

Review of the use of fixed wireless links and spectrum implications

Update

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1. Overview

- 1.1 This document provides an update on our review of the use of fixed wireless links and spectrum implications. Our call for inputs (CFI), published in October 2023, presented information on recent trends in fixed links usage and sought views from stakeholders on future fixed links use and market / technology developments.
- 1.2 In general, the responses we received confirmed the trends we identified in our CFI and agreed that these trends were likely to continue. The key trends included:
 - The overall number of fixed links are expected to continue to decline. This is mainly driven by a continued reduction in the number of links used by mobile network operators as they migrate more of their backhaul links to fibre networks.
 - However, the overall amount of spectrum bandwidth used by fixed links (the total aggregate bandwidth) has increased and is likely to continue to increase. This is mainly driven by a demand for high capacity links in higher frequency bands (E-band, 71-76 / 81-86 GHz).
- 1.3 Overall, taking account of trends in fixed links use, current technology and market developments and responses to the CFI, we consider that the currently available spectrum is broadly sufficient to meet future needs.
- 1.4 However, in view of the continued growth in use of higher capacity, higher frequency fixed links, we will continue to monitor developments in this area, with a view to commencing a new work item, within the next couple of years, to further consider the potential authorisation of W-band (92-114.25 GHz).

2. Summary of responses to the CFI and next steps

- 2.1 In our CFI, published in October 2023, we presented an overview of current fixed links use in the UK and showed how usage had changed since our last review of fixed links in 2016. We also discussed market, technology and international developments as they relate to fixed links.
- 2.2 To help us gain a deeper understanding of trends in fixed links, we sought input from stakeholders on their current and future potential use of fixed wireless links (fixed links), along with the decision factors that lead to the selection of a fixed wireless link instead of an alternative technology.
- 2.3 We received 29 responses to the CFI, eight of which were confidential. We have published non-confidential responses on our [website](#).
- 2.4 In this update we summarise key points raised by respondents to the CFI and provide feedback on points related to the spectrum available for, and authorisation of, fixed links.
- 2.5 To provide context for this discussion, a list of current (and potential future) frequency bands for fixed links use is shown in Table 2.1 below.

Table 2.1: Current (and potential future) frequency bands for fixed links¹

Frequency band	Frequencies covered	Status
1.4 GHz	1350-1375 / 1492-1517 MHz	Closed
4 GHz	3815-3875 / 4135-4195 MHz	Open (limited availability)
Lower 6 GHz	5925-6425 MHz	Open
Upper 6 GHz	6425-7125 MHz	Open
7.5 GHz	7425-7900 MHz	Open
8 GHz	7.9-8.5 GHz	Open (limited geographical areas)
10 GHz	10.125-10.575 GHz	Block-assigned band
13 GHz	12.75-13.25 GHz	Open
15 GHz	14.5-15.35 GHz	Open
18 GHz	17.7-19.7 GHz	Open
23 GHz	22-23.6 GHz	Open
26 GHz	24.5-26.5 GHz	Closed
28 GHz	27.828-29.452 GHz	Block-assigned band ²
31 GHz	31-31.8 GHz	Unused
32 GHz	31.8-33.4 GHz	Block-assigned band ³
38 GHz	37-39.5 GHz	Open

¹ Details of band structures, channel plans and centre gaps for the Ofcom managed bands can be found in document [OFW48](#).

² We have [proposed](#) to open some of the currently unassigned spectrum in this band for fixed links on an Ofcom-managed basis.

³ We have [proposed](#) to open the currently unassigned spectrum in this band for fixed links on an Ofcom-managed basis.

40 GHz	40.5-43.5 GHz	Closed
52 GHz	51.4-52.6 GHz	Unused
55 GHz	55.78-57 GHz	Unused
E-band	71-76 / 81-86 GHz	Open
W-band	92-114.25 GHz	Potential future use
D-band	130-174.8 GHz	Potential future use

Summary of responses

- 2.6 Responses came from a range of user types and industry sectors, including broadband providers, broadcasters, mobile network operators, public safety, public services, transport and utilities.
- 2.7 In general, the responses we received confirmed the trends we had identified in our CFI and agreed that these trends were likely to continue.
- 2.8 We highlight some of our high-level takeaways from CFI responses below. We then present summaries of responses to some of the key questions in our CFI.

High-level takeaways

- 2.9 Numbers of links overall are expected to continue to decline, mainly driven by a continued reduction in the number of MNO links. However, the increase in capacity and channel bandwidths required by many users means that actual spectrum used (total aggregate bandwidth) is likely to increase across the different bands as larger channels are used, as well as an increase in the use of higher frequency bands, where more bandwidth and capacity capability is available.
- 2.10 Mobile network operators (MNOs), the biggest users of fixed links with ~58% of the total number of UK links, indicated they have fibre-first strategies and that we can expect to see a continued reduction in the total number of their fixed links, as fibre is extended much deeper into and across their networks. They identified increased availability of fibre and the rising demand for capacity (delivered using fibre networks) as two of the main factors driving the reduction in their use of fixed links, especially in urban and dense suburban areas.
- 2.11 Broadband providers and business telecoms users also expected bandwidth requirements to increase over time.
- 2.12 Other users of fixed links were generally less focused on bandwidth and capacity. Some respondents, e.g. Airwave, highlighted that they were more focused on coverage than capacity and that fixed links remain the most attractive option to reach more remote areas.
- 2.13 Utilities companies expected the number of links they use to grow significantly. They noted that in many cases fixed links are the only option that enable them to meet operational and regulatory requirements.
- 2.14 There is a trend towards use of higher frequencies (e.g. E-band⁴) as these frequencies enable higher channel bandwidths and greater channel capacity. Lower frequencies continue to be

⁴ 71-76 and 81-86 GHz

important to deliver connectivity over long distances, especially in rural areas where fibre is not available.

- 2.15 There is increasing use of technologies that enable greater capacity to be delivered over existing channel bandwidths, including Co-Channel Dual Polar (CCDP)⁵ technology and higher order adaptive coding and modulation (ACM)⁶.
- 2.16 Most respondents do not see satellite backhaul becoming a realistic substitute for fixed links in the next few years. A small number of respondents said that they would use satellite backhaul in remote areas where fixed links or fibre were not available or too expensive.

Drivers of choice of fixed links vs alternative technologies

- 2.17 A range of drivers in the choice of fixed links vs other technologies were highlighted by respondents. Cost or lack of availability of fibre in certain geographies were two of the top drivers highlighted by many. Other factors mentioned by several respondents included reliability, resilience and diversity, and speed/ease of deployment. Most respondents said that these factors were unlikely to change over the next five years.
- 2.18 MNOs said that they used fibre where available and only used fixed links where fibre was unavailable, impractical or uneconomic. BT said that fixed links would continue to be required for network resilience, especially in remote parts of the UK. Vodafone noted that, while fibre rollout will cover more of the country in 5 years' time, there will still be significant areas of the country which need mobile connectivity but where fibre rollout will not be commercially viable.
- 2.19 Utilities companies highlighted operational capability and reach as key factors alongside cost and speed of deployment. Some noted that the high availability they need cannot be provided by commercial operators.
- 2.20 A number of other respondents, including Airwave, MCA and Network Rail highlighted the difficulty and cost of getting fibre to remote areas.

Future spectrum for fixed links

- 2.21 Most respondents felt that the current spectrum available for fixed links was sufficient, but some noted difficulties with congestion in certain bands, in particular lower frequency bands (below 10 GHz) and higher frequency bands (E-band). Some highlighted challenges with Ofcom's recent decisions to remove access to certain bands. There were also concerns raised about international developments which could affect future use of some bands currently available for fixed links including upper 6 GHz, 7.5 GHz, 8 GHz and 15 GHz.
- 2.22 Most utilities companies that commented on this issue said that the current spectrum available was sufficient, or only just sufficient, while emphasising the need for long-term certainty and expressing concerns about the recent withdrawal of certain bands (1.4 and 26 GHz) and potential removal of others (e.g. upper 6 GHz).

⁵ CCDP is used to increase capacity on a given link path and is where both the vertical and horizontal polarisations are used simultaneously.

⁶ ACM technology allows a link to increase its capacity capability under favourable propagation conditions by dynamically selecting a higher order modulation.

- 2.23 Utilities companies and a number of others, including Arqiva and Airwave, additionally highlighted concerns with international work looking at potential future use of 7 and 15 GHz for IMT.
- 2.24 A number of respondents noted congestion in the 7.5 GHz band, with some noting that this was the reason for applying for links in the 6 GHz band. BT commented that there could be increasing instances of congestion in the 7.5 - 18 GHz range.
- 2.25 JRC/ENA, National Grid and ENWL asked for additional spectrum in the 10.5 GHz range to be made available.
- 2.26 A small number of respondents, including Airwave, Norfolk Police and Orkney Islands Council felt that the currently available spectrum was not sufficient. Airwave asked Ofcom to reverse its decision not to preserve 200 MHz in the 26 GHz band for fixed links. Norfolk Police said that L-band withdrawal means there is no longer a frequency band capable of circumnavigating slightly obstructed paths.

Ofcom view and update on recent developments

- 2.27 We note the concerns raised about the future availability of spectrum in frequencies below 10 GHz, especially in view of international developments potentially affecting bands in this range. Our response to future developments that affect these bands will take account of the ongoing requirements for fixed links in this spectrum as highlighted in CFI responses while being guided by our overarching duty to secure optimal spectrum use.
- 2.28 We do not have any current plans to open access to additional spectrum in the 10.5 GHz range. We also do not plan to review our decision not to retain access to 200 MHz of the 26 GHz fixed links use, for the reasons set out in our March 2023 statement and consultation on mmWave spectrum. The 1.4 GHz band was closed on 5 January 2019 as set out in our 2018 review of spectrum used by fixed wireless services and has been cleared of fixed links to facilitate new mobile services. While we note some of the unique properties of the 1.4 GHz band, fixed links are normally planned on a clear line of sight basis, without obstructions in the path. We therefore consider that the remaining fixed links bands will continue to be suitable for the vast majority of scenarios.
- 2.29 Separately, we note that additional spectrum has recently become available in the 28 GHz and 32 GHz band as a result of incumbent licensees surrendering (or varying) some of their licensed spectrum.
- 2.30 In the 28 GHz band, 2 x 224 MHz of spectrum became available on a near-national basis following Arqiva's variation of its licence. In March 2024 we published a [statement and consultation](#) in which we proposed to make some of this spectrum (2 x 112 MHz in the ranges 27.9405 - 28.0525 GHz and 28.9485 - 29.0605 GHz) available for point-to-point fixed links under an Ofcom-managed authorisation approach. This consultation closed on 31 May 2024 and we expect to publish our decision on future use of this spectrum later this year.
- 2.31 More recently, MLL surrendered its licence to use 2 x 126 MHz of spectrum in the 32 GHz band in April 2024. We published a [consultation](#) on 1 August 2024 in which we proposed to make this unassigned spectrum available for new fixed links assignments on an Ofcom-managed basis across the UK. This consultation closes on 13 September 2024.

W & D bands⁷

- 2.32 Interest in using these bands for fixed links was expressed by the MNOs. BT called for W-band to be opened up as soon as possible for licensed use to help mitigate congestion in certain locations at E-band⁸.
- 2.33 However, VMO2 thought that there was no current demand or use case for these bands and noted that hardware is not yet available.

Ofcom response

- 2.34 In view of the continued growth in use of higher capacity, higher frequency fixed links, we will continue to monitor developments in this area, with a view to commencing a new work item, within the next couple of years, to further consider the potential authorisation of W-band (92-114.25 GHz).

Framework for authorising fixed links licences

- 2.35 Approximately half of the respondents to the CFI were content with, or made no comments on, Ofcom's current framework for authorising fixed links. Other respondents made requests for additional functionality or suggested things that Ofcom could do differently.
- 2.36 Suggestions for additional functionality included:
- To introduce online licensing.
 - To be able to view progress with licence applications.
 - To know in advance which frequencies are available in particular areas (to avoid getting quotes for equipment in frequencies which turn out to be not available).
 - An efficient and timely means of finding out the high-low status of the links on an existing or future site licensed by Ofcom (this used to be provided in Excel format).
 - A rapid assignment process for emergencies.
 - Incentivisation for class 4 antennas⁹, ATPC¹⁰ and MIMO¹¹.
- 2.37 Other suggestions included:
- Ofcom to maintain proactive involvement in any new propagation modelling activity to address the impact of climate change on precipitation models. One other respondent said that updating propagation models to align with current industry standards and technological advancements was crucial.
 - The coordination process could potentially be modified to improve efficiency of assignments, e.g. in E-band.
 - Reintroduce a stakeholder group for fixed links with representatives from different industries.
 - Guidance regarding higher modulation schemes combined with adaptive coding and modulation (ACM) in line with ETSI recommendations.

⁷ W-band: 92-114.25 GHz and D-band: 130-174.8 GHz

⁸ 71-76 and 81-86 GHz

⁹ ETSI (European Telecommunications Standards Institute) has defined four classes of fixed links antennas, with class 4 being the highest performing class. These antennas have a tighter radiation pattern envelope (RPE) which increases their resistance to interference and can enable greater reuse of frequencies within a given geographic area.

¹⁰ ATPC: Automatic Transmit Power Control

¹¹ MIMO or Multiple Input Multiple Output is an antenna technique in which multiple transmit and receive antennas are used to improve the capacity of a radio link.

Ofcom view

- 2.38 As noted in our latest Plan of Work¹², Ofcom is currently carrying out a multi-year programme of work to upgrade its licensing systems. This will include introducing the ability to apply online for a larger number of licence products. Licensees would also be able to view their submitted applications online and check the current status of these. Overall, we expect the planned changes to our licensing systems to, over time, deliver greater automation and improve the licensee experience. Further updates will be provided on Ofcom’s website as the work progresses.
- 2.39 We agree that knowing in advance which frequencies are available in certain areas would be a helpful feature and we have this on our list of potential future developments. However, the advice which is highlighted in the fixed links application form continues to apply, i.e. “when making a new application, you are advised not to commit to the purchase of the equipment until you have received your licence documentation.”
- 2.40 We also agree that some of the other suggested approaches could be helpful, e.g. incentivisation of more efficient fixed link antennas. We note here that there is a natural incentive for licensees to use higher performance antennas. For example, if an application is being made in a known busy band / area, then a higher performance class (e.g. Class 4) antenna will give a greater certainty that the link can be assigned.
- 2.41 Whilst we no longer provide a spreadsheet specifically for the purpose of finding out the high-low status of links on an existing or future site licensed by Ofcom, we do publish licensing data on our [Spectrum Information Portal](#). Interested parties can download the data from this page and filter by frequency and location to identify licensed fixed links in their area of interest.
- 2.42 With regard to a rapid assignment process, highlighted by one respondent, for ‘emergencies’; we do not provide such a facility as part of our routine licensing processes. However, where a licence applicant informs us that they need a new fixed link urgently due to an emergency and provides reasons for this requirement, our licensing team can consider such applications on an exceptional case by case basis.
- 2.43 On propagation modelling and its application, we are currently carrying out a number of related activities:
- Incorporating the use of an updated rain-rate map¹³ in our licensing processes. This is based on the last 20 years’ worth of Met Office rain gauge data, providing our best current estimate for the UK of the 0.01% exceedance rain rates.
 - incorporating new terrain and land use datasets¹⁴ in our licensing system based on the most recent and high-quality topographic information we have acquired for the UK.

¹² [Statement: Ofcom’s Plan of Work 2024/25](#), page 44

¹³ One of the most important climate related datasets is the UK rain map used in application of the assignment criteria for fixed links. Rain attenuates radio waves due to absorption and scattering. The degree of attenuation depends upon the rain rate (millimetres per hour), drop size and radio frequency, and has a measurable impact above 10 GHz.

¹⁴ The propagation models we use also rely on topographic datasets representing physical features such as the height of bare earth (terrain), land use (clutter) and associated representative heights, e.g. vegetation, man-made structures, etc.

- updating our licensing framework with the latest versions (version 18) of ITU Recommendations P.530 and P.452¹⁵.
- 2.44 In addition, as noted in our Spectrum Roadmap, we have initiated a long-term propagation measurement campaign to capture, understand and model the impact of infrequent weather patterns that can lead to outages of broadcast and fixed links services. The output of this campaign will help to benchmark and refine our modelling dealing with anomalous propagation mechanisms.
- 2.45 E-band has two assignment approaches in the UK; self co-ordinated and Ofcom managed/co-ordinated. For the Ofcom managed part of the band, we use our standard planning and interference criteria (as set out in Ofcom document OfW446¹⁶) to ensure efficient assignments are made, while minimising the risk of interference to other links. In addition, given the uncertainty around using the propagation models at these higher frequencies¹⁷, Ofcom has taken some special measures with regard to the configuration of the radio propagation models in the assignment tool; these are mainly a minimum fade margin of 20 dB and the use of the free space model instead of the ITU Recommendation P.452. These settings aim to ensure that links overall achieve their planned performance availabilities and that undue interference is not generated to other links. We will keep our approach under review, and the potential enhancements in this area are part of our wider propagation workplan.
- 2.46 While Ofcom no longer holds regular Fixed Wireless Industry Liaison Forum (FWILF) meetings, we do maintain an active stakeholder e-mail distribution list so that when new developments take place, there is a means of contacting fixed wireless sector stakeholders to highlight publications / updates e.g. consultation documents, statements etc.
- 2.47 Our approach to Adaptive Coding and Modulation (ACM) is set out in our Technical Frequency Assignment Criteria (TFAC), document [OfW446](#).

Expected change in usage over the next 5-10 years

- 2.48 Most MNOs expected to see a continued decrease in the number of links for mobile backhaul and a continued increase in channel bandwidths. This would be especially the case in urban areas, but fixed links would continue to be important in suburban and rural areas. VMO2 noted that any reduction of links in urban environments will be offset by more E-band in suburban and rural settings and that overall they expected to see an increase in E-band link volume.
- 2.49 Other respondents that thought they would see a decrease in links included Arqiva (an expected 18% decrease) and Norfolk Police (due to licensing costs).
- 2.50 Other respondents generally expected their numbers of fixed links to remain the same or increase. Utilities companies in particular expected to need more fixed links, especially if

¹⁵ Updated versions of these models, i.e. ITU-R Recommendations P.530-18 & P.452-18, include significant enhancements made to the modelling of precipitation, improved use of topographic datasets and refined underlying algorithms dealing with the modelling of complex propagation mechanisms.

¹⁶ [OfW 446: Technical Frequency Assignment Criteria for Fixed Point-to-Point Radio Services with Digital Modulation](#)

¹⁷ ITU-R Recommendation P.452-18 covers frequencies above 100 MHz and the prediction procedure has been tested for radio stations operating in the frequency range to 50 GHz.

they are successful in obtaining spectrum for a private LTE network. They also expect to achieve higher capacity through wider RF channels and advanced modulation schemes.

- 2.51 Airwave also expected to need more links, with plans to move from 1.4 to 7.5GHz and from 26 to 23 GHz.

Market developments affecting the future use of fixed links

- 2.52 In our CFI we set out a number of market developments which we expected would have an impact on future usage of fixed links across a variety of sectors but especially on MNOs. These included:

- increased fibre roll-out.
- a move to centralised radio signal processing in datacentres, rather than mast sites.
- densification of mobile networks using small cells.
- the increase in use of higher capacity NGSO satellites which offer lower latency compared to traditional geostationary satellites.

- 2.53 MNOs generally agreed that increase of fibre availability would result in an increased proportion of mobile backhaul networks delivered over fibre.

- 2.54 BT highlighted that network densification and C-RAN would lead to more emphasis on fibre deployment, but noted that small cell deployments and network densification will primarily occur in urban and dense suburban areas where fibre is more readily available. VMO2 noted that 5G RAN developments, increased access spectrum and possible centralisation of function would be a challenge for fixed links.

- 2.55 However, Vodafone noted that the fibre technology being rolled out is predominantly consumer-oriented, without much capacity headroom for mobile or enterprise requests. For effective backhaul in hard-to-reach areas, it would need access to dedicated dark fibre.

- 2.56 Most other respondents that commented on this point said that increased fibre roll-out would not greatly impact their future use of fixed links. For example, Airwave noted that its network provides coverage throughout the UK land mass and includes a number of sites located in remote areas and far from fibre points of presence (PoP). Arqiva made a similar point, noting that “given the remote location of many transmitter sites away from fibre points of presence and the possible issues involved to provide wayleaves for fibre to remote sites, it has also not been an attractive option to use fibre at many sites.”

- 2.57 Utilities companies said that the anticipated allocation of dedicated spectrum for a private LTE network would have the biggest impact on its future use of fixed links, noting that several thousand more links would be needed to provide backhaul for this network.

Future use of satellite backhaul

- 2.58 Most respondents did not think that NGSO satellites would be an effective alternative for fixed links at this time. Some of the reasons highlighted by respondents included the higher latency of these services compared to terrestrial fixed links and that satellite operators did not provide service level agreements with their services.

- 2.59 A small number of respondents said that they would use satellite backhaul in remote areas where fixed links or fibre were not available or too expensive. BT said that it would use a blend of technologies, most likely including NGSO. It noted that resilience is also an important consideration and low earth orbit (LEO) systems with adequate capacity and lower latency are important in this context.

Technology and equipment developments

- 2.60 In the CFI we noted some of the key fixed links' technologies that are likely to have an impact on spectrum requirements in the future and asked respondents to provide information on their plans for use of these technologies. We are grateful for the respondents who provided feedback on this. As noted above, responses indicated that there is increasing use of technologies that enable greater capacity to be delivered over existing channel bandwidths, including Co-Channel Dual Polar (CCDP) technology and adaptive coding and modulation (ACM).

International developments

- 2.61 As noted earlier (in paragraph 2.23), some respondents highlighted concerns with international work looking at the potential future use of 7 and 15 GHz for IMT under WRC-27 agenda item 1.7. BT also noted that WRC-27 agenda item 1.10 would be looking at satellite PFD limits to protect fixed and mobile services in E-band (71-76 and 81-86 GHz).

Ofcom view

- 2.62 We note and understand the uncertainty that can be generated when new frequency bands are considered for IMT mobile identification / use that overlap with existing services, e.g. WRC-27 agenda item 1.7 and our current work on Upper 6 GHz¹⁸, and that these could potentially put pressure on the fixed link use of these bands. As noted above we recognise the ongoing requirement for fixed links across a range of different frequency bands and will take this into account when responding to future possible developments with IMT mobile.
- 2.63 WRC-27 agenda item 1.10 was originally proposed by the UK, to address gaps in the existing international Radio Regulations, and was confirmed as an agenda item by WRC-23. We are now working internationally with the aim to ensure a suitable international technical-regulatory framework is in place to allow satellite services and fixed links to share E-band, through the development of appropriate Power Flux Density (PFD) and equivalent isotropically radiated (EIRP) limits for inclusion in Article 21 of the Radio Regulations.
- 2.64 We also sought further information on the future potential use of E-band by satellite services in the UK in our Call for Input (CFI), [Expanding spectrum access for satellite gateways, published in March 2024](#).

Summary and next steps

- 2.65 Overall, taking account of trends in fixed links use, current technology and market developments and responses to the CFI, we consider that the currently available spectrum is broadly sufficient to meet future needs.
- 2.66 However, in view of the continued growth in use of higher capacity, higher frequency fixed links, we will continue to monitor developments in this area, with a view to commencing a new work item, within the next couple of years, to further consider the potential authorisation of W-band (92-114.25 GHz).
- 2.67 We also have ongoing work looking at how to authorise spectrum that has recently become available in the 28 and 32 GHz bands.

¹⁸ [Hybrid sharing: enabling both licensed mobile and Wi-Fi users to access the upper 6 GHz band](#)

- 2.68 In addition, we have noted the concerns raised by respondents about future availability of bands below 10 GHz. Our response to future developments that affect these bands will take account of the ongoing requirements for fixed links in this spectrum as highlighted in CFI responses while being guided by our overarching duty to secure optimal spectrum use.
- 2.69 On the authorisation framework, we have an ongoing programme of work to upgrade our licensing systems, which will include introducing online applications for most of our licence products. Further updates will be provided on our website in due course.