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Annual licence fees for 2100 MHz spectrum

STATEMENT:

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Contents

Section

1. Overview

In this statement, we set out our decision on the level of annual licence fees for the paired 2100 MHz spectrum.

The 2100 MHz licences, consisting of paired spectrum and unpaired spectrum, were auctioned in 2000 for a fixed period of 20 years. In 2011, and in light of a Government Direction, Ofcom varied each of the 2100 MHz licences to make them indefinite and to include a new provision requiring the payment of annual licence fees from 1 January 2022.

On 14 July 2021, we published a consultation on proposed annual licence fees for 2100 MHz spectrum. In this statement, we set out our decision on the level of annual licence fees for the paired 2100 MHz spectrum based on a conservative estimate of the market value having regard to UK mobile spectrum auctions' evidence alongside international evidence (where available).

We consider that setting fees for the paired 2100 MHz spectrum which reflect the market value (opportunity cost) of the underlying spectrum is consistent with our statutory duties, including our duty to secure the optimal use of the spectrum. It is also in line with our general policy on spectrum pricing as well as the Government Direction.

On unpaired spectrum, further to consultation responses, we plan to consult further in the first half of 2022 on the future use of the band, including on a proposal to revoke the unpaired licences and therefore are not setting a fee in this statement.

What we have decided – in brief

- to set an annual licence fee of **£0.561m per MHz for paired 2100 MHz spectrum**; and
- to consult further on the unpaired 2100 MHz spectrum.

This overview is a simplified high-level summary only. The decisions we have taken, and our reasoning, are set out in the full document.

2. Introduction

Background

2.1 The 2100 MHz spectrum was auctioned in April 2000 for deployment of third generation (3G) national mobile networks. It consists of both paired spectrum[1] and unpaired spectrum.[2]

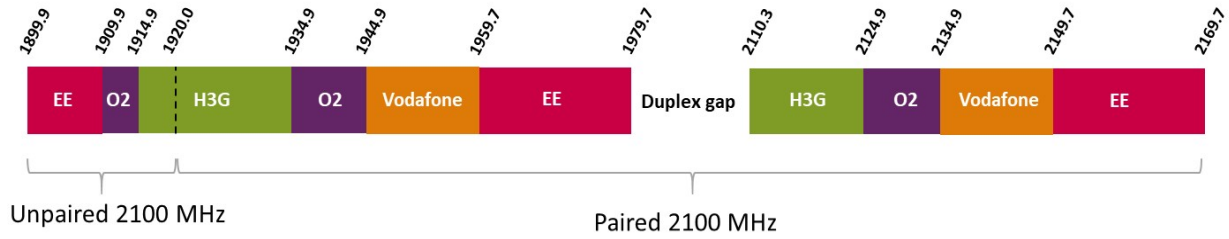
2.2 This was the first mobile spectrum auction in the UK and generated £22.5 billion. To promote a new fifth entrant into the mobile market, some spectrum was reserved for a new entrant (and was ultimately won by Hutchison 3G UK Ltd ("**H3G**")). The licences were initially granted for a fixed period of 20 years.

2.3 Since the auction, several mergers and acquisitions have occurred in the mobile market resulting in the existing four mobile network operators ("**MNOs**") which between them hold the 2100 MHz spectrum; Everything Everywhere Ltd[3] ("**EE**"), H3G, Telefónica UK Ltd[4] ("**O2**") and Vodafone Ltd ("**Vodafone**"). Their 2100 MHz spectrum holdings are shown in Table 2.1 and Figure 2.1 below.

Table 2.1: Spectrum holdings in the 2100 MHz spectrum

2100 MHz band	EE	H3G	O2	Vodafone
Paired spectrum	40 MHz	29.5 MHz	20 MHz	29.6 MHz
Unpaired spectrum	10 MHz	5.1 MHz	5 MHz	-

Figure 2.1: Spectrum holdings in the 2100 MHz spectrum



2.4 In June 2011, Ofcom varied[5] each of the 2100 MHz licences in order to give effect to a Government Direction ("**the Direction**").[6] Amongst other things, the term of the licences was made indefinite (until revoked by Ofcom or surrendered by the licensee, and a new

[1] 1920 - 1979.7 MHz paired with 2110.3 - 2169.7 MHz
[2] 1899.9 – 1920 MHz
[3] Acquired by BT in 2016.
[4] Merged with Virgin Media in June 2021 and now known as Virgin Media 02 ("**VM02**").
[5] Ofcom, *Statement on variation of 2100 MHz Third Generation Mobile Wireless Telegraphy Act Licences*, July 2011, https://www.ofcom.org.uk/__data/assets/pdf_file/0027/73854/statement.pdf.
[6] https://www.legislation.gov.uk/uksi/2010/3024/article/5/made

provision was introduced requiring the payment of annual licence fees ("**ALF**") from 1 January 2022. The Direction requires Ofcom to set ALF which reflects the full market value of the frequencies in that band having regard to its duties and the value of UK mobile spectrum auctions.

Our spectrum pricing policy

2.5 Our spectrum pricing policy is set out in our Strategic Review of Spectrum Pricing ("**SRSP**") in 2010[7] which included our approach to setting licence fees. In the SRSP, we said that this would be used in the future as a guide to setting fees above administrative cost (which we referred to in the SRSP as administered incentive pricing ("**AIP**")). The SRSP was itself established as part of meeting our statutory duties when imposing spectrum licence fees.

2.6 We explained in the SRSP that the purpose of AIP is to set fees for spectrum holdings to reflect the market value of the spectrum (based on its opportunity cost) in order to promote the optimal use of spectrum, in line with our duties.

Annual licence fees for 2100 MHz spectrum

2.7 Ofcom published a consultation in July 2021 proposing the level of annual licence fees that should apply to this spectrum (the "**July 2021 consultation**").[8] We received four responses[9] and the non-confidential versions of these are available to view on the Ofcom website.

2.8 This statement sets out the approach we have decided to take in setting licence fees for the paired 2100 MHz spectrum and the level of fee applicable from January 2022.[10] In reaching our final decision, we have taken account of the points raised by respondents to the July 2021 consultation. We consider and respond to those points in this document.

2.9 In taking the decisions set out in this statement, we have had regard to the Statement of Strategic Priorities for telecommunications, the management of radio spectrum and postal services (the "**SSP**").[11] We consider that our decisions are broadly aligned with the objectives set out in the SSP, in particular securing efficient use of spectrum and promoting competition in the mobile market.

2.10 Our approach to determine the market value of the paired 2100 MHz spectrum which is set out in more detail in Section 3 is to consider the evidence on the market value of

[7] Ofcom, *SRSP: The revised Framework for Spectrum Pricing*, December 2010, https://www.ofcom.org.uk/__data/assets/pdf_file/0024/42909/srsp-statement.pdf.
[8] Ofcom, *Proposed annual licence fees for 2100 MHz spectrum*, 14 July 2021, https://www.ofcom.org.uk/__data/assets/pdf_file/0032/221999/1900_2100-mhz-condoc.pdf.
[9] BT, Three, VM02 and Vodafone (including Frontier Economics report commissioned by Vodafone)
[10] We have decided to set the date for payment of the ALF from 4 January 2021 because 1 January is a bank holiday throughout the United Kingdom.
[11] DCMS, *Statement of Strategic Priorities for telecommunications, the management of radio spectrum and postal services*, 18 July 2019, https://www.gov.uk/government/publications/statement-of-strategic-priorities.

mobile spectrum bands which have been auctioned in the UK alongside other international evidence (where available).

2.11 In this statement, we use the terms AIP and ALF interchangeably. We consider that our decisions in this statement are consistent with the approach to pricing set out in the SRSP to set fees based on opportunity cost[12] for spectrum.

2.12 Based on responses received on unpaired 2100 MHz spectrum that there are no plans for incumbents to deploy in the foreseeable future due to economic viability, we plan to consult further in the first half of 2022 on the future use of the band, including on a proposal to revoke the unpaired licences and therefore are not setting a fee in this statement.

Relevant legal framework

2.13 Ofcom has the power pursuant to the Wireless Telegraphy Act 2006 (the "**Wireless Telegraphy Act**") to require spectrum licensees to pay fees to Ofcom on the grant of a licence and subsequently. This includes the power to set fees at an amount that is higher than the cost to us of carrying out our radio spectrum functions, if we think this is appropriate in light of our statutory duties at Section 3 of the Wireless Telegraphy Act.

2.14 These duties include having regard to:

a) the extent to which the electromagnetic spectrum is available for use, or further use, for wireless telegraphy;

b) the demand for use of the spectrum for wireless telegraphy;

c) the demand that is likely to arise in future for the use of the spectrum for wireless telegraphy; and

d) the desirability of promoting:

i) the efficient management and use of the part of the electromagnetic spectrum available 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.

2.15 Ofcom also has a number of statutory duties under the Communications Act 2003 (the "**Communications Act**") which are relevant to its spectrum management functions. These include its principal duty to further the interests of citizens and consumers (where appropriate by promoting competition) and its duties to secure the optimal use for wireless telegraphy of the electro-magnetic spectrum and to promote competition. It is also required to have regard to the desirability of encouraging investment and innovation

[12] Opportunity cost is the value of alternative spectrum use forgone by society due to the current spectrum use.

in relevant markets and encouraging the availability and use of high speed data transfer services throughout the UK.

2.16 Our July 2021 consultation comprised an assessment of the impacts of ALFs for 2100 spectrum in accordance with section 7 of the Communications Act, the Equalities Act 2010 and the Northern Ireland Act 1998.

2.17 Further detail on our impact assessment and the relevant legal framework including the Direction is set out in Section 5 and Annex A1 of this statement.

2.18 In reaching our decisions, we have also had regard to the SSP as required under section 2B of the Communications Act, and the Direction.

Structure of this document

2.19 The rest of this document is set out as follows:

- **Section 3** sets out our view on the next highest value use or user for the 2100 MHz spectrum and approach to determining annual licence fees.
- **Section 4** outlines the market value of the paired 2100 MHz spectrum.
- **Section 5** sets out our further consideration of ALFs based on market value, in light of our statutory duties.
- **Section 6** summarises our conclusions and outlines implementation.

2.20 Supporting material is set out in the following separate annexes:

- **Annex A1** outlines the relevant legal framework.
- **Annex A2** outlines our approach to international benchmarking for the paired 2100 MHz spectrum.
- **Annex A3** sets out our assessment of spectrum awards relevant to the paired 2100 MHz spectrum.
- **Annex A4** outlines our approach to annualisation for the paired 2100 MHz spectrum.
- **Annex A5** contains a copy of the Regulations that we have made in order to set annual licence fees in accordance with this document. The final version of these Regulations will be published at https://www.legislation.gov.uk/ and come into force on 27th December 2021.

3. Approach to determining annual licence fees for paired 2100 MHz spectrum

Introduction

3.1 The purpose of AIP is to set fees for spectrum holdings that reflect the market value[13] of the spectrum (based on its opportunity cost) in order to promote the optimal use of spectrum, in line with our duties. When we refer to opportunity cost, and as discussed in more detail in our SRSP, we mean the value to the next highest value use or user that is denied access to the spectrum.

3.2 In this section, we discuss our view of the next highest value use or user for the 2100 MHz spectrum taking account of consultation responses. We then set out the approach we have used to determine the annual licence fees payable for paired 2100 MHz spectrum based on that use/user.

Next highest value use or user for the 2100 MHz spectrum

Our provisional view

3.3 In our July 2021 consultation, we said that the next highest value use case for both the paired and unpaired 2100 MHz spectrum comes from mobile services and we expect that the next highest value user for the 2100 MHz spectrum would be another MNO.

Consultation responses

Paired 2100 MHz spectrum

3.4 BT and Vodafone agreed that mobile services are the next highest value use case for the paired 2100 MHz spectrum. BT and VMO2 noted that this spectrum is being refarmed to support 4G/5G technologies.[14]

Unpaired 2100 MHz spectrum

3.5 Vodafone and VMO2 agreed that mobile services are the next highest value use case for the unpaired 2100 MHz spectrum.[15] BT disagreed that high power public mobile services are the highest value user in the unpaired 2100 MHz spectrum at least in the near term but agreed that the next highest value user could be other mobile application.[16] Three indicated there is no excess demand now and in the future for their 1914.9 to 1920 MHz

[13] We define market value as the market-clearing price in a well-functioning market, or the forward-looking marginal opportunity cost of the spectrum, and we use the terms "full market value", "market value" and "marginal opportunity cost" interchangeably in this document.
[14] BT consultation response, section 3.1.1; VMO2 consultation response, p. 1; Vodafone consultation response, p. 4.
[15] Vodafone consultation response, p. 4; VMO2 consultation response, p. 4.
[16] BT consultation response, p. 7.

spectrum as their spectrum would have to be a guard band to enable the high power mobile TDD use of the unpaired 2100 MHz spectrum that Ofcom envisaged.[17]

3.6 All respondents indicated a number of barriers that prevent future economical deployment of high power mobile service. We summarise these below.

Mobile use not permitted in existing licence

3.7 BT stated current licence conditions do not permit high power mobile use and urged Ofcom to work with licensees to make the 2100 MHz unpaired licence conditions more technology neutral as well as support any request to trade the spectrum or to share the spectrum on a geographic basis via Local Access licences. It said there is a lack of any evidence of demand for use of the spectrum.[18]

3.8 VMO2 confirmed it is not using the spectrum and that current licence conditions do not permit high power mobile use. It also noted the need for synchronisation required for mobile deployment of unpaired 2100 MHz spectrum will increase cost or limit viability to deploy as not all sites support phase synchronisation.[19]

Limited available bandwidth and compatibility with adjacent paired 2100 MHz spectrum

3.9 BT noted that a guard band may be needed to achieve compatibility with paired 2100 MHz spectrum. This limits the amount of spectrum available which in turn is less economical to deploy high-power mobile.[20] VMO2 and Three also noted that there is a 5 MHz guard band between the paired and unpaired 2.6 GHz spectrum, with Three pointing to a similar guard band between the 700 MHz SDL and FDD uplink spectrum.[21]

3.10 VMO2 suggested that a minimum of 10 MHz spectrum is needed for economically viable mobile deployment and existing small holdings by individual MNOs (5 and 10 MHz) further limits potential for mobile use cases. The band can only support a maximum of two MNOs and requires effective interference management with adjacent paired 2100 MHz spectrum in the absence of a guard band. It noted Ofcom has not considered compatibility with spectrum below 1900 MHz in the event that the 1900-1915 MHz unpaired spectrum is used to deploy high power mobile.[22]

Lack of equipment ecosystem

3.11 BT indicated the main equipment issue is not the availability of mobile devices but of base station equipment operating across the whole 1900-1920 MHz that is compatible with the adjacent paired 2100 MHz spectrum. It said that even if this could be resolved, global harmonization is unlikely and there would be a time delay before high power 4G/5G has the potential to be deployed in the band.[23]

[17] Three consultation response, p. 6.
[18] BT consultation response, section 3.1.2 and 3.3.1.
[19] VM02 consultation response, p. 5 and p. 7.
[20] BT consultation response, p. 7.
[21] Three consultation response, paragraphs 2.3 and 2.4; VM02 consultation response, p. 8.
[22] VM02 consultation response, p. 5 and p. 8.
[23] BT consultation response, p. 6.

3.12 VMO2 indicated there is no base station equipment supplier that it is permitted to purchase from that supply equipment in this band. Even if equipment is developed, it would take years to become available and at a very high cost due to lack of scale. It also noted that mobile devices that support this band (band 39) are produced for the Chinese market and need to be adapted to comply with European requirements. It would take years for devices to become available and even longer for a substantial number of users to have devices that support the band.[24]

Our decision

Paired 2100 MHz spectrum

3.13 We maintain our view that the highest value use in the paired 2100 MHz spectrum is mobile services noting that there is no disagreement with this view from respondents.

Unpaired 2100 MHz spectrum

3.14 The responses from MNOs indicate that they have no plans to deploy in the band in the foreseeable future under the current licensing arrangements and that there are a number of barriers to economic deployment. We also note that MNOs have not deployed since acquiring the unpaired 2100 MHz spectrum in 2000.

3.15 Consequently, we are concerned that this spectrum will continue to be unused in the future. We are considering the issues raised and how we might enable this spectrum to be used more effectively in the future noting planned emergency services gateway use, European harmonisation for railway services and utilities sector spectrum requirement for secure network.

3.16 We plan to consult on the future use of the band, including on a proposal to revoke the unpaired licences and consider it would be appropriate to consider the issue of fees at that time and within that context. We are not therefore, setting a fee for unpaired 2100 MHz spectrum in this statement.

Approach to determining the annual licence fees payable for paired 2100 MHz spectrum

Our provisional view

3.17 In the July 2021 consultation, we explained that having provisionally determined the next highest value use or user, and following the framework we set out in the SRSP, our starting point when calculating the appropriate fee for a spectrum band is to first determine the market value (based on its opportunity cost to that next highest use or user) of the spectrum concerned. For mobile spectrum, we considered the evidence on the market value of mobile spectrum bands which have been auctioned in the UK alongside other

[24] VM02 consultation response, p. 6 and p. 7.

evidence (where available). We then converted these lump-sum market values into equivalent annual rates by applying an annualisation rate. Next, we considered in light of our statutory duties, what the likely impact of setting fees at that level would be, and whether, as a consequence of that assessment, there was any reason for us to set fees at a different level. Taking all the above into account, we reached a provisional view on the appropriate level of fees for the 2100 MHz spectrum.

Consultation responses

3.18 BT, VMO2 and Vodafone agreed with our approach and made the following points:

a) BT suggested that the approach whilst practical is subject to a large margin of error and must be applied with caution and results interpreted conservatively due to differences in market situations over time and a reliance on auction data from limited countries.[25]

b) VMO2 suggested that Ofcom and industry should evaluate this methodology outside the context of setting ALFs for an individual spectrum band, arguing that the methodology, while supporting ALFs that reflect reasonable market values, lacks an intuitive understanding of how ALFs vary in UK auction outcomes and international benchmarks.[26]

c) Vodafone questioned the sustainability of the approach when, in its view, there are likely to be fewer relevant auctions and the current approach will thus be relying on increasingly historical data. It considers it is already difficult to determine whether auction price differences are due to the different values placed on specific bands or are an artefact of when the spectrum award took place. It also suggested an alternative approach whereby holders of the least spectrum would pay an administrative fee whilst those operators using more spectrum would pay for their excess usage.[27]

Our decision

3.19 We recognise that auction values are in practice affected to a significant extent by factors specific to the particular award.

3.20 We note that there is no disagreement with the overarching approach and that the key focus of all responses was how Ofcom exercises regulatory judgement with regard to specific auctions. We also note that Vodafone's suggestion of an alternative methodology is related to future determinations of ALF (in other spectrum bands) rather than ALF in this specific case. We consider that the evidence we have included in this assessment is relevant to assessing the market value of the paired 2100 MHz spectrum.

3.21 In considering the evidence on the market value of mobile spectrum bands which have been auctioned in the UK we note:

[25] BT consultation response, section 2.2.
[26] VMO2 consultation response, p. 2 and p. 4.
[27] Vodafone consultation response, p. 5 and p. 6.

a) when setting the ALF for 3.4 GHz and 3.6 GHz spectrum already held by UK Broadband Ltd ("**UKB**") in 2019, we based our estimate of market value on the results of the 2018 auction of 3.4 GHz spectrum;[28] and

b) when setting ALFs for 900 MHz and 1800 MHz spectrum in 2018, neither of those bands had been auctioned in the UK. In that case we used the results of the 2013 UK auction of 800 MHz and 2.6 GHz spectrum, alongside the results of auctions involving 800 MHz, 900 MHz, 1800 MHz and 2.6 GHz in other European countries, to derive our estimates of the value of the 900 MHz and 1800 MHz bands.[29]

3.22 The 2100 MHz spectrum was auctioned in the UK in 2000.[30] However, our view is that it would not be appropriate to use this 20-year old auction result to inform our forward-looking view of the market value of this spectrum, noting that there is no disagreement to this view from respondents.

3.23 There is no directly relevant UK auction evidence since 2000 to inform the market value of the paired 2100 MHz spectrum, which means that we cannot adopt the same approach as we did when setting ALF for UKB's 3.4 and 3.6 GHz spectrum.

3.24 We therefore consider the more appropriate approach is that taken for 900 MHz and 1800 MHz ALFs. That is, to use the results of recent UK auctions of mobile spectrum in other bands alongside other relevant evidence, including the results of auctions in other European countries (in each case, where available).

3.25 Our approach to determining the ALF payable for the paired 2100 MHz spectrum can therefore be summarised as follows:

a) We estimate the lump-sum market value of UK spectrum bands that have been auctioned in recent years (the "auction bands").

b) We consider auction prices for 2100 MHz and the auction bands in European countries from 2010 onward, from which we derive the relative value of 2100 MHz to the auction bands in these benchmark countries. We use these relative values, in combination with our estimates of the UK market value of the auction bands to derive a set of benchmarks for the lump-sum market value in the UK of the paired 2100 MHz spectrum.

c) We assess this benchmark evidence to reach a view on the lump-sum market value of UK paired 2100 MHz spectrum. In view of our statutory duties to secure the optimal

[28] Ofcom, *Annual Licence Fees for UK Broadband's 3.4 GHz and 3.6 GHz spectrum*, June 2019, https://www.ofcom.org.uk/__data/assets/pdf_file/0013/151231/statement-annual-licence-fees-uk-3.4-ghz-and-3.6-ghz-spectrum.pdf.

[29] Ofcom, *Annual Licence Fees for 900 MHz and 1800 MHz frequency bands,* December 2018, https://www.ofcom.org.uk/__data/assets/pdf_file/0020/130547/Statement-Annual-licence-fees-900-MHz-and-1800-MHz.pdf.

[30] https://webarchive.nationalarchives.gov.uk/20080715010941/http://www.ofcom.org.uk/static/archive/spectrumauctions/press/200427.htm

use of spectrum, we adopt a conservative approach to the interpretation of the evidence.

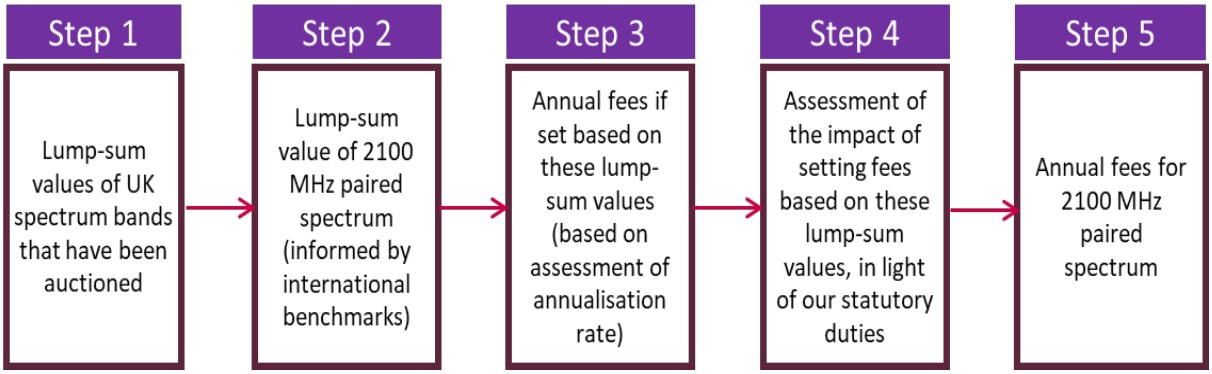
d) To convert the lump-sum value into an equivalent annual payment, we apply an annualisation rate, derived from a post-tax discount rate (which takes into account the degree of risk-sharing between licensees and the Government) and a tax adjustment factor (reflecting the more favourable tax treatment of annual fees compared to lump-sum auction payments).

e) Next, we consider in light of our statutory duties, what the likely impact of setting fees at that level would be, and whether, as a consequence of that assessment, there is any reason for us to set fees at a different level. Taking all of the above into account, we reached a conclusion on the appropriate level of fees for the 2100 MHz spectrum in this case.

3.26 The Direction requires Ofcom to set the annual licence fees for the 2100 MHz spectrum so that they reflect the full market value of the frequencies in the band. The approach we have decided to adopt in this case is therefore also consistent with and reinforced by the Direction which has been considered in the light of our statutory duties.

3.27 This overall approach for paired 2100 MHz spectrum is illustrated in Figure 3.1 below.

Figure 3.1: Framework of steps to determine ALF for paired 2100 MHz spectrum



3.28 Steps 1, 2 and 3 above are outlined in the next section (Section 4). Section 5 sets out our impact assessment under Step 4, and Step 5 is set out in Section 6.

4. Market value of paired 2100 MHz spectrum

Introduction

4.1 This section sets out our assessment of the market value of the paired 2100 MHz spectrum, based on the framework of steps set out in Figure 3.1 in Section 3, taking into account consultation responses.

4.2 We first set out market values of UK spectrum bands that have been auctioned (Step 1). Step 2 starts with our approach to international benchmarking, followed by our decision on the relevant international benchmarks, and finally our estimate of the lump-sum market value of paired 2100 MHz spectrum informed by the international benchmarks. We conclude this section with Step 3 which converts the lump-sum market value into an annualised sum.

Market value of UK mobile spectrum bands which have been auctioned

4.3 Step 1 in determining the market value of the paired 2100 MHz spectrum, as outlined in Figure 3.1, is to consider the evidence on the market value of mobile spectrum bands which have been auctioned in the UK.

Our provisional view

4.4 In the July 2021 consultation, we noted that since the auction of the 2100 MHz spectrum in 2000, we had carried out three mobile spectrum auctions and derived auction prices for each of these awards:

a) award of 800 MHz (paired) and 2.6 GHz (paired and unpaired) spectrum in March 2013;

b) award of 2.3 GHz (unpaired) and 3.4 GHz (unpaired) spectrum in April 2018; and

c) award of 700 MHz (paired and supplemental downlink) and 3.6 GHz (unpaired) spectrum in April 2021.

Consultation responses

4.5 VMO2 and Frontier Economics (commissioned by Vodafone) were of the view that the UK 3.6 GHz (2021) auction result should receive a greater weight than the less recent UK 3.4 GHz (2018) auction result, while BT and Three suggested that the latter should be disregarded altogether. BT argued that the more recent price reflects the current marginal value of spectrum in the UK 3.4-3.6 GHz band,[31] while VMO2 argued that it is more informative about the current value in that wider band.[32] Three suggested that the older

[31] BT consultation response, pp. 8-9.
[32] VMO2 consultation response, p. 3.

price is now "superseded" by the more recent price and that bids and values in the UK 3.4 GHz auction were dependent on assumptions about the outcome of the subsequent UK 3.6 GHz auction which awarded further spectrum in that wider band.[33]

4.6 Frontier noted that the two awards of 3.4 GHz and 3.6 GHz spectrum may have been influenced to an extent by strategic bidding given complexity on bidding on sequential auctions. It considered it was unclear whether the resulting prices were likely to over or under-estimate market value. Frontier considered that the prices paid for 800 MHz and 2.6 GHz spectrum in 2013 were unlikely to be informative of the current forward-looking market value of these bands, given the trend for convergence in values of sub 1-GHz spectrum. It also noted that it had previously identified issues with Ofcom's approach to estimating the prices of 800 MHz and 2.6 GHz. It considered that estimates based on the more recent UK 700 MHz and 3.6 GHz auction prices should receive a greater weight than estimates based on other, less recent UK auction prices. [34]

Our decision

UK auction bands

4.7 We consider that the auction prices from the three recent mobile spectrum auctions that we have carried out are relevant evidence for determining the market value of UK 2100 MHz spectrum.

4.8 Table 4.1 below sets out the auction prices (in April 2021 prices[35]) from these auctions. In this document we refer to these spectrum bands as the "auction bands."

Table 4.1: Auction prices from recent UK mobile spectrum auctions

Spectrum band	Auction date	Price (per MHz)
700 MHz	March 2021	£14.1m[36]
800 MHz	March 2013	£37.0m[37]
2.3 GHz	April 2018	£5.4m
2.6 GHz	March 2013	£6.2m[38]
3.4 GHz	April 2018	£7.9m
3.6 GHz	March 2021	£4.2m

[33] Three consultation response, paragraphs 3.2 and 3.6-3.8.
[34] Frontier Economics (commissioned by Vodafone), pp. 15-16.
[35] In this Statement, we state all auction prices in April 2021 prices. This is to ensure consistency and aid comparability with the July 2021 consultation where auction prices were also stated in April 2021 prices.
[36] Market value for 700 MHz paired spectrum.
[37] This is gross of expected DTT co-existence costs. See Ofcom, *Annual Licence Fees for 900 MHz and 1800 MHz frequency bands,* December 2018, https://www.ofcom.org.uk/__data/assets/pdf_file/0020/130547/Statement-Annual-licence-fees-900-MHz-and-1800-MHz.pdf, paragraphs 4.5 and 4.6. In the remainder of this section we refer to this as the **2018 Statement.**
[38] Market value for 2.6 GHz paired spectrum.

Source: Ofcom[39]

4.9 In December 2018, we set ALFs for 900 MHz based on a lump-sum value of £19.8m, and for 1800 MHz based on a lump-sum value of £14.6m (in April 2021 prices). These were informed by the UK auction values from the March 2013 auction.

4.10 The UK auction results show that there can be significant variation in the prices achieved for similar spectrum bands, reflecting the fact that auction values are in practice affected to a significant extent by factors specific to the particular award, market developments and timing. This feature in turn illustrates the complexity of the challenge we have in determining the appropriate market value for UK 2100 MHz paired spectrum, and the fact there is no one "correct" value that can be mechanistically derived from the data we have.

4.11 Notwithstanding significant price variation for mobile spectrum bands, the UK auction results indicate that sub-1 GHz spectrum is more highly valued than high frequency spectrum.

Weight on more recent auctions

4.12 We have considered the points raised by stakeholders in relation to the UK 3.4 GHz and 3.6 GHz auctions. In 2019 (following the 3.4 GHz auction but before the 3.6 GHz auction) when we set the ALF for UK Broadband's 3.4 and 3.6 GHz spectrum we were of the view (and the four MNOs did not disagree) that *"the long-term value of the 3.6-3.8 GHz band will be the same as the 3.4-3.6 GHz band."*[40]

4.13 We recognise that the different auction prices for 3.4-3.8 GHz spectrum in the UK 2018 3.4 GHz and 2021 3.6 GHz auctions raise a question as to how we interpret the results of these two auctions for the purposes of estimating the market value of the paired 2100 MHz spectrum.

4.14 We also recognise that in assessments involving quantitative evidence, there is often a presumption that the most recent evidence will give the most accurate picture. However, in this case for the purposes of estimating the market value of the paired 2100 MHz spectrum, we do not consider that that is necessarily the case.

4.15 This presumption most clearly applies in relation to trending data that follows a pattern over time. In the present case, notwithstanding the different auction outcomes, we do not consider that there is strong evidence to suggest that the long-term value of the 3.4-3.8

[39] March 2013 auction prices derived from Ofcom 2018 Statement, paragraphs 4.6 and 4.9. April 2018 auction prices derived from Ofcom, *Award of 2.3 and 3.4 GHz spectrum bands - Publication under regulation 111 of the Wireless Telegraphy (Licence Award) Regulations 2018 of results of auction,* 13 April 2018, https://www.ofcom.org.uk/__data/assets/pdf_file/0018/112932/Regulation-111-Final-outcome-of-award.pdf. March 2021 auction prices derived from Ofcom, *Award of the 700 MHz and 3.6-3.8 GHz spectrum bands – Publication of the results of the Principal Stage of the auction under regulation 49 of the Wireless Telegraphy (Licence Award) Regulations 2020,* 17 March 2021, https://www.ofcom.org.uk/__data/assets/pdf_file/0017/216107/publication-ps-results-reg-49.pdf.

[40] Ofcom, *Annual Licence Fees for UK Broadband's 3.4 GHz and 3.6 GHz spectrum*, June 2019, https://www.ofcom.org.uk/__data/assets/pdf_file/0013/151231/statement-annual-licence-fees-uk-3.4-ghz-and-3.6-ghz-spectrum.pdf, paragraphs 3.22-3.30.

GHz band changed between the two auctions such that the more recent auction is presumptively, in our view more informative.

4.16 Rather, as we noted in the SRSP, a number of different factors can influence the outcome of a particular auction. We therefore consider, consistent with our general approach to all auction evidence used in our assessment, that the appropriate approach is to include all relevant evidence.[41]

4.17 In this case, we consider that both the UK 3.4 GHz and 3.6 GHz auctions are relevant evidence. Neither auction had unsold spectrum, both sold above reserve price (albeit not by much in the case of the more recent 3.6 GHz auction), and there appears to be some evidence of competitive bidding in both auctions.

4.18 As a result, our view is that there is not a clear reason to prefer one auction result over the other. As such, we place equal weight on both auction outcomes when making our assessment. We also do not think it is appropriate for the value for the high frequency spectrum to have a strong influence on the resulting value we set for 2100 MHz – given that the latter is a mainstream coverage band we think it is more similar to the lower frequency spectrum used for coverage and should be influenced to a greater extent by the value of spectrum at this end of the range.

4.19 With regards to the point raised by Frontier in relation to the 800 MHz and 2.6 GHz (2013) auction prices, we discuss Frontier's more general point about spectrum values over time in more detail in paragraphs 4.61 to 4.63 below and remain of the view that these auction prices are relevant evidence.

Conclusion

4.20 For the reasons set out above, we consider that the auction prices from the three recent UK mobile spectrum auctions that we have carried out are relevant evidence for determining the market value of paired 2100 MHz spectrum.

4.21 Our expectation is (consistent with our position in the consultation) that the value of the paired 2100 MHz spectrum will lie somewhere between the value of the higher frequency spectrum bands and sub-1 GHz spectrum – that is, somewhere between £4.2m per MHz and £37.0m per MHz. We also consider it is unlikely to be valued at significantly more than the lowest value sub-1 GHz auction price (£14.1m per MHz) and unlikely to be valued at significantly less than the highest value higher frequency band auction price (£7.9m per MHz).

4.22 We also expect the value of the paired 2100 MHz spectrum to be relatively close to the value of the 1800 MHz spectrum given both bands are mainstream coverage bands with similar propagation characteristics and established equipment ecosystem.

[41] As we set out in paragraph 3.22 above, we do not use the UK auction evidence from the 2000 award of the 2100 MHz spectrum because we do not consider this to be relevant evidence – spectrum prices in that award were considerably higher than spectrum prices observed in the UK subsequently.

Market value of paired 2100 MHz spectrum

4.23 Step 2 in determining the market value of the paired 2100 MHz spectrum, as outlined in Figure 3.1, is to consider the relevant evidence from European auctions, alongside the evidence from the recent UK auctions of low and high frequency mobile spectrum to reach a view on the lump-sum market value of UK paired 2100 MHz spectrum.

4.24 We break this step down into three parts:

a) first, we set out our approach to the international benchmarking exercise;

b) we then set out the relevant international benchmarks that we have decided to use in this case, further to consideration of consultation responses; and

c) we then assess this benchmark evidence to reach our view on the lump-sum market value of the paired 2100 MHz spectrum.

Approach to international benchmarking

4.25 In our July 2021 consultation, as we did in the case of 1800 MHz in 2018, we proposed to take the evidence from recent UK auctions of low and high frequency mobile spectrum as a starting point for the bounds within which the paired 2100 MHz value is likely to lie, and then to use evidence from European auctions to inform our view of where within this range it is likely to sit in the UK. We have previously referred to this as a "distance method benchmark".[42]

4.26 In the case of 1800 MHz, we used one low frequency band (800 MHz) and one high frequency band (2.6 GHz) in the benchmark. We noted that as we now have more UK auction bands – two UK sub-1 GHz auction bands (700 MHz and 800 MHz), and four higher frequency UK auction bands (2.3 GHz, 2.6 GHz, 3.4 GHz and 3.6 GHz), there are more possible combinations of benchmarks that we can use.

4.27 We considered the relative benchmarks from each of these combinations on their merits. We did not consider there were strong *a priori* reasons to believe that a particular distance method would be more informative of the forward-looking market value of UK paired 2100 MHz spectrum than another. We also noted that considering each of these combinations in the round enables us to take into account the widest range of relevant UK and European auction evidence.

4.28 We identified European countries in which there had been a recent spectrum award of paired 2100 MHz for which it was possible to derive band specific prices and where there had also been recent spectrum awards of at least one of the auction bands (700 MHz, 800 MHz, 2.3 GHz, 2.6 GHz, 3.4 GHz and 3.6 GHz). We noted that the auction results from these

[42] The distance method consists of (a) calculating the Y/X ratio (calculated as the difference in value between (in this case) 2100 MHz and the higher frequency comparator band ("Y"), divided by the difference in value between the lower frequency comparator band and the higher frequency comparator band ("X"), and (b) relating this to the corresponding lower and higher frequency band values in the UK to solve for the UK value of 2100 MHz. Further details on these calculations are set out in Annex A2.

countries provided potentially useful information on the relative value of the different spectrum bands to help inform our view on where the value of the paired 2100 MHz was likely to sit relative to spectrum bands which had been auctioned in the UK.

4.29 Consistent with our approach in 900 MHz and 1800 MHz ALFs, we categorised these benchmarks into three tiers. These categorisations reflect how informative of relative UK market values we consider the benchmarks to be, with Tier 1 the most informative and Tier 3 the least informative.[43] Our criteria for placing a relative benchmark in Tier 1 are that:

a) the auction prices appear likely to have been primarily determined by a market-driven process of bidding in the auctions (generally this means the prices were not set by reserve prices);

b) based on the evidence available to us, the relative prices in the auction are at least as likely to be based on bidders' intrinsic valuations of spectrum as on strategic bidding; and

c) the outcome appears likely to be informative of forward-looking relative spectrum values in the UK, having regard to country-specific circumstances and auction dates. [44]

4.30 In addition to our assessment of which tier a benchmark is in, we assessed whether there was a risk that each benchmark was an understated or overstated estimate of the UK value of paired 2100 MHz. For example, a binding spectrum cap could create a risk of that auction understating the market value in that country.

4.31 We have adopted the above approach, noting there was no disagreement from respondents to the consultation on the distance method approach for international benchmarking; and that all respondents supported the addition of more recent auctions in our estimation of market value for paired 2100 MHz spectrum.

Relevant international benchmarks

Our provisional view

4.32 In our July 2021 consultation, there were four countries for which we derived Tier 1 distance method benchmarks: Austria, Germany, Hungary, and Slovenia. We also had four countries for which we derived Tier 3 distance method benchmarks. We did not identify any countries for which we could derive Tier 2 distance method benchmarks.

4.33 We also had good (Tier 1) quality 700 MHz and 2100 MHz evidence from the Netherlands, but we were not able to derive a Tier 1 distance method benchmark because we did not have a Tier 1 quality high frequency auction result. In the July 2021 consultation we sought

[43] For the avoidance of doubt, each individual benchmark is assessed against the tiering criteria and given its own tier. That means it is possible for two different benchmarks from a particular country to end up in different tiers.
[44] Our criteria for placing a benchmark in Tier 2 are that one or more of the criteria for Tier 1 are not met; but
i) there is some evidence that the relative auction prices reflect bidders' relative intrinsic valuations of different bands; and
ii) while there is a clear, evidence-based reason for considering that the outcome is less informative of forward-looking relative spectrum values in the UK, the outcome is not obviously uninformative of forward-looking relative spectrum values in the UK. Our criterion for placing a benchmark in Tier 3 is that it does not meet the criteria for Tier 1 or Tier 2.

to take this evidence from the Netherlands into account alongside our Tier 1 benchmarks by deriving Dutch relative value benchmarks for 2100 MHz using proxy values for the high frequency bands.

Consultation responses

4.34 In their consultation responses, each of the MNOs set out which benchmarks they considered should be classified as Tier 1 benchmarks. In the following paragraphs we first set out the points raised by stakeholders which underpinned their views on which benchmarks should be Tier 1. We then summarise in Table 4.2 which benchmarks each of the MNOs considered should be classified as Tier 1 benchmarks.

German and Slovenian benchmarks where Y/X>1

4.35 All four respondents raised concerns about benchmarks that produce a Y/X ratio greater than 1 (where 2100 MHz is valued more highly than 700 MHz). That is, the three Slovenian benchmarks and the three German benchmarks which use 700 MHz as the low frequency band.

4.36 The MNOs argued that these benchmarks should be disregarded, excluded or capped at a Y/X ratio equal to 1 as they considered a higher value of the ratio was counter-intuitive, "non-sensical" and inconsistent with the view that sub-1 GHz spectrum was more highly valued per MHz than higher bandwidth spectrum.[45]

4.37 In addition, BT and Vodafone raised specific points about those German and Slovenian auctions, which in their view meant that the resulting benchmarks should not be considered as Tier 1. Vodafone considered that in both cases the difference in 700 MHz and 2100 MHz auction pricing was more likely to be a result of specific circumstances relating to the auctions than being indicative of the underlying relative value of the bands. BT suggested that the Slovenian auction results may have been due to strategic bidding and considered that the German 700 MHz auction was affected by strategic bidding and a temporary 3 MNO market and as such did not meet the criteria for Tier 1.[46] We discuss these specific points in more detail in Annex A3.

Dutch benchmarks using proxy values

4.38 Respondents presented mixed views on using the Dutch proxy benchmarks. BT, Three and VMO2 submitted that the Dutch proxy benchmarks should be given the same weight as the other Tier 1 benchmarks, consistent with the approach taken in setting 1800 MHz ALFs. BT also suggested that an alternative approach would be to just look at the relativity of the available Netherlands 700 MHz and 2100 MHz auction prices.[47] Frontier considered that there were shortcomings with the use of proxy data which in their view meant that the

[45] BT consultation response, pp. 9-11; Three consultation response, paragraphs 3.2, 3.6 and 3.8-3.9; Vodafone consultation response, p. 6; and VMO2 consultation response, p. 3.
[46] BT consultation response, pp. 12-15; Vodafone consultation response, p. 2 and pp. 6-7; and Frontier Economics, pp. 17-23.
[47] BT consultation response, p. 9; Three consultation response, paragraphs 3.3 and 3.10-3.15; and VMO2 consultation response, p. 3.

resulting estimates were less robust and should be demoted in importance in Ofcom's assessment (for example, being considered as Tier 2 evidence).[48]

Spectrum values over time

4.39 Frontier considered that the valuations in auctions prior to 2015 reflected market valuations based on 4G technology and services rather than forward looking valuations which reflect current technologies such as 5G and mMIMO and therefore only those benchmarks based solely on the most recent auctions should be considered Tier 1. [49]

Respondents' views on relevant Tier 1 benchmarks

4.40 Table 4.2 below sets out which benchmarks each of the MNOs considers should be treated as Tier 1 benchmarks. These are based on their views of which international benchmarks should be considered as Tier 1, and their views on the respective weights that should be given to the UK 3.4 GHz and 3.6 GHz auction results (as discussed in paragraphs 4.5 to 4.6 above).

Table 4.2: Benchmarks respondents considered should be in Tier 1

Country	Benchmark	July 2021 consultation	BT	Three	VMO2	Vodafone
Austria	700-2100-2600	Y	Y	Y	Y	Y**
Austria	700-2100-3400	Y			Y*	Y
Austria	700-2100-3600	Y	Y	Y	Y	Y
Austria	800-2100-2600	Y	Y	Y	Y	Y**
Austria	800-2100-3400	Y			Y*	Y**
Austria	800-2100-3600	Y	Y	Y	Y	Y**
Germany	700-2100-2600	Y				
Germany	700-2100-3400	Y				
Germany	700-2100-3600	Y				
Germany	800-2100-2600	Y	Y	Y	Y	
Germany	800-2100-3400	Y			Y*	
Germany	800-2100-3600	Y	Y	Y	Y	
Hungary	700-2100-3400	Y			Y*	Y
Hungary	700-2100-3600	Y	Y	Y	Y	Y
Slovenia	700-2100-2300	Y				

[48] Frontier Economics, p. 24.
[49] Frontier Economics, pp. 11-16, and pp. 24-25.

Slovenia	700-2100-3400	Y				
Slovenia	700-2100-3600	Y				
Netherlands	Proxy values	Y	Y multiple values	Y multiple values	Y multiple values	Y**

Source: Ofcom, based on stakeholder responses.

Note: Y: VMO2 suggested giving less weight to this benchmark but unlike BT and Three did not propose excluding altogether. Y**: Frontier in its report commissioned by Vodafone did not include this benchmark in Tier 1.*

4.41 **BT** excluded[50] the Slovenian benchmarks and the German 700 MHz benchmarks on the basis that they did not satisfy the Tier 1 criteria; excluded the benchmarks based on the UK 3.4 GHz auction; and included Dutch proxy-derived LSVs. This left it with 13 benchmarks, of which 6 were Dutch proxy values.[51]

4.42 **Three** excluded the Slovenian benchmarks and German 700 MHz benchmarks on the basis that the Y/X>1; excluded the benchmarks based on the UK 3.4 GHz auction; and included Dutch proxy-derived LSVs. This left it with 10 benchmarks, of which 3 were Dutch proxy values.[52]

4.43 **VMO2** suggested excluding the Slovenian and German 700 MHz benchmarks on the basis that the Y/X>1, placing more weight on the benchmarks based on the UK 3.6 GHz than those based on the UK 3.4 GHz auction, taking more account of the risk of overstatement of the Slovenian results, and including the Dutch proxy benchmarks.[53]

4.44 **Vodafone** excluded all the German and Slovenian benchmarks on the basis that the relative pricing was rooted in specific local circumstances rather than being reflective of the intrinsic values of the bands.[54] **Frontier** took a slightly different approach. It proposed excluding from Tier 1 all benchmarks which relied on data from auctions before 2015, in addition to the Slovenian benchmarks and the German 700 MHz benchmarks. It also considered that the Dutch proxy values should not be included in Tier 1. This left it with four benchmarks (two from Austria and two from Hungary).[55]

[50] Here, and in the following paragraphs, we use the phrase "excluded" to mean that stakeholders did not consider the benchmarks should be included in Tier 1. This includes situations where stakeholders proposed moving a benchmark(s) to a lower tier.
[51] BT consultation response, section 3.2.3. BT also updated the PPP and population data to the most up-to-date data in deriving its estimate. It also made an adjustment to the Slovenian auction results to account for the assignment fee. As set out in Annex A2, paragraphs A2.38-A2.39 we have also made this adjustment to the Slovenian prices we use following BT's comments.
[52] Three consultation response, paragraphs 3.4-3.5 and 3.16-3.22.
[53] VMO2 consultation response, p. 3.
[54] Vodafone consultation response, p. 7.
[55] Frontier Economics, pp. 25-26.

Our decision

4.45 In reaching our decision on the relevant international benchmarks in this case, we begin with the Tier 1 distance method benchmarks from Austria, Germany, Hungary, and Slovenia, and the Dutch benchmark using proxy values, that we used in the July 2021 consultation. We note that no respondent suggested that there were benchmarks from other countries that should be considered as Tier 1.

4.46 In the following paragraphs, we set out our view on which benchmarks should be considered Tier 1, taking into account the specific points raised by stakeholders. The detailed assessment of each of these benchmarks against the tiering criteria is set out in Annex A3.

German and Slovenian benchmarks where Y/X>1

4.47 As set out in the July 2021 consultation and set out further above, our expectation is that the value of the paired 2100 MHz spectrum will lie somewhere between the value of the higher frequency spectrum bands and sub-1 GHz spectrum – that is, somewhere between £4.2m per MHz and £37.0m per MHz (see Table 4.1 above). We also consider it will be unlikely to be valued at significantly more than the lowest value sub-1 GHz auction price (£14.1m per MHz) and unlikely to be valued at significantly less than the highest value higher frequency band auction price (£7.9m per MHz).

4.48 However, we do not consider that it is appropriate to discount or downgrade individual benchmarks purely on the basis that the values they generate do not fit with our prior expectations.

4.49 Instead, we consider the appropriate approach is to consider the individual benchmarks on their merits, and ensure that if we do include them as Tier 1 benchmarks (on the basis they meet the criteria for inclusion) we interpret them in an appropriate manner.

Do the individual benchmarks satisfy the criteria for Tier 1?

4.50 In Annex A3 we carefully consider the points raised by BT and Vodafone (including Frontier's report) in relation to the German and Slovenian auctions.

a) In the case of Slovenia, for the reasons set out in Annex A3 paragraphs A3.108 to A3.118, we do not consider that the points raised by respondents support downgrading the Slovenian benchmarks from Tier 1 to Tier 2. In particular, although the limited pre-auction spectrum holdings of the smallest bidder T-2, who only held spectrum in the 2100 MHz band, may have made the auction conducive to strategic bidding in the form of price driving by other bidders, we note that this was to some extent mitigated by the pre-auction holdings in the same band of all the other bidders and we do not consider that there is clear evidence to suggest that price driving did in fact occur.

b) In the case of Germany, we agree that there was a degree of strategic bidding in the 2015 auction such that it is finely balanced as to whether the German benchmarks involving 700 MHz (which was part of the 2015 auction) should be considered Tier 1 or Tier 2 benchmarks. For the reasons set out in Annex A3 paragraphs A3.51 to A3.59, we

> conclude on balance that these benchmarks should be included in Tier 1. In particular, whilst the initial bidding rounds appear consistent with strategic demand reduction in the 700 MHz band, the later rounds appear to reflect more competitive bidding which, despite its apparent use for signalling purposes, has ultimately driven the auction price significantly above the reserve price towards the intrinsic value. We note that this is consistent with our treatment of the 900 MHz and 1800 MHz bands from the same auction in our 2015 and 2018 ALF determinations.[56]

4.51 We therefore conclude that these benchmarks should be included as Tier 1 benchmarks.

How do we interpret the German and Slovenian benchmarks where Y/X>1?

4.52 As BT and Frontier rightly point out, the distance method we use is designed to interpolate a value for 2100 MHz between the UK values of the higher frequency and sub-1 GHz spectrum bands. When a situation arises where the value of 2100 MHz in a benchmark country is greater than the value of 700 MHz (that is, Y/X>1) the distance method instead extrapolates a value for 2100 MHz above the UK value for 700 MHz, which raises a question as to how meaningful the resulting value is and therefore we need to be careful how we interpret these results.[57]

4.53 Stepping back from the complexity of deriving a value for these benchmarks, what the available auction evidence in each of these cases suggests is (i) a value of 2100 MHz greater than £14.1m per MHz, and (ii) that that value is at risk of overstatement.

4.54 One option, as proposed by BT, would be to cap the Y/X ratio at 1 (that is, cap the lump-sum value at £14.1m per MHz). While this suggestion has some merit, particularly if we were taking a mechanistic approach to deriving a lump-sum value, it is an arbitrary adjustment and ignores the fact that the available auction evidence points to a lump-sum value greater than that. As a result, it could carry a risk of understatement.

4.55 We consider that, on balance, the approach we should take is to use the value generated by the distance method as a reasonable estimate for that benchmark, and note that it carries a risk of overstatement. We will use those values when generating summary statistics and will be careful when interpreting those values in the round, recognising the limitations associated with their derivation.

Dutch benchmarks using proxy values

4.56 Based on the responses from BT, Three and VMO2 it appears that there was some misunderstanding of how the Dutch proxy values were incorporated into our analysis in the consultation. It was not the case that we did not rely on them to estimate the market value or that they were used only as a sense check.

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[56] Ofcom, *Annual Licence Fees for 900 MHz and 1800 MHz spectrum,* September 2015, paragraphs 3.65-3.67 and 3.75-3.76. https://www.ofcom.org.uk/__data/assets/pdf_file/0033/79764/statement.pdf
Ofcom*, Annual Licence Fees for 900 MHz and 1800 MHz frequency bands*, December 2018, paragraphs 4.42-4.48,

[57] For example, as BT note, counterintuitively a lower UK high frequency band price results in a higher estimated UK 2100 MHz when Y/X>1. See BT consultation response, pp. 9-11.

4.57 In setting ALFs for 1800 MHz spectrum we used a single distance method approach based on 800 MHz and 2.6 GHz. This meant that for each Tier 1 benchmark country we had one relative value benchmark, and for each Tier 1 country for which we used a proxy for 2.6 GHz we had one resulting relative value benchmark. In that case, it was therefore appropriate to give equal weight to each of these benchmark values.

4.58 The complexity in the present case is that we have multiple comparator spectrum bands and can therefore derive four different relative benchmarks for the Netherlands using proxy values. We consider that if we were to just mechanistically include all four of these results alongside the other Tier 1 benchmarks we would be giving disproportionate weight to the Dutch proxy values – it would lead to a situation where we had more benchmarks from the Netherlands than either Hungary or Slovenia despite having fewer data points.

4.59 On the other hand, whilst we recognise, as Frontier points out, that there are necessarily limitations with using proxy data, on balance we consider that these results are sufficiently informative to be considered Tier 1 evidence.

4.60 We therefore remain of the view that the appropriate approach to including the Dutch evidence is (as we did in the consultation) to set out the range of values generated by the Dutch proxies; consider the impact on the average of the Tier 1 benchmarks of including an estimate based on the Dutch proxy values[58]; and consider the evidence from the Netherlands alongside the other Tier 1 benchmarks in reaching our view on the appropriate estimate of the lump-sum value.

Spectrum values over time

4.61 In relation to the points raised by Frontier regarding spectrum values over time, we recognise that technological and commercial developments could have an impact on forward-looking market values. While these developments make the interpretation of benchmarks involving older auctions and auctions at different points in time less straight-forward, we remain of the view that, appropriately interpreted, these auctions are informative of forward-looking market value.[59]

4.62 As we are deriving relative value benchmarks, the respective timing of the UK and international auction is also of relevance. For the benchmarks that use 800 MHz and 2.6 GHz (for which the UK auction took place in 2013), we note that the respective international auctions in Austria and Germany took place between 2010 and 2013.

4.63 We also note that none of the MNOs (including Vodafone who commissioned the Frontier report) raised concerns about including auction evidence from before 2015 in Tier 1.

[58] In the consultation we considered the average of the Tier 1 benchmarks including the lowest of the Dutch proxy values.
[59] As mentioned above in paragraph 3.22 it is also the case that we do consider some older auctions not to be informative of forward-looking market value. In particular, we have disregarded the 2000 auction of 2100 MHz. This was on the basis that the auction prices paid in that auction (and some other European spectrum awards around that time) were considerably higher than all subsequent auctions and were therefore unlikely to be informative of forward-looking market value.

Decision on Tier 1 benchmarks

4.64 Having considered stakeholders' responses, and for the reasons set out above, our view is that all the benchmarks (listed in Table 4.3 below) from Austria, Germany, Hungary and Slovenia should be considered Tier 1 benchmarks.

4.65 Our view is that we should consider each of these relative benchmarks and the additional Dutch benchmark using proxy values on their merits. We do not consider there are strong *a priori* reasons to believe that a particular distance method would be more informative of the forward-looking market value of UK paired 2100 MHz spectrum than another, or that we should in principle attach more weight to benchmarks based on more recent auction evidence.

Table 4.3: Distance method benchmarks we can derive for each Tier 1 country

Country	Date of 2100 MHz auction	700-2300	700-2600	800-2600	700-3400/3600	800-3400/3600
Austria	2020		Y	Y	Y	Y
Germany	2019		Y	Y	Y	Y
Hungary	2020				Y	
Slovenia	2021	Y			Y	

Assessment of the market value of paired 2100 MHz spectrum

Our provisional view

4.66 In our July 2021 consultation, we explained (in paragraphs 4.26 to 4.57 of the consultation) having taken account of the evidence from the UK and international relative benchmarks, that a lump-sum market value estimate of the paired 2100 MHz spectrum of £10.5m per MHz (in April 2021 prices) was appropriate.

Consultation responses

4.67 In their consultation responses, each of the MNOs set out what they considered to be an appropriate value for the paired 2100 MHz spectrum. The differences in these values are primarily driven by the MNOs' respective views on which benchmarks should be included in Tier 1 (as discussed in the previous section).

a) **BT** suggested the value should be **£8.0m per MHz**, representing the mid-point between the minimum and the mean values of the benchmarks it considered should be included in Tier 1.[60]

[60] BT consultation response, section 3.2.3. BT also updated the PPP and population data to the most up-to-date data in deriving its estimate. It also made an adjustment to the Slovenian auction results to account for the assignment fee. As set out in Annex A2, paragraphs A2.38-A2.39 we have also made this adjustment to the Slovenian prices we use following BT's comments.

b) **Three** suggested that the value should be no more than **£8.5m per MHz**, to be 'truly conservative' given the asymmetric risk of setting ALFs below or above market value, corresponding to the bottom of the range of values generated by its application of the distance method using its preferred set of benchmarks and reasoning steps which it considers to be the same as in our consultation.[61]

c) **VMO2** considered a a truly conservative approach would give rise to a market value likely around the **£9.5m per MHz**, lower threshold that Ofcom identified in the consultation.[62]

d) **Vodafone** suggested that the value should be **£7.4m per MHz**, representing the bottom quartile of the values generated by the benchmarks it considered should be included in Tier 1.[63] **Frontier** also suggested a value of **£7.4m per MHz** which was equal to the lowest of the four benchmarks it considered to be Tier 1.[64]

Our decision

Introduction

4.68 In this section, we explain how we have reached our estimate for the lump-sum market value of the paired 2100 MHz spectrum, taking account of the evidence from the UK and international relative benchmarks. Reaching our view has involved considerable exercise of our judgement, reflecting the fact that trying to determine a forward-looking estimate of market value for a specific spectrum band is not a precise science. In using our judgement, we (consistent with our approach in previous ALF determinations) adopted a conservative approach to interpreting the evidence.[65]

4.69 Our assessment is based upon the same structure as we set out in our July 2021 consultation. That is:

a) We begin by looking at the evidence from the Tier 1 benchmarks in the round and present some summary statistics.

b) We then consider the individual benchmarks in more detail to assess their relative merit.

c) Next, we explain how we have assessed all this evidence to reach a view on the appropriate value for the paired 2100 MHz spectrum.

d) Finally, as a cross-check, we look at the values from the Tier 3 benchmarks and compare our value for the paired 2100 MHz spectrum with the value we used to derive the 1800 MHz annual licence fee.

[61] Three consultation response, paragraphs 3.4-3.5 and 3.16-3.22.
[62] VMO2 consultation response, p. 3.
[63] Vodafone consultation response, p. 7.
[64] Frontier Economics, pp. 25-26.
[65] We take a conservative approach to interpreting the evidence to reflect the asymmetry of risk as between the effects on spectrum efficiency from inadvertently setting ALFs either above or below market value, given the uncertainty about the correct estimates for market value.

4.70 We note that respondents to the consultation did not raise concerns about how we had structured our assessment of the evidence and that Three and VMO2 adopted a similar approach in reaching their view on the value of the paired spectrum.

4.71 We note that BT's approach of taking the midpoint between the lowest and average values of the Tier 1 benchmarks is consistent with the approach we have taken in previous ALF determinations where we used that as the starting point for analysis. As set out below (paragraph 4.78), we continue to consider this is a useful way of putting structure on any individual distance method calculation. However, we do not consider that is appropriate to apply in a mechanistic way across all benchmarks. In particular, as we have significantly more Tier 1 benchmarks in our dataset than we did in the case of either 900 MHz or 1800 MHz, we consider that it risks placing disproportionate weight on the lowest value benchmark.

4.72 Similarly, while we recognise that looking at the overall distribution of the Tier 1 benchmarks can be informative in reaching a view on the appropriate market value, we consider Vodafone's approach of taking the bottom quartile of Tier 1 benchmarks as the estimate of market value risks placing disproportionate weight on lower value benchmarks and effectively ignores the values of all benchmarks outside the bottom quartile.[66]

4.73 We recognise that some respondents felt we could have been more conservative in our interpretation of the evidence. In the remainder of this section we explain how we have taken a conservative approach to interpreting the evidence. As we have set out previously in the context of ALFs, taking a conservative approach is not the same as deliberately setting ALFs below our view of the appropriate level.[67]

4.74 We have made some small changes to some of the individual benchmark values further to the consultation. This is a result of updating the PPP and population data to the latest available and removing the assignment fee from the Slovenia auction prices, as BT suggested, and updating the discount rate inputs in accordance with our latest view presented in Annex A4.[68]

Assessment of the Tier 1 benchmark evidence

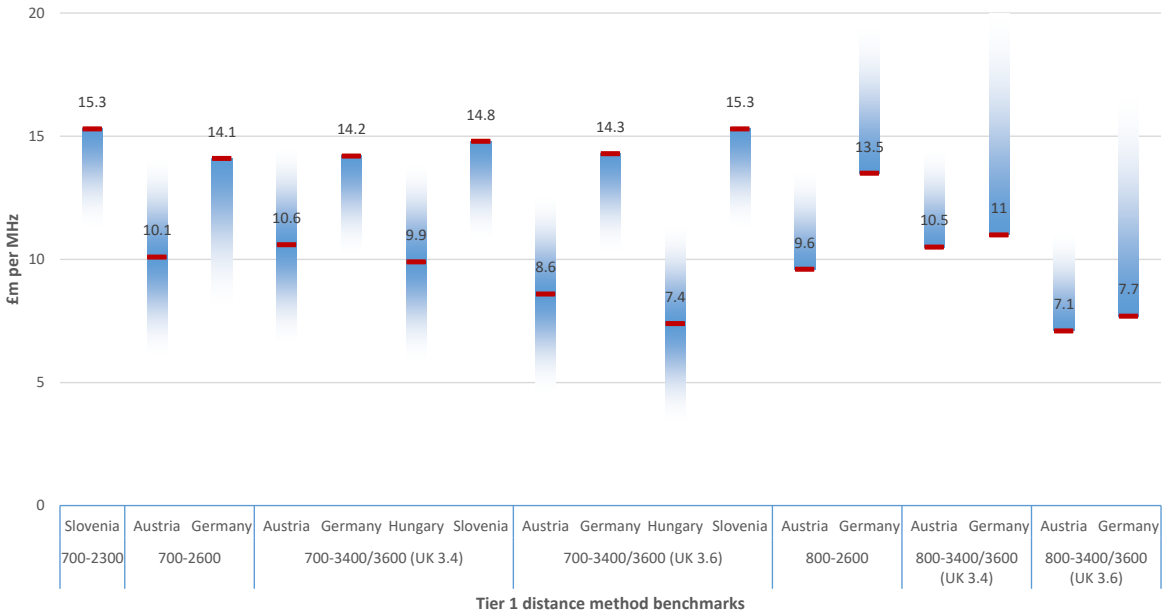
4.75 We begin by looking at evidence from all possible Tier 1 distance method benchmarks, presented in Figure 4.1 below. Whilst there is considerable variation in these results, the majority of benchmarks (10 out of 17) fall within a relatively narrow range of £9.5m - £14.5m per MHz. This too is consistent with our view (discussed in paragraph 4.47 above) that the market value for paired 2100 MHz should lie between the market value for low frequency and high frequency bands in the UK.

[66] With respect to Frontier's approach of considering the lowest value benchmark to be an appropriate indicator of market value we understand its view was based on the fact that it considered there were only four Tier 1 benchmarks. Based on its reasoning we do not consider that it would advocate such an approach in a situation where there were in excess of 15 Tier 1 benchmarks.

[67] See Ofcom, *Annual licence fees for 900 MHz and 1800 MHz spectrum*, 24 September 2015, https://www.ofcom.org.uk/__data/assets/pdf_file/0033/79764/statement.pdf, paragraph 1.39.

[68] See Annex A2, paragraphs A2.38-A2.42 for more information.

Figure 4.1: 2100 MHz Tier 1 distance method benchmarks in £m per MHz



The Tier 1 distance method benchmarks for paired 2100 MHz are shown grouped by the spectrum bands used in the benchmark. The shaded areas illustrate our assessment of the likelihood or scale of possible understatement and overstatement associated with each benchmark.

4.76 Given the way our dataset is constructed, we need to exercise some caution when looking at summary statistics such as averages across all benchmarks.

a) Firstly, as we will discuss in more detail below, some benchmark values are at larger risk of under - or overstatement. Where this is the case, we should exercise caution to ensure that these results are not exerting an undue influence on the overall outcome.

a) Secondly, the dataset we observe in this context is significantly expanded compared to previous ALF determinations as we are using a larger number of recent UK spectrum awards to derive the value of the paired 2100 MHz spectrum. One consequence of this is that we can derive multiple results from countries that have auctioned more comparator bands. We need to exercise caution to ensure that we do not place disproportionate weight on countries that have auctioned more comparator bands.

b) Thirdly, as discussed in paragraphs 4.52 to 4.55 above, there are particular complexities associated with interpreting the values of benchmarks above £14.1m per MHz.

4.77 Nonetheless, we need some way of putting structure on a range of outcomes in our dataset and consider these measures potentially informative. In this context, we observe that the average over all possible Tier 1 benchmarks is £11.4m per MHz[69], and that the large majority of benchmarks (13 out of 17) lie above £9.5m per MHz.

[69] This includes six benchmarks which are at risk of overstatement, and six benchmarks which are at risk of understatement. We note that if we capped Y/X equal to 1, then the average would reduce to £11.2m per MHz but it would be less clear whether the six benchmarks which we had capped remained at risk of overstatement.

4.78 In previous ALF determinations, we have looked at the mid-point between the average and the lowest benchmarks as a starting point for our analysis. We continue to consider this a useful way of putting structure on any individual distance method calculation (e.g. 700-2100-2300 or 700-2100-3600) and present our results for each combination of frequency bands below in Table 4.4.[70]

4.79 These results, again, provide considerable support for our initial assessment: four out of the seven possible combinations of frequency bands have a lower midpoint of between £10.6m - £11.1m per MHz. One combination of frequency bands produces a value of £15.3m per MHz but based on only one data point. The remaining two combinations, both based on UK auction values for the 3.6 GHz band, have lower midpoints which are lower than this, at £7.3m and £9.4m per MHz. We note that one of these has a wide spread of values, with a maximum value of £15.3m per MHz and an average of £11.4m per MHz.

Table 4.4: Summary statistics by spectrum bands used in the benchmark

Spectrum bands used in benchmark	Number of results	Average	Lowest	Midpoint between average and lowest
700-2100-2300	1	15.3	15.3	15.3
700-2100-2600	2	12.1	10.1	11.1
700-2100-3400/3600 (using UK 3400)	4	12.4	9.9	11.1
700-2100-3400/3600 (using UK 3600)	4	11.4	7.4	9.4
800-2100-2600	2	11.6	9.6	10.6
800-2100-3400/3600 (using UK 3400)	2	10.8	10.5	10.6
800-2100-3400/3600 (using UK 3600)	2	7.4	7.1	7.3

4.80 We consider below the individual benchmarks in more detail to assess their relative merit, before presenting our overall assessment that has informed our decision.

[70] We note we do not consider the lower midpoint an appropriate way of looking at all of our distance method benchmarks in the round. This is in part for the same reason we do not place much weight on summary statistics across the sample in its entirety (i.e. not wishing to over-weight a particular country without good reason), and also that in the context of an expanded dataset it then places very significant weight on the single lowest value.

Benchmarks using 2.3 GHz or 2.6 GHz spectrum as the high frequency band

4.81 As shown in Figure 4.1 above, we are able to derive five benchmarks from three different countries using 700 MHz or 800 MHz as the low frequency band and 2.3 GHz or 2.6 GHz as the high frequency band:

a) Slovenia 700-2100-2300 benchmark gives a lump-sum value estimate for 2100 MHz of £15.3m per MHz;

b) For Austria and Germany, we can derive both 700-2100-2600 and 800-2100-2600 benchmarks. For both countries, the results are fairly similar whether looking at the 700-2100-2600 or 800-2100-2600. For Austria it is £10.1m per MHz using 700 MHz and £9.6m per MHz when using 800 MHz; for Germany it is £14.1m per MHz using 700 MHz and £13.5m per MHz using 800 MHz.

4.82 These benchmarks suggest a fairly narrow range of values for the paired 2100 MHz spectrum between £9.6m and £15.3m per MHz, with the average being £12.5m per MHz. We note that both the Slovenian and highest German benchmarks are at risk of overstatement and the lowest Austrian and lowest German benchmarks are at risk of understatement.

Benchmarks using 3.4-3.8 GHz spectrum as the high frequency band

4.83 When looking at benchmarks using 3 GHz spectrum, there are four different Tier 1 countries which have auctioned spectrum in the 3.4-3.8 GHz band for which we can derive relative benchmarks: Austria, Germany, Hungary, and Slovenia.

4.84 As shown in Table 4.5 below, because there have been two separate UK auctions in the 3.4-3.8 GHz band (the 2018 3.4 GHz and 2021 3.6 GHz auction) we get two different estimates for the value of 2100 MHz for each country depending on which UK auction results we use in the calculation.

Table 4.5: Benchmarks using 3 GHz spectrum

Estimate of UK value of 2100 MHz (£m per MHz)	Using UK 3.4 GHz auction result	Using UK 3.6 GHz auction result	Average
Austria 700-2100-3400/3600	10.6	8.6	9.6
Austria 800-2100-3400/3600	10.5	7.1	8.8
Germany 700-2100-3400/3600	14.2	14.3	14.2
Germany 800-2100-3400/3600	11.0	7.7	9.4
Hungary 700-2100-3400/3600	9.9	7.4	8.7
Slovenia 700-2100-3400/3600	14.8	15.3	15.1
Average	**11.8**	**10.1**	**11.0**

4.85 The difference in the UK auction results has a particular impact on the estimates the closer the paired 2100 MHz value in the comparator country is to the 3.4-3.8 GHz spectrum value in that country.

4.86 Consistent with the benchmarks derived using 2.3 GHz and 2.6 GHz spectrum, the results when using the UK 3.4 GHz auction suggest a fairly narrow range of values for 2100 MHz between £9.9m and £14.8m per MHz. There is a bigger range when using the UK 3.6 GHz auction result with four of the results being between £7.1m and £8.6m per MHz, and the other two results being over £14m per MHz.

Additional Dutch benchmarks using proxy values

4.87 In addition to the four countries for which we have been able to derive Tier 1 benchmarks, we also have good (Tier 1) quality 700 MHz and 2100 MHz evidence from the Netherlands, but we have not been able to derive a direct Tier 1 distance method benchmark because we do not have a Tier 1 quality high frequency auction result.

4.88 We have therefore sought to estimate proxy values for 2.3 GHz, 2.6 GHz and 3.4-3.8 GHz for the Netherlands and use these to derive a relative value benchmark for 2100 MHz for inclusion alongside our Tier 1 benchmarks.[71]

4.89 The resulting relative benchmarks range from £7.2m per MHz to £10.4m per MHz, with an average of £9.1m per MHz.[72] It is the same Dutch data (the 700 MHz and 2100 MHz auction results) that is being used in all benchmarks with the difference in results being driven by the proxies, and, in the case of the 3 GHz spectrum benchmarks, the difference in the UK auction results. We note that, as per BT's suggestion, the paired ratio of 700 MHz to 2100 MHz results in an estimate of £7.3m per MHz, which is towards the lower end of the range of estimates generated by using the Dutch proxy-derived benchmarks (£7.2m to £10.4m).

Reaching a view

4.90 In the preceding paragraphs we have summarised the data that we have available to inform our view on the appropriate lump-sum value of UK 2100 MHz paired spectrum for the purposes of ALFs.

4.91 Looking at all the estimates we have, we note that 10 of the 17 benchmarks are between £9.6m per MHz and £14.3m per MHz. The four benchmarks below £9.6m per MHz are all benchmarks which use the UK 3.6 GHz auction results, and the corresponding benchmarks using the UK 3.4 GHz auction results are between £9.9m and £11m per MHz. We consider both sets of these results to be informative, but we are cautious about placing too much weight on either set of values in isolation. At a high level, we do not think it appropriate for the value for the high frequency spectrum to have a strong influence on the resulting value we set for the 2100 MHz. Given that the latter is a mainstream coverage band we

[71] In 2018 when looking at the international benchmark evidence to inform our view of the value of UK 1800 MHz spectrum, for countries where we had auction evidence for 800 MHz and 1800 MHz but not 2.6 GHz, we derived a 2.6 GHz proxy value to enable us to then calculate a relative value for 1800 MHz. We have used a similar approach here – see Annex A2 for more information.

[72] See Annex A3, Table A3.16 for more information.

think it is more similar to the lower frequency spectrum used for coverage and should be influenced to a greater extent by the value of spectrum at this end of the range.[73]

4.92 We therefore consider that the value should be above £9.6m per MHz. We consider that a value below that level would be an overly conservative interpretation of the evidence and would involve putting undue weight on the Dutch proxy values and some of the benchmarks using the UK 3.6 GHz auction results.

4.93 The question then arises as to how far above £9.6m per MHz is appropriate. We do not consider that a value above £14m per MHz would be appropriate given the risk of overstatement of the six benchmarks above £14m per MHz and we consider it would be inconsistent with taking a conservative approach to interpreting the evidence.

4.94 We also do not consider that the data provides a strong reason to suggest the value should be above the average of our Tier 1 benchmarks, particularly in light of our conservative approach to interpreting the evidence. The average of the Tier 1 benchmarks (including the lowest Dutch proxy value) is £11.2m. However, we also do not consider it appropriate to go too far below the average given the number of benchmarks we have and that a significant number point to a value above the average.

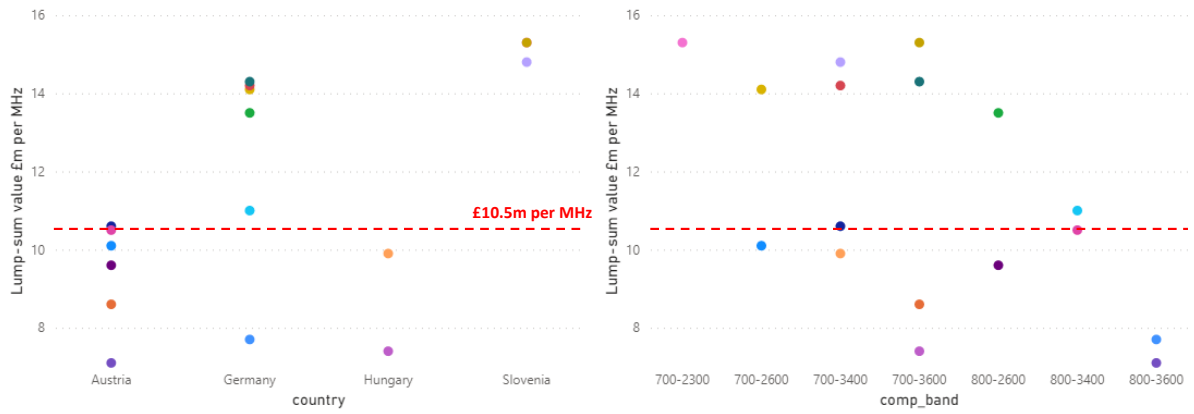
4.95 In light of this, our regulatory judgement is that a lump-sum value estimate of **£10.5m per MHz** is appropriate. While we are cautious about placing too much weight on the proxy values derived for the Netherlands, we consider that they, and the lower value benchmarks which use the UK 3.6 GHz auction results, support a value below the overall average.

4.96 In addition, as the charts below illustrate, a value of £10.5m per MHz is consistent with the evidence from the different benchmark countries, and from the different comparator spectrum bands. In both cases, the majority of observations lie above this point and those which lie below are not, in the context of the overall dispersion we see, significantly below this point. We note that £10.5m per MHz is below the country average for Slovenia (£15.1m per MHz[74]) and Germany (£12.5m per MHz). It is above the country average for Austria (£9.4m per MHz) and Hungary (£8.7m per MHz) but is within the range of values for Austria and just slightly above the higher of the two values we have for Hungary (which is £9.9m per MHz).

4.97 We also note that £10.5m per MHz is below the average for six of the seven combination of frequency bands (see Table 4.4 above). If we were to reduce the lump sum value estimate of paired 2100 MHz spectrum down to £10m per MHz, that would mean our estimate would be lower than the lowest value for three of the seven combination of frequency bands.

[73] As a more detailed point, we note the wide dispersion around one of the 3.6 GHz benchmarks, the average of which would be more consistent with a market value closer to where the density of other benchmarks lie.
[74] Although as shown in Figure 4.1 we consider each of the Slovenian benchmarks to be at risk of overstatement.

Figure 4.2: Scatterplot of data points by country and distance method benchmark[75]



4.98 We have sense-checked our assessment to ensure that we are not giving disproportionate weight to the Slovenian and German benchmarks for which Y/X>1 given the particular complexities associated with interpreting the values of these benchmarks (as discussed in paragraphs 4.52 to 4.55 above). We are satisfied that this is not the case. We note that we are estimating the market value to be over £3.5m per MHz lower than each of these six benchmarks. We also note that if we capped each of these benchmarks at £14.1m per MHz it would still be the case that the overall Tier 1 benchmark average; the German and Slovenian country averages; and the average for six of the seven combination of frequency bands would all be above £10.5m per MHz.

4.99 We have also considered the values from the Tier 3 benchmarks (set out in Annex A3).[76] Our view is that they do not consistently point to a different value, and in any case, we consider it appropriate to place less weight on these benchmarks than we did in the case of 900 MHz and 1800 MHz given we have far more Tier 1 evidence.

Comparison with 1800 MHz annual licence fees

4.100 Both the 1800 MHz and 2100 MHz band are mainstream coverage bands, therefore it might be expected that the values of the two spectrum bands would be similar given proximity in frequency.

4.101 The ALF for 1800 MHz which we set in 2018 is based on a lump sum value of £14.6m (in April 2021 prices). Our lump-sum value for 2100 MHz is 28% less than this. We note this is a fairly significant difference for what we consider to be similar spectrum bands.

4.102 As a sense check, we have compared this to our Tier 1 benchmark countries. In all three countries for which we have band-specific prices for both 1800 MHz and 2100 MHz (Austria, Germany and Hungary), the value of 2100 MHz is less than the value of 1800 MHz. In Germany it is 28% less and Hungary 20% less. In Austria it is 81% less although we consider that this significantly overstates the difference in value between the bands - we concluded previously that the 1800 MHz Austrian auction was at larger risk of

[75] Note these scatterplots do not include the Dutch proxy values.
[76] As set out in Annex A3 we do not have any Tier 2 benchmarks.

overstatement and also note that there were structural changes in the Austrian market between the two auctions.

4.103 In light of the German and Hungarian relative values, we do not consider the relative values of 2100 MHz and 1800 MHz implied by our lump sum value for 2100 MHz paired spectrum are inconsistent with the available international evidence.

Annualisation

4.104 Step 3 as outlined in Figure 3.1 in determining the market value of the paired 2100 MHz spectrum is to convert our estimate of the lump-sum value of the 2100 MHz paired spectrum into an annual value.

4.105 Annex A4 sets out in full our approach to annualisation, the evidential basis for it and how we have taken account of stakeholders' comments to our July 2021 consultation.

Our provisional view

4.106 We proposed to adopt the same methodology to converting the lump-sum market values into an annual payment as we had used for 900 MHz, 1800 MHz and 3.4 – 3.6 GHz ALFs.

4.107 Our proposed approach involved spreading the lump-sum value of spectrum over 20 years, using an ALF profile that is flat in real terms (i.e. adjusted for inflation).

4.108 To calculate the annualisation rate, we estimated the relevant post-tax real discount rate and a tax adjustment factor (TAF), to reflect the more favourable tax treatment of annual fees compared to a lump-sum payment.

4.109 The discount rate depends on, among other things, the uncertainty associated with this future ALF payment stream. One significant uncertainty relates to changes in the market value of the spectrum over time. The discount rate which will leave licensees indifferent between paying ALFs and paying a lump-sum depends on the extent to which they (rather than the Government) are exposed to the effect of such changes in the market value of spectrum over time and, therefore, it is an important consideration in determining the appropriate discount rate.

4.110 In our July 2021 consultation, consistent with our approach in previous ALF determinations, we considered that the appropriate discount rate would sit somewhere between a lower polar case of the cost of debt (as an approximation of the case where the licensee would bear the risk associated with the variation in the market value of the spectrum) and, as an upper polar case, the weighted average cost of capital (i.e. WACC, which is an approximation of the case where the government would bear the full risk of variation in market value of the spectrum).[77] We used a risk sharing adjustment to determine where between these two polar cases the appropriate discount rate would lie.

[77] The WACC reflects the cost of capital weighted between the cost of debt and the cost of equity, where the weights are a function of, respectively, the proportion of debt to enterprise value and equity to enterprise value.

4.111 Updating the input parameters for the discount rate and the TAF as appropriate, we proposed an annualisation rate of 5.4%. This resulted in base level of ALFs of **£0.567m per MHz** (in April 2021 prices) for paired 2100 MHz spectrum.

4.112 These would then increase in line with Consumer Price Index inflation in subsequent years.

Consultation responses

4.113 Vodafone agreed with the overall approach adopted by Ofcom to annualisation and VMO2 supported our approach to annualisation in terms of high-level methodology.[78]

4.114 All four MNOs considered that we had overstated the annualisation rate by using inappropriate inputs for our calculation of the real post-tax discount rate.

a) BT, Three and VMO2 questioned our decision to set the discount rate between a lower polar case of the cost of debt and an upper polar case of the cost of capital, and instead proposed that the discount rate should be set equal to the lower polar case.[79]

b) All four MNOs disagreed with various aspects of our methodology used to derive the input parameters for the discount rate in both the lower and the upper polar cases.[80]

c) BT and Three raised concerns that the rounding of figures in intermediate calculations led to a higher annualisation rate than if more significant figures or unrounded figures were used.[81]

d) Vodafone also requested that the existing 900/1800 MHz ALFs should be recalculated to align with our latest assessment of the annualisation rate.[82]

Our decision

Annualisation rate

4.115 Having considered stakeholder comments, we are of the view that our methodology for calculating the annualisation rate is appropriate and note that it is consistent with the methodology adopted in previous ALF determinations.

a) Because of the possibility of a review of ALFs which exposes the government to the systematic risk of the cash flows from the operation of the licences, we are of the view that it is appropriate to make an adjustment for the degree of risk sharing between licence holders and the government. That is, that the discount rate should lie somewhere between a lower polar case of the cost of debt and an upper polar case of the cost of capital. The appropriate size of risk sharing adjustment involves a degree of regulatory judgement. As set out in Annex A4, we do not consider that the points made

[78] Vodafone consultation response, p. 8; VMO2 consultation response, page 1; and VMO2 additional consultation response.
[79] BT consultation response, page 18; Three consultation response, p. 16 and VMO2 additional consultation response.
[80] BT consultation response, pp. 22-24; Three consultation response, pp. 13-17; VMO2 additional consultation response; and Vodafone consultation response, pp. 8-10.
[81] BT consultation response, p. 24; and Three consultation response, pp. 13-14.
[82] Vodafone consultation response, p. 10.

by stakeholders support a reduction in the risk sharing adjustment from that used in previous ALF determinations.

b) With respect to the specific points raised by stakeholders in relation to the derivation of the input parameters, we discuss our detailed reasoning and our responses to these stakeholder comments in Annex A4.

c) We continue to round the final discount rate to one decimal point, consistent with previous ALF determinations, to reflect that this final number is ultimately a judgement. As set in Annex A4, in this decision, our rounding approach produces a discount rate that is slightly lower than if we had rounded the discount rate to two decimal points.

d) Regarding Vodafone's request to realign the 900/1800 MHz ALFs to our latest view of the annualisation rate, we recognise that the annualisation rate does vary over time. However, our overall approach to setting ALFs is to assume a fixed rate over a 20-year period at the time of making the decision on the level of ALFs. As we are not revisiting the lump-sum values for 900 and 1800 MHz spectrum in this decision, we are also not revisiting the annualisation rate.

4.116 As signalled in the July 2021 consultation, we have reviewed latest market evidence on the input parameters underpinning our discount rate and TAF. The result is a modest reduction in the annualisation rate from the proposed value of 5.40% to 5.34%, as summarised in Table 4.6 below.

Table 4.6: Comparison of input values for calculating base level of ALF in the July 2021 Consultation and this Statement

	July 2021 Consultation	2021 Statement
Length of period over which we spread the lump-sum value	20 years	20 years
Real post-tax discount rate	0.2%	0.1%
TAF	1.060	1.058
Annualisation rate	5.40%	5.34%

Source: Ofcom

Converting from a lump sum into an annual amount

4.117 As set out above, the annualisation rate is now 5.34%. Multiplying the lump sum value by the annualisation rate gives the base level of ALF set at market value (expressed in April 2021 prices). Consistent with our approach to the other mobile spectrum ALFs, and as proposed in our July 2021 consultation, we derive the base level of ALFs rounded to three decimal places in £m per MHz.

4.118 Based on the annualisation rate of 5.34% and lump-sum values of £10.5m per MHz for paired 2100 MHz spectrum, the base level of ALF is **£0.561m per MHz** (in April 2021 prices).

4.119 These would then increase in line with Consumer Price Index inflation in subsequent years.

4.120 In the following section, we consider whether ALFs set at this value are appropriate in the context of our statutory duties.

5. Assessment of ALFs in light of our statutory duties

Introduction

5.1 We have carried out an impact assessment in accordance with section 7 of the Communications Act [83] and consulted on our assessment in July 2021. We have considered stakeholder responses in reaching our decision and set out throughout this statement and accompanying annexes how, in Ofcom's opinion, setting ALFs at the level determined in this statement for paired 2100 MHz spectrum is in accordance with our statutory duties.

5.2 We explain in Section 2 above that as set out in the SRSP, our existing spectrum pricing policy is to set fees for spectrum holdings to reflect the market value of the spectrum (based on its opportunity cost) in order to promote the optimal use of spectrum. We also note that this approach is consistent with and reinforced by the Direction requiring Ofcom to set the annual licence fees for the 2100 MHz spectrum so that they reflect the full market value of the frequencies in the band.

5.3 For the reasons explained in Section 4, our conservative estimate of the lump-sum market value of the paired 2100 MHz spectrum is £10.5m per MHz, corresponding to an ALF (if set based on that estimate) of £0.561m per MHz (in April 2021 prices).

5.4 In this section, we present our updated assessment of whether setting ALFs for the paired 2100 MHz spectrum based on this conservative estimate of the full market value of the spectrum is appropriate in light of our statutory duties in line with Step 4 as outlined in Figure 3.1.

5.5 As explained in Section 2, when we exercise our powers in relation to setting spectrum fees, a number of statutory duties are relevant. Broadly speaking, these can be categorised as follows:

a) *Optimal use of spectrum*: The Communications Act requires Ofcom to secure the optimal use for wireless telegraphy of the electro-magnetic spectrum. The Wireless Telegraphy Act also requires Ofcom to have regard to: (i) the desirability of promoting the efficient management and use of spectrum, and (ii) the extent to which spectrum is available for use, and the demand (current and likely future) for use of the spectrum.

b) *Furthering the interests of citizens and consumers*: Ofcom's principal duty in the Communications Act is to further the interests of citizens in relation to communication matters and of consumers in relevant markets, where appropriate by promoting competition.

[83] Further detail of the Legal Framework is set out in Annex A1 to this Statement.

c) *Encouraging investment and innovation:* Ofcom is required by the Communications Act to have regard to the desirability of encouraging investment and innovation in relevant markets and to encourage the availability and use of high-speed data transfer services throughout the UK. It is also required by the Wireless Telegraphy Act to have regard to the desirability of promoting the development of innovative services.

d) *Promoting competition:* Ofcom is required by the Communications Act to promote competition when managing the radio spectrum, and to have regard to the desirability of promoting competition in relevant markets. It is also required by the Wireless Telegraphy Act to have regard to the desirability of promoting competition in the provision of electronic communications services.

5.6 We therefore consider in this section the specific effects of our proposed ALFs on:

a) securing the optimal use of spectrum;

b) investment and innovation;

c) competition; and

d) consumers.

Our provisional assessment

5.7 We considered that setting ALFs for the paired 2100 MHz spectrum based on market value was in line with our statutory duties.[84] In particular, ALFs at market value:

a) will secure the optimal use of spectrum, which we consider to be in the interests of UK citizens and consumers;

b) benefit consumers in the long run by ensuring that spectrum is used in the most efficient way for the provision of downstream services for which there is greatest value. We recognised that this could lead to higher consumer prices than if ALFs were set at a discount to market value. However, we considered that retail prices should reflect all input costs including the resource costs of spectrum, and this does not represent a market failure, or markets failing to work in the interests of consumers;

c) can be expected to promote efficient investment and innovation; and

d) are consistent with promoting competition.

Securing the optimal use of spectrum

Consultation responses

5.8 Vodafone suggested Ofcom treated the impact assessment as a bolt-on analysis rather than carrying out an impact assessment of each stage of the analysis.[85] BT noted that

[84] July 2021 consultation, paragraph 5.33.
[85] Vodafone consultation response, p. 10.

Ofcom has not provided evidence that ALFs promote efficiency, investment, competition or consumer benefits.[86]

Efficiency of existing spectrum use and users

5.9 VMO2 considered that ALFs play a major role in incentivising efficient use of spectrum and investment.[87]

5.10 BT said that ALFs did not promote optimal spectrum use and that Ofcom had not evidenced the benefits of ALFs on optimal use of spectrum.[88] BT requested that Ofcom revisits the SRSP and discuss the 2010 Directions to Ofcom with Government.[89] BT suggested that Ofcom's approach to ALFs set out in the SRSP had not envisaged a requirement on MNOs to provide greater mobile coverage for customers and allow access to spectrum for new users, or technological progress and more efficient spectrum use, changes that have happened since 2010.[90] BT said that all these factors together, make the case for ALFs in ensuring efficient allocation and use of spectrum weaker and if anything, ALFs at market value, only have a neutral impact on efficiency, rather than promote its optimal use.[91]

5.11 Three[92], Vodafone[93] and BT[94] disagreed with Ofcom that MNOs may be less responsive to the opportunity cost of their own spectrum holdings (the foregone revenue from trading away part or all of their spectrum), than having to pay ALFs on their spectrum holdings. Three and BT referred to previous spectrum trades, where the traded spectrum was not subject to ALFs, as evidence that ALF is unnecessary to secure efficient spectrum allocation for tradeable licences.[95,96]

a) Three said that Ofcom has not made a convincing case for applying ALFs (at or below market value) to spectrum that is freely tradeable, and noted that even without ALFs tradable spectrum would still find its way to the highest-value users; with only four MNOs, transaction costs, coordination and/or incomplete price information are unlikely to prevent trading.[97] Three suggested that, at best, ALFs were redundant, and at worst, licensees could end up returning the spectrum to Ofcom resulting in unused spectrum.[98] Three said Ofcom's conclusion on whether MNOs consider opportunity cost of their own spectrum holdings relied on insufficient and flawed evidence[99] and

[86] BT consultation response, section 3.5.1.
[87] VMO2 consultation response, p. 1.
[88] BT consultation response, pp. 24-25.
[89] BT consultation response, p. 38.
[90] BT consultation response, pp. 31-32.
[91] BT consultation response, pp. 25-26.
[92] Three consultation response, pp. 4-5, paragraphs 1.3-1.6.
[93] Vodafone consultation response, p. 13.
[94] BT consultation response, p. 26.
[95] Three consultation response, p. 5, paragraph 1.9.
[96] BT consultation response, p. 28.
[97] Three consultation response, section 1, from p. 4.
[98] Three consultation response, p. 5, paragraphs 1.7-1.9.
[99] Three noted that Ofcom's position is based on a confidential response to the 2014 consultation on ALFs for 900/1800 MHz.

that Ofcom should either drop this presumption or evidence this conclusion, for example by using its information-gathering powers.[100]

b) Vodafone suggested that cash from spectrum trades would incentivise an inefficient licensee to act.[101]

c) BT said that absent evidence of inefficient allocation of spectrum in the 2100 MHz band, or that trading would be insufficient to ensure efficient use of spectrum in the future, introducing ALFs for 2100 MHz is disproportionate considering the expected harm Ofcom seeks to mitigate.[102] Although BT also noted that ALFs may induce efficient outcomes with non-commercial entities if they are less sensitive to the opportunity cost of holding spectrum in other sectors.[103]

ALFs at market value and spectrum trading

5.12 Vodafone[104] and Three suggested that, contrary to Ofcom's view, ALFs make spectrum trading harder and/or complicate trading, and are a barrier rather than an incentive, for efficient allocation and use of spectrum. Three suggested that a potential trade in the 3.4-3.8 GHz band stalled, at least partially because of level of ALFs.[105]

5.13 BT considered that Ofcom's proposed ALFs were in any case likely to be above market value which risk efficiency of spectrum use by potentially hindering trade, and this way prevent Ofcom from fulfilling its statutory duties.[106]

Our assessment

5.14 Vodafone and BT said that our analysis in the July consultation did not sufficiently consider or demonstrate the potential impacts of our proposed ALFs for 2100 MHz on the efficiency of spectrum use, competition, investment, and consumers. BT further suggested that introducing ALFs at market value would be disproportionate relative to the harm given the lack of evidence of inefficient allocation of spectrum in the 2100 MHz band.

5.15 We disagree with these points. We considered the potential impacts of our proposed ALFs in 2100 MHz at market value, and set out our analysis of this in our July consultation.[107] We have since considered the potential effects, in light of the consultation responses, and outline our updated assessment below.

5.16 We recognise that the way spectrum is used to provide mobile services for customers may have changed since the introduction of the SRSP as BT highlighted in their response, but agree with VMO2 that ALFs play a major role in ensuring efficient allocation of spectrum;

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[100] Three consultation response, p. 4, paragraphs 1.5-1.6.
[101] Vodafone consultation response, p. 13.
[102] BT said that the proposed ALFs for 2100 MHz would cost the sector nearly £75 million annually, additional to the £250 million per year MNOs pay for 900 MHz, 1800 MHz and 3.4/3.6 GHz ALFs. BT consultation response, p. 4.
[103] BT consultation response, p. 26.
[104] Vodafone consultation response, pp. 13-14.
[105] Three consultation response, p. 20, paragraphs 5.17-5.19.
[106] BT consultation response, pp. 25-26.
[107] July 2021 consultation, section 5.

we do not consider that changes in the way spectrum is used or requirements on MNOs to provide services for customers have changed the rationale for ALFs or justify us departing from the approach set out in the SRSP. We consider that pricing a scarce resource such as spectrum below its full market value, creates a risk that it will not be used efficiently. Considering this risk, our view is that ALFs at market value are proportionate, and we discuss this rationale further below.

Efficiency of existing spectrum use and users

5.17 The purpose of AIP is to provide users with a sustained long-term signal of the value of spectrum as indicated by its opportunity cost in the next highest use or user. This gives the current user incentives to use the spectrum in a way that maximises benefits for society over time. The SRSP explains why if the price of spectrum does not reflect its opportunity cost, there will be less incentive to use spectrum efficiently and mean it will not be available for alternative users/uses, and this can result in wasteful use of resources, which ultimately impacts consumers and the wider society.[108]

5.18 As discussed in previous Ofcom decisions, we recognise that setting ALFs above market value would not secure optimal use of spectrum and we have addressed this risk by setting the ALFs based on our conservative estimate of paired 2100 MHz market value. We also consider that setting ALFs below market value, firstly would risk the efficient use of spectrum but also, contrary to BT's suggestion, be an effective subsidy for the paired 2100 MHz licence holders, which could result not only in inefficient use of spectrum but also sub-optimal outcomes for investment, competition and consumers over time. We consider this point further in paragraphs 5.36, 5.42 and 5.50.

5.19 Whilst operators may have incentives to use spectrum that they hold efficiently even without ALFs at market value, as BT, Three, and Vodafone suggested, this does not necessarily mean that they are the highest value users of that spectrum. And, although MNOs currently holding paired 2100 MHz spectrum may be particularly high value users, and the current allocation of spectrum is efficient as suggested by BT, we consider that there could be other efficient users/uses of this spectrum in the future. And therefore, we remain of the view that there may be scope for efficiency improvements from transferring spectrum to another operator/user in the paired 2100 MHz spectrum, which may not be realised without ALFs set at market value.

5.20 Three, Vodafone and BT did not think ALFs were needed to ensure efficient spectrum use and asked Ofcom for evidence that, when able to trade, MNOs are less responsive to their own opportunity cost of holding spectrum than ALFs. We note that we have considered this point in response to MNOs comments in our previous ALF decisions.[109] And, having

[108] Ofcom, *SRSP: The revised Framework for Spectrum Pricing*, December 2010, paragraphs 3.33-3.35, https://www.ofcom.org.uk/__data/assets/pdf_file/0024/42909/srsp-statement.pdf. In the remainder of this section we refer to this as the **SRSP**.

[109] Ofcom, *Annual Licence Fees for 900 MHz and 1800 MHz frequency bands*, December 2018, paragraphs 5.36-5.49, https://www.ofcom.org.uk/__data/assets/pdf_file/0020/130547/Statement-Annual-licence-fees-900-MHz-and-1800-MHz.pdf. In the remainder of this section we refer to this as the **2018 Statement.**

considered MNOs' comments in the context of the paired 2100 MHz spectrum in response to the July consultation, our view is that:

a) We recognise that, if the MNOs wish to trade away their existing spectrum holdings, they can identify potential buyers for their spectrum licences (e.g. among other MNOs) and assess the value of spectrum through negotiations and/or other valuation exercises in similar frequencies;

b) Even if the MNOs can assess what the opportunity cost of their spectrum licence is, and identify potential buyers for their spectrum, they may not respond to these opportunity costs and trade unwanted spectrum or seek trades to gain access to additional spectrum. This could happen because[110]:

   i) Managers making the decisions may lack the incentives to act on opportunity costs of holding spectrum, e.g. if an organisation considers minimising costs a greater priority, and places less weight on realising untapped revenues from existing spectrum holdings; and/or

   ii) Managers' response to opportunity costs could also depend on whether outcomes are framed in terms of losses or gains; studies have shown that losses tend to carry greater weight than equivalent gains, which would imply that managers may respond more easily to the direct cost of a licence fee than the foregone revenues from trading spectrum.

5.21 We recognise that MNOs may be incentivised to trade but disagree with suggestions that previous spectrum trades in other bands demonstrate that ALFs are not needed for paired 2100 MHz spectrum as suggested by Three and BT. While operators do not necessarily ignore the opportunity cost of their spectrum holdings, they may be less responsive to foregone revenue from trading spectrum than to having to pay the market value of spectrum for reasons discussed above. As a result, we still consider that trading by itself may not be enough to ensure efficient allocation of spectrum.

5.22 For the reasons discussed above, spectrum priced to reflect the forward looking opportunity cost of spectrum captured by market value should ensure that the licensees have sufficient incentives to use all spectrum efficiently and only hold the spectrum that they value as highly as the best alternative user or use. Therefore, we consider that setting ALFs for paired 2100 MHz spectrum at market value is in line with our statutory duty to secure optimal use of spectrum.

ALFs at market value and spectrum trading

5.23 We considered Vodafone and Three's suggestion that ALFs, whether at market value or not, make trading harder. We considered a similar point relating to whether ALFs at market value could deter efficient trading in our December 2018 Statement[111], where we referred to our October 2013 consultation:

[110] Ofcom 2018 Statement, paragraph 5.44.
[111] Ofcom 2018 Statement, paragraph 5.60.

a) "*…our perspective is that, whilst a higher ALF would reduce the buyer's willingness to pay for spectrum, it would also reduce the price at which the seller was willing to sell by the same amount; accordingly, it would not alter the potential gain from trade*".

5.24 Our view is that this is the most appropriate characterisation of the present situation and consider that ALFs at market value continue to be needed to play a role complementary to spectrum trading to ensure efficient allocation and use of spectrum.

5.25 BT suggested that our proposed ALF for 2100 MHz spectrum is likely to be above market value which would not secure optimal use of spectrum. We disagree with BT's assessment, as we consider that we have adequately addressed the risk of setting the ALFs above market value by interpreting the evidence conservatively, as set out in section 4. Setting fees below market value would provide the licensees with a subsidy, which we do not consider appropriate in this case.

Impact on investment and innovation

Our provisional view

5.26 Our view was that investment decisions should reflect the true costs of inputs.[112] Setting ALFs based on market value, would require mobile operators to consider and pay the opportunity cost of their spectrum holdings.

5.27 We noted that in some cases this may disincentivise existing licence-holders from making investments which they would otherwise have made and choose not to invest or pursue alternative more efficient solutions. We also said that ALFs for 2100 MHz spectrum reflecting market value would not necessarily result in lower investment levels. We did not consider that lowering fees to below market value to support investment was appropriate as this would provide an unconditional subsidy for operators holding such spectrum.

Consultation responses

5.28 BT said that Ofcom had not evidenced that ALFs promote investment and suggested ALFs were unnecessary to incentivise innovation because MNOs already consider and respond to the opportunity costs of holding spectrum[113], and suggested that instead they harm efficient investment.[114] Vodafone suggested that Ofcom had not considered the impact of the total amount of ALFs the industry pays annually (over £300m) and how this impacts on investment and consumers.[115]

5.29 BT noted that ALFs reduce profitability, and overall, the cumulative effect of all mobile regulation is likely to result in sub-optimal investment.[116] Both Vodafone and BT said that

[112] July 2021 consultation, paragraphs 5.25-5.27.
[113] BT consultation response, p. 29.
[114] BT consultation response, p. 24.
[115] Vodafone consultation response, p. 13.
[116] BT consultation response, pp. 32-35.

having to rely on external funding to invest was likely to reduce investments[117,118]; as operators typically favour internal funding due to lower costs, and having to pay ALFs reduce available internal funding. Operators having to rely on external funding are likely to invest less, and in cases where the expected returns are lower than the cost of additional capital. Vodafone suggested that higher spectrum fees risk that network investment is delayed or lower, and Ofcom's analysis should consider the consequences of this for the UK economy.[119]

Our assessment

5.30 We disagree with BT and Vodafone that ALFs necessarily have an adverse impact on investment and innovation.

5.31 As discussed in our July 2021 consultation and in the SRSP, we still hold the view that investment decisions should reflect the true costs of inputs. This will be achieved where ALFs are set based on market value, as operators are required to pay the opportunity cost of their spectrum holdings which should ensure MNOs only hold on to spectrum that they need and use their spectrum holdings efficiently. We believe, however, that it is important to distinguish between efficient and inefficient investment and to consider the impact on efficient investment only.

5.32 We consider that MNOs should pay the input cost of their spectrum holdings and use, and these should be priced to reflect the market-clearing price in a well-functioning market, as MNOs can expect to get a return for their spectrum investment. We recognise that setting ALFs at market value could in theory reduce the ability of existing licence holders to make investments that they would otherwise have made. However, we consider that outcome is likely to be efficient because the licence-holder will either pursue alternative, more efficient solutions (taking account of the true cost of all inputs) or will choose not to invest (thereby avoiding over-investment in spectrum-based solutions).

5.33 We recognise that setting ALFs for paired 2100 MHz spectrum above market value could deter efficient investment, but we have addressed this risk by assessing the evidence on market values conservatively. Therefore, we consider that pricing paired 2100 MHz spectrum at market value should ensure efficient spectrum use and investment and therefore aligns with our wider duties.

5.34 We consider that ALFs set at market value do not necessarily result in lower investment overall, and even if they did, this risk is likely to be low. We discussed why this is the case in more detail in our previous documents on the ALFs for 900/1800 MHz spectrum[120,121]; but

[117] Vodafone consultation response, pp. 11-13.
[118] BT consultation response, pp. 33-35.
[119] Vodafone consultation response, p. 13.
[120] Ofcom, *Annual Licence Fees for 900 MHz and 1800 MHz frequency bands,* June 2018, pp. 52-56, https://www.ofcom.org.uk/__data/assets/pdf_file/0022/114736/consultation-alf.pdf.
[121] Ofcom 2018 Statement, paragraphs 5.97-5.103.

in summary, for the ALFs at market value to prevent network investment in the UK, the following circumstances would need to prevail:

a) the expected return of an investment would need to exceed the internal cost of capital but to be below the external cost of capital; and

b) ALFs at market value would reduce the internal funds that mobile operators have available for investment to the extent that such investments would not be made.

5.35 In considering the likelihood of such an outcome, we note that the ALF payments for paired 2100 MHz spectrum represent around 3% of average annual industry EBITDA minus capital expenditure over the last three years (i.e. between 2018 and 2020)[122], and around 2% of average annual industry capex over the same period.[123] This implies that the risk to overall investment levels from setting ALFs for this spectrum at market value is likely to be low – before considering the efficiency of investments made.

5.36 We recognise that the total amount of ALF is more significant than ALFs for the paired 2100 MHz spectrum alone. However, we do not think that the impact of the total amount of ALFs that the MNOs pay or the cumulative impact of mobile regulation are relevant considerations in the context of whether to set ALFs for 2100 MHz at market value or not.In this specific circumstance, and given the differences in spectrum holdings among the MNOs, by setting ALFs for paired 2100 MHz below market value would disproportionately benefit the licence holders in the 2100 MHz band, relative to licence holders that have greater spectrum holdings in other bands subject to ALFs. Furthermore, we do not consider that setting the ALFs below market value is in general the appropriate way to support network investment in mobile, as it would be an effective subsidy for the operator holding such spectrum and potentially distort investment decisions. This point is captured below and discussed in more detail in the SRSP:[124]

a) *"We believe that if it is considered that a subsidy should be provided to support wider policy objectives, it is more efficient for those services to be explicitly subsidised by government from general taxation, leaving those providing them to have the same incentives to use resources, such as spectrum, efficiently, rather than seeking to provide such services through concessions on the fee charged."*[125]

5.37 In summary, we consider that efficient investment will be promoted when operators face a market price (reflective of the relevant resource costs) for the inputs they use. We disagree with stakeholders that ALFs set at market value will lead to lower efficient investment levels. The alternative, of setting ALFs below market value, would effectively be an unconditional subsidy for operators holding such spectrum.

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[122] Where 2020 refers to financial year ended 31 December 2020 or financial year ended 31 March 2021 and so on.
[123] We use EBITDA minus capex as a proxy for cash flow, although we note it assumes no change in working capital. Total industry ALFs for 2100 MHz amount to c.£70m, EBITDA minus capex averaged around £2.7 billion per year over this period (in nominal terms), while capex averaged £3.0 billion. Data sourced from S&P Capital IQ and group financial statements. Also note that the industry numbers include an element of EBITDA and capex related to fixed retail telecoms and TV, because BT and Vodafone do not report the results of their fixed and mobile operations separately.
[124] Ofcom SRSP, paragraph 4.214.
[125] Ofcom SRSP, paragraph 4.230.

Impact on competition

Our provisional view

5.38 Our view on spectrum fees and competition, as set out in the SRSP, was that fees are unlikely to introduce distortions to competition in downstream markets when they reflect the opportunity cost of spectrum. We noted that MNOs hold different amounts of spectrum currently subject to ALFs and by setting ALFs for 2100 MHz below market value could distort competition by giving different subsidies to MNOs, depending on their spectrum holdings.

Consultation responses

5.39 BT considered that ALFs set at market value do not promote competition but agreed that they were equally unlikely to distort competition. [126] BT further noted that as MNOs already consider the opportunity cost of holding spectrum, ALFs at market value have a neutral impact on competition but are unlikely to promote competition as per Ofcom's statutory duty. BT did, however, also consider that our proposed ALFs were above market value, which we discuss separately in section 4.

Our assessment

5.40 As set out in our consultation and the SRSP, further to consideration of responses, we are of the view that ALFs are unlikely to distort competition in downstream markets when they reflect the opportunity cost of spectrum.[127,128]

5.41 We agree that if the paired 2100 MHz ALF was set above the market value of that spectrum, and the opportunity cost, this could potentially distort competition.

5.42 Furthermore, we also consider that if the ALFs were set below the opportunity cost of this spectrum this could have a detrimental effect on competition as it would effectively give the paired 2100 MHz licence holders a subsidy. We are mindful of the fact that the existing 2100 MHz spectrum licence holders (the MNOs) hold a variety of mobile spectrum; some of that spectrum will have been won in auctions and (where it is in its initial term) will not be subject to ALFs, whilst the remainder of that spectrum will be subject to ALFs. The MNOs relative holdings of ALF and non-ALF spectrum are different, and we consider that subsidising ALF spectrum (by setting it below market value) could risk distorting competition on the basis that it would be giving a different level of subsidy to different MNOs. Furthermore, if ALFs set at market value revealed differences in value for different MNOs, they can buy or release spectrum to enhance their competitive position.

[126] BT consultation response, p. 35.
[127] July 2021 consultation, paragraphs 5.28-5.32.
[128] Ofcom SRSP, paragraph 4.68.

5.43 For these reasons, by setting the ALFs for paired 2100 MHz spectrum based on our estimate of its market value is in our view consistent with promoting competition.

Impact on consumers

Our provisional view

5.44 We said that ALFs for 2100 MHz set at the market value was consistent with our statutory duties. We did not consider it appropriate to price 2100 MHz spectrum below its market value to suppress consumer prices as this risked sub-optimal allocation of spectrum amongst MNOs. We considered that this harm to the prospects for long-term efficiency and consumer welfare to be enough to set ALFs based on our estimate of market value even if consumer prices for today's mobile services could be lower with subsidised use of 2100 MHz spectrum. We considered that a policy based on efficient price signals, and by setting the ALFs at market value, should result in an efficient allocation of spectrum, which in turn could mean that operators are able to offer the best price mobile packages and technology to consumers available in the market over time.

Consultation responses

5.45 Vodafone suggested that by expanding the ALFs to cover the 2100 MHz band, the annual cost of ALFs to consumers would increase to over £300 million and that this increase in fees would affect all users, but disproportionately impacting vulnerable consumers, at a time when consumers are increasingly relying on mobile services (see also paragraph 5.28).[129]

5.46 On the other hand, while BT said that Ofcom had not evidenced that ALFs promote consumer benefits, BT considered it unlikely that introducing ALFs for 2100 MHz would result directly in an increase in consumer prices as long as ALFs did not exceed the opportunity cost of MNOs holding 2100 MHz spectrum.[130] Although, BT considered that Ofcom's proposed ALFs for the 2100 MHz band were likely to exceed full market value, and therefore risked higher customer bills.

Our assessment

5.47 We considered Vodafone's suggestion that ALFs on 2100 MHz are effectively a regressive tax, and if implemented would adversely impact vulnerable consumers. As discussed in our July consultation, and in previous Ofcom documents, our view is that in general, and consistent with our wider spectrum policy, consumer prices on mobile services should reflect all input costs, including that of spectrum. And, this does not reflect a market failure, or markets failing to work in the interests of consumers.[131] We do not think it would

[129] Vodafone consultation response, pp. 10-11.
[130] BT consultation response, p. 35.
[131] July 2021 consultation, paragraphs 5.21-5.24.

be appropriate to set the price of spectrum below market value to suppress consumer prices through a mobile spectrum subsidy.

5.48 By pricing the paired 2100 MHz spectrum based on its opportunity cost and setting ALFs at market value, we seek to ensure efficient spectrum allocation and use of scarce spectrum by the MNOs. Setting ALFs at market value also replicates how consumer prices would be set in well-functioning markets and is likely to promote consumers' long-term interests. Our view is that an efficient price signal is likely to result in spectrum being held by the highest value users which is likely to ensure customers are able to access the best retail offers, not only in price but in quality of service, maximizing consumer welfare over time.

5.49 If setting ALFs for paired 2100 MHz spectrum at market value led to an increase in prices for mobile services (which is not certain), we would expect consumers to choose communication goods and services which can be supplied at lower cost (with inputs appropriately reflecting the cost of supply), improving overall consumer outcomes. Alternatively, if setting ALFs at market value encourages spectrum release by a licensee, this in turn could facilitate expansion by rival operators or new market entry and that way lower mobile consumer prices.

5.50 Vodafone suggested that we should thoroughly assess the impacts of ALFs in 2100 MHz on vulnerable consumer groups as any ALFs in 2100 MHz would be passed through to consumers. We note, and agree with BT, that consumer prices are unlikely to increase if ALFs are set at or below opportunity cost of spectrum as the opportunity cost of spectrum should already be reflected in the cost of consumer offers. And, in instances where this is not the case, it is more likely that the licensees have not sufficiently accounted for the opportunity cost of their spectrum holdings resulting in the cost of ALFs being passed through to consumers. Furthermore, if the price of paired 2100 MHz spectrum is set below opportunity cost, there is a risk that it will be held by providers that are not the highest value users of that asset. This would be harmful for consumers. We consider that this harm to efficiency and consumers welfare, mean that setting ALFs at market value will benefit all consumers in the long run even if consumer prices for mobile services today could be lower with subsidized use of paired 2100 MHz spectrum.

5.51 We have also considered the impact of our proposals on vulnerable consumers, including those with protected characteristics under the Equality Act 2010. As set out above, we do not consider it is certain that ALFs that reflect market value would lead to higher consumer prices. However, we note that if the total ALFs in the paired 2100 MHz spectrum were passed on to consumers in full, this would amount to around 71p per year per subscriber, equivalent to 6p per month.[132] Further to this, Vodafone has not presented any evidence to suggest that specific groups of vulnerable consumers would be impacted by the level of ALFs for paired 2100 MHz spectrum, and we have not identified such groups either.

[132] We note that there were 94.67 million active mobile subscriptions in 2020, and the introduction of ALFs in 2100 MHz spectrum would amount to around £67 million increase in annual fees paid by the MNOs (paragraph 6.2). Ofcom, *Communications Market Report 2021*, 22 July 2021, https://www.ofcom.org.uk/research-and-data/multi-sector-research/cmr/cmr-2021/interactive-data.

5.52 We recognise the importance of mobile services to consumers, and to vulnerable consumers, and the potential impact on them of any price increases. As explained above, in paragraph 5.48, an increase in mobile competition could result in a fall in retail prices for all consumers. However, we do not consider that setting ALFs below market value is the appropriate way to address this concern as discussed in paragraph 5.47 above. If otherwise efficient markets are not serving vulnerable consumers effectively, where appropriate we would intervene with targeted measures to address such concerns.

Our decision

5.53 We therefore conclude that it is appropriate, taking account of our statutory duties and for the reasons set out above, to set the ALF for the paired 2100 MHz spectrum at our conservative estimate of market value of £0.561m per MHz (in April 2021 prices)**.** This:

a) will secure the optimal use of spectrum, which we consider to be in the interests of UK citizens and consumers;

b) will benefit consumers in the long run by ensuring that spectrum is used in the most efficient way for the provision of downstream services for which there is greatest value;

c) is consistent with promoting competition; and

d) can be expected to promote efficient investment and innovation.

6. Conclusion and implementation

Level of ALF

6.1 As set out in Section 5, we consider that it is appropriate, taking account of our statutory duties, to set the 2100 MHz ALF based on our estimate of market value. We are therefore setting ALFs for the paired 2100 MHz spectrum at £0.561m per MHz (in April 2021 prices).

6.2 This means that, based on their current paired 2100 MHz spectrum holdings (and based on April 2021 prices), the MNOs are required to pay the following annual licence fees:

a) EE: £22,440,000

b) H3G: £16,549,500

c) O2: £11,220,000

d) Vodafone: £16,605,600

Implementation

6.3 This section sets out how we have decided to implement the revised fees, including:

a) phasing in;

b) implementing inflation indexation; and

c) applying revised fees via the Fee Regulations.

Phasing in

6.4 Vodafone believed that there should be a transitionary year where ALFs are levied at a discount rate noting that they are not able to predict the magnitude of ALF in setting its forward looking budget and does not consider this is compatible with a desire for regulatory certainty.[133]

6.5 We disagree. The magnitude of the potential fee for the paired 2100 MHz spectrum could be deduced from ALFs in the 1800 MHz band as BT[134] noted in its response to the Spectrum Management Strategy[135] indicating its potential future ALF liabilities with the addition of 2100 MHz ALF from 2022.

6.6 In line with our provisional view, we have decided that there should not be a phase-in period for these new fee rates, with the full fees becoming payable from the fee payment date of 4 January 2022. In taking this view, we have taken into account that:

[133] Vodafone consultation response, p. 16.
[134] BT consultation response to Ofcom's Spectrum Management Strategy on Supporting the UK's Wireless Future consultation, p. 17.
[135] Ofcom, *Supporting the UK's Wireless Future,* 4 December 2020, https://www.ofcom.org.uk/__data/assets/pdf_file/0027/208773/spectrum-strategy-consultation.pdf.

a) the 2100 MHz spectrum licences were varied in 2011 to give effect to the Direction requiring the setting of ALFs after 31 December 2021. We consider that the existing licensees have therefore had sufficient notice (over ten years) of the fact that they would be liable for ALFs reflecting the full market value of the spectrum;

b) similar to ALFs in other mobile spectrum, we are providing licensees with the option to pay their annual licence fees across ten equal monthly instalments (rather than as a single, upfront payment).

Inflation indexation

6.7 We have converted the lump sum value of ALF to an annual figure that is specified in real terms that would incorporate an annual increase in ALF in line with inflation, as measured by the CPI. This is also consistent with our previous ALF determinations in other mobile spectrum which increase the ALF to reflect inflation.

6.8 Specifically, when calculating each year's ALF (ALF_t), the nominal value of ALF would be inflated by the ratio:

$$\frac{CPI_t}{CPI_0}$$

where:

- CPI_0 is the level of the CPI (all items) index in April 2021 (which is currently 110.1); and
- CPI_t is the latest available figure for the same index published by the Office for National Statistics ("**ONS**").

6.9 A copy of the fee Regulations is published at Annex A5 setting out the formula that we will use to derive inflation-adjusted ALF rates.

Application of revised fees

6.10 The annual licence fees that we have decided to set in this document will become payable from 4 January 2022. A copy of the fee regulations is provided in Annex A5.

6.11 Vodafone suggested that given they are paying for ALFs in multiple bands with a different invoicing cycle, a simpler approach would be either to have a single invoice that covers all bands payable across 12 months in line with the Network and Services fees or to align the invoice date for the 2100 MHz with the current 900/1800 MHz ALF invoice issued in October.[136]

6.12 We understand that having a single invoice cycle that covers multiple bands could simplify accounting. As the payment covers multiple bands with different licensees, we would be

[136] Vodafone consultation response, p. 17.

open to consider such changes in the future to consolidate payment to a single invoice cycle if we receive mutually agreed request from all affected licensees.

6.13 The fees in these regulations would remain applicable until we amend or revoke them. This means that, in effect, ALFs are set for an indefinite period and are not time limited.

Other issues raised

ALFs in other mobile bands

6.14 Three requested that Ofcom reduce the ALF payable in respect of UKB spectrum in 3.4 – 3.8 GHz band to £20m per 5 MHz based on the market clearing price of the recent 3.6 GHz spectrum auction compared to the 2018 3.4 GHz auction on which the current ALF is based. BT made a similar request for the fee to be revised downwards. Three said that its current level of ALF is much higher than what other MNOs paid in the recent 3.6 GHz auction which is unfair and discriminatory, as well as preventing the ability to trade with other MNOs to secure spectrum contiguity in the 3.4 – 3.8 GHz spectrum.[137]

6.15 BT also requested that Ofcom revise the 900 MHz, 1800 MHz and 3.4/3.6 GHz ALF downwards as a consequence of recent UK auctions prices.[138]

6.16 We note that the review of ALFs in other mobile bands are not within the scope of this statement and where appropriate would be subject to separate consideration.

[137] Three consultation response, pp. 18-20.
[138] BT consultation response, p. 37.