Fixed Wireless Spectrum Strategy

Call for Input

Publication date: 11 July 2016

Closing Date for Responses: 19 September 2016

About this document

This Call for Input is asking stakeholders for their input and initial views on a strategic review of spectrum used by fixed wireless services.

Fixed wireless services are wireless links which operate between two or more fixed points and support various data-heavy applications – including backhaul services for mobile network operators, high-frequency trading and utilities.

This call for input is part of a phased review, and will support Ofcom's wider future spectrum management policies, taking account of market trends and technology changes.

Ofcom is keen to develop a deeper understanding of current usage, as well as how technologies, supply and demand are likely to develop.

Responses will help inform Ofcom's strategy, future spectrum policy decisions and the prioritisation of work related to fixed wireless services.

The closing date for responses is 19 September.

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Section 1

Purpose of the Strategic Review

Introduction

1.1 The objective of the review is to develop our long term strategy for the Fixed Service sector. This will inform our wider future spectrum management policies in light of market, technology and international changes. The review aims to:

i) further our understanding of the benefits that the Fixed Service delivers to citizens and consumers by refining our understanding of the different uses and applications provided within the Fixed Service;

ii) improve our understanding of the market and technology trends affecting future demand for these uses; and

iii) ensure we continue to be responsive to international developments affecting this sector as well as linkages with other key projects such as the Mobile Data Strategy[1] (MDS).

1.2 The Fixed Service in the context of the review refers to fixed wireless services delivered by fixed wireless links used to convey voice or data traffic between specified geographic locations. Such links provide an alternative or a complement to other transmission media such as copper cables or fibre and are used for a variety of applications, including backhaul provision for mobile network base stations; distributing TV signals from studios to broadcast transmitter sites; providing direct voice or data connections to end users (leased lines) and connecting nodes within private or corporate communication networks.

1.3 It is important that we conduct a review of this sector in order to continue to provide a clear regulatory environment for the Fixed Service in the UK. This is particularly important at the current time given the fast pace of technology development, the changing wireless landscape and the surges in data capacity requirements being predicted for both access and backhaul networks. This document details the developments that have led to the need to review this sector now and defines our approach.

1.4 The review will look forward over the medium to longer term (next 5 – 10 years)[2], while also taking into account any shorter term policy initiatives. This Call for Input is the first step in the review. We invite stakeholders to present information and evidenced views to help us understand the current use and likely future demand, technology changes, and their impact on spectrum within the Fixed Service sector. This is to help us determine the scope and scale of the policy issues that might be addressed in due course. We also draw stakeholders' attention to issues that we believe require attention in the near term.

[1] http://stakeholders.ofcom.org.uk/consultations/mobile-data-strategy/
[2] Our Spectrum Management Strategy in 2014 also made specific reference to sectors which will require on-going regulatory attention and specific regulatory action at times over the next 10 years.

Why we are conducting the review now

The Spectrum Review[3] of Fixed Services, carried out in 2012, focused on the way the spectrum was managed and considered whether any change was required in bands used by the Fixed Service. It therefore largely focussed on bands managed by Ofcom[4]. Since this review, there have been a number of technology, market and international developments and we consider that a strategic review of this sector is appropriate now. We highlight below, those developments with the potential to significantly impact the Fixed Service use in the UK.

Growing consumer demand for mobile broadband[5], greater capacity and better coverage leading to an increased demand for backhaul capacity.	Mobile data traffic has been growing rapidly, at around 60%[6] per year, and we believe growth will continue into the future, spurred by increasing use of high bandwidth applications (such as video streaming) and technology developments such as 5G[7]. The demand for wireless backhaul to support 5G and how this can best be managed also needs to be considered. Currently, the majority of fixed wireless links in the UK are used to support mobile services and therefore an increasing demand for mobile broadband will directly impact the Fixed Service sector. This has two main aspects: i) An increasing requirement for capacity in the wireless backhaul part of the network. ii) An increasing future requirement for additional spectrum for the access part of the network, in particular, in bands that are currently used for the Fixed Service.
Our Spectrum Management Strategy[8] identified areas of significance to the Fixed Service sector which may require on-going regulatory attention and specific regulatory action at times over the next 10 years.	Since our last sector review in 2012, Ofcom published a revised spectrum management strategy for the next ten years, which identified the following areas of impact on the use of fixed wireless links: • Mergers between mobile network operators (MNO) and increasing infrastructure sharing, may result in a reduction in the number of fixed wireless links required to macrocells but could

[3] http://stakeholders.ofcom.org.uk/consultations/spectrum-review/
[4] Section 4.18 http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum-management-strategy/annexes/Spectrum_attribution_metrics.pdf
[5] http://stakeholders.ofcom.org.uk/consultations/mobile-data-strategy/
[6] See *Smartphone Cities*, March 2016, http://stakeholders.ofcom.org.uk/market-data-research/other/telecoms-research/broadband-speeds/smartphone-cities, and *The Communications Market 2015 (August)*, http://stakeholders.ofcom.org.uk/market-data-research/market-data/communications-market-reports/cmr15/
[7] Fifth generation mobile phone standards and technology
[8] http://stakeholders.ofcom.org.uk/consultations/spectrum-management-strategy/statement/

	increase capacity requirements along consolidated routes. • The increase in the deployment of localised, high capacity small cells could raise demand for millimetre wave spectrum for fixed wireless links at frequencies above 60 GHz, particularly in urban areas.
Strategic Review of Digital Communications (DCR)[9] includes a major shift to promote new fibre networks, using BT's infrastructure.	In February 2016, Ofcom published its interim conclusions on the DCR and the next steps to implement our strategy. One of the strategies is to promote large-scale investment in more fibre by allowing BT's competitors easier access to lay their own fibre cables in BT's infrastructure of underground cable ducts and along its telegraph poles ("duct and pole access"). Improved access to fibre would increase attractiveness of fibre for future mobile backhaul solutions and reduce reliance on fixed wireless links.
Specific sectoral changes and international developments. There are a large number of users of fixed wireless links in the UK and each user type has different spectrum requirements.	We highlight some specific sectoral and international developments below: • The outcome of WRC-15[10] resulted in the identification of the 1492-1518 MHz band for IMT[11] (currently used by fixed wireless links in the UK) as well as the need to identify additional spectrum for IMT/5G. Eight out of the eleven bands identified for study for 5G are currently used for Fixed Service applications in the UK. This includes five[12] Fixed Service bands managed by Ofcom and three[13] bands that have been awarded. In addition to the identification of spectrum to be studied for IMT, there are a number of other WRC-19 Agenda items that involve sharing studies between Fixed Service bands with other services that may impact on future availability of Fixed Service spectrum. • New Fixed Service bands 'W band' (92 – 114.5

[9] http://stakeholders.ofcom.org.uk/telecoms/policy/digital-comms-review/

[10] World radiocommunication conferences (WRC) are held every three to four years. It is the job of WRC to review, and, if necessary, revise the Radio Regulations, the international treaty governing the use of the radio-frequency spectrum and the geostationary-satellite and non-geostationary-satellite orbits

[11] International Mobile Telecommunications (IMT) systems are mobile systems that provide access to a wide range of telecommunication services including advanced mobile services, supported by mobile and fixed networks, which are increasingly packet-based.

[12] 24.25-27.5 GHz ('26 GHz"), 37-40.5 GHz ("38 GHz"), 50.4-52.6 GHz ("52 GHz"), 66-76 GHz ("70/80 GHz") and 81-86 GHz ("70/80 GHz")

[13] 31.8-33.4 GHz, 40.5-42.5 GHz and 42.5-43.5 GHz

GHz) and 'D band' (130 – 174.8 GHz) are being studied within Europe for very high capacity (e.g. n x 10 Gbps) fixed wireless links applications including backhaul for next generation mobile networks.

- In the mobile backhaul sector, MNO network sharing and migration to block assigned[14] spectrum (10-40 GHz) has seen a reduction in the number of fixed wireless links required in Ofcom managed bands. However, at the same time we have also seen an increasing trend for higher capacity fixed wireless links, using larger channel bandwidths, licensed to MNOs.

- The key change in the emergency service sector is the evolution of the previous Airwave network to an LTE network managed by EE.

- We have recently, over the last two to three years, experienced a significant demand for fixed wireless links for high frequency trading applications at specific locations / routes.

- We have also noted various new technological developments and options being explored including very high order modulation schemes, multiple input multiple output (MIMO) and the move towards wider channels to cater for the very high capacity fixed wireless applications across the bands.

The scope of the review

1.6 In view of the evolving landscape facing the sector, the purpose of the review is to develop a long term strategy for the Fixed Service and provide, to the extent possible, a clear regulatory environment to Fixed Service spectrum users and manufacturers.

1.7 The review builds on the information collected and the analysis carried out as part of the 2012 review as well as the analysis we published in 2013 as part of our Spectrum Management Strategy but has a wider strategic focus on the citizen and consumer benefits delivered by applications supported by the Fixed Service. We aim to further our understanding of the applications used and the benefits derived from these uses, future demand across all bands and any significant developments since the previous review.

[14] Section 4.18 http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum-management-strategy/annexes/Spectrum_attribution_metrics.pdf

1.8 Through the review, we also aim to build a clear picture of existing and future use in spectrum bands that are block assigned. Additionally, we intend to gather stakeholders' input on other technologies that could complement the use of fixed wireless links and in certain situations replace fixed wireless links, such as the use of fibre. The Fixed Service bands related to this review are given in Tables 1 and 2 below. Furthermore the review will also be considering potential new spectrum for the Fixed Service e.g. 8 GHz and bands above 86 GHz.

Table 1: Frequency bands managed[15] by Ofcom

Frequency Band	Frequency Range[16]
1.4 GHz	1350-1375 MHz 1492-1517MHz
4 GHz	3689 -3875 MHz 4009-4200 MHz
5.8 GHz	5725 – 5850 MHz
Lower 6 GHz	5925-6425 MHz
Upper 6 GHz	6425-7125 MHz
7.5 GHz	7425-7900 MHz
13 GHz	12.75-13.25 GHz
15 GHz	14.5- 15.35 GHz
18 GHz	17.7-19.7 GHz
23 GHz	22-23.6 GHz
26 GHz[17]	24.5-26.5 GHz
31 GHz	31.0-31.3 GHz 31.5-31.8 GHz
38 GHz	37- 39.5 GHz
52 GHz	51.4-52.6 GHz
55 GHz	55.78 – 57 GHz
60 GHz	57-64 GHz
65 GHz	64-66 GHz

[15] These are bands that are either technically coordinated by Ofcom on a link by link basis or self-coordinated by the licensee.
[16] Note that the ranges given may include edge guard bands and centre gaps. Specific band edges are defined in Ofcom document OfW48.
[17] In our interactive data this band is currently referred to as "25 GHz".

Frequency Band	Frequency Range[16]
70/80 GHz	71.125- 75.875 GHz 81.125- 85.875 GHz

Table 2: Block assigned frequency bands awarded by Ofcom

Frequency Band	Frequency Range
10 GHz	10.125-10.225 GHz 10.475-10.575 GHz
28 GHz	27.8285-28.4445 GHz 28.8365-29.4525 GHz
32 GHz	31.8-33.4 GHz
40 GHz	40.5-43.5 GHz

1.9 In this Call for Input, we are seeking input from stakeholders on developments related to:

- Different uses and applications currently provided within the Fixed Service, the rationale for choosing specific bands for specific applications, and the benefits these applications deliver to citizens and consumers across all spectrum bands.
- Demand trends and drivers affecting existing Fixed Service applications. We are observing increased capacity requirements, driven by consumer use of data heavy applications.
- Technology developments within existing sectors and new high capacity fixed wireless link bands identified at frequency bands above 100 GHz.
- Emerging demand from new Fixed Service applications. Since our last review, we have seen significant demand for fixed wireless links from the financial sector and the need for additional spectrum to be studied for WRC-19 to facilitate deployment of high altitude platform stations (HAPS[18]), and within the spectrum used for fixed wireless links to provide broadband access in remote areas.

[18] A High Altitude Platform Station, according to Article 1.66A of the International Radio Regulations, is “a station on an object at an altitude of 20 to 50km and at a specified nominal, fixed point relative to Earth”.

Other relevant work

1.10 The review is related to a number of other projects currently being undertaken by Ofcom:

- **Mobile Data Strategy**: This project has identified the 3.6–3.8 GHz band and upgraded the 1492–1517 MHz band to high priority[19] for mobile use, and is currently considering additional bands above 6 GHz (most of which are currently used for Fixed Service applications) for potential future use by 5G mobile technologies.

- **Fee Review:** We plan to consult on our proposals for the revised fees for the fixed and satellite sectors later this year.

- **3.8 – 4.2 GHz sharing:** We published a Call for Input[20] in April 2016, introducing the 3.8 - 4.2 GHz fixed link band as a candidate band for enhanced spectrum sharing, for potential new innovative applications. We intend to publish an update in the summer.

- **Space Spectrum Strategy:** We recently consulted on the Space Spectrum Strategy[21] and are currently working on publishing a statement in the autumn. A number of bands used by fixed wireless links are also shared with the Fixed Satellite Service. We note stakeholder responses mentioned a number of bands which are used for the Fixed Service, namely 14 GHz, 18 GHz and 28 GHz. There are also responses referring to new spectrum for satellite applications at Q/V[22] band.

- **Public Sector Spectrum Release Programme**: The Government has recently published an update[23] indicating that up to 168 MHz of spectrum in the 7.9–8.4 GHz band could be available for possible sharing with the Fixed Service.

- **Additional Wi-Fi spectrum in the 5 GHz band**: We are currently consulting[24] on making available an additional 125 MHz of 5 GHz spectrum at 5725–5850 MHz for Wi-Fi subject to first establishing the correct technical parameters to ensure the appropriate protection of other users of this band. The 5725–5850 MHz band is subject to a light licensing regime which requires users to register their terminals with Ofcom and is used to provide application such as broadband fixed wireless access.

[19] http://stakeholders.ofcom.org.uk/consultations/mobile-data-strategy/update-strategy-mobile-spectrum/?utm_source=updates&utm_medium=email&utm_campaign=update-strategy-mobile-spectrum
[20] http://stakeholders.ofcom.org.uk/consultations/opportunities-for-spectrum-sharing-innovation/
[21] http://stakeholders.ofcom.org.uk/consultations/space-spectrum-strategy/
[22] Approximate Q/V band range referred to here is between 37-51 GHz.
[23] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/518303/enabling_uk_growth_pssr_programme_annual_report.pdf
[24] http://stakeholders.ofcom.org.uk/binaries/consultations/5-GHz-Wi-Fi/summary/improving-spectrum-access-consumers-5GHz.pdf

Publication of data in interactive form

1.11 Alongside this Call for Input, we are publishing an interactive analysis of licensed fixed wireless links to assist stakeholders in understanding how our current Ofcom managed bands are used. The data is set out by location, bandwidth, channel occupancy and path length.

1.12 As stated in our Spectrum Management Strategy, we are seeking to provide more information on how spectrum is used in the UK. We are also keen as part of this Call for Input to gather and analyse information from various sources to build a more comprehensive picture of the sectors for which we authorise spectrum use.

Structure of the document

1.13 The remainder of the document is structured as follows:

- **Section 2** sets out the key areas in which we are seeking information from stakeholders and;
- **Section 3** outlines our next steps for the review.

Section 2

This Call for Input

Our approach

2.1 We are taking a phased approach to the review with two main phases:

- **Phase 1** - Information gathering and;
- **Phase 2** - Development of our strategy.

2.2 This Call for Input forms the first phase of our review and its aim is to gather information on existing applications and use, key market and technology trends, and specific sectoral changes affecting future demand within the Fixed Service. This will be followed by bilateral[25] engagement with stakeholders. The information gathered will feed into Phase 2 which will focus on the development of our long term strategy to allow us to take informed policy decisions affecting future requirements for uses within the Fixed Service.

2.3 The work of Phase 2 will be scoped after the completion of Phase 1 as this will largely be informed by the stakeholders' responses to this Call for Input, the stakeholder engagement, as well as other internal projects and ongoing international activities.

Refining our understanding of existing uses within the Fixed Service

2.4 The Radio Regulations define the Fixed Service as the transmission, reception or emission of radio waves for telecommunications purposes between two specified fixed points (point to point) or from a fixed point(s) to a number of fixed points within a specified area (point to multipoint or multipoint to multipoint). Such links provide an alternative or a complement to other transmission media such as copper cables or fibre and are used for a variety of applications.

2.5 Fixed wireless links may be quicker and cheaper to deploy than wired communications in certain circumstances and have lower latency compared to fibre links. They are an integral part of any communication network and are used by a number of sectors to support varying communication needs. Demand for fixed wireless links and the choice of frequency bands is therefore often very specific to the needs of the user and the nature of the application provided.

2.6 As part of this Call for Input, we would like to refine our understanding of how fixed wireless links are used, the applications they support and the bands they use. We have categorised existing licensees within Ofcom managed Fixed Service bands into "user types" shown in Table 3 based on what we consider to be the main business of the licensees. In the table, we also provide a brief description of our current understanding of the main use of fixed wireless links by these users.

[25] See section 3.

Table 3: Typical applications provided by user type

User Type	Application
Mobile network operators	Provision of backhaul between mobile base stations and core network.
Fixed telecom operators	Provision of communications links by fixed network operators, internet service providers and wireless network solutions providers.
Public safety	Provision of communications networks for the police, fire and ambulance services, including video surveillance and backhaul.
Utilities	Provision of communications links for substation monitoring, network backup and security for energy, electricity, water and offshore windfarm companies.
Financial sector	Provision of communication links by the financial sector to support financial applications such as high frequency trading.
Broadcaster	Transmitter feeds for local and national digital TV/audio broadcasting and for connecting and interconnecting broadcast studios.
Local authorities	Provision of video surveillance or broadband connectivity used by local authorities.
Oil and gas	Provision of communication links between offshore oil rigs and land based communication systems.
Transport	Provision of communication links for transport sector including airports, ports, trains, buses and taxis.
Other	Provision of communication links for hospitals, schools, manufacturers, or other users.

2.7 The choice of frequency band by users to support a given application is dependent on a number of factors such as the availability of the band at the desired location, the desired link length, the capacity and the cost of deployment. Figure 1 shows the usage of bands based on our initial categorisation of user types across Ofcom managed Fixed Service bands. We understand that a user type may provide different applications in different bands or may provide the same application to different user types. Therefore, we also intend to use this Call for Input to refine the categorisation based on information we receive from stakeholder responses.

Figure 1: Initial categorisation of Fixed Service spectrum managed by Ofcom with usage shown by user types – the size of the circle is relative to the number of fixed wireless links licensed in the UK

Question 1:
a) Please indicate which user type given in Table 1 best describes your use of fixed wireless links?

b) If you are a telecom network operator or an organisation providing wireless solutions for different user types, please indicate where possible, a breakdown of the percentage of fixed wireless links used to support the different user types i.e. mobile network operator, emergency services etc.

Question 2:
a) Please indicate the applications provided by your use of fixed wireless links and the benefits these provide to citizens and consumers.

b) For each application, please indicate the frequency band used and the rationale for choosing that band, i.e. the application specific characteristics that affect your specific choice of frequency band.

c) For each link, please provide details of the application supported.

Understanding market and technology trends

2.8 In order to assess future demand for fixed wireless links, we would like to understand the market drivers and technology trends affecting demand for both user type and applications. Please note that future demand and drivers for some specific users of fixed wireless links which would be most affected by potential changes in the availability of future fixed wireless links are covered in the next section. If you are one of these users, you can skip the next question.

Question 3:
a) How do you envisage the current and future applications provided by your use of fixed wireless links to change in the next 5-10 years?

b) What market trends and drivers will affect the use of fixed wireless links to deliver the relevant applications in the future?

c) What bands will be relevant to support the future changes?

d) Could your use of fixed wireless links be provided by alternative solutions? If so please give details of alternatives.

2.9 Fixed Service equipment continues to evolve in order to meet the ever increasing backhaul capacity demands by deploying capacity enhancement techniques such as advanced modulation, adaptive modulation, MIMO, channel aggregation and multiband solutions which all impact on spectrum.

Question 4:
a) How will Fixed Service equipment continue to evolve to meet the increasing capacity requirements?

b) What is the timescale for implementation in equipment?

Question 5:
a) What capacity enhancing techniques are you deploying or intend to deploy?

b) How does this affect your future demand for spectrum?

c) Do you see any barriers in the current authorisation approaches preventing use of such technology? If so, please indicate the changes you consider would be required to facilitate this?

Understanding specific sectoral changes and international developments

2.10 International developments have a direct impact on our continued ability to facilitate access to spectrum for the Fixed Service.

2.11 WRC-15 identified the upper duplex of the 1.4 GHz band (1492–1517 MHz) for IMT on a global basis. This band has also recently been upgraded to a 'high priority' status in our latest MDS Update. We have indicated in this update document that we will be considering our options on whether and how to make the 1492–1517 MHz band available for mobile.

2.12 The 3.6–3.8 GHz band remains a 'high priority' band in the MDS Update. This band (and the 3.4–3.6 GHz band) is also being considered by the RSPG[26] to be the primary band suitable for the introduction of 5G use in Europe before 2020. We are considering how spectrum can be made available for mobile use in this band. We intend to publish a consultation in the third quarter of 2016, considering whether to make spectrum in this band available for mobile broadband use in the future and how this can be achieved.

[26] https://circabc.europa.eu/d/a/workspace/SpacesStore/1a40dd19-c8a8-4ed0-bc9c-6cc5a7755f7d/RSPG16-031Final_Opinion_5G_for_public_consultation.pdf

2.13 In addition, WRC-15 identified a number of bands for study for future mobile services (5G) where eight of the eleven bands identified for study are used by the Fixed Service.

2.14 It is essential for us to understand the impact of these developments on fixed wireless link users. In addition, we are also keen to explore potential demand for emerging applications and new bands in the Fixed Service which are currently being studied in the different international groups and how this may benefit UK citizens and consumers in the future. This would also enable us to consider and take any necessary proactive action as required. In the following sections, we focus on the specific users.

Mobile network operators

2.15 Mobile network operators are major users of fixed wireless links, accounting for around 50%[27] of the total fixed wireless links licences from Ofcom. They are the majority users of bands above 20 GHz (accounting for 67% of total links in the 23, 26 and 38 GHz bands). Therefore, developments in the mobile backhaul sector will have the most material impact on demand for spectrum used for fixed wireless links.

2.16 Fixed wireless links and fibre play a complementary role in the delivery of mobile backhaul traffic. As backhaul networks have evolved, fixed wireless links are now typically used at the edge of a mobile backhaul network to connect mobile base stations to fibre connected sites (or aggregation points) where fibre is used for onward transmission to core networks. Without adequate backhaul, mobile services cannot be delivered to consumers and businesses. Fixed wireless links are also used to provide backhaul in hard to reach and rural areas where there is no fibre presence.

2.17 Since the 2012 review, we have seen a reduction in the number of fixed wireless links in Ofcom managed bands used by MNOs who also have holdings in the 10 GHz, 28 GHz, 32 GHz and 42 GHz auctioned bands. The preference seems to be to use self-managed spectrum[28] to provide mobile backhaul. However, there has also been around 30% overall increase in the total backhaul capacity used by MNOs in Ofcom managed bands since 2012, which reflects the increase in mobile data consumption driven by the evolution towards 4G.

2.18 Fibre is now the first choice for mobile backhaul where available and cost effective[29]. In February 2016, Ofcom published its interim conclusion on the DCR and the next steps to implement our strategy. One of the strategies is to promote large-scale investment in more fibre by allowing BT's competitors easier access to lay their own fibre cables in BT's infrastructure of underground cable ducts and along its telegraph poles ("duct and pole access"). Improved access to fibre would increase attractiveness of fibre for future mobile backhaul solutions and reduce reliance on fixed wireless links.

2.19 Mobile technology continues to undergo rapid change with the current evolution towards 5G. It is envisaged that this will require very high capacity, low latency

[27] Actual numbers of fixed wireless links used for mobile backhaul would be greater (as indicated in our 2012 review) because a significant proportion of fixed wireless links licenced to fixed telecom operators would also be used for mobile backhaul networks.
[28] Section 3.20 in http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum-review/update.pdf
[29] Section A.7.11 in http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/statement/final-annexes-1-13.pdf

communication with greater traffic asymmetry. This will require evolution of end to end mobile network architecture to ensure future backhaul solutions are flexible, scalable and cost effective.

2.20 Dense small cells are likely to be a significant feature of 5G and will present both technical and economic challenges for backhaul. It is envisaged that a combination of fibre, where available, and fixed wireless links will be required to provide small cell backhaul solutions. The latter will need a combination of lower frequencies for non-line of sight (NLOS) or near line of sight (NLOS) paths and higher frequencies for capacity.

2.21 Given the trends outlined above, we need to understand how this may affect the future role of fixed wireless links for the provision of mobile backhaul and how this will develop over time.

Question 6:
a) How do you expect future mobile backhaul network architecture to evolve as part of the 5G ecosystem?

b) How would this impact on future demand for fixed wireless links as a backhaul solution in the next 5-10 years and beyond? Please explain in terms of specific frequency bands i.e. which bands will be important for macro and small cell backhaul and why.

c) What is the most appropriate authorisation regime to facilitate this?

Question 7:
For each Fixed Service band[30] currently identified for study for 5G under WRC-15 Agenda Item 1.13 and 3.6–3.8 GHz band, please explain the impact on your backhaul use should the bands be identified and be repurposed for 5G given that the viability of in-band sharing between mobile access and backhaul is currently being studied.

Question 8
a) What is the current use in the block assigned bands at 10 GHz, 28 GHz, 32 GHz and 42 GHz bands and how do you expect usage in these bands to evolve given that the 32 GHz and 42 GHz bands are also being considered for study for 5G globally?

b) For each band, please provide details including geographic location of each fixed wireless link deployed and the application it supports. Where these bands are used for fixed wireless links, please give details in terms of the capacity supported and total numbers of links deployed.

Public safety

2.22 Public safety users include the police, fire brigade and ambulance services. Fixed wireless links are used to provide communication needs, including surveillance for individual organisations or backhaul of Airwave's national public safety mobile broadband network.

2.23 Public safety use of fixed wireless links range from 1.4 GHz to 38 GHz. Public safety is the second largest user in the 1.4 GHz band (33% of total links) and 26 GHz band

[30] 26 GHz, 38 GHz, 52 GHz, 70/80 GHz.

(24% of total links). Airwave is one of the key spectrum users for public safety and accounts for 10% of total fixed wireless links licence. However, Airwave's contract with the Home Office is coming to an end. It is possible that the replacement of the Home Office use of the TETRA system, due in mid-2017, could lead to a reduction in the number of associated fixed wireless links in these bands. EE is the new national emergency service network provider for police, ambulance and fire and rescue in mainland UK excluding Northern Ireland. We anticipate that most of the backhaul requirement would be facilitated from EE's existing mobile network infrastructure.

Question 9:
What impact does the change in the provision of national emergency service network have on both the future demand and supply of spectrum to support the backhaul requirement for the emergency service network? Please explain in terms of frequency bands, particularly but not limited to the 1.4 GHz, 26 GHz, 38 GHz bands?

Question 10:
a) How do you expect future public safety use of fixed wireless links to change in the next 5-10 years?

b) Please indicate the market and technology drivers affecting your future use of fixed wireless links, and whether your use could be provided by alternative solutions. If relevant, please explain in terms of frequency bands, particularly but not limited to 1.4 GHz, 26 GHz and 38 GHz?

Utilities

2.24 The utility users include the electricity, water and windfarm companies. Fixed wireless links are mainly used to connect sites into the core communications network and to inter-connect control centres.

2.25 The frequency bands used by this sector range from 1.4 GHz to 38 GHz but most links are concentrated at 1.4 GHz, 7.5 GHz and 13 GHz. We note that a stakeholder[31] has anticipated an increase in demand for spectrum for utility use for the roll-out of smart grid systems.

2.26 The utilities sector is the major user in the 1.4 GHz band. 1.4 GHz is currently the only band offering narrow channels at bandwidth less than 1.75 MHz to support low data rate applications. Usage at 1.4 GHz makes up 20% of total number of links used by utilities sector. This band is attractive due to low installation costs (antenna and mounting) compared to higher bands for a given path length.

2.27 As shown in the interactive dataset, 74% of links in 1.4 GHz are below 20 km with the majority of links (70%) above 20 km provided by the Lower 6, Upper 6, 7.5 and 13 GHz bands.

2.28 As indicated in 2.11, we will be considering our options on whether and how to make the 1.4 GHz band (1492–1517 MHz) available for mobile use following identification of the band for IMT at WRC-2015.

[31] http://stakeholders.ofcom.org.uk/binaries/consultations/review-spectrum-fees-fixed-links-satellite/responses/The_Joint_Radio_Company_Ltd_JRC.pdf

2.29 Work on the implementation of fixed point to point narrow channels in the centre gaps of the Lower and Upper 6 GHz band has been completed in Europe[32]. This could provide the possibility of an alternative band[33] to accommodate narrowband links. Therefore, we would like to understand views on the suitability of using the 6 GHz band centre gaps and guard bands for the type of applications that currently use the 1.4 GHz band.

Question 11:
Please indicate whether you consider that the guard band and centre gap of the 6 GHz band would be a suitable substitute for current and future 1.4 GHz applications, particularly in terms of costs to provide for like for like links and if not, the costs of alternative solutions. Please provide detailed evidence to support your answer.

Question 12:
a) How do you expect the utility sector's future use of fixed wireless links to change in the next 5-10 years?

b) Please indicate the market and technology drivers affecting your future use of fixed wireless links, and whether your use could be provided by alternative solutions. For example, which part of the smart grid network will require fixed wireless links? If relevant, please explain in terms of frequency bands, particularly but not limited to the 1.4 GHz, 26 GHz and 38 GHz bands.

Financial sector

2.30 Since the Spectrum Review, we have seen increasing demand for low latency links from the financial services sector to support high frequency trading (HFT). The use of fixed wireless links reduces the time it takes to transmit trading instructions by a few milliseconds compared to fibre.

2.31 These links are mostly concentrated on specific routes between South West England/Ireland and London and/or between London and continental Europe, aiming to link major financial centres with the shortest routes. The links cover bands ranging from 4 GHz up to 70/80 GHz.

2.32 The financial sector is the main user in the 4 GHz band where most links are concentrated between Greater London and across the South East. As indicated in 2.12, the MDS update identifies the 3.6–3.8 GHz band as a high priority band and we are considering how spectrum can be made available for mobile use in this band.

2.33 55% of total links used by financial sector are in the self-coordinated 70/80 GHz band with bandwidths greater than 1 GHz. Continued demand in the coordinated part of the 70/80 GHz band at specific routes has meant that Ofcom has had to decline applications at those locations because all the available channels have been assigned.

[32] http://www.erodocdb.dk/Docs/doc98/official/pdf/REC1406.PDF
[33] New links will be subjected to existing coordination procedures with existing links operating in the lower and upper 6 GHz bands.

Question 13:
a) How do you expect the future requirements for fixed wireless links that support HFT applications to change over the next 5-10 years?

b) Please indicate the market and technology drivers affecting your future use of fixed wireless links. If relevant, please explain in terms of frequency bands, particularly the 70/80 GHz band.

Potential use by high altitude platform stations (HAPS) in the Fixed Service

2.34 HAPS are stations operating at high altitudes, providing connectivity to a fixed ground terminal or between HAPS. HAPS offer a possible means to provide fixed broadband connectivity that would enable wireless broadband deployment in remote areas and where other communications infrastructure may not be available or suitable. They may also be used to provide communication in the event of a disaster.

2.35 One of the conclusions from the DCR is to guarantee universal broadband availability at sufficient speeds to meet modern consumer needs. We note that HAPS could play a role in complementing terrestrial and satellite delivery of broadband access technologies to deliver this goal.

2.36 WRC-19 will consider the need for additional spectrum identifications for use by HAPS and if the spectrum needs for HAPS cannot be met within the existing frequency identifications, WRC-19 will consider additional allocations in the 38–39.5 GHz band for identification on a global basis and the bands 21.4-22 GHz and 24.25-27.5 GHz for ITU Region 2. Here it is noted that the 38 GHz band is also being studied for potential identification for 5G. In order to develop our international position for this, we would like to understand potential interest in deploying HAPS in the UK within this band and in general.

2.37 In response to our Call for Input on the Space Spectrum Strategy, a stakeholder[34] indicated that there is a need for additional Fixed Service identification for HAPS to enable high capacity communication, consistent with the throughput speeds available with 4G mobile technologies and planned for 5G technologies.

Question 14:
a) What is the future demand for HAPS in the UK both in terms of being a network provider and service provider? Please provide details including specific applications and envisaged deployment scenarios for HAPS.

b) How could sharing with existing fixed wireless links be facilitated? What would this mean in terms of the most appropriate authorisation regime to facilitate deployment of HAPS?

Band specific issues

2.38 In the previous section, we looked at sector specific issues. We are also keen to bring out band specific issues that may impact on current and future use of fixed

[34] http://stakeholders.ofcom.org.uk/binaries/consultations/space-science-cfi/responses/Facebook.pdf

wireless links. We are asking for your input to ensure we bring these bands into the wider context of future changes.

New Fixed Service bands and channel plans

2.39 CEPT[35] has studied and demonstrated the technical feasibility[36] of introducing narrow band channels in the guard bands and centre gaps of existing channel plans for the Lower and Upper 6 GHz bands addressing compatibility issues with other services as well as within Fixed Service. This could provide a complementary band to the 1.4 GHz band for low capacity digital fixed wireless links.

2.40 CEPT has also studied[37] as a long term option to combine the Lower 6 GHz band and Upper 6 GHz band to form a new channel plan. This could provide up to 5 paired 112 MHz very high capacity, wide channels for fixed wireless applications. There are practical implementation issues that need to be carefully considered to assess coexistence between the new band plan with existing channel plans in the Lower 6 GHz and Upper 6 GHz band and with potential narrowband channels within the guard bands.

2.41 The Government through the Public Sector Spectrum Release programme is advancing feasibility work on possible sharing between fixed wireless links and public sector users. The update published in April 16 indicated that up to 168 MHz of spectrum in the 7.9–8.4 GHz (8 GHz) band could be available for possible sharing with fixed wireless links.

2.42 There are also ongoing international activities to study channelling arrangements at the 92-115 GHz ("W" band) and 130–175 GHz ("D" band) for Fixed Service. These extremely high capacity bands could meet the demand including for future backhaul solutions for high capacity small cells. We would like to understand the potential applications envisaged to be deployed in these bands and the equipment availability timescales.

2.43 Work is also progressing in international groups in preparation for WRC-19 to identify frequency bands in the 275–450 GHz range for Fixed Services applications.

Question 15:
a) How could the 8 GHz band and narrowband channels within the guard bands and centre gaps of the existing channel plans for the 6 GHz band meet future demand for fixed wireless links if additional spectrum could be made available?

b) What types of applications do you consider would be of interest for these bands?

c) What is the status of fixed wireless links equipment availability in these bands?

Question 16:
a) What is the demand for a combined Lower and Upper 6 GHz channel plan that could provide wider channels at 112 MHz bandwidth?

[35] European Conference of Postal and Telecommunications Administrations consist of 48 countries whose activities include co-operation on commercial, operational, regulatory and technical standardisations issues.
[36] http://www.erodocdb.dk/Docs/doc98/official/pdf/REC1406.PDF
[37] http://www.erodocdb.dk/doks/filedownload.aspx?fileid=4149&fileurl=http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP235.PDF

b) What are the practical implications for existing equipment that operates under the existing band plans who wish to migrate to the new band plan?

c) What is the status of Fixed Service equipment availability for the wider 112 MHz channels in the combined Lower 6 GHz and Upper 6 GHz band?

Question 17:
a) What are the applications envisaged in the W and D bands?

b) What is the timescale of equipment availability for these bands?

c) What would you consider to be the appropriate authorisation regime to facilitate access to spectrum in the W and D bands?

Question 18:
a) Do you have a view on potential frequency bands between 275–450 GHz that could be suited for Fixed Service and for what applications?

b) What are the anticipated timescales for development of equipment and applications for these bands?

Lightly used and unused Fixed Service bands

2.44 There are a number of Fixed Service bands which are either lightly used or not used at all. These are shown in Table 4. There have been recent revisions made to the European harmonised channel plans for the 52 GHz[38] and 55 GHz[39] bands to provide options for wideband high capacity fixed wireless links to include 112 MHz channel bandwidths. We would like to understand future demand for these bands to support applications within the Fixed Service.

Table 4: Lightly used and unused Fixed Service bands

Bands	Method of assignment for fixed wireless links
31 GHz[40]	Externally managed
52 GHz[41]	Technically coordinated and assigned on a first come first served basis
55 GHz	Technically coordinated and assigned on a first come first served basis
65 GHz	Light licenced on a self-coordinated basis

[38] http://www.erodocdb.dk/doks/filedownload.aspx?fileid=1607&fileurl=http://www.erodocdb.dk/Docs/doc98/official/pdf/ERCREC1211.PDF
[39] http://www.erodocdb.dk/doks/filedownload.aspx?fileid=1610&fileurl=http://www.erodocdb.dk/Docs/doc98/official/pdf/REC1212.PDF
[40] The 31 – 31.3 GHz band is identified for HAPS (ground to HAPS) in several countries mainly in Asia.
[41] Being considered for study for 5G and fixed satellite service at WRC-19.

Question 19:
a) What is the future demand for bands listed in Table 4 for Fixed Service applications?

b) What is the status of fixed wireless links equipment availability in these bands?

Other issues

2.45 In this Call for Input, we have referred to areas that we consider to have the most likely impact on the Fixed Service Sector. However, we would welcome other information which you consider is relevant to our review regarding possible changes in demand for fixed wireless links.

Question 20:
Are there other aspects of the review on which you have evidence that would help inform our consideration of future developments in the Fixed Service sector? If so please provide as much evidence possible.

Section 3

Next steps

3.1 Stakeholders have until 19 September 2016 to respond to this Call for Input. During that time, we intend to engage with stakeholders in bilateral meetings. Any stakeholders wishing to have such a meeting should contact the Ofcom project team as soon as possible.

3.2 We expect to publish an update towards the end of the year. Whether this includes formal proposals for changes to the management of these bands will depend in part on the nature of the information provided in response to the Call for Input.

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 19 September 2016**.

A1.2 Ofcom strongly prefers to receive responses using the online web form at https://stakeholders.ofcom.org.uk/consultations/call-for-inputs-fixed-wireless-spectrum-strategy/howtorespond/form, 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 FSReview@ofcom.org.uk attaching your response in Microsoft Word format, together with a consultation response coversheet.

A1.4 Responses may alternatively be posted to the address below, marked with the title of the consultation.

Mrinal Patel
3/179
Spectrum Group
Riverside House
2A Southwark Bridge Road
London SE1 9HA

A1.5 Note that we do not need a hard copy in addition to an electronic version. Ofcom will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.

A1.6 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 4. 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 or mrinal.patel@ofcom.org.uk .

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, ideally on receipt. If you think your response should be kept confidential, can you please specify what part or whether

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

A1.9 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and will try to respect this. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A1.10 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's approach on intellectual property rights is explained further on its website at http://www.ofcom.org.uk/terms-of-use/

Next steps

A1.11 Following the end of the consultation period, Ofcom intends to publish an update in Q3 2016/17.

A1.12 Please note that you can register to receive free mail Updates alerting you to the publications of relevant Ofcom documents. For more details please see: http://www.ofcom.org.uk/email-updates/

Ofcom's consultation processes

A1.13 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information please see our consultation principles in Annex 2.

A1.14 If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at consult@ofcom.org.uk . 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 Steve Gettings, Acting Secretary to the Corporation, who is Ofcom's consultation champion:

Steve Gettings
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA

Tel: 020 7981 3601

Email Steve.Gettings@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.

A3.2 We have produced a coversheet for responses (see below) and would be very grateful if you could send one with your response (this is incorporated into the online web form if you respond in this way). This will speed up our processing of responses, and help to maintain confidentiality where appropriate.

A3.3 The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore Ofcom would encourage respondents to complete their coversheet in a way that allows Ofcom to publish their responses upon receipt, rather than waiting until the consultation period has ended.

A3.4 We strongly prefer to receive responses via the online web form which incorporates the coversheet. If you are responding via email, post or fax you can download an electronic copy of this coversheet in Word or RTF format from the 'Consultations' section of our website at http://stakeholders.ofcom.org.uk/consultations/consultation-response-coversheet/.

A3.5 Please put any parts of your response you consider should be kept confidential in a separate annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your cover sheet only, so that we don't have to edit your response.

Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

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

Nothing ☐

Whole response ☐

Part of the response ☐

Name/contact details/job title ☐

Organisation ☐

If there is no separate annex, which parts?

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

DECLARATION

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

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

Name

Signed (if hard copy)

Annex 4

Consultation questions

Question 1:
a) Please indicate which user type given in Table 1 best describes your use of fixed wireless links?

b) If you are a telecom network operator or an organisation providing wireless solutions for different user types, please indicate where possible, a breakdown of the percentage of fixed wireless links used to support the different user types i.e. mobile network operator, emergency services etc.

Question 2:
a) Please indicate the applications provided by your use of fixed wireless links and the benefits these provide to citizens and consumers.

b) For each application, please indicate the frequency band used and the rationale for choosing that band, i.e. the application specific characteristics that affect your specific choice of frequency band.

c) For each link, please provide details of the application supported.

Question 3:
a) How do you envisage the current and future applications provided by your use of fixed wireless links to change in the next 5-10 years?

b) What market trends and drivers will affect the use of fixed wireless links to deliver the relevant applications in the future?

c) What bands will be relevant to support the future changes?

d) Could your use of fixed wireless links be provided by alternative solutions? If so please give details of alternatives.

Question 4:
a) How will Fixed Service equipment continue to evolve to meet the increasing capacity requirements?

b) What is the timescale for implementation in equipment?

Question 5:
a) What capacity enhancing techniques are you deploying or intend to deploy?

b) How does this affect your future demand for spectrum?

c) Do you see any barriers in the current authorisation approaches preventing use of such technology? If so, please indicate the changes you consider would be required to facilitate this?

Question 6:
a) How do you expect future mobile backhaul network architecture to evolve as part of the 5G ecosystem?

b) How would this impact on future demand for fixed wireless links as a backhaul solution in the next 5-10 years and beyond? Please explain in terms of specific frequency bands i.e. which bands will be important for macro and small cell backhaul and why.

c) What is the most appropriate authorisation regime to facilitate this?

Question 7:
For each Fixed Service band[42] currently identified for study for 5G under WRC-15 Agenda Item 1.13 and 3.6–3.8 GHz band, please explain the impact on your backhaul use should the bands be identified and be repurposed for 5G given that the viability of in-band sharing between mobile access and backhaul is currently being studied.

Question 8
a) What is the current use in the block assigned bands at 10 GHz, 28 GHz, 32 GHz and 42 GHz bands and how do you expect usage in these bands to evolve given that the 32 GHz and 42 GHz bands are also being considered for study for 5G globally?

b) For each band, please provide details including geographic location of each fixed wireless link deployed and the application it supports. Where these bands are used for fixed wireless links, please give details in terms of the capacity supported and total numbers of links deployed.

Question 9:
What impact does the change in the provision of national emergency service network have on both the future demand and supply of spectrum to support the backhaul requirement for the emergency service network? Please explain in terms of frequency bands, particularly but not limited to the 1.4 GHz, 26 GHz, 38 GHz bands?

Question 10:
a) How do you expect future public safety use of fixed wireless links to change in the next 5-10 years?

b) Please indicate the market and technology drivers affecting your future use of fixed wireless links, and whether your use could be provided by alternative solutions. If relevant, please explain in terms of frequency bands, particularly but not limited to 1.4 GHz, 26 GHz and 38 GHz?

Question 11:
Please indicate whether you consider that the guard band and centre gap of the 6 GHz band would be a suitable substitute for current and future 1.4 GHz applications, particularly in terms of costs to provide for like for like links and if not, the costs of alternative solutions. Please provide detailed evidence to support your answer.

Question 12:
a) How do you expect the utility sector's future use of fixed wireless links to change in the next 5-10 years?

b) Please indicate the market and technology drivers affecting your future use of fixed wireless links, and whether your use could be provided by alternative solutions. For example, which part of the smart grid network will require fixed wireless links? If

[42] 26 GHz, 38 GHz, 52, GHz, 70/80 GHz

relevant, please explain in terms of frequency bands, particularly but not limited to the 1.4 GHz, 26 GHz and 38 GHz bands.

Question 13:
a) How do you expect the future requirements for fixed wireless links that support HFT applications to change over the next 5-10 years?

b) Please indicate the market and technology drivers affecting your future use of fixed wireless links. If relevant, please explain in terms of frequency bands, particularly the 70/80 GHz band.

Question 14:
a) What is the future demand for HAPS in the UK both in terms of being a network provider and service provider? Please provide details including specific applications and envisaged deployment scenarios for HAPS.

b) How could sharing with existing fixed wireless links be facilitated? What would this mean in terms of the most appropriate authorisation regime to facilitate deployment of HAPS?

Question 15:
a) How could the 8 GHz band and narrowband channels within the guard bands and centre gaps of the existing channel plans for the 6 GHz band meet future demand for fixed wireless links if additional spectrum could be made available?

b) What types of applications do you consider would be of interest for these bands?

c) What is the status of fixed wireless links equipment availability in these bands?

Question 16:
a) What is the demand for a combined Lower and Upper 6 GHz channel plan that could provide wider channels at 112 MHz bandwidth?

b) What are the practical implications for existing equipment that operates under the existing band plans who wish to migrate to the new band plan?

c) What is the status of Fixed Service equipment availability for the wider 112 MHz channels in the combined Lower 6 GHz and Upper 6 GHz band?

Question 17:
a) What are the applications envisaged in the W and D bands?

b) What is the timescale of equipment availability for these bands?

c) What would you consider to be the appropriate authorisation regime to facilitate access to spectrum in the W and D bands?

Question 18:
a) Do you have a view on potential frequency bands between 275–450 GHz that could be suited for Fixed Service and for what applications?

b) What are the anticipated timescales for the development of equipment and applications for these bands?

Question 19:
a) What is the future demand for bands listed in Table 4 for Fixed Service applications?

b) What is the status of fixed wireless links equipment availability in these bands?

Question 20:
Are there other aspects of the review on which you have evidence that would help inform our consideration of future developments in the Fixed Service sector? If so, please provide as much evidence possible.