

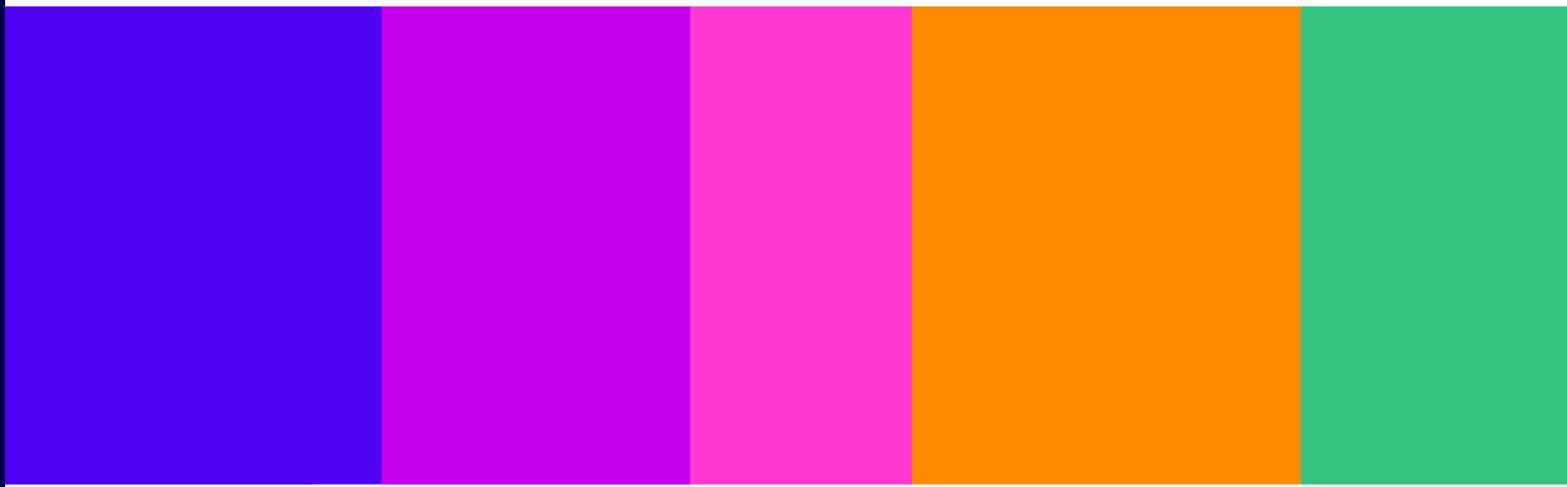
Supporting increased use of shared spectrum

A consultation on proposals to enhance our Shared Access framework to support a growing variety of spectrum users

Consultation

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1. Overview

- 1.1 This document sets out proposals for the evolution of Ofcom’s Shared Access framework, to secure continued access to this spectrum for a growing range of users, and to support innovation across the UK.
- 1.2 Spectrum sharing is a key part of Ofcom’s strategy for spectrum management. The Shared Access framework provides a mechanism to access frequencies with established or developing mobile equipment ecosystems, on a localised basis. We have seen growing interest in this form of access over the last four years, with more than 1,500 licences now issued, and a number of other countries adopting similar approaches.
- 1.3 In light of this demand and projected future growth, we are now proposing steps to enhance the supply of spectrum available, especially in the popular 3.8-4.2 GHz band. We propose to do this by relaxing certain coordination assumptions to better match real world conditions, and by giving users a greater role in coordination decisions.
- 1.4 We have also identified measures to support this growing set of users with additional opportunities and flexibility, including increased power levels (for Low Power users) and simplifying our exceptions process. Alongside this, we are setting out a range of operational improvements to provide licensees with more information, and support faster turnaround times as our automation plans progress.
- 1.5 Finally, we also explore the role that potential adjustments to our pricing approach could play in enhancing spectrum supply to meet further growth, and seek to gauge stakeholder views on this and any further future additions to the framework that may be necessary.
- 1.6 Our proposals reflect what we’ve learned since setting out our initial policy for Shared Access over four years ago, and feedback from our March 2023 Call for Inputs (CFI).¹

The measures we’re consulting on, and ongoing operational improvements - in brief

We have identified the following opportunities to update our approach, especially in the popular 3.8-4.2 GHz band.

We are proposing to update our rules to support new opportunities for users, whilst progressing a range of process improvements to improve user experience:

- We propose permitting an additional 3 dB EIRP on our ‘Low Power’ product, to support wider coverage and lessen deployment challenges, especially in urban environments.
- We propose removing a requirement for users to maintain certain records for mobile terminals connected to Low Power indoor base stations in the 3.8-4.2 GHz band, to enable more ‘neutral host’ style solutions.
- We propose new steps for additional user input to our coordination decisions, including an option for users to collectively agree that additional deployments can go ahead.
- We will also provide, as part of general operational improvements, updated spectrum availability maps, and progress plans to move applications online in the first half of 2024.

¹ Ofcom, [Call for Inputs: Evolution of the Shared Access Licence Framework](#), March 2023

We are proposing to update our coordination approach, shrinking separation distances between users by around at least 75% (Low Power) to 90% (Medium Power), and will continue to look at further improvements to support more sharing longer term:

- We propose updating the technical assumptions we apply when coordinating users in the 3.8-4.2 GHz band, focussing on coordinating base station transmissions with other users' terminal receivers; using an updated Building Entry Loss figure; and amended adjacent band coordination with UK Broadband.

We are also considering adjustments to our pricing approach, for the 3.8-4.2 GHz band:

- We would like to explore with stakeholders how moving to a more incentive based pricing approach could enable more efficient use of spectrum for all. We expect to consult further on specific proposals for revised fees, based on stakeholder feedback.

Putting our proposals in context

- 1.7 When we launched the Shared Access framework in 2019, there was limited experience of how new users sharing these bands would interact, uncertain levels of demand, and limited real-world information on coexistence between services. Through our review, we have sought to build our understanding of developing use cases, ensure the framework remains responsive to stakeholder needs, and put it on a footing that is able to support a greater density of use for the future.
- 1.8 To provide additional options for new deployment models, we are proposing to double the permissible power level that applies to the 'Low Power' licence.² We believe this strikes a reasonable balance between enabling more optimal use for individual users, and potential impacts on others – which would not be achieved by authorising 'Medium Power' more broadly in urban areas. It also reflects what users have told us about commonly available equipment and would bring our threshold closer to standards in place for the CBRS band.³
- 1.9 We also propose removing a requirement for users in the 3.8-4.2 GHz band to maintain records of mobile terminals and the address of where they will be used, for indoor-only Low Power deployments. This condition reflected our policy that use of this band should not supplement national mobile networks (for which other spectrum had been made nationally available). However, such Low Power indoor deployments are unlikely to form part of a wide area network, or overly impact opportunities for others. Recognising the regular feedback we have received that this requirement can be a significant challenge for 'neutral host' operators, we are taking steps to support additional innovation in the band.⁴
- 1.10 As demand has grown over the last four years, especially in 3.8-4.2 GHz, some users have experienced frustration where spectrum has not always been available (because of the presence of other users), or delays in the assignment process. We are now taking steps to improve this user experience (as part of ongoing operational improvements) by providing

² This 3 dB increase would permit 27 dBm per channel for bandwidths of up to 20 MHz, and 21 dBm per 5 MHz for larger channels in the 3.8-4.2 MHz band.

³ The FCC's Citizen's Broadband Radio Service band at 3550-3700 MHz permits 30 dBm/10 MHz for low power equipment. We believe that much of the equipment ecosystem supporting this will be compatible with our revised proposals, and users have indicated there may be benefits from leveraging this.

⁴ 'Neutral hosts' refer to network operators who provide a service to multiple parties, and can serve a mix of private networks, and may also carry some MNO consumer traffic.

more information for users to understand the availability of spectrum, and progressing with plans to move user applications online in 2024. Over time, we will automate more of this process and expect to significantly reduce licensing wait times as a result.

- 1.11 We are also proposing additional updates to our coordination tools to support more sharing, in light of what stakeholders have told us about likely growth in future demand. These proposals reflect feedback from stakeholders that equipment operates far better alongside interference from other users than our coordination procedures assume. They are intended to support the levels of sharing we would expect to see long term in some locations to derive best value from the framework we have put in place.
- 1.12 For 3.8-4.2 GHz we are proposing updated coordination assumptions and (for indoor deployments) updated building entry loss parameters. For the purposes of coordination, we propose assuming that licensees' transmissions are synchronised.⁵ This allows us to establish separation distances between users on the basis that the dominant interference path is from base station transmissions into the receivers of other user's terminals.⁶ This less risk averse approach should substantially reduce separation distances (often by more than 90% for Medium Power users), whilst still providing flexibility for users to operate the frame structures they want. We have also identified an opportunity across all Shared Access bands to utilise additional antenna parameters provided by users to further improve coordination, and will in addition move to update our propagation clutter model for all bands in 2024.
- 1.13 With demand for localised access to shared spectrum projected to keep growing in the coming years, we have considered the role our pricing approach could play in incentivising the most efficient use of the spectrum, and increasing overall levels of spectrum supply. Although we recognise that some users may find access to very large bandwidths (e.g. 100 MHz) desirable, we are considering options to incentivise users to think more carefully about the bandwidth (and power) they need - whilst continuing to support low-cost access, especially for bandwidths of 50 MHz or less.
- 1.14 At this stage, we are setting out principles for how and why we believe such an approach could apply. But we are not consulting on firm proposals, which will be shaped by stakeholder feedback, and the impact of final decisions on the other measures we are consulting on. We welcome views on how a different fee structure could support continued access for a wide set of users into the future, whilst meeting the needs of users in the band today. We intend to consult on firm proposals in due course.
- 1.15 We recognise that even with these new proposals, there may remain cases where we are not able to authorise everything that stakeholders would like to do. Our 'exceptions' process already provides a potential route for users to seek some flexibility beyond our core products, and we are setting out proposals to streamline the criteria we apply, and sharing more detail on the assessments we will make, to improve usability for stakeholders. However, the finite supply of shared access spectrum means that a balance must continue

⁵ We note that we do not propose to mandate synchronisation in 3.8-4.2 GHz.

⁶ Coordinating from the perspective of interference to other user terminals will move our approach in 3.8-4.2 GHz towards that used in other Shared Access bands.

to be struck between supporting the preference of an individual user and knock on effects for others.⁷

1.16 We remain open to exploring other ways we could evolve our approach longer term, for example giving users greater flexibility to deploy in ways that suit them best, provided any interference issues are managed. This might mean some users having to take more responsibility in the future for ensuring they don't cause harmful interference to their neighbours.⁸ As an initial step towards this, the proposals we are consulting on include a new mechanism for users to 'override' Ofcom coordination decisions, provided all impacted licensees in a local area are content.

1.17 Below we provide an overview of how the proposals contained in this document - and the additional operational improvements we are making - apply across the Shared Access bands:

Table 1: Summary of our proposals for the evolution of Shared Access⁹

	1800 MHz band: (1781.7 to 1785 MHz paired with 1876.7 to 1880 MHz)	2300 MHz band: (2390 to 2400 MHz)	3800 to 4200 MHz band	24.25-27.76 GHz & 40 GHz
Increased low power limit	—	—	✓* + 3 dB,	—
Local coordination agreement option	✓	✓	✓	✓
Accounting for additional antenna parameters	✓	✓	✓	✓
Updated Building Entry Loss	—	—	✓	14 dB proposed in recent statement
Coordinating on the assumption of synchronisation	Not relevant as the band is Frequency Division Duplex	Currently mandated for outdoor deployments	✓ Assumed for coordination	Assumed for coordination, as per existing proposals
Potential Pricing Measures	—	—	✓	—
Clarified Exceptions Criteria	✓	—	✓	—
Reduced requirement for terminal record keeping	Not Required	Not Required	✓* Not required for indoor Low Power	Not Required
Additional Ongoing Measures				
Online Licensing Process	✓	✓	✓	✓
Updated propagation model	✓	✓	✓	✓
Additional Information on Spectrum Availability	TBD – subject to demand	TBD – subject to demand	✓	TBD – subject to demand

⁷ Although there is a total of 390 MHz of 3.8-4.2 GHz spectrum available in some locations, the presence of other users sharing the band (including Fixed Links, Earth Stations and UK Broadband means that some locations have only one or two 100 MHz channels available. Evidence to date indicates that most users opt for such very large channels.

⁸ Our Spectrum Sandboxes programme, running alongside this review, provides another potential forum in which to explore such innovative and alternative solutions.

⁹ * denotes measures we plan to implement via amended licence terms, whilst other changes relate to authorisation processes. We will issue updated guidance in due course.

1.18 Our full set of consultation questions, and a consultation response form, can be found at Annexes A4 and A5.

2. Introduction

The Evolution of our Shared Access framework

- 2.1 As part of our duty to ensure the optimal use of the UK’s spectrum, we want to support innovation and allow as many users as possible to benefit from wireless technology.
- 2.2 As innovation stimulates greater demand for limited spectrum resources, spectrum sharing becomes ever more important. We are looking to encourage this sharing by taking an increasingly flexible approach to assessing sharing conditions, striking a balance on the level of harmful interference protection given to different services.
- 2.3 In 2019, we recognised emerging demand from a new set of stakeholders to secure their own access to spectrum in bands with existing or developing ecosystems for mobile equipment. In response, we introduced our Shared Access framework, which provides opportunities to share spectrum on a local area basis.
- 2.4 We envisaged that our framework - and the different opportunities it provided across a range of spectrum bands - could support a broad set of potential use cases.

Table 2.1: Overview of initially envisaged Shared Access Use Cases¹⁰

Uses	1800 MHz shared spectrum	2300 MHz shared spectrum	3.8-4.2 GHz	Lower 26 GHz band
Private networks	✓ (Narrowband)	✓	✓	✓ (Indoor)
Mobile coverage (rural)	✓	Certain locations	✗	✗
Mobile coverage (indoor)	✓	✓	✗	✓
Fixed wireless broadband	✗	✗	✓	Prior authorisations

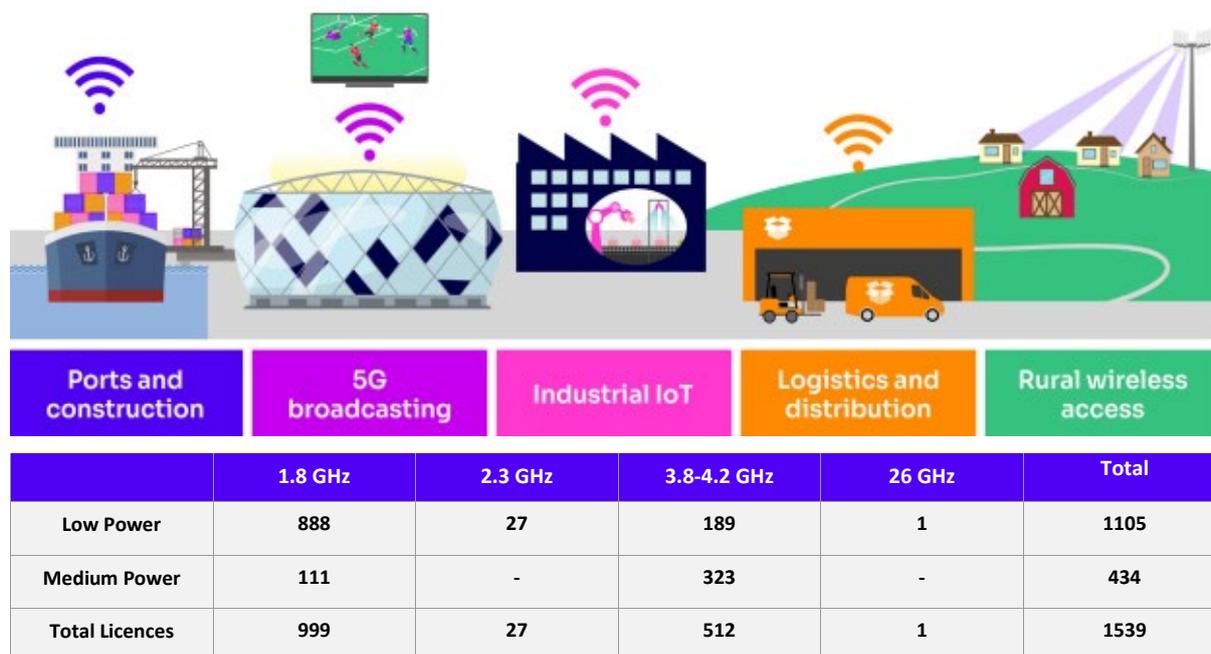
- 2.5 We developed two core Shared Access products to support this, a ‘Low Power’ licence and ‘Medium Power’ licence. The ‘Low Power’ licence is available across all bands and locations and authorises any number of base station deployments in a 50m radius from a specific location. The ‘Medium Power’ licence is coordinated on a per base station basis (because of its greater coverage range). Different bands have slightly different rules (e.g. limitations on

¹⁰ NB that we are in the process of making more spectrum available for mmWave sharing, including adding 24.45-27.25 GHz and 40.5-43.5 GHz to the sharing framework outside of ‘high density’ areas.

height, or power) which reflected our assessment of the balance between user needs and interference risks, including for existing users of the bands.^{11 12}

2.6 There has been significant interest in these opportunities from stakeholders, especially in the 3.8-4.2 GHz band. We have observed many innovative new uses, ranging from using 5G cameras to broadcast large events, to increased monitoring and automation of logistics and industrial sites, and Fixed Wireless Access via 5G. We have issued a total of 2059 Shared Access licences since 2019 (including licences that have been surrendered or revoked)¹³. Currently there are more than 1500 such live licences on issue, of which more than 500 are in 3.8-4.2 GHz.¹⁴

Figure 2.1: Overview of SAL use cases and licences on issue as of October 2023



Broader public policy context and international developments

2.7 There are reasons to believe this interest in localised spectrum access will continue to grow, driven by activity from industry and policy makers, nationally and internationally.

2.8 The 3.8-4.2 GHz band in particular forms part of a developing global market seeking to maximise the potential for 5G to support private networks and industrial verticals, with an

¹¹ For a visualisation of the different products, and the detail of our current rules please see our statement, [Enabling Wireless Innovation through Local Licensing](#), July 2019.

¹² We also provided an ‘exceptions’ process, where requests can be made to authorise an application outside our core framework, where limited impact on other users is expected.

¹³ We note that there has been a recent drop in the number of licences in the 3.8-4.2 GHz band. We attribute this to the conclusion of certain 5G Test and Trials projects and to other users upgrading existing equipment to reduce the number of licences required to support the same deployments. We note that the rate of new applications over the last 6 months remains consistent with projected growth long term, and that our experience of Shared Access has been that there are periods of peaks and troughs in applications, but we will keep this picture under review.

¹⁴ Note that although we have observed a growing interest in the 2x3.3 MHz of spectrum available at 1800 MHz, the majority of licences recorded here are ‘legacy’ licences transferred into our framework in 2019.

expanding equipment ecosystem supporting these new uses. For example, Apple indicated in June 2023 that it would henceforth support private network functionality on selected devices¹⁵. In October 2023, Nokia also announced handset plans directly targeting the Private Network market, and an expansion of its Private Network products.¹⁶ These developments come alongside work to provide additional support for vertical use cases in 3GPP's 5G release 17, with a 'Reduced Capability' or 'RedCap' standard tailored to meet the needs of different sectors at lower costs.¹⁷ Other technologies, including DECT NR, are also developing solutions to address these opportunities.

- 2.9 As we noted in our April CFI, work is also continuing in CEPT to assess the potential for harmonising use of the 3.8-4.2 GHz band for shared access in Europe. Following the publication of our CFI, new national proposals have also come forward.¹⁸ We expect that increasing international activity around this band (and associated sharing proposals in neighbouring bands) will further stimulate equipment development (potentially covering a growing range of technologies) and commercial interest.
- 2.10 In the UK, the National Infrastructure Commission has supported Ofcom's framework, while highlighting the importance of enabling as many use cases as possible.¹⁹ The UK Spectrum Policy Forum has also recently published an analysis (undertaken by Analysys Mason) on the future needs of Shared Access users in 3.8-4.2 GHz, with 12 recommendations to develop the framework for the future.²⁰ And the UK Government has also announced further funding to support wireless innovation on the back of its existing 5G testbeds and trials programme.²¹

The spectrum supply context for meeting user demands in 3.8–4.2 GHz

- 2.11 As growth is forecast to continue, especially in the 3.8-4.2 GHz band, we want to ensure that we continue to support as many users as possible. However, we are mindful that some of the preferences of individual users may result in harmful interference to others, or sterilise opportunities for several other users.
- 2.12 Whilst there are, in parts of the UK, a full 390 MHz of this spectrum available, it is being shared with other existing incumbents, including satellite earth stations, fixed links and UK Broadband²². This means that in many locations there is less spectrum available (and in some locations significantly less) to share with new users from the outset.

¹⁵ Apple, [Apple device support for private 5G and LTE networks- Apple Support \(UK\)](#)

¹⁶ Fierce Wireless, [Nokia bolsters private 5G as a service](#), October 2023.

¹⁷ 3GPP, [How to find RedCap in 3GPP](#), June 2023

¹⁸ This includes proposals from Poland for 3.8-4.2 GHz, and from Switzerland at 3.5 GHz.

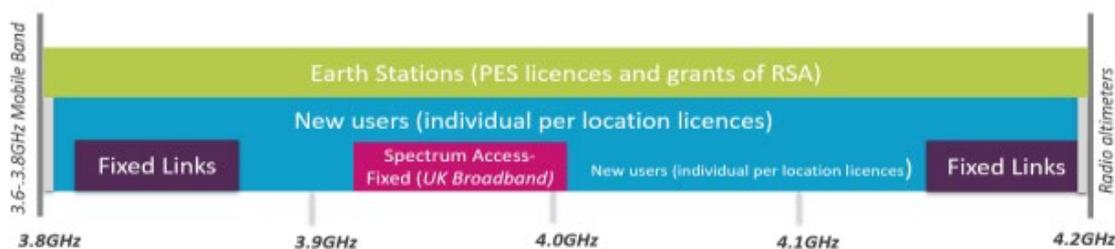
¹⁹ National Infrastructure Commission, [The National Infrastructure Assessment](#), October 2023 (page 99)

²⁰ Recommendations range from expedited online processes, to more granular coordination tools, as set out in the report published: [Use Case Requirements in the 3.8-4.2GHz band](#), October 2023

²¹ UK Government, [£40 million fund launched to unlock 5G benefits across the UK](#), July 2023

²² UK Broadband is owned by Three UK and holds spectrum access rights in 3925-4009 MHz, as set out on Ofcom's website [mobile wireless broadband below 5 GHz](#).

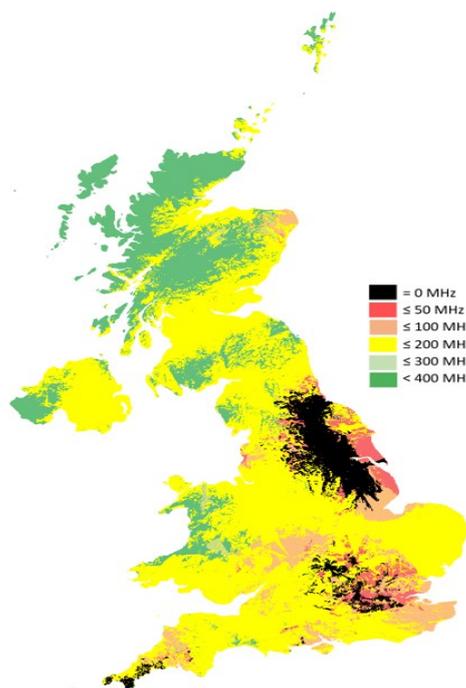
Figure 2.2: Overview of 3.8-4.2 GHz band plan



2.13 In 2019, our expectation was that typical new users in 3.8-4.2 GHz would require about c40 MHz of bandwidth, and as such, there was likely to be sufficient spectrum for all players in most locations.²³ Over time, we have found that around 80% of users are preferring large bandwidths of 80-100 MHz when they apply for a licence. We have also found that users currently have strong preferences for certain parts of this spectrum (especially spectrum below 4.1 GHz), based on the frequency range of their equipment. The interaction of these demands and our coordination requirements has meant that spectrum supply is more limited in some locations.

2.14 Figure 2.3 highlights this challenge, and the variations in spectrum supply across the UK, with a focus on contiguous spectrum available (which we consider particularly relevant given the current demand for 100 MHz bandwidths).

Figure 2.3: Overview of contiguous spectrum availability in 3.8-4.2 GHz (Medium Power)²⁴

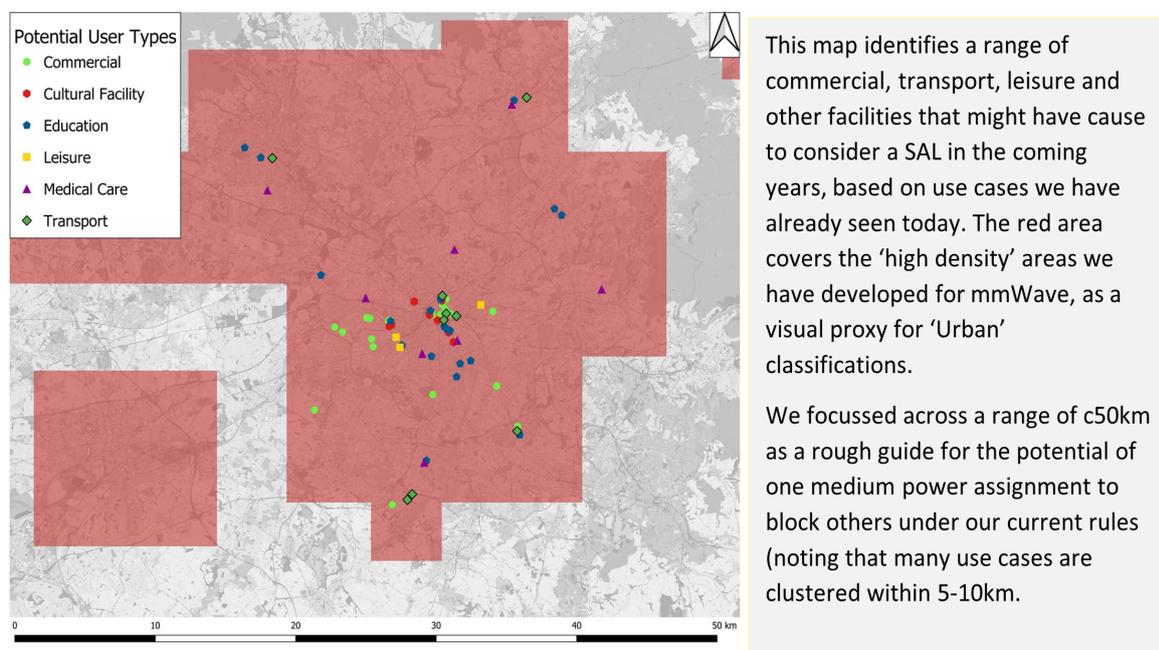


²³ We discussed our expectations for typical usage in our 2019 statement :Ofcom, [Enabling Wireless Innovation Through Local Licensing](#), July 2019 , page 48.

²⁴ This map provides an indicative representation of the amount of contiguous spectrum available across the UK (by which we mean uninterrupted bandwidth available in an area, which we consider particularly relevant where users require 100 MHz channels). Note that it does not completely replicate all of the checks which are

- 2.15 In some instances, these variations in spectrum supply have led to localised challenges in meeting the requests of prospective licensees in the 3.8-4.2 GHz band (we have not seen the same issues in other bands). Finding solutions to meet stakeholder needs in these instances can be difficult, takes time and often involves authorising a smaller amount of spectrum, or a lower power level, than the applicant would initially have preferred.
- 2.16 We would like to find new ways to meet stakeholders' needs, ensuring we can make spectrum available in as many places as possible. We also want to strike the right balance between the preferences of today's users and impacts on opportunities for the future.
- 2.17 To understand this challenge, we considered case studies for what local demand could look like if the Shared Access uses that we have seen in certain settings (e.g. leisure facilities, business parks, schools) became more commonly adopted in a single area. This is illustrated by the example of Greater Manchester, below.

Figure 2.4: Illustration of potential future demand in urban and rural areas, Greater Manchester



- 2.18 Whilst Figure 2.4 presents what is likely to be an extreme view of how future demand might play out, it gives a sense of the potential for future demand in 3.8-4.2 GHz, and the value of taking measures to allow more sharing, in more proximate locations, today and in the future.

undertaken in Ofcom's planning tool, and that it does not take account of adjacent band coordination with UK Broadband (which can further reduce availability in some locations).

Gathering initial stakeholder input

- 2.19 In May 2023, we launched a CFI with the intention of gaining stakeholder feedback to support the evolution of our Shared Access framework. In the CFI, we highlighted some of these emerging challenges.
- 2.20 We received 22 responses, covering mobile equipment vendors, mobile infrastructure providers and neutral hosts, fixed wireless access providers, PMSE users, Mobile Network Operators and logistics infrastructure providers.²⁵ Alongside this, we have continued to build our understanding through individual discussions with stakeholders, and through our ‘Spectrum Sandboxes’ programme (which is providing a platform to explore innovative, data-led coordination solutions, with a focus on spectrum sharing).
- 2.21 The majority of respondents considered the overall Shared Access framework to be positive, and expected both individual and overall use of the framework to grow, especially in 3.8-4.2 GHz. Many respondents highlighted areas where they felt there were opportunities to amend or develop the framework, from the integration of extra planning details to more user-led coordination. In other areas we received mixed responses, with, for example, some users supporting our exceptions process and others seeking a more fundamental change to permitted power levels.

²⁵ Non-confidential responses can be found [here](#) on our website

Table 2.2: Summary of issues identified in our CFI, and high-level summary of points raised

Ofcom CFI Reflections	High Level Summary of Stakeholder Feedback
<p>A growing focus on 3.8-4.2 GHz from stakeholders</p> <p>We recognised that this spectrum was seeing the greatest demand, and is well suited to new and innovative use cases.</p>	<ul style="list-style-type: none"> Many stakeholders expected demand for Shared Access Licences to grow, primarily focussed in the 3.8-4.2GHz band. Respondents noted that existing use cases such as ports, airports and logistics were likely to continue and demand would increase while others noted the potential for neutral host style deployments. Others also said there was an opportunity to expand the use of 3.8-4.2 GHz for video broadcast applications.
<p>Our licensing process</p> <p>We acknowledged stakeholder interest in additional upfront information on spectrum availability to support them before making an application, and a desire for faster application turnaround times.</p>	<ul style="list-style-type: none"> Widespread interest in Ofcom adopting measures to make the licensing process more automated, and accelerating application processing times. Additional requests that Ofcom develop a predictive toolset that would help advise applicants design their applications in a way that was more likely to receive a successful response. Some comments that Ofcom might need to further resource its exceptions process, reflecting that this area was likely to see an increase in work in the future.
<p>Our coordination approach and methodology</p> <p>We acknowledged opportunities to take account of additional network information, and highlighted some of the trade-offs associated with synchronisation (e.g. reduced coordination requirements but less flexibility).</p>	<ul style="list-style-type: none"> Numerous respondents suggested we should consider including additional information in our coordination process such as antenna directionality, data on sectorisation, antenna tilt and type and additional clutter information. Others went further and indicated our overall approach was too conservative, with some of these respondents suggesting that Ofcom could address this by enabling local agreements. Mixed views expressed on synchronisation as a tool to reduce separation distances, with some noting the potential to reduce these distances significantly but many also highlighting that this could be problematic for use cases with more uplink heavy frame structures.
<p>Our exceptions process, and interest in higher powers</p> <p>We noted the need to consider the flexibility enabled by our exceptions process (through which medium power can be accessed in urban areas) in the context of increased automation, and the risk that a more permissive approach to operating powers could preclude many other deployments.</p>	<ul style="list-style-type: none"> A range of views were expressed on our exceptions process, with a number of respondents eager for it to be accelerated, and potentially simplified, whilst also valuing the flexibility provided. Some respondents indicated interest in broader access to higher power levels in general, or wished to deploy medium power in urban areas without having to obtain an exception. Against this, some stakeholders noted this could reduce available spectrum, or raise interference concerns.
<p>Higher than expected demand for very large bandwidths</p> <p>We provided analysis showing around 80% of licences on issue in 3.8-4.2 GHz were for 80-100 MHz. We noted this could have an increasing impact on spectrum availability.</p>	<ul style="list-style-type: none"> Many respondents reaffirmed interest in wide bandwidths but we received relatively limited evidence on the underlying reasons for this. Evidence provided included links to 3GPP specifications for 5G low latency requirements, and the potential for some AR/VR type applications to require even greater bandwidths in the future.
<p>Spectrum supply and fees</p> <p>We sought stakeholder views on how developments in the equipment ecosystem were impacting overall demand, and the impact of adding mmWave spectrum to the SAL framework. We also noted how, in the context of growing demand, a simple cost-based approach to setting fees might limit options for managing supply and demand.</p>	<ul style="list-style-type: none"> Stakeholders provided additional information on available equipment, noting that not all equipment tuned across the full frequency range in 3.8-4.2 GHz. There were limited comments made on our fees approach, although one respondent questioned whether the current structure reflected the reality of cost recovery, where costs for new licences were treated in the same way as renewals, and if the existing limitations on Medium Power in urban areas implied some excess demand that could be addressed with incentive pricing.
<p>Other relevant comments</p>	<p>Several stakeholders expressed a desire for clarification on how existing requirements to maintain a record of addresses associated with terminals connecting to their network affected neutral host deployments. Many respondents indicated that loosening existing restrictions was important because the ability to access a large amount of contiguous spectrum would make mobile coverage improvements in difficult locations more economic, and at the same time tip the balance on the business case for many new private network opportunities.</p> <p>Additional comments indicated a wish to explore increasing the 10m height restriction in urban areas to 15m, and to consider the benefits of Active Antenna Systems (AAS) antenna in our coordination process.</p>

Our approach to this review

- 2.22 We want to continue to support and encourage innovative services and applications using the Shared Access bands, particularly the continuing interest in 3.8-4.2 GHz. We also want to maintain a simple, user-friendly and relatively low-cost process for licensees and prospective licensees. We established these objectives in light of our duties.
- 2.23 We have carefully considered how to take account of stakeholder views in evolving our Shared Access framework for the future. We note that in many of the areas identified, there is not a clear consensus among respondents, reflecting the different needs our framework seeks to balance. In determining next steps, we have assessed the benefits and potential downsides of the various suggestions, both in terms of their immediate impact, their impact on the wider spectrum environment, and on the opportunities for other future users.
- 2.24 We also remain mindful that the opportunities which Shared Access can support, and the market for local wireless connectivity, are still evolving. Whilst there have been significant developments over the last four years, which support stakeholder's projections of future demand, we expect that the uses of these bands will continue developing. Experience from other countries also highlights the potential range of different approaches to meeting this demand. For example, the CBRS band in the United States is based on database managed access, whilst in Germany, BNETZA has established a more 'area-defined' regime that encourages users to work together to resolve any interference issues.
- 2.25 In this context of evolving demand and different regulatory approaches, we think it is appropriate to prioritise a degree of continuity and regulatory certainty as we look to increase spectrum supply for the near-term, whilst providing some additional user flexibility. We recognise that as demand evolves further, and the characteristics of users become more established, it may be appropriate to consider further evolutions, for instance by embedding more automation, or placing more responsibility on users to manage interference.
- 2.26 Our current policy proposals reflect our analysis of the best measures to support our objectives and improve spectrum supply to meet the needs of today's users, and put our framework on a footing that will meet near term increases in demand.
- 2.27 We welcome further stakeholder feedback on the proposals set out Chapters 3-6, with a full set of consultation questions, and a response form, available in Annexes 4 and 5.

Ofcom's duties

- 2.28 Ofcom's statutory powers and duties in relation to spectrum management are set out primarily in the Communications Act 2003 (the "2003 Act") and the Wireless Telegraphy Act ("WT Act").

Communications Act 2003

- 2.29 Our principal duties under the 2003 Act are to further the interests of citizens and consumers in respect to communications matters, where appropriate by promoting competition. In doing so, we are also required (among other things) to secure the optimal use of spectrum and the availability throughout the United Kingdom of a wide range of electronic communications services.
- 2.30 Our spectrum management duties require us to have regard to:

- i. the desirability of promoting competition in relevant markets;
- ii. the desirability of encouraging investment and innovation in relevant markets;
- iii. the different needs and interests, so far as the use of the electro-magnetic spectrum for wireless telegraphy is concerned, of all persons who may wish to make use of it; and
- iv. the different interests of persons in the different parts of the United Kingdom, of the different ethnic communities within the United Kingdom and of persons living in rural and in urban areas.

Wireless Telegraphy Act 2006

- 2.31 We permit the use of the radio spectrum by granting wireless telegraphy licences under the WT Act. It is unlawful and an offence to install or use wireless telegraphy apparatus without holding a licence granted by Ofcom, unless the use of such equipment is exempted.
- 2.32 In carrying out our spectrum functions we have a duty under section 3 of the Act to have regard in particular to:
- i. the extent to which the spectrum is available for use, or further use, for wireless telegraphy;
 - ii. the demand for use of that spectrum for wireless telegraphy; and
 - iii. the demand that is likely to arise in future for such use.
- 2.33 We also have a duty to have regard to the desirability of promoting:
- i. the efficient management and use of the spectrum for wireless telegraphy;
 - ii. the economic and other benefits that may arise from the use of wireless telegraphy;
 - iii. the development of innovative services; and
 - iv. competition in the provision of electronic communications services.
- 2.34 Section 8(3B) of the WT Act says the terms, provisions and limitations specified in the licences must be:
- i. objectively justifiable in relation to the wireless telegraphy stations or wireless telegraphy apparatus to which they relate;
 - ii. not such as to discriminate unduly against particular persons or against a particular description of persons;
 - iii. proportionate to what they are intended to achieve; and transparent in relation to what they are intended to achieve.

Structure of this document

- 2.35 The remainder of this document is structured as follows:
- i. Chapter 3: outlines areas where we think we can make some relatively straightforward changes to improve user experience and open new opportunities.
 - ii. Chapter 4: sets out our current technical parameters and our proposed amendments to this technical coordination framework.
 - iii. Chapter 5: discusses how potential pricing measures could further help incentivise efficient use and so increase spectrum supply to accommodate more users.
 - iv. Chapter 6: addresses our exceptions process, related stakeholder asks, and some potential opportunities for developing Shared Access further in the future.

- v. Chapter 7: addresses how our proposals satisfy our relevant legal tests, sets out our impact assessments, and explains next steps.

3. Supporting new opportunities and improved user experience

- 3.1 In this chapter, we highlight measures which we believe represent relatively straightforward opportunities to enhance spectrum access, and improve the authorisation experience for users.
- 3.2 We are already taking steps to progress some of these measures, and we explain how these steps can support users across each stage of the licensing journey: from additional pre-application information, to more automation in the application process, and transferring of issued licences.
- 3.3 We also set out proposals to gather, and take account of, additional information from users at the application stage to improve coordination, and to provide greater flexibility by allowing user-led coordination where licensees have access to additional information.
- 3.4 Finally, we set out proposals to loosen some existing restrictions on the permissible power for Low Power operations, and the requirement to keep a register of user terminals for Low Power indoor deployments.

Our plans to improve processes supporting spectrum access

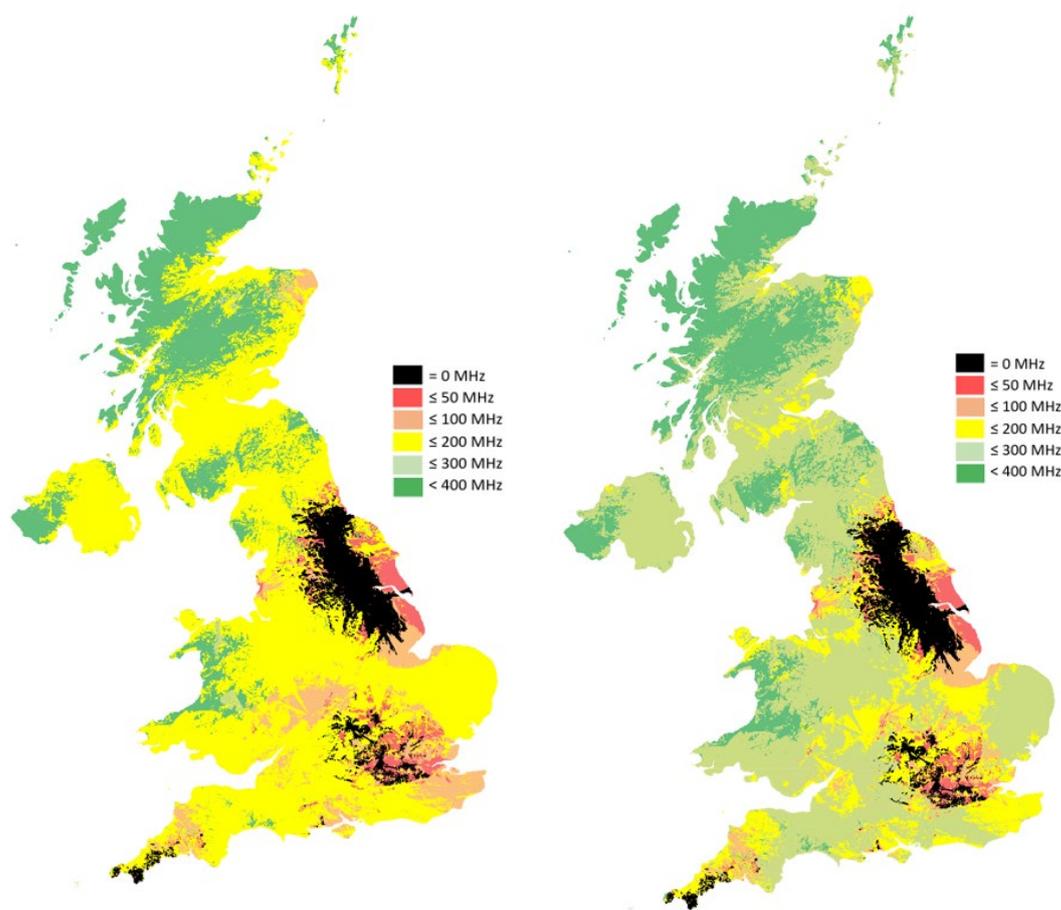
- 3.5 This section sets out the steps we are taking now to enhance spectrum access and improve the authorisation experience for Shared Access users. We are not consulting on these steps but are providing an update to stakeholders to set out the potential benefits we expect them to provide.

Pre-application information

- 3.6 Ofcom recognises the value of providing users with information about the spectrum environment in which they operate, and we already make significant amounts of information available through our Spectrum Information Portal.²⁶ The Portal provides detail on assignment locations, and the bandwidths and power authorised - across the Shared Access bands and other spectrum bands.
- 3.7 We are responding to stakeholder interest in accessing additional information to guide their applications, by providing updated maps of spectrum availability in the 3.8-4.2 GHz band. These maps provide a static snapshot of the spectrum available for a potential Medium Power application, covering both contiguous and total bandwidth available. Future updates of these maps will be made available on the Ofcom website and updated periodically (full page versions can also be found in Annex 1).

²⁶ Ofcom, [Spectrum information portal - Ofcom](#)

Figure 3.1: Spectrum availability in 3.8-4.2 GHz from the perspective of a Medium Power user²⁷ based on contiguous spectrum (left) and total bandwidth (right)



3.8 Our aim in making these updated maps available is to facilitate more informed applications, based on an updated view of local spectrum availability. We understand that the provision of further granularity, with an interactive capability, might allow applicants to determine changes they could make to improve their chances of a successful application.²⁸ While the maps we are making available do not support that interactivity, we envisage they will provide a helpful indication of locations that would be more or less challenging, and where wide bandwidth applications may be harder to support. We will continue to develop the information we make available to stakeholders, and will also explore the potential to make a more interactive tool available over time. We consider that in less busy Shared Access Licence bands, the existing level of information gathering and sharing through the Spectrum Information Portal is likely to remain proportionate.

²⁷ Based on licensing data held by Ofcom in July 2023, and current coordination rules. We note that this representation does not completely replicate the full coordination processes run by our licensing tools and does not account for the impacts of adjacent channel coordination with UK Broadband. We also note that Medium Power use is not generally permitted in urban areas, but we provide this perspective here as an indication of total supply.

²⁸ There are some limitations on the information we can provide in this way which are outside Ofcom's control - for instance where a user deployment impacts on national security - which makes it difficult for Ofcom to provide a completely comprehensive picture of spectrum availability.

Increased automation of user applications, and trading of licences

- 3.9 As part of our wider commitment to automating licensing processes, we are continuing steps to further automate our Shared Access licensing process, beginning with bringing user applications online. Licensees will be provided with the ability to manage their own accounts, applications and licences. In addition, data entry validation and a 'batch loading' capability are being developed that will permit a user to upload multiple applications together. We envisage this initial stage of automation will be completed by early 2024, although automating other stages of the licensing process such as coordination with other users will take longer.
- 3.10 Ultimately, we expect this process will lead to significantly reduced wait times - which we know can frustrate applicants - especially on straightforward applications and where there is bandwidth available.²⁹ We acknowledge however that this approach is unlikely to be suitable for users with very short notice 'pop-up' style spectrum requirements that cannot be planned several days or weeks in advance, where other spectrum products may remain more appropriate. This reflects the position we set out in our paper on Adaptive Spectrum Allocation, that for the majority of Shared Access users there were significant benefits maintaining a more certain, less dynamic form of spectrum allocation.^{30 31}
- 3.11 We note that, in our experience, the applications that have taken longest to process have tended to be those with non-standard requirements, or where our initial assessment saw applications rejected because there was limited spectrum available. In these cases, a dialogue is required with stakeholders, and this discussion period can impact turnaround times (and may not resolve the core spectrum availability issues). We hope that by providing users with more guidance on what spectrum is available - coupled with the plans to reduce separation distances between users set out in Chapter 4 and the plans to clarify 'exception' rules set out in Chapter 6 - we will limit the instances where such additional discussions are necessary.³²
- 3.12 We are also taking steps to ensure that, in the future, Shared Access licences will be tradeable. This process is already underway, in line with our general policy to enable trading and market mechanisms where possible (and as set out in our statement on mmWave in September 2023³³). It delivers on the intention we set out in our original statement on Shared Access, and should ease the process for stakeholders transferring a licence where the licence holding entity is acquired by, or merges with, another entity. It also provides

²⁹ We hope that a standard application in an area where spectrum is available might in the future (when automation is more fully embedded) be processed in the order of several days, rather than several weeks.

³⁰ Ofcom, [Opportunities for dynamic or adaptive approaches to managing spectrum in the UK](#), March 2023.

³¹ As a consequence of this decision, we are planning to remove the clause from our Shared Access licence products which put licensees on notice that Ofcom intended to move towards a DSA approach. However, we plan to maintain the licence conditions through which Ofcom may notify licensees to change their transmitting frequency, which has a wider spectrum management purpose.

³² Where these discussions take place because an applicant has requested an exception from our standard rules, we are also seeking to provide further clarity on the tests we will apply (with more detail on this approach is set out in Chapter 6).

³³ Ofcom, [Enabling mmWave spectrum for new uses](#), September 2023, paragraph 8.38.

potential routes for users to make agreements that could help deconflict assignments in areas where there is less spectrum available.³⁴

Our proposals to account for more user specific details in our coordination decisions

Capturing more information in the coordination process

- 3.13 We are proposing to ask stakeholders to provide additional information on their planned deployment, where they are able to do so, to improve the chances of their application being approved, and so improve overall user experience.
- 3.14 Ofcom assesses spectrum availability based on data that users provide about their intended deployment. We recognise that a more granular assessment of network deployments (specifically antenna details) will enable a less conservative view of the sterilisation area from deployments.
- 3.15 Although our initial approach was to establish a simple and accessible framework for all users, we understand that a significant portion of stakeholders in 3.8-4.2 GHz are open to providing Ofcom with more information, where this can be used to support better coordination between users. Dense Air, BT, University of Strathclyde and Neutral Wireless indicated in CFI responses that Ofcom should consider additional information in its coordination, including antenna tilt and directionality³⁵.
- 3.16 Given the importance of enabling more users to share, we are now proposing to facilitate this across all Shared Access bands by:
- a) **Seeking information on Antenna Tilt** – dropping the main beam of an antenna below the horizon can significantly improve separation distances. We recognise that in many cases network design takes this into account, and we will now require this information where it is available. We acknowledge that at the point of applying for a licence, users may not be certain of the final configuration of their site, and so would need to provide an estimate of the likely deployment.
 - b) **Seeking information on Antenna directionality and pattern** – we will seek information on where a user antenna is intended to cover only up to 180 degrees in azimuth, as well as the directionality of the antenna itself. We expect that including this information in our coordination tool will provide a significant benefit and support more efficient sharing in the future.
- 3.17 We recognise that a potential challenge to this approach could be the range of antenna parameters available on the market, which could evolve further over time. We have identified two options to manage this challenge:
- a) Ofcom specifies 4-5 ‘standard’ patterns, based on stakeholder feedback and market engagement, and for the applicant to select a ‘best fit’ option.

³⁴ For example, it provides an option for a user who has not been able to come to a coordination agreement with a neighbour on technical grounds (as set out in Paragraph 3.21 below) to consider a more commercial agreement to acquire that licensee’s usage rights.

³⁵ [Dense Air](#), pg. 2, [BT](#), p.5 [University of Strathclyde](#), p.3, [Neutral Wireless](#), p.7.

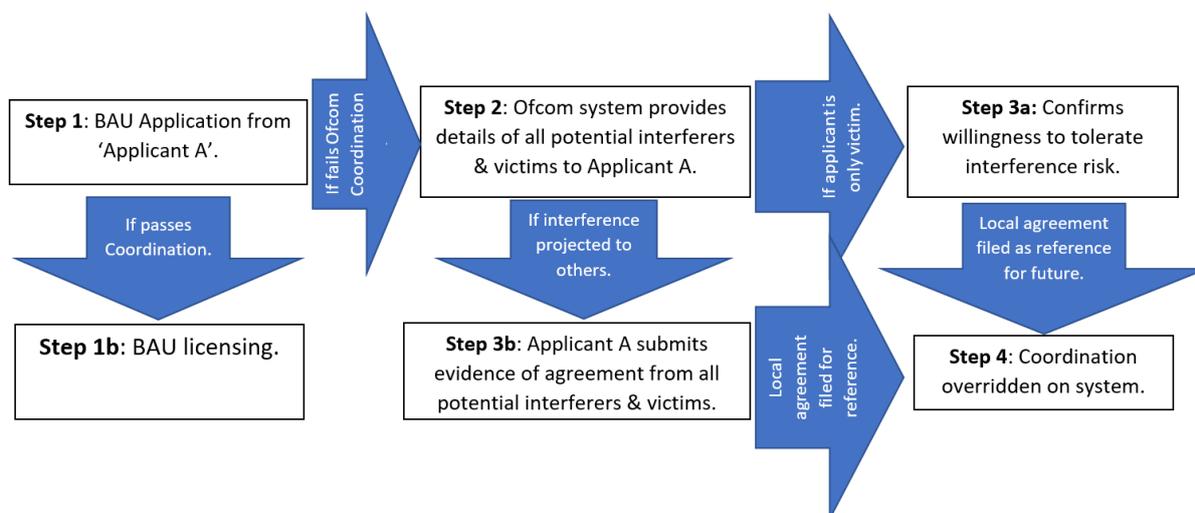
- b) Request that each stakeholder submits details of the antenna systems they plan to use at the stage of application, and Ofcom uses this information to build a 'library' of real-world antenna parameters. This is an approach we have used for other bands and services (e.g. Fixed Links).
- 3.18 Whilst we recognise that this latter approach is likely to produce more realistic results, we are conscious there may be cases where it is not obvious to users what the precise performance parameters of this equipment are. In this case, and especially where equipment stakeholders are using is very varied, this may become resource intensive for Ofcom. We welcome stakeholder views on how readily they would expect to be able to provide us with specific performance details of their antenna equipment.
- 3.19 We are also aware that some stakeholders have mentioned that we should account further for AAS in our coordination processes, where they are deployed. This is because where a narrow and dynamic beam is in operation, the potential interference exposure this causes to an adjacent site is lower in the time domain. We note that use of AAS equipment that complies with our existing EIRP requirements is already permitted in the Shared Access bands. We also note that there is ongoing work underway at the CEPT level to develop methodologies to take account of this issue, which we are participating in. We think it is likely to be beneficial to consider any further steps we can take in this regard when that work concludes.

More support for user led coordination agreements

- 3.20 Several CFI responses expressed a view that, leaving aside any coordination improvements Ofcom proposed, some stakeholders can access more advanced commercial planning tools, and account for the unique circumstances of each on the ground deployment, enabling them to better assess local interference risks.
- 3.21 We are proposing to take a significant step towards enabling this by establishing a new process where an applicant can gather the agreement of all potentially impacted licensees in a local area and ask for an 'override' to requests rejected by our coordination tool. If an applicant obtains written agreement to their proposal from all the potential sharers which our coordination tool identifies as barriers to that application (i.e. because it predicts they would be exposed to undue interference, but they consider any risk tolerable) we would then approve this application.³⁶
- 3.22 An overview of the envisaged process is set out below.

³⁶ Where the new applicant is projected to be the victim, but will not cause interference, and is operating within the standard framework rules, this process would not be necessary and we would simply accept confirmation that the applicant was willing to proceed 'at risk'.

Figure 3.2: Overview of user-led coordination process



3.23 We note that one CFI respondent (Cellnex) went further, suggesting that Ofcom should consider approving a group of ‘certified providers’ who were empowered to undertake their own coordination and planning. We do not believe it is likely to be appropriate for Ofcom to delegate this planning and coordination function entirely at this time and in this band, for the following main reasons:

- a) **Other incumbent users:** whilst Ofcom seeks to make as much information as possible available on spectrum assignments through our ‘Spectrum Information Portal’, it is not always possible to release all of this information. This can include where users are operating on a licence exempt or receive only basis, operate under Crown immunity, or where deployment locations are considered sensitive on national security grounds. This is likely to make it challenging for other parties to make a full assessment of interference risks.
- b) **The challenge of authorising ‘certified providers’:** whilst Ofcom recognises that there may well be differences in radio planning capability between different users - and that some users may have access to bespoke tools that Ofcom does not - it does not appear straightforward to establish which entities would be suited to these responsibilities, in a way that was transparent and not burdensome for Ofcom, or stakeholders.

3.24 We believe that the process outlined above represents a straightforward alternative, which would allow users who wish to rely more heavily on Ofcom coordination to do so, but ensure that we do not stand in the way of informed users who see opportunities to share more intensively. We consider this a fair and simple solution that would enable additional use where it is agreeable to all parties.

3.25 We note that in the cases of such ‘side-agreements’ we would expect all licensees to continue to operate within the essential requirements of their licence (e.g. respecting fundamental limits on emissions and height restrictions for Shared Access) and that the terms of such agreements would not impact users who are not party to the agreement. This would enable Ofcom to coordinate any potential future users moving into the relevant area. We would also expect this new agreement to become the default baseline for any further changes licensees might request. If any of the licensees party to the agreement wished to

seek changes to their licence that might impact the agreement, all parties would then need to agree this change.³⁷

- 3.26 Subject to stakeholder feedback on this proposal, we will bring forward more detailed guidance on the requirements for this process prior to its introduction.

Additional flexibility to enable more opportunities for users

- 3.27 We are also keen to ensure that our rules are sufficiently flexible to meet significant areas of additional demand. We note that the National Infrastructure Commission, whilst supporting Ofcom's overall approach, has also encouraged us to facilitate as many such uses as possible.
- 3.28 We have identified two key areas in which we think we should take steps to support more flexible use of the busy 3.8-4.2 GHz spectrum:
- a) by increasing the permitted output power for Low Power operations by 3 dB; and
 - b) by loosening existing requirements for users to maintain records of addresses associated with user terminals for Low Power indoor base station deployments.
- 3.29 We address these in turn below.

Low Power Increase in 3.8-4.2 GHz

- 3.30 A common theme in stakeholder feedback to our CFI, and in discussions we have had with stakeholders, is an interest in higher operating powers for their equipment. This feedback has included a desire to increase the power limit on Low Power equipment, an interest in greater operating powers in urban areas, and higher operating powers in general.
- 3.31 Reflecting on this broader context, and our objectives, we consider it is appropriate to increase the Low Power level by 3 dB in 3.8-4.2 GHz. This would see our existing limit rise from 24 dBm to 27 dBm for bandwidths up to 20 MHz, and 21 dBm per 5 MHz for larger bandwidths.³⁸ In doing so, we acknowledge the challenges some stakeholders have told us they have faced in adapting current equipment to stay within our existing limits. We are also seeking increased alignment with the power levels authorised for lower power users under the FCC's CBRS framework, which we believe should support enhanced equipment availability for users.
- 3.32 We recognise the benefits that greater operating powers can bring to users, in terms of reducing the amount of equipment they need to deploy, improved coverage and additional capacity. This power increase would allow more users to do more things, more efficiently, in both urban and rural locations, without significantly increasing their impact on opportunities for neighbouring users. We also note that although this could increase the worst-case sterilisation area of an individual licensee, we anticipate this will typically have little to no impact on spectrum availability, once our plans to update the terrain and clutter maps in our

³⁷ In the event that all parties to an existing agreement did not agree to a new variation from one party, the change could only proceed if the resultant change would have passed our overall coordination rules, or where the only user projected to be subject to interference was the party seeking this change.

³⁸ In making this change, we will take steps to ensure that any existing assignments that would wish to make use of this higher power do not cause harmful interference to other users in the band.

coordination tools are taken into account. (See Para 4.32 for detail on these plans, and Figure 4.2 for an illustrative analysis supporting this judgement).

- 3.33 We consider that this proposal (which doubles the power permitted in urban transmitters) may also address some of the latent demand some users have told us they have for Medium Power in urban areas, which is only available through the exceptions process. We remain mindful that a more permissive approach, where we simply allow all the things which stakeholders would like to do (including access to Medium Power in urban areas) would likely run counter to our overall objectives, by allowing a small number of users to sterilise areas that might be significant opportunities for many others. We set out additional rationale for this position and plans to simplify the exceptions process which supports requests for Medium Power in urban areas (in certain limited circumstances) in Chapter 6.

Relaxing our requirement for terminal records to be kept in 3.8-4.2 GHz

- 3.34 In our 2019 statement on Shared Access, we set out a requirement for all users of Shared Access licences who intended to connect mobile terminals in 3.8-4.2 GHz to keep a record of the address where those terminals will be used. We are proposing to remove this requirement for all Low Power indoor deployments, to free up neutral hosts to deliver additional services and support additional private networks.
- 3.35 This requirement was designed to give effect to our broader intention that Shared Access in this band should not be used as a mechanism to provide regional or national mobile networks.³⁹ However, over the last few years, and through the CFI process, Ofcom has received regular feedback that this approach has had the effect of limiting the scope of so-called 'neutral host' deployments.⁴⁰ These stakeholders have indicated that, with this requirement in place, it is difficult for them to carry additional consumer traffic on behalf of mobile operators. They consider the limitation on this capability can impact the business case for new private network projects, and withhold potential mobile coverage benefits for consumers. Those benefits would typically accrue in deep in-building environments, where macro-cell coverage cannot reach, and in congested locations where additional capacity is required.
- 3.36 We recognise that it may be challenging for neutral hosts to gather this information in circumstances where they are also seeking to support mobile coverage enhancements.⁴¹ This may then restrict opportunities to improve UK indoor coverage, and support the business case for some types of Private Networks, where the combining of new private capabilities with additional public network capabilities could tip the investment balance.
- 3.37 We think it is highly unlikely that Low Power indoor deployments could be used to assemble a wide area network, and that the resulting sterilisation effect would only limit opportunities

³⁹ We adopted this policy position in light of the spectrum that we were making available in other parts of the 3 GHz band for national mobile coverage, and the potential for such deployments to unduly limit the opportunities for other innovative applications in this band.

⁴⁰ These neutral host operators are present in the band, providing coverage solutions for a range of parties, including private networks to support local authority led innovation projects.

⁴¹ This is because they may not have full control over the terminals which their network might support, and which would likely move in and out of their coverage area.

for users in the relatively near vicinity. We are therefore proposing to remove this requirement in such circumstances, including where some terminals operated outside the building hosting the base station.

- 3.38 We remain conscious that use of 3.8-4.2 GHz to support a large increase in neutral host deployments outdoors, to infill outdoor macro-network capacity challenges, whilst offering some benefits, might not look materially different to the kind of wide area MNO deployment we did not intend to support in this band. Such deployments (including Low Power outdoors, and Medium Power indoors and out) would have a larger sterilisation effect, and would likely be focussed in busy urban locations where other spectrum users might over time see opportunities denied to them.⁴² Consequently we believe at this point that, given the envisaged use cases, it is appropriate to only lift this restriction for Low Power indoor deployments, which we believe will support a majority of envisaged demands and benefits.

Question 1: Do you have any comments on our proposals to gather additional antenna parameters, and would you prefer Ofcom to specify a small number of antenna pattern 'envelopes' or for users to provide details of the specific antenna parameters in use for Ofcom to assess? Please provide reasons for your views.

Question 2: Do you have comments on the suggested approach to enable user-led coordination in certain circumstances?

Question 3: Do you have any comments on our proposal to increase the power level of our Low Power product by 3 dBm in the 3.8-4.2 GHz band?

Question 4: Do you have any comments on our proposal to remove the requirement for licensees holding a Low Power 3.8-4.2 GHz licence to keep a record of the address at which mobile terminals connected to an indoor base station will be used?

⁴² We note that where this is the primary purpose of a neutral host deployment (as opposed to an ancillary benefit of another deployment, such as a private network) these players already have routes to providing coverage enhancements, utilising spectrum licensed to the MNOs.

4. Updated coordination rules to increase sharing in 3.8–4.2 GHz

- 4.1 In this chapter, we consider additional amendments to our coordination framework for Shared Access, which we believe would support better sharing. We have focussed particularly on the 3.8-4.2 GHz band because this is where we have the greatest demand, whilst considering opportunities to make broader updates where appropriate.⁴³
- 4.2 In line with our spectrum management strategy, we propose to implement a more flexible and less cautious approach to coordination, which we nevertheless consider will not significantly increase the harmful interference risk for users.
- 4.3 We propose to take the following steps for the 3.8-4.2 GHz band:
- a) Coordinate users on the assumption that they are synchronised and thus the main interference path will be from base stations to terminals rather than to other base stations, with a resultant update to the protection thresholds we coordinate against;
 - b) Update the building entry loss that we assume for indoor deployments, moving from 12 dB to 14 dB;
 - c) Update our approach to protecting Shared Access from UK Broadband assignments, retaining our co-channel coordination procedures but limiting adjacent channel coordination to the 5 MHz above and below UK Broadband.
- 4.4 In addition, we will move forward with ongoing work to update the clutter and propagation model used to coordinate all Shared Access users, across all Shared Access bands.⁴⁴
- 4.5 Taken together, these measures - in conjunction with the additional information on antenna patterns to be collected and used in coordination - should enable us to substantially decrease the separation distances between users and so accommodate more users.

Updating coordination assumptions in the 3.8–4.2 GHz band

- 4.6 A summary of the current coordination framework for Shared Access users in 3.8-4.2 GHz, and the measures we are now proposing, is shown in Table 4.1.⁴⁵ This includes a preferred option that would support significantly more sharing, and a more conservative alternative that would deliver only some of these benefits:

⁴³ We are open to applying the logic of the 3.8-4.2 GHz specific measures, such as additional adjustments to BEL, in other bands, although our current view is that there is not the same need to do so.

⁴⁴ This update is in line with our normal approach to ensuring the tools we use are kept up to date, and as such we are not consulting on this measure, which we plan to implement in 2024.

⁴⁵ Full details of our current approach can be found here: [Enabling wireless innovation through local licensing Annexes 1 to 5 – Supporting information](#), July 2019.

Table 4.1: Overview of existing and proposed approach to coordination of Shared Access users in 3.8-4.2 GHz

Current coordination parameters ⁴⁶	3.8-4.2GHz		
	Current Approach	Revised Proposals	
		Preferred Option	Alternative Option
Approach to Synchronisation	No mandated frame structure, coordination based on unsynchronised usage	No mandated frame structure, coordination based on synchronized usage assumption supporting updated I/N ratio	
Coordination Approach	Coordination focus is base station to base station	Coordination focus is base station to terminal, terminal height 1.5m	Coordination focus is base station to terminal, terminal height 3m
Interference to noise ratio (I/N thermal)	-6 dB	+ 3dB	0 dB
Protection Threshold	-97 dBm	-88 dBm	- 91 dBm
Building Entry Loss	12 dB	14 dB	

4.8 Below we explain the rationale for these proposals, which reflect our experience administering licences in 3.8-4.2 GHz as well as feedback received from users that our existing approach may be overly conservative, and that demand is projected to increase.

Impact on coordination thresholds when assuming synchronisation

- 4.9 Synchronisation is a common tool for reducing separation distances and interference risk between certain types of wireless operations.⁴⁷
- 4.10 Where licensees use the same frame structure in TDD spectrum (e.g. the same mix of uplink and downlink transmissions, aligned in time) interference is not caused to other licensees base stations but rather to their terminals, which are usually at a lower height. This can allow smaller geographic separation distances between co-channel users compared with unsynchronised use.⁴⁸
- 4.11 We know that a diverse group of users operate in the 3.8-4.2 GHz band, including more downlink heavy services such as Fixed Wireless Access, and more uplink heavy services such as content production. We wish to continue supporting this diversity of use, and to see the innovation that it supports grow, and so do not propose to require synchronisation as a way of reducing separation distances.
- 4.12 However, we have observed (based on licensing information we hold on users and their primary activities) that in many locations there are likely to be similarities between the operating patterns of some users. Many outdoor users in rural areas are more likely to be operating downlink heavy frame structures, for example FWA-type applications. Similarly,

⁴⁷ For example, it is commonly deployed by mobile operators within their networks and across international borders.

⁴⁸ Separation distances are greater for unsynchronised use because the dominant interference path is base station to base station, often above the clutter.

we expect that many urban users (for example content production or logistics monitoring) are likely to have balanced or uplink heavy frame structures (and where this is not the case, more downlink heavy urban users will mostly operate at Low Power and could also be indoors).⁴⁹

- 4.13 Even if the transmissions of local users are not synchronised, there would be options available to users to offset most effects, including antenna positioning, or acceptance of some transient interference. We also note that such interference would occur only during uplink time slots where another nearby base station is transmitting in the downlink. This is unlikely to affect all time slots, so we expect the overall impact on user throughputs, were this to happen, would be limited.⁵⁰
- 4.14 In 2019, we decided that - given the range of different users who might wish to use the band - we would not mandate synchronisation in 3.8-4.2 GHz, but that we would keep this position under review (and reserved the right to impose it in certain local circumstances).⁵¹
- 4.15 **We now consider that continuing to coordinate on the basis that all users are unsynchronised (i.e. for base station to base station interference) is likely to be overly conservative. Instead, we propose to coordinate on the basis that all users are synchronised – but not to mandate synchronisation.** This proposed change will lead to significant reductions in the separation distances between users, and support more sharing longer term. We consider the potential increase in interference risk is a reasonable trade-off for the very substantial increase in the number of users that would be supported.⁵²
- 4.16 In developing this proposal, we have considered two alternative options:
- a) Maintain current unsynchronised approach to coordination in 3.8-4.2 GHz band; and
 - b) Imposing a mandatory frame structure for the 3.8-4.2 GHz band.
- 4.17 We considered that whilst maintaining our current approach would retain flexibility for users, and provide the broadest protection envelope, it would mean that we are over-protecting in many cases, and restricting access to the band unduly – especially where neighbouring users operate in relatively similar ways. Alternatively, a mandated frame structure would significantly reduce the separation distances between users, and mitigate against interference, but significantly constrain user flexibility. For example, a 2:2 frame structure could potentially provide a compromise between uplink and downlink heavy requirements, but would not be optimal for many users, and may lead to some other inefficiencies (e.g. unused resource blocks). We also considered that a mandated frame structure could also dampen innovation or limit use of non-3GPP technologies.
- 4.18 Our assessment is that coordinating with the assumption that all users are synchronised is likely to provide the greatest benefit, and support enhanced sharing of the band as demand

⁴⁹ This is because Medium Power urban use is only permitted by exception, and is therefore not a common use case in urban areas in the 3.8-4.2 GHz band.

⁵⁰ For example, see Performance Evaluation for the Co-existence of Embb and URLLC Networks: Synchronized versus Unsynchronized TDD [IEEE Conference Paper Template \(arxiv.org\)](#).

⁵¹ Ofcom, [Enabling Wireless Innovation through Local Licensing](#), July 2019, paragraph 3.102, paragraph 3.106

⁵² We note that this approach reflects our recent proposals to coordinate users in the 26 GHz band ‘as if’ synchronised, without actually requiring them to do so: [Enabling mmWave spectrum for new uses: Making the 26 GHz and 40 GHz bands available for mobile technology](#), March 2023, paragraph 13.32. We confirmed our decision in our [September 2023 statement](#) (see paragraph 4.110).

grows, by capitalising on local synergies in use and the resilience of systems in the band, whilst retaining maximum operational flexibility for users.

- 4.19 If users do face harmful interference and are unable to agree suitable mitigations, we will retain the option to take measures to combat this, potentially including but not limited to, imposing a requirement to synchronise based on a specific frame structure.⁵³ In such cases, our default approach would be to find a reasonable compromise, of which one example would be a 2:2 frame structure.⁵⁴

Consequential changes proposed to our 3.8-4.2 GHz coordination parameters

- 4.20 As a result of the analysis set out above, we propose moving our coordination approach in 3.8-4.2 GHz from base station to base station coordination, to base station to terminal coordination, in line with the dominant interference path for synchronised systems.
- 4.21 In our 2018 consultation, we proposed that for co-channel synchronised systems, we would consider the minimum acceptable interference power at the receive base station to be a level based on an interference to noise ratio (I/N) of 0 dB⁵⁵ and a 10 dB noise figure for Medium Power base stations.⁵⁶
- 4.22 We expect, however, that most systems deployed in this band have some form of adaptive modulation and coding and can tolerate a degree of interference. This aligns with stakeholder feedback that equipment is more tolerant to interference than we had previously assumed. **We now propose, as our preferred option for giving effect to assumed synchronisation, to use a threshold at 1.5m height of -88 dBm/ 20 MHz (based on n I/N of +3 dB, and a 10 dB noise figure). This compares to the previous protection threshold of -97 dBm/20 MHz (based on base station to base station coordination with an I/N of -6 dB and 10dB noise figure).**
- 4.23 We recognise that some stakeholders may consider this to be too relaxed in some circumstances, particularly when considering terminal heights in FWA deployments. We have therefore considered, as an alternative option, the case for applying an alternative protection threshold of -91dBm/20 MHz at a height of 3m (based on changing the I/N to 0dB) to take additional account of other scenarios possible in the band.⁵⁷
- 4.24 Examples of the potential differences in sterilisation effect between these two options, compared against our existing coordination requirements, are shown below in Figure 4.1.

⁵³ Note that we reserved this right to impose synchronisation in our 2019 statement, but that we also reserve the right to use other means to combat interference, including frequency reassignment. See: Ofcom, [Enabling Wireless innovation through local licensing](#), July 2019, paragraph 3.242.

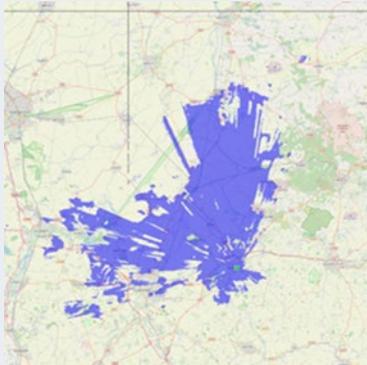
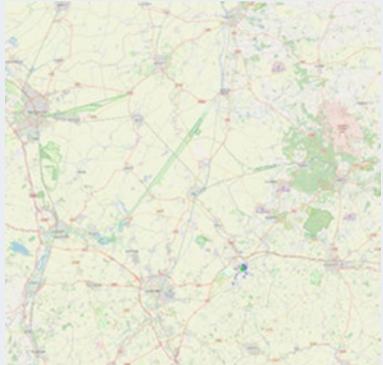
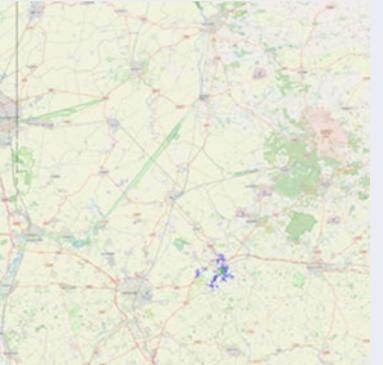
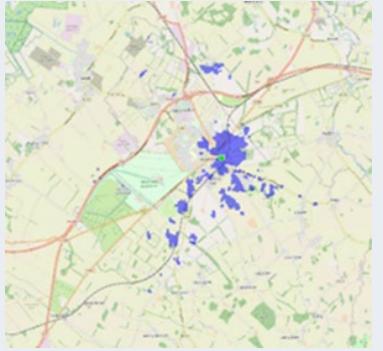
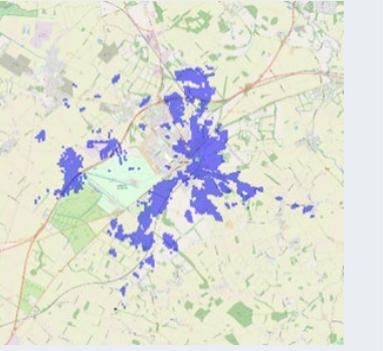
⁵⁴ We may choose to impose a different solution depending on the local circumstances, and technologies prevalent in an area. Users should take into account the fact that they may need to adjust to different regimes when procuring radio equipment.

⁵⁵ Ofcom, [Enabling Opportunities for Innovation](#), December 2018, paragraph 5.66.

⁵⁶ Ofcom, [Enabling Opportunities for innovation, Annexes 1-5](#) July 2019, Table A4.1.

⁵⁷ We note that there are some Shared Access use cases where terminals may not be in the clutter (e.g. an industrial site) but in such cases we would expect direct line of sight to a strong wanted signal from a parent base station.

Figure 4.1: Illustration of the potential sterilisation of hypothetical rural and urban deployments from our current approach, our preferred future option, and a more conservative alternative^{58 59}

Medium Power Rural Outdoors – Newmarket (transmitter at 20m)		
Current Approach	Preferred Option A	Alternative Option B
BS to BS coordination Receiver threshold at 10m of -97 dBm/20 MHz based on I/N of -6 dB, existing clutter & terrain data, EIRP 42 dBm/20 MHz	BS to Terminal coordination Receiver threshold at 1.5m of -88 dBm/20 MHz based on I/N of +3 dB, existing clutter & terrain data, EIRP 42 dBm/20 MHz	BS to Terminal coordination Receiver threshold at 3m of -91 dBm/20 MHz based on I/N of 0 dB, existing clutter & terrain data, EIRP 42 dBm/20 MHz
 <p>Sterilised area= 746 km²</p>	 <p>Sterilised area = 2.3 km²</p>	 <p>Sterilised area = 7.6 km²</p>
	 <p>Zoomed in</p>	 <p>Zoomed in</p>

⁵⁸ For practical reasons, this analysis was undertaken with ITU-R P.452-14 to represent our current approach. We discuss our plans to update our propagation and clutter model below.

⁵⁹ Note that for this analysis we have accounted for 16 dB of receiver gain for medium power, and assumed 0 dBi receiver gain for our preferred and alternative options. We note that for some users, including FWA, terminals may be installed with a higher gain. However, we believe it is unlikely that these terminals will be in boresight of another user’s base station.

Figure 4.1, continued:

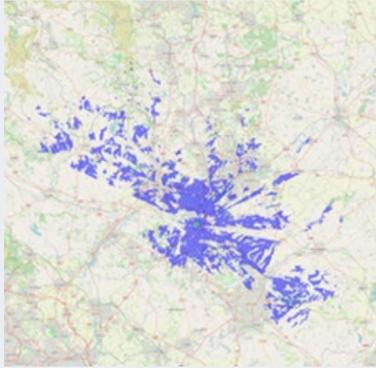
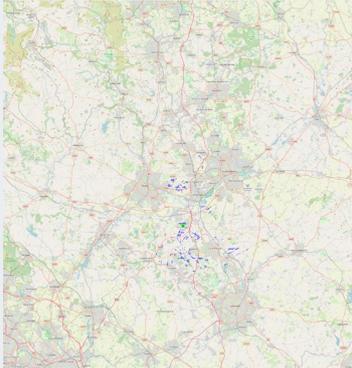
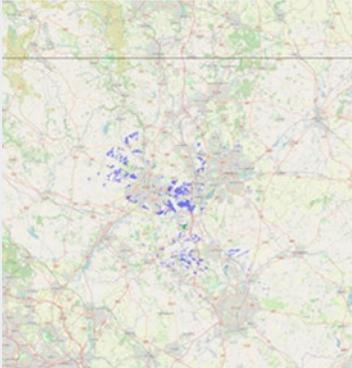
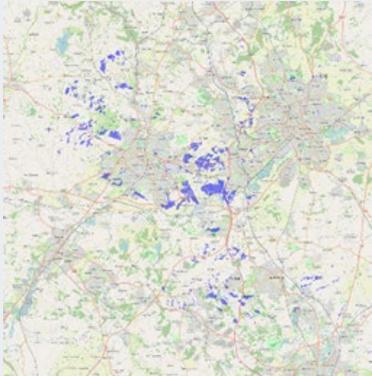
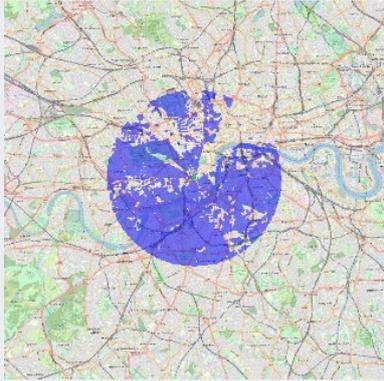
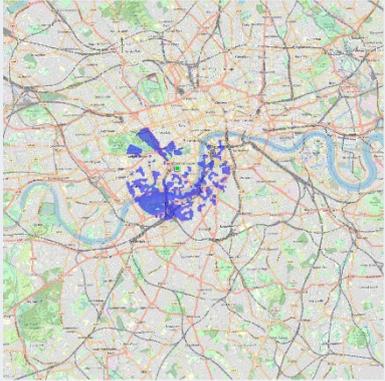
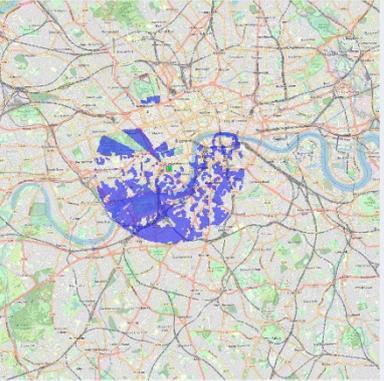
Medium Power Rural Outdoors - East Midlands Airport (transmitter at 20m)		
Current Approach	Preferred Option A	Alternative Option B
BS to BS coordination Receiver threshold at 10m of -97 dBm/20 MHz based on I/N of -6 dB existing clutter & terrain data EIRP 42 dBm/20 MHz	BS to terminal coordination Receiver threshold at 1.5m of -88 dBm/20 MHz based on I/N of +3 dB existing clutter & terrain data EIRP 42 dBm/20 MHz	BS to terminal coordination Receiver threshold at 3m of -91 dBm/20 MHz based on I/N of 0 dB existing clutter & terrain data EIRP 42 dBm/20 MHz
 <p>Sterilised area = 621.6 km²</p>	 <p>Sterilised area = 7 km²</p>	 <p>Sterilised area = 45.8 km²</p>
	 <p>Zoomed in</p>	 <p>Zoomed in</p>

Figure 4.1, continued:

Low Power Urban Outdoors – Central London (transmitter at 10m)		
Current Approach	Preferred Option A	Alternative Option B
BS to BS station coordination Rx threshold at 10m of -93 dBm/20 MHz based on I/N of -5 dB existing clutter & terrain data EIRP 24 dBm/20 MHz	BS to terminal coordination Rx threshold at 1.5m of -88 dBm/20 MHz based on I/N of +3 dB existing clutter & terrain data EIRP 24 dBm/20 MHz	BS to terminal coordination Rx threshold at 3m of -91 dBm/20 MHz based on I/N of 0 dB existing clutter & terrain data EIRP 24 dBm/20 MHz
		
Sterilised area = 28.4 km ²	Sterilised area = 2.9 km ²	Sterilised area = 7.8 km ²

4.25 As can be seen, there can be very significant differences in both the absolute sterilisation level, and the relative impact of our proposed changes, depending on the site topography and power levels. Both options for giving effect to our proposal to coordinate on the basis of protecting user terminals would typically lead to significant reductions, with Medium Power separation distances reduced under our preferred option by more than 90% (from tens of kilometres to a few kilometres in most directions) compared with our current approach. However, the more conservative Option B may, depending on location, contribute between two to three times more sterilisation than Option A. Given our interest in materially increasing the spectrum supply available to users across the country, we consider Option A our preferred choice.

4.26 We welcome stakeholder views on these options, and the underlying interference tolerance of their equipment, to guide our final decision.⁶⁰

Proposed update of Building Entry Loss assumptions for Indoor Deployments

4.27 An additional consideration when coordinating users indoors is the attenuation due to the building they are operating within. This impact varies by frequency. Our original

⁶⁰ We recognise that, because users are not providing us with details of their actual terminal locations, these may in some cases be higher, but we consider this a reasonable expectation in the round.

coordination process took account of this by incorporating a generic 12 dB of building entry loss into our coexistence analysis across Shared Access bands.⁶¹

- 4.28 As part of our review, we have reconsidered this approach. We propose taking a band specific approach to the 3.8-4.2 GHz band, given:
- a) the potential difference between BEL at these frequencies compared with 1800 MHz and 2300 MHz (because higher frequencies typically experience greater losses); and
 - b) the importance of accounting for this difference in the context of significant demand for 3.8-4.2 GHz.
- 4.29 To do this, we have also taken account of the latest ONS data trends indicating improvements in thermal insulation in both commercial and domestic building stock, which we would expect a majority of Shared Access deployments to be based within.^{62 63}
- 4.30 Therefore, we consider it is appropriate to use an updated BEL of 14 dB for the 3.8-4.2 GHz band.⁶⁴

Other relevant work: ongoing updates to our propagation clutter model

- 4.31 In addition to the consultation proposals above, we are already working to update the mapping data and associated propagation model that underpins our coordination process. These updates will allow coordination more reflective of real-world conditions and that better accounts for the impacts of barriers like trees and buildings.
- 4.32 Our current coordination approach utilises ITU-R P.452-10 across the existing Shared Access bands. We are moving to update our coordination tool to run with the latest, updated version (ITU-R P.452-18). This is in line with the approach we set out for Shared Access in our recent mmWave publication. We are also updating our clutter and terrain datasets to work in conjunction with this. We expect that this will provide significant benefits to coordination across all Shared Access bands (including contributing to the substantial net reduction in separation distances for 3.8-4.2 GHz shown in Figure 4.2 below).

Net effect of proposed changes for 3.8–4.2 GHz and across Shared Access framework

- 4.33 Our proposed changes will work together to make our overall coordination process more reflective of reality, and substantially improve access in the 3.8-4.2 GHz band. These benefits will vary depending on the terrain, and whether sharers are operating at medium or low power, but will generally deliver very significant reductions in separation distances between users.

⁶¹ We have separately proposed a threshold of 14 dB for coordinating mmWave users.

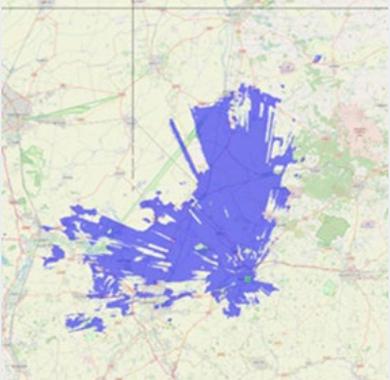
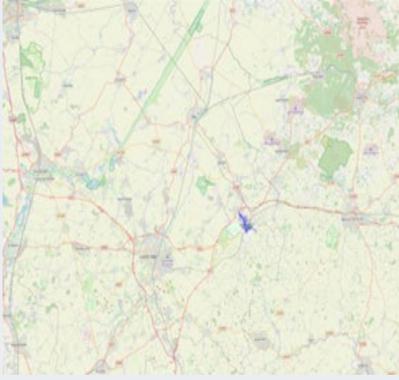
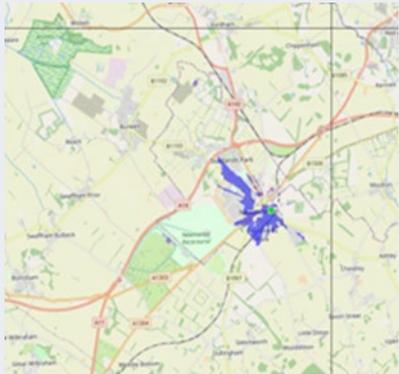
⁶² Office for National Statistics, [Insulation and Energy Efficiency of Housing in England and Wales](#), May 2023. UK Government, [Live Tables on Energy Performance of Buildings](#), October 2023.

⁶³ See for an illustration of predicted losses for traditional and thermally efficient buildings: ITU, P.2109: [Prediction of building entry loss](#), August 2023.

⁶⁴ In doing so, we are assuming the 30th percentile of the BEL distribution as the basis for the value and assuming a 50/50 split of thermally efficient and traditional buildings.

4.34 The figure below demonstrates this aggregated impact of all our proposed changes to our coordination process for a hypothetical deployment. It incorporates the changes to our propagation model, our preferred option for an interference threshold of -88 dBm and the move to base station to terminal coordination due to assuming synchronisation, as well as an updated BEL of 14 dB for indoor deployments.

Figure 4.2: Comparison of the sterilisation impacts from hypothetical deployments with our current approach compared with the combined effect of updating our I/N protection threshold, propagation model clutter maps and building entry loss.⁶⁵

Medium Power Rural Outdoors – Newmarket (transmitter at 20m)	
Current Approach	Preferred New Approach ⁶⁵
BS to BS coordination Receiver threshold at 10m of -97 dBm/20 MHz based on I/N of -6 dB, existing clutter & terrain data, EIRP 42 dBm/20 MHz	BS to Terminal coordination Receiver threshold at 1.5m of -88 dBm/20 MHz based on I/N of +3 dB, updated clutter & terrain data, EIRP 42 dBm/20 MHz
 <p>Sterilised area= 746 km²</p>	 <p>Sterilised area = 2.4 km²</p>
	 <p>Zoomed in</p>

⁶⁵ For practical reasons, this analysis was undertaken with ITU-R P.452-14 to represent our current approach, and undertaken with ITU-R P.1812-6 (in HTZ communications) as a proxy for ITU-R P.452-18 to represent the preferred new approach.

⁶⁶ We note that there is a small increase in sterilisation area for the Newmarket example compared with the analysis in Figure 4.1 when updating the propagation model and associated data. However, the sterilisation area remains small and overall we consider this update supports more realistic coordination.

Figure 4.2, continued:

Low Power Indoors, transmitter height 5m, central London ⁶⁷	
Current Approach	Preferred New Approach
Base station to base station coordination Receiver threshold at 10m of -93 dBm/20 MHz based on I/N of -5 dB existing clutter & terrain data EIRP 24 dBm/20 MHz BEL of 12 dB	Base station to terminal coordination Receiver threshold at 1.5m of -88 dBm/20 MHz based on I/N of +3 dB updated propagation model, clutter & terrain data EIRP 27 dBm/20 MHz BEL of 14 dB
 <p style="text-align: center;">Sterilised area = 2.9 km²</p>	 <p style="text-align: center;">Sterilised area = 0.7 km²</p>

4.35 Whilst our proposed BEL update is specific to 3.8-4.2 GHz, the move to base station to terminal coordination will bring the band more into line with the approaches we have taken in other Shared Access bands. These other bands will also benefit from the updates that we are making to our propagation model, and the additional detail on user systems which we set out our intention to gather in Chapter 3.

4.36 An updated summary of how our proposed changes would look in the context of our approach across the Shared Access bands, is set out below (with changes in red).

Table 4.1: Summary of Current Approaches and Proposed Changes

Coordination Inputs	1781.7-1785 MHz with 1876.7-1880 MHz	2390-2400 MHz	3.8-4.2 GHz	26 GHz
Building Entry Loss	12 dB	12 dB	14 dB	14 dB ⁶⁸
Coordinating on the assumption of synchronisation	Not relevant as the band is Frequency Division Duplex	Currently mandated for outdoor deployments	Synchronisation assumed for coordination	Synchronisation assumed for coordination
Additional network details in coordination assessment	✓	✓	✓	✓

⁶⁷Please note that the map to the left is based on base station to base station coordination and, therefore, the signal is primarily above the clutter, which is why the sterilisation effect here resembles free space path loss.

⁶⁸Our existing mm wave coordination proposals assume a BEL of 14 dB, in line with our proposals for 3.8-4.2 GHz. See Ofcom, [Enabling mmWave spectrum for new uses, March 2023](#), paragraph 10.39.

Coordination Inputs	1781.7-1785 MHz with 1876.7-1880 MHz	2390-2400 MHz	3.8-4.2 GHz	26 GHz
Steps We Are Already Taking				
Propagation & clutter model update	✓	✓	✓	✓

Other in-band users and new coordination proposals for users adjacent to UK Broadband assignments

Applicability of selected coordination proposals to non-Shared Access Users

- 4.37 The proposals set out above regarding base station-to-terminal coordination and assumed synchronisation apply to situations where we are coordinating Shared Access users with other Shared Access users.
- 4.38 We do not consider these proposals relevant to coordinating Shared Access users with Earth Stations or Fixed Links. This is because these are different kinds of services and technologies, with different performance characteristics and protection requirements. We also note these services are relatively limited in number across the band.
- 4.39 However, our proposals for local coordination agreements set out in Chapter 3 would apply to coordination between Shared Access and other band users (Earth Stations, Fixed Links and UK Broadband). This may provide another means of fitting more users together in closer proximity, particularly where new Shared Access users believe their systems are sufficiently resilient to tolerate any modelled risk from existing users of the band. In addition, coordination with all users will benefit from our updated propagation model, and the proposed update to Building Entry Loss assumptions will also be applied when coordinating these other users with Shared Access indoor users in 3.8-4.2 GHz.

Adjacent channel coordination with UK Broadband

- 4.40 To date, we have undertaken adjacent band coordination to protect Shared Access users above and below 3925-4009 MHz from the impacts of UK Broadband assignments on the basis of an out of band emissions mask.
- 4.41 This coordination approach currently considers impacts for other users across 2.5 times the bandwidth of UK Broadband's assignments, with the impact of this varying depending on the potential proximity between a UK Broadband and a Shared Access deployment. Our experience is that the impact of assuming UK Broadband out of block emissions over this wide frequency range can substantially constrain assignments for Shared Access in these adjacent frequencies.
- 4.42 In 2019, we took a different approach to ensuring co-existence with mobile services below 3.8 GHz, applying 5 MHz of separation to manage adjacent frequency interactions, rather than detailed coordination. We noted that beyond such separations OOB emissions are

often significantly reduced from the regulatory masks.⁶⁹ This approach was broadly supported by stakeholders.⁷⁰

- 4.43 We want to provide appropriate protection for Shared Access (and UK Broadband), without unduly constraining sharing opportunities.
- 4.44 Consequently, we consider it would be more efficient to amend our approach to protecting Shared Access users from adjacent UK Broadband assignments with a similar approach to that taken at the 3.8 GHz boundary. We propose to give effect to this by accounting for UK Broadband emissions in our protection of adjacent Shared Access users over only 5 MHz of adjacent spectrum (above and below the UK Broadband assignments). We propose to continue with our existing arrangements for co-channel coordination, including taking account of the geographic proximity of different users to safeguard effective sharing.
- 4.45 We recognise that Shared Access users will not always be operating with frame structures that fully align with UK Broadband, but on balance consider it unlikely that any out of band emissions beyond this 5 MHz of adjacent band coordination would materially degrade the experience of neighbouring Shared Access users. We consider that any risk is offset by the improved access to spectrum such a change will afford, and that were users to be impacted, there would be options to mitigate this.
- 4.46 We welcome stakeholder feedback on this proposal to change our current OOB coordination mask between UK Broadband and new Shared Access users by considering only 5 MHz of emissions outside of the UK Broadband assignments.

Consultation question 5, 6, 7 and 8:

Question 5: Do you agree with our proposals to assume synchronisation between users, and coordinate base station to terminal instead of base station to base station in the 3.8-4.2GHz band? If no, please explain how other measures could increase sharing of the band.

Question 6. Please indicate whether you support our preferred option of coordination at -88 dBm/20 MHz (based on I/N of + 3dB, at 1.5m) or a more conservative alternative of -91 dBm/20 MHz (based on I/N of 0dB at 3m), with reasons for your view.

Question 7: Do you agree with our proposals for an increase in BEL in 3.8-4.2GHz? If no, are there alternatives which you consider could better achieve similar results?

Question 8: Do you agree with our proposal that adjacent band protection for Shared Access users is in future limited to considering only the first 5 MHz above and below UK Broadband assignments?

⁶⁹ Detail of the analysis supporting this 5 MHz separation is set out at page 93 of our 2018 consultation: Ofcom, [Enabling opportunities for innovation](#), December 2018.

⁷⁰ See Ofcom, [Enabling opportunities for innovation](#), July 2019, p. 53 for a discussion of this issue.

5. Options for revising fees in 3.8-4.2 GHz to enable more sharing

- 5.1 Shared Access licence fees are primarily cost-based,⁷¹ reflecting our 2019 view that there would not be excess demand for Shared Access licences, and our desire to promote innovation (by making licences affordable to a range of users).
- 5.2 We said we would keep the fees under review as we observed real-world demand and would expect to review them only if:
- There was a significant misalignment with costs in the future; or
 - There was evidence of excess demand such that it was appropriate to move to Administered Incentive Pricing (AIP)-based fees.⁷²
- 5.3 We now consider there is a risk that demand will exceed supply in some geographic locations in the 3.8-4.2 GHz band, particularly as licensees' preference for very large bandwidths limits the number of users who can share in close proximity. We are minded to set fees above cost in the 3.8-4.2 GHz band to encourage deployment that minimises sterilisation and increase the spectrum supply, but we are keen to understand the potential impact of such a change on stakeholders and on innovation. We do not think it is necessary to revise fees for the other Shared Access bands, as we do not currently see evidence of excess demand in those bands.
- 5.4 In this section we set out some options for how we might change fees in the 3.8-4.2 GHz band. The main elements of our proposed approach are (a) creating four price categories: Rural Low Power, Urban Low Power, Rural Medium Power, and Urban Medium Power (the last of these is only licensed via an exceptions process); and (b) within these categories:
- Maintaining the current fees schedule for Rural Low Power.
 - For Urban Low Power and Rural Medium Power, retaining the current fees schedule for bandwidths up to 50 MHz.
 - For all price categories except Rural Low Power (where we see little risk of scarcity), setting higher per MHz prices for bandwidths above 50 MHz.
 - Adding an additional pricing factor for all bandwidths with Urban Medium Power (exceptions), in view of the large number of premises typically affected/sterilised by such deployments.
- 5.5 We also provide some of the illustrative prices that flow from this proposed approach (see table 5.1 for the extract, and table 5.4 for the full potential fees schedule). These prices are intended to inform the discussion with stakeholders and are not firm proposals. We note that there are some additional factors we are considering accounting for which could lead to lower final prices in some cases.

⁷¹ Although fees are primarily cost-based, the cost of licences varies with bandwidth. We assumed that the average licence would be for 40 MHz bandwidth and proposed that fees for higher and lower bandwidths should be proportional to the fee set for a 40 MHz licence. Our rationale for the current fees is set out in the July 2019 Statement [Enabling Wireless Innovation through Local Licensing](#), paragraphs 3.157-3.170.

⁷² Ofcom, [Enabling Wireless Innovation through Local Licensing](#), July 2019, paragraph 3.148.

Table 5.1: Illustration of potential changes to annual fees in 3.8-4.2 GHz band (extract)

	Current price	Rural Low Power	Urban Low Power	Rural Medium Power	Urban Medium Power (by exception)
50 MHz	£400	£400	£400	£400	£2,500
80 MHz	£640	£640	£1,120	£1,120	£7,000
100 MHz	£800	£800	£1,600	£1,600	£10,000

5.6 We are mindful that the illustrative prices could represent a significant price increase for some users, and we are seeking stakeholders’ views on the principles of the pricing approach, as well as how best to ensure that any price increases are proportionate and appropriate. We will consider stakeholder responses and consult on specific pricing proposals prior to introducing any fee changes. Our proposals will be influenced by the decisions we take on technical measures to maximise sharing (as set out in the previous section), which will impact our final assessment of spectrum scarcity.

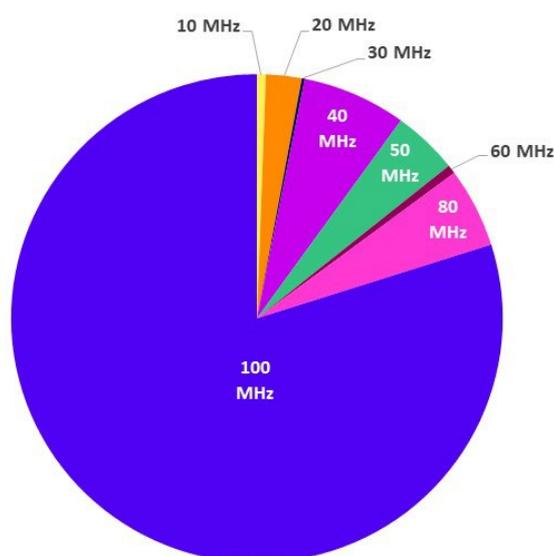
Context for reconsidering our fees in 3.8-4.2 GHz

5.7 We have seen substantial demand for Shared Access in the 3.8-4.2 GHz band, which stakeholders have told us is likely to increase. This must be accommodated alongside other services already sharing the spectrum, including Fixed Links, Satellite Earth Stations and UK Broadband. As a result, we have experienced situations where we were unable to meet stakeholder demand in some locations. The availability of unused spectrum in the band is variable across the country, with most availability often in more remote and less populous areas (as shown in Chapter 2, Figure 2.3). We note that areas with more limited supply can often be in areas where future demand may be greatest.

5.8 We have set out updated technical proposals in Chapter 4 which we think could reduce typical separation distances by around 75% (for Low Power) to 90% (for Medium Power). If adopted, these measures will significantly reduce the chances of one deployment preventing a neighbouring use that is more than 5-10 kilometres away. However, it will not fully address scenarios where demand is more closely packed together. We illustrated in Section 2 (Figure 2.4) the potential for such co-located demand to arise.

5.9 Our ability to support multiple nearby users depends upon the requirements of those users. The larger the channel size and the higher the power, the fewer users an area can accommodate. Evidence to date suggests that demand is overwhelmingly for 100 MHz of 3.8-4.2 GHz spectrum per licence, as opposed to the c40 MHz per licence we had originally assumed. Figure 5.1 below shows how only around 7% of current licences are for 40 MHz, and almost 80% of licences are for 100 MHz. Given the presence of other users in the band, there may often only be room for one or two channels of 100 MHz in a given area.

Figure 5.1: Analysis of the bandwidths (in MHz) of issued licences in 3.8-4.2 GHz⁷³



- 5.10 From the responses to our CFI, there is an expectation that demand for large bandwidths will continue to drive interest in 3.8-4.2 GHz. Some respondents indicated that more than 100 MHz might be required for some applications in the future (e.g. Virtual Reality applications).
- 5.11 Whilst we recognise there are circumstances where a user would find 80-100 MHz preferable, we think that for many existing use cases, significantly less spectrum will be needed. For instance, 40 to 50 MHz of spectrum is likely to be sufficient to cater for a significant number of use cases - with 80 to 100 MHz only likely to be necessary for the most demanding use cases.
- 5.12 Although wider bandwidths can provide greater capacity and higher throughputs, very significant data rates and traffic volumes can be supported by less spectrum.⁷⁴ Real world performance will also be heavily impacted by other factors, including the geometry of the deployment, the Signal Interference to Noise Ratio that is achieved, antenna configuration, etc.
- 5.13 Our view that most applications can be delivered with less than 100 MHz is supported by our experience. Stakeholder engagement, through informal discussions and our CFI process, has suggested that 100 MHz is not always required where it is requested.⁷⁵ Our experience with the exceptions process has also been that in most cases, where less spectrum is available, users have continued to successfully pursue their deployments with lower bandwidths.⁷⁶

⁷³ As of 26 October 2023.

⁷⁴ For example, ECC report 287 notes a target IMT 2020 peak data rate of 1.2 Gbps for a single user and an average of 0.312 Gbps for 40 MHz bandwidths in a dense urban cell. ECC, [Guidance on defragmentation of the frequency band 3400- 3800 MHz](#), October 2018.

⁷⁵ For example, Nokia noted in their [CFI response](#) that some companies request 100 MHz due to the potential to obtain higher throughput but not all use cases require this level of throughput.

⁷⁶ We note that this is also reflected in other approaches internationally. For example, Canada plans on a 20 MHz limit with 80 MHz of spectrum available in total, and Finland offers 20 MHz at 2.3 GHz. See [Decision on a Non-Competitive Local Licensing Framework, Including Spectrum in the 3900-3980 MHz band and portions of the 26, 28 and 38 GHz bands](#), May 2023 and [Local 4G/5G networks](#) [accessed on 14 November 2023].

5.14 We recognise that we do not have a perfect knowledge of all the potential use cases for 3.8-4.2 GHz and that it is up to individual users to decide how much spectrum they require but we would like to incentivise them to only apply for what they need. We are not, therefore, looking to prohibit users from accessing these larger bandwidths. However, we consider it is likely to be beneficial to the long-term support of sharing in the band that these bandwidths are only requested where they are necessary. We welcome further dialogue with users to understand where this is the case.

We are minded to revise our fees for Shared Access licences in the 3.8-4.2 GHz band

5.15 The current annual licence fees for Shared Access are shown in the table below. We offer short term licences for durations of less than one year; these are priced on a pro rata basis with a current minimum cost of £32 for licences in the 1800 MHz, 2300 MHz, 3.8-4.2 GHz bands and 26 GHz band.⁷⁷

Table 5.2: Licence fees for the Shared Access licence (per annum)

1800 MHz shared spectrum	2300 MHz shared spectrum	3.8-4.2 GHz	Lower 26 GHz	mmWave
£80 for 2x3.3 MHz	£80 for 10 MHz	£80 per 10 MHz	£320 ⁷⁸	£80 per 100 MHz

5.16 Under s 13 of the WT Act, we may charge fees greater than those necessary to recover the costs incurred in connection with our radio spectrum functions. If we do so, we are required to have regard in particular to the matters in s 3 of the WT Act, including the extent to which the spectrum is available; present and likely future demand; and the desirability of promoting efficient management and use of the spectrum, economic and other benefits, innovation and competition.⁷⁹

5.17 Ofcom’s typical approach to spectrum pricing is that:

- a) **For spectrum that is not in excess demand**, we set fees at a level to cover Ofcom’s cost of administering the spectrum licences concerned;
- b) **For spectrum that would be in excess demand if cost-based fees were applied**, we instead set fees based on the market value (or equivalently the opportunity cost) of the spectrum. This approach is termed Administered Incentive Pricing (AIP). Its purpose is to

⁷⁷ A minimum licence fee of £80 in the 26 GHz and 40 GHz bands will apply when the Shared Access licences become available in those bands in 2024 and 2028 respectively. See: Ofcom, [Enabling mmWave spectrum for new uses](#), September 2023, paragraph 1.13-1.14.

⁷⁸ For the Lower 26 GHz band a licence currently costs £320 regardless of how much bandwidth is used. Given our decision to extend Shared Access in the 26 GHz and 40 GHz bands, we have now set out a fee structure of £320 per 400 MHz (pro rata for different bandwidth options within a minimum cost of £80 for bandwidths up to 100 MHz). See: Ofcom, [Enabling mm Wave spectrum for new uses](#), September 2023.

⁷⁹ Ofcom, [SRSP: The revised Framework for Spectrum Pricing](#), December 2010 , paragraph 3.8.

give licensees an incentive to return licences if they value the spectrum at less than its market value, and so to encourage efficient use of spectrum.⁸⁰

- 5.18 AIP sets licence fees based on the estimated market value of the spectrum in the current use and any feasible alternative uses.⁸¹ Under an AIP approach we would look to identify the use of the 3.8-4.2 GHz band which had the highest market value, and set licence fees based on this valuation.
- 5.19 However, in the case of Shared Access, we made a policy decision to prioritise innovation in the 3.8-4.2 GHz band by encouraging the development of new uses and facilitating access to spectrum for new users, based on our wider objectives. As innovative uses continue to emerge, and long-term demand is uncertain, setting fees based on a market valuation at this stage in the development of new use cases is challenging and might not contribute to securing long term optimal innovation outcomes. Shared Access licences might become unaffordable for many potential users which, at this stage, would be inconsistent with our innovation policy decision for the band.
- 5.20 We have therefore considered other options for setting licence fees above cost in this band, evolving our existing approach to charge higher amounts for larger bandwidths. We consider this a way of managing congestion and maximising sharing opportunities, while recognising that the resulting fees may be below the market value of the spectrum.

Pricing bandwidth, power, and location

- 5.21 The primary drivers of spectrum scarcity relate to the bandwidth which licensees use, and the geographic area that their use sterilises for others (which will vary based on operating power, or specifics of site locations, including rurality, topography, and antenna height).
- 5.22 We have developed a potential pricing framework that takes these into account by creating new geographic and power categories for pricing, with an increased focus on bandwidths we consider more likely to result in scarcity.

Bandwidth and location

- 5.23 Recognising that most licence applications are for 100 MHz (as shown in Figure 5.1 above) we have considered if this is due to the low incremental price of Shared Access spectrum, or if there is a genuine need for, or benefit from, 100 MHz channels.
- 5.24 On the one hand, larger-bandwidth licences may have a benefit in future-proofing applications. On the other hand, while we recognise there may be circumstances where 100 MHz is desirable to users, we are not aware of many current applications that require full 100 MHz channels to be delivered. With this uncertainty in mind, and with a view to avoiding situations where low fees lead licensees to request 100 MHz where it is not needed, we are proposing prices that give applicants a greater incentive to minimise the amount of spectrum they request - in cases where this might otherwise contribute to scarcity.

⁸⁰ Fixed link and satellite users in the 3.8-4.2 GHz are charged AIP-based fees, which were set before the introduction of Shared Access to the band. In our 2019 Statement we found that existing users are likely to contribute to excess demand given the larger sterilisation areas from the deployment of these users. See [2019 Statement](#), para 3.148-3.156.

⁸¹ Ofcom, [SRSP: The revised Framework for Spectrum Pricing](#), March 2010, page 4.

- 5.25 To do this we have divided the existing licence products into four categories which we believe best reflect the difference in deployment scenarios contributing to scarcity: **Rural Low Power; Rural Medium Power; Urban Low Power; and Urban Medium Power.**^{82 83}
- 5.26 **We do not expect Rural Low Power to be a driver of scarcity.** The impact of these uses should typically not extend more than a kilometre or so. Given the lower population densities and more limited set of potential users in such rural locations, we think such limited sterilisation of low density areas is unlikely to trigger congestion. As a result, we do not see a need to move from our existing fees for these uses.
- 5.27 **We expect that other use types are more likely to drive scarcity:**
- a) Rural Medium Power deployments sterilise significantly more places than Low Power deployments, increasing the chance that neighbouring deployments (including neighbour locations in urban areas) are impacted.
 - b) All urban deployments have potential to sterilise a significant number of premises, with this effect exacerbated at higher power levels.
- 5.28 Our initial view is that for **Rural Medium Power** and **Urban Low Power** we would **retain our existing linear price per MHz for bandwidths up to 50 MHz**, because we think these power and bandwidth combinations are unlikely to be a significant driver of scarcity. **We consider a higher per MHz price could apply to wider bandwidths in these categories, so that, for example, 100 MHz would cost four times more than 50 MHz (i.e. £1600).**⁸⁴

Medium Power in urban areas

- 5.29 Medium Power licences are only granted in urban areas via the exception process. This limitation reflects the potential for the increased range of higher power applications to limit more opportunities that could be available to Low Power users.⁸⁵
- 5.30 To inform our approach to updating fees for this kind of deployment, we have undertaken an initial analysis of this effect in a range of locations, as shown in Table 5.3 below.⁸⁶ Note that this analysis, and the indicated sterilisation areas, are based on modelling undertaken according to our preferred option for updated coordination rules outlined in chapter 4.

⁸² To define the urban and rural categories we have used the same definition as for determining whether medium power is restricted – this is set out in our Statement, see: Ofcom, [Enabling wireless innovation through local licensing](#), July 2019, paragraph 3.55.

⁸³ We note that Medium Power Urban deployments are only available by the exceptions process.

⁸⁴ Note we would not expect a licensee to apply for multiple small bandwidth licences to cover a larger bandwidth deployment on the same base station, and that were this to occur we would expect for pricing purposes to consider their collective bandwidth holding in that location.

⁸⁵ Ofcom, [Enabling Wireless Innovation through Local Licensing](#), para 3.54-5.

⁸⁶ We have included a range of urban location types including some areas that are likely to have potential for industrial use cases, i.e. airports. However, we recognise that this is not a complete study of all potential locations.

Table 5.3: Comparison of modelled sterilisation areas for a sample of hypothetical Low vs. Medium Power urban deployments^{87 88}

Area	Medium Power: premises sterilised	Low Power: premises sterilised	Ratio
London	370,000	9,400	39
Glasgow	39,000	1,300	30
Cardiff	68,000	2,700	25
Belfast	87,000	2,900	29
Aberdeen	47,000	170	290
Colchester	16,000	4,000	4
High Wycombe	16,000	2,600	6
Manchester Airport	44,000	35	1,300
Glasgow Airport	23,000	130	170
Liverpool Airport	24,000	2	12,000

5.31 The ratio of the number of premises sterilised at Low Power versus at Medium Power varies widely, as it is impacted heavily by the surrounding terrain and density of local populations. For example:

- a) Colchester and High Wycombe have comparatively less dense populations than parts of Manchester, Glasgow and Liverpool (and High Wycombe also lies in a valley surrounded by the Chiltern Hills).
- b) Airport locations are often in the vicinity of dense urban settlements, but with a degree of geographic separation. We see the effects of this at Liverpool Airport, where the impacts of a nominal Low Power transmitter would stay largely within the airport boundaries, whilst a Medium Power transmitter impacts residential Speke to the north, and communities south and west across the Mersey estuary.

5.32 Whilst these examples do not represent a systematic study, they do demonstrate that Medium Power can have a sterilisation effect many times that of a Low Power deployment. It also highlights that the difference between the two products will vary significantly depending on location.

5.33 In urban areas, we propose setting higher prices for Medium Power deployments, in order to reflect the greater opportunity cost and to increase users' incentive to consider whether

⁸⁷ We modelled using base station to terminal coordination, with our proposed threshold of -88dBm and 27dBm/20MHz EIRP for low power deployment, and updated terrain and clutter (we used ITU-R P.1812-6 path loss model which is as a close proxy for our proposed updated version of ITU-R P.452-18).

⁸⁸ Figures in this table have been rounded to two significant figures. Because premises and ratio numbers have been rounded, the ratios may not precisely match the premises numbers presented in the table.

they can use Low Power instead, particularly for high bandwidth deployments.⁸⁹ Our initial thinking is that an appropriate price for Urban Medium Power with 100 MHz could be around £10,000. This proposal would be just over six times the price of an Urban Low Power deployment of the same bandwidth. It is informed by the analysis set out above, but takes a conservative view of the impact and is at low end of the ratios we have shown.⁹⁰

- 5.34 These higher fees would only be applied where users seek an exception to deploy Medium Power in urban areas – of which there are currently only around 30 examples. Not all of these licensees have required bandwidths of 100 MHz, and we envisage lower bandwidth deployments will have lower fees (as shown in Table 5.4). We also note that many of these Medium Power exceptions feature several base stations in close proximity to each other, and we discuss below ways in which we could account for this that would also offset fee increases (in situations where users could not reduce the power or bandwidth they required).
- 5.35 We are keen to understand stakeholders’ views about a price at these levels, including whether stakeholders think that the fee needs to be higher to reflect the fact that sterilisation levels may be more than six times Low Power in some areas, or whether fees set at this level would be unaffordable and impact our objectives for the 3.8-4.2 GHz band.

Illustrative Prices

- 5.36 Table 5.4 below shows what fees could look like for the different categories of deployment were we to implement the changes outlined above. These are not firm proposals, and we explore below some additional factors which we could take into account which might reduce the net effect of some fee increases. At present we are seeking stakeholder comments on the framework and the principles underpinning them, as well as potential behavioural changes that could result from the illustrative prices.

Table 5.4: Illustration of potential changes to fees in 3.8-4.2 GHz band, compared to existing fees⁹¹

	10 MHz	20 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz
Current Price	£80	£160	£240	£320	£400	£480	£640	£800
Rural Low Power	£80	£160	£240	£320	£400	£480	£640	£800
Urban Low Power	£80	£160	£240	£320	£400	£640	£1,120	£1,600
Rural Medium Power	£80	£160	£240	£320	£400	£640	£1,120	£1,600

⁸⁹ We are aware that a limited number of Medium Power licences in urban areas cover users who are operating at very low powers (because our Medium Power product allows us to capture the actual operating power of a deployment, including where this is very low). We will take account of this in applying any pricing changes to such use cases as we develop our full proposals.

⁹⁰ We note that an additional reason why this conservative view is likely to be appropriate is the ‘premises sterilisation test’, which we apply to such exceptions requests and is likely to preclude deployments with the largest impacts. See paragraph 6.7 for a fuller explanation of this test.

⁹¹ Bandwidths shown are those authorised in the 3.8-4.2 GHz band per our guidance document. See: [Shared Access Licence: Guidance document](#), September 2022

	10 MHz	20 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz
Urban Medium Power (by exception)	£500	£1,000	£1,500	£2,000	£2,500	£4,000	£7,000	£10,000

Additional factors which pricing could account for

- 5.37 We recognise that for users with many licences, or for the few who have been granted exceptions for Medium Power in urban areas, such changes could materially increase the total fee for their Shared Access deployments, if they consider they cannot make some reductions in the level of bandwidth they ask for (or operate at a lower power). However, there are factors that we could take into account that may reduce the impact of these fees. These are set out below, from factors we are most minded to account for, to those which we are less persuaded of:
- Reflecting closely clustered sites in pricing.
 - Reflecting technical characteristics of actual deployments.
 - Accounting for indoor use.
 - More refined reflection of geographical demand.

Reflecting closely clustered sites in pricing

- 5.38 We are aware that some existing use cases involve multiple Medium Power sites from a single user in close proximity to each other.
- 5.39 As explained above, we think it is appropriate to set higher prices for Medium Power because its greater sterilisation area has a higher opportunity cost. However, where deployments are very close together and using the same set of frequencies, it is likely that their sterilisation areas will substantially overlap. After taking account of the initial site, subsequent sites deployed nearby will not have the same impact on other users (i.e. their effect is largely accounted for by the first deployment). In such cases, we think that charging the full price for each site may be disproportionate.
- 5.40 We are currently exploring options to address this issue through our licensing process, but in doing so are mindful of adding extra complexity, given the importance of speedy licensing to stakeholders. Options could include mechanisms to set a lower fee for second and third sites that are very close to an initial deployment. We are also considering alternative approaches to recognising this issue, for example whether it would be appropriate to apply a discount to overall fees to 'price in' this effect, or to seek to calculate the actual sterilisation effect of additional deployments more directly. We will set out more detail on our approach to this issue as we develop our full pricing proposals. We expect that addressing this could substantially mitigate cost impacts of our proposals for users of the band with geographically concentrated uses, whilst retaining the incentives we wish to provide.
- 5.41 We would welcome input from stakeholders on the types of use cases associated with this 'clustering' effect, to inform our thinking on how best to account for it.

Reflecting technical characteristics of actual deployments

- 5.42 We have set out in Section 3 of this document our intention to collect additional deployment data from users, where they are willing and able to provide this. This includes information

on the number and size of antenna sectors at a given site, as well as antenna directionality and tilt.

- 5.43 We propose to gather this information because we consider it may materially impact the sterilisation area we associate with a given user, and consequently their potential impact on other users. Where these impacts are very substantial, there may be an opportunity to take account of this in an updated pricing approach. For example, where a licensee is deploying on a single sector up to 180 degrees in azimuth, as opposed to a 360 degree omnidirectional or three sector site, a simple 50% fee reduction could be applied to account for this.⁹²
- 5.44 We also consider that accounting for some of these details in a revised pricing approach could incentivise more users to provide us with this information, and therefore allow us to coordinate better, and enable more sharing. However, we are mindful that users may wish to retain the flexibility to fine tune these parameters over time. We are also mindful that to limit complexity, it may only be appropriate to account for these details in so far as they drive significant changes to the sterilisation area.⁹³ We intend to set out further views on how far this detail should be accounted for in light of stakeholder feedback, and at a point when we have taken a final decision on whether this additional data is collected.

Accounting for Indoor use

- 5.45 Our reasons for proposing to charge more for Medium Power and Urban Low Power deployments are based on their potential impacts on opportunities in neighbouring areas.
- 5.46 We have considered whether this impact is likely to be lower where such uses take place indoors, and if different, lower prices could be justified in these cases. We are taking steps to account for the reduced sterilisation effect of indoor use in our coordination framework, and are proposing an updated Building Entry Loss of 14 dB for 3.8-4.2 GHz. However, whilst this will typically reduce the sterilisation effect for Low Power deployments indoors compared with outdoors, our analysis indicates that a Low Power indoor user in a dense urban area could still sterilise use for a significant number of premises in the surrounding area. Whilst the reduction in impact for Medium Power use might be more significant, we are not aware of major use cases requiring such power levels indoors. Because of this, and in order to avoid undue complexity from multiple fee products, our current view is that creating additional fee products to reflect indoor use would not be proportionate.

More refined reflection of geographical demand

- 5.47 The pricing approach set out earlier in this section would create different pricing categories depending on whether a deployment is urban or rural. However, there can be substantial differences in the nature of urban areas, and some locations may have more congestion, or be more prone to it, than others.
- 5.48 We recognise that, in theory, there could be more complex ways to reflect differences in demand across these locations, for example:
- Creating additional categories within “urban” to reflect population density; or

⁹² We do not believe it is proportionate to vary prices in line with the precise sterilisation of each individual deployment, as this would be complex to administer and create uncertainty as to the fees users might pay.

⁹³ Our experience suggests that the majority of users are deploying multi-sector sites, and that the sterilisation effect from a typical 3 sector site may not be radically different from an omni-directional site. Our analysis also suggests that antenna tilt must be substantial to make a large change to an interference footprint.

- Only implement a higher price once an area becomes congested, measured by spectrum availability falling below a certain threshold.
- 5.49 Our current view is that reflecting more variable demand in this way is unlikely to achieve our aims. Creating additional area categories would add complexity to the Shared Access licence product. Additionally, as we believe that the indicative prices in this chapter are set conservatively, it is not clear that there is much to be gained by breaking down the pricing structure further.
- 5.50 Implementing a dynamic approach to pricing based on current use and localised congestion would be challenging on a number of levels, including creating potentially significant price uncertainties that could impact user business cases and innovation in the band. Issues would include how to define when an area is congested (given that the Shared Access products are local), and how to track, review and implement pricing changes. More importantly, in this model pricing changes would be reactive – the price would change once the band is already congested (or likely to be so soon). This would lessen the incentive for licensees to use spectrum efficiently from the outset. It could also mean that licensees' fees could change significantly at short notice, if an area where they have deployment(s) later became congested and moved into a higher fee category, which could be problematic for licensees' investment decisions. Our current view is that it would be better to have a consistent and predictable long-term incentive for efficient use.

Next steps on introduction of new fees

- 5.51 We will consider the responses to this consultation, and consult again on firm proposals for future pricing of Shared Access licences prior to introducing any fee changes. Our approach to developing fee proposals will give stakeholders the opportunity to submit evidence before we develop final proposals. It will also allow us to calibrate our final proposals based on the decisions we take on our coordination approach, and its impacts on spectrum supply.
- 5.52 We recognise that for some users, price increases could have a significant impact on their business models. However, users will have options that could mitigate the impact of this by reducing the bandwidth they use, and considering alternative ways to maintain capacity where required. Should we decide to implement new fees, we will also give some time before these are introduced to allow stakeholders to adjust, and would not expect to introduce new fees before 2025.

Consultation question 9, 10 & 11:

Question 9: Do you agree with our assessment that, in circumstances where localised shortages of spectrum have occurred, pricing can be used to influence requested spectrum amounts?

Question 10: Do you agree that we should take measures to reflect the impact of bandwidth, power levels and urban/rural location in our pricing approach for the 3.8-4.2 GHz band? Do you think there are other factors we should be taking into account?

Question 11: How do you consider the illustrative prices would impact your spectrum requirements and future deployment plans in the 3.8-4.2 GHz band? Please provide evidence in support of your view.

6. Exceptions and future opportunities

- 6.1 In undertaking our review, we have recognised other areas where there is stakeholder interest in additional changes to Shared Access, including further flexibility on Medium Power use and antenna heights, currently made possible through our ‘exceptions’ process.
- 6.2 In this chapter, we set out our approach to these issues and the associated exceptions process, and highlight some emerging spectrum opportunities which we believe could further support Shared Access, and help meet existing and additional stakeholder needs.

Refining our ‘Exceptions’ process for simpler and speedier user interactions

Existing exceptions framework

- 6.3 When we made Shared Access available in 2019, we established an ‘exceptions’ process for applications outside the overarching band rules, in both the 1.8 GHz and 3.8-4.2 GHz bands. This reflected some of the uncertainties we had over how the 1.8 GHz and 3.8-4.2 GHz band might be used.^{94 95}
- 6.4 At the time, we noted this process could consider requests for Medium Power licences in urban areas, and exceptions to the maximum permitted antenna height, on a case-by-case basis.⁹⁶ We also said that in doing so we would consider the potential for other users to be denied access to spectrum by the increased potential for interference. We then set out a framework for how we would judge whether an exception request was consistent with our policy objectives:
 - a) Any proposed Medium Power deployment must demonstrate that it could not be delivered using Low Power as an alternative;
 - b) Emissions from the prospective users’ site should have a similar sterilisation impact to a Low Power site;
 - c) That the irregular boundaries of one of the rural/urban classification systems places a location in an “urban” area even though surrounding locations with similar characteristics on the ground have been classed as “rural”.⁹⁷

Our proposed revised approach to exceptions

- 6.5 We have reflected on feedback from stakeholders that whilst they broadly welcome the flexibility provided by this exceptions process, the time taken to make an assessment can be a cause of frustration (as well as impacting our own resources, given the need for a

⁹⁴ Ofcom, [Shared Access Licence: Guidance document \(ofcom.org.uk\)](https://www.ofcom.gov.uk/consult/condocs/sharedaccess/sharedaccess_220922.pdf), September 2022

⁹⁵ It is important to note that this exceptions process is not something we typically offer in other bands and is not available in 2.3 GHz or 26 GHz.

⁹⁶ Ofcom, [Enabling Wireless Innovation Through Local Licensing](https://www.ofcom.gov.uk/consult/condocs/wirelessinnovation/wirelessinnovation_220719.pdf), July 2019

⁹⁷ Ofcom, [Shared Access Licence: Guidance document \(ofcom.org.uk\)](https://www.ofcom.gov.uk/consult/condocs/sharedaccess/sharedaccess_220922.pdf), September 2022

dedicated engineering assessment). Some CFI respondents also requested that we make our exceptions process more transparent to users.

6.6 We want to be clear how we decide whether to grant an exception, and to make this process both simpler and clearly focused on a specific set of circumstances where we think additional flexibility may be appropriate. This will provide clarity for users and help us to resource a more efficient and timely process.⁹⁸ Consequently, we propose to continue to accept applications for the following measures only:

- a) Requests to use higher antenna heights; and
- b) Requests for Medium Power licences in urban areas.⁹⁹

6.7 We also propose a simplified and transparent approach to considering these requests, with two core tests supporting our assessment, set out below.

- i) **We will use a ‘premises sterilisation’ test as an initial step to establish if an exception can be granted.**

If the number of premises denied by the proposed deployment is less than number of premises set out below, we will grant the exception request. These numbers have been derived by our analysis of average premise sterilisation for an equivalent Low Power deployment in an urban area which is in line with our stated rationale for granting exceptions.¹⁰⁰

Spectrum Band	Premise sterilisation number
1800 MHz	57,000
3.8 – 4.2 GHz	44,200

- ii) **If the proposed exception exceeds this number, we will apply an additional test regarding the spectrum availability in the area of the desired deployment.**

This enables us to be pragmatic and grant an exception if there is plenty of spectrum available in an area, even if the initial premises test is exceeded. If there is little spectrum available in an area, the proposed exception will not be granted.

6.8 This framework will continue to support flexibility for users where there is plenty of spectrum available while ensuring that a deployment which could unduly restrict spectrum access for others is not permitted. We think this approach will streamline the exceptions

⁹⁹ For the avoidance of doubt, we are continuing to offer this opportunity only in the 1.8 GHz and 3.8-4.2 GHz bands. We do not offer the opportunity to deviate from standard licence conditions in the 2.3 GHz band due to coexistence requirements with the MoD. We have also outlined in our wider approach to the 26 GHz band that we will not be offering exceptions in this band.

¹⁰⁰ Whilst we could take steps to adjust the 3.8-4.2 GHz threshold (and so make the exceptions test more stringent) to reflect average sterilisation based on our new coordination proposals, our current view is to retain the threshold derived from our current approach. This is because we have already used this threshold to determine a view of acceptable impacts in approving current exceptions, and because our indicative plans for pricing Medium Power urban deployments allow for a greater sterilisation impact. Were we not to proceed with our new approach on pricing, it might be necessary to update this number.

process and support improved turnaround times, and still give users access to Medium Power in urban areas, or additional antenna heights, under certain circumstances.

We are not proposing broader flexibility for Medium Power levels and locations

- 6.9 As noted in Chapter 3, we recognise there remains interest from some stakeholders in seeing amendments to the rules defining access to a 'Medium Power' licence, regardless of our 'exceptions' process. This interest falls into two main categories:
- a) Use of higher power levels than the 42 dBm/20 MHz we currently permit; and
 - b) Use of the existing Medium Power level in urban locations, without recourse to the 'exceptions' process through which such requests are currently considered.

Higher Medium Power

- 6.10 We acknowledge the stakeholder interest in operating at a higher power level, which was expressed by 4 of our 22 CFI respondents, and the potential benefits for users from accessing higher powers (e.g. coverage range or reduction in the number of sites required). However, for the same reasons this could provide benefits for individual users, the suggested increases to c49-52 dBm/20 MHz would substantially increase the sterilisation effect of such deployments.
- 6.11 We note that even in rural areas, the impact from such higher power uses could well impact opportunities for other users in suburban and urban areas several miles away. We consider the increased sterilisation effect of these higher powers (which provide an incremental benefit, rather than being required for a specific use) would cut against our intention to fit more users into the band.¹⁰¹

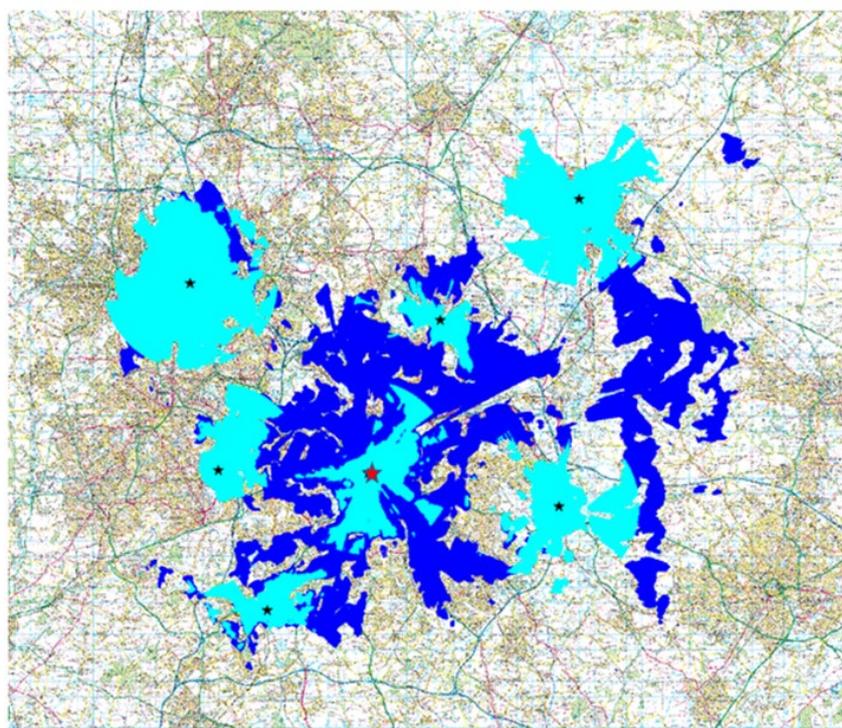
Role of Urban Power Restrictions

- 6.12 We limited access to Medium Power in urban areas because we were worried that a small number of users could sterilise opportunities across very wide areas where there was likely to be significant interest in alternative Low Power deployments over the medium term.¹⁰² We highlighted in our CFI the potentially very significant sterilisation effect that a Medium Power deployment could have compared with a Low Power deployment, and that it is often possible that an additional 5-10 Low Power deployments could be enabled in an area that a Medium Power base station sterilises.

¹⁰¹ We acknowledge that in some limited cases, in very deep rural areas, this increase might not have a very material effect on the opportunities for others. However, very often deployments of medium power sites in rural areas already do impact opportunities for other users, and can spill over into neighbouring suburban areas.

¹⁰² See paragraph 3.54 of our 2019 statement: [Enabling wireless innovation through local licensing](#), September 2019.

Figure 6.1: Illustration of relative sterilisation area of Medium and Low Power (as shown in our CFI)



★ Initial medium/low power base station
★ Subsequent low power base stations
■ Area sterilised by a single medium power site
■ Area sterilised by different low power sites

This image shows a hypothetical initial Shared Access base station (red) in Birmingham city centre, at medium power (dark blue) and low power (light blue). The medium power sterilisation area would preclude the additional 6 low power base stations (in black).

Note that the gaps in the area sterilised by the medium power base station reflect the impacts of terrain and clutter.

6.13 We acknowledge that there are scenarios where access to additional power would be useful to users, including in urban environments. We consider that we are going some way to meeting this need by proposing to double the transmit power allowed under our Low Power product, as set out in Chapter 3. We remain concerned about the potential for more widespread urban use of Medium Power by a small number of players today to deny the opportunity for a larger range of other Low Power users that could emerge in the future.

6.14 There may be greater potential to support urban Medium Power in indoor locations in the future. This is because its impacts should not be materially greater than Low Power outdoors (if we proceed with our updated proposals for Low Power emissions, and for BEL). However, we are not yet aware of significant use cases which would require this product.¹⁰³

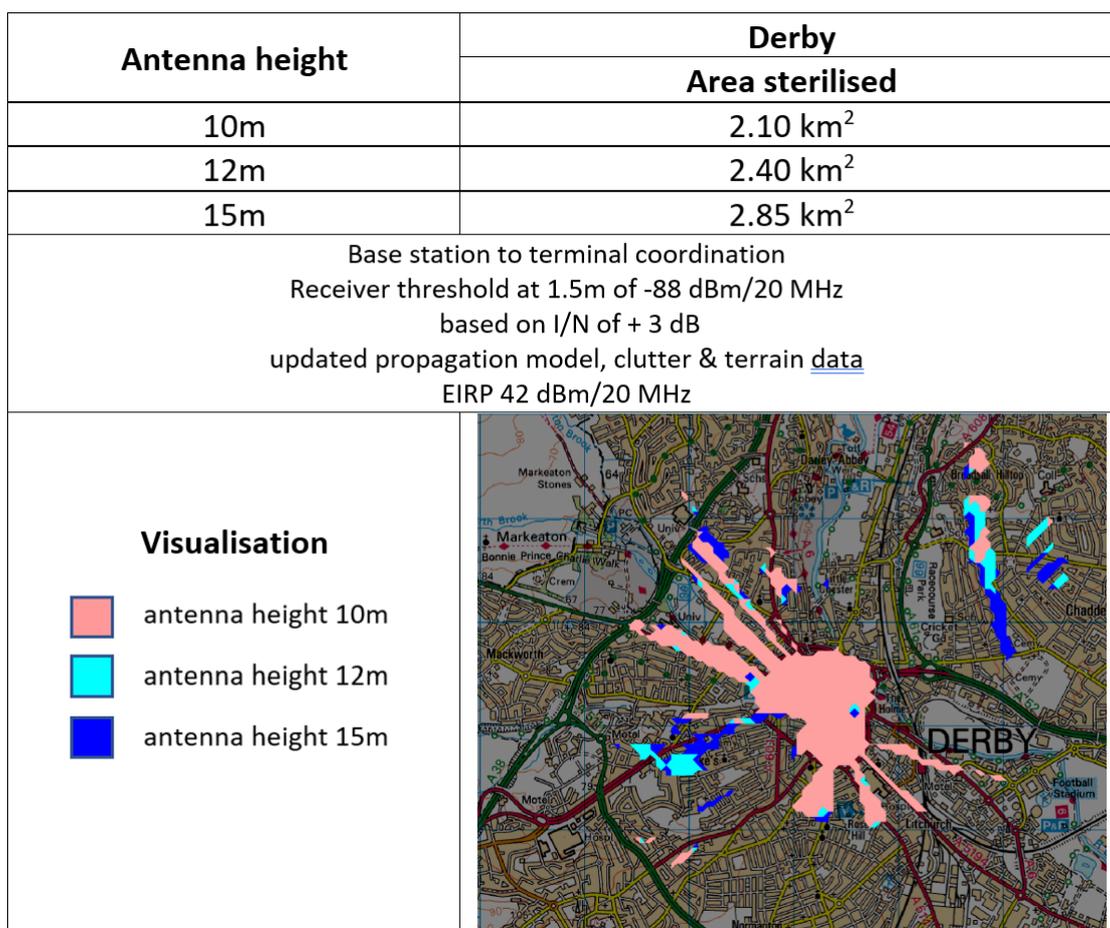
Height Increases

6.15 We have also considered interest from stakeholders in a more general loosening of our restrictions on antenna heights, which particularly focussed on options to increase the 10m limit on outdoor Low Power antenna to 15m.

¹⁰³ Note that we consider DAS style deployments with a higher base station power distributed across a range of antennas could be considered a Low Power solution depending on the radiated power per antenna.

- 6.16 Whilst recognising some potential benefits this could provide to users, we consider that a broad decision to authorise higher antenna would pose challenges for effective sharing of the band, similar to those outlined for higher power levels above.
- 6.17 Higher antenna can be expected to increase the propagation path of a transmitter, especially where it takes the signal clear of clutter, with a significant net effect both on coverage and the interference footprint. The impacts of this will vary by location, but we estimate that for a low power deployment, allowing an additional 5m increase in transmitter height could result in an increase of around a third in the interference footprint in some locations.

Figure 6.2: Illustration of relative sterilisation area for different Low Power antenna heights



- 6.18 Because of our desire to support more sharing rather than less, and allow a range of users the chance to innovate, we do not believe it is appropriate to facilitate a blanket increase in antenna height. We instead intend to continue to provide the option to request an exception, where users find this a fundamental need, and potential impacts can be mitigated (for example when an increased height is combined with a significant antenna tilt).
- 6.19 We would also be interested in stakeholder feedback on opportunities that may exist to improve this process. Options could include a more automated check on surrounding clutter heights, the impact of significant antenna tilt on directional antenna, or user self-assessment. For example, we could look in future to build an additional option into our application process where a user indicates they will deploy at a higher height, but commits to this this being below the height of immediately adjacent clutter, as a binding condition.

Additional spectrum opportunities

- 6.20 Whilst most of this document contains proposals to address potential issues driven by demand for 3.8-4.2 GHz, we are keen to ensure that the wider framework supports users by offering a range of different opportunities and spectrum options.
- 6.21 As set out in our separate consultation on the award of mmWave spectrum, we are continuing with our plans to make much of the 26 GHz and 40 GHz band available for Shared Access. This spectrum provides for very large bandwidths, at a low-cost point. Given the spectrum available, we do not envisage a need to apply the same pricing principle that we are considering for 3.8-4.2 GHz in these bands. As such it provides a potential alternative opportunity for existing and new users. We note that whilst this spectrum has different propagation characteristics, and a developing equipment system, significant work is already taking place to demonstrate its potential for high-capacity services such as machine to machine communication and FWA.¹⁰⁴
- 6.22 We also indicated in our CFI that we were exploring opportunities to extend existing access to the 2.3 GHz band to support more users and enable wider bandwidth services.
- 6.23 We continue to expect to make some (but not all) of the spectrum in the range 2302-2350 MHz available under the Shared Access framework for low power indoor-only use, and in the next few months will progress our work with the MOD to ensure Defence locations and capabilities remain adequately protected.
- 6.24 We are also mindful of the feedback we have had about PMSE style opportunities in 3.8 GHz. Whilst we remain keen to support these uses in 3.8-4.2 GHz, we have also confirmed with MOD that existing arrangements for analogue PMSE in the 2.3 GHz band may be extended to digital uses (e.g. for major events).

Future options for meeting user needs in return for additional user responsibilities

- 6.25 In setting out our proposals in this document, our intention has been to develop a package of measures that taken together, substantially increases the levels of sharing possible - especially within 3.8-4.2 GHz - whilst working within the spirit of our existing framework. We have sought to avoid materially increasing the risks or burdens placed on stakeholders. We also remain keen to maintain a simple, user-friendly approach to coordination, that allows a range of players to access the band, without requiring significant radio planning expertise.
- 6.26 We recognise this centralised approach is unlikely to ever take full account of all the individual circumstance of each deployment. For example, a user may wish to operate at a higher power or antenna height than our rules would allow, when a combination of factors (for example specific antenna characteristics, shielding of the local environment and receiver performance of neighbouring systems) would mean that harmful interference is unlikely. We are suggesting some steps to take account of more details of local circumstances, and have

¹⁰⁴ For example, see: Nokia, [Nokia hits extended range mmWave 5G speed record in Finland](#), June 2023 and Ericsson, [Closing the digital divide with extended range for FWA](#), November 2022

in addition proposed a new user-led coordination 'override' to allow more opportunities to be exploited (where the deployment falls within our overarching rules).

- 6.27 Whilst the UK approach has established a path that has been followed by a number of other National Regulatory Authorities, we are conscious that alternative approaches remain possible. In particular, we understand that the approaches taken by BNETZA (Germany) and PTS (Sweden) place a greater emphasis on interference 'outcomes', rather than network design 'inputs'.^{105 106} We consider that the key feature of these approaches - which are based on user-defined operational areas - is that the management of interference risk becomes predominantly a matter for each user (expressed as Power Flux Density (PFD) limit at the boundary). We also understand that Spectrum Access (SAS) providers in the FCC's CBRS band can take a similar approach.
- 6.28 We recognise that there may be potential benefits from taking a more permissive approach, which places greater responsibility on stakeholders to manage interference between them in the same way as they manage their own capacity and throughput needs. Such an approach would give users the flexibility to deploy any number of sites, or site configurations, within the area that they paid for, provided this did not increase the interference profile outside of their area or impacts were coordinated with adjacent users.
- 6.29 However, we have also identified challenges associated with this approach in the UK. We consider it may make it more challenging for less experienced and less expert users to enter the band, since meeting the requirement is likely to involve quite complex radio surveys of a candidate site. Consequently, such an approach could also increase deployment costs for users. We are also conscious that it may not always be possible to resolve harmful interference challenges, and if this proves to be the case, we would effectively be asking users to deploy 'at risk', with the potential that they might in the future have to significantly reduce their desired operating powers to support coexistence. We envisage that it may also be difficult to assess compliance with PFD limits specified over the quite small areas that might be associated with campus style networks.
- 6.30 As set out in our spectrum strategy, we recognise the value of including more real-world data from user deployments in our coexistence analysis and licensing decisions. At this stage, we are minded to consider that the overall coordination framework we have in place, with the changes set out throughout this document, will be appropriate for today's challenges. We consider that these will significantly reduce separation distances between users, and that alternative, user-managed methods may not offer significant gains beyond this for current needs.
- 6.31 We note that we are already opening an avenue for users to override our coordination process where they can agree an alternative approach, and we would expect to monitor how this process plays out in the coming years. We would also welcome further input from

¹⁰⁵ Details of the BNetzA approach for local access at 3700-3800 MHz include i) a negotiation requirement for adjacent operators to seek to reach agreements and ii) a fallback requirement of field strength limit of 32 dBµV/m/5 MHz at a height of three metres at and beyond the border of the assignment, where agreements are not reached. Bundesnetzagentur, [Administrative rules for spectrum assignments for local spectrum usages in the 3700-3800 MHz](#), May 2023.

¹⁰⁶ PTS makes available local licences in 3720-3800 MHz with a permissible power of 38 dBm TRP per cell, with each cell located within a designated premise or area, and an additional requirement that the maximum field strength outside this area at a height of 2metres is -80 dBm/20 MHz for 20% time, or -70 dBm/20 MHz for 1% of time. See PTS, [Villkor för tillstånd inom frekvensbandet 3720–3800 MHzf, December 2022](#).

stakeholders, including any existing data they may have now, to support this ongoing evolution as we look to the future.

Question 12: Do you have any comments on our proposals to clarify the circumstances in which exceptions are available, the tests we will apply, and how this supports user flexibility outside our overarching rules?

Question 13: Do you agree with our overall approach based around refining our existing coordination framework for Shared Access, whilst monitoring future opportunities for more user led and outcomes led coordination where evidence suggests it would be of benefit?

7. Legal tests, impact assessments and next steps

- 7.1 This chapter sets out:
- a) The legal tests relevant to our proposals and how we meet those legal tests;
 - b) Our impact assessment;
 - c) Our equality impact assessment;
 - d) Our Welsh language impact assessment; and
 - e) Our proposed next steps.

Legal tests

- 7.2 In developing our proposals we have taken account of our duties under the 2003 Act and the WT Act. We consider that our proposals are consistent with these duties. In particular, we have taken account of:
- a) the need to secure the optimal use of spectrum;
 - b) the different needs of persons who wish to make use of spectrum;
 - c) the extent to which spectrum is available for use;
 - d) the future demand for spectrum;
 - e) the desirability of promoting the efficient management and use of spectrum; and
 - f) the development of innovative services efficient management of spectrum;
- by formulating a package of proposals which (among other things) takes account of growing demand, including by providing additional flexibility to enable opportunities for more users; supports new use cases, including by loosening restrictions on certain neutral host deployments; strikes a balance between the needs of different users; and changes our approach to coordination, which we expect should significantly reduce separation distances typically required between co-channel users.
- 7.3 We are also exploring moving to a more incentive-based pricing approach, which could make more spectrum available for sharing by encouraging users to consider the impacts of large bandwidths and higher operating powers on others.
- 7.4 We consider that our proposals are:
- a) Objectively justifiable insofar as they are likely to meet our policy objectives of supporting and encouraging innovating services and applications using the shared access band; and are intended to ensure that more users have more opportunities to have access to shared access spectrum across the UK;
 - b) Not unduly discriminatory against particular persons or against a particular description of persons in that they are intended to apply to all users and potential users of shared access spectrum, and any differences in the treatment of different users (e.g. depending on the location of their deployments) are justified;

- c) Proportionate to what they are intended to achieve, in that our proposals are necessary to ensure that users are able to enjoy the benefits of shared access spectrum, to ensure the continuing coexistence of different services and users, and to reduce administrative burdens;
- d) Transparent in relation to what they are intended to achieve, in that they are clearly described and explained in this consultation document.

Impact Assessment

- 7.5 Section 7 of the Communications Act requires us to carry out and publish an assessment of the likely impact of implementing a proposal which would be likely to have a significant impact on businesses or the general public, or when there is a major change in Ofcom's activities.
- 7.6 Below we discuss the impact that we expect various aspects of our proposals to have.
- 7.7 As noted in Chapter 3, we are already taking steps to improve the processes that support spectrum access, and hence user experience. We are also proposing to provide some additional flexibility around our rules governing terminal registration and permitted power levels.
- 7.8 We think these measures will have a positive impact on Shared Access users. We recognise that, where Ofcom is incurring additional cost in administering the updated process improvements for Shared Access we set out, there is the potential for this to result in increased fees for users where such costs need to be recouped. However, we consider that the expected growth in demand which these proposals are intended to benefit is likely to cover costs which we currently expect to be modest. We will keep this position under review as our plans develop.
- 7.9 We note that whilst we are intending to seek further information from stakeholders to support our coordination assessments (described in Chapter 3 under the heading 'Capturing more information in the coordination process'), CFI feedback has indicated that the majority of this information should be commonly available. In addition, we have taken account of the possibility such information may not be commonly available to all stakeholders by retaining the option to provide only the existing levels of network deployment data, where that is all users have available to them.
- 7.10 In relation to our proposals to loosen Low Power restrictions and terminal registration requirements for Low Power indoors (described in Chapter 3 under the heading 'Additional flexibility to enable opportunities for more users'), we note that these measures are specifically intended to reduce stakeholder burdens. In particular, our Low Power increase is designed to reduce deployment costs by aligning with available equipment ecosystems and enabling users to increase their coverage range. In making these proposals, we have considered whether it would be appropriate to go even further, either by loosening restrictions on permitted deployment heights or amending the circumstances in which Medium Power could be deployed. We have not done so in consideration of the potential impacts of other users, as set out in more detail at Paragraph 6.9-6.19. Similarly, we have considered whether we could go further and remove the existing terminal registration requirement in all environments. We have set out our rationale for not doing so, given the continuing need to give effect to our broader intentions for 3.8-4.2 GHz not to be used for wide area mobile coverage networks, in Chapter 3 (under the heading 'Relaxing our

requirement for terminal records to be kept in 3.8-4.2 GHz'). We are making these proposals, rather than more radical proposals (e.g. to increase the Low Power level further, or to do away with the terminal restriction in all environments) as part of our wider strategy to ensure a range of users continue to have the opportunity to access the spectrum.

- 7.11 In relation to our proposals on technical coordination (see Chapter 4), we began by considering a counterfactual in which we took no action. Whilst this approach might offer maximum protection to existing deployments, we considered it could inhibit the further utility of the band, including for existing licensees seeking new deployments. We have taken account of future demand by proposing to move to a more flexible and less cautious coordination approach, which will reduce separation distances between individual deployments. While this has the potential to increase the risk of interference for some deployments, we considered that the potential to enable many more deployments, both for existing and new users, was likely to outweigh this risk. We have set out the analysis that informed our assessment that these impacts should be minimal in Chapter 4 under the heading 'Updating coordination assumptions in the 3.8-4.2 GHz band'.
- 7.12 In relation to pricing, we recognise that any proposal to increase prices in certain circumstances has the potential to have a negative impact on some stakeholders. However, we believe that stakeholders do have a range of options to address this, including seeking to access smaller amounts of spectrum at a low price in the future. This will ensure the optimal use of spectrum and ensure maximum benefit overall. Whilst we have considered the proportionality of price increases on existing stakeholders where they do not feel able to adjust their existing usage patterns, we have not yet undertaken a full impact assessment in this area, as we are undertaking only an initial consultation to gather more feedback to inform a further consultation on specific proposals.

Equality Impact Assessment

- 7.13 We have carefully considered whether our proposals will have a particular impact on persons sharing protected characteristics, and in particular whether they may discriminate against such persons or impact on equality of opportunity or good relations. We have also had regard to the matters in section 3(4) of the Communications Act.
- 7.14 We do not consider that our proposals will affect any specific groups of persons differently to the general population.
- 7.15 We have not carried out separate equality impact assessments in relation to the additional equality groups in Northern Ireland: religious belief, political opinion and dependents. This is because we anticipate that our proposals would not have a differential impact in Northern Ireland compared to consumers in general.

Welsh language impact assessment

- 7.16 Ofcom is required to take Welsh language considerations into account when formulating, reviewing or revising policies which are relevant to Wales (including proposals which are not targeted at Wales specifically but are of interest across the UK).
- 7.17 We do not consider our proposals have any impact on opportunities for persons to use the Welsh language or treating the Welsh language no less favourably than the English language. We also do not think there are ways in which our proposal could be formulated so as to

have, or increase, a positive impact, or not have adverse effects or decrease any adverse effects. This is because our proposals relate to a nationwide licensing regime and the relevant licence products are available to anyone within the UK.

- 7.18 We note that Ofcom’s current practice is to offer to produce spectrum licences in Welsh, and when requested does provide licenses in Welsh, in accordance with its obligations set by the Welsh Language Commissioner.¹⁰⁷ Ofcom will continue to take this approach in the future in relation to shared access licences.

Next steps

Template licences

- 7.19 Some of the proposals set out in this consultation will involve changing our existing Shared Access licence products. In Annex 5 we have set out template Shared Access licence products which highlight the substantive changes we propose to make. However, we have not highlighted minor or ‘editorial’ changes that we propose to make to these licence products. We have also not included a template Indoor 26 GHz licences because changes to this licence product are addressed in our 27 September 2023 statement ‘*Enabling mmWave spectrum for new uses: Making the 26 GHz and 40 GHz bands available for mobile technology*’.¹⁰⁸

Guidance

- 7.20 Other proposals set out in this consultation will not involve changing our existing licence products but will require changes to our guidance regarding Shared Access licences.¹⁰⁹
- 7.21 We propose to issue revised guidance at, or shortly after, the time at which we publish our statement in this Shared Access licence review. The guidance will be amended to reflect those parts of the statement that change our approach to licencing and that applicants may find relevant for the purpose of their applications.

Fees

- 7.22 As noted in chapter 5, we are not consulting on firm proposals for fee changes at this time. We will consider stakeholder responses and consult on specific pricing proposals prior to introducing any fee changes.
- 7.23 If we ultimately decide to change the pricing of Shared Access licences, we will issue a further statement, amend the fees regulations, and further revise our guidance to reflect the new pricing regime.

¹⁰⁷ Compliance Notice – Section 44 Welsh Language (Wales) Measure 2011, The Office of Communications, 25 July 2016, paragraph 38.

¹⁰⁸ https://www.ofcom.org.uk/data/assets/pdf_file/0033/268656/Statement-Enabling-mmWave-spectrum-for-new-uses.pdf

¹⁰⁹ Our existing guidance can be found here:

https://www.ofcom.org.uk/data/assets/pdf_file/0035/157886/shared-access-licence-guidance.pdf

Question 14: Do you agree with our assessment of the potential impact on specific groups of persons?

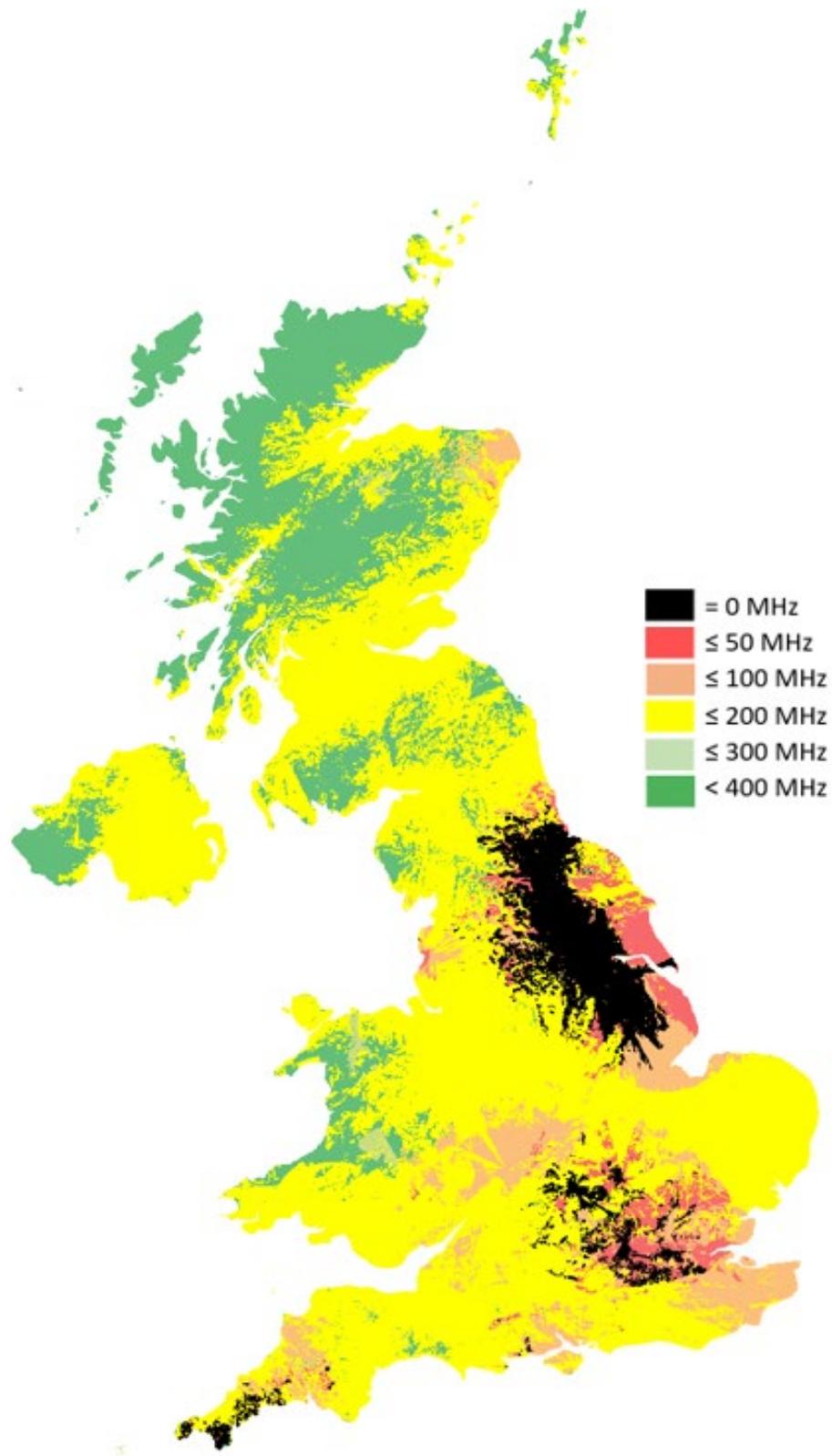
Question 15: Do you agree with our assessment of the potential impact of our proposal on the Welsh language? Do you think our proposal could be formulated or revised to ensure, or increase, positive effects, or reduce/eliminate any negative effects, on opportunities to use the Welsh language and treating the Welsh language no less favourably than English?

Question 16: Do you have any other comments on the proposals set out in this document?

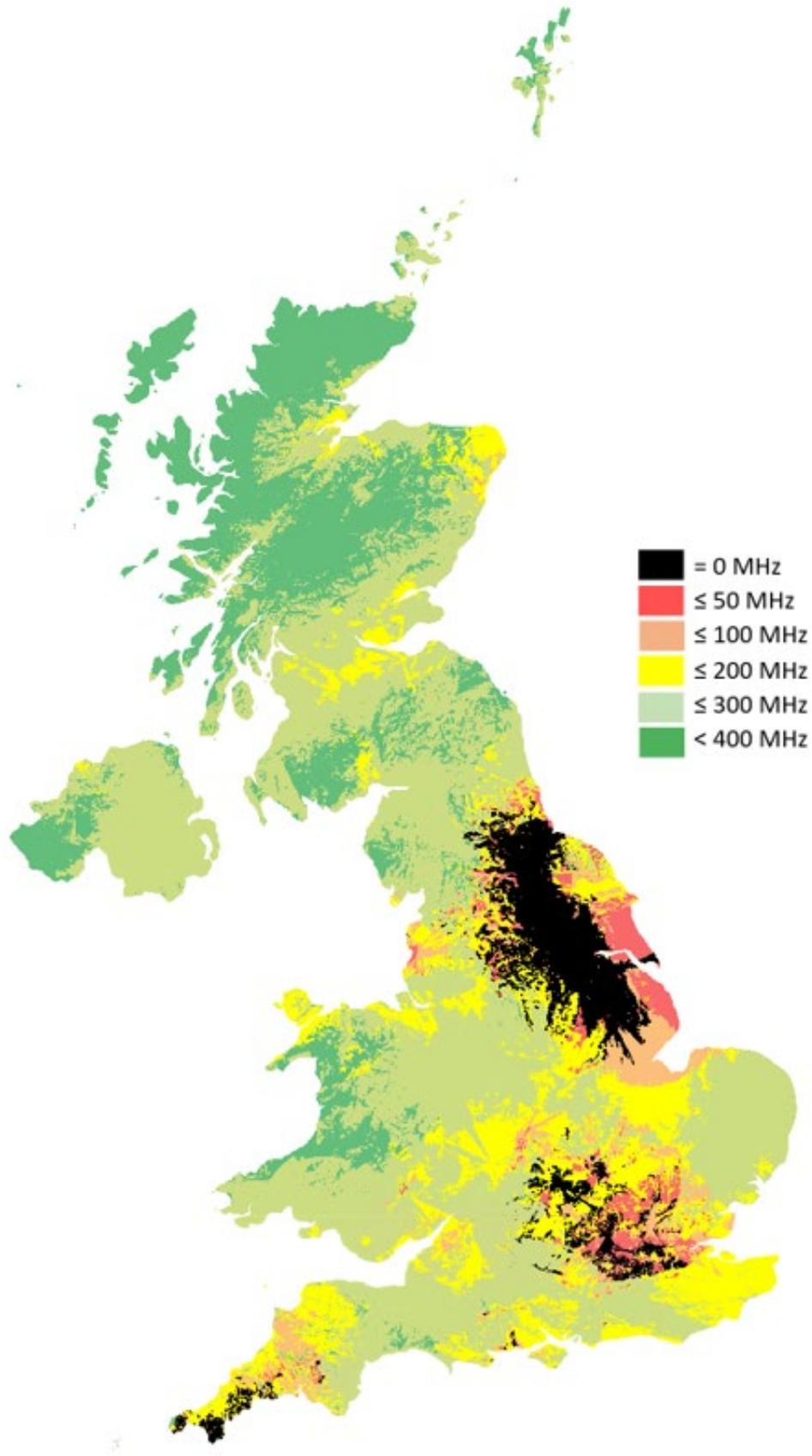
A1. Spectrum Availability Maps for 3.8–4.2 GHz

- A1.1 This Annex presents enlarged full-page versions of the spectrum availability maps provided in Chapters 2 and 3 of the consultation ‘Supporting increased used of shared spectrum’.
- A1.2 These maps provide a UK wide view of current spectrum availability in the 3.8-4.2 GHz band, from the perspective of a Medium Power user (we note that availability will typically be greater for a prospective Low Power user).
- A1.3 Map 1 provides a view of contiguous bandwidth available, meaning the maximum total of uninterrupted bandwidth available to a new user in that area. Map 2 provides a view of the total bandwidth available. Note that Medium Power is only available in urban areas as an exception, and that this UK wide perspective is provided only to illustrate overall availability.
- A1.4 These maps were produced on the basis of licence data held by Ofcom in July 2023. We note that this analysis does not fully replicate all the measures undertaken in our coordination process, and should be interpreted only as an indication of relative availability.
- A1.5 We also note that this analysis does not take account of our current adjacent band coordination checks with UK Broadband assignments, which can reduce availability in some locations (but is difficult to visualise because the impact of the out of band mask varies depending on the precise location of an applicant).

Map A1: Contiguous spectrum availability in 3.8-4.2 GHz, from perspective of a Medium Power user.



Map A2: Total bandwidth available in the 3.8-4.2 GHz band, from perspective of a Medium Power user



A2. Responding to this consultation

How to respond

- A2.1 Ofcom would like to receive views and comments on the issues raised in this document, by 5pm on 2nd of February 2024.
- A2.2 You can download a response form from <https://www.ofcom.org.uk/consultations-and-statements/category-1/consultation-supporting-increased-use-of-shared-spectrum>. You can return this by email or post to the address provided in the response form.
- A2.3 If your response is a large file, or has supporting charts, tables or other data, please email it to sharedaccessresponses@ofcom.org.uk as an attachment in Microsoft Word format, together with the cover sheet. This email address is for this consultation only and will not be valid after the 29th of February 2024.
- A2.4 Responses may alternatively be posted to the address below, marked with the title of the consultation:
- Jack Hindley
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA
- A2.5 We welcome responses in formats other than print, for example an audio recording or a British Sign Language video. To respond in BSL:
- send us a recording of you signing your response. This should be no longer than 5 minutes. Suitable file formats are DVDs, wmv or QuickTime files; or
 - upload a video of you signing your response directly to YouTube (or another hosting site) and send us the link.
- A2.6 We will publish a transcript of any audio or video responses we receive (unless your response is confidential).
- A2.7 We do not need a paper copy of your response as well as an electronic version. We will acknowledge receipt of a response submitted to us by email.
- A2.8 You do not have to answer all the questions in the consultation if you do not have a view; a short response on just one point is fine. We also welcome joint responses.
- A2.9 It would be helpful if your response could include direct answers to the questions asked in the consultation document. The questions are listed at Annex 5. It would also help if you could explain why you hold your views, and what you think the effect of Ofcom's proposals would be.
- A2.10 If you want to discuss the issues and questions raised in this consultation, please contact Jack.Hindley@ofcom.org.uk

Confidentiality

- A2.11 Consultations are more effective if we publish the responses before the consultation period closes. This can help people and organisations with limited resources or familiarity with the issues to respond in a more informed way. So, in the interests of transparency and good regulatory practice, and because we believe it is important that everyone who is interested in an issue can see other respondents' views, we usually publish responses on the Ofcom website at regular intervals during and after the consultation period.
- A2.12 If you think your response should be kept confidential, please specify which part(s) this applies to and explain why. Please send any confidential sections as a separate annex. If you want your name, address, other contact details or job title to remain confidential, please provide them only in the cover sheet, so that we don't have to edit your response.
- A2.13 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and try to respect it. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.
- A2.14 To fulfil our pre-disclosure duty, we may share a copy of your response with the relevant government department before we publish it on our website.
- A2.15 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's intellectual property rights are explained further in our Terms of Use.

Next steps

- A2.16 Following this consultation period, Ofcom plans to publish a statement in the first half of 2024. We will also consult on firm proposals for future pricing of Shared Access Licences prior to introducing any fee changes.
- A2.17 If you wish, you can register to receive mail updates alerting you to new Ofcom publications.

Ofcom's consultation processes

- A2.18 Ofcom aims to make responding to a consultation as easy as possible. For more information, please see our consultation principles in Annex x.
- A2.19 If you have any comments or suggestions on how we manage our consultations, please email us at consult@ofcom.org.uk. We particularly welcome ideas on how Ofcom could more effectively seek the views of groups or individuals, such as small businesses and residential consumers, who are less likely to give their opinions through a formal consultation.
- A2.20 If you would like to discuss these issues, or Ofcom's consultation processes more generally, please contact the corporation secretary:

Corporation Secretary
Ofcom
Riverside House
2a Southwark Bridge Road

London SE1 9HA

Email: corporationsecretary@ofcom.org.uk

A3. Ofcom's consultation principles

Ofcom has seven principles that it follows for every public written consultation:

Before the consultation

A3.1 Wherever possible, we will hold informal talks with people and organisations before announcing a big consultation, to find out whether we are thinking along the right lines. 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

A3.2 We will be clear about whom we are consulting, why, on what questions and for how long.

A3.3 We will make the consultation document as short and simple as possible, with an overview of no more than two pages. We will try to make it as easy as possible for people to give us a written response.

A3.4 We will consult for up to ten weeks, depending on the potential impact of our proposals.

A3.5 A person within Ofcom will be in charge of making sure we follow our own guidelines and aim to reach the largest possible number of people and organisations who may be interested in the outcome of our decisions. Ofcom's Consultation Champion is the main person to contact if you have views on the way we run our consultations.

A3.6 If we are not able to follow any of these principles, we will explain why.

After the consultation

A3.7 We think it is important that everyone who is interested in an issue can see other people's views, so we usually publish the responses on our website at regular intervals during and after the consultation period. After the consultation we will make our decisions and publish a statement explaining what we are going to do, and why, showing how respondents' views helped to shape these decisions.

A4. Consultation coversheet

Basic details

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

Confidentiality

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

- Nothing
- Name/contact details/job title
- Whole response
- Organisation
- Part of the response

If you selected 'Part of the response', please specify 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)?

Yes No

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 aims to publish responses at regular intervals during and after the consultation period. 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)

A5. Consultation questions

Question 1: Do you have any comments on our proposals to gather additional antenna parameters, and would you prefer Ofcom to specify a small number of antenna pattern ‘envelopes’ or for users to provide details of the specific antenna parameters in use for Ofcom to assess? Please provide reasons for your views.

Question 2: Do you have comments on the suggested approach to enable user-led coordination in certain circumstances?

Question 3: Do you have any comments on our proposal to increase the power level of our Low Power product by 3dBm in the 3.8-4.2 GHz band?

Question 4: Do you have any comments on our proposal to remove the requirement for licensees holding a Low Power 3.8-4.2 GHz licence to keep a record of the address at which mobile terminals connected to an indoor base station will be used?

Question 5: Do you agree with our proposals to assume synchronisation between users, and coordinate base station to terminal instead of base station to base station in the 3.8-4.2GHz band? If no, please explain how other measures could increase sharing of the band.

Question 6: Please indicate whether you support our preferred option of coordination at -88 dBm/20 MHz (based on I/N of + 3dB, at 1.5m) or a more conservative alternative of -91 dBm/20 MHz (based on I/N of 0dB at 3m), with reasons for your view.

Question 7: Do you agree with our proposals for an increase in BEL in 3.8-4.2GHz? If no, are there alternatives which you consider could better achieve similar results?

Question 8: Do you agree with our proposal that adjacent band protection for Shared Access users is in future limited to considering only the first 5 MHz above and below UK Broadband assignments?

Question 9: Do you agree with our assessment that, in circumstances where localised shortages of spectrum have occurred, pricing can be used to influence requested spectrum amounts?

Question 10: Do you agree that we should take measures to reflect the impact of bandwidth, power levels and urban/rural location in our pricing approach for the 3.8-4.2 GHz band? Do you think there are other factors we should be taking into account?

Question 11: How do you consider the illustrative prices would impact your spectrum requirements and future deployment plans in the 3.8-4.2 GHz band? Please provide evidence in support of your view.

Question 12: Do you have any comments on our proposals to clarify the circumstances in which exceptions are available, the tests we will apply, and how this supports user flexibility outside our overarching rules?

Question 13: Do you agree with our overall approach based around refining our existing coordination framework for Shared Access, whilst monitoring future opportunities for more user led and outcomes led coordination where evidence suggests it would be of benefit?

Question 14: Do you agree with our assessment of the potential impact on specific groups of persons?

Question 15: Do you agree with our assessment of the potential impact of our proposal on the Welsh language? Do you think our proposal could be formulated or revised to ensure, or increase, positive effects, or reduce/eliminate any negative effects, on opportunities to use the Welsh language and treating the Welsh language no less favourably than English?

Question 16: Do you have any other comments on the proposals set out in this document?

A6. Sample Shared Access Licence

7.24 In order to aid stakeholders' understanding of our proposed changes, we have included a sample Shared Access Licence below. Additions resulting from our proposed changes are marked in green while deletions are marked in red.

Office of Communications (Ofcom)
Wireless Telegraphy Act 2006



SHARED ACCESS LOW POWER LICENCE

Sector/Class/Product: 615001 - Shared Access (Low Power) / Shared Access

Licence number:

Licensee:

Company Registration:

Licensee Address:

Email:

Date of Issue:

Valid From:

[Licence end date:]

Payment Interval: 1 Year

1. The Office of Communications (Ofcom) grants this wireless telegraphy licence ("the **Licence**") to [*Licensee's name*] to establish, install and use wireless telegraphy stations and/or wireless telegraphy apparatus as described in the schedules to this Licence (together "the **Radio Equipment**") subject to the terms set out below.

Licence Term

2. This Licence shall continue in force until revoked by Ofcom or surrendered by the Licensee or if it is a Short Term Licence, when it reaches its expiration date.

Licence Revocation

3. Pursuant to schedule 1 paragraph 8 of the Wireless Telegraphy Act 2006 ("the Act"), Ofcom may not revoke this Licence under schedule 1 paragraph 6 of the Act except:
 - a) at the request, or with the consent, of the Licensee;
 - a) if there has been a breach of any of the terms of this Licence;
 - b) in accordance with schedule 1 paragraph 8(5) of the Act;
 - c) if it appears to Ofcom to be necessary or expedient to revoke the Licence for the purpose of complying with a direction by the Secretary of State given to Ofcom under section 5 of the Act or section 5 of the Communications Act 2003;

- d) for reasons related to the management of the radio spectrum provided that in such a case the power to revoke may only be exercised after at least one month's notice is given in writing.
4. Ofcom may only revoke this Licence by notification in writing to the Licensee and in accordance with schedule 1 paragraphs 6, 6A and 7 of the Act.

Licence variation

5. Ofcom may only vary this Licence by notification in writing to the Licensee and in accordance with schedule 1 paragraphs 6, 6A and 7 of the Act.

Requirement to commence and maintain transmission within 6 months

6. The Licensee must establish, install and use the Radio Equipment to commence regular wireless telegraphy transmissions in accordance with the provisions of this Licence within six months of the date that this Licence is issued, and maintain such transmissions thereafter.

Transfer

7. This Licence may not be transferred. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30 of the Act.¹¹⁰

Changes to Licensee details

8. The Licensee shall give prior notice to Ofcom in writing of any proposed changes to the Licensee's name, email address and/or address as recorded above paragraph 1 of this Licence.

Fees

9. The Licensee shall pay to Ofcom the relevant fee(s) as provided in section 12 of the Act and the regulations made thereunder on or before the fee payment date shown above, or on or before such dates as are notified in writing to the Licensee.
10. If the Licence is surrendered, revoked or varied, no refund, whether in whole or in part, of any amount which is due under the terms of this Licence, payable in accordance with any regulations made by Ofcom under sections 12 and 13(2) of the Act will be made, except at the absolute discretion of Ofcom.

Radio Equipment Use

11. The Licensee shall ensure that the Radio Equipment is established, installed and used only in accordance with the provisions specified in the schedules to this Licence. Any proposal to amend any detail specified in any of the schedules to this Licence must be agreed with Ofcom in advance and implemented only after this Licence has been varied or reissued accordingly.
12. The Licensee shall ensure that the Radio Equipment is operated in compliance with the terms of this Licence and is used only by persons who have been authorised in writing by the Licensee to do so and that such persons are made aware of, and of the requirement to comply with, the terms of this Licence.

¹¹⁰ See Ofcom's website for the latest position on spectrum trading and the types of trade which are permitted.

Access and Inspection

13. The Licensee shall permit any person authorised by Ofcom:

- a) to have access to the Radio Equipment; and
- b) to inspect this Licence and to inspect, examine and test the Radio Equipment,

at any and all reasonable times or, when in the opinion of that person an urgent situation exists, at any time, to ensure the Radio Equipment is being used in accordance with the terms of this Licence.

Modification, Restriction and Closedown

14. Any person authorised by Ofcom may require the Radio Equipment or any part thereof, to be modified or restricted in use, or temporarily or permanently closed down immediately if in the opinion of the person authorised by Ofcom:

- a) a breach of this Licence has occurred; and/or
- b) the use of the Radio Equipment is, or may be, causing or contributing to undue interference to the use of other authorised radio equipment.

15. Ofcom may require any of the Radio Equipment to be modified or restricted in use, or temporarily closed down either immediately or on the expiry of such period as may be specified in the event of a national or local state of emergency being declared. Ofcom may only exercise this power after a written notice has been served on the Licensee or a general notice applicable to holders of a named class of licence has been published.

Geographical Boundaries

16. Subject to the requirements of any coordination procedures notified to the Licensee pursuant to the schedules to this Licence, the Licensee is authorised to establish, install and use a base station at the location set out the schedules to this Licence and any terminals connecting to it.

Synchronisation requirement

17. Where synchronisation requirements are set out in Schedule 3 to this Licence, the Licensee must transmit within the transmission limits specified.

18. Where synchronisation requirements have not been specified, in the event that harmful interference arises, the Licensee shall endeavour to discuss and agree with the other licence holder(s) how to coordinate their use. If agreement between licence holders cannot be reached, Ofcom may notify the Licensee to comply with additional technical conditions relating to synchronisation requirements.

19. The Licensee must comply with such technical conditions relating to synchronisation requirement notified to it by Ofcom from time to time.

20. The Licensee accepts that they may need to alter or replace Radio Equipment in order to comply with any synchronisation requirement notified from time to time.

Future Dynamic Spectrum Approach

21. On 25 July 2019, Ofcom published a statement called Enabling wireless innovation through local licensing containing a spectrum management decision to enable shared access to spectrum supporting mobile technology. In that decision, Ofcom stated that it will assess whether it is appropriate to transition towards a Dynamic Spectrum Approach in order to provide users more access to spectrum by means of automatic database frequency assignment. The Licensee is therefore notified that Ofcom currently intends to vary this

Licence in accordance with paragraph 5 from time to time in future, or may re-issue the Licence, to give effect to that decision.

Notification in electronic form

22. The Licensee shall accept notifications and other related documents under this Licence electronically to the designated email address as recorded above paragraph 1 of this Licence. The Licensee must update Ofcom about changes to the designated email address in accordance with paragraph 8.

Interpretation

23. In this Licence:
- a) the establishment, installation and use of the Radio Equipment shall be interpreted as establishment and use of wireless telegraphy stations and installation and use of wireless telegraphy apparatus for wireless telegraphy as specified in section 8(1) of the Act;
 - b) the expression “**interference**” shall have the meaning given by section 115 of the Act;
 - c) the expressions “**wireless telegraphy station**” and “wireless telegraphy apparatus” shall have the meanings given by section 117 of the Act;
 - d) the schedule(s) form part of this Licence together with any subsequent schedule(s) which Ofcom may issue as a variation to this Licence; and
 - e) the Interpretation Act 1978 shall apply to the Licence as it applies to an Act of Parliament.

Issued by Ofcom

SCHEDULE 1 TO LICENCE NUMBER: [xxx]

Description of Radio Equipment

1. References in this schedule(s) to the Radio Equipment are references to any wireless telegraphy station or wireless telegraphy apparatus that is established, installed and/or used under this schedule(s).

Interface Requirements for the Radio Equipment

2. Use of the Radio Equipment shall be in accordance with the following Interface Requirement:

IR 2103 Shared Access Low power

Special conditions relating to the Radio Equipment

3. This Licence authorises the use of the Radio Equipment within the Permitted Frequency Band and the Licensee warrants that the Radio Equipment is capable of transmitting across the Permitted Frequency Band.
4. However, the Licensee is only authorised to transmit on the Permitted Channel Centre Frequency within the Permitted Frequency Band, as set in Schedule 2 to this Licence or as notified to the Licensee by Ofcom from time to time.
5. The Licensee must comply with any change to the Permitted Channel Centre Frequency notified by Ofcom within the timescale indicated in the notification.
6. During the period that this Licence remains in force, unless consent has otherwise been given by Ofcom, the Licensee shall compile and maintain accurate written records of the following details relating to the Radio Equipment:
 - a) For all base stations the:
 - i) postal address (including post code); and
 - ii) Antenna height (above ground level), type: and
 - b) For all fixed/ installed terminals the:
 - i) postal address (including post code);
 - ii) National Grid Reference (to 1m resolution); and
 - iii) Antenna height (above ground level), type, and boresight bearing east of true north (if applicable); and
 - c) For all mobile and nomadic terminals in the 3.8-4.2 GHz band **connecting to an outdoor base station**, the postal address (including post code) of where it will be used.
7. The Licensee shall submit to Ofcom in such manner and within such period as specified by Ofcom, such other information in relation to the Radio Equipment, or any wireless telegraphy station or wireless telegraphy apparatus which the Licensee is planning to use, as Ofcom may from time to time request. Such information may include, but is not limited to, information in relation to the radio frequency, transmitted power and date of first use for wireless telegraphy stations or wireless telegraphy apparatus to be established, installed or used within such timeframe and in such areas as Ofcom may reasonably request.
8. The use of the Radio Equipment is not permitted airborne.

Coordination at frequency and geographical boundaries

9. The Licensee shall ensure that the Radio Equipment is operated in compliance with such coordination procedures as may be notified to the Licensee by Ofcom from time to time.

Cooperation between licensees

10. In addition to complying with the specific transmission terms, conditions and limitations set out in this Licence, the Licensee must liaise and co-operate with other holders of licences in the Permitted Frequency Band (if necessary adjusting transmission power and other technical parameters of transmission) in such a way that harmful interference is not caused by one network deployment to that of another licensee within the band.

Interpretation of terms in this schedule

11. In this schedule:
 - a) “**Fixed or installed**” means used or installed at specific fixed points.
 - b) “**IR**” means a United Kingdom Radio Interface Requirement published by Ofcom in accordance with the Radio Equipment Regulations 2017, as amended by the Product Safety and Metrology etc. (Amendment etc.) (EU Exit) Regulations 2019.
 - c) “**mobile or nomadic**” means intended to be used while in motion or during halts at unspecified points.
 - d) “**Permitted Channel Centre Frequency**” means the frequency assigned by Ofcom that is the midpoint between the upper and lower channel edge frequencies.
 - e) “**Permitted Frequency Band**” means the frequency range within which Ofcom will assign the Permitted Channel Centre Frequency.

SCHEDULE 2 TO LICENCE NUMBER: [xxx]

Licence category: Shared Access Low Power

1800 MHz

Transmitter(s)	
Authorised Base Station Deployment Area	Area of 50 m radius from the following location: NGR [xxx xxx]
Station Name/Address	
Deployment location	[Indoor only/Indoor or Outdoor] NB. Indoors only does not permit the deployment of outdoor base stations and fixed/installed terminal devices.
Permitted Frequency Band	1871.7 - 1880 MHz
Permitted Channel Centre Frequency Tx	1878.35 MHz
Permitted Channel Centre Frequency Rx	1783.35 MHz
Permitted Channel frequency bandwidth	3.3 MHz
Antenna height	maximum 10m outdoors

Maximum power within the Permitted Channel

- When transmitting, the licensee must transmit within the limits set out below.

Radio Equipment	Band	Maximum Power	
Base Station	1876.7-1880 MHz	24 dBm / carrier (up to 3 MHz) EIRP	
		Frequency offset from the lower frequency of the band edge	Maximum Mean EIRP density
		0 to 0.05 MHz	$-33.6 + 153.3 \times \Delta FL^*$ dBm / kHz
		0.05 to 0.1 MHz	$-26 + 60 \times (\Delta FL^* - 0.05)$ dBm / kHz
		0.1 to 0.2 MHz	$-23 + 230 \times (\Delta FL^* - 0.1)$ dBm / kHz
		0.2 to 3.2 MHz	24 dBm / carrier
		3.2 to 3.3 MHz	$-23 + 230 \times (3.3 - \Delta FL^*)$ dBm / kHz

Radio Equipment	Band	Maximum Power
		* Note: Δ FL in MHz is the offset from the lower edge of the permitted frequency band at 1876.7 MHz (it has values in the range 0 to +0.2 MHz and +3.2 to +3.3MHz)
Fixed / installed terminal station	1781.7 - 1785 MHz	23 dBm EIRP
Mobile or nomadic terminal station	1781.7 - 1785 MHz	23 dBm TRP

2300 MHz

Transmitter(s)	
Authorised Base Station Deployment Area	Area of 50 m radius from the following location: NGR [xxx xxx]
Station Name/Address	
Deployment location	[Indoor only/Indoor or Outdoor] NB. Indoors only does not permit the deployment of outdoor base stations and fixed/installed terminal devices.
Permitted Frequency Band	2390-2400 MHz
Permitted Channel Centre Frequency Tx	2395 MHz
Permitted Channel Centre Frequency Rx	2395 MHz
Permitted Channel frequency bandwidth	10 MHz

Maximum power within the Permitted Channel

2300 MHz shared spectrum

1. When transmitting, the Licensee must transmit within the limits set out below.

Radio Equipment	Band	Maximum Power
Base Station	2390 - 2400 MHz	24 dBm / carrier (up to 10 MHz) EIRP
Fixed / installed terminal station	2390 - 2400 MHz	25 dBm TRP (includes a 2 dB tolerance)
Mobile or nomadic terminal station	2390 - 2400 MHz	25 dBm TRP (includes a 2 dB tolerance)

3.8 – 4.2 GHz

Transmitter(s)	
Authorised Base Station Deployment Area	Area of 50 m radius from the following location: NGR [xxx xxx]
Station Name/Address	
Deployment location	[Indoor only/Indoor or Outdoor] NB. Indoors only does not permit the deployment of outdoor base stations and fixed/installed terminal devices.
Permitted Frequency Band	3805 – 4195 MHz
Permitted Channel Centre Frequency Tx	
Permitted Channel Centre Frequency Rx	
Permitted Channel frequency bandwidth	[10, 20, 30, 40, 50, 60, 80 and 100 MHz]
Antenna Height	maximum 10m outdoors

Maximum power within the Permitted Channel

3.8 – 4.2 GHz shared spectrum

1. When transmitting, the Licensee must transmit within the limits set out below.

Radio Equipment	Band	Maximum Power
Base Station	3805 – 4195 MHz	27 dBm / carrier for carriers ≤ 20 MHz; OR 21dBm / 5 MHz for carriers > 20 MHz
Fixed / installed terminal station	3805 – 4195 MHz	28 dBm TRP (includes a 2 dB tolerance)
Mobile or nomadic terminal station	3805 – 4195 MHz	28 dBm TRP (includes a 2 dB tolerance)

26 GHz and 40 GHz

Transmitter(s)	
Authorised Base Station Deployment Area	Area of 50 m radius from the following location: NGR [xxx xxx]
Station Name/Address	

Transmitter(s)	
Deployment location	[Indoor only/Indoor or Outdoor] NB. Indoors only does not permit the deployment of outdoor base stations and fixed/installed terminal devices.
Permitted Frequency Band	[24.45 – 27.5 GHz] / [40.5 – 43.5 GHz]
Permitted Channel Centre Frequency	
Permitted Channel frequency bandwidth	

Transmitter and antenna restrictions

- If transmitting in 24.45-25.05 GHz, the Licensee is authorised to deploy no more than 3 outdoor base stations (a sector antenna equates to a base station).
- The Licensee shall ensure that when deploying Active Antenna System (AAS) outdoor base stations and transmitting in 24.45-27.5 GHz or 42.5-43.5 GHz, each antenna is normally transmitting only with main beam pointing below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the base station is only receiving.

Maximum power within the Permitted Channel

26 GHz & 40 GHz shared spectrum

- When transmitting, the Licensee must transmit within the limits set out below.

Radio Equipment	Band	Maximum mean TRP
Base Station	24.45-27.5 GHz	25 dBm/200 MHz
	40.5-43.5 GHz	
Fixed / installed terminal station	24.45-27.5 GHz	23 dBm
	40.5-43.5 GHz	
Mobile or nomadic terminal station	24.45-27.5 GHz	23 dBm
	40.5-43.5 GHz	

All bands

Interpretation of terms in this schedule

- In this schedule:
 - “Active antenna systems (AAS)”** means a base station and an antenna system where the amplitude and/or phase between antenna elements is continually adjusted resulting in an antenna pattern that varies in response to short term changes in the radio environment. This excludes long-term beam shaping such as fixed electrical down tilt. In AAS base stations the antenna system is integrated as part of the base station system or product.
 - “dBm”** means the power level in decibels (logarithmic scale) referenced against 1 milliwatt (i.e. a value of 0 dBm is 1 milliwatt);

- a) **“EIRP”** means the equivalent isotropically radiated power. This is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain), measured during the “on” part of the transmission;
- b) **“Fixed or installed”** means used or installed at specific fixed points;
- c) **“Indoor”** or **“indoors”** means inside premises which have a ceiling or a roof; and except for any doors, windows or passageways, are wholly enclosed;
- d) **“mobile or nomadic”** means intended to be used while in motion or during halts at unspecified points;
- e) **“NGR”** means National Grid Reference;
- f) **“outdoor”** or **“outdoors”** means anywhere that is not indoor;
- g) **“Permitted Channel”** means the frequency assigned by Ofcom that is the upper and lower cutoff frequencies;
- h) **“Permitted Channel Centre Frequency”** means the frequency assigned by Ofcom that is the midpoint between the upper and lower cutoff frequencies.
- i) **“Permitted Channel Frequency Bandwidth”** means the total amount of spectrum assigned to the channel;
- j) **“Permitted Frequency Band”** means the frequency range within which Ofcom will assign the Permitted Channel Centre Frequency;
- k) **“TRP”** means the total radiated power. This is the integral of the power transmitted in different directions over the entire radiation sphere, measured during the on part of the transmission;

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SCHEDULE 3 TO LICENCE NUMBER: [xxx]

Maximum power of Radio Equipment outside the Permitted Channel

1800 MHz

- When transmitting, the Licensee must transmit within the limits set out below.

Frequency offset from the lower frequency of the band edge	Maximum mean EIRP density
-6.2 to -3.2 MHz	-55 dBm / kHz
-3.2 to 0 MHz	$-45 + 10 \times (\Delta FL^* + 0.2) / 3$ dBm / kHz

Frequency offset from the upper frequency of the band edge	Maximum mean EIRP density
0 to 0.05 MHz	$-23 - 60 \times \Delta FH^*$ dBm / kHz
0.05 to 0.1 MHz	$-26 - 153.3 \times (\Delta FH^* - 0.05)$ dBm / kHz
0.1 to 2.8 MHz	$-45 - 10 \times (\Delta FH^* + 0.2) / 3$ dBm / kHz
2.8 to 5.8 MHz	-55 dBm / kHz

*Notes ΔFL in MHz is the offset from the lower edge of the permitted frequency band at 1876.7 MHz (it has values in the range -3.2 to 0 MHz)
 ΔFH in MHz is the offset from the upper edge of the permitted frequency band at 1880 MHz (it has values in the range 0 to 2.8 MHz)

2300 MHz

- When transmitting, the Licensee must transmit within the limits set out below.

Frequency	Power
2385 to 2390 MHz	(PMax - 40) dBm / 5 MHz
2400 to 2403 MHz	EIRP per antenna
2300 to 2385 MHz	(PMax - 43) dBm / 5 MHz EIRP per antenna
Above 2403 MHz	-17 dBm / 5 MHz EIRP*

*The maximum mean power relates to the EIRP of a specific piece of Radio Equipment irrespective of the number of transmit antennas.

- The licensee's base stations must transmit within the limits of transmission Frame Structure A, except for indoor base stations. If indoor base stations cause undue interference to other licensees in the 2390-2400 MHz shared spectrum or to the licensee in the 2350-2390 MHz band, we reserve the right to require the indoor base stations to transmit within the limits of transmission Frame Structure A.
- Frame Structure A means:

- timeslots (or subframes) 0, 2 to 5 and 7 to 9 must be allocated to Downlink (D) or Uplink (U) transmissions as indicated or may be left with no transmissions;
- the Licensee must ensure that the special subframe (S) in timeslots 1 and 6 has a structure that is compatible with TD-LTE special subframe configuration 6, also known as 9:3:2;
- all timeslots must be 1 millisecond in duration and the frame must start at a common reference time so that frames are aligned with licensee(s) that hold a Spectrum Access licence in 2350-2390MHz and transmissions synchronised; and
- TD-LTE frame configuration 2 (3:1) is compatible with this frame structure. Other technologies are permitted provided that the requirements are met.

Frame Structure A

DL/UL ratio	Subframe number									
	0	1	2	3	4	5	6	7	8	9
3:1	D	S	U	D	D	D	S	U	D	D

3.8 – 4.2 GHz

1. When transmitting, the Licensee must transmit within the limits set out below.

Frequency	Power
-5 to 0 MHz offset from lower channel edge 0 to 5 MHz offset from upper channel edge	(PMax – 40) dBm / 5 MHz EIRP per antenna
-10 to -5 MHz offset from lower channel edge 5 to 10 MHz offset from upper channel edge	(PMax – 43) dBm / 5 MHz EIRP per antenna
< -10 MHz offset from lower channel edge > 10 MHz offset from upper channel edge	(PMax – 43) dBm / 5 MHz EIRP per antenna

2. In addition, the EIRP emanating from the Radio Equipment transmissions at any frequency outside the Permitted Frequency Channel shall not exceed the following additional band edge requirements:

Frequency	Power
3795 MHz – 3800 MHz 4200 MHz – 4205 MHz	(PMax – 40) dBm / 5 MHz EIRP per antenna
3760 MHz - 3795 MHz 4205 MHz – 4240 MHz	(PMax – 43) dBm / 5 MHz EIRP per antenna
Below 3760 MHz Above 4240 MHz	-2 dBm / 5 MHz EIRP per antenna

26 GHz shared spectrum

1. When transmitting, the Licensee must transmit within the least restrictive of the limits set out below.

Frequency range	Maximum mean TRP
0 to 50 MHz below or above an assigned Permitted Channel	12 dBm/50 MHz
Within 24.25-27.5 GHz	4 dBm/50 MHz
Within 23.6-24.0 GHz	-39 dBW/200 MHz (Base station) -35 dBW/200 MHz (Terminal station)

40 GHz shared spectrum

1. When transmitting, the Licensee must transmit within the least restrictive of the limits set out below.

Frequency range	Maximum mean TRP
0 to 50 MHz below or above an assigned Permitted Channel	12 dBm/50 MHz
Within 40.5-43.5 GHz	4 dBm/50 MHz

Interpretation of terms in this schedule

2. In this schedule:
 - a) “**dBm**” means the power level in decibels (logarithmic scale) referenced against 1 milliwatt (i.e. a value of 0 dBm is 1 milliwatt);
 - b) “**Permitted Channel**” means the frequency assigned by Ofcom that is the upper and lower cut-off frequencies
 - c) “**TRP**” means the total radiated power. This is the integral of the power transmitted in different directions over the entire radiation sphere, measured during the on part of the transmission;

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SHARED ACCESS MEDIUM POWER LICENCE

Sector/Class/Product: 615002 - Shared Access (Medium Power) / Shared Access

Licence number:

Licensee:

Company Registration:

Licensee Address:

Email:

Date of Issue:

Valid From:

[Licence end date:]

Payment Interval: 1 Year

1. The Office of Communications (Ofcom) grants this wireless telegraphy licence ("the Licence") to [the Licensee's name] to establish, install and use wireless telegraphy stations and/or wireless telegraphy apparatus as described in the schedules to this Licence (together "the Radio Equipment") subject to the terms set out below.

Licence Term

2. This Licence shall continue in force until revoked by Ofcom or surrendered by the Licensee or if it is a Short Term Licence, when it reaches its expiration date.

Licence Revocation

3. Pursuant to schedule 1 paragraph 8 of the Wireless Telegraphy Act 2006 ("the Act"), Ofcom may not revoke this Licence under schedule 1 paragraph 6 of the Act except:
 - a) at the request, or with the consent, of the Licensee;
 - b) if there has been a breach of any of the terms of this Licence;
 - c) in accordance with schedule 1 paragraph 8(5) of the Act;
 - d) if it appears to Ofcom to be necessary or expedient to revoke the Licence for the purpose of complying with a direction by the Secretary of State given to Ofcom under section 5 of the Act or section 5 of the Communications Act 2003;
 - e) for reasons related to the management of the radio spectrum provided that in such a case the power to revoke may only be exercised after at least one month's notice is given in writing.
4. Ofcom may only revoke this Licence by notification in writing to the Licensee and in accordance with schedule 1 paragraphs 6, 6A and 7 of the Act.

Licence variation

5. Ofcom may only vary this Licence by notification in writing to the Licensee and in accordance with schedule 1 paragraphs 6, 6A and 7 of the Act.

Requirement to commence and maintain transmission within 6 months

6. The Licensee must establish, install and use the Radio Equipment to commence regular wireless telegraphy transmissions in accordance with the provisions of this Licence within six months of the date that this Licence is issued, and maintain such transmissions thereafter.

Transfer

7. This Licence may not be transferred. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30 of the Act.¹¹¹

Changes to Licensee details

8. The Licensee shall give prior notice to Ofcom in writing of any proposed changes to the Licensee's name, email address and/or address as recorded above paragraph 1 of this Licence.

Fees

9. The Licensee shall pay to Ofcom the relevant fee(s) as provided in section 12 of the Act and the regulations made thereunder on or before the fee payment date shown above, or on or before such dates as are notified in writing to the Licensee.
10. If the Licence is surrendered, revoked or varied, no refund, whether in whole or in part, of any amount which is due under the terms of this Licence, payable in accordance with any regulations made by Ofcom under sections 12 and 13(2) of the Act will be made, except at the absolute discretion of Ofcom.

Radio Equipment Use

11. The Licensee shall ensure that the Radio Equipment is established, installed and used only in accordance with the provisions specified in the schedules to this Licence. Any proposal to amend any detail specified in any of the schedules to this Licence must be agreed with Ofcom in advance and implemented only after this Licence has been varied or reissued accordingly.
12. The Licensee shall ensure that the Radio Equipment is operated in compliance with the terms of this Licence and is used only by persons who have been authorised in writing by the Licensee to do so and that such persons are made aware of, and of the requirement to comply with, the terms of this Licence.
13. The Licensee must ensure that all Radio Equipment is established, installed, modified and used only in accordance with the provisions specified in schedule 4 (EMF Licence Condition) of this Licence.

Access and Inspection

14. The Licensee shall permit any person authorised by Ofcom:
 - a) to have access to the Radio Equipment; and
 - b) to inspect this Licence and to inspect, examine and test the Radio Equipment,at any and all reasonable times or, when in the opinion of that person an urgent situation exists, at any time, to ensure the Radio Equipment is being used in accordance with the terms of this Licence.

¹¹¹ See Ofcom's website for the latest position on spectrum trading and the types of trade which are permitted.

Modification, Restriction and Closedown

15. Any person authorised by Ofcom may require the Radio Equipment or any part thereof, to be modified or restricted in use, or temporarily or permanently closed down immediately if in the opinion of the person authorised by Ofcom:
 - a) a breach of this Licence has occurred; and/or
 - b) the use of the Radio Equipment is, or may be, causing or contributing to undue interference to the use of other authorised radio equipment.
16. Ofcom may require any of the Radio Equipment to be modified or restricted in use, or temporarily closed down either immediately or on the expiry of such period as may be specified in the event of a national or local state of emergency being declared. Ofcom may only exercise this power after a written notice has been served on the Licensee or a general notice applicable to holders of a named class of licence has been published.

Geographical Boundaries

17. Subject to the requirements of any coordination procedures notified to the Licensee pursuant to the schedules to this Licence, the Licensee is authorised to establish, install and use a base station at the location set out the schedules to this Licence and any terminals connecting to it.

Synchronisation requirement

18. Where synchronisation requirements are set out in Schedule 3 to this Licence, the Licensee must transmit within the transmission limits specified.
19. Where synchronisation requirements have not been specified, in the event that harmful interference arises, the Licensee shall endeavour to discuss and agree with the other licence holder(s) how to coordinate their use. If agreement between licence holders cannot be reached, Ofcom may notify the Licensee to comply with additional technical conditions relating to synchronisation requirements.
20. The Licensee must comply with such technical conditions relating to synchronisation requirement notified to it by Ofcom from time to time.
21. The Licensee accepts that they may need to alter or replace Radio Equipment in order to comply with any synchronisation requirement notified from time to time.

Future Dynamic Spectrum Approach

22. On 25 July 2019, Ofcom published a statement called Enabling wireless innovation through local licensing containing a spectrum management decision to enable shared access to spectrum supporting mobile technology. In that decision, Ofcom stated that it will assess whether it is appropriate to transition towards a Dynamic Spectrum Approach in order to provide users more access to spectrum by means of automatic database frequency assignment. The Licensee is therefore notified that Ofcom currently intends to vary this Licence in accordance with paragraph 5 from time to time in future, or may re-issue the Licence, to give effect to that decision.

Notification in electronic form

23. The Licensee shall accept notifications and other related documents under this Licence electronically to the designated email address as recorded above paragraph 1 of this Licence. The Licensee must update Ofcom about changes to the designated email address in accordance with paragraph 8.

Interpretation

24. In this Licence:

- a) the establishment, installation and use of the Radio Equipment shall be interpreted as establishment and use of wireless telegraphy stations and installation and use of wireless telegraphy apparatus for wireless telegraphy as specified in section 8(1) of the Act;
- b) the expression “interference” shall have the meaning given by section 115 of the Act;
- c) the expressions “wireless telegraphy station” and “wireless telegraphy apparatus” shall have the meanings given by section 117 of the Act;
- d) the schedule(s) form part of this Licence together with any subsequent schedule(s) which Ofcom may issue as a variation to this Licence; and
- e) the Interpretation Act 1978 shall apply to the Licence as it applies to an Act of Parliament.

Issued by Ofcom

SCHEDULE 1 TO LICENCE NUMBER: [xxx]

Schedule Date:	[xxx]
Licence category:	Shared Access Medium Power

Description of Radio Equipment

1. References in this schedule(s) to the Radio Equipment are references to any wireless telegraphy station or wireless telegraphy apparatus that is established, installed and/or used under this schedule(s).

Interface Requirements for the Radio Equipment

2. Use of the Radio Equipment shall be in accordance with the following Interface Requirement:

IR 2104 Shared Access Medium power

Special conditions relating to the Radio Equipment

3. This Licence authorises the use of the Radio Equipment within the Permitted Frequency Band and the Licensee warrants that the Radio Equipment is capable of transmitting across the Permitted Frequency Band.
4. However, the Licensee is only authorised to transmit on the Permitted Channel Centre Frequency within the Permitted Frequency Band, as set in Schedule 2 to this Licence or as notified to the Licensee by Ofcom from time to time.
5. The Licensee must comply with any change to the Permitted Channel Centre Frequency notified by Ofcom within the timescale indicated in the notification.
6. During the period that this Licence remains in force, unless consent has otherwise been given by Ofcom, the Licensee shall compile and maintain accurate written records of the following details relating to the Radio Equipment:
 - a) For all fixed/ installed terminals the:
 - i) postal address (including post code);
 - ii) National Grid Reference (to 1m resolution); and
 - iii) Antenna height (above ground level), type, and boresight bearing east of true north (if applicable); and
 - b) For all mobile and nomadic terminals in the 3.8-4.2 GHz band the postal address (including post code) of where it will be used.
7. The Licensee shall submit to Ofcom in such manner and within such period as specified by Ofcom, such other information in relation to the Radio Equipment, or any wireless telegraphy station or wireless telegraphy apparatus which the Licensee is planning to use, as Ofcom may from time to time request. Such information may include, but is not limited to, information in relation to the radio frequency, transmitted power and date of first use for wireless telegraphy stations or wireless telegraphy apparatus to be established, installed or used within such timeframe and in such areas as Ofcom may reasonably request.
8. The use of the Radio Equipment is not permitted airborne.

Coordination at frequency and geographical boundaries

9. The Licensee shall ensure that the Radio Equipment is operated in compliance with such coordination procedures as may be notified to the Licensee by Ofcom from time to time.

Cooperation between licensees

10. In addition to complying with the specific transmission terms, conditions and limitations set out in this Licence, the Licensee must liaise and co-operate with other holders of licences in the Permitted Frequency Band (if necessary adjusting transmission power and other technical parameters of transmission) in such a way that harmful interference is not caused by one network deployment to that of another Licensee within the band.

Interpretation of terms in this schedule

11. In this schedule:
 - a) "Fixed or installed" means used or installed at specific fixed points.
 - b) "IR" means a United Kingdom Radio Interface Requirement published by Ofcom in accordance with the Radio Equipment Regulations 2017, as amended by the Product Safety and Metrology etc. (Amendment etc.) (EU Exit) Regulations 2019.
 - c) "mobile or nomadic" means intended to be used while in motion or during halts at unspecified points.
 - d) "Permitted Channel Centre Frequency" means the frequency assigned by Ofcom that is the midpoint between the upper and lower channel edge frequencies.
 - e) "Permitted Frequency Band" means the frequency range within which Ofcom will assign the Permitted Channel Centre Frequency.

Ofcom

SCHEDULE 2 TO LICENCE NUMBER: [xxx]

Schedule Date:	[xxx]
Licence category:	Shared Access Medium Power

1800 MHz

Transmitter(s)	
Base station location	NGR [xxx xxx]
Station Name/Address	
Deployment location	[Indoor only/Indoor or Outdoor]
Permitted Frequency Band	1871.7 - 1880 MHz
EIRP Tx	
Permitted Channel Centre Frequency Tx	1878.35 MHz
Permitted Channel Centre Frequency Rx	1878.35 MHz
Permitted Channel frequency bandwidth	3.3 MHz
Antenna Gain	X dBi
Antenna Height (Metres)	

Maximum power within the Permitted Channel

1. When transmitting, the licensee must transmit within the limits set out below.

Radio Equipment	Band	Maximum Power	
Base Station	1876.7-1880 MHz	42 dBm / carrier (up to 3 MHz) EIRP	
		Frequency offset from the lower frequency of the band edge	Maximum Mean EIRP density
		0 to 0.05 MHz	$-33.6 + 153.3 \times \Delta FL^*$ dBm / kHz
		0.05 to 0.1 MHz	$-26 + 60 \times (\Delta FL^* - 0.05)$ dBm / kHz
		0.1 to 0.2 MHz	$-23 + 230 \times (\Delta FL^* - 0.1)$ dBm / kHz
		0.2 to 3.2 MHz	42 dBm / carrier
		3.2 to 3.3 MHz	$-23 + 230 \times (3.3 - \Delta FL^*)$ dBm / kHz

Radio Equipment	Band	Maximum Power
		* Note: Δ FL in MHz is the offset from the lower edge of the permitted frequency band at 1876.7 MHz (it has values in the range 0 to +0.2 MHz and +3.2 to +3.3MHz)
Fixed / installed terminal station	1781.7 - 1785 MHz	23 dBm EIRP
Mobile or nomadic terminal station	1781.7 - 1785 MHz	23 dBm TRP

2300 GHz

Transmitter(s)	
Base station location	NGR [xxx xxx]
Station Name/Address	
Deployment location	[Indoor only/Indoor or Outdoor]
Permitted Frequency Band	[24.45 – 27.5 GHz] / [40.5 – 43.5 GHz]
Maximum mean TRP	[x] dBm / 200 MHz
Permitted Channel Centre Frequency	
Permitted Channel frequency bandwidth	
Antenna Height	
Antenna Gain	

3.8 – 4.2 GHz

Transmitter(s)	
Base station location	NGR [xxx xxx]
Station Name/Address	
Deployment location	[Indoor only/Indoor or Outdoor]
Permitted Frequency Band	3805 – 4195 MHz
EIRP Tx	
Permitted Channel Centre Frequency	

Transmitter(s)	
Permitted Channel frequency bandwidth	
Antenna Gain	
Antenna Height (Metres)	

Maximum power within the Permitted Channel

3.8 – 4.2 GHz shared spectrum

1. When transmitting, the Licensee must transmit within the limits set out below.

Radio Equipment	Band	Maximum Power
Base Station	3805 – 4195 MHz	42 dBm / carrier for carriers \leq 20 MHz; or 36 dBm / 5 MHz for carriers > 20 MHz (EIRP)
Fixed / installed terminal station	3805 – 4195 MHz	28 dBm TRP and 35 dBm/5 MHz EIRP (includes a 2 dB tolerance)
Mobile or nomadic terminal station	3805 – 4195 MHz	28 dBm TRP (includes a 2 dB tolerance)

26 GHz and 40 GHz

Transmitter(s)	
Base station location	NGR [xxx xxx]
Station Name/Address	
Deployment location	[Indoor only/Indoor or Outdoor]
Permitted Frequency Band	[24.45 – 27.5 GHz] / [40.5 – 43.5 GHz]
Maximum mean TRP	[x] dBm / 200 MHz
Permitted Channel Centre Frequency	
Permitted Channel frequency bandwidth	
Antenna Gain	
Antenna Height (Metres)	

Transmitter and antenna restrictions

2. The Licensee shall ensure that when deploying Active Antenna System (AAS) outdoor base stations and transmitting in 24.45-27.5 GHz or 42.5-43.5 GHz, each antenna is normally transmitting only with main beam pointing below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the base station is only receiving.

Maximum power within the Permitted Channel

26 GHz & 40 GHz shared spectrum

3. When transmitting, the licensee must transmit within the limits set out below.

Radio Equipment	Band	Maximum mean TRP
Fixed / installed terminal station	26 & 40 GHz	23 dBm
Mobile or nomadic terminal station	26 & 40 GHz	23 dBm

All bands

Interpretation of terms in this schedule

4. In this schedule:

- a) "Active antenna systems (AAS)" means a base station and an antenna system where the amplitude and/or phase between antenna elements is continually adjusted resulting in an antenna pattern that varies in response to short term changes in the radio environment. This excludes long-term beam shaping such as fixed electrical down tilt. In AAS base stations the antenna system is integrated as part of the base station system or product.
- b) "dBm" means the power level in decibels (logarithmic scale) referenced against 1 milliwatt (i.e. a value of 0 dBm is 1 milliwatt);
- c) "Fixed or installed" means used or installed at specific fixed points;
- d) "Indoor" or "indoors" means inside premises which have a ceiling or a roof; and except for any doors, windows or passageways, are wholly enclosed;
- e) "mobile or nomadic" means intended to be used while in motion or during halts at unspecified points;
- f) "NGR" means National Grid Reference;
- g) "outdoor" or "outdoors" means anywhere that is not indoor;
- h) "Permitted Channel" means the frequency assigned by Ofcom that is the upper and lower cutoff frequencies;
- i) "Permitted Channel Centre Frequency" means the frequency assigned by Ofcom that is the midpoint between the upper and lower cutoff frequencies.
- j) "Permitted Channel Frequency Bandwidth" means the total amount of spectrum assigned to the channel;
- k) "Permitted Frequency Band" means the frequency range within which Ofcom will assign the Permitted Channel Centre Frequency;
- l) "TRP" means the total radiated power. This is the integral of the power transmitted in different directions over the entire radiation sphere, measured during the on part of the transmission.

Ofcom

SCHEDULE 3 TO LICENCE NUMBER: [xxx]

Maximum power of Radio Equipment outside the Permitted Channel

1800 MHz

- When transmitting, the Licensee must transmit within the limits set out below.

Frequency offset from the lower frequency of the band edge	Maximum mean EIRP density
-6.2 to -3.2 MHz	-55 dBm / kHz
-3.2 to 0 MHz	$-45 + 10 \times (\Delta FL^* + 0.2) / 3$ dBm / kHz

Frequency offset from the upper frequency of the band edge	Maximum mean EIRP density
0 to 0.05 MHz	$-23 - 60 \times \Delta FH^*$ dBm / kHz
0.05 to 0.1 MHz	$-26 - 153.3 \times (\Delta FH^* - 0.05)$ dBm / kHz
0.1 to 2.8 MHz	$-45 - 10 \times (\Delta FH^* + 0.2) / 3$ dBm / kHz
2.8 to 5.8 MHz	-55 dBm / kHz

*Notes ΔFL in MHz is the offset from the lower edge of the permitted frequency band at 1876.7 MHz (it has values in the range -3.2 to 0 MHz)
 ΔFH in MHz is the offset from the upper edge of the permitted frequency band at 1880 MHz (it has values in the range 0 to 2.8 MHz)

3.8 – 4.2 GHz

- When transmitting, the Licensee must transmit within the limits set out below.

Frequency	Power
-5 to 0 MHz offset from lower channel edge 0 to 5 MHz offset from upper channel edge	(PMax – 40) dBm / 5 MHz EIRP per antenna
-10 to -5 MHz offset from lower channel edge 5 to 10 MHz offset from upper channel edge	(PMax – 43) dBm / 5 MHz EIRP per antenna
< -10 MHz offset from lower channel edge > 10 MHz offset from upper channel edge	(PMax – 43) dBm / 5 MHz EIRP per antenna

- In addition, the EIRP emanating from the Radio Equipment transmissions at any frequency outside the Permitted Frequency Channel shall not exceed the following additional band edge requirements:

Frequency	Power
3795 MHz – 3800 MHz 4200 MHz – 4205 MHz	(PMax – 40) dBm / 5 MHz EIRP per antenna
3760 MHz - 3795 MHz 4205 MHz – 4240 MHz	(PMax – 43) dBm / 5 MHz EIRP per antenna
Below 3760 MHz Above 4240 MHz	-2 dBm / 5 MHz EIRP per antenna

26 GHz

26 GHz shared spectrum

1. When transmitting, the Licensee must transmit within the least restrictive of the limits set out below.

Frequency range	Maximum mean TRP
0 to 50 MHz below or above an assigned Permitted Channel	12 dBm/50 MHz
Within 24.25-27.5 GHz	4 dBm/50 MHz
Within 23.6-24.0 GHz	-39 dBW/200 MHz (Base station) -35 dBW/200 MHz (Terminal station)

40 GHz

40 GHz shared spectrum

2. When transmitting, the Licensee must transmit within the least restrictive of the limits set out below.

Frequency range	Maximum mean TRP
0 to 50 MHz below or above an assigned Permitted Channel	12 dBm/50 MHz
Within 40.5-43.5 GHz	4 dBm/50 MHz

All bands

Interpretation of terms in this schedule

3. In this schedule:
 - a) “dBm” means the power level in decibels (logarithmic scale) referenced against 1 milliwatt (i.e. a value of 0 dBm is 1 milliwatt);
 - b) “Permitted Channel” means the frequency assigned by Ofcom that is the upper and lower cutoff frequencies;

- c) "PMax" is the maximum mean power for the base station in question, measured as EIRP per carrier and determined irrespective of the number of antennas;
- d) "TRP" means the total radiated power. This is the integral of the power transmitted in different directions over the entire radiation sphere, measured during the on part of the transmission.

SCHEDULE 4 - EMF Licence Condition

Schedule Date:	[xxx]
Licence category:	Spectrum Access Licence

Sites which are not shared with another licensee

1. The Licensee shall only establish, install, modify or use Relevant Radio Equipment if the total electromagnetic field exposure levels produced by the Licensee's On-Site Radio Equipment do not exceed the basic restrictions¹¹² in the relevant tables for general public exposure identified in the ICNIRP Guidelines¹¹³ in any area where a member of the general public is or can be expected to be present when transmissions are taking place.

Sites which are shared with another licensee

2. In the case of a shared site where the Shared Site Exemption applies to the Licensee, the Licensee shall comply with paragraph 1 above.
3. In the case of a shared site where the Shared Site Exemption does not apply to the Licensee, the Licensee shall only establish, install, modify or use the Relevant Radio Equipment if:
 - a) the total electromagnetic field exposure levels produced by the Licensee's On-Site Radio Equipment, together with
 - b) the total electromagnetic field exposure levels produced by all other wireless telegraphy stations and wireless telegraphy apparatus operated by another licensee on the same site for which the Licensee can reasonably assume that a Shared Site Exemption does not apply,do not exceed the basic restrictions¹¹⁴ in the relevant tables for general public exposure identified in the ICNIRP Guidelines¹¹⁵ in any area where a member of the general public is or can be expected to be present when transmissions are taking place.

Emergency Situations

4. The obligations in paragraphs 1, 2 and 3 above will not apply if the Relevant Radio Equipment is being used for the purpose of seeking emergency assistance or reporting and responding to an emergency situation (in the vicinity of that situation) including for search and rescue activities and maritime emergency communications¹¹⁶.

¹¹² Compliance with the reference levels for general public exposure identified in the ICNIRP Guidelines will ensure compliance with the basic restrictions.

¹¹³ The relevant tables for general public exposure are identified in Ofcom's "Guidance on EMF Compliance and Enforcement".

¹¹⁴ Compliance with the reference levels for general public exposure identified in the ICNIRP Guidelines will ensure compliance with the basic restrictions.

¹¹⁵ The relevant tables for general public exposure are identified in Ofcom's "Guidance on EMF Compliance and Enforcement".

¹¹⁶ Further information on emergency situations is set out in Ofcom's "Guidance on EMF Compliance and Enforcement".

Relationship with authorised transmission levels

5. The Licensee shall comply with paragraphs 1, 2 and 3 above notwithstanding the maximum transmission levels authorised in the Licence.

Records

6. The Licensee shall keep, or shall procure that a third party shall keep, and shall make available to Ofcom on request, records (including the type of records identified in Ofcom's "Guidance on EMF Compliance and Enforcement") that demonstrate how it has complied with paragraphs 1, 2 and 3 above when Relevant Radio Equipment is established, installed, modified or used.

Ofcom's "Guidance on EMF Compliance and Enforcement"

7. When evaluating its compliance with paragraphs 1, 2 and 3 above, the Licensee shall take into account Ofcom's "Guidance on EMF Compliance and Enforcement" that is in force at the relevant time.

Interpretation

8. In this schedule:
 - a) "**dB_i**" means the ratio in dB (decibel) when comparing the gain of the antenna to the gain of an isotropic antenna. An isotropic antenna is a theoretical antenna which radiates power uniformly in all directions;
 - b) "**EIRP**" means equivalent isotropically radiated power which is the product of the power supplied to an antenna and the absolute or isotropic antenna gain in a given direction relative to an isotropic antenna;
 - c) "**ERP**" means effective radiated power which is the product of the power supplied to an antenna and its gain in a given direction relative to a half-wave dipole;
 - d) "**general public**" means any person who is not: (a) the Licensee, owner, operator or installer of the Relevant Radio Equipment; or (b) acting under a contract of employment or otherwise acting for purposes connected with their trade, business or profession or the performance by them of a public function;¹¹⁷
 - e) "**ICNIRP Guidelines**" means the version of the Guidelines published by the International Commission on Non-Ionizing Radiation Protection for limiting exposure to electromagnetic fields which are identified in Ofcom's "Guidance on EMF Compliance and Enforcement" that is in force at the relevant time.¹¹⁸

¹¹⁷ There is pre-existing health and safety legislation which already requires employers to protect workers from exposure to electromagnetic fields ("EMF") including the following legislation specifically relating to EMF (as amended from time to time): [The Control of Electromagnetic Fields at Work Regulations 2016](#), [The Control of Electromagnetic Fields at Work Regulations \(Northern Ireland\) 2016](#) and [The Merchant Shipping and Fishing Vessels \(Health and Safety at Work\) \(Electromagnetic Fields\) Regulations 2016](#).

¹¹⁸ Ofcom's "Guidance on EMF Compliance and Enforcement" will initially require the Licensee to comply with the ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz), published in: Health Physics 74(4):494-522, dated April 1998 and available at: <https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf> ("1998 Guidelines") or the ICNIRP Guidelines for limiting exposure to electromagnetic fields (100 KHz to 300 GHz), published in: Health Physics 118(5): 483-524; 2020 and available at: <https://www.icnirp.org/cms/upload/publications/ICNIRPrgdI2020.pdf> ("2020 Guidelines"). However, once work on the relevant standards explaining the methodology for assessing

- f) **“Licensee’s On-Site Radio Equipment”** means the Relevant Radio Equipment and any other wireless telegraphy station(s) and wireless telegraphy apparatus on the same site which transmits at powers higher than 10 Watts EIRP or 6.1 Watts ERP.¹¹⁹
- g) **“Relevant Radio Equipment”** means all the Radio Equipment that is authorised by this Licence to transmit at powers higher than 10 Watts EIRP or 6.1 Watts ERP.
- h) **“Shared Site Exemption”** means any of the following three situations apply on a shared site in relation to the Licensee’s or another licensee’s wireless telegraphy station(s) or wireless telegraphy apparatus that is authorised to transmit at powers higher than 10 Watts EIRP or 6.1 Watts ERP:
- The first situation is that all of the licensee’s wireless telegraphy station(s) or wireless telegraphy apparatus on a shared site do not transmit at a combined total radiated power in any particular direction¹²⁰ that is higher than 100 Watts EIRP or 61 Watts ERP;¹²¹
 - The second situation is that the total electromagnetic field exposure levels produced by the licensee’s wireless telegraphy station(s) or wireless telegraphy apparatus in any area where a member of the general public is or can be expected to be present when transmissions are taking place is no more than 5% of the basic restrictions or 5% of the reference levels in the relevant tables for general public exposure identified in the ICNIRP Guidelines;¹²²
 - The third situation is where the licensee’s wireless telegraphy station or wireless telegraphy apparatus has an antenna gain that is equal to or higher than 29 dBi and has a fixed beam;
- i) **“shared site”** means a site that is shared by the Licensee and at least one other licensee for the purposes of establishing, installing, modifying or using wireless telegraphy stations or wireless telegraphy apparatus;
- j) **“site”** means a physical structure, building, vehicle or moving platform;
- k) **“wireless telegraphy apparatus”** has the meaning given to it in section 117 of the Wireless Telegraphy Act 2006; and
- l) **“wireless telegraphy station”** has the meaning given to it in section 117 of the Wireless Telegraphy Act 2006.

compliance with the 2020 Guidelines has progressed sufficiently, Ofcom will publish a public consultation on updating its “Guidance on EMF Compliance and Enforcement” to explain that going forward Ofcom will be requiring the Licensee to comply with the 2020 Guidelines only. Following this public consultation, Ofcom will publish an updated version of Ofcom’s “Guidance on EMF Compliance and Enforcement” on its website. Ofcom will follow the same process for any subsequent versions of the ICNIRP Guidelines.

¹¹⁹ 10 Watts EIRP is equivalent to 6.1 Watts ERP. In linear units $EIRP (W) = 1.64 \times ERP (W)$; in decibels $EIRP (dB) = ERP (dB) + 2.15$. Ofcom’s “Guidance on EMF Compliance and Enforcement” explains how the Licensee can determine if wireless telegraphy station(s) or wireless telegraphy apparatus “transmits at powers higher than 10 Watts EIRP or 6.1 Watts ERP”.

¹²⁰ For the purpose of this situation, the combined total radiated power is a simple sum of the radiated powers (in EIRP or ERP) of all of the licensee’s wireless telegraphy station(s) or wireless telegraphy apparatus on the shared site that transmits signals covering the same or overlapping areas.

¹²¹ 100 Watts EIRP is equivalent to 61 Watts ERP.

¹²² The relevant tables for general public exposure are identified in Ofcom’s “Guidance on EMF Compliance and Enforcement”.

The overview section in this document is a simplified high-level summary only. The decisions we are consulting on are set out in follow in the sections that follow.