with our proposals to offer a mixed solution that allows stakeholders to choose between the currently available self coordinated authorisation approach and a new Ofcom coordinated approach for the band?*

*b) Do you agree with the segmented band plan with the split of 2 x 2 GHz and 2 x 2.5 GHz for Ofcom coordinated and self coordinated approaches respectively?*

*c) Is the guard band size of 250 MHz considered appropriate between the two approaches?*

### Question 3:

*a) For the Ofcom coordinated part of the band, do you agree with the proposal to make available channels of 500 MHz and 250 MHz (with smaller channels being made available when the standards are completed) and to make these channels available in up to 1 GHz bandwidth in the first instance?*

*b) Is there a requirement for channel sizes greater than 500 MHz in the coordinated block? Please submit evidence to support your view.*

### Question 4:

*a) Are there any aspects of the current self coordinated licensing and link registration process that could benefit from improvements? Please provide specific information and reasons for how your suggestions would improve the process.*

*b) Should Ofcom consider mandating the CEPT channel plan, ECC/REC/(05)07 for the self coordinated block? Explain clearly the reasons to support your view.*

*c) Are the technical parameters shown on the register sufficient to enable self coordination? Should Ofcom consider presenting additional parameters on the register? If so, which parameters and why?*

## 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 14 October 2013**.
- A1.2 Ofcom strongly prefers to receive responses using the online web form at <http://stakeolders.ofcom.org.uk/consultations/70-80ghz-review/>, 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 **7080GHzReview@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.
- Mrinal Patel  
Spectrum Policy Group  
Riverside House  
2A Southwark Bridge Road  
London SE1 9HA
- Fax: 020 7981 3090
- 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 in section 7. 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 Mrinal Patel on 020 7981 3127.

## 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/about/accoun/disclaimer/>

## Next steps

- A1.11 Following the end of the consultation period, Ofcom intends to publish a statement in December 2013.
- 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/static/subscribe/select\\_list.htm](http://www.ofcom.org.uk/static/subscribe/select_list.htm)

## 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 [www.ofcom.org.uk/consult/](http://www.ofcom.org.uk/consult/).
- 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

# Implementation of an Ofcom Coordinated Approach

## Introduction

A4.1 In this annex we cover implementation of an Ofcom coordinated approach and how we are preparing to facilitate this. We detail specific action that will be required in the interim to consider existing self coordinated links that are within or overlap with the proposed coordinated block.

## Frequency Assignment Methodology

A4.2 Ofcom uses a classical noise-limited frequency assignment methodology and a description of this well established approach is set-out in OfW446, Technical Frequency Assignment Criteria for Fixed Point-to-Point Radio Services with Digital Modulation published by Ofcom.

A4.3 In general, Ofcom proposes to extend the current frequency assignment service to 71-76 GHz and 81-86 GHz without making changes to the methodology or the associated technical-policy unless this is necessary.

A4.4 However, there are some significant issues to be considered including radio propagation modelling and the preparation of data associated with self coordinated links. These two issues are discussed in the following sub-sections.

## Radio Propagation Modelling

A4.5 Radio propagation studies at 71-76 GHz and 81-86 GHz are at an early stage in the UK and internationally. Ofcom has recently commissioned a short study by dB Spectrum Services in order to ensure that adequate preparations are made for the best use and configuration of the propagation models currently available and used in the Ofcom assignment systems.

A4.6 The study assessed the problems and risks associated with the established fixed link propagation models and provided expert advice on the best use and configuration of these models when used at 71-76 GHz and 81-86 GHz. Ofcom has considered this advice and has formulated proposals based on this while also taking account of some practical constraints and timelines.

A4.7 The key findings of the study and the steps proposed by Ofcom in relation to a coordinated solution are summarised here:

### ITU Recommendation P.530-10.

- Modelling set out in ITU Recommendation P.530-10 and in subordinate models (called by P.530-10) is used in Ofcom's frequency assignment procedures to calculate the smallest EIRP needed to resolve a candidate fixed link's propagation availability requirement.

- These EIRPs are assigned by Ofcom to a link-end and are used to model sources of interference in the frequency assignment process. The study concludes that this model is likely to over-predict clear-air fading and under-predict precipitation-fading at 71-76 GHz and 81-86 GHz.
- In addition, there is a risk that the subordinate ITU Recommendation P.676-4 will under-predict gaseous attenuation.
- It is well established that precipitation-fading dominates at these frequencies and, on this basis and in order to remove the risk of inaccurate predictions for clear-air fading, Ofcom proposes that this model is configured such that precipitation-fading is considered and clear-air fading is switched-off.
- In general, Ofcom uses a Minimum Fade Margin of 10 dB but, in order to mitigate under-prediction of rain-fading, proposes to use a value of 20 dB in this frequency band.
- Ofcom proposes that a conservative assumption for water vapour density of  $10 \text{ g/m}^3$  is utilised with ITU Recommendation P.676-4.
- A bespoke sleet attenuation model is used in combination with ITU Recommendation P.530-10 and Ofcom proposes that this combination is used at 71-76 GHz and 81-86 GHz.

#### ITU Recommendation P.452.

- This model is used to predict short- and long-term unwanted signal levels incident to receivers, taking account of propagation mechanisms on the interference path. The study highlighted a significant problem at 71-76 GHz and 81-86 GHz where outputs are dominated by the accuracy of topographic and positional information and concluded that, on this basis, the model is unreliable at these frequencies.
- Ofcom proposes that this model is switched-off and replaced by the free space model used in conjunction with ITU Recommendation P.676-4 and the standard assumption for water vapour density of  $7.5 \text{ g/m}^3$ .
- Ofcom's frequency assignment criteria uses two wanted-to-unwanted (W/U) tests: the first test models the median unwanted signal incident to a receiver with a fully-faded wanted signal while the second test models an enhanced unwanted signal incident to a receiver for a small percentage of time and the median wanted signal. Using free space means that the first test is conservative on non line-of-sight interference paths while the second test is, effectively, switched-off.

A4.8 The proposals described above are very practical proposals that allow Ofcom to facilitate a frequency assignment service within a short timescale while managing the interference environment and minimising the risk of interference between assigned links. In taking this approach it is recognised that there may be a future requirement to update the different propagation models and associated configurations when results of further propagation studies and research in this area becomes available.

## Data Preparation

- A4.9 Ofcom's proposals require that a coordinated solution takes account of existing fixed link deployments registered under the self coordinated regime. Candidate links exposed to Ofcom's frequency assignment procedures under a coordinated solution would be modelled in the radio interference environment and, in order for a frequency to be assigned, W/U protection ratios would need to be satisfied at all of the receivers considered in the frequency assignment procedure, including receivers associated with self coordinated links.
- A4.10 Some practical steps would be necessary in order that the data on the Register of self coordinated links could be migrated to Ofcom's frequency assignment database and to ensure that these links were accurately modelled in the technical calculations in accordance with Ofcom's frequency assignment methodology and procedures.
- A4.11 Some data specified on the Register requires validation and, where necessary, correction. In some cases, data requires enhancement and all registrations would require some new parameters to be added.
- A4.12 A brief summary of these data-preparation tasks is set-out here:
- Registrations can be mapped to an ETSI Spectral Efficiency Class based on transmission efficiency (Mbit/s/MHz). Information about data-rate and bandwidth are available from the Register.
  - A W/U protection ratio can be assigned to each registration based on Spectral Efficiency Class. W/U should be assigned in accordance with Ofcom's frequency assignment methodology and criteria.
  - A Receiver Sensitivity Level ( $BER = 10^{-6}$ ), based on specifications set-out in the ETSI manufacturing standard, bandwidth and Spectral Efficiency Class, can be assigned to each registration in accordance with Ofcom's methodology.
  - Site positional information can be validated and, where necessary, corrected. The accuracy of site positional information can be validated by correlating the path lengths derived from the site positional information and the path-length data on the Register.
  - Vertical and Horizontal signal polarity can be assigned to all registrations. There is no information on the Register about signal polarisation but Ofcom can model both Vertical and Horizontal signal polarisation in the technical calculations.
  - Antenna patterns can be obtained from link operators or manufacturers. Information about antenna models is held on the Register but not the detailed antenna patterns required for practical frequency assignment work.