Review of Annual Licence Fees

Proposals for revised Annual Licence Fees for 900, 1800 and 2100 MHz spectrum

Consultation

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Annex

1. Overview

1.1 Annual licence fees ("**ALFs**") are fees we charge mobile network operators ("**MNOs**") to use certain spectrum bands. They typically come into effect after a mobile operator's licence won at auction has come to the end of its initial period. The initial period is typically 20 years.

1.2 We aim to set ALFs at an estimate of the forward-looking market value of the spectrum. This is because ALFs are intended to ensure that the spectrum is used efficiently: an operator who is not willing to pay the market price for spectrum should have an incentive to return some or all of it to Ofcom, or to trade the rights to use the spectrum to a more efficient user.

1.3 We currently charge ALFs for three mobile spectrum bands (900 MHz, 1800 MHz and 2100 MHz,[1] together the "**ALF spectrum**"). The ALFs for this spectrum total around £320m per year and are paid by MNOs to His Majesty's Treasury.

1.4 MNOs can submit evidence and request a review of the levels of ALFs, if they consider there is a case for revising the fees. If we believe there is sufficient evidence that there is a material misalignment between ALFs and the underlying market value, we can take a decision to review. In July 2024, we announced our decision to review these fees, in response to a request from BT/EE. We are now consulting on proposals for revised fees in each band.

What we are proposing – in brief

We are proposing to revise the ALFs we charge for mobile spectrum as follows:

- For 900 MHz spectrum, we propose to reduce the ALFs to £1.097m per MHz (a 21% reduction).
- For 1800 MHz spectrum, we propose to reduce ALFs to £0.81m per MHz (also a 21% reduction).
- For 2100 MHz spectrum, we propose to increase ALFs to £0.766m per MHz (a 12% increase).

The net effect of our proposed changes is that the total amount the MNOs pay to use these mobile spectrum bands would reduce by around £40m per year, with each of the MNOs seeing a reduction in the total payment amount they pay.

Summary of our proposals

1.5 In reaching the proposals set out in this consultation, we have carefully considered:

a) how we should calculate the lump sum value ("**LSV"**) of the ALF spectrum (i.e. the value of a 20 year licence for 1 MHz of spectrum in each of the ALF spectrum bands);

[1] MNOs hold spectrum licences for paired and unpaired 2100 MHz spectrum. We do not charge ALFs for their unpaired spectrum as we are revoking the licences for this spectrum. "2100 MHz" in this document therefore refers only to the paired spectrum, as this is the spectrum we charge ALFs for.

b) how we should apply inflation (both to past auction results, and to our final ALFs, going forwards); and
c) how we should convert the LSVs into an equivalent annual rate by spreading the lump-sum values over 20 years, using what we refer to as an "**annualisation rate**".

1.6 As set out in Ofcom's Strategic Review of Spectrum Pricing ("**SRSP**") and our January 2024 review of our approach to mobile spectrum management, we continue to consider that setting fees to 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.

1.7 In order to determine these fees, we are proposing:

a) to take a similar approach to that we have taken in the past to estimating the LSVs of the relevant spectrum. This entails using the results of recent UK auctions of mobile spectrum in other bands alongside the results of auctions in other European countries to estimate the value of the relevant spectrum. In particular:
    i) For 900 MHz we propose to focus on the relevant auction evidence for sub-1 GHz mobile spectrum bands, placing particular weight on the recent UK auction of 700 MHz spectrum.
    ii) For 1800 MHz and 2100 MHz we propose to take the relevant evidence from UK auctions of low and high frequency mobile spectrum as a starting point for the bounds within which the values of 1800 MHz and 2100 MHz are likely to lie, and to use international auction evidence to inform our estimate of where within these bounds the values of 1800 MHz and 2100 MHz are likely to lie. We refer to this approach as the "**distance method**".
b) to place more weight on more recent auctions than older auctions in estimating these LSVs;
c) to adjust the prices of relevant UK and international benchmark auctions for inflation using UK Consumer Price Index ("**CPI"**), as well as to increase ALFs by CPI every year, to keep them constant in real terms; and
d) to use the same method for calculating the annualisation rate as we have used in past ALF decisions.

The overview section in this document is a simplified high-level summary only. The proposals we are consulting on and our reasoning are set out in the full document.

2. Introduction

What are Annual Licence Fees?

2.1 The radio spectrum (the invisible airwaves that enable wireless technology), is a valuable and limited resource which is essential for delivering wireless services. Ofcom is responsible for managing the UK's radio spectrum, to ensure it is used in the best interests of the UK's consumers.

2.2 To help us secure the optimal use of spectrum, our general approach is to make use of market mechanisms where possible. For mobile spectrum licences, this usually means allocating the spectrum by auction when we first make it available. Allocating mobile spectrum by auction allows us to identify the user with the highest value for it (and therefore, the likely most efficient user).

2.3 However, with evolving market forces and technology the most efficient user of the spectrum can change over time. For this reason, we have tended to auction licences with an initial period of 15-20 years, following which we can either charge fees to ensure the continued efficient use of the relevant spectrum, or give notice of revocation with a view to reallocating the relevant licences if there may be a more efficient use or user for the spectrum.

2.4 In the case of mobile spectrum licences, the fees we charge at the end of the initial term of a licence are known as Annual Licence Fees, or "**ALFs**". We seek to set ALFs to reflect the forward-looking market value of the spectrum. ALFs are intended to incentivise licensees to hold licences only if they are the highest-value users of the spectrum. An operator who is not willing to pay the market price for the spectrum should have an incentive to return some or all of it to Ofcom, or to trade/sell it to a more efficient user.

Review of Annual Licence Fees

Review of our market-based approach to mobile spectrum management

2.5 In January 2024, we published the conclusions of our review of our market based approach to allocating mobile spectrum licences, which we carried out in response to a request from Government. Among other things, we concluded that allocating spectrum using auctions of indefinite licences with ALFs requires the availability of sufficient benchmarks to set fees and the application of regulatory judgement, but that ALFs nonetheless constitute a valuable part of our spectrum management toolkit.

2.6 We stated that we were open to reviewing the levels of ALFs if stakeholders provided evidence on the market value of the spectrum that would support such a review.

BT/EE's request

2.7 In March 2024, BT/EE requested that we review the ALFs which we charge for use of 1800 MHz spectrum. In that request, BT/EE set out its view that there is "*strong evidence*

that the level of fees charged for the 1800 MHz spectrum is materially misaligned with the current market value of this spectrum given:

- *material inconsistencies in relative spectrum fees for different bands today, with 1800 MHz fees 49% higher than 2.1 GHz;*
- *significant changes in supply and demand conditions since fees were set;*
- *the risks to efficient spectrum use, and consumer benefits, from misaligned fees; and*
- *if left unaddressed, today's distortions are likely to be exacerbated over time*."

This review

2.8 We considered the evidence set out in BT/EE's request and, in July 2024, we decided to open a review of the ALFs we charge mobile network operators for use of three mobile spectrum bands (900 MHz, 1800 MHz and 2100 MHz).

2.9 After opening this review, we met with each of the MNOs to understand their views on how we should conduct our review. Following those meetings, VMO2, BT/EE and Vodafone shared written submissions with us. In formulating our proposals, we have considered the MNOs' submissions and summarise and discuss these where relevant in this document.

Background to current ALFs

2.10 As shown in Table 2.1 below, we currently charge ALFs for three mobile spectrum bands (900 MHz, 1800 MHz and 2100 MHz). In this document we refer to them collectively as the "**ALF spectrum bands**". The ALFs for this spectrum total around £320m per annum and are paid to the His Majesty's Treasury.

Table 2.1: Current ALFs per MNO, per band, £m

	900 MHz	1800 MHz	2100 MHz	Total
BT/EE	-	92.3	26.8	**119.2**
H3G	-	30.8	19.8	**50.6**
VMO2	48.5	11.9	13.4	**73.8**
Vodafone	48.5	11.9	19.8	**80.2**
Total	**96.9**	**146.9**	**79.9**	**323.7**

Note: numbers may not sum due to rounding. The 900 MHz and 1800 MHz fees are those applicable from 31 October 2024, and the 2100 MHz fees are those applicable from 4 January 2024.

900 MHz and 1800 MHz

2.11 The 900 MHz spectrum was awarded by administrative allocation in 1985 and the 1800 MHz spectrum was awarded using the same approach in 1991.

2.12 The MNOs use 900 MHz and 1800 MHz spectrum to provide mobile voice and data services, using a mix of 2G, 3G and 4G technologies.

2.13 We last set the fees for the 900 MHz and 1800 MHz bands in December 2018, when we concluded that the appropriate ALFs for these bands (expressed in April 2018 prices) were:

a) 900 MHz: £1.093m per MHz per annum

b) 1800 MHz: £0.805m per MHz per annum

2.14 Licences to use 900 MHz and 1800 MHz spectrum are allocated as follows:

Table 2.2: Spectrum holdings in the 900 and 1800 MHz bands

	Vodafone	VMO2	BT/EE	H3G
900 MHz	34.8 MHz	34.8 MHz		
1800 MHz	11.6 MHz	11.6 MHz	90 MHz	30 MHz

2100 MHz

2.15 We auctioned the 2100 MHz spectrum in April 2000 for deployment of 3G national mobile networks. The award consisted of both paired spectrum and unpaired 2100 MHz spectrum. MNOs now use the paired spectrum to provide mobile voice and data services, using a mix of 3G, 4G and 5G technologies.

2.16 All the MNOs hold licences to use 2100 MHz spectrum, as shown in Table 2.3 below.

Table 2.3: Spectrum holdings in the 2100 MHz band

	Vodafone	VMO2	BT/EE	H3G
Paired spectrum	29.6 MHz	20 MHz	40 MHz	29.5 MHz
Unpaired spectrum	-	5 MHz	10 MHz	5.1 MHz

2.17 The licences authorising use of this spectrum came to the end of their initial terms in 2020, and in 2021 we decided to:

a) set ALFs of £0.561m per MHz for paired 2100 MHz spectrum (in April 2021 prices); and
b) to consult further on the unpaired 2100 MHz spectrum.

2.18 The unpaired spectrum has not been used to provide high powered mobile services in the UK. In December 2023, we decided to revoke all of the unpaired 2100 MHz spectrum licences with a five-year notice period, and not to set annual licence fees for these licences during the revocation period. In the remainder of this document when we refer to "2100 MHz" we mean the paired 2100 MHz spectrum.

Our objectives

2.19 We must exercise our functions in accordance with our statutory duties. When we exercise our powers in relation to setting spectrum fees, a number of statutory duties are relevant in particular, these can be broadly categorised as follows:

a) **Optimal use of spectrum:** The Communications Act 2003 (the "**Communications Act**") requires Ofcom to secure the optimal use for wireless telegraphy of the electro-magnetic spectrum. The Wireless Telegraphy Act 2006 (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.

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 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.

2.20 In developing our proposals we have also had regard to the desirability of promoting economic growth (the "**growth duty**") and the UK Government's Statement of Strategic Priorities ("**SSP**").

2.21 Annex 8 of this document includes more detail on the legal framework which is relevant to this consultation.

Summary of our proposals

Lump Sum Values

2.22 We have considered the UK and European auction benchmarks, and we propose to set the following LSVs (all of which represent reductions compared the existing LSVs):

Table 2.4: Proposed revised Lump Sum Values (in September 2024 prices)

Band	Existing LSV (£m per MHz)	Proposed LSV (£m per MHz)
900MHz	24.2	17.2
1800MHz	17.8	12.7
2100MHz	12.8	12.0

2.23 We explain how we have estimated these LSVs in greater detail in Section 4.

Annualisation rate and revised ALFs

2.24 The LSVs represent our estimate of the value of a 20-year licence for 1 MHz of the relevant spectrum. To convert this to an ALF, we apply an annualisation rate. The aim of the annualisation rate is to make the MNO indifferent between paying: (i) the entire LSV today, or (ii) a stream of annual payments over 20 years.

2.25 We are proposing to maintain the same method for calculating the annualisation rate as we have used in past ALF decisions. Our proposed annualisation rate (6.38%) is higher than the rate we applied in 2021 to the 2100 MHz ALFs (5.34%). The increase is primarily due to an increase in the cost of debt over this period.

2.26 Applying our proposed annualisation rate to the LSVs set out in Table 2.4 above gives the following revised ALFs. We explain how we have calculated this annualisation rate in greater detail in Section 5.

Table 2.5: revised ALFs and inputs to ALF calculations

Spectrum band	LSV (£m per MHz)	Annualisation rate	ALF (£m per MHz)	% change in ALF
900 MHz	17.2	6.38%	**1.097**	-21%
1800 MHz	12.7	6.38%	**0.810**	-21%
2100 MHz	12.0	6.38%	**0.766**	+12%

Structure of this document

2.27 The remainder of this document is structured as follows:

- Section 3: approach to determining ALFs
- Section 4: proposed LSVs for the ALF spectrum
- Section 5: proposed approach to annualisation and resulting ALFs
- Section 6: impact assessment
- Section 7: implementation proposals.

2.28 This consultation also includes the following Annexes:

- Annex 1: responding to this consultation
- Annex 2: Ofcom's consultation principles
- Annex 3: consultation coversheet
- Annex 4: consultation questions
- Annex 5: annualisation
- Annex 6: approach to international benchmarking
- Annex 7: relevant spectrum awards
- Annex 8: legal framework

Next steps

2.29 We welcome responses to this consultation by 5pm on **7 March 2025**.

2.30 We expect to consult on draft Regulations which would implement the proposals in this document early next year.

2.31 We aim to publish a statement on the proposals set out in this document in Q2 FY 2025/6.

3. Proposed approach to determining LSVs

Summary

3.1 We aim to set ALFs that reflect the market value of the spectrum, based on its opportunity cost (i.e. the value of the spectrum to the potential alternative user with the next highest value).

3.2 As explained in Section 1, we propose to calculate ALFs by:

i) estimating Lum Sum Values ("**LSVs**") for each of the ALF spectrum bands in current prices, using the results of recent UK auctions of mobile spectrum in other bands alongside the results of auctions in other European countries;
ii) calculating an annualisation rate which we can use to convert the LSV into annual payments;
iii) converting the LSVs from step one into equivalent annual payments by applying the annualisation rate from step two; and
iv) for subsequent years' fees, inflating the value of the ALF payment by the UK Consumer Price Index ("**CPI**").

Structure of this section

3.3 In the remainder of this Section, we explain in more detail:

a) why we consider the potential alternative user with the next highest value for the ALF spectrum is likely to be an alternative MNO;

b) how we have calculated LSVs for ALF purposes in the past;

c) the MNOs' submissions on the approach we should take to calculating LSVs in this review, and on how we should adjust past auction results for inflation; and

d) our proposed approach to setting LSVs for the ALF spectrum.

Next highest value use or user for the ALF spectrum

3.4 The 900 MHz, 1800 MHz and 2100 MHz bands are mainstream bands providing national mobile services. Our provisional view is that the next highest value use case for each of these bands is mobile services and we expect that the next highest value user for each of these bands would be another MNO. We consider below how we might determine the LSV of the ALF spectrum for an MNO.

Previous approaches to setting ALFs

900, 1800 and 2100 MHz

3.5 When we set ALFs for 900 MHz and 1800 MHz spectrum in 2018, neither of those bands had been auctioned in the UK.

3.6 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. In particular:

a) For the 900 MHz band, we focused on the relative value of 900 MHz to 800 MHz in countries where both bands had been auctioned.
b) For 1800 MHz, we adopted what we referred to as the "distance method". This used evidence from European auctions to inform our view of where the value of 1800 MHz lay between the value of 800 MHz and 2.6 GHz.[2]

3.7 For 2100 MHz, we also used the distance method, taking account of the results of the UK auctions in 2013 (800 MHz and 2.6 GHz), 2018 (2.3 GHz and 3.4 GHz), and 2021 (700 MHz and 3.6 GHz), and European countries involving 2100 MHz and those other auctioned bands. We did not deem the 2000 auction of 2100 MHz relevant to our estimates of the forward-looking value of the band, given the data was already 20 years old.

3.8 Across all three bands, we:

a) Used relative values from international auctions to establish a UK estimate for the LSV.
b) Categorised the international benchmark evidence into three tiers. These categorisations reflected how informative of relative UK market values we considered the benchmarks to be, with Tier 1 being the most informative and Tier 3 the least informative.[3]
c) Recognised the interpretation of benchmarks involving older auctions and auctions at different points in time is not always straight-forward. We did not place greater weight on more recent auctions.
d) Adjusted the prices of relevant UK and international benchmarks auctions for inflation using UK CPI, to keep prices constant in real terms.

MNOs' submissions

3.9 After we announced our decision to open a review into the ALFs we charge for mobile spectrum, we met with each of the MNOs. BT/EE, Vodafone and VMO2 also subsequently provided us with written submissions, setting out their initial views on this review. In addition, the UK SPF noted it welcomed our decision to open this review, and re-submitted the report conducted by Analysys Mason on the use of market mechanisms as applied to mobile spectrum in the UK.[4]

Auction evidence and method

3.10 In both its March 2024 request for a review, and its September 2024 written submission, BT/EE proposed that we should use a linear interpolation between the most recent low and

[2] The distance method consists of (a) calculating the Y/X ratio (calculated as the difference in value between (in this case) 1800 MHz and the higher frequency comparator band ("Y"), divided by the difference in value between the lower frequency comparator band and higher frequency comparator bands ("X")), and (b) relating this to the corresponding lower and higher frequency band values in the UK to solve for the UK value of 1800 MHz. Further details on these calculations are set out in Annex 6.
[3] See Annex 6 for a description of the criteria for the different tiers.
[4] We considered this report before reaching the conclusions in our January 2024 review of our market-based approach to mobile spectrum management.

high band UK auction results (i.e. 700 MHz and 3.6 GHz from the 2021 auction). In its view this would reduce the complexity and degree of judgement involved in estimating the level of ALFs.[5]

3.11 BT/EE considered that the distance method approach was no longer reliable because:

a) some of the UK auctions are now very old meaning they are less likely to be reflective of current values;
b) CPI has been "abnormally high", further increasing the disconnect between ALFs and the underlying value of the spectrum; and
c) with a much larger number of international auction results now available, many anomalous results mean that there is more noise than clarity in the data and more subjective reasoning is required to interpret the data.

3.12 H3G proposed that for 1800 MHz we continue to use the distance method approach using only the 700 MHz and 3.6 GHz UK auction results from 2021 as the comparator bands. For 2100 MHz, it suggested we re-evaluate the current ALF to ensure it is lower than the revised 1800 MHz ALF, given its shorter propagation distance.[6]

3.13 Vodafone considered that there has been a profound change in the technology available to MNOs over the past decade, with the technology specificity of different bands within groups of frequencies largely disappearing. In Vodafone's view this means that these bands' functional equivalence and values are therefore converging. As a result, it suggested that ALFs should be largely equivalent for spectrum in the following groupings:

a) deep indoor/outdoor coverage – low band (700 MHz, 800 MHz, and 900 MHz);
b) shallow indoor/outdoor coverage – lower mid-band (1800 MHz and 2100 MHz); and
c) capacity – upper mid-band (2.3 GHz, 2.6 GHz, 3.4 GHz).

3.14 Accordingly, it proposed that LSVs should be set at a level which reflects functional equivalence. It said that the 900 MHz LSV should be set at the 700 MHz auction value and the 1800 MHz ALF should be set according to the 2100 MHz ALF (which it considered should be "rebaselined to remove the effect of inflation shock").[7]

3.15 VMO2 advocated retiring the UK 4G benchmarks (from 2013), and supported setting the 900 MHz value based on the UK 700 MHz auction price without reference to other bands. In doing so, it cautioned that the ongoing fall in low band values may mean that the 700 MHz auction price overstates the current or future value of 900 MHz.[8]

3.16 VMO2 proposed a single LSV for 1800 MHz and 2100 MHz on the basis that the equivalence in function of these bands should lead to an equivalence in value.

3.17 Based on benchmarking analysis undertaken by NERA, an economic consulting firm, on its behalf, VMO2 considered that 25% could be a reasonable estimate of the 900 MHz ALF's premium over the 1800/2100 MHz ALFs, and suggested this premium could be considered in determining final values for 900 MHz and lower mid-band spectrum. For instance, this could suggest that the 900 MHz value is too high relative to the lower mid-band value if the difference was much larger than 25%.[9]

[5] BT/EE's September submission, p3
[6] Ofcom/H3G meeting, 27 August 2024
[7] Vodafone's September submission, p2-3
[8] VMO2's September submission, p12-13
[9] VMO2's September submission, p13

Adjusting past auction results for inflation

3.18 BT/EE, Vodafone and VMO2 are all of the view that we should not continue to adjust past auction results for inflation using CPI.

3.19 In its September 2024 submission, BT/EE set out its view that the previous assumption that the value of ALF spectrum remains constant in real terms over time is no longer reasonable given:

a) Recent evidence shows declining marginal efficiencies in terms of cost (per unit of traffic) and flat or declining real revenues (per unit of traffic) demonstrating that operators' unit margins are falling over time, which in its view indicates that the real value of spectrum is also declining over time.
b) The Office of National Statistics ("**ONS**") has found that previous official telecoms services deflators using CPI were flawed and understated 'true' reductions in the price of telecoms products – suggesting that CPI inflation is unlikely to be a meaningful indicator of either the evolution of telecoms prices in real terms, or of spectrum values used as an input.

3.20 BT/EE considered that, given recent levels of inflation, removing inflation altogether is likely to be more appropriate than using CPI absent a more accurate approach to estimating sectoral inflation (which, in its view, may actually indicate spectrum values declining in real terms).

3.21 Vodafone suggested that, when inflation-indexing the 700 MHz valuation from 2021-2024, ideally a value of 2% per annum should be used, but at worst inflation should be capped at 4% per annum.

3.22 In support of this view, Vodafone said that:

a) Our previous analysis assumed that inflation would not deviate widely from the Bank of England ("**BoE**") target of 2% (which has not been the case in the last few years) and that there was strong evidence that assets do not increase in value in-line with inflation when there are inflation-shock events, and as such it cannot credibly be argued that spectrum has increased in value by 25% over the last couple of years (when there has been no corresponding increase in industry revenues).
b) While, absent inflationary shocks, it may be reasonable to consider that overall spectrum values increase in-line with inflation (or at least with industry revenues), it challenged whether it was credible that the unit value of spectrum had remained the same in real terms when there had been a doubling of available spectrum over the past decade but no corresponding increase in demand (i.e. mobile industry revenues).

3.23 Vodafone's economic analysts, Frontier Economics ("**Frontier**"), additionally stated that the fall in MNOs' parent share prices over the last five years suggests the value of MNOs' assets has not been stable in real terms.

3.24 VMO2 was of the view that the current approach to indexation must not be continued and that alternatives exist. In particular, it proposed the introduction of a CPI-X approach, and proposed X=CPI for this review.[10]

3.25 It noted that our current approach presumes that CPI and spectrum values move in the same direction and evidence that changes are of a similar magnitude. Given CPI has been

[10] 'X' set at 'CPI' would equate to ALFs being kept constant in nominal terms.

much greater in recent years compared to the level when we previously set ALFs, and in its view there is now more evidence on the decrease in spectrum values.

3.26 It considered that operator profitability and auction prices are the most relevant indicators of spectrum value, rather than industry revenue and prices.

3.27 VMO2's economic analysts, NERA, stated in its report that in the current era of declining spectrum prices, historic nominal prices on average are likely to overstate current values, so adjusting for inflation increases the risk of overstatement. It considered reverting to nominal prices to be a partial fix.

Proposed approach to estimating LSVs for this review

3.28 We set out below our proposed approach to estimating LSVs for this review, taking into account the submissions made by MNOs.

Auction evidence and method

Auction evidence

3.29 We consider that the most appropriate approach to estimating the LSVs for the ALF spectrum 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), i.e. a similar approach to that used when we have set ALFs in the past.

3.30 The recent UK auctions of mobile spectrum we have are the:

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.

Method

3.31 For **900 MHz** we propose to focus on the relevant auction evidence for sub-1 GHz mobile spectrum bands. In doing so, we note Vodafone and VMO2's submissions regarding the convergence in the value of sub-1 GHz spectrum.

3.32 For **1800 MHz** and **2100 MHz** we propose to take the relevant evidence from UK auctions of low and high frequency mobile spectrum as a starting point for the bounds within which the values of 1800 MHz and 2100 MHz are likely to lie. In addition, we propose to draw on evidence from European auctions using the 'distance method' approach that we have used previously. The distance method entails (a) calculating the difference in value between (in this case) 1800 MHz/2100 MHz and a higher frequency comparator band ("Y"), divided by the difference in value between a lower frequency comparator band and higher frequency comparator bands ("X") in a European country, and (b) relating this to the corresponding lower and higher frequency band values in the UK to solve for the UK value of 1800 MHz/2100 MHz.

3.33 Whilst BT's linear interpolation approach would remove some complexity from our analysis, we do not consider that there is a strong reason to suppose that the relationship between spectrum value and frequency would be linear.

3.34 Instead, we consider it more appropriate to take account of the relevant European auction evidence to inform our view as to the appropriate LSVs for 1800 MHz and 2100 MHz. Analysing and interpreting that evidence is not always straight-forward and involves us exercising our regulatory judgement. However, in this case it is preferable to consider the available evidence and then exercise our judgement.

3.35 We set out in detail our proposed approach for each band in their respective sub-sections of Section 4 below. In view of our statutory duties to secure the optimal use of spectrum, we propose to continue to adopt a conservative approach to the interpretation of the evidence.

Weight attached to different auction benchmarks

Weight on more recent auctions

3.36 We have considered stakeholders' views that older auction evidence is less informative of current spectrum values than newer auctions.

3.37 We agree that technological and commercial developments over time can have an impact on forward-looking market values; that the UK 2013 auction is almost 12 years old now (and some European auctions precede that), and that the interpretation of benchmarks involving older auctions and auctions at different points in time is not always straight-forward. However, we are also cautious about arbitrarily introducing a cut-off date and discarding potentially relevant evidence from before the cut-off.

3.38 Rather than discard the data from older auctions, our proposed approach is to place more weight on auctions and benchmarks from the 5G era, and place less weight on auctions from the 4G era. This is a change from the approach we took in our 2021 ALF decision[11] where we did not differentiate the weight we placed on benchmarks based on the timings of the underlying auctions.

3.39 In its report for VMO2, NERA observed the cut-off date between 4G and 5G awards is less distinct than that between 3G and 4G era awards. NERA noted that while it generally refers to 2017 as a start date for 5G era awards, there were some European awards of 700 MHz as early as 2015, and accordingly it suggested we focus our analysis on awards from 2015 onwards.

3.40 Our provisional view is that this is a reasonable approach, and accordingly we propose to:

a) place more weight on the UK 2018 and 2021 auctions than the UK 2013 auction;
b) place more weight on international benchmarks where all the UK and international auctions used to derive the benchmark are from 2015 onwards; and
c) consider the post-2015 auction evidence in the round, rather than segmenting this data further by date.[12]

3.41 We recognise that the UK 3.4 GHz and 3.6 GHz auctions both took place post-2015 and resulted in different auction prices, despite the spectrum being functionally equivalent. This raises a question as to how we interpret the results of these two auctions. 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 GHz spectrum band changed between the two auctions. This is because: (a) neither auction had unsold spectrum, (b) both sold above

[11] 2021 Statement, paragraphs 4.7-4.22
[12] As we noted in the SRSP, a number of different factors can influence the outcome of a particular auction.

reserve price (albeit not by much in the case of the more recent 3.6 GHz auction), and (c) there was evidence of competitive bidding in both auctions.

3.42 We therefore propose to place equal weight on both auction outcomes when making our assessment. This is consistent with our treatment of these auctions in our 2021 Statement on 2100 MHz ALFs.

Tiering

3.43 Consistent with the approach we have taken in our previous ALF decisions, we have categorised the international benchmark evidence into three tiers. These tiers 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.[13] Our criteria for placing a relative benchmark in Tier 1 are that:

a) the auction prices appear likely to have been primarily driven by a market-driven process of bidding in 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.[14]

3.44 In light of our proposal to place more weight on auctions and benchmarks from the 5G era, and less weight on auctions from the 4G era, we have considered whether to regard all benchmarks that include a UK or international auction from before 2015 as failing to satisfy the third Tier 1 criteria.

3.45 On balance we propose not to do so. Instead, we propose to first consider Tier 1 benchmarks where all the UK and international auctions that go into deriving that benchmark are from 2015 onwards, and then consider Tier 1 benchmarks where one or more of the UK or international auctions that go into deriving that benchmark are from before 2015. Finally, we will consider, as a cross-check, the Tier 2 and 3 benchmark evidence. This will enable us to distinguish in our assessment between Tier 1 quality benchmarks that involve older auctions, and Tier 2 and Tier 3 quality benchmarks, and enable us to give appropriate weight to each of these in our assessment.

3.46 In addition to attributing each benchmark to a tier, we assessed whether there is a risk that the benchmark was likely to be an understated or overstated estimate of the UK value of the ALF spectrum band. For example, a binding spectrum cap could create a risk that the auction understated the market value in that country.

[13] 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.

[14] 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.

Adjusting past auction results for inflation

3.47 We explain below how we propose to adjust past auction results for inflation ('backward-looking approach to inflation'). In Section 7, we discuss how we propose to adjust ALFs year on year once we have set them ('forward-looking approach to inflation').

3.48 Because of the relatively high levels of inflation over the past couple of years, our choice of approach has a material impact on our estimates of the LSVs of mobile spectrum. For example, if we assume that the value of 700 MHz had remained constant in nominal terms since the auction in 2021 that would imply its current value was £14m per MHz, while if we assume its value has remained constant in real terms that would imply its current value (in September 2024 prices) was £17.2m per MHz.

3.49 Our starting point, consistent with our previous ALF decisions, is that all else equal, the value of spectrum is likely to remain constant in real terms over time. Spectrum is an input into the production of mobile services. As such, we consider that the value of incremental spectrum to an MNO is likely to depend on:

a) the additional profits the MNO could generate through increased coverage, capacity and higher quality if it had the additional spectrum; and/or

b) the avoided network costs required to achieve similar coverage, capacity and quality without the additional spectrum.

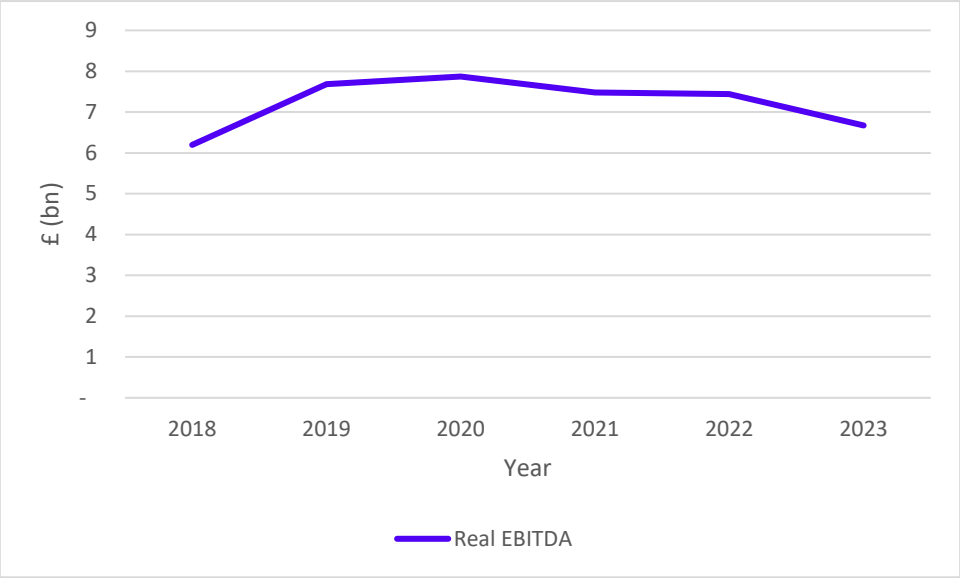
3.50 In general, these network costs and MNOs' revenue and profits are likely to broadly increase in line with general inflation.

3.51 In light of stakeholders' comments and given the specific circumstances of the past few years, we have considered whether that remains a reasonable assumption.

3.52 We consider MNO profits are likely to be a better indicator of value for mobile spectrum licences than revenue. As set out in Figure 3.1, the aggregate real EBITDA[15] of the four MNOs increased between 2018 (when we set the 900 MHz and 1800 MHz ALFs) and 2020, before declining between 2020 and 2023. Overall, it is 8% higher in 2023 than in 2018, but 15% lower than its peak in 2020.

[15] Earnings before interest, taxes, depreciation and amortisation.

Figure 3.1: Aggregate real EBITDA for the four MNOs, 2018-2023 (in 2023 prices)



Source: Ofcom, based on UK company financial statements (Vodafone Limited, O2 Holdings Limited – 2018-2021, Telefonica UK Limited – 2022-2023, Hutchison 3G UK Limited and EE Limited). Note: 2023 either refers to year ended 31 December 2023 or 31 March 2024.

3.53 We also estimate that the MNOs' average EBITDA margin has remained stable between 31% and 33% in each of the years between 2020 and 2023 (up from 24% in 2018 and 30% in 2019).

3.54 With respect to the points raised by the MNOs in their submissions, our provisional view is that:

a) EBITDA margins are more informative of spectrum values over time than unit margins, especially when technological developments can enable an increase in the amount of traffic that can be carried over a given amount of spectrum.
b) The focus of the ONS' work cited by BT/EE was on how to improve the telecoms services deflator used in the output measure of GDP, in particular how to quality-adjust the price of telecoms services given the growth in data usage. To the extent that the evolution in the price of mobile services is an indicator of the value of spectrum, we consider this would be best observed directly. We note that in 2023 and 2024 all four MNOs increased their in-contract prices by more than CPI (BT/EE, Three and Vodafone increased their prices by CPI + 3.9% while VMO2 increased its by RPI + 3.9%).[16]
c) The fall in MNOs' parent share prices over the last five years cited by Frontier indicates a decline in the expected *future* cashflows of MNOs (while real EBITDA has remained relatively stable), potentially reflecting technological or commercial developments that will decrease profitability. We expect that MNOs account for anticipated technological or commercial developments that could affect the value of spectrum when bidding in spectrum auctions, leading to real term auction results that reflect these expectations.

3.55 In light of this, we do not consider there is a compelling reason to depart from our starting point that, all else equal, the value of spectrum is likely to remain constant in real terms over time.

[16] Ofcom, Prohibiting inflation-linked price rises, Statement, July 2024. Table 1.

3.56 With respect to Vodafone's point on whether the unit values of spectrum have remained constant in real terms given the increase in supply of spectrum over the past decade (see paragraph 3.22b) above), we note that ALFs are set on a forward-looking basis, and we expect MNOs to take into account known future spectrum releases when bidding in auctions. It was known in 2018 (both when the 2.3 GHz and 3.4 GHz auction took place and when we set the ALFs for 900 MHz and 1800 MHz later that year) that the 700 MHz and 3.6 GHz spectrum bands were going to be made available for mobile – they were auctioned in 2021. As such, we expect that that increase in supply of spectrum was factored into the unit values of spectrum at that time.

3.57 We also recognise that there can be technological or commercial developments that can have an impact on the value of spectrum (either positively or negatively). Consistent with our approach in previous ALF decisions, we consider that it is more appropriate to consider these specific developments in our overall interpretation of the benchmarking evidence, than holding spectrum values constant in nominal terms - which we consider would constitute a largely arbitrary real terms adjustment that was unlikely to reflect the magnitude of market developments.

3.58 Therefore, our provisional view is that, when determining the LSVs, it remains appropriate to adjust the prices of relevant UK and international benchmark auctions for inflation using UK CPI.

Question 1: Do you have any comments on our proposed approach to deriving ALFs?

Question 2: Do you agree with our proposal to adjust past auction results in line with CPI?

4. Proposed LSVs for the ALF spectrum bands

Summary

4.1 In this Section, we set out our proposed LSVs for the ALF spectrum bands, which we have derived using the approach set out in Section 3 above.

4.2 In coming to our proposed LSVs:

a) We consider that the auction prices from Ofcom's three most recent auctions of mobile spectrum are relevant evidence for determining the market values of the ALF spectrum. As explained further below, this is because of their recency and the frequencies involved. As explained in paragraphs 3.36-3.41 above, we propose to place more weight on the UK 2018 and 2021 auctions than the 2013 auction.

b) As explained above, we have separated our estimates into those that rely exclusively on post-2015 auction evidence (we refer to this as "**post-2015**" auction evidence) and those which include at least one input which is from an auction prior to 2015 (we refer to this as "**pre-2015**" auction evidence). This temporal segmentation broadly aligns with the start of the "5G era". We propose to place more weight on the post-2015 evidence.

4.3 Determining a forward-looking estimate of market value for a specific spectrum band is not a precise science, and there is no 'right' way of doing it. To arrive at our proposed LSVs we have had to exercise our judgement based on the economic evidence and technical characteristics of the spectrum bands. We have done so using the method we established in previous ALF decisions, and taking a conservative approach to interpreting the evidence.[17]

4.4 Table 4.1 below sets out the LSVs used to calculate the current ALFs and our proposed revised LSVs, both in September 2024 prices.

Table 4.1: LSVs for current ALFs and proposed LSVs (September 2024 prices)

Spectrum band	LSVs for current ALFs (per MHz)	Proposed LSVs (per MHz)
900 MHz	£24.2m*	£17.2m
1800 MHz	£17.8m*	£12.7m
2100 MHz	£12.8m**	£12.0m

*ALF set in December 2018.
**ALF set in December 2021

4.5 In the remainder of this chapter we explain how we have reached our provisional view on the appropriate LSV for each of the ALF bands in turn.

[17] 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.

Proposed LSV for 900 MHz

4.6 In this sub-section we consider the LSV for 900 MHz spectrum for the purposes of setting its ALF. As set out in paragraph 3.31 above, for 900 MHz we propose to focus on the relevant auction evidence for sub-1 GHz mobile spectrum bands. We consider that these bands are the closest functional substitutes for 900 MHz.

4.7 The most recent available UK evidence for the value of sub-1 GHz mobile spectrum is the 2021 auction of the 700 MHz band. The 700 MHz spectrum sold for £17.2m per MHz (in September 2024 prices). We also have evidence from the UK 800 MHz auction in 2013, albeit we are proposing to place less weight on that evidence given that it is more than ten years old.

Table 4.2: Auction prices from sub-1 GHz UK mobile spectrum auctions (in September 2024 prices)

Spectrum band	Auction date	Price (per MHz)
700 MHz	March 2021	£17.2m[18]
800 MHz	March 2013	£45.1m[19]

Converging values of sub-1 GHz spectrum

4.8 The MNOs' have submitted that the value of sub-1 GHz spectrum is converging.[20] Broadly, this view is based on these bands' propagation characteristics, uses, and equipment availability.

4.9 They also believe the 800 MHz auction value was significantly higher than the subsequent 700 MHz auction value because when it was awarded in 2013 it was the only sub-1 GHz band which could be used to deploy the then latest 4G technology. Our 2018 ALF decision reflected this with the 900 MHz LSV being set at 54% of the value of 800 MHz.

4.10 Based on their view that the bands are now functionally substitutable given changes in technology, Vodafone and VMO2 (the two MNOs that hold 900 MHz spectrum licences) suggest that we should set the 900 MHz LSV based on the UK 700 MHz auction value from 2021.[21]

4.11 We agree that there has been a convergence in the values of the sub-1 GHz spectrum bands over time. We therefore expect the value of 900 MHz to be broadly convergent with the 2021 UK auction price of 700 MHz, that is, in the region of £17.2m per MHz.

4.12 However, we also note that there may be reasons to expect a slight difference between the values of 700 MHz and 900 MHz spectrum, for example:

a) There is a difference in the equipment ecosystems for the two bands: as of 5 December 2024, there were 3,542 user devices models supporting 4G or 5G in the 700 MHz band,

[18] Market value for 700 MHz paired spectrum. This does not include the 700 MHz SDL spectrum also sold as part of this award.
[19] This is gross of expected DTT co-existence costs. See, 2018 Statement, paragraphs 4.5 and 4.6.
[20] See, section 1 of Vodafone's submission, and Part 2 of VMO2's submission.
[21] See, section 1 of Vodafone's submission, and Part 2 of VMO2's submission.

and 5,597 devices supporting use of 4G or 5G in the 900 MHz band.[22] This may imply the 900 MHz spectrum may be slightly more valuable than the 700 MHz spectrum because an MNO might expect to be able to address the needs of more users and their devices with 900 MHz than with 700 MHz.

b) We expect 700 MHz to be slightly better at providing deep indoor coverage, due to its propagation characteristics.[23] This may imply 700 MHz is slightly more valuable than 900 MHz spectrum because an MNO might expect to address the needs of more users in more locations with 700 MHz than 900 MHz.

4.13 We nonetheless consider that these differences are small and are unlikely to result in a material difference in how 700 MHz and 900 MHz are used in MNOs' networks. We therefore consider that the two bands are likely to be relatively close substitutes and accordingly are likely to have very similar values.

4.14 In the next sub-sections, we consider whether the international auction evidence supports the view that 700 and 900 MHz are likely to be of similar value.

Relevant international benchmarks

4.15 We have identified auctions in European countries in which:

a) there has been a spectrum award for 900 MHz;
b) the auction design did not prevent us from deriving band-specific prices;[24] and
c) there has also been a spectrum award of another sub-1 GHz mobile spectrum band (i.e. either 700 MHz or 800 MHz).

4.16 To create a benchmark value for 900 MHz spectrum in the UK from a given country we calculate the relative value of 900 MHz to 700 MHz (or 800 MHz) in that country and then multiply the resulting ratio by the corresponding UK 700 MHz (or 800 MHz) auction value.

4.17 Table 4.3 below sets out the three post-2015 Tier 1 benchmarks[25] we have identified.

Table 4.3: Year of post-2015 Tier 1 international benchmark auctions for 900 MHz and relevant UK auctions

Country	900 MHz	700 MHz	UK 700 MHz
Germany	2015	2015	2021
Hungary	2021	2020	2021
Sweden	2023	2018	2021

4.18 In addition, we have six pre-2015 Tier 1 benchmarks. These are set out in Table 4.4 below.

[22] Global Mobile Suppliers Association's Analyser for Mobile Broadband Data ("Gambod"), accessed 5 December 2024.
[23] See, for example, Figures A6.4 and A6.5 in the 13 March 2020 Statement: Award of the 700 MHz and 3.6-3.8 GHz spectrum bands. These showed that 700 MHz could be used to provide coverage to slightly more shallow and deep indoor locations than could be covered using 900 MHz. The difference in coverage between the two bands was slightly more pronounced in urban areas with almost no difference in rural areas.
[24] Deriving band-specific prices is challenging for results from combinatorial auctions.
[25] Tier 1 benchmarks are the benchmarks we consider to be most informative. See Annex 6 for an explanation of the tiering criteria we use.

Table 4.4: Year of pre-2015 Tier 1 international benchmark auctions for 900 MHz and relevant UK auctions

Country	900 MHz	800 MHz	700 MHz	UK 700 MHz or 800 MHz
Austria	2013	-	2020	2021
Austria*	2013	2013	-	2013
Croatia	2023	2023	-	2013
Germany*	2015	2010	-	2013
Ireland*	2012	2012	-	2013
Sweden	2023	2011	-	2013

** Auctions used to set the 900 MHz LSV in the 2018 Statement.*

4.19 We have reviewed each of these auctions in detail to test if they suggest the value of 900 MHz should lie above or below the value of 700 MHz.

4.20 Figure 4.1 below shows:

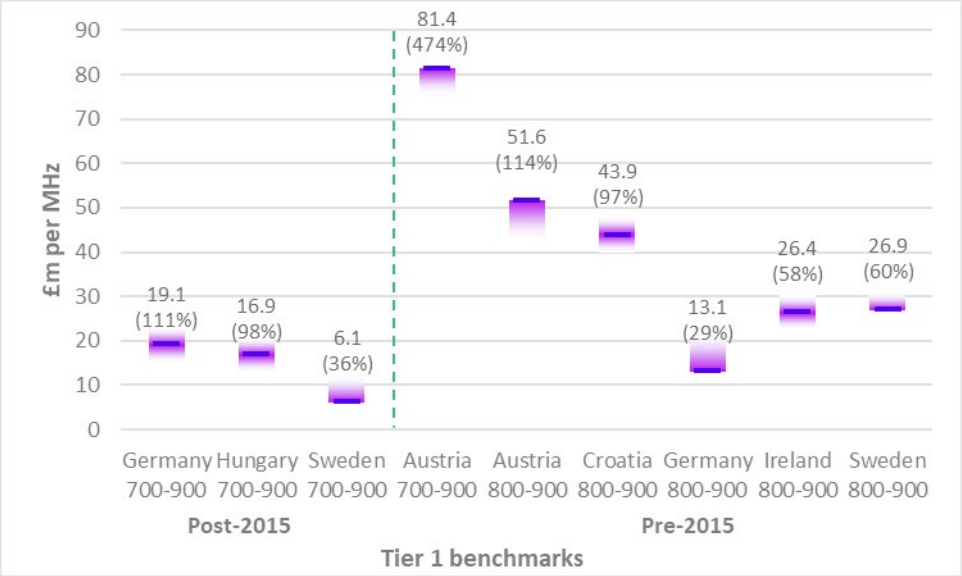
a) *To the left of the vertical dotted line:* Tier 1 benchmarks for the three countries where both the UK and the international auctions used to generate those benchmarks were conducted post-2015: Germany, Hungary and Sweden.
b) *To the right of the vertical dotted line:* Tier 1 benchmarks for countries which involve at least one auction that was conducted pre-2015: Austria, Croatia, Germany, Ireland, and Sweden.

4.21 The interpretation of the datapoints is:

a) the percentage is the ratio of the 900 MHz to the 700 MHz (or 800 MHz) auction values for the relevant country;
b) the number is the ratio multiplied by the corresponding value of UK 700 MHz (or 800 MHz) (i.e. the relevant benchmark for the UK value of 900 MHz); and
c) the shaded areas illustrate our assessment of the likelihood or scale of possible understatement or overstatement associated with each benchmark.[26]

[26] This includes factors such as binding spectrum caps, coverage obligations and potential strategic bidding. See Annex 7 for our assessment of the individual benchmarks.

Figure 4.1: Pre-2015 and post-2015 Tier 1 benchmarks for 900 MHz



Source: Ofcom

4.22 Of the three post-2015 benchmarks, there is one country where 900 MHz sold for slightly more than 700 MHz (Germany), one country where they sold for very similar amounts (Hungary), and one country where 900 MHz sold for considerably less than 700 MHz (Sweden). In considering these datapoints in the round, we note that:

a) *There may have been strategic bidding in the German auction.* In previous ALF decisions we noted there was likely a degree of strategic bidding with respect to both 700 MHz and 900 MHz in the 2015 auction.[27]
b) *The Swedish benchmark is likely to understate the relative value of 900 MHz.* There was significantly more intense competition for the 700 MHz spectrum than the 900 MHz spectrum. We consider this was in part because only 2x20 MHz of 700 MHz spectrum was available, meaning not all three MNOs could acquire 2x10 MHz (and indeed one of the MNOs who participated in the auction ended up with no 700 MHz spectrum). In contrast, there was 2x35 MHz of 900 MHz spectrum available with each MNO acquiring at least 2x10 MHz. Consequently, we consider the 900/700 MHz ratio in Sweden partially reflects the differences in the availability of spectrum in each auction, rather than the relative values of the bands.[28]

4.23 In addition to this more recent auction evidence, we also have six pre-2015 Tier 1 benchmarks. These are:

a) three 900/800 MHz benchmarks, which we used to set the 900 MHz ALF in 2018 from Austria, Germany and Ireland;
b) two new 900/800 MHz benchmarks from Croatia and Sweden; and
c) one new 900/700 MHz benchmark from Austria.

4.24 Of these benchmarks, we consider the most relevant evidence is from Croatia. This is because both 800 MHz and 900 MHz for that country were auctioned in 2023. In that auction, 800 MHz sold for 3% more than 900 MHz, supporting the view that the value of

[27] We discuss this auction and our treatment of auctions in previous ALF decisions in Annex 7.
[28] See also, https://www.aethaconsulting.com/the-swedish-700mhz-auction-why-such-a-high-price/

sub-1 GHz spectrum has converged in recent years.[29] This ratio is categorised as pre-2015 because the UK 800 MHz auction, which we rely on to generate this LSV estimate, took place in 2013.

4.25 The other pre-2015 benchmarks tend to suggest higher values for UK 900 MHz than the post-2015 benchmarks. However, we are conscious that:

a) some are based on a set of auction results that occurred more than ten years ago (900/800 MHz benchmarks for Austria, Germany, Ireland); or
b) involve auctions that took place at different points in time (in the case of Austria 900/700 MHz and Sweden 900/800 MHz), making their interpretation less straight-forward.

4.26 Consistent with our proposed approach, we are inclined to place less weight on these pre-2015 benchmarks than the post-2015 benchmarks.

4.27 Overall, we consider that the international benchmarking evidence provides a mixed picture, with some benchmarks lying below and some lying above the value for the UK 700 MHz band. However, in the round, our provisional view is that the international evidence broadly supports the view that 900 MHz has a similar value to 700 MHz.[30]

Our provisional view on the 900 MHz LSV

4.28 We propose to set the 900 MHz LSV equal to the UK value of 700 MHz from the 2021 auction, that is at £17.2m per MHz (in September 2024 prices).

4.29 Our rationale is:

a) The uses, equipment ecosystems and propagation characteristics of the 700 MHz and 900 MHz bands indicate that they should have very similar values.
b) Our assessment of the international benchmark evidence is that it broadly supports the view that 900 MHz has a similar value to 700 MHz.
c) Given our assessment in points a) and b), we believe that the UK 700 MHz auction value from 2021 (inflated to current prices) is the best indicator of the likely value of the UK 900 MHz spectrum.

Proposed LSV for 1800 MHz

4.30 In this sub-section, we consider the LSV for 1800 MHz spectrum for the purposes of setting its ALF. Our proposed approach (consistent with our established method from previous ALF reviews) is:

a) to take the relevant evidence from UK auctions of low and high frequency mobile spectrum as a starting point for the bounds within which the value of 1800 MHz is likely to lie; and

[29] For the avoidance of doubt, we do not interpret the evidence from Croatia as suggesting the forward-looking value of 900 MHz is in the region of £43.9m per MHz. This figure is generated by the model by applying the ratio of 900/800 MHz from the Croatian 2023 auction to the UK 800 MHz auction price from 2013. The relevant from the Croatia auction data is the relative value of the 900 MHz and 800 MHz spectrum.
[30] As a cross-check, we also tested if the Tier 2 and Tier 3 benchmarks (see Annex 7 for more details) were inconsistent with our provisional view. They were not.

b) to identify an appropriate value for 1800 MHz within this range, draw on evidence from European auctions using the 'distance method' approach that we have used in previous ALF decisions (see paragraph 3.32 above).

Recent UK auction evidence

4.31 Table 4.5 below summarises the recent UK auction evidence.

Table 4.5: Auction prices from recent UK mobile spectrum auctions (in September 2024 prices)

Spectrum band	Auction date	Price per MHz
700 MHz	March 2021	£17.2m[31]
800 MHz	March 2013	£45.1m[32]
2.3 GHz	April 2018	£6.6m
2.6 GHz	March 2013	£7.5m[33]
3.4 GHz	April 2018	£9.6m
3.6 GHz	March 2021	£5.2m

4.32 Our expectation is that the value of 1800 MHz lies somewhere between the value of higher frequency spectrum bands (i.e. 2.3 GHz – 3.6 GHz) and sub-1 GHz bands – that is, somewhere between £5.2m per MHz and £45.1m per MHz. We also consider it would be unlikely that 1800 MHz would be valued at significantly more than the lowest value sub-1 GHz auction price (£17.2m per MHz) or significantly less than highest value higher frequency band auction price (£9.6m per MHz).

Relevant international benchmarks

4.33 We have identified European auctions of 1800 MHz for which it is possible to derive band specific prices and where there had also been recent spectrum awards of a sub-1GHz band and a higher frequency band.

4.34 As set out in Table 4.6 there are three countries from which we can derive post-2015 Tier 1 benchmarks. For each of these countries we have generated two benchmarks – one using the UK 3.4 GHz auction result and one using the UK 3.6 GHz auction result.

Table 4.6: Auction years for post-2015 Tier 1 benchmarks for 1800 MHz

	700 MHz	1800 MHz	3.4-3.8 GHz auction
Belgium	2022	2022	2022
Germany	2015	2015	2015
Hungary	2020	2021	2020

[31] Market value for 700 MHz paired spectrum. This does not include the 700 MHz SDL spectrum also sold as part of this award.
[32] This is gross of expected DTT co-existence costs. See, 2018 Statement, paragraphs 4.5 and 4.6.
[33] Market value for 2.6 GHz paired spectrum.

4.35 In addition, we have Tier 1 benchmarks where one or more of the UK or international auctions are pre-2015 for six countries. These are Germany (for which, as shown in Table 4.6 above, we also have post-2015 Tier 1 benchmarks) and five other countries for which we do not have more recent benchmarks. These are shown in Table 4.7 below. We have also been able to update the Irish proxy benchmark used in 2018 with newer proxy values.[34]

Table 4.7: Availability of pre-2015 Tier 1 benchmarks for 1800 MHz

Comparator bands	700 MHz – 2.3 GHz	700 MHz-2.6 GHz	700 MHz-3.4/3.6 GHz	800 MHz – 2.3 GHz	800 MHz-2.6 GHz*	800 MHz-3.4/3.6 GHz
Austria		Y	Y		Y	Y
Czech Republic					Y	Y
Denmark					Y	
Germany		Y			Y	Y
Italy					Y	Y
Sweden	Y	Y	Y	Y	Y**	Y

** These six benchmarks plus the Irish proxy benchmark were the Tier 1 benchmarks used in the 2018 Statement.*
***In the 2018 Statement we used a proxy value for Sweden. We now have an actual 2.6 GHz auction result from Sweden. We have calculated the distance method benchmark for Sweden using that auction result.*

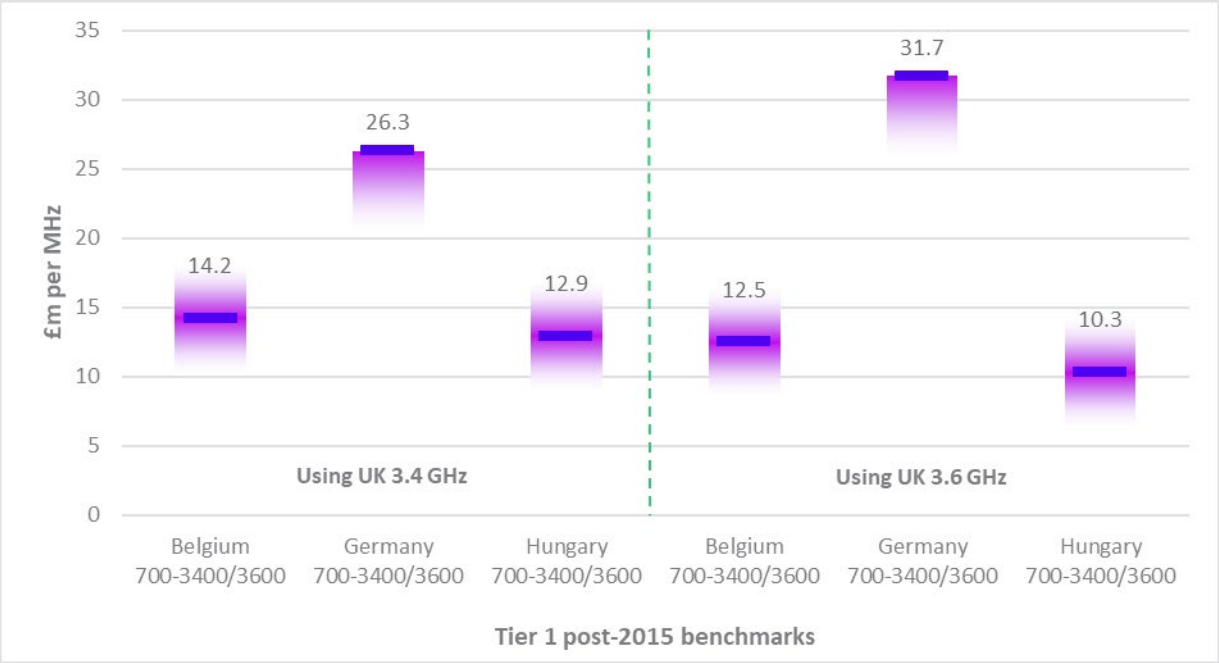
Post-2015 Tier 1 benchmarks

4.36 We begin by looking at evidence from the six post-2015 Tier 1 distance method benchmarks presented in Figure 4.2 below. The vertical dotted line shows the split between 700 MHz and 3.4 GHz comparisons (left of the vertical dotted line), and 700 MHz and 3.6 GHz comparisons (right of the dotted line). The interpretation of the datapoints in this figure is:

a) the absolute number is the result of the application of the distance method described in paragraph 3.32 above; and
b) the shaded areas illustrate our assessment of the likelihood or scale of possible understatement or overstatement associated with each benchmark.

[34] 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. Ireland and Sweden were the two countries for which we had a Tier 1 benchmark based on a 2.6 GHz proxy value.

Figure 4.2: Post-2015 Tier 1 benchmarks for 1800 MHz (£m per MHz)



Source: Ofcom

4.37 The four benchmarks from Hungary and Belgium are between £10.3m per MHz and £14.2m per MHz.

4.38 The two German benchmark values are considerably higher in value than the benchmarks from Hungary and Belgium. This is because the German 1800 MHz spectrum sold for more than its 700 MHz.[35] This could be due to the timing of the German auction (2015) when the future value of 700 MHz as a 5G band may have been less clear to operators.

4.39 Looking at the evidence in the round, we provisionally consider that the value should lie between £12.5m per MHz and £14.1m per MHz.[36] We consider that a value below £12.5m per MHz would be an overly conservative interpretation of the evidence as it would mean we were setting the LSV at a level below five of the six benchmarks. On the other hand, we consider that a value above £14.1m per MHz would be inconsistent with taking a conservative approach to the evidence given that two of the three benchmarks above £14.1m per MHz are at risk of overstatement.

4.40 Our initial view is that a reasonable value for the 1800 MHz spectrum is between £12.5m per MHz (the lower of the Belgian benchmarks) and £12.9m per MHz (the higher of the Hungarian benchmarks).

[35] The distance method is designed to interpolate a value for 1800 MHz between the values, in this case, of 700 MHz and 3.4-3.8 GHz spectrum bands. When a situation such as this arises - where the value of 1800 MHz in a benchmark country is greater than the value of 700 MHz (that is, Y/X>1 in the distance method calculation) - the distance method instead extrapolates a value for 1800 MHz above the UK value for 700 MHz. This raises a question as to how meaningful the resulting value is and therefore, we need to be careful how we interpret these results. However, what the available German evidence suggests is a value of 1800 MHz greater than £17.2m per MHz (the UK 700 MHz value).

[36] £14.1m per MHz is the average value of the six benchmarks if we capped the German benchmarks at £17.2m per MHz (i.e. where the Y/X = 1). The average value of the six benchmarks where the German benchmarks are not capped (i.e. the average of the values shown in Figure 4.2) is £18.0m per MHz.

4.41 We consider below the pre-2015 Tier 1 benchmarks before reaching a provisional view on the LSV for 1800 MHz.

Pre-2015 Tier 1 benchmarks

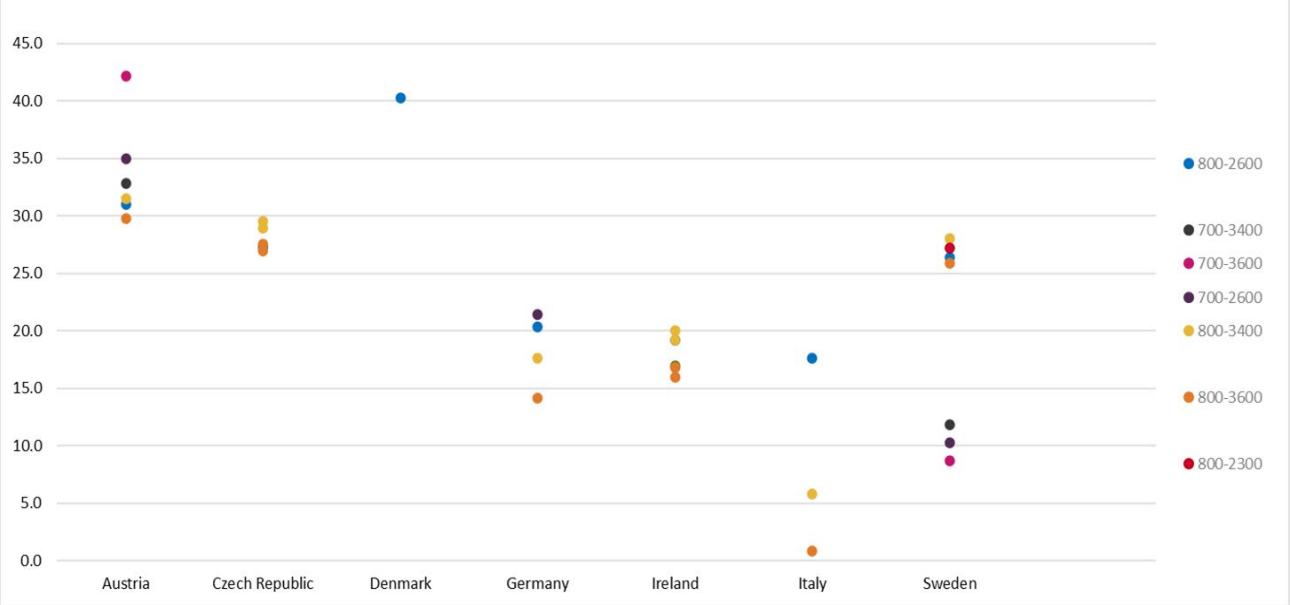
4.42 As set out in Figure 4.3 below, we have 27 pre-2015 Tier 1 distance method benchmarks (plus the Irish proxy benchmarks).

4.43 Whilst we are able to generate a large number of benchmarks, we do not have any new 1800 MHz auction data from any of these countries compared to what we had in 2018:

a) we have four benchmarks using 800 MHz and 2.6 GHz as the comparator bands that we had in 2018 plus the Swedish benchmark using 800 MHz and 2.6 GHz and new proxies for Ireland;[37]
b) we have a further 14 benchmarks (including proxy benchmarks for Ireland) which use the same 800 MHz and 1800 MHz data that we used in 2018 but use 2.3 GHz or 3.4-3.6 GHz rather than 2.6 GHz as the higher frequency band; and
c) we have eight benchmarks which use 700 MHz as the low frequency band.

4.44 Each dot in Figure 4.3 represents the value of one of these distance method benchmarks grouped by country, with the different colours relating to the comparator bands.

Figure 4.3: Pre-2015 Tier 1 benchmarks for 1800 MHz (£m per MHz)



Source: Ofcom

4.45 The majority of the pre-2015 datapoints indicate a value for 1800 MHz which is well above the UK 700 MHz auction value (£17.2m per MHz).

4.46 For completeness, the table below shows the average benchmark value based on the data in Figure 4.3 above. In six of the seven countries the average is above £17m per MHz.[38]

[37] In 2018 we used a proxy value for the Swedish 2.6 GHz.
[38] The Italian average is driven by 3.4-3.8 GHz selling for more than 1800 MHz on a per MHz basis.

Table 4.8: Pre-2015 Tier 1 benchmarks for 1800 MHz

Country	£m per MHz
Austria	33.7
Czech Republic	28.0
Denmark	40.2
Germany	18.4
Ireland	17.9
Italy	8.1
Sweden	18.5

Our provisional view

4.47 In light of the above, we propose to set the LSV for 1800 MHz at £12.7m per MHz.

4.48 Our rationale based on the Tier 1 benchmarks is:

a) As set out in paragraph 4.40 above, the post-2015 benchmark evidence indicates that a value between £12.5m per MHz and £12.9m per MHz would be appropriate.
b) The post-2015 German benchmarks would support a value towards the top end of that range as would the pre-2015 benchmarks (although we are cautious about placing too much weight on the older auction evidence).
c) Given points a) and b), we consider the mid-point between the lower Belgian and higher Hungarian benchmarks (i.e. a value of £12.7m per MHz) is consistent with a conservative interpretation of the benchmarks.

4.49 As a cross-check, we also tested if the Tier 2 and Tier 3 benchmarks (see Annex 7 for more details) were inconsistent with our provisional view.[39] They were not.

Proposed LSV for 2100 MHz

4.50 We consider below the LSV for 2100 MHz spectrum for the purposes of setting its ALF. As set out in paragraph 3.32 above, our proposed approach is (as for 1800 MHz):

a) take the relevant evidence from UK auctions of low and high frequency mobile spectrum as a starting point for the bounds within which the value of 2100 MHz is likely to lie; and
b) to identify an appropriate value for 2100 MHz within this range, draw on evidence from European auctions using the 'distance method' approach that we have used previously.

4.51 Given we set the current 2100 MHz ALF relatively recently (in December 2021), and that there has not been any new UK auction evidence since, our expectation is that the LSV for 2100 MHz is likely to be similar to the value determined in 2021. That value was £12.8m per MHz (in September 2024 prices).

[39] When we set the 900 MHz and 1800 MHz ALFs in 2018, we placed greater weight on the Tier 2 and Tier 3 benchmarks. This was because we had few Tier 1 benchmarks.

4.52 In addition, we expect 1800 MHz and 2100 MHz to have similar values given that they can be used in similar ways in a mobile network because of their similar propagation characteristics and the maturity of their ecosystems.[40]

Recent UK auction evidence

4.53 We summarised the recent UK auction evidence in Table 4.5 above.

4.54 Our expectation is that, similar to 1800 MHz, the value of 2100 MHz lies somewhere between the value of higher frequency spectrum bands (i.e. 2.3 GHz – 3.6 GHz) and sub-1 GHz bands – that is, somewhere between £5.2m per MHz and £45.1m per MHz. We also consider it is unlikely that 2100 MHz would be valued at significantly more than the lowest value sub-1 GHz auction price (£17.2m per MHz) or significantly less than highest value higher frequency band auction price (£9.6m per MHz).

Relevant international benchmarks

4.55 In our 2021 Statement, we considered benchmarks from auctions in Austria, Germany, Hungary and Slovenia to be Tier 1 benchmarks.

4.56 We also included in our 2021 assessment proxy benchmarks from the Netherlands. We used proxies because there were no auctions of higher frequency bands.[41] However, the Netherlands auctioned 3.5 GHz spectrum in June 2024. In the analysis below, we have included these actual auction values as Tier 1 benchmarks and set aside the proxy values.

4.57 As with the other LSVs, we have segmented the international benchmarks according to whether they are post-2015 or pre-2015. We have also identified new benchmarks based on European auctions that have taken place since our 2021 Statement. Table 4.9 below sets out the Tier 1 benchmarks.

Table 4.9: Availability of Tier 1 benchmarks for 2100 MHz

		Post-2015		Pre-2015			
Comparator bands		**700 MHz-2.3 GHz**	**700 MHz - 3.4/3.6 GHz**	**700 MHz -2.6 GHz**	**800 MHz-2.3 GHz**	**800 MHz -2.6 GHz**	**800 MHz-3.4/3.6 GHz**
Benchmarks used in 2021 Statement	**Austria**		Y	Y		Y	Y
	Germany		Y	Y		Y	Y
	Hungary		Y				
	Slovenia	Y	Y				
New benchmarks since 2021 Statement	**Belgium**		Y				
	Netherlands		Y				
	Sweden	Y	Y	Y	Y	Y	Y

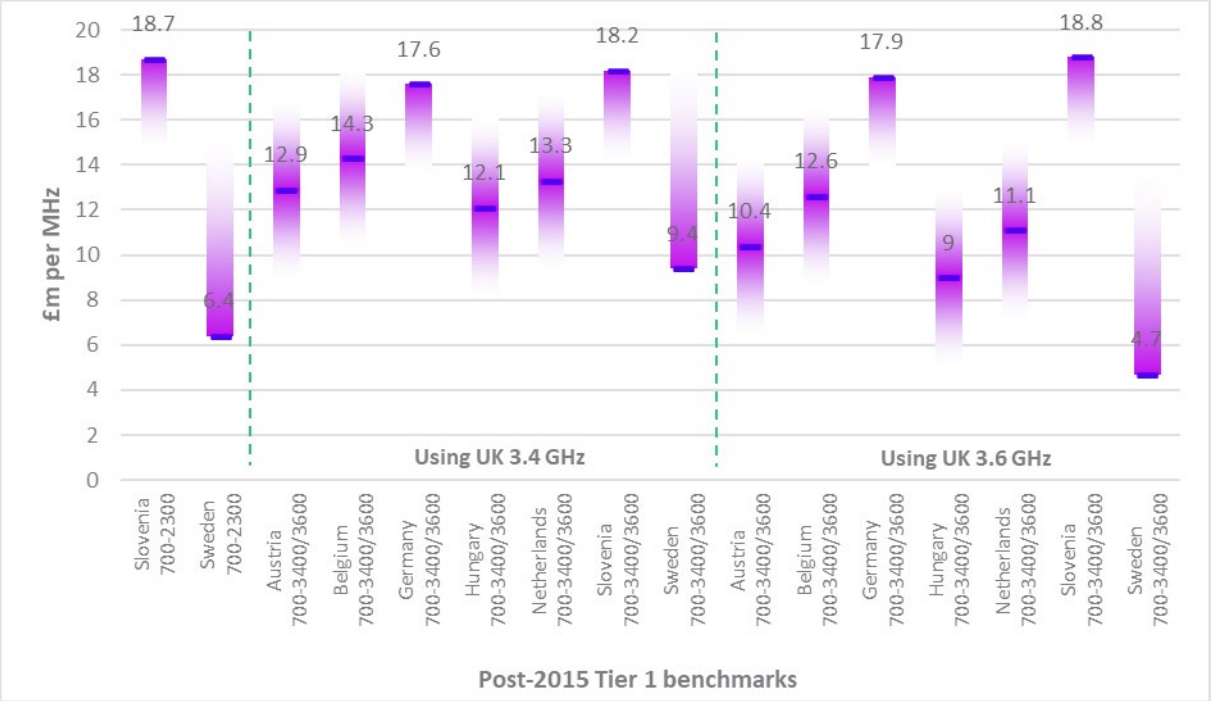
[40] 5,997 user device models support 1800 MHz and 5,890 user device models support 2100 MHz. Global Mobile Suppliers Association's Analyser for Mobile Broadband Data ("**Gambod**"), accessed 5 December 2024.

[41] We had Tier 1 quality 700 MHz and 2100 MHz auction evidence from the Netherlands, but we were not able to derive a direct Tier 1 distance method benchmark because we did not have a Tier 1 quality higher frequency auction result. We therefore sought to proxy values for the higher frequency bands in the Netherlands and use those to derive a relative value benchmark. See 2021 Statement, paragraphs 4.87-4.89.

Post-2015 Tier 1 benchmarks

4.58 We begin by looking at the evidence from post-2015 Tier 1 distance method benchmarks. This consists of 16 benchmarks from seven countries, as shown in Figure 4.4 below. As in the previous charts, the absolute number is the value arrived at using the distance method and the blue shaded area illustrates our assessment of the likelihood or scale of possible understatement or overstatement associated with each benchmark.

Figure 4.4: Post-2015 2100 MHz Tier 1 benchmarks (£m per MHz)



Source: Ofcom

4.59 We note that:

a) we have five benchmarks (from Germany and Slovenia) for which Y/X>1, that is that 2100 MHz sold for more than 700 MHz, with values between £17.6m per MHz and £18.8m per MHz;
b) we have three benchmarks (from Sweden) for which Y/X<0, that is 2100 MHz sold for less than 2.3 GHz and 3.4-3.8 GHz, with values between £4.7m per MHz and £9.4m per MHz;[42] and
c) the remaining eight benchmarks (from Austria, Belgium, Hungary and the Netherlands) are between £9.0m per MHz and £14.3m per MHz.
d) the average across all post-2015 Tier 1 benchmarks is £13m per MHz.[43]

4.60 Looking at this evidence in the round, we provisionally consider that a conservative interpretation of this data would suggest a value in the region of £12.0m to £12.5m per MHz would be appropriate. This is because:

[42] As discussed in Annex 6, there are particular complexities interpreting the values of these benchmarks, where Y/X>1 or Y/X<0.
[43] If we capped the Y/X=1 for the German and Swedish benchmarks where Y/X>1, and capped Y/X=0 for the Swedish benchmarks where Y/X<0 that would reduce the average slightly to £12.7m per MHz.

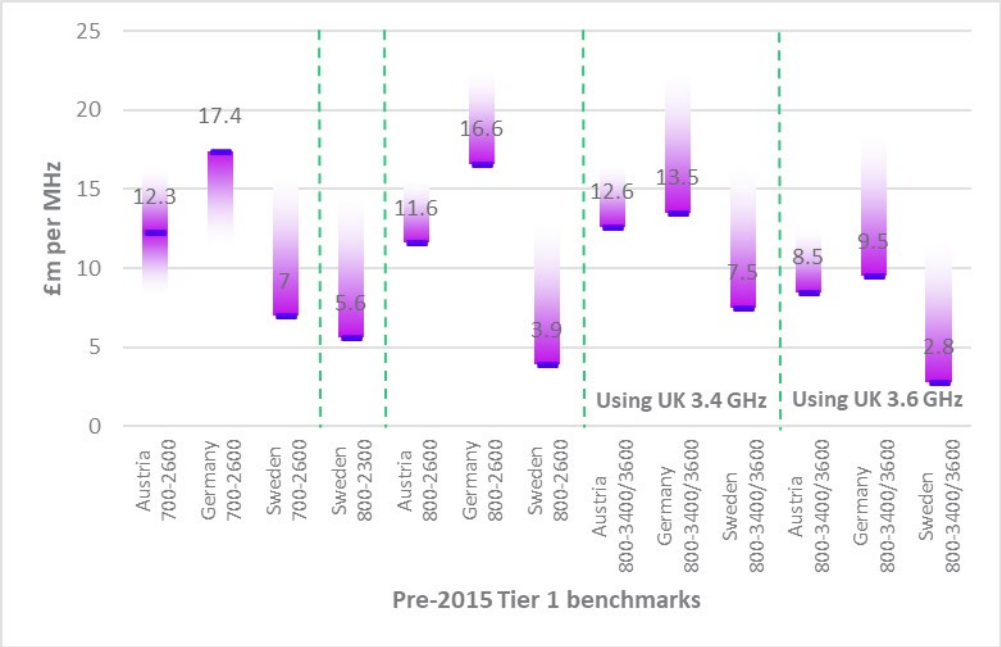
a) We do not consider the data provides a strong reason to suggest a value above the average, but we also do not consider it appropriate to go too far below the average given the number of benchmarks we have and that nine of the 16 benchmarks point to a value above £12.5m per MHz.
b) We consider that a value below £12.0m per MHz would be an overly conservative interpretation of the evidence and would involve putting undue weight on the Swedish values.

4.61 Below we consider the pre-2015 Tier 1 benchmarks before reaching a provisional view on the LSV for 2100 MHz.

Pre-2015 Tier 1 benchmarks

4.62 As set out in Figure 4.5 below, we have 14 pre-2015 Tier 1 distance method benchmarks. This consists of Austrian and German benchmarks that we included in our 2021 Statement, along with new benchmarks from Sweden.

Figure 4.5: Pre-2015 2100 MHz Tier 1 benchmarks (£m per MHz)



Source: Ofcom

4.63 Table 4.10 sets out for each country the average benchmark value for all relevant auctions segmented into post-2015 and pre-2015 data. This indicates that for all three countries the older benchmarks suggest a slightly lower value than the more recent benchmarks.

Table 4.10: Average post-2015 and pre-2015 2100 MHz Tier 1 benchmark values by country

	Post-2015	Pre-2015	
Country	**Average benchmark value (£m per MHz)**	**Average benchmark value (£m per MHz)**	**Difference (£m per MHz)**
Austria	11.7	11.3	-0.4
Germany	17.7	14.2	-3.5
Sweden	6.8	5.4	-1.5
Belgium	13.5	-	-

	Post-2015	Pre-2015	
Hungary	10.6	-	-
Netherlands	12.2	-	-
Slovenia	18.6	-	-
Average of averages	***13***	***9.9***	

Note: some values do not sum due to rounding.

Our provisional view

4.64 In light of the above, we propose to set the LSV for 2100 MHz at £12m per MHz.

4.65 Our rationale is:

a) The post-2015 benchmarks indicate that a value in the region of £12.0m per MHz to £12.5m per MHz is appropriate.
b) Whilst we are cautious about placing too much weight on the pre-2015 benchmarks, particularly when we have more recent auction evidence from the same countries, we consider that they support a value towards the lower end of that range.[44]
c) This tends to indicate that a value of £12m per MHz is appropriate.

4.66 We ran two additional cross-checks:

a) We have sense-checked our assessment against the LSV we set in 2021.[45] The LSV we are proposing is £0.7m per MHz lower than the LSV we set in 2021 (in September 2024 prices). Whilst, with the exception of the new evidence from Sweden, the changes we have made since 2021 point to an upwards revision to the LSV, our provisional view is that a reduction in the LSV by £0.7m per MHz is consistent with our conservative approach to interpreting the evidence and gives appropriate weight to the new evidence from Sweden alongside the other new evidence.[46]
b) We checked if the Tier 2 and Tier 3 evidence (see Annex 7) indicated a significantly different value to £12m per MHz. It did not. Consistent with our approach in our 2021 Statement, we consider it appropriate to place less weight on these benchmarks given we have far more Tier 1 evidence.

Question 3: Do you have any comments on our proposed LSVs for the ALF spectrum?

[44] A value of £12.0m per MHz is consistent with the evidence from the different benchmark countries. It is below the average benchmark value for four of the seven countries (see table 4.10 above). It is above the country average for Austria, Hungary and Sweden but is within the range of values for both Austria and Hungary. We note that the LSV set in 2021 was slightly above the range of values for Hungary.
[45] In terms of what has changed since then, we have replaced the Dutch proxy results with actual results from the Netherlands – the average value of these benchmarks are slightly higher than the proxy results (£12.2m per MHz compared to £11.1m per MHz); added new auction evidence from Belgium and Sweden – the values from Belgium suggest a higher value than that set in 2021 whilst Sweden suggests a significantly lower value; and placed more weight on post-2015 benchmarks.
[46] We also note that the average of the Tier 1 benchmarks where all UK and international auctions are from 2015 onwards is £0.7m per MHz lower than the average Tier 1 benchmark (including the lowest Dutch proxy value) from our 2021 Statement (£13.0m per MHz compared to £13.7m per MHz (in September 2024 prices) – see paragraph 4.94 of 2021 Statement).

5. Proposed approach to annualisation and resulting ALFs

Introduction

5.1 In this Section, we:

a) summarise the approach we propose to adopt to convert our estimates of the LSVs of the ALF spectrum bands into an annual value; and
b) set out the resulting ALFs for each of the ALF spectrum bands.

Proposed approach to annualisation and proposed annualisation rate

5.2 As in previous reviews, our objective is to convert the LSVs into an equivalent annual rate by spreading the LSVs over 20 years.[47] In doing so, we use a discount rate at which the present value of the annual payment stream equals the lump-sum value paid today, and which will in principle leave licensees indifferent between paying ALFs and paying the lump sum value.

5.3 As our objective is the same as that in previous reviews of ALFs, we propose to adopt the same approach to annualisation that we used when we set the ALFs for 2100 MHz spectrum, updating the input values as appropriate.

5.4 We calculate the ALFs by 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). The annualisation rate used to calculate the annual payment depends on three key parameters. These are set out in the table below, alongside the values which we are using in our proposed approach.

Table 5.1: Inputs to our proposed annualisation calculation

Parameter	Proposed value	Value used in 2021 Statement
Length of period over which we spread the LSV for the purposes of calculating ALF	20 years	20 years
Real post-tax discount rate	1.7%	0.1%
Tax adjustment factor	1.093	1.058

5.5 These input values result in an annualisation rate of 6.38%. Our approach and the derivation of the annualisation rate is set out in more detail in Annex 5.

[47] As set out in paragraph 2.24 the LSVs represent our estimate of the value of a 20-year licence for 1 MHz of the relevant spectrum.

5.6 Table 5.2 below shows the annualisation rates from previous ALF reviews. Our proposed annualisation rate is higher than the annualisation rates used in previous reviews, albeit it is similar to the 2015 annualisation rate. We believe our proposed rate is appropriate with the changes from 2018 and 2021 primarily reflecting the increase in the cost of debt over recent years.

Table 5.2: Annualisation rate used in previous ALF reviews

Review	Annualisation rate
2015 (900 MHz and 1800 MHz)[48]	6.27%
2018 (900 MHz and 1800 MHz)[49]	5.75%
2021 (2100 MHz)[50]	5.34%
2024 (this consultation)	6.38%

5.7 We will update our annualisation rate for latest market evidence, as appropriate, for the Statement.

Proposed ALFs

5.8 Based on the proposed LSVs set out in Section 4 and the proposed annualisation rate of 6.38%, Table 5.3 sets out the proposed ALFs in £m per MHz (expressed in September 2024 prices). Consistent with our approach in previous ALF reviews, we have rounded these to three decimal places.

Table 5.3: Proposed ALFs

Spectrum band	LSV (£m per MHz)	Annualisation rate	ALF (£m per MHz)
900 MHz	17.2	6.38%	**1.097**
1800 MHz	12.7	6.38%	**0.810**
2100 MHz	12.0	6.38%	**0.766**

5.9 As discussed in more detail in Section 7 below, we propose that these ALFs would increase in line with CPI inflation in subsequent years.

5.10 Table 5.4 below summarises our proposed revised ALFs and how they compare to the current ALFs.

[48] 2015 Statement, paragraph 6.134.
[49] 2018 Statement, Table 4.1
[50] 2021 Statement, Table 4.6

Table 5.4: Comparison of proposed revised ALFs with current ALFs (in September 2024 prices)

Spectrum band	Proposed revised ALF (£m per MHz)	Current ALF (£m per MHz)[51]	% change
900 MHz	1.097	1.392	-21%
1800 MHz	0.810	1.025	-21%
2100 MHz	0.766	0.684	12%

5.11 As shown in Table 5.5 below, based on current spectrum holdings, each of the MNOs will see a reduction in their overall ALF payments, with overall ALF payments reducing by 13%.

Table 5.5: proposed revised ALFs payable by each MNO (£m in September 2024 prices)

	900 MHz	1800 MHz	2100 MHz	Total	% change in total ALFs
BT/EE	-	72.9	30.6	**103.5**	-13%
H3G	-	24.3	22.6	**46.9**	-8%
VMO2	38.2	9.4	15.3	**62.9**	-15%
Vodafone	38.2	9.4	22.7	**70.2**	-13%
Total	**76.4**	**116.0**	**91.2**	**283.6**	**-13%**

Relative values of the ALF spectrum bands

5.12 As set out in paragraph 2.7, in its request for a review of the 1800 MHz ALF, BT/EE set out its view is that there are material inconsistencies in relative spectrum fees for different bands, highlighting the difference in the fee levels for 1800 MHz and 2100 MHz.

5.13 In deciding to open a review of the ALFs for all three of the ALF spectrum bands, we recognised that that had the advantage of enabling us to consider not only the absolute levels of each of the ALFs but also the relative values of the ALF spectrum bands.

5.14 Having set out above our provisional view on the ALFs for each band we now turn to consider the relative values of the three bands as a cross-check.

1800 MHz and 2100 MHz

5.15 Currently the ALF for 1800 MHz is 49% higher than the LSV for 2100 MHz. Our proposed new LSV for 1800 MHz would be 6% higher than the proposed new LSV for 2100 MHz. We consider this to be more consistent with the maturity of the bands' ecosystems, and their similar propagation characteristics. We note that Vodafone and VMO2 suggested that we

[51] In order to compare the revised fees with existing fees, the current ALF figures shown in this column have been calculated based on the base level of ALFs set out in the 2018 and 2021 Statements, adjusted into September 2024 prices. They therefore differ slightly from the actual fees being paid by the MNOs as the 900 MHz and 1800 MHz fees are updated annually based on August CPI, whilst the 2100 MHz fees are updated annually based on November CPI.

should set the same LSV for the two bands, whilst H3G suggested that the value of 2100 MHz should remain lower than 1800 MHz given its shorter propagation distance.[52]

900 MHz and 1800 MHz

5.16 Currently the ALF for 900 MHz is 36% higher than the LSV for 1800 MHz. Our proposed new ALFs would mean this marginally decreases to 35%.

5.17 We continue to consider that 900 MHz is likely to have a higher value on a per MHz basis than 1800 MHz and 2100 MHz given its superior propagation characteristics. We recognise that there is some evidence of convergence in the value of low-band and lower mid-band spectrum, such that we would not expect this ratio to have increased since 2018.[53] On balance, our provisional view is that this relativity remains appropriate.

Question 4: Do you have any comments on our proposed approach to annualisation of the LSVs (noting the further detail we provide on annualisation in Annex 5)?

[52] BT/EE's proposed linear interpolation method would also result in a lower value for 2100 MHz than 1800 MHz.

[53] We note that NERA (in its report for VMO2) proposed a premium of around 25%. It noted that based on its calculations (i) as of 2023, the premium for the three-year moving average of low-band over mid-band spectrum for the global and Europe samples were 30% and 20% respectively; and (ii) European countries that have sold both low band and lower mid-band since 2015 have on average priced low band spectrum about 50% higher, although it considered this data noisy and sometimes contradictory.

6. Impact Assessment

Background

6.1 Section 7 of the Communications Act 2003 (the "**Communications Act**") requires us to carry out and publish an assessment of the likely impact of implementing a proposal which would be likely to have a significant impact on businesses or the general public, or when there is a major change in Ofcom's activities. Such an assessment must set out how, in our opinion, the performance of our general duties is secured or furthered by or in relation to what we propose.

6.2 More generally, impact assessments form part of good policy making, and we therefore expect to carry them out in relation to a large majority of our proposals. We use impact assessments to help us understand and assess the potential impact of our policy decisions before we make them. They also help us explain the policy decisions we have decided to take and why we consider those decisions best fulfil our applicable duties and objectives in the least intrusive way. Our impact assessment guidance sets out our general approach to how we assess and present the impact of our proposed decisions.

6.3 We consider that the analysis presented in this consultation represents an impact assessment as defined in s.7 of the Communications Act. Below we discuss the impact that we expect from our consultation proposals.

Impact assessment

6.4 Consistent with the policy set out in our Strategic Review of Spectrum Pricing on how we interpret our general duty to secure the optimal use of spectrum,[54] the current ALFs were set to reflect our view of the forward-looking market value of spectrum. By setting fees at estimated market value, or equivalently at the opportunity cost of the spectrum, this approach aims to replicate the price signal licensees would receive in a well-functioning market for spectrum.

6.5 As we said in our January 2024 review of our use of market mechanisms, we continue to consider that ALFs set to reflect the forward looking market value, or equivalently at the opportunity cost of the spectrum, is appropriate to secure the optimal use of the spectrum. Our view on this has not changed, and as set out in Sections 1 and 2 of this document, we are proposing to revise the fees we charge for the ALF spectrum in order to ensure they reflect our current view of the forward-looking market value of the spectrum.

6.6 We consider in the context of this review that setting ALFs at a conservative estimate of the market value of the spectrum will secure and further the performance of our general duties (within the meaning of section 3), as it will in particular:

a) **Secure optimal use of spectrum:** We consider that setting ALFs at a conservative estimate of the forward-looking market value of the spectrum helps to secure the optimal use of the spectrum by:

[54] Paragraphs 3.13 to 3.20.

i) incentivising licensees who are not the highest value user of the relevant spectrum to relinquish some or all of their spectrum holdings, which can then be made available to the highest-value user; and
ii) encouraging licensees to make efficient investment decisions, for example in considering the trade-off between their levels of spectrum holdings and their network investments.

b) **further the interests of citizens and consumers:** As set out above, we expect setting ALFs at a conservative estimate of the market value of the relevant spectrum to help to secure the efficient allocation of the spectrum. We expect that setting ALFs which encourage an efficient allocation of spectrum will in turn maximise the amount of investment and innovation in mobile services and thereby secure the greatest benefits to consumers and citizens.
c) **encourage investment and innovation:** We consider that efficient investment decisions should reflect the true costs of inputs, and we expect to encourage this by setting ALFs based on market value, as this requires operators to pay the opportunity cost of their spectrum holdings.
d) **promote competition**: We consider that ALFs set at market value are likely to promote competition. We note that:

i) MNOs have different holdings of ALF and non-ALF spectrum and, if we did not set ALFs, we would be distorting competition by subsidising one type of MNO over another; and
ii) if ALFs set at market value revealed differences in value for different MNOs, this should encourage them to trade spectrum to enhance their competitive position.

For the reasons set out in Sections 3 and 4, we consider our proposed revised fees reflect a conservative estimate of the forward-looking market value of the spectrum and therefore are consistent with our general duties.

6.7 Under s.108 of the Deregulation Act 2015, Ofcom has to have regard to the desirability of promoting economic growth (the "**growth duty**"). We consider that by encouraging efficient investment, promoting competition and incentivising the efficient use of spectrum our proposals can be expected to have a positive impact on economic growth.

6.8 We have also considered the UK Government's Statement of Strategic Priorities. We note that the Government's objectives in relation to spectrum, as articulated in the SSP, include ensuring the efficient use of spectrum (including preventing under-utilisation of spectrum); encouraging innovation and investment in new 5G services to meet future demands; and promoting competition in mobile markets. For the reasons set out above, we consider the proposals set out in this document are likely to support the Government's objectives.

Equality Impact Assessment

6.9 We have given careful consideration to whether our decision and proposals will have a particular impact on persons sharing protected characteristics (broadly including race, age, disability, sex, sexual orientation, gender reassignment, pregnancy and maternity, marriage and civil partnership and religion or belief in the UK and also dependents and political opinion in Northern Ireland), and in particular whether they may discriminate against such persons or impact on equality of opportunity or good relations. This assessment helps us comply with our duties under the Equality Act 2010 and the Northern Ireland Act 1998. We have also had regard to the matters in section 3(4) of the Communications Act

6.10 When thinking about equality we think more broadly than persons that share protected characteristics identified in equalities legislation and think about potential impacts on various groups of persons (see paragraph 4.7 of our impact assessment guidance).

6.11 Section 3(4) of the Communications Act also requires us to have regard to the needs and interests of specific groups of persons when performing our duties, as appear to us to be relevant in the circumstances. These include:

- the vulnerability of children and of others whose circumstances appear to us to put them in need of special protection;
- the needs of persons with disabilities, older persons and persons on low incomes; and
- the different interests of persons in the different parts of the UK, of the different ethnic communities within the UK and of persons living in rural and in urban areas.

6.12 We do not consider that our proposals will affect any specific groups of persons (including persons that share protected characteristics under the 2010 Act or the 1998 Act) differently to the general population.

6.13 Ofcom can provide information in a variety of formats on request, e.g. accessible PDF, large print, easy read, audio recording or braille. If you let us know what information you require and in what format, we will consider the request and respond within 21 days.

Welsh language impact assessment

6.14 Ofcom is required to take Welsh language considerations into account when formulating, reviewing or revising policies which are relevant to Wales (including proposals which are not targeted at Wales specifically but are of interest across the UK).[55]

6.15 We do not consider our proposals have any impact on opportunities for persons to use the Welsh language or treat the Welsh language less favourably than the English language. We also do not think there are ways in which our proposals could be formulated so as to have, or increase, a positive impact, or not have adverse effects or decrease any adverse effects. This is because our proposals relate to spectrum access across the UK.

Question 5: Do you agree with our assessment that fees set based on our conservative estimates of market value secure and further the performance of our statutory duties?

[55] See Standards 84 – 89 of Hysbysiad cydymffurfio (in Welsh) and compliance notice in English. Section 7 of the Welsh Language Commissioner's Good Practice Advice Document provides further advice and information.

7. Implementation

7.1 Our final decisions on the appropriate level of ALFs will be given effect by Regulations. We expect to consult on draft Regulations which would implement the proposals set out in this document early next year.

Updating ALFs by inflation

MNOs' submissions

7.2 The MNOs made the following submissions about how we should apply inflation to the ALFs each year:

a) BT/EE said that its concerns about inflation could be "*addressed by pegging annual ALFs increases at, say, 2%. Alternatively, Ofcom could revise its long run forecast CPI from 2% to 3% to reflect potentially higher forward-looking CPI (i.e. there may be even greater tolerance than in the past for the BoE to diverge from its 2% inflation target).*"[56]
b) VMO2 proposed "*the introduction of a CPI-X approach … where historic values and ALFs are adjusted by CPI-X, with X set by Ofcom*". VMO2 suggested that X would be set at CPI for this review, which it said "*would keep ALFs constant in nominal value until ALFs are re-set and potentially a different X is set at a future review as a function of evidence on spectrum values*".
c) Vodafone thought that we should apply inflation at 2% per year, and at worst, cap inflation at 4%.

Our proposal

7.3 Our provisional view is that it remains appropriate to increase the level of ALFs in line with inflation year on year. This is consistent with our approach in previous ALF decisions, and with our proposed approach of adjusting past prices of relevant UK and international auctions for inflation, and reflects our view that, all else equal, the value of spectrum is likely to remain constant in real terms over time (see paragraphs 3.49-3.55).

7.4 We do not consider that VMO2's proposal of adjusting by CPI-X (where X=CPI for this review period) is appropriate. Given ALFs are set for an indefinite period rather than being subject to planned regular reviews this would effectively mean ALFs were kept constant in nominal terms until we next conducted an ALF review.

7.5 We consider there are two broad options for adjusting ALFs each year to account for inflation:

a) we could adjust by out-turn inflation, i.e. the level of ALFs increase in line with CPI each year (this is the approach we have taken to increasing ALFs in the past); or
b) we could adjust by forecast inflation, i.e. the level of ALFs increase in line with the Bank of England's target rate of inflation (as suggested by BT/EE and Vodafone).

[56] BT/EE submission, p8

7.6 Our provisional view is that we should continue to increase ALFs in line with out-turn inflation, because we think it is appropriate to increase ALFs by actual, rather than forecast, inflation such that they remain constant in real terms.

7.7 However, we are open to considering arguments for why we should move to adjusting in line with the Bank of England's target rate of inflation. We recognise that this would give MNOs greater certainty over future ALF payments and reduce potential volatility. We also note that this would transfer the inflation risk from the MNOs to the Government (as the recipient of ALF payments). Therefore, we consider that if we adopted this approach it would be appropriate to remove the inflation risk premium adjustment from the calculation of the annualisation rate. This would have the effect of slightly increasing the annualisation rate.[57]

Implementing our proposal

7.8 To implement our proposed approach of increasing ALFs in line with CPI each year, we propose a formula for calculating each year's (ALF_t) that would incorporate an annual increase in ALF in line with inflation, as measured by the CPI. In particular, we propose that the nominal value of ALF would be inflated by the ratio:

$$\left[\frac{CPI_t}{CPI_0}\right]$$

7.9 where:

- CPI_0 is the level of the CPI (all items) index in September 2024; and
- CPI_t means the most recent CPI value that was available on the 30th September prior to when the charges are due.

Further reviews

7.10 This document sets out our proposals for revised ALFs for the 900, 1800 and 2100 MHz bands. We also intend to set ALFs for the 1.4 GHz spectrum currently licensed to H3G and Vodafone after the proposed auction of the upper block of the 1.4 GHz band. After that, the next time we will need to set ALFs will be for 800 MHz and 2.6 GHz spectrum in 2033. We do not expect to review these ALFs again before that point.

Consultation questions

Question 6: Do you agree with our proposal to change ALFs each year in line with out-turn CPI?

[57] Removing our proposed inflation risk premium adjustment of 0.4% from the lower polar case would increase the annualisation rate from 6.38% to 6.50%.

A1. Responding to this consultation

How to respond

A1.1 Ofcom would like to receive views and comments on the issues raised in this document, by 5pm on 7 March 2025.

A1.2 You can download a response form from https://www.ofcom.org.uk/spectrum/innovative-use-of-spectrum/consultation-review-of-annual-licence-fees/. You can return this by email or post to the address provided in the response form.

A1.3 If your response is a large file, or has supporting charts, tables or other data, please email it to ALF.Review@ofcom.org.uk, as an attachment in Microsoft Word format, together with the cover sheet.

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

ALF Review Team, Spectrum Group
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

A1.5 We welcome responses in formats other than print, for example an audio recording or a British Sign Language video. To respond in BSL:

- send us a recording of you signing your response. This should be no longer than 5 minutes. Suitable file formats are DVDs, wmv or QuickTime files; or
- upload a video of you signing your response directly to YouTube (or another hosting site) and send us the link.

A1.6 We will publish a transcript of any audio or video responses we receive (unless your response is confidential)

A1.7 We do not need a paper copy of your response as well as an electronic version. We will acknowledge receipt of a response submitted to us by email.

A1.8 You do not have to answer all the questions in the consultation if you do not have a view; a short response on just one point is fine. We also welcome joint responses.

A1.9 It would be helpful if your response could include direct answers to the questions asked in the consultation document. The questions are listed at Annex 4. It would also help if you could explain why you hold your views, and what you think the effect of Ofcom's proposals would be.

A1.10 If you want to discuss the issues and questions raised in this consultation, please email ALF.Review@ofcom.org.uk.

Confidentiality

A1.11 Consultations are more effective if we publish the responses before the consultation period closes. This can help people and organisations with limited resources or familiarity with the issues to respond in a more informed way. So, in the interests of transparency and good regulatory practice, and because we believe it is important that everyone who is interested in an issue can see other respondents' views, we usually publish responses on the Ofcom website at regular intervals during and after the consultation period.

A1.12 If you think your response should be kept confidential, please specify which part(s) this applies to and explain why. Please send any confidential sections as a separate annex. If you want your name, address, other contact details or job title to remain confidential, please provide them only in the cover sheet, so that we don't have to edit your response.

A1.13 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and try to respect it. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A1.14 To fulfil our pre-disclosure duty, we may share a copy of your response with the relevant government department before we publish it on our website.

A1.15 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's intellectual property rights are explained further in our Terms of Use.

Next steps

A1.16 Following this consultation period, we aim to publish a statement on the proposals set out in this document in Q2 FY 2025/6.

A1.17 If you wish, you can register to receive mail updates alerting you to new Ofcom publications.

Ofcom's consultation processes

A1.18 Ofcom aims to make responding to a consultation as easy as possible. For more information, please see our consultation principles in Annex x.

A1.19 If you have any comments or suggestions on how we manage our consultations, please email us at consult@ofcom.org.uk. We particularly welcome ideas on how Ofcom could more effectively seek the views of groups or individuals, such as small businesses and residential consumers, who are less likely to give their opinions through a formal consultation.

A1.20 If you would like to discuss these issues, or Ofcom's consultation processes more generally, please contact the corporation secretary:

Corporation Secretary
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA

Email: corporationsecretary@ofcom.org.uk

A2. Ofcom's consultation principles

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

Before the consultation

A2.1 Wherever possible, we will hold informal talks with people and organisations before announcing a big consultation, to find out whether we are thinking along the right lines. If we do not have enough time to do this, we will hold an open meeting to explain our proposals, shortly after announcing the consultation.

During the consultation

A2.2 We will be clear about whom we are consulting, why, on what questions and for how long.

A2.3 We will make the consultation document as short and simple as possible, with an overview of no more than two pages. We will try to make it as easy as possible for people to give us a written response.

A2.4 We will consult for up to ten weeks, depending on the potential impact of our proposals.

A2.5 A person within Ofcom will be in charge of making sure we follow our own guidelines and aim to reach the largest possible number of people and organisations who may be interested in the outcome of our decisions. Ofcom's Consultation Champion is the main person to contact if you have views on the way we run our consultations.

A2.6 If we are not able to follow any of these seven principles, we will explain why.

After the consultation

A2.7 We think it is important that everyone who is interested in an issue can see other people's views, so we usually publish the responses on our website at regular intervals during and after the consultation period. After the consultation we will make our decisions and publish a statement explaining what we are going to do, and why, showing how respondents' views helped to shape these decisions.

A3. Consultation coversheet

Basic details

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

Confidentiality

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

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

If you selected 'Part of the response', please specify which parts:

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

Yes ☐ No ☐

Declaration

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

Ofcom aims to publish responses at regular intervals during and after the consultation period. If your response is non-confidential (in whole or in part), and you would prefer us to publish your response only once the consultation has ended, please tick here.

Name Signed (if hard copy)

A4. Consultation questions

Question 1: Do you have any comments on our proposed approach to deriving ALFs?

Question 2: Do you agree with our proposal to adjust past auction results in line with CPI?

Question 3: Do you have any comments on our proposed LSVs for the ALF spectrum?

Question 4: Do you have any comments on our proposed approach to annualisation of the LSVs (noting the further detail we provide on annualisation in Annex 5)?

Question 5: Do you agree with our assessment that fees set based on our conservative estimates of market value secure and further the performance of our statutory duties?

Question 6: Do you agree with our proposal to change ALFs each year in line with out-turn CPI?

Question 7: Do you have any other comments on the proposals set out in this consultation?

A5. Annualisation

Our proposed approach

A5.1 In this chapter we set out the approach we propose to adopt to annualise our estimates of the lump-sum value (LSV) of the ALF spectrum bands.

A5.2 As in previous reviews, our objective is to convert the LSVs into an equivalent annual rate by spreading the lump-sum values over 20 years.[58] In doing so, we use a discount rate at which the present value of the annual payment stream equals the lump-sum value paid today, and which will in principle leave licensees indifferent between paying ALFs and paying the LSV.

A5.3 As our objective is the same as that in previous reviews of ALFs, we propose to adopt the same approach to annualisation that we used in the 2021 Statement, when we set the ALFs for 2100 MHz spectrum. Vodafone suggested maintaining the annualisation rate used in our 2021 Statement. However, we do not consider doing so would meet our objective to leave licensees indifferent between paying ALFs and paying the LSV, as the rate used in our 2021 Statement does not reflect market conditions today.

A5.4 We calculate the ALFs by 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). The annualisation rate used to calculate the annual payment depends on three key parameters:

- the discount rate (which we explain below);
- the time period for annualisation (20 years); and
- the tax adjustment factor (TAF), which is used to adjust the annual fees to reflect the more favourable tax treatment of annual fees compared to a lump-sum payment.

A5.5 Specifically, the value of ALF in year t is derived from the LSV, annualisation rate and inflation as follows:

$$ALF_t = LSV * TAF * \underbrace{\left[\frac{r}{1-(1+r)^{-t*}}\right] * \left[\frac{1}{(1+r)}\right]}_{\text{Annualisation rate}} * \left[\frac{CPI_t}{CPI_{t0}}\right]$$

A5.6 Where:

- ALF_t is the value of ALF in year t;
- LSV is the lump-sum value of spectrum;
- TAF is an adjustment factor that reflects the tax advantages of ALF over lump-sum payments;
- r is the real post-tax discount rate;

[58] As set out in paragraph 2.24 the LSVs represent our estimate of the value of a 20-year licence for 1 MHz of the relevant spectrum.

- t* is the length of period over which we spread the LSV for the purposes of calculating ALF, i.e. 20 years; and
- CPI is the level of the CPI (all items) index published in the Consumer Price Inflation Reference Tables by the Office for National Statistics, where:
  - CPI_{t0} is the CPI value for September 2024;[59] and
  - CPI_t is the most recent CPI value available on the 30th September prior to when the charges are due.[60]

Discount rate for annualisation

A5.7 In spreading the lump sum over a 20-year period, we use a discount rate at which the present value of the resulting payment stream equals the lump-sum value if it had been paid today.

A5.8 The discount rate which will leave MNOs indifferent between paying ALFs and paying a lump-sum amount depends on, amongst other things, the extent to which changes in the market value of spectrum over time affect the level of ALFs (i.e. the extent to which MNOs, rather than government, are exposed to the effect of changes in the market value of spectrum). Licensees' ability to avoid ALFs by handing back spectrum and our ability to revise ALFs in response to material changes in the market value of spectrum alter the balance of risks between the Government and licensees compared to a situation where ALFs are set once and fixed for the duration of the licence.

A5.9 As in previous ALF decisions, we consider 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 ALFs are fixed for 20 years and do not vary with market value) and an upper polar case of the weighted average cost of capital (WACC, as an approximation of the case where the ALFs vary with the market value of the spectrum). We use a risk-sharing adjustment to determine where between these two polar cases the appropriate discount rate would lie.

A5.10 We propose a real post-tax discount rate of 1.7% based on a lower polar case of 1.2%, upper polar case of 3.3% and a 25% risk sharing adjustment.[61] We explain our proposals for each of these inputs to the discount rate below.

Lower polar case: cost of debt

A5.11 Consistent with our established methodology, we propose to use an estimate of the post-tax real cost of debt for UK MNOs in the lower polar case. Our estimate of 1.2% is based on:

- A pre-tax nominal cost of debt of 4.95%,

[59] This is the month in which we express the LSVs in for this consultation. For consistency we will also express the LSVs for the statement in September 2024 prices and hence CPI_{t0} will remain as September 2024.
[60] See Section 7 for more information.
[61] The discount rate is calculated as: [lower polar case + (upper polar case – lower polar case) * risk-sharing adjustment], rounded to one decimal point.

- Reduced by 0.7 percentage points to 4.25% for our estimate of the inflation risk premium and liquidity risk premium.
- Converted to a real-post tax rate of 1.2% using our long-term inflation (2%) and corporate tax (25%) assumptions.

A5.12 We explain our calculations below. We expect to update the cost of debt for the latest market evidence in our final statement.

Pre-tax nominal cost of debt

A5.13 As in previous decisions, we propose to continue to calculate a pre-tax nominal cost of debt using market rates for BBB-rated 10-year corporate bonds[62], calculated over the last 12 months. The reasons for this approach are:

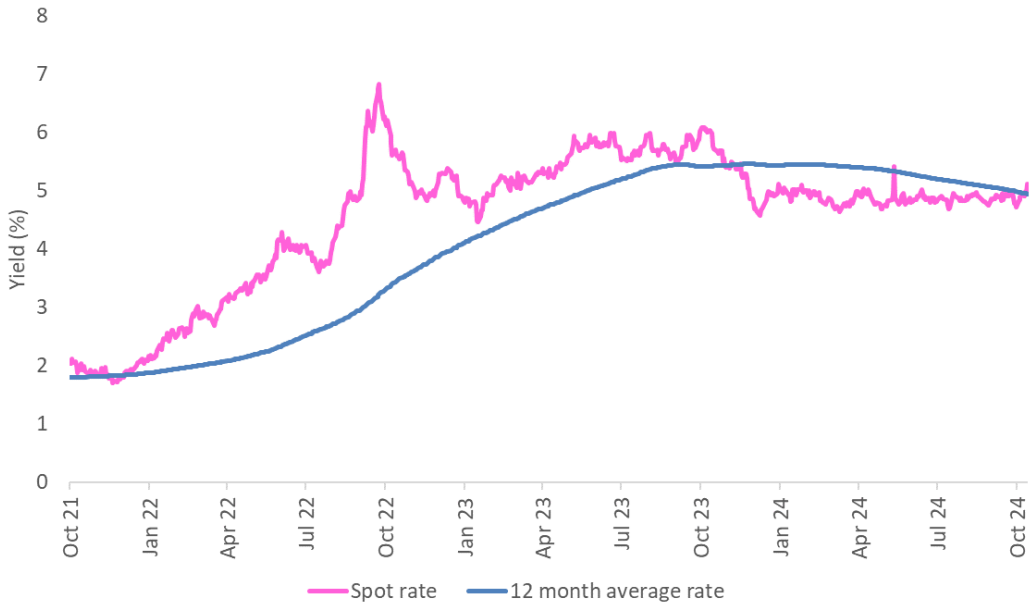
a) The discount rate in the lower polar case should reflect the credit risk of a UK MNO. In the absence of a pure-play UK MNO which issues debt on a stand-alone basis, we continue to consider that BBB bond yields provide a reasonable estimate of that risk.[63]
b) As our objective is to leave MNOs indifferent between paying a LSV or ALFs, we consider it is appropriate for the cost of debt in the lower polar case to reflect the relevant cost of debt today. As in previous decisions, we consider that estimating the average cost of debt over the last 12 months reflects current market rates while avoiding placing all weight on the spot rate from a single day or shorter averaging period, which could be dominated by atypical short-term movements.[64]

A5.14 We estimate that the 12-month average yield on an index of 10-year BBB bonds was 4.95% on 31 October 2024. This is higher than the 1.7% used in our 2021 Statement, which referenced average yields in the 12 months to October 2021.[65]

A5.15 The increase in yields since October 2021 is illustrated in Figure A5.1. The chart shows the spot rate and the 12-month average spot rate.

[62] A constant stream of payments (i.e. an annuity like ALF) has a lower duration than the same maturity bond with a bullet payment at the end. Hence, yields on bonds with a maturity of around 10 years have a similar duration to a 20-year ALF. See paragraphs A10.21-A10.26 of our 2015 Statement.
[63] As of October 2024, the credit ratings of the parent companies of UK MNOs range from B+- to A- according to S&P: BT (EE) and Vodafone are rated BBB, CK Hutchison Group Telecom Holdings Ltd (Three) is rated A- and VMed O2 UK Ltd (O2) is rated B+.
[64] See also paragraph 6.54 of our 2015 Statement.
[65] See paragraph A4.20 of the 2021 Statement.

Figure A5.1: Yields on 10-year BBB bonds since 2021 Statement



Source: Ofcom analysis using S&P Capital IQ, GBP All Corporates (ID = 283911499). Data up to 31 October 2024.

A5.16 BT said that we should estimate the cost of debt in the lower polar case by reference to average BBB bonds yields over a longer period of 10-15 years, to avoid current market volatility and better represent 'more stable market conditions'.[66] Alternatively, BT said we could estimate the cost of debt using a point estimate between yields on BBB bonds today and yields used to inform our 2018 decision (when BT said markets were more stable). [67]

A5.17 We don't consider that estimating the cost of debt by reference to longer term average yields would align with our objective to leave MNOs indifferent between paying a LSV or ALFs in the lower polar case. As explained above, we consider the appropriate way to achieve this objective would be for the cost of debt in the lower polar case to reflect current market conditions.[68]

Reduction for inflation risk premium

A5.18 In deriving a real discount rate from data on nominal bond yields, we assume a constant rate of CPI inflation of 2% (consistent with our long-term view of inflation). However, as actual annual ALF payments will be indexed to outturn inflation, this provides the government with protection against outturn inflation being different to forecast, and as such, the government does not need to be compensated for this risk via an inflation risk premium in nominal yields.

A5.19 In previous decisions, we acknowledged that there was some empirical evidence of a positive RPI inflation risk premium.[69] With RPI more volatile than CPI and given that there is no explicit official inflation target for RPI (unlike CPI), we considered any adjustment for a CPI inflation risk premium should be at the lower end of any range derived from figures

[66] BT submission, paragraph 38, 'Option A'.
[67] BT submission, paragraph 38, 'Option B'.
[68] This approach is consistent with previous reviews. As explained in paragraph 6.54 of the 2015 Statement, we are seeking a rate which reflects current market conditions, rather than a long-term rate.
[69] See paragraphs A10.43 to A10.49 of our 2015 Statement.

based on RPI inflation. In previous decisions we reduced the observed nominal yield by 10 basis points to account for a potential CPI inflation risk premium.

A5.20 In a September 2023 speech, Bank of England Monetary Policy Committee member Catherine L. Mann said that there could be an increasing inflation risk premium being priced into the UK's macroeconomic prospects.[70] She said that inflation compensation implied by financial markets, which explicitly includes an inflation risk premium, had been volatile and high over the previous two years, and that the inflation risk premium would tend to rise if people expect inflation to be more volatile in the future or skewed to the upside. Based on a comparison between survey-based inflation expectations and inflation compensation implied by financial markets, she said the inflation risk premium (measured with respect to RPI) had risen from 20 basis points in 2014 to 40 basis points in 2019 and in 2023 was 90 basis points.

A5.21 While the inflation risk premium can vary over time,[71] we want to use an estimate of the inflation risk premium in our lower polar case that broadly reflects today's market conditions. This suggests it could be appropriate to assume an inflation risk premium higher than the 10 basis points previously used.

A5.22 Current longer-term forecasts for RPI appear to average below 3%[72] while 10-year breakeven inflation is currently around 3.6%.[73] This suggests an RPI inflation risk premium could be above 50 basis points.

A5.23 As CPI is less volatile than RPI,[74] we think a CPI inflation risk premium would be below an RPI inflation risk premium and consider than an assumption of 40 basis points would be reasonable.

Reduction for liquidity risk premium

A5.24 Liquidity risk refers to the difficulties that a creditor may encounter when trying to sell an asset on the secondary market. This can restrict the creditor's ability to manage risk exposure, and so creditors may require a premium for bearing liquidity risk. In our case, there is no realistic prospect of the creditor (the government) wanting to resell the ALF payment stream. To the extent that our measure of the discount rate includes some compensation for liquidity risk, it might therefore be appropriate to remove it.

A5.25 As discussed in the 2018 Statement and 2021 Statement, there is empirical evidence that nominal bond yields include compensation for liquidity risk (i.e. the inability to easily trade the asset). However, we noted that this is an area of ongoing empirical research and

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[70] Inflation Models and Research: Distilling dynamics for monetary policy decision making - speech by Catherine L. Mann, 11 September 2023. See pages 19 to 21.

[71] For example, a 2015 Bank of England paper, The informational content of market-based measures of inflation expectations derived from government bonds and inflation swaps in the United Kingdom, estimated that between 2004 and 2013 the inflation risk premium averaged 15 basis points, but varied from -40 basis points to 75 basis points.

[72] For example, the OBR's Economic and fiscal outlook – October 2024Economic and fiscal outlook – October 2024 forecasts RPI to Q1 2025 (see 'detailed forecast tables: economy'). Average RPI in the five-year period Q1 2025 to Q1 2030 is 3.1%, though the OBR expects RPI to fall to 2.5% in Q1 2030 (i.e. when RPI is expected to align with CPIH) suggesting longer term average RPI forecasts would be below 3%.

[73] See Bank of England, Yield Curves, GLC inflation daily data series. Breakeven inflation implied by 10-year government gilts in October 2024 was around 3.6%.

[74] Between January 1998 and September 2024, the standard deviation on monthly RPI was 2.57% compared to 2.05% for CPI.

estimates of the liquidity risk premium need to be treated with caution. In previous decisions, we applied a 30% adjustment to the debt premium to adjust for liquidity risk.[75]

A5.26 In the 12 months to October 2024, we estimate that the average debt premium on an index of 10-year BBB bonds index was 0.9%.[76] After applying a 30% adjustment to this debt premium for liquidity risk, this translates into a 30bp reduction to our cost of debt estimate (rounded to one decimal place).

Converting to a real post-tax figure

A5.27 After adjusting for inflation and liquidity risk, the pre-tax nominal cost of debt is 4.25%. We then derive a post-tax nominal discount rate using our estimate of the average corporate tax rate which will prevail over the 20-year period (25%[77]). This gives a post-tax nominal rate of 3.2%. The equivalent post-tax real rate is then 1.2%, using our CPI inflation forecast of 2%.

Table A5.1: Proposed discount rate in the lower polar case

Parameter	Value	Source or derivation
Pre-tax nominal cost of debt	4.95%	Ofcom estimate based on average yield on 10-year BBB bonds in 12 months to October 2024
Debt premium	0.9%	Ofcom estimate based on average debt premium on 10-year BBB bonds to October 2024
Inflation risk premium	0.4%	Ofcom estimate
Liquidity risk premium	0.3%	Ofcom estimate based on 30% x debt premium
Adjusted pre-tax nominal cost of debt	4.25%	= pre-tax nominal cost of debt –inflation risk premium– liquidity risk premium
Corporate tax rate	25%	Based on current tax rates published by HMRC
Post tax nominal cost of debt	3.2%	= adjusted pre-tax nominal cost of debt * (1 – tax rate)
CPI inflation forecast	2%	Bank of England target
Post tax real cost of debt (lower polar case)	1.2%	= (1+ post-tax nominal cost of debt) / (1 + CPI inflation forecast) - 1

Upper polar case: WACC

A5.28 Consistent with previous ALF decisions, we propose to base our estimate of the upper polar case on the forward-looking WACC reflecting the systematic risk of a UK MNO. This is consistent with how we define the upper polar case, which is that, hypothetically, if the ALF payments were set up in such a way that they varied in line with the future after-tax cash flows of the licensee (e.g. through some form of net revenue sharing arrangement between the licensees and the government) the government would be fully exposed to the underlying systematic risk.

[75] See our 2018 Statement, Annex 5, paragraph A5.53 and 2021 Statement paragraph A4.23 to A4.25
[76] This is based on the difference in yield between an index of 10-year BBB bonds (as illustrated in Figure 7.1) and nominal gilts. Nominal gilt yields were taken from the Bank of England's Yield Curves (using the GLC nominal daily data dataset).
[77] The main rate of corporation tax is 25%. See Corporation tax rates and allowances.

A5.29 We propose a real post-tax WACC of 3.3%, below the 3.6% real post-tax WACC we used in our 2021 Statement.

A5.30 The WACC used in our 2021 Statement was informed by input parameters underpinning our March 2021 MCT decision[78] (published 9 months before our 2021 Statement). As set out below, we have considered whether more recent evidence would support a change to the input parameters used in our 2021 Statement. We expect to update the upper polar case for the latest market evidence in our final statement.

Estimating WACC

A5.31 The WACC combines the cost of funding from debt (Kd) and equity (Ke), each weighted by gearing (i.e. the value of debt relative to enterprise value, denoted by g in the formula below). The pre-tax WACC is obtained by scaling the post-tax cost of equity by the corporate tax rate (t), i.e. 1/(1-t), the cost of debt already being pre-tax.

$$pre-tax\ nominal\ WACC = K_e * \frac{1-g}{1-t} + K_d * g$$

A5.32 For the purposes of setting ALFs, we use a forward-looking cost of debt in the WACC, consistent with the lower polar case (i.e. 4.95% pre-tax nominal).

A5.33 We estimate the cost of equity using the Capital Asset Pricing Model (CAPM), where the cost of equity is a function of the risk-free rate (RFR), the expected return on the equity market as a whole above the RFR (i.e. the equity risk premium, or "ERP") and the systematic risk of the company (i.e. equity beta, βequity):

$$K_e = RFR + ERP * \beta equity$$

A5.34 There are several parameters we must estimate to calculate WACC. Some parameters reflect economy-wide factors that affect all firms, in particular the expected market return ("EMR"), which represents the sum of RFR and ERP, the RFR and the corporate tax rate. We set out our estimates of these below.

- **RFR**. In line with previous ALF decisions, we propose to use a nominal RFR consistent with our cost of debt. Given our nominal cost of debt of 4.95% and an estimated debt premium of 0.9%, the implied nominal RFR is 4.05%.[79]
- **EMR**. We propose to use a real EMR of 6.7% (with respect to CPI). This is the same assumption used in our cost of capital decisions in telecoms (WFTMR 2021 and MCT 2021) as we expect the EMR to be more stable over time than the RFR and ERP.[80] A real EMR of 6.7% combined with a CPI inflation forecast of 2.0% produces a nominal EMR of 8.8%.[81] Our estimated discount rate is not particularly sensitive to estimates of the EMR.[82]

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[78] Statement: Wholesale Voice Markets Review 2021–26. 30 March 2021.
[79] i.e. nominal RFR + debt premium = nominal cost of debt.
[80] WFTMR 2021 Statement, Annex 20, Table A20.1 and paragraph A20.75. UKRN's cost of capital guidance also recognises that UK regulators assume relative stability in the TMR (page 19 of the guidance).
[81] Using the Fisher equation. Nominal EMR = (1 + real EMR) * (1 + CPI inflation) - 1
[82] For example, other UK regulators have recently estimated the real EMR (in CPIH terms) to be broadly between 6.3% and 7%. (Ofwat proposed a real EMR (CPIH) range of 6.29% to 6.87% (PR24 draft determinations, Aligning risk and return - Allowed return appendix, July 2024, Table 1) and Ofgem proposed a real EMR (CPIH) range of to 6.5% to 7% (see RIIO-3 Sector Specific Methodology Decision – Finance Annex, July 2024, Table 6). EMR estimates in this range would not materially affect our estimated discount rate.

- **Corporate tax rate**. We have used a corporate tax rate of 25%, consistent with current tax rates.[83]

A5.35 Other parameters that influence the WACC are firm-specific, such as gearing, equity and asset betas. We set out our estimate of these below and, where possible, we use data on parent companies of UK MNOs to support our calculations.

Asset beta, equity beta and gearing

A5.36 A company's equity beta measures the movements in returns from its shares relative to the movement in the total return from a relevant equity market. The equity beta includes the effect of capital structure on the systematic risk of the company, so an asset beta is often calculated to remove financial leverage effects from the equity beta to compare the betas of different companies (which may have different gearing).

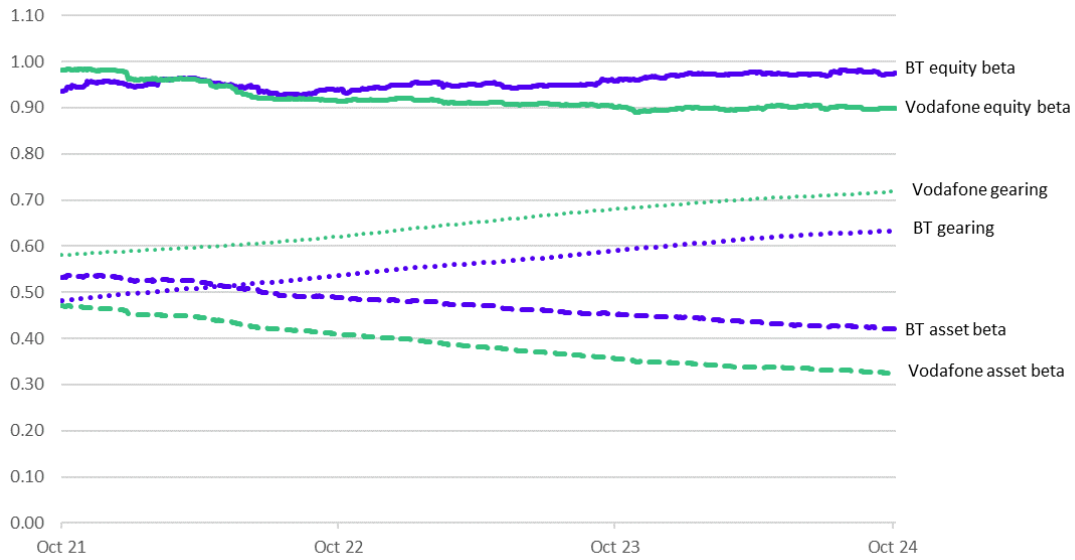
A5.37 In our 2021 Statement we used an asset beta of 0.62, a debt beta of 0.1, and gearing of 45%, consistent with our WFTMR 2021 and MCT 2021 decisions. These implied an equity beta of 1.05.[84]

A5.38 We have considered whether recent trends in betas and gearing for BT and Vodafone, as the two UK listed telecoms operators which own UK mobile networks, would support a change to the beta and gearing assumptions used in our 2021 Statement. We recognise that BT and Vodafone are not perfect proxies for a UK MNO: BT's revenues are predominantly generated in the UK[85] but EE represents perhaps only one-third[86] of BT's total revenues, and while the majority of Vodafone revenues relate to mobile activities, the UK only represents around 20%[87] of total revenues. In the absence of a pure-play listed UK MNO however, we consider the betas and gearing of BT and Vodafone provide a reasonable benchmark of these parameters for a UK MNO.

A5.39 Since 2021, asset betas for BT and Vodafone have generally decreased and gearing levels increased, though equity betas are more stable.[88] Figure A5.2 illustrates that 5-year equity betas for BT and Vodafone are between 0.90 and 1.0, as they were in 2021, while asset betas have declined, and gearing has increased.

[83] The main rate of corporation tax is 25%. See Corporation tax rates and allowances.
[84] Calculated as (asset beta – debt beta x gearing)/(1 – gearing).
[85] In its 2024 annual report, BT reported that almost 90% of revenues were from the UK.
[86] EE Ltd reported revenues of £7,169m in financial year 2024, which was 34% of BT Group's reported revenues of £20,797m in that financial year. EE Ltd's revenue also includes revenue related to non-mobile activities.
[87] Vodafone Group plc's 2024 annual report says it generated €6,837m revenue from the UK out of total revenue of €36,717m (18.6%).
[88] Note that the beta and gearing information informing the WFTMR 2021 and MCT 2021 decisions was from 2020. See for example Table A20.5 of the WFTMR 2021 decision.

Figure A5.2: Five-year equity beta, asset beta and gearing for BT and Vodafone



Source: Ofcom analysis using S&P Capital IQ Pro. Gearing calculated based on total debt/(market capitalisation + total debt). [89] *Betas have been estimated using daily data against the FTSE All Share index. Asset betas calculated assuming a debt beta of 0.1. Chart shows data to 31 October 2024.*

A5.40 Table A5.2 summarises our estimates of 2-year and 5-year equity betas, asset betas and average gearing for BT and Vodafone, as of 31 October 2024.[90]

Table A5.2: Two-year and five-year beta and gearing for BT and Vodafone

Parameter	Equity beta	Gearing	Asset beta
BT			
2 - year	0.99	66%	0.40
5 - year	0.98	63%	0.42
Vodafone			
2 - year	0.88	76%	0.29
5 - year	0.90	76%	0.32

Source: Ofcom analysis using S&P Capital IQ Pro. Gearing calculated based on total debt/(market capitalisation + total debt)

A5.41 Given the relative stability of equity betas since 2021 we propose to use an equity beta range of 0.9 to 1.0 to inform the WACC of a UK MNO, which broadly captures the most recent equity beta estimates for BT and Vodafone from Table A5.2. We propose to use a gearing range of 60% to 75% which also broadly captures the most recent average gearing estimates for BT and Vodafone.

Estimated WACC

A5.42 Applying the parameters discussed above, we estimate a post-tax real WACC range of 2.8% to 3.7%. The midpoint of this range is 3.3%. We consider the midpoint represents a

[89] Total debt includes the impact of IFRS16, which was adopted by BT and Vodafone in 2019.
[90] Betas have been estimated using daily data against the FTSE All Share index. Asset betas calculated assuming a debt beta of 0.1.

reasonable estimate of the WACC of a UK MNO and propose to use this value in our discount rate estimate. A summary of the calculation is shown in Table A5.3 below.

Table A5.3: Proposed discount rate in the upper polar case

Parameter	Value	Source or derivation
Nominal RFR	4.05%	Ofcom estimate
Nominal EMR	8.8%	Ofcom estimate
Nominal ERP	4.7%	= nominal EMR – nominal RFR
Gearing (g)	60% - 75%	Ofcom estimate
Equity beta (βe)	0.9 – 1.0	Ofcom estimate
Pre-tax nominal cost of equity (Ke)	11.1% - 11.8%	= (RFR + ERP *βe) / (1-t)
Pre-tax nominal cost of debt (Kd)	4.95%	Nominal cost of debt used in lower polar case
Pre-tax nominal WACC	6.5% - 7.7%	= Ke*(1-g) + Kd*g
Corporate tax rate (t)	25%	
Post-tax nominal WACC	4.9% - 5.8%	= pre-tax nominal WACC * (1-t)
CPI inflation	2%	Ofcom estimate
Post-tax real WACC (upper polar case)	2.8% - 3.7%	= (1+ post-tax nominal WACC) / (1+CPI inflation) -1
Midpoint	**3.3%**	

Risk-sharing adjustment

A5.43 We propose to make an adjustment for the degree of risk sharing between licence holders and the government – which arises due to the possibility of future fee reviews that could increase or decrease the ALF payments (subject to the completion of any such review).

A5.44 The possibility of a review of ALFs exposes the government to a degree of systematic risk of the cash flows from the operation of the licences. Therefore, we consider that a risk-sharing adjustment remains appropriate.

A5.45 The risk-sharing adjustment determines where the final discount rate sits between the lower and the upper polar cases. A non-zero risk-sharing adjustment means there is a likelihood of future fee reviews that could increase or decrease the ALFs.

A5.46 In previous reviews we did not think it sensible to try to assign specific probabilities to when a review (or reviews) might take place. We considered some stylised examples to gain insight into the question but said that ultimately we needed to exercise judgement. For example, in our 2018 Statement we said:

- A single review in a 20-year period taking place in year 10, with the probability of an increase in ALF equal to the probability of a decrease, would see the government bear over 40% of the risk;[91]

[91] 2018 Statement, paragraphs A5.94 to A5.97.

- A single review for some year other than year 10 would reduce the extent to which risk is transferred to the government as there would be a long period either before or after the review where ALFs were fixed;[92]
- More than one review in a 20-year period could significantly increase the transfer of risk to the government.[93]
- In practice, a review of ALFs would likely be taken only when there was a material misalignment between ALFs and the underlying market value, and this would tend to reduce the extent of risk transfer from the licensee to the government, all else equal.[94]

A5.47 Taking a conservative approach to interpreting the evidence, we decided in previous reviews that a risk-sharing adjustment of 25% was appropriate.[95] We remain of the view that while it is possible to create different scenarios of how and when any review of ALFs might occur, there is no certainty as to whether and when any review would be undertaken. The risk-sharing adjustment ultimately reflects our regulatory judgement, and we continue to believe that this is an appropriate level for the adjustment.

A5.48 Therefore, in line with our previous ALF decisions, we propose to allow for a 25% risk sharing adjustment between the lower polar case and upper polar case to estimate the final discount rate.

Discount rate for annualisation

A5.49 Combining our discount rates in the lower and upper polar cases together with the 25% risk-sharing adjustment produces an overall post-tax real discount rate of 1.7% (rounding to one decimal place). Note that the lower and upper polar case estimates used to estimate the discount rate are unrounded figures.

Table A5.4: Discount rate for annualisation

Parameter	Value	Source or derivation
Lower polar case	1.2%	See Table A5.1
Upper polar case	3.3%	See Table A5.3
Risk sharing adjustment	25%	Ofcom assumption
Discount rate for annualisation	1.7%	= lower polar case + 25% x (upper polar case – lower polar case)

Tax adjustment

A5.50 Consistent with previous reviews, we apply a tax adjustment factor to the real post-tax discount rate to reflect the more favourable tax treatment of annual fees compared to a

[92] 2018 Statement, paragraphs A5.99(a). We noted that a single review in year 5 would see the government bear around 30% of the risk.
[93] 2018 Statement, paragraphs A5.99(b). We noted that two equally spaced reviews in the 20-year period would see the government bear roughly 60% of the risk.
[94] See also 2018 Statement, paragraphs A5.99(c)
[95] For example, see our 2021 Statement, paragraph A4.53 and 2018 Statement, paragraph A5.100.

lump-sum payment.[96] We calculate a tax adjustment from the difference in tax benefits from ALF payments compared to the tax deductions available from amortisation of a lump-sum payment, converted to present values using the post-tax discount rate. The tax adjustment factor (TAF) is calculated the same as in previous reviews as:

$$TAF = 1 + \left[\frac{(PV\ of\ tax\ benefits\ of\ ALF - PV\ of\ tax\ benefits\ of\ the\ amortisation\ of\ LSV)}{LSV}\right]$$

A5.51 We estimate a tax adjustment factor of 1.093, which equates to an average tax rate of 25% over the 20-year period. The spreadsheet showing the calculation of this tax adjustment factor is published alongside this consultation.

Annualisation rate

A5.52 As summarised in Table A5.5 below, our proposed annualisation rate, applying the formula from paragraph A5.5 (copied below), is 6.38%.

$$ALF_t = LSV * TAF * \underbrace{\left[\frac{r}{1-(1+r)^{-t*}}\right] * \left[\frac{1}{(1+r)}\right] * \left[\frac{CPI_t}{CPI_{t0}}\right]}_{\text{Annualisation rate}}$$

Table A5.5: Proposed annualisation rate

Parameter	Value
Length of period over which we spread the LSV for the purposes of calculating ALF (t*)	20 years
Real post-tax discount rate (r)	1.7%
Adjustment factor that reflects tax advantages over lump-sum payments (TAF)	1.093
Annualisation rate	6.38%

A5.53 Table A5.6 compares our proposed annualisation rate to those used in previous reviews.

Table A5.6: Annualisation rate used in previous ALF reviews

Review	Annualisation rate
2015 (900 MHz and 1800 MHz)[97]	6.27%
2018 (900 MHz and 1800 MHz)[98]	5.75%
2021 (2100 MHz)[99]	5.34%
2024 (this consultation)	6.38%

[96] The tax adjustment is discussed in paragraphs 6.121 to 6.131 of our 2015 Statement and A5.136 to A5.139 of our 2018 Statement. We previously said the tax treatment of ALFs would be more favourable than a lump-sum payment due to the ALF incorporating an allowance for the time value of money and adjusting for inflation.
[97] 2015 Statement, paragraph 6.134.
[98] 2018 Statement, Table 4.1
[99] 2021 Statement, Table 4.6

A6. Approach to international benchmarking

Introduction

A6.1 In this annex we set out the method for the international benchmarking analysis used to inform our assessment of the LSVs for the ALF spectrum bands. In particular, we provide an overview of how we:

a) derive the relative value benchmarks for European auctions; and
b) tier these benchmarks based on the quality of the evidence.

A6.2 This method is consistent with that used in the 2021 Statement on the 2100 MHz ALFs and the 2015 and 2018 Statements on 900 MHz and 1800 MHz ALFs.

A6.3 Our assessment of the individual European auctions is provided in Annex 7.

Derivation of benchmarks

A6.4 To derive relative value benchmarks from international auctions:

a) First, we identify the individual results of European auctions which have been held since 2010 in the 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2.3 GHz, 2.6 GHz, and 3.4-3.8 GHz spectrum bands. We consider European awards to be the most relevant in informing us about the value of 900 MHz, 1800 MHz and 2100 MHz spectrum in the UK. This is because European countries are more likely to share regulatory and other characteristics that affect the value of the ALF spectrum bands in the UK. We consider that this approach gives us a sufficient and appropriate set of comparators.
b) Second, to make the international auctions comparable, we convert them into 'UK-equivalent absolute values'. This involves adjusting the auction values to take account of factors such as population, different licence durations and auctions that happened at different times. We express all UK-equivalent values in September 2024 prices.
c) Third, we use the UK-equivalent absolute values to derive our relative value benchmarks using the paired ratio method (for 900 MHz) and distance method (for 1800 MHz and 2100 MHz).

A6.5 The second and third steps are described further in this sub-section.

UK equivalent absolute values

A6.6 In constructing the UK-equivalent absolute values for the European auctions, we make a series of adjustments to account for country-specific factors which have the potential to affect auction values in comparator countries relative to the UK:

a) All payments associated with an auction are summed to get a final award value. Payments not paid at the date of award, such as on-going licence fees, are discounted

from the date of initial payment to derive the present value of the award using the pre-tax nominal cost of debt[100] for the respective country.[101]

b) Where there was a material delay between the auction and the date the spectrum became available to winning bidders, we calculate an adjustment to allow for the fact that observed auction prices likely reflect the value of the licence at the date the spectrum becomes available for use, discounted back to the date of the auction.[102] We use a post-tax real weighted average cost of capital (WACC)[103] for the respective country.[104]

c) The present value of any award is scaled by differences in licence duration between that award and the 20-year duration of the UK spectrum awards using the post-tax real WACC for the respective country.

d) All awards are converted from the domestic currency in which they were awarded to pound sterling using purchasing power parity (PPP) exchange rate conversions in the year of the award.[105]

e) All awards are converted to today's prices by applying the UK CPI.[106]

f) All awards are scaled from the size of the respective country's population to the UK population.[107]

g) A single absolute per MHz value for each spectrum band in an auction is generally derived by averaging the values of all relevant lots sold, weighted by the size of a given lot, or a specific lot(s) where it is more reflective of market value.

A6.7 Despite making these adjustments, country-specific factors have the potential to affect auction prices in comparator countries relative to the UK. Absolute auction prices may therefore not provide reliable indicators of the value of spectrum in the UK. Some country-specific factors, such as general price levels, will be reflected in the PPP estimates which we have used to derive absolute value benchmarks. However, other differences in auction

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[100] The adjustment to incorporate the present value of annual fees into a lump sum for licences is essentially the reverse adjustment we make in annualising the lump sums into annual fees if there were no likelihood of review. Generally, annual fees in the benchmark countries do not appear to be adjusted annually for inflation in the same way we are adopting for ALFs in the UK. We therefore discount future fee payments using a nominal discount rate. We previously set out that the implications of using a pre-tax approach are broadly similar to using a post-tax approach with a separate adjustment for the differential tax treatment of ALFs. We therefore considered it a reasonable proxy to apply the pre-tax discount rate. 2018 Statement, Annex A1, A1.44. We also apply a liquidity risk premium adjustment of 30bp, consistent with our approach to annualisation in the lower polar case, as set out in Annex A5.

[101] BEREC Report on Regulatory Accounting in Practice 2023, Chapter 5, Section 5.2.4; BEREC Report on Regulatory Accounting in Practice 2022, Chapter 5, Section 5.2.4 ;BEREC Report on Regulatory Accounting in Practice 2021, Chapter 5, Section 5.2.4; earlier values as used in the 2021 and 2018 Statement.

[102] For this analysis, we consider a delay longer than a year between the auction date and the date at which spectrum becomes available to the winning bidders as likely to be factored into the auction prices.

[103] In estimating an adjustment to an auction price for licence duration or delayed access to spectrum, we are adjusting for the difference in value an operator would place on having access to spectrum for a shorter (or longer) period. This will reflect the difference in cash flows they expect to earn. The risk of these expected cash flows should be reflected in this adjustment, and so we consider it appropriate to use the WACC in adjusting for licence duration and delayed access to spectrum. The appropriate WACC to use will reflect expectations at the time of the auction.

[104] BEREC Report on Regulatory Accounting in Practice 2023, Chapter 5, Section 5.2.4;; BEREC Report on Regulatory Accounting in Practice 2022, Chapter 5, Section 5.2.4 ;BEREC Report on Regulatory Accounting in Practice 2021, Chapter 5, Section 5.2.4; earlier values as used in the 2021 and 2018 Statement.

[105] The World Bank: PPP conversion factor, GDP

[106] Office for National Statistics, CPI (all items) Index, https://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/d7bt/mm23

[107] World Bank, DataBank, Population, https://data.worldbank.org/indicator/sp.pop.totl

values are more difficult to address in a robust way – for example, the greater propagation characteristics of lower-frequency bands may be more or less important depending on the level of urbanisation and population density in a country.

A6.8 In general, consistent with our approach in previous ALF-setting exercises, we expect that relative values are less likely to be affected by country-specific factors than absolute values.

Relative value benchmarks

A6.9 As explained below, to derive relative value benchmarks for 900 MHz we focus on the relevant auction evidence for sub-1 GHz mobile spectrum bands using a paired ratio method, while for 1800 MHz and 2100 MHz we use the distance method.

Paired ratio method benchmarks: 900 MHz

A6.10 To calculate the relative values of the 900 MHz band we identify European countries in which the 900 MHz spectrum band and either of the 700 MHz and 800 MHz bands (the "low frequency bands") have been auctioned since 2010.

A6.11 To calculate the relative values of 900 MHz we apply the "paired ratio" method. This involves calculating the ratio between 900 MHz and a low frequency band (800 MHz or 700 MHz) values in the country concerned and applying this ratio to the corresponding value of the low frequency band (800 MHz or 700 MHz) in the UK.

A6.12 The paired ratio method is expressed formulaically as follows, where the term "L" and the number 900 represent the value of the low frequency band and 900 MHz band for a given benchmark country or the UK. Benchmark country and UK values are denoted by the subscripts "BC" and "UK", respectively.

$$900_{UK} = \frac{900_{BC}}{L_{BC}} \cdot L_{UK}$$

Distance method benchmarks: 1800 MHz and 2100 MHz

A6.13 To calculate the relative values for the 1800 MHz and 2100 MHz bands we identify European countries in which the 1800 MHz spectrum band or the 2100 MHz spectrum band, either of the 700 MHz and 800 MHz bands (the "**low frequency bands**") and preferably also any of the 2.3 GHz, 2.6 GHz and 3.4-3.8 GHz bands (the "**high frequency bands**") have been auctioned since 2010.

A6.14 We then calculate relative values for the value of the ALF spectrum using the distance method by:

a) calculating the "Y/X ratio" as the difference in value between 1800 MHz/2100 MHz and the high frequency band ("Y"), divided by the difference in value between the low frequency band and the high frequency band ("X") in the benchmark country; and

b) relating this to the corresponding values of the low frequency band and the high frequency band in the UK.

A6.15 The distance method is expressed formulaically as follows, where the terms "L" and "H" and the number 1800/2100 represent the value of the low frequency band, high frequency band and 1800 MHz/2100 MHz band for a given benchmark country or the UK denoted by the subscripts "BC" and "UK", respectively.

$$1800_{UK} = \frac{1800_{BC} - H_{BC}}{L_{BC} - H_{BC}} \cdot (L_{UK} - H_{UK}) + H_{UK}$$

$$2100_{UK} = \frac{2100_{BC} - H_{BC}}{L_{BC} - H_{BC}} \cdot (L_{UK} - H_{UK}) + H_{UK}$$

Proxies for the value of high frequency bands

A6.16 In countries where auction prices are available for a low frequency band and the 1800 MHz or 2100 MHz band, but not a high frequency band, we derive a proxy for the value of the high frequency band, which we then use alongside the low frequency band and the 1800 MHz/2100 MHz price to calculate relative value benchmarks.

A6.17 Our approach starts by considering auction evidence from countries other than the country we need the proxy for and calculating a ratio between the price of a high frequency band and the price of a second band in those countries. We then apply this ratio to the price of the second band in the country where a proxy is needed. For example, to derive a proxy value of the 3.4-3.8 GHz band in a country where the price of this band is not available, we start by calculating the ratio of the 3.4-3.8 GHz band price relative to the 800 MHz band price in countries where both these prices are available; we then multiply the 800 MHz band price from the first mentioned country by the calculated ratio to arrive at a proxy value of the 3.4-3.8 GHz band in that country. This approach can be similarly applied to other combinations of bands for which prices are available in relevant countries.

A6.18 Ireland is the only country for which we have Tier 1 benchmarks using proxy values.

Interpretation of benchmarks

Quality of evidence: tiers

A6.19 We categorise the available relative value benchmarks into three tiers, which reflect how informative of UK market values we consider them to be. The categories range from Tier 1 (highest quality) to Tier 3 (lowest quality). 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 spectrum sold at more than the reserve price);

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.

A6.20 Our criteria for placing a benchmark in **Tier 2** are that one or more of the criteria for Tier 1 are not met; but

a) there is some evidence that the relative auction prices reflect bidders' relative intrinsic valuations of different bands; and

b) 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.

A6.21 Our criterion for placing a benchmark in **Tier 3** is that it does not meet the criteria for Tier 1 or Tier 2.

Risk of understatement or overstatement

A6.22 In addition to our assessment of which tier a benchmark is in we have assessed whether there is a risk that each benchmark is an understated or overstated estimate of the UK value of the relevant band.

A6.23 We characterise the nature of the risks according to the:

a) Likelihood of understatement or overstatement: we consider whether this can be categorised as a larger risk or a smaller risk, but in some cases, we cannot be sure of the likelihood of possible understatement or overstatement.

b) Scale of the potential understatement or overstatement: we consider whether this can be categorised as larger or a smaller understatement or overstatement, but in some cases, we cannot be sure of the scale of possible understatement or overstatement.

c) Direction of potential effect: whether the risk is of an understatement or overstatement, or both. In some cases, there may be some reasons for considering the benchmark may be an understatement, and other reasons for considering it may be an overstatement. In these cases, we reach a view as to whether the effects tend to balance out, or one is likely to be stronger than the other.

A6.24 In assessing the risks, we consider both whether the auction outcomes are likely to reflect market value in the country concerned, and also whether there are other factors, such as country-specific factors or the date of the award, that might inform our interpretation of what the benchmark says about market value in the UK.

A6.25 The risk associated with a benchmark is based on the risks associated with the individual auctions that constitute the benchmark and any risks that arise from combining those auctions into a benchmark.

Distance method benchmarks where Y/X> 1 or Y/X<0

A6.26 The distance method is designed to interpolate a value for the target band (1800 MHz or 2100 MHz) that lies between the value of the low frequency (800 or 700 MHz) and high frequency (2300 MHz, 2600 MHz and 3.4-3.8 GHz) band.

A6.27 When the value of 1800 MHz or 2100 MHz in a given country is:

a) greater than the value of the low frequency band (i.e. the Y/X ratio is greater than 1), the distance method instead extrapolates a value for the target band above the UK value for the low frequency band; or
b) less than the value of the high frequency band (i.e. the Y/X ratio is negative), the distance method extrapolates a value for the target band below the UK value for the high frequency band.

A6.28 We need to be careful how we interpret the resulting benchmark values. Consistent with our approach in our 2021 Statement[108], we propose not to downgrade the tier of a benchmark because the values it generates do not fit with our prior expectations. Instead, we consider the appropriate approach is to assess the individual benchmarks on their merits, and ensure that, if we include them as Tier 1 benchmarks, (on the basis they meet the criteria for inclusion) we interpret them in an appropriate manner.

A6.29 We consider that benchmarks where:

a) the Y/X>1 are at larger risk of overstating the LSV of the UK target band; and
b) the Y/X<0 are at larger risk of understating the LSV of the UK target band.

[108] See 2021 Statement, paragraphs 4.47-4.49 and Annex A2, paragraphs A2.32-A2.36.

A7. Relevant spectrum awards

Introduction

A7.1 In this annex we discuss the results of mobile spectrum awards which have taken place in Europe since the beginning of 2010, and which we have considered in deriving relative value benchmarks for the 900 MHz, 1800 MHz and 2100 MHz spectrum bands in the UK.

A7.2 This annex contains separate sections for each of the countries for which we can derive a Tier 1 benchmark. For each of these countries, we set out the auctions used to derive the benchmarks, and include:

a) A summary of those auctions we have analysed in previous ALF Statements.
b) Information on the circumstances and outcome of the auction or auctions that we have not analysed in previous ALF statements. This includes a summary of the amount of spectrum awarded to each winning bidder, the prices paid in the local currency at the time of the auction, and the main rules and features of the auction design.
c) Our provisional assessment of whether the values derived from each auction are likely to reflect the market value in the country concerned, and whether the relative market values of different bands in the country concerned are likely to reflect the UK relative market values.
d) A summary of the relative value benchmarks and our assessment. This includes the tier of evidence to which we have provisionally assigned the relative value benchmarks, and our interpretation of the benchmarks in terms of the likelihood, scale, and direction of any understatement or overstatement of the UK market value.

A7.3 Finally, we briefly summarise the Tier 2 and Tier 3 auction evidence.

Austria

Relevant auctions

A7.4 Table A7.1 below sets out the auction data we have used to derive Tier 1 benchmarks from Austria. As set out in the final column, we have analysed each of these auctions in a previous ALF decision.

Table A7.1: Summary of Tier 1 auction evidence from Austria

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction was analysed
700 MHz	Sep-20	25.5	Risk of under- or overstatement	2021 Statement[109]
800 MHz	Oct-13	105.6 (RC) 107.7 (UC)[110]	Risk of overstatement	2015 Statement[111]

[109] 2021 Statement, A3, paragraphs A3.6-A3.31
[110] 2015 Statement, A8, paragraphs A8.9-A8.223
[111] 2015 Statement, A8, paragraphs A8.9-A8.223

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction was analysed
900 MHz	Oct-13	120.7	Larger risk of larger overstatement	2015 Statement[112]
1800 MHz	Oct-13	67.1	Larger risk of overstatement	2015 Statement[113]
2100 MHz	Sep-20	14.2	No specific risks	2021 Statement[114]
2.6 GHz	Sep-10	2.9	No specific risks	2015 Statement[115]
3.4-3.8 GHz	Mar-19	5.5	No specific risks	2021 Statement[116]

Relative value benchmarks

A7.5 Based on the auction data set out above, we can derive the benchmarks in Table A7.2 below for Austria. Consistent with our assessment of benchmarks involving these auctions in past ALF decisions, our provisional view is that the Tier 1 criteria are satisfied for each of these relative value benchmarks from Austria.

A7.6 The distance method benchmarks for 1800 MHz with 700 MHz as the low frequency band carry the risk of overstatement due to the 1800 MHz band selling for more than the 700 MHz band. As explained in Annex 6, distance method benchmarks for which the target band sold for more than the low frequency band carry a risk of generating artificially high benchmark values.

A7.7 Table A7.2 below sets out a summary of Tier 1 benchmarks from Austria.

Table A7.2: Summary of Tier 1 benchmarks from Austria

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
900 MHz model					
Band combination	**700 MHz**		**900 MHz**	**Paired ratio**	**UK 900 MHz (£m/MHz)**
Value	25.5		120.7	4.74	81.4
Risk assessment; Tier	Risk of under or over-statement		Larger risk of larger overstatement	Tier 1 Larger risk of overstatement	

[112] 2015 Statement, A8, paragraphs A8.9-A8.223
[113] 2015 Statement, A8, paragraphs A8.9-A8.223
[114] 2021 Statement, A3, paragraphs A3.6-A3.31
[115] 2015 Statement, A8, paragraphs A8.9-A8.223
[116] 2021 Statement, A3, paragraphs A3.6-A3.31

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Band combination	**800 MHz**		**900 MHz**	**Paired ratio**	**UK 900 MHz (£m/MHz)**
Value	105.6		120.7	1.14	51.6
Risk assessment; Tier	Risk of over-statement		Larger risk of larger over-statement	Tier 1 Larger risk of larger overstatement	
1800 MHz model					
Band combination	**700 MHz**	**1800 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	25.5	67.1	2.9	2.84	34.9
Risk assessment; Tier	Risk of under or over-statement	Larger risk of overstatement	No specific risk identified	Tier 1 Larger risk of overstatement	
Band combination	**700 MHz**	**1800 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	25.5	67.1	5.5	3.08	32.9 (based on UK 3.4 GHz) 42.2 (based on UK 3.6 GHz)
Risk assessment; Tier	Risk of under or over-statement	Larger risk of overstatement	Risk of under- or overstatement	Tier 1 Larger risk of overstatement	
Band combination	**800 MHz**	**1800 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	105.6	67.1	2.9	0.62	31.0
Risk assessment; Tier	Risk of overstatement	Larger risk of overstatement	No specific risk identified	Tier 1 Larger risk of overstatement	

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Band combination	**800 MHz**	**1800 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	105.6	67.1	5.5	0.61	31.5 (UK 3.4 GHz) 29.7 (UK 3.6 GHz)
Risk assessment; Tier	Risk of overstatement	Larger risk of overstatement	Risk of under- or overstatement	Tier 1 Risk of under- or overstatement	
2100 MHz model					
Band combination	**700 MHz**	**2100 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	25.5	14.2	2.9	0.5	12.3
Risk assessment; Tier	Risk of under or over-statement	No specific risk identified	No specific risk identified	Tier 1 Risk of under- or overstatement	
Band combination	**700 MHz**	**2100 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	25.5	14.2	5.5	0.43	12.9 (UK 3.4 GHz) 10.4 (UK 3.6 GHz)
Risk assessment; Tier	Risk of under or over-statement	No specific risk identified	Risk of under- or overstatement	Tier 1 Risk of under- or overstatement	
Band combination	**800 MHz**	**2100 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	107.7	14.2	2.9	0.11	11.6

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Risk assessment; Tier	Risk of overstatement	No specific risk identified	No specific risk identified	Tier 1 Risk of understatement	
Band combination	**800 MHz**	**2100 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	107.7	14.2	5.5	0.08	12.6 (UK 3.4 GHz) 8.5 (UK 3.6 GHz)
Risk assessment; Tier	Risk of overstatement	No specific risk identified	Risk of under- or overstatement	Tier 1 Risk of overstatement	

Source: Ofcom analysis

Belgium

Relevant auctions

A7.8 Table A7.3 below sets out the auction data we have used to derive Tier 1 benchmarks from Belgium.

Table A7.3: Summary of Tier 1 auction evidence from Belgium

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction analysed
700 MHz	Jun-22	47.2	Risk of overstatement	New
1800 MHz	Jun-22	30.8	No specific risks	New
2100 MHz	Jun-22	31.1	No specific risks	New
3.4-3.8 GHz	Jun-22	4.8	Smaller risk of understatement	New

Source: Ofcom analysis

New auction evidence

June 2022 multiband auction

A7.9 In June 2022 the 700 MHz, 900 MHz, 1800 MHz, 2100 MHz and 3.4-3.8 GHz spectrum bands were auctioned in Belgium using a Simultaneous Multi-Round Auction (SMRA) auction format.

A7.10 The award information is set out in Table A7.4 and the auction's features are summarised in Table A7.5.

Table A7.4: June 2022 auction results[117]

Frequency band	Bidder	Amount of spectrum (MHz)	Price at time of auction (million EUR)
700 MHz	Citymesh	10	19.3
	Orange	20	122.9
	Proximus	20	122.9
	Telenet	10	21.3
900 MHz	Citymesh	10	28.0
	Orange	20	56.7
	Proximus	20	57.4
	Telenet	20	57.4
1800 MHz	Citymesh	30	27.0
	Orange	30	27.0
	Proximus	50	110.0
	Telenet	40	69.4
2100 MHz	Citymesh	10	9.0
	Orange Belgium	30	60.0
	Proximus	50	144.6
	Telenet	30	60.4
3.4-3.8 GHz	Citymesh	50	31.0
	Network Research Belgium	20	11.0
	Orange Belgium	100	54.9
	Proximus	100	56.3
	Telenet	100	55.8

Source: BIPT

[117] BIPT, *Radio spectrum auction brings in 1.2 billion euro*, June 2022, 2022-06-21_PR_Spectrum-auction.pdf

Table A7.5: June 2022 auction features[118]

	Description	Comment
Licence duration	700 MHz - 20 years 900 MHz - 20 years 1800 MHz - 20 years 2100 MHz - 20 years 3.4-3.8 GHz - 17 years and 8 months	
No of bidders; no. of lots; lot sizes	700 MHz – 4 bidders, 6 lots of 2x5 MHz 900 MHz – 4 bidders, 7 lots of 2x5 MHz 1800 MHz – 4 bidders, 12 lots of 2x5 MHz 2100 MHz – 4 bidders, 12 lots of 2x5 MHz 3.4-3.8 GHz – 5 bidders, 37 lots of 10 MHz	
Spectrum caps/restrictions	700 MHz – 2x10 MHz 900 MHz – 2x15 MHz 1800 MHz – 2x30 MHz 2100 MHz – 2x25 MHz 3.4-3.8 GHz – 100 MHz	
Reserve prices	700 MHz – EUR 19.3m per 10 MHz block 900 MHz – EUR 28.0m per 10 MHz block 1800 MHz – EUR 9m per 10 MHz block 2100 MHz – EUR 9m per 10 MHz block 3.4-3.8GHz – EUR 4.6m per 10 MHz block	
Obligations	Only operators holding rights of use for frequencies in the 900 MHz band or in the 700 MHz band are subject to coverage obligations. Existing operators in the 900 MHz band must provide 99.5% population coverage in the coverage zone. Other operators must reach 99.5% coverage 8 years after the starting date of the period of rights of use. Existing operators in the 700 MHz band must provide 99.8% population coverage in the coverage zone 6 years after the starting date of the period of the rights of use. Other operators must reach this level 8 years after the starting date of the validity period of the rights of use. Operators holding rights of use for frequencies in the 700 MHz band are also subject to coverage obligations on selected railway lines.	

Source: BIPT

[118] BIPT, *Information Memorandum,* January 2022, https://auction2022.be/sites/default/files/2022-01/Memorandum_EN.pdf

Whether award outcomes are likely to reflect market value in Belgium

A7.11 We note that for the 700 MHz, 900 MHz, 1800 MHz and 2100 MHz frequency bands several blocks of spectrum were reserved at reserve price for new entrants and incumbents.

A7.12 For the 700 MHz band the following blocks of spectrum were reserved at reserve price:

a) 1 block of 2x5 MHz (10 MHz in total) reserved for new entrants. Taken up by Citymesh.

1.2 For the 900 MHz band the following blocks of spectrum were reserved at reserve price:

a) 1 block of 2x5 MHz (10 MHz in total) reserved for new entrants. Taken up by Citymesh.
b) Each incumbent operator was entitled to 1 block of 2x5 MHz (10 MHz per operator, 30 MHz in total across the three incumbent operators). The 10 MHz per operator was taken up by all 3 incumbent operators.

A7.13 For the 1800 MHz band the following blocks of spectrum were reserved at reserve price:

a) 3 blocks of 2x5 MHz (30 MHz in total) reserved for new entrants. All 30 MHz was taken up by Citymesh.
b) Each incumbent operator was entitled to 3 blocks of 2x5 MHz (30 MHz per operator, 90 MHz in total across operators). 30 MHz per operator was taken up by all 3 incumbent operators.

A7.14 For the 2100 MHz band the following blocks of spectrum were reserved at reserve price:

a) 1 block of 2x5 MHz (10 MHz in total) reserved for new entrants. All 10 MHz was taken up by Citymesh.
b) Each incumbent operator was entitled to 2 blocks of 2x5 MHz (20 MHz per operator, 60 MHz in total across operators). 20 MHz per operator was taken up by all 3 incumbent operators.

A7.15 To reflect the prices more accurately for the spectrum bands that resulted from a competitive bidding process we have removed the reserved blocks from the auction results and use the prices and amounts of MHz set out in Table A7.6.

A7.16 For the 700 MHz band we have based our estimate of the market value on the prices paid by Orange and Proximus for their unreserved spectrum (as set out in Table A7.6) as we consider they were the lots on which there was competitive bidding in the auction and therefore most closely reflect the market clearing price for the 700 MHz spectrum band. We do not include Telenet's lot which sold at a much lower price.

Table A7.6: June 2022 auction results used in our analysis

Frequency band	Candidate	Amount of spectrum (MHz)	Price at time of auction (million EUR)
700 MHz	**Orange**	20	122.9
	Proximus	20	122.9
900 MHz	**Orange**	10	28.7
	Proximus	10	29.4
	Telenet	10	29.4

Frequency band	Candidate	Amount of spectrum (MHz)	Price at time of auction (million EUR)
1800 MHz	**Proximus**	20	82.9
	Telenet	10	42.4
2100 MHz	**Orange Belgium**	10	42.0
	Proximus	30	127
	Telenet	10	42.4
3.4-3.8 GHz	**Citymesh**	50	31.0
	Network Research Belgium	20	11.0
	Orange Belgium	100	54.9
	Proximus	100	56.3
	Telenet	100	55.8

Source: Ofcom analysis

A7.17 The 700 MHz band sold for well above reserve price. The spectrum cap was binding for Orange and Proximus which could create a risk that the prices paid by them understates the market value in Belgium. However, this is likely mitigated to some extent by the presence of a third bidder (Telenet) for whom the spectrum cap was not binding. In addition, we note that the lot won by Telenet sold for a considerably lower price. We also note that there were coverage obligations on the 700 MHz (and 900 MHz band). These obligations, if sufficiently onerous on operators, could lead to a risk of understatement for the auction prices. However, we do not have sufficiently clear evidence to determine how onerous the coverage obligations were on operators. Considering these factors in the round, we consider that the prices paid by Orange and Proximus are reflective of market value in Belgium but carry a risk of under-or-overstatement.

A7.18 The 1800 MHz band sold well above reserve price. While there was a spectrum cap, this was not binding for any of the operators. We do not identify a specific risk of understatement or overstatement of the market value in Belgium for the 1800 MHz auction.

A7.19 The 2100 MHz band sold well above reserve price. We note that the spectrum cap was binding for one of the bidders which could create the risk that the auction price understates the market value in Belgium. However, this is likely mitigated by the two other bidders for whom the spectrum cap was not binding. We do not identify a specific risk of understatement or overstatement of the market value in Belgium for the 2100 MHz auction.

A7.20 The 3.4-3.8 GHz band sold well above reserve price. We note that the spectrum cap was binding for the three incumbent operators which could create the risk that the auction price understates the market value in Belgium. However, this may be partially mitigated by the presence of two other bidders for whom the spectrum cap was not binding. We

consider that the 3.4-3.8 GHz auction prices carry a smaller risk of understatement of the market value in Belgium.

A7.21 The 900 MHz band sold only slightly above reserve price. In addition to the lots for incumbent operators that were available at reserve price, 30 MHz of spectrum was available in the auction with the three incumbent operators bidding for them. This allowed for a natural division of the band with each operator acquiring one additional 10 MHz block. Two operators paid 5% above reserve price and one operator paid 2.5% above reserve, suggesting only a few rounds of bidding.

A7.22 Our provisional view is that, based on the evidence available to us, it appears more likely that this auction outcome reflects strategic bidding rather than the bidders' intrinsic valuations of the 900 MHz spectrum. We consider this view is also supported by comparison to the 700 MHz spectrum in the same auction where, with 50 MHz available for the three incumbent operators, there was not the same natural division of the spectrum available, and as a result there was intense competition for the band with the two bidders who acquired 20 MHz each both paying over 300% of the reserve price, and around double what was paid for the 900 MHz spectrum on a per MHz basis.

A7.23 As a result, we consider that the 900 MHz/700 MHz relative value benchmark for Belgium should be considered as Tier 2 evidence. We summarise this benchmark alongside the other Tier 2 and 3 benchmarks in Table A7.48.

Relative value benchmarks

A5.1 Based on the auction data set out above, we can derive the following benchmarks for Belgium. Our provisional view is that the Tier 1 criteria are satisfied for the each of these relative value benchmarks from Belgium.

A5.2 We provisionally consider the relative value benchmark using 700 MHz, 1800 MHz and 3.4-3.8 GHz, and the relative value benchmark using 700 MHz, 1800 MHz and 3.4-3.8 GHz to carry a risk of under-or-overstatement, the size and direction of which we do not know. This is due to the 700 MHz band carrying a risk of under-or-overstatement, while the 3.4-3.8 GHz band carries a smaller risk of understatement. We do not know how these two risks interact.

Table A7.7: Summary of Tier 1 benchmarks from Belgium

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
1800 MHz model					
Band combination	**700 MHz**	**1800 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Value	47.2	30.8	4.8	0.61	14.2 (based on UK 3.4 GHz) 12.5 (based on UK 3.6 GHz)
Risk assessment; Tier	Risk of under- or- overstatement	No specific risk identified	Smaller risk of understatement	Tier 1 Risk of under- or overstatement	
2100 MHz model					
Band combination	**700 MHz**	**2100 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	47.2	31.1	4.8	0.62	14.3 (UK 3.4 GHz) 12.6 (UK 3.6 GHz)
Risk assessment; Tier	Risk of under- or- overstatement	No specific risk identified	Smaller risk of understatement	Tier 1 Risk of under- or overstatement	

Source: Ofcom analysis

Croatia

Relevant auctions

A7.24 Table A7.8 below sets out the auction data we have used to derive Tier 1 benchmarks from Croatia.

Table A7.8: Summary of Tier 1 auction evidence from Croatia

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction analysed
800 MHz	Mar-23	37.0	No specific risks	New
900 MHz	Mar-23	35.9	No specific risks	New

Source: Ofcom analysis

New auction evidence

March 2023 multiband auction

A7.25 In March 2023 the 800 MHz and the 900 MHz spectrum bands were auctioned in Croatia using an SMRA auction format.

A7.26 The award information is set out in Table A7.9 and the auction's features are summarised in Table A7.10.

Table A7.9: March 2023 auction results[119]

Frequency band	Candidate	Amount of spectrum (MHz)	Price at time of auction (million EUR)
800 MHz	A1 Hrvatska	20	19.6
	Hrvatski Telekom	20	19.6
	Telemach Hrvatska	20	20.0
900 MHz	A1 Hrvatska	30	28.8
	Hrvatski Telekom	30	28.8
	Telemach Hrvatska	10	9.5

Source: Hakom

Table A7.10: March 2023 auction features[120]

	Description	Comment
Licence duration	15 years	
No of bidders; no. of lots; lot sizes	800 MHz – 3 bidders; 12 lots of 5 MHz 900 MHz – 3 bidders; 14 lots of 5 MHz	
Spectrum caps/restrictions	800 MHz and 900 MHz combined limit: 2x25 MHz	
Reserve prices	EUR 7 million per 10 MHz	
Obligations	Both 800 MHz and 900 MHz come with the obligation of 99.4% population coverage by the end of 2029	

Source: Hakom

Whether award outcomes are likely to reflect market value in Croatia

A7.27 The 800 MHz and 900 MHz spectrum bands both sold above reserve price. We note that the spectrum cap was binding for two of the bidders which could create the risk that the auction prices understate the market value in Croatia. This may be mitigated in part by the presence of a bidder (Telemach Hrvatska) for whom the cap was not binding.

A7.28 We note that there were coverage obligations on the 900 MHz and 800 MHz band. These obligations, if sufficiently onerous on operators, could lead to a risk of understatement for

[119]Hakom, *Auction results,* March 2023, https://www.hakom.hr/hr/hakom-dodijelio-spektar-za-mreze-pokretnih-komunikacija/10500

[120]Hakom, *Tender documentation,* December 2022, https://www.hakom.hr/UserDocsImages/2023/dokumenti/Drazbovna%20dokumentacija_20221012.pdf?vel=2375010

the auction prices. However, we do not have sufficiently clear evidence to determine how onerous the coverage obligation is on operators.

A7.29 With that said, the spectrum cap and coverage obligations apply to both bands. This implies that, even if these factors led to understatement of the value of the individual bands, it is less likely to have influenced the relative value of the bands. Using the paired-ratio method, the 800-900 MHz benchmark depends on the relative values between 800 MHz and 900 MHz in Croatia. Therefore, we conclude that we are not able to identify a specific risk associated with the 800 MHz and 900 MHz auction prices.

Relative value benchmarks

A7.30 Based on the auction data set out above, we can derive a relative value benchmark for Croatia using 800 MHz and 900 MHz. Our provisional view is that the Tier 1 criteria are satisfied for this relative value benchmark.

A7.31 Based on the above assessment of 800 MHz and 900 MHz, we provisionally consider that we cannot identify a specific risk of over- or understatement for the relative value benchmark using 800 MHz and 900 MHz.

A7.32 Table A7.11 below sets out a summary of this Tier 1 benchmark from Croatia.

Table A7.11: Summary of Tier 1 benchmarks from Croatia

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
900 MHz model					
Band combination	**800 MHz**		**900 MHz**	**Paired ratio**	**UK 900 MHz (£m/MHz)**
Value	37.0		35.9	0.97	43.9
Risk assessment; Tier	No specific risk identified		No specific risk identified	Tier 1 No specific risk identified	

Source: Ofcom analysis

Czech Republic

Relevant auctions

A7.33 Table A7.12 below sets out the auction data we have used to derive Tier 1 benchmarks from the Czech Republic.

Table A7.12: Summary of Tier 1 auction evidence from Czech Republic

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction analysed
800 MHz	Nov-13	65.2	No specific risk identified	2015 Statement[121]
1800 MHz	Jun-16	38.1	Risk of understatement	2018 Statement[122]
2.6 GHz	Jun-16	9.2	No specific risk identified	2018 Statement[123]
3.4-3.6 GHz	Nov-20	6.8	Risk of understatement	New
3.6-3.8 GHz	Jul-17	4.9	Risk of understatement	New

Source: Ofcom analysis

New auction evidence

July 2017 3.6–3.8 GHz auction

A7.34 In July 2017 national licences in the 3.6-3.8 GHz spectrum band were auctioned in the Czech Republic using an SMRA auction format.

A7.35 The award information is set out in Table A7.13 and the auction's features are summarised in Table A7.14.

Table A7.13: July 2017 auction results[124]

	3.6-3.8 GHz (MHz)	Price at time of auction (CZK m)
O2	40	203
Vodafone	40	203
Nordic Telecom 5G	80	406
PODA	40	203

Source: CTU

Table A7.14: July 2017 3.6-3.8 GHz auction features[125]

	Description	Comment
Licence duration	15 years.	

[121] 2015 Statement, A8, paragraphs A8.224-A8.255
[122] 2018 Statement, A2, paragraphs A2.47-A2.74
[123] 2018 Statement, A2, paragraphs A2.47-A2.74
[124] CTU, *Auction results*, https://ctu.gov.cz/en/press-release-frequencies-37-ghz-band-will-be-granted-2-current-and-2-new-operators
[125] CTU, *Auction results,* https://ctu.gov.cz/en/press-release-frequencies-37-ghz-band-will-be-granted-2-current-and-2-new-operators

	Description	Comment
No of bidders; no. of lots; lot sizes	6 bidders. Suntel Net and T-Mobile Czech Republic did not place a winning bid for any auctioned block. 5 lots of 1 x 40 MHz.	
Spectrum caps/restrictions	40 MHz cap for current operators. 80 MHz cap for new entrants.	Nordic Telecom 5G was the only new entrant. It obtained 80 MHz.
Reserve prices	CZK 29m (per 40 MHz)	Each auctioned block was sold at seven times the reserve price.
Obligations	None.	

Source: CTU

November 2020 3.4–3.6 GHz auction

A7.36 In November 2020 national licences in the 3.4-3.6 GHz spectrum band were auctioned in the Czech Republic using an SMRA auction format.

A7.37 The award information is set out in Table A7.15 and the auction's features are summarised in Table A7.16.

Table A7.15: November 2020 auction results[126]

	3.4-3.6 GHz (MHz)	Price paid (CZK m)	Comment
O2	20	152	B1 block (lower reserve price).
Vodafone	20	168	
Nordic Telecom 5G	20	168	
CentroNet	80	628	Including one B1 block (lower reserve price).
T-Mobile	60	490	

Source: CTU

Table A7.16: November 2020 3.4-3.6 GHz auction features[127]

	Description	Comment
Licence duration	12 years.	
No of bidders; no. of lots; lot sizes	7 bidders. Seven Innovation and PODA did not place a winning bid for any auctioned block. 12 lots of 1 x 20 MHz.	
Spectrum caps/restrictions	None.	
Reserve prices	CZK 110m for B1 blocks. CZK 140m for B2 category blocks.	Reserve price for B1 blocks lowered by 25% due to obligation to lease radio frequencies for the purpose of industry.

[126] CTU, *Auction results,* https://www.ctu.cz/aukce-700/vyhlaseni
[127] CTU, *Results,* https://www.ctu.cz/aukce-700/oznameni-vysledku-aukcni-faze

	Description	Comment
Obligations	For all 3.4-3.6 GHz blocks: Within 3/5 years, at least 15/230 5G base stations using the 3.4-3.8 GHz band. c) Within 5 years, 30 districts must have at least one 3.4-3.8 GHz 5G base station. For B1 blocks, there is an obligation to lease radio frequencies for non-public local electronic communications networks within Industry.	

Source: CTU

Whether award outcomes are likely to reflect market value in the Czech Republic

A7.38 The 3.6-3.8 GHz spectrum sold in July 2017 sold well above reserve price. We note that the spectrum cap was binding for three of the six bidders which could create the risk that the auction price understates the market value in the Czech Republic. This may be mitigated in part by the presence of bidders, including PODA who obtained spectrum, for whom the cap was not binding. On balance, we think there is a risk that the auction prices understate the market value in the Czech Republic.

A7.39 The 3.4-3.6 GHz spectrum sold in November 2020 sold well above reserve price. However, some of the sold lots came with the obligation to lease radio frequencies and had a lower reserve price. Therefore, we think there is a risk of understatement associated with the 3.4-3.6 GHz benchmark.

Relative value benchmarks

A7.40 Based on the auction data set out above, we can derive the following benchmarks for the Czech Republic. Consistent with our assessment of benchmarks involving these auctions in past ALF decisions and our assessment of the new auctions set out above, our provisional view is that the Tier 1 criteria are satisfied for the each of these relative value benchmarks from the Czech Republic.

A7.41 Based on the above, we provisionally consider that the relative value benchmark using 800 MHz, 1800 MHz and 3.6-3.8 GHz frequency bands carries a risk of understatement - the likelihood and scale of which we are unable to determine. This is due to both the 1800 MHz and 3.6-3.8 GHz prices carrying a risk of understatement. For the 1800 MHz frequency band, the risk of understatement is due to two of the sold lots being 2x2.9 MHz which may be of lower value due to their size. For the 3.6-3.8 GHz band this is due to binding spectrum caps.

A7.42 Similarly, we provisionally consider that the relative value benchmark using 800 MHz, 1800 MHz and 3.4-3.6 GHz frequency bands carries a risk of understatement - the likelihood and scale of which we are unable to determine - as the 1800 MHz and 3.4-3.6 GHz bands both carry a risk of understatement.

Table A7.17: Summary of Tier 1 benchmarks from the Czech Republic

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Band combination	**800 MHz**	**1800 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	65.2	38.1	9.2	0.52	27.3
Risk assessment; Tier	No specific risk identified	Risk of understatement	No specific risk identified	Risk of under- over overstatement Tier 1	
Band combination	**800 MHz**	**1800 MHz**	**3.6-3.8 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	65.2	38.1	4.9	0.56	27.5 (UK 3.6 GHz) 29.5 (UK 3.4 GHz)
Risk assessment; Tier	No specific risk identified	Risk of understatement	Risk of understatement	Risk of understatement Tier 1	
Band combination	**800 MHz**	**1800 MHz**	**3.4-3.6 GHz**	**"Y/X" ratio**	**UK 1800 MHz**
Value (£m/MHz)	65.2	38.1	6.7	0.54	26.9 (UK 3.6 GHz) 29.0 (UK 3.4 GHz)
Risk assessment; Tier	No specific risk identified	Risk of understatement	Risk of understatement	Risk of understatement Tier 1	

Source: Ofcom analysis

Denmark

Relevant Auctions

A7.43 Table A7.18 below sets out the auction data we have used to derive Tier 1 benchmarks from Denmark. We have analysed all of these auctions in previous ALF statements.

Table A7.18: Summary of Tier 1 auction evidence from Denmark

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction analysed
800 MHz	Jun-12	25.9	Risk of understatement	2015 Statement[128]
1800 MHz	Sept-16	24.5	Larger risk of larger understatement	2018 Statement[129]
2.6 GHz	May-10	15.4	No risk identified	2015 Statement[130]

Source: Ofcom analysis

Relative value benchmarks

A7.44 Based on the auction data set out above, we can derive a relative value benchmark for Denmark for the 1800 MHz band. Consistent with our assessment of this benchmark in our 2018 Statement, our provisional view is that the Tier 1 criteria are satisfied for this relative benchmark.

Table A7.19: Summary of Tier 1 benchmarks from Denmark

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Band combination	**800 MHz**	**1800 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	25.9	24.5	15.4	0.87	40.2
Risk assessment; Tier	Risk of understatement	Risk of over-statement	No risk identified	Risk of overstatement Tier 1	

Source: Ofcom analysis

Germany

Relevant auctions

A7.45 Table A7.20 below sets out the auction data we have used to derive Tier 1 benchmarks from Germany. We have analysed all of these auctions in previous ALF statements.

[128] 2015 Statement, A8, paragraphs A8.256-298
[129] 2018 Statement, A2, paragraphs A2.76-A2.185
[130] 2015 Statement, A8, paragraphs A8.256-298

Table A7.20: Summary of Tier 1 auction evidence from Germany

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction analysed
700 MHz	Jun-15	20.4	Risk of understatement	2015 Statement[131]
800 MHz	May-10	78.5	Larger risk of larger over-statement	2015 Statement[132]
900 MHz	Jun-15	22.7	Larger risk of understatement	2015 Statement[133]
1800 MHz	Jun-15	28.4	Larger risk of understatement	2015 Statement[134]
2100 MHz	Jun-19	20.8	No specific risks	2021 Statement[135]
2.6 GHz	May-10	2.4	Risk of understatement	2015 Statement[136]
3.4-3.8 GHz	Jun-19	13.8	No specific risks	2021 Statement[137]

Source: Ofcom analysis

Relative value benchmarks

A7.46 Based on the auction data set out above, we can derive the following benchmarks for Germany. Consistent with our assessment of benchmarks involving these auctions in past ALF decisions, our provisional view is that the Tier 1 criteria are satisfied for each of these relative value benchmarks from Germany.

A5.3 We cannot accurately assess the size and direction of the risk associated with the 700-900 MHz benchmark. The 900 MHz band carries a larger risk of understatement. The 700 MHz band also carries a risk of understatement, but we are not able to quantify the size of this risk. Therefore, we cannot say if the risks of understatement cancel each other out.

A5.4 The 1800 MHz and 2100 MHz benchmarks using 700 MHz as the lower frequency band carry a larger risk of overstatement. This is due to both the 1800 MHz and 2100 MHz bands selling for more than the 700 MHz band, which leads the distance method to extrapolate a value for 1800 MHz and 2100 MHz above the UK value for 700 MHz.

A5.5 The 800-1800-3.4-3.8GHz benchmark carries a risk of understatement. This is due to the 800 MHz prices carrying a larger risk of larger overstatement while the 1800 MHz prices carry a larger risk of understatement.

A5.6 Table A7.21 below sets out a summary of Tier 1 benchmarks from Germany.

[131] 2015 Statement, A8, paragraphs A8.365-A8.492
[132] 2015 Statement, A8, paragraphs A8.297-A8.364
[133] 2015 Statement, A8, paragraphs A8.365-A8.492
[134] 2015 Statement, A8, paragraphs A8.365-A8.492
[135] 2021 Statement, A3, paragraphs A3.32-A3.59
[136] 2015 Statement, A8, paragraphs A8.297-A8.364
[137] 2021 Statement, A3, paragraphs A3.32-A3.59

Table A7.21: Summary of Tier 1 benchmarks from Germany

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
900 MHz model					
Band combination	**700 MHz**		**900 MHz**	**Paired ratio**	**UK 900 MHz (£m/MHz)**
Value	20.4		22.7	1.11	19.1
Risk assessment; Tier	Risk of understatement		Larger risk of under-statement	Tier 1 Risk of under-or-overstatement	
Band combination	**800 MHz**		**900 MHz**	**Paired ratio**	**UK 900 MHz (£m/MHz)**
Value	78.5		22.7	0.29	13.1
Risk assessment; Tier	Larger risk of larger over-statement		Larger risk of under-statement	Tier 1 Larger risk of larger under-statement	
1800 MHz model					
Band combination	**700 MHz**	**1800 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	20.4	28.4	2.4	1.44	21.4
Risk assessment; Tier	Risk of understatement	Larger risk of under-statement	Risk of under-statement	Tier 1 Larger risk of overstatement	
Band combination	**700 MHz**	**1800 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	20.4	28.4	13.8	2.20	26.3 (based on UK 3.4 GHz) 31.7 (based on UK 3.6 GHz)

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Risk assessment; Tier	Risk of understatement	Larger risk of under-statement	No specific risk identified	Tier 1 Larger risk of overstatement	
Band combination	**800 MHz**	**1800 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	78.5	28.4	2.4	0.34	20.4
Risk assessment; Tier	Larger risk of larger over-statement	Larger risk of under-statement	Risk of understatement	Tier 1 Risk of understatement	
Band combination	**800 MHz**	**1800 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	78.5	28.4	13.8	0.23	17.6 (UK 3.4 GHz) 14.2 (UK 3.6 GHz)
Risk assessment; Tier	Larger risk of larger over-statement	Larger risk of under-statement	No specific risk identified	Tier 1 Risk of understatement	
2100 MHz model					
Band combination	**700 MHz**	**2100 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	20.4	20.8	2.4	1.02	17.4
Risk assessment; Tier	Risk of under-statement	No specific risk identified	Risk of understatement	Tier 1 Larger risk of overstatement	
Band combination	**700 MHz**	**2100 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	20.4	20.8	13.8	1.06	17.6 (UK 3.4 GHz) 17.9 (UK 3.6 GHz)

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Risk assessment; Tier	Risk of under-statement	No specific risk identified	No specific risk identified	Tier 1 Risk of overstatement	
Band combination	**800 MHz**	**2100 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	78.5	20.8	2.4	0.24	16.6
Risk assessment; Tier	Larger risk of larger over-statement	No specific risk identified	Risk of understatement	Tier 1 Larger risk of understatement	
Band combination	**800 MHz**	**2100 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	78.5	20.8	13.8	0.11	13.5 (UK 3.4 GHz) 9.5 (UK 3.6 GHz)
Risk assessment; Tier	Larger risk of larger over-statement	No specific risk identified	No specific risk identified	Tier 1 Larger risk of larger understatement	

Source: Ofcom analysis

Hungary

Relevant auctions

A7.47 Table A7.22 below sets out the auction data we have used to derive Tier 1 benchmarks from Hungary.

A7.48 The Hungarian spectrum licenses had the option for a 5-year extension. In line with the methodology we used in the 2021 Statement, we adjust the auction values to assume this 5-year extension option is taken up.[138]

[138] 2021 Statement, A3, footnote 71

Table A7.22: Summary of Tier 1 auction evidence from Hungary

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction analysed
700 MHz	Mar-20	93.9	Risk of under- or overstatement	2021 Statement[139]
900 MHz	Jan-21	92.3	No specific risks	New
1800 MHz	Jan-21	47.0	No specific risks	New
2100 MHz	Mar-20	38.3	Risk of under- or overstatement	2021 Statement[140]
3.4-3.8 GHz	Mar-20	11.7	Risk of under- or overstatement	2021 Statement[141]

Source: Ofcom analysis

New auction evidence

January 2021 multiband auction

A7.49 In January 2021, the 900 MHz and 1800 MHz frequency bands were sold in Hungary in a clock auction format.

A7.50 The award information is set out in Table A7.23 and the auction's features are summarised in Table A7.24.

Table A7.23: January 2021 auction results[142]

Frequency band	Candidate	Amount of spectrum (MHz)	Price at time of auction (trillion HUF)
1800 MHz	**Telekom**	40	25.0
	Telenor	40	25.0
	Vodafone	40	26.4
900 MHz	**Telekom**	16	19.5
	Telenor	26	31.6
	Vodafone	18	22.7

Source: NMHH

[139] 2021 Statement, A3, paragraphs A3.60-A3.75
[140] 2021 Statement, A3, paragraphs A3.60-A3.75
[141] 2021 Statement, A3, paragraphs A3.60-A3.75
[142] NMHHH, *Auction results*, March 2021, https://nmhh.hu/dokumentum/218739/UF_25112_95_2020_900_1800MHz_erdemi_hatarozat.pdf

Table A7.24: January 2021 auction features[143]

	Description	Comment
Licence duration	1800 MHz - 15 years, with the possibility of a 5-year extension. 900 MHz – 15 years, with the possibility of a 5-year extension.	
No of bidders; no. of lots; lot sizes	1800 MHz – 3 bidders, 16 blocks of 10 MHz 900 MHz – 3 bidders, 4 blocks of 10 MHz, 2 blocks of 2x3 MHz, 1 block of 2x4 MHz	
Spectrum caps/restrictions	1800 MHz - Max of 2x30 MHz per operator. 900 MHz - The spectrum cap was set at 2x10 MHz in the first round of the auction, and at a total of 2x15 MHz during the entire auction process.	
Reserve prices	1800 MHz - HUF 6 trillion per 10 MHz 900 MHz – HUF 12 trillion HUF per 10 MHz	
Obligations	An operator which has acquired spectrum in both the 900 MHz and 1800 MHz bands is obliged to meet the following conditions: 97% of the country's population and at least 85% of its territory by 15/10/2022. d) 99% of the country's population and at least 90% of its territory by 15/10/2025.	

Source: NMHH

Whether award outcomes are likely to reflect market value in Hungary

A7.51 Both the 900 MHz and 1800 MHz bands sold above reserve price. While there were spectrum caps in place, these were not binding for any of the bidders.

A7.52 As all operators that participated in the auction acquired spectrum in both the 900 MHz and 1800 MHz bands, they were subject to coverage obligations. These obligations, if sufficiently onerous on operators, could lead to a risk of understatement for the auction prices. However, we do not have sufficiently clear evidence to determine how onerous the coverage obligation were on operators. Therefore, we cannot identify a specific risk associated with the 900 MHz and 1800 MHz bands.

Relative value benchmarks

A7.53 Based on the auction data set out above, we can derive the following benchmarks for Hungary. Consistent with our assessment of benchmarks involving these auctions in past ALF decisions and our assessment of the new auctions set out above, our provisional view is that the Tier 1 criteria are satisfied for the each of these relative value benchmarks from Hungary.

[143] NMHH, *Tender documentation,* October 2020, https://nmhh.hu/dokumentum/215391/900_1800_MHz_dokumentacio_hu_20201016.pdf

A7.54 We provisionally consider that the benchmark based on 700 MHz and 900 MHz carries a risk of under- or overstatement.

A7.55 We provisionally consider that the benchmark based on 700 MHz, 1800 MHz and 3.4-3.8 GHz carries a risk of under- or overstatement.

A7.56 We provisionally consider that the benchmark based on 700 MHz, 2100 MHz and 3.4-3.8 GHz carries a risk of under- or overstatement.

Table A7.25: Summary of Tier 1 benchmarks from Hungary

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
900 MHz model					
Band combination	**700 MHz**		**900 MHz**	**Paired ratio**	**UK 900 MHz (£m/MHz)**
Value	93.9		92.3	0.98	16.9
Risk assessment; Tier	Risk of under- or overstatement		No specific risk identified	Risk of under-or overstatement	
1800 MHz model					
Band combination	**700 MHz**	**1800 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	93.9	47.0	11.7	0.44	12.9 (based on UK 3.4 GHz) 10.3 (based on UK 3.6 GHz)
Risk assessment; Tier	Risk of under- or overstatement	No specific risk identified	Risk of under- or overstatement	Risk of under-or overstatement	
2100 MHz model					
Band combination	**700 MHz**	**2100 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	93.9	38.3	11.7	0.32	12.1 (UK 3.4 GHz) 9.0 (UK 3.6 GHz)

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark
Risk assessment; Tier	Risk of under- or overstatement	No specific risk identified	Risk of under- or overstatement	Tier 1 Risk of under- or overstatement

Source: Ofcom analysis

Ireland

Relevant auctions

1.3 Table A7.26 below sets out the auction data we have used to derive Tier 1 benchmarks from Ireland.

Table A7.26: Summary of Tier 1 auction evidence from Ireland

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction analysed
800 MHz	Nov-12	84.2	Risk of under or over-statement	2015 Statement[144]
900 MHz	Nov-12	49.2	Risk of under-or-overstatement	2015 Statement[145]
1800 MHz	Nov-12	32.6	Larger risk of over-statement	2015 Statement[146]

Source: Ofcom analysis

Proxies for the value of high frequency bands

A7.57 In the 2018 statement,[147] we estimated a proxy value for 2.6 GHz as we had Tier 1 quality 800 MHz and 1800 MHz evidence but did not have a Tier 1 quality 2.6 GHz auction result. In December 2022, the 2.6 GHz band was sold in a combinatorial auction together with the 700 MHz, 2100 MHz and 2.3 GHz frequency bands. The 3.4-3.8 GHz band was auctioned in 2017 on a regional basis.[148] These auction results do not enable us to easily derive a national band-specific value for any of these frequency bands.

A7.58 As a result, to derive distance method benchmarks for Ireland we continue to estimate proxy values for the high frequency bands, as discussed in Annex 6, paragraphs A6.16-A6.18.

A7.59 As we now include evidence from additional higher frequency bands, we replace the single proxy for the 800MHz-2.6GHz benchmark with updated proxies for 800MHz-2.6GHz and

[144] 2015 Statement, A8, paragraphs A8.537-A8.612
[145] 2015 Statement, A8, paragraphs A8.537-A8.612
[146] 2015 Statement, A8, paragraphs A8.537-A8.612
[147] Ofcom, Annual Licence Fees for 900 MHz and 1800 MHz frequency bands, December 2018, and annexes
[148] https://www.comreg.ie/media/dlm_uploads/2017/05/ComReg-1738.pdf

800MHz-3.4-3.8GHz using the same methodology for constructing proxies as used in the 2021 statement. [149]

A7.60 As set out in Table A7.27 below, auction evidence from other countries is available to calculate ratios for the following combinations of high frequency bands and 'second bands'.

Table A7.27: Combinations of spectrum bands to derive a high frequency band proxy ratio for Ireland

Band combination	Number of ratios	Countries	Ratio Upper to Lower Band	Comments
2.6 GHz / 800 MHz	7	Austria, Germany, Czech Republic, Denmark, Italy, Sweden, UK	Min: 0.03 Avg: 0.18 Max: 0.60	A relatively wide range of values generated by a sample of seven benchmarks. The highest value is twenty larger than the lowest value.
3.4-3.8 GHz / 800 MHz	7	Austria, Germany, Czech Republic (2x), Italy, UK (2x)	Min: 0.05 Avg: 0.16 Max: 0.39	A relatively wide range of values generated by a sample of seven benchmarks. The highest value is more than seven times larger than the lowest value.
2.6 GHz / 1800 MHz	7	Austria, Germany, Czech Republic, Denmark, Italy, Sweden, UK	Min: 0.04 Avg: 0.29 Max: 0.63	A relatively wide range of values generated by a sample of seven benchmarks. The highest value is more than fifteen times larger than the lowest value.

[149] We do not have sufficient evidence to derive a 2.3 GHz proxy.

Band combination	Number of ratios	Countries	Ratio Upper to Lower Band	Comments
3.4-3.8 GHz / 1800 MHz	9	Austria, Belgium, Hungary, Germany, Czech Republic (2x), Italy, UK (2x)	Min: 0.08 Avg: 0.37 Max: 1.20	A relatively wide range of values generated by a sample of nine benchmarks. The highest value is fifteen times larger than the lowest value.

A7.61 Based on available evidence, we do not consider any of these band combinations to be clearly more informative of the relative market values in the Ireland than the other band combinations. Consequently, we derive a range of relative value benchmarks based on the available proxies for Ireland, which we then interpret in the context of all other international benchmarks.

A7.62 The range of proxy values for the available band combinations is summarised in Table A7.28.

Table A7.28: Proxies for the value of high frequency bands in Ireland

High frequency band	Band combination used to derive proxy	Relative value ratio based on international benchmarks	UK-equivalent absolute value of proxy (£m per MHz)
2.6 GHz	800 MHz-2.6 GHz	0.18	15.3
	1800 MHz-2.6 GHz	0.29	9.4
3.4-3.8 GHz	800 MHz – 3.4/3.8 GHz	0.16	13.5
	1800 MHz – 3.4/3.8 GHz	0.37	12.0

Source: Ofcom analysis

Relative value benchmarks

A7.63 Based on the auction data set out above, we can derive the following benchmarks for Ireland. Consistent with our assessment of benchmarks involving these auctions in past ALF decisions, our provisional view is that the Tier 1 criteria are satisfied for each of these relative value benchmarks from Ireland.

A7.64 Consistent with our assessment in previous ALF decisions, we consider that the relative value benchmark using 800 MHz, 1800 MHz and a high frequency proxy carries a risk of

overstatement since 1800 MHz carries a larger risk of overstatement due to potential presence of price driving.[150]

A7.65 Table A7.29 below sets out a summary of Tier 1 benchmarks from Ireland.

Table A7.29: Summary of Tier 1 benchmarks from Ireland

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
900 MHz model					
Band combination	**800 MHz**		**900 MHz**	**Paired ratio**	**UK 1800 MHz (£m/MHz)**
Value	84.2		49.2	0.58	26.4
Risk assessment; Tier	Risk of under or over-statement		Risk of under or over-statement	Tier 1 Risk of under- or overstatement	
1800 MHz model					
Band combination	**800 MHz**	**1800 MHz**	**2.6 GHz proxy**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	84.2	32.6	9.4-15.3	0.25-0.31	16.9-19.2
Risk assessment; Tier	Risk of under or over-statement	Larger risk of over-statement	Risk of under- or overstatement	Tier 1 Risk of overstatement	
Band combination	**800 MHz**	**1800 MHz**	**3.4-3.8 GHz proxy**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	84.2	32.6	12.0-13.5	0.27-0.29	19.2-19.8(based on UK 3.4 GHz) 15.9-16.6 (based on UK 3.6 GHz)

[150] 2015 Statement, A8, paragraphs A8.537-A8.612

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark
Risk assessment; Tier	Risk of under or over-statement	Larger risk of over-statement	Risk of under- or overstatement	Tier 1 Risk of overstatement

Source: Ofcom analysis

Italy

Relevant auctions

A7.66 Table A7.30 below sets out the auction data we have used to derive Tier 1 benchmarks from Italy.

Table A7.30: Summary of Tier 1 auction evidence from Italy

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction analysed
800 MHz	Sep-11	83	Larger risk of larger overstatement	2015 Statement[151]
1800 MHz	Sep-11	26.7	Larger risk of overstatement	2015 Statement[152]
2.6 GHz	Sep-11	6.1	Risk of understatement	2015 Statement[153]
3.4-3.8 GHz	Oct-18	32.2	Larger risk of overstatement	New

Source: Ofcom analysis

New auction evidence

October 2018 multiband auction

A7.67 In October 2018 national licences in the 3.4-3.8 GHz spectrum band and the 700 MHz spectrum band were auctioned in Italy using an SMRA auction format.

A7.68 The award information for 3.4-3.8 GHz is set out in Table A7.31 and the auction's features are summarised in Table A7.32. Information about the 700 MHz auction values can be found in the section on Tier 2 and Tier 3 benchmarks.

[151] 2015 Statement, A8, paragraphs A8.613-A8.647
[152] 2015 Statement, A8, paragraphs A8.613-A8.647
[153] 2015 Statement, A8, paragraphs A8.613-A8.647

Table A7.31: October 2018 3.4-3.8 GHz auction results[154]

	3.4-3.8 GHz (MHz)	Price at time of auction (EUR m)
Telecom Italia	80	1,694
Vodafone	80	1,685
Wind	20	484
Iliad	20	484

Source: MIMIT

Table A7.32: October 2018 3.4-3.8 GHz auction features[155]

	Description	Comment
Licence duration	19 years.	
No of bidders; no. of lots; lot sizes	4 bidders. 2 lots of 80 MHz and 2 lots of 20 MHz.	
Spectrum caps/restrictions	Cap of 100 MHz per operator including spectrum already held in the 3.4-3.6 GHz (even if held on a regional basis).	
Reserve prices	EUR 39.7m per 20 MHz block.	
Obligations	Coverage obligations for the 80MHz blocks only. Obligation includes coverage of a list of towns/municipalities by end-2024 (including at least 10% of towns with population of less than five thousand people and identified as "white areas").	

Source: MIMIT

Whether award outcomes are likely to reflect market value in Italy

A7.69 The 3.4-3.8 GHz spectrum sold well above reserve price. The high prices in the 3.4-3.8 GHz auction may be explained by an uneven distribution of spectrum: the regulator made two blocks of 80 MHz and two blocks of 20 MHz available in the 3.4 GHz-3.8 GHz band. This may have driven up the prices as operators competed to secure the larger blocks of spectrum.[156] Therefore, there is a risk that the award overstates the value of 3.4-3.8 GHz.

Relative value benchmarks

A7.70 Based on the auction data set out above, we can derive the following benchmarks for Italy. Consistent with our assessment of benchmarks involving these auctions in past ALF decisions, and our assessment of the new auctions set out above, our provisional view is that the Tier 1 criteria are satisfied for the each of these relative value benchmarks from Italy.

[154] MIMIT, *Auction results,* October 2018
[155] MIMIT, *Tender documentation,* May 2018,
[156] PolicyTracker, *Italy's 5G auction is over, but will the €6.5bn spectrum investment ever pay off?*, October 2018

A7.71 Due to the high prices in the 3.4-3.8 GHz band auction, 3.4-3.8 GHz was sold for more than the 1800 MHz band. As explained in Annex 6, distance method benchmarks for which the low frequency band sold for more than the target band, carry a larger risk of understatement.

Table A7.33: Summary of Tier 1 benchmarks from Italy

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Band combination	**800 MHz**	**1800 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	83.0	26.7	6.1	0.27	17.6
Risk assessment; Tier	Larger risk of larger over-statement	Larger risk of overstatement	Risk of understatement	Tier 1 Risk of over- or understatement	
Band combination	**800 MHz**	**1800 MHz**	**3.4-3.6 GHz**	**"Y/X" ratio**	**UK 1800 MHz**
Value	83.0	26.7	32.2	-0.11	0.88 (UK 3.6 GHz) 5.8 (UK 3.4 GHz)
Risk assessment; Tier	Larger risk of larger over-statement	Larger risk of overstatement	Larger risk of overstatement	Tier 1 Larger risk of understatement	

Source: Ofcom analysis

Netherlands

Relevant auctions

A7.72 Table A7.34 below sets out the auction data we have used to derive Tier 1 benchmarks from Netherlands.

Table A7.34: Summary of Tier 1 auction evidence from the Netherlands

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction analysed
700 MHz	Jul-20	33.3	No specific risks	2021 Statement[157]
2100 MHz	Jul-20	17.3	No specific risks	2021 Statement[158]
3.4-3.8 GHz	Jun-24	1.9	No specific risks	New

New auction evidence

June 2024 3.5 GHz auction

A7.73 In June 2024, the 3.5 GHz band was sold in the Netherlands in a clock auction format.

A7.74 The award information is set out in Table A7.35 and the auction's features are summarised in Table A7.36.

Table A7.35: June 2024 auction results[159]

	3.5 GHz (MHz)	Price at time of auction (EUR m)	Comment
Odido	100	58.5	€39.2m for 60 MHz and €19.2m for 40 MHz
KPN	100	58.5	€39.2m for 60 MHz and €19.2m for 40 MHz
VodafoneZiggo	100	57.5	€39.2m for 60 MHz and €18.3m for 40 MHz

Source: RDI

Table A7.36: June 2024 auction features[160]

	Description	Comment
Licence duration	16 years.	
No of bidders; no. of lots; lot sizes	3 bidders. 3 lots of 60 MHz and 12 lots of 10 MHz. In total, 300 MHz of spectrum at 3450 MHz-3750 MHz frequency was made available for auction.	

[157] 2021 Statement, A3, paragraphs A3.83-A3.85
[158] 2021 Statement, A3, paragraphs A3.83-A3.85
[159] RDI, KPN, Odido and VodafoneZiggo acquire frequencies through 5G auction | News item | State Inspectorate for Digital Infrastructure (RDI)
[160] Dutch Government publications

	Description	Comment
Spectrum caps/restrictions	Cap of 120 MHz per operator including spectrum already held in the 3.5 GHz.	Spectrum caps not binding
Reserve prices	The reserve price for the 60 MHz blocks was €39.2m each, and the reserve price for the 10 MHz lots was €4.3m each.	Each bidder won the 60 MHz lot at reserve price, while the 10 MHz lots were won above reserve price
Obligations	For 10 MHz licences, the holder is obligated to provide a publicly available electronic communications service to at least 54 square km per permit after two years, 536 square km per after five years. For 60MHz licences, 324 square km per permit after two years and 3216 square km per permit after five years.	

Source: Overheid.nl

Whether award outcomes are likely to reflect market value in the Netherlands

A7.75 In the June 2024 auction of 3.5 GHz spectrum, each bidder won 60 MHz of the spectrum at reserve price. The additional 10 MHz lots sold above reserve price. We use these 10 MHz lots in our analysis and consider that their auction prices may reflect market value of spectrum in the Netherlands.

A7.76 We note that the spectrum caps were not binding for any of the bidders. We also do not consider that the obligations in this auction were likely to require deployments significantly in excess of commercial levels.

A7.77 Therefore, we consider that the prices of the 10 MHz lots are likely to be reflective of market value in the Netherlands. We have not identified any specific risk of over- or understatement for the benchmark.

Relative value benchmarks

A7.78 Based on the auction data set out above, we can derive the following benchmark for the Netherlands. Consistent with our assessment of benchmarks involving these auctions in past ALF decisions, and our assessment of the new auction set out above, our provisional view is that the Tier 1 criteria are satisfied for this relative value benchmark.

A7.79 We do not consider that the relative value benchmarks carries any specific risks of over- or understatement.

Table A7.37: Summary of Tier 1 benchmarks from the Netherlands

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Band combination	**700 MHz**	**2100 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Value	33.3	17.3	1.9	0.49	11.1 (UK 3.6 GHz) 13.3 (UK 3.4 GHz)
Risk assessment; Tier	No specific risk identified	No specific risk identified	No specific risk identified	Tier 1 No specific risk identified	

Source: Ofcom analysis

Slovenia

Relevant Auctions

A7.80 Table A7.38 below sets out the auction data we have used to derive Tier 1 benchmarks from Slovenia. We have analysed all of these auctions in the 2021 Statement.

Table A7.38: Summary of Tier 1 auction evidence from Slovenia

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction analysed
700 MHz	Apr-21	31.5	Risk of understatement	2021 Statement[161]
2100 MHz	Apr-21	34.8	No specific risks	2021 Statement[162]
2.3 GHz	Apr-21	9.8	No specific risks	2021 Statement[163]
3.4-3.8 GHz	Apr-21	7.4	No specific risks	2021 Statement[164]

Relative value benchmarks

A7.81 Based on the auction data set out above, we can derive the following benchmarks for Slovenia for the 2100 MHz band. Consistent with our assessment of benchmarks involving these auctions in the 2021 ALF decision, our provisional view is that the Tier 1 criteria are satisfied for each of these relative value benchmarks from Slovenia.

[161] 2021 Statement, A3, paragraphs A3.95-A3.101
[162] 2021 Statement, A3, paragraphs A3.95-A3.101
[163] 2021 Statement, A3, paragraphs A3.95-A3.101
[164] 2021 Statement, A3, paragraphs A3.95-A3.101

Table A7.39: Summary of Tier 1 benchmarks from Slovenia

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
2100 MHz model					
Band combination	**700 MHz**	**2100 MHz**	**2.3 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	31.5	34.8	9.8	1.15	18.7
Risk assessment; Tier	Risk of under-statement	No specific risk identified	No specific risk identified	Tier 1 Risk of over-statement	
Band combination	**700 MHz**	**2100 MHz**	**3.4-3.6 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	31.5	34.8	7.4	1.13	18.2 (UK 3.4 GHz) 18.8 (UK 3.6 GHz)
Risk assessment; Tier	Risk of under-statement	No specific risk identified	No specific risk identified	Tier 1 Risk of over-statement	

Source: Ofcom analysis

Sweden

Relevant auctions

A7.82 Table A7.40 below sets out the auction data we have used to derive Tier 1 benchmarks from Sweden.

Table A7.40: Summary of Tier 1 auction evidence from Sweden

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction analysed
700 MHz	Dec-18	43.9	No specific risks	New
800 MHz	Mar-11	26.3	Larger risk of over-statement	2015 Statement[165]
900 MHz	Sep-23	15.7	No specific risks	New

[165] 2015 Statement, A8, paragraphs A8.869-A8.923

Auction band	Date of auction	UK-equivalent absolute value (£m per MHz)	Risk of understatement or overstatement	Where auction analysed
1800 MHz	Oct-16	11.6	Risk of overstatement	2015 Statement[166]
2100 MHz	Sep-23	2.1	No specific risks	New
2.3 GHz	Jan-21	2.7	No specific risks	New
2.6 GHz	Sep-23	4.2	No specific risks	New
3.4-3.8 GHz	Jan-21	3.5	No specific risks	New

Source: Ofcom analysis

New auction evidence

December 2018 700 MHz auction

A7.83 In December 2018, the 700 MHz band was auctioned in Sweden using an SMRA auction format.

A7.84 The award information is set out in Table A7.41 and the auction's features are summarised in Table A7.42.

Table A7.41: December 2018 auction results[167]

Frequency band	Candidate	Amount of spectrum (MHz)	Price at time of auction (million SEK)
700 MHz	Telia	20	1383
	Net4Mobility	20	1442

Source: PTS

Table A7.42: December 2018 auction features[168]

	Description	Comment
Licence duration	22 years	
No of bidders; no. of lots; lot sizes	3 bidders (Hi3G did not win any spectrum); 2 lots of 2x5 MHz and 1 lot of 2x10 MHz	
Spectrum caps/restrictions	Single spectrum cap of 40MHz (covering both FDD and SDL spectrum, SDL spectrum went unsold in the auction).	
Reserve prices	SEK 100 million per 2x5 MHz	

[166] 2015 Statement, A8, paragraphs A8.869-A8.923
[167] PTS, May 2024, https://pts.se/radio/auktioner/genomforda-auktioner/
[168] Aetha Consulting, December 2018, PTS, May 2024

	Description	Comment
Obligations	Coverage obligation attached to the 2x10MHz block which was won by Telia. Obligation to provide 100% outdoor residential voice/data coverage of at least 10Mbit/s.	

Source: PTS

January 2021 multiband auction

A7.85 In January 2021, the 2.3 GHz and 3.4-3.6 GHz bands were auctioned in Sweden using a clock auction format.

A7.86 The award information is set out in Table A7.43 and the auction's features are summarised in Table A7.44.

Table A7.43: January 2021 auction results[169]

Frequency band	Candidate	Amount of spectrum (MHz)	Price at time of auction (million SEK)
2.3 GHz	Teracom	80	400
3.4-3.8 GHz	Hi3g Access	100	491
	Net4Mobility	100	666
	Telia	120	760

Source: PTS

Table A7.44: January 2021 auction features[170]

	Description	Comment
Licence duration	2.3 GHz - 25 years 3.4-3.8 GHz - 25 years	
Spectrum caps/restrictions	2.3 GHz – None 3.4-3.8 GHz - Max of 120 MHz per operator in the 3500 MHz band	
Reserve prices	2.3 GHz - SEK 160 million per 80 MHz 3.4-3.8 GHz – SEK 500 million per 100 MHz	3.4-3.8 GHz – Reserve price does not apply for the lot bought by Hi3G, which only has 80 MHz spectrum for generic use.
Obligations	None	

Source: PTS

A7.87 The 3.4-3.8 GHz spectrum acquired by Hi3G Access includes the 3400-3420 MHz frequency range which had usage conditions attached. This is reflected in Hi3G paying a lower price per MHz than the other operators (and indeed its total price was below the reserve price for 100 MHz of unencumbered spectrum). Therefore, we have excluded the spectrum won

[169] PTS, May 2024, https://pts.se/radio/auktioner/genomforda-auktioner/
[170] PTS, May 2024, https://pts.se/radio/auktioner/genomforda-auktioner/, PolicyTracker database

by Hi3G from our analysis, basing our benchmark on the prices paid by Telia and Net4Mobility.

September 2023 multiband auction

A7.88 In September 2023, the 900 MHz, 2100 MHz, 2.6 GHz bands were auctioned in Sweden using a hybrid SMRA clock auction format.

A7.89 The award information is set out in Table A7.45 and the auction's features are summarised in Table A7.46.

Table A7.45: September 2023 auction results[171]

Frequency band	Candidate	Amount of spectrum (MHz)	Price at time of auction (million SEK)
900 MHz	Telia	30	833
	Hi3G Access	20	701
	Net4Mobility	20	755
2100 MHz	Telia	40	190
	Hi3G Access	40	190
	Net4Mobility	40	190
2.6 GHz	Telia	60	529
	Hi3G Access	20	319
	Net4Mobility	60	529

Source: PTS

Table A7.46: September 2023 auction features[172]

	Description	Comment
Licence duration	900 MHz – 23 years 2100 MHz - 25 years 2.6 GHz - 25 years	
No of bidders; no. of lots; lot sizes	900 MHz – 3 bidders 2100 MHz - 3 bidders 2.6 GHz – 3 bidders	
Spectrum caps/restrictions	2x20 MHz in 900 MHz band. 120 MHz across 2100 MHz and 2.6 GHz bands.	

[171] PTS, May 2024, https://pts.se/radio/auktioner/genomforda-auktioner/

[172] PTS, *PTS fastställer reglerna inför auktionen i 900 MHz-, 2,1 GHz- och 2,6 GHz-banden*, April 2023

	Description	Comment
Reserve prices	900 MHz – SEK 150 million per 10 MHz 2100 MHz – SEK 35 million per 10 MHz 2.6 GHz – SEK 35 million per 10 MHz	
Obligations	900 MHz: licence holders are required to improve coverage with a focus on coverage through new masts where there is no coverage today. 2100 MHz and 2.6 GHz: the licence holders are required increase capacity along high-traffic railway sections.	

Source: PTS

Whether award outcomes are likely to reflect market value in Sweden

A7.90 The 700 MHz spectrum band sold above reserve price. While there was a spectrum cap in place it was not binding on any of the bidders.

A7.91 The 2x10 MHz block in the 700 MHz spectrum band that was won by Telia came with the coverage obligation to provide 100% outdoor residential voice/data coverage of at least 10Mbit/s. These obligations, if sufficiently onerous on operators, could lead to a risk of understatement for the auction prices. However, we do not have sufficiently clear evidence to determine how onerous the coverage obligation is on operators. One reason we may think the coverage obligations do not place a significant burden on operators is the relatively small difference in price per MHz between the lot with obligations (won by Telia) and the lot without obligations (won by Net4Mobility). On balance, we do not identify a specific risk of understatement or overstatement of the market value in Sweden for the 700 MHz auction.

A7.92 The 900 MHz spectrum band sold above reserve price. While there was a spectrum cap in place it was not binding on any of the bidders. We cannot identify a specific risk of under or-overstatement for the 900 MHz auction.

A7.93 The 2.3 GHz band sold above reserve price. We do not identify a specific risk of understatement or overstatement of the market value in Sweden for the 2.3 GHz auction.

A7.94 When considering the lots that do not come with restricted use, the 3.4-3.8 GHz band sold above reserve price. There was a spectrum cap of 120 MHz that was binding on Telia. This means there is a risk that the auction prices may understate the value of the band 3.4-3.8 GHz in Sweden. This may be mitigated in part by the presence of two bidders for whom the cap was not binding. Therefore, we do not identify a specific risk of understatement or overstatement of the market value in Sweden for the 3.4-3.8 GHz auction.

A7.95 For the 2023 auction, we are aware of a couple of features that may affect the outcomes. First, a spectrum cap of 120 MHz per bidder applied across 2100 MHz and 2.6 GHz bands. Second, there were coverage obligations for both 2100 MHz and 2.6 GHz auctions. However, the spectrum cap was not binding on any of the bidders.

A7.96 The coverage obligations, if sufficiently onerous on operators, could lead to a risk of understatement for the auction prices. However, we do not have sufficiently clear evidence to determine how onerous the coverage obligation is on operators.

A7.97 Therefore, we do not identify a specific risk associated with the 2100 MHz and 2.6 GHz auction.

Relative value benchmarks

A7.98 Based on the auction data set out above, we can derive the following benchmarks for Sweden. Consistent with our assessment of benchmarks involving these auctions in past ALF decisions, and our assessment on new auctions set out above, our provisional view is that the Tier 1 criteria are satisfied for the each of these relative value benchmarks from Sweden.

A7.99 For the 900-700 MHz benchmark, we observe there was significantly more intense competition for the 700 MHz spectrum than the 900 MHz spectrum. We consider this was in part because only 2x20 MHz of 700 MHz spectrum was available meaning not all three MNOs could acquire 2x10 MHz (and indeed one of the MNOs who participated in the auction ended up with no 700 MHz spectrum). In contrast, there was 2x35 MHz of 900 MHz spectrum available with each MNO acquiring at least 2x10 MHz. Consequently, we consider the 900/700 MHz ratio in Sweden partially reflects the differences in the availability of spectrum in each auction, rather than the relative values of the bands.[173] Therefore, we consider that the 900-700 MHz benchmark that results from combining these auctions carries a risk of understatement.

A7.100 The 900-800 MHz benchmark carries a risk of understatement due to the 800 MHz auction carrying a larger risk of over-statement.

A7.101 The distance method benchmarks that have 700 MHz as the low frequency band carry a risk of overstatement due to the 1800 MHz band carrying a risk of overstatement, while no risk is identified for the outer bands.

A7.102 The distance method benchmarks that have 800 MHz as the low frequency band carry a risk that we cannot further identify as both the low frequency and target band carry a risk of overstatement, but we cannot be certain whether these risks cancel each other out.

A7.103 We observe the 2100 MHz auction price is lower than the auction price for high frequency bands in Sweden, namely 2.3 GHz, 2.6 GHz, 3.4-3.8 GHz. As explained in Annex 6, the resulting benchmark values for 2100 MHz are extrapolations below the UK value of higher frequency bands. As such, we provisionally consider that all Sweden 2100 MHz benchmarks carry a larger risk of understatement.

A7.104 Table A7.47 below sets out a summary of Tier 1 benchmarks from Sweden.

Table A7.47: Summary of new Tier 1 benchmarks from Sweden

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
900 MHz model					
Band combination	**700 MHz**		**900 MHz**	**Paired ratio**	**UK 900 MHz (£m/MHz)**

[173] See also, https://www.aethaconsulting.com/the-swedish-700mhz-auction-why-such-a-high-price/

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Value	43.9		15.7	0.36	6.1
Risk assessment; Tier	No specific risk identified		No specific risk identified	Tier 1 Risk of understatement	
Band combination	**800 MHz**		**900 MHz**	**Paired ratio**	**UK 900 MHz**
Value	26.3		15.7	0.60	26.9
Risk assessment; Tier	Larger risk of over-statement		No specific risk identified	Tier 1 Risk of understatement	
1800 MHz model					
Band combination	**700 MHz**	**1800 MHz**	**2.3 GHz**	**"Y/X" ratio**	**UK 1800 MHz (£m/MHz)**
Value	43.9	15.3	2.7	0.31	9.8
Risk assessment; Tier	No specific risk identified	Risk of overstatement	No specific risk identified	Tier 1 Risk of overstatement	
Band combination	**700 MHz**	**1800 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 1800 MHz**
Value	43.9	15.3	4.2	0.28	10.2
Risk assessment; Tier	No specific risk identified	Risk of overstatement	No specific risk identified	Tier 1 Risk of overstatement	
Band combination	**700 MHz**	**1800 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 1800 MHz**
Value	43.9	15.3	3.5	0.29	11.8 (based on UK 3.4 GHz) 8.7 (based on UK 3.6 GHz)
Risk assessment; Tier	No specific risk identified	Risk of overstatement	No specific risk identified	Tier 1 Risk of overstatement	

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Band combination	**800 MHz**	**1800 MHz**	**2.3 GHz**	**"Y/X" ratio**	**UK 1800 MHz**
Value	26.3	15.3	2.7	0.53	27.2
Risk assessment; Tier	Larger risk of over-statement	Risk of overstatement	No specific risk identified	Tier 1 No specific risk identified	
Band combination	**800 MHz**	**1800 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 1800 MHz**
Value	26.3	15.3	4.2	0.50	26.4
Risk assessment; Tier	Larger risk of over-statement	Risk of overstatement	No specific risk identified	Tier 1 No specific risk identified	
Band combination	**800 MHz**	**1800 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 1800 MHz**
Value	26.3	15.3	3.5	0.52	28.0 (based on UK 3.4 GHz) 25.9 (based on UK 3.6 GHz)
Risk assessment; Tier	Larger risk of over-statement	Risk of overstatement	No specific risk identified	Tier 1 No specific risk identified	
2100 MHz model					
Band combination	**800 MHz**	**2100 MHz**	**2.3 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	26.3	2.1	2.7	-0.02	5.6
Risk assessment; Tier	Larger risk of over-statement	No specific risks identified	No specific risk identified	Tier 1 Larger risk of understatement	
Band combination	**800 MHz**	**2100 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	26.3	2.1	4.2	-0.1	3.9

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark	
Risk assessment; Tier	Larger risk of over-statement	No specific risks identified	No specific risk identified	Tier 1 Larger risk of understatement	
Band combination	**800 MHz**	**2100 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	26.3	2.1	3.5	-0.06	7.5 (based on UK 3.4 GHz) 2.8 (based on UK 3.6 GHz)
Risk assessment; Tier	Larger risk of over-statement	No specific risk identified	No specific risk identified	Tier 1 Larger risk of understatement	
Band combination	**700 MHz**	**2100 MHz**	**2.3 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	43.9	2.1	2.7	-0.01	6.4
Risk assessment; Tier	No specific risk identified	No specific risk identified	No specific risk identified	Tier 1 Larger risk of understatement	
Band combination	**700 MHz**	**2100 MHz**	**2.6 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	43.9	2.1	4.2	-0.05	7.0
Risk assessment; Tier	No specific risk identified	No specific risk identified	No specific risk identified	Tier 1 Larger risk of understatement	
Band combination	**700 MHz**	**2100 MHz**	**3.4-3.8 GHz**	**"Y/X" ratio**	**UK 2100 MHz (£m/MHz)**
Value	43.9	2.1	3.5	-0.03	9.4 (UK 3.4 GHz) 4.7 (UK 3.6 GHz)

	UK-equivalent absolute value (£m/MHz)			Relative value benchmark
Risk assessment; Tier	No specific risk identified	No specific risk identified	No specific risk identified	Tier 1 Larger risk of understatement

Source: Ofcom analysis

Tier 2 and Tier3 benchmarks

A7.105 Table A7.48 below summarises Tier 2 and 3 benchmarks using the paired-ratio method for the 900 MHz band.

Table A7.48: Tier 2 and Tier 3 benchmarks for 900 MHz band

Country	Low frequency award year	900 MHz auction year	Benchmark value	Tier	Whether analysed previously	Key Considerations
700 MHz/900 MHz						
Belgium	2022	2022	£10.1m	2	New	Possible strategic bidding in the 900 MHz band.
Portugal	2021	2021	£23.1m	3	New	700 MHz band sold at reserve price. 900 MHz band sold at reserve price.
Croatia	2021	2023	£51.5m	3	New	Two out of three 700 MHz lots were sold at reserve price.
Slovakia	2020	2020	£3.6m	3	New	900 MHz band sold at reserve price.
Norway	2019	2017	£19.7m	3	New	700 MHz band sold close to reserve, prices skewed due to coverage obligations.
800 MHz/900 MHz						
Belgium	2013	2022	£23.1m	3	New	800 MHz band sold at reserve price.

Country	Low frequency award year	900 MHz auction year	Benchmark value	Tier	Whether analysed previously	Key Considerations
Portugal	2011	2011	£33.2m	2	2015 Statement[174]	Some unsold 900 MHz spectrum; all 800 MHz spectrum sold at reserve price. Non-contiguous 900 MHz lots.
Spain	2011	2011	£38.0m	2	2015 Statement[175]	900 MHz spectrum sold at reserve price; 800 MHz sold above reserve price. LTE commercial developments may have increased value of 900 MHz since award.
Denmark	2012	2010	£6.4m	3	2015 Statement[176]	The three incumbents prevented from bidding for 900 MHz. Joint bidding reduced the number of bidders for 800 MHz.
Greece	2014	2011	£33.7m	3	2015 Statement[177]	900 MHz sold at reserve price. 900 MHz lots were very small. 900 MHz price set before developments in availability of 700 MHz band at World Radiocommunication Conference 2012 (WRC-12).

[174] 2015 Statement, A8, paragraphs A8.670-A8.721
[175] 2015 Statement, A8, paragraphs A8.823-A8.868
[176] 2015 Statement, A8, paragraphs A8.256-298
[177] 2015 Statement, A8, A8.493-A8.536

Country	Low frequency award year	900 MHz auction year	Benchmark value	Tier	Whether analysed previously	Key Considerations
Romania	2012	2012	£49.1m	3	2015 Statement[178]	Some unsold 800 MHz spectrum, all 900 MHz spectrum sold at reserve price. Greater importance of 2G.

A7.106 Table A7.49 below summarises Tier 2 and 3 distance method benchmarks for the 1800 MHz band.

Table A7.49: Tier 2 and Tier 3 benchmarks for the 1800 MHz band

Country	Low frequency award year	1800 MHz award year	High frequency award year	Benchmark value	Tier	Whether analysed previously	Key Considerations
700 MHz – 2.3 GHz							
Slovenia	2021	2016	2021	£9.6m	3	New	For the 1800 MHz band, only one lot sold above reserve price.
Sweden	2018	2016	2021	£8.9m	3	New	Only one bidder for the 1800 MHz auction.
700 MHz – 2.6 GHz							
Belgium	2022	2022	2020	£13.5m	3	New	2.6 GHz band sold at reserve price.

[178] 2015 Statement, A8, A8.722-A8.771

Country	Low frequency award year	1800 MHz award year	High frequency award year	Benchmark value	Tier	Whether analysed previously	Key Considerations
Croatia	2021	2023	2023	£26.0m	3	New	Two out of three 700 MHz lots were sold at reserve price. Two out of three 2.6 GHz lots were sold at reserve price.
Czech Republic	2020	2016	2016	£16.0m	3	New	700 MHz band sold at reserve price.
Greece	2020	2017	2014	£14.3m	3	New	1800 MHz sold at reserve price.
Italy	2018	2011	2011	£10.7m	3	New	700 MHz band sold very near reserve price.
Norway	2019	2015	2021	£27.7m	3	New	700 MHz band sold close to reserve, prices skewed due to coverage obligations.
Portugal	2011	2021	2021	£16.1m	3	New	700 MHz band sold at reserve price.
Sweden	2018	2016	2023	£9.3m	3	New	Only one bidder for the 1800 MHz auction.
700 MHz – 3.4-3.8 GHz							

Country	Low frequency award year	1800 MHz award year	High frequency award year	Benchmark value	Tier	Whether analysed previously	Key Considerations
Croatia	2021	2023	2021	£24.2m (UK 3.4 GHz) £28.3m (UK 3.6 GHz)	3	New	Two out of three 700 MHz lots were sold at reserve price.
Czech Republic 700-3500	2020	2016	2020	£16.3m (UK 3.4 GHz) £15.8m (UK 3.6 GHz)	3	New	700 MHz band sold at reserve price.
Czech Republic 700-3600	2020	2016	2017	£16.4m (UK 3.4 GHz) £15.9m (UK 3.6 GHz)	3	New	700 MHz band sold at reserve price.
Greece	2020	2017	2020	£15.1m (UK 3.4 GHz) £13.9m (UK 3.6 GHz)	3	New	Both 1800 MHz and 800 MHz spectrum sold at or very near reserve prices.
Italy	2018	2011	2018	£8.5m (UK 3.4 GHz) £3.3m (UK 3.6 GHz)	3	New	700 MHz band sold very near reserve price.
Norway	2019	2015	2021	£27.0m (UK 3.4 GHz) £32.9m (UK 3.6 GHz)	3	New	700 MHz band sold close to reserve, prices skewed due to coverage obligations.

Country	Low frequency award year	1800 MHz award year	High frequency award year	Benchmark value	Tier	Whether analysed previously	Key Considerations
Slovakia	2020	2020	2016	£8.2m (UK 3.4 GHz) £2.9m (UK 3.6 GHz)	3	New	1800 MHz band sold at reserve price.
Slovakia	2020	2020	2022	£10.4m (UK 3.4 GHz) £6.3m (UK 3.6 GHz)	3	New	1800 MHz band sold at reserve price. For the 3.5 GHz band only one lot sold above reserve price.
Slovakia	2020	2020	2017	£11.0m (UK 3.4 GHz) £7.3m (UK 3.6 GHz)	3	New	1800 MHz band sold at reserve price.
Slovenia	2021	2016	2021	£12.3m (UK 3.4 GHz) £9.4m (UK 3.6 GHz)	3	New	For the 1800 MHz band, only one lot sold above reserve price.
Sweden	2016	2016	2021	£11.1m (UK 3.4 GHz) £7.6m (UK 3.6 GHz)	3	New	Only one bidder for the 1800 MHz auction.
800 MHz – 2.3 GHz							
Sweden	2011	2016	2021	£21.1m	3	New	Only one bidder for the 1800 MHz auction.
800 MHz – 2.6 GHz							
Belgium	2013	2022	2020	£27.6m	3	New	800 MHz band sold at reserve price.

Country	Low frequency award year	1800 MHz award year	High frequency award year	Benchmark value	Tier	Whether analysed previously	Key Considerations
Croatia	2023	2023	2023	£27.1m	3	New	2.6 GHz band sold close to reserve price.
Portugal	2011	2021	2021	£13.8m	3	New	800 MHz band sold at reserve price.
Romania	2021	2012	2021	£155.5m	3	New	800 MHz band sold at reserve price. 2.6 GHz band sold at reserve price, with one unsold lot.
Slovakia	2013	2020	2013	£6.7m	3	New	1800 MHz band sold at reserve price.
Germany	2010	2010	2010	£7.7m	2	2015 Statement[179]	Likely that 1800 MHz was not perceived as a core LTE band at the time of the award. Possible lack of competition for frequency-specific 1800 MHz lots.

[179] 2015 Statement, A8, paragraphs A8.297-A8.364

Country	Low frequency award year	1800 MHz award year	High frequency award year	Benchmark value	Tier	Whether analysed previously	Key Considerations
Czech Republic	2013	2013	2013	£10.3m	3	2015 Statement[180]	2x1 MHz lot sizes may have raised aggregation risks in the 1800 MH band. Incumbent operators excluded from bidding for the only large 1800MHz block. Unsold 2.6GHz with binding caps.
Greece	2014	2017	2014	£20.1m	3	2018 Statement[181]	Both 1800 MHz and 800 MHz spectrum sold at or very near reserve prices, and some of the lots in the 2.6 GHz award sold marginally above reserve.

[180] 2015 Statement, A8, paragraphs A8.224-A8.255
[181] 2015 Statement, A8, A8.493-A8.536

Country	Low frequency award year	1800 MHz award year	High frequency award year	Benchmark value	Tier	Whether analysed previously	Key Considerations
Greece	2011	2011	2011	£18.6m	3	2015 Statement[182]	1800MHz sold at reserve price. Binding spectrum caps in 1800MHz. 1800MHz price set before developments in availability of 700MHz band at WRC-12.
Romania	2012	2012	2012	£16.6m	3	2015 Statement[183]	1800 MHz sold at reserve price, no caps were binding. Unsold 800 MHz. Unsold 2.6 GHz.
Slovak Republic	2013	2013	2013	£9.8m	3	2015 Statement[184]	Incumbents excluded from bidding for large block of contiguous 1800 MHz. Reserve price used for 2.6 GHz. Possible lack of competition in the 800 MHz band due to cap.

[182] 2015 Statement, A8, A8.493-A8.536
[183] 2015 Statement, A8, A8.722-A8.771
[184] 2015 Statement, A8, A8.772-A8.813

Country	Low frequency award year	1800 MHz award year	High frequency award year	Benchmark value	Tier	Whether analysed previously	Key Considerations
Sweden	2011	2016	2023	£20.1m	3	New	Only one bidder for the 1800 MHz auction.
800 MHz – 3.4-3.8 GHz							
Belgium	2013	2022	2022	£28.3m (UK 3.4 GHz) £26.2m (UK 3.6 GHz)	3	New	800 MHz band sold at reserve price.
Croatia	2023	2023	2021	£28.1m (3.4 GHz) £25.9m (3.6 GHz)	3	New	3.4-3.8 GHz band sold very close to reserve price.
Greece	2014	2017	2020	£22.5m (UK 3.4 GHz) £19.6m (UK 3.6 GHz)	3	New	Both 1800 MHz and 800 MHz spectrum sold at or very near reserve prices.
Portugal	2011	2021	2021	£16.2m (UK 3.4 GHz) £12.6m (UK 3.6 GHz)	3	New	800 MHz band sold at reserve price.
Sweden	2011	2016	2021	£22.3m (UK 3.4 GHz) £19.4m (UK 3.6 GHz)	3	New	Only one bidder for the 1800 MHz auction.

A7.107 Table A7.50 below summarises the Tier 2 and 3 distance method benchmarks for the 2100 MHz band.

Table A7.50: Tier 2 and Tier 3 benchmarks for the 2100 MHz band

Country	Low freq. award year	2100 MHz award year	High freq. award year	Benchmark value (£m per MHz)	Tiering	Whether analysed previously	Key considerations
700 MHz-2.6 GHz							
Belgium	2022	2022	2020	13.6	3	New	2.6 GHz sold at reserve price
Croatia	2021	2023	2023	43.6	3	New	Two out of three 700 MHz lots were sold at reserve price. Two out of three 2.6 GHz lots were sold at reserve price.
Greece	2020	2020	2014	9.6	3	2021 Statement[185]	700 MHz, 2.6 GHz, and 2100 MHz bands sold at very close to reserve price.
Iceland	2017	2017	2017	17.4	3	2021 Statement[186]	The 700 MHz and 2100 MHz bands sold at reserve price.
Norway	2019	2019	2021	12.0	3	New[187]	2100 MHz lots sold at reserve price.

[185] 2021 Statement, Annex 3, paragraphs A3.126-A3.128.
[186] 2021 Statement, Annex 3, paragraphs A3.129-A3.130.
[187] In the 2021 Statement, we derived benchmarks for Norway based on proxy values for the high frequency bands, but these benchmarks were considered to be Tier 3. See 2021 Statement, Annex 3, paragraphs A3.131-A3.133. There has since been auctions for higher frequency bands in Norway, but due to the quality of the 2100 MHz auction evidence we still consider these benchmarks as Tier 3.

Country	Low freq. award year	2100 MHz award year	High freq. award year	Benchmark value (£m per MHz)	Tiering	Whether analysed previously	Key considerations
Portugal	2021	2021	2021	8.8	3	New	The 2100 MHz auction was for only 10 MHz, which were previously unsold spectrum. The 700 MHz auction sold at reserve price.
700 MHz-3.4-3.6 GHz							
Croatia	2021	2023	2021	38.1 (UK 3.4 GHz) 50.5 (UK 3.6 GHz)	3	New	Two out of three 700 MHz lots were sold at reserve price. 3.6 GHz lots sold at reserve price.
Greece	2020	2020	2020	11.7 (UK 3.4 GHz) 8.5 (UK 3.6 GHz)	3	2021 Statement[188]	700 MHz and 2100 MHz bands sold at very close to reserve price.
Norway	2019	2019	2021	12.3 (UK 3.4 GHz) 9.4 (UK 3.6 GHz)	3	New[189]	2100 MHz lots sold at reserve price.
Portugal	2021	2021	2021	11.3 (3.4 GHz) 7.8 (3.6 GHz)	3	New	The 2100 MHz auction was for only 10 MHz, which were previously unsold spectrum. The 700 MHz auction sold at reserve price.

[188] 2021 Statement, Annex 3, paragraphs A3.126-A3.128.

[189] In the 2021 Statement, we derived benchmarks for Norway based on proxy values for the high frequency bands, but these benchmarks were considered to be Tier 3. See 2021 Statement, Annex 3, paragraphs A3.131-A3.133. There has since been auctions for higher frequency bands in Norway, but due to the quality of the 2100 MHz auction evidence we still consider these benchmarks as Tier 3.

Country	Low freq. award year	2100 MHz award year	High freq. award year	Benchmark value (£m per MHz)	Tiering	Whether analysed previously	Key considerations
800 MHz-2.6 GHz							
Belgium	2013	2022	2011	27.8	3	New	The 800 MHz auction sold at reserve price.
Croatia	2023	2023	2023	45.8	3	New	Two out of three 2.6 GHz lots were sold at reserve price.
Greece	2014	2020	2014	10.9	3	2021 Statement[190]	800 MHz, 2.6 GHz, and 2100 MHz bands sold at very close to reserve price.
Iceland	2017	2017	2017	45.8	3	2021 Statement[191]	The 800 MHz and 2100 MHz bands sold at reserve price.
Portugal	2011	2021	2021	7.8	3	New	The 2100 MHz auction was for only 10 MHz, which were previously unsold spectrum. The 800 MHz auction sold at reserve price.
800 MHz-3.4-3.6 GHz							
Belgium	2013	2022	2022	28.5 (UK 3.4 GHz) 26.4 (UK 3.6 GHz)	3	New	The 800 MHz auction sold at reserve price.
Croatia	2023	2023	2021	45.8 (UK 3.4 GHz) 45.9 (UK 3.6 GHz)	3	New	3600 MHz lots sold at reserve price.

[190] 2021 Statement, Annex 3, paragraphs A3.126-A3.128.
[191] 2021 Statement, Annex 3, paragraphs A3.129-A3.130.

Country	Low freq. award year	2100 MHz award year	High freq. award year	Benchmark value (£m per MHz)	Tiering	Whether analysed previously	Key considerations
Greece	2014	2020	2020	14.0 (UK 3.4 GHz) 10.1 (UK 3.6 GHz)	3	2021 Statement[192]	800 MHz and 2100 MHz bands sold at very close to reserve price.
Portugal	2021	2021	2021	10.0 (UK 3.4 GHz) 5.7 (UK 3.6 GHz)	3	New	The 2100 MHz auction was for only 10 MHz, which were previously unsold spectrum. The 800 MHz auction sold at reserve price.

[192] 2021 Statement, Annex 3, paragraphs A3.126-A3.128.

A8. Legal Framework

Communications Act 2003

A8.1 Ofcom's statutory powers and duties in relation to spectrum management are set out primarily in the Communications Act 2003 (the "**Communications Act**") and the Wireless Telegraphy Act 2006 (the "**Wireless Telegraphy Act**").

A8.2 Our principal duties under section 3 of the Communications Act are to further the interests of citizens and consumers in respect to communications matters, where appropriate by promoting competition. In doing so, we are also required (among other things) to secure the optimal use of spectrum and the availability throughout the United Kingdom of a wide range of electronic communications services.

A8.3 Section 4 of the Communications Act requires Ofcom to act in accordance with six requirements when carrying out certain specified functions, including our functions under the Wireless Telegraphy Act. These include a requirement to promote competition in relation to the provision of electronic communications networks and electronic communications services, and to take account of the desirability of carrying out its functions in a manner which, so far as practicable, does not favour one form of electronic communications network, electronic communications service or associated facility, or one means of providing these, over another.

Wireless Telegraphy Act 2006

A8.4 We permit the use of the radio spectrum by granting wireless telegraphy licences under the Wireless Telegraphy Act. It is unlawful and an offence to install or use wireless telegraphy apparatus without holding a licence granted by Ofcom, unless the use of such equipment is exempted.

A8.5 In carrying out our spectrum functions we have a duty under section 3 of the Wireless Telegraphy Act to have regard in particular to:

a) the extent to which the spectrum is available for use, or further use, for wireless telegraphy;
b) the demand for use of that spectrum for wireless telegraphy; and
c) the demand that is likely to arise in future for such use.

A8.6 We also have a duty to have regard to the desirability of promoting:

a) the efficient management and use of the spectrum for wireless telegraphy;
b) the economic and other benefits that may arise from the use of wireless telegraphy;
c) the development of innovative services; and
d) competition in the provision of electronic communications services.

Ofcom's powers to set fees

A8.7 Under Section 12 of the Wireless Telegraphy Act, Ofcom has power to require licensees to pay fees to Ofcom on the grant of a licence and subsequently. The requirement to pay fees at times after the grant of a licence must be imposed by way of regulations made by Ofcom. The timing of the fee payment must be set out in the regulations, and the amount

of the fee can be prescribed in the regulations, or alternatively the regulations may provide for the amount to be determined by Ofcom in accordance with the regulations.

A8.8 Section 12(5) of the Wireless Telegraphy Act provides that, where a licence has been awarded as part of an auction process, subsequent fees cannot ordinarily be charged for that licence. This is however subject to section 12(6) of the Wireless Telegraphy Act which provides that fees may be payable for auctioned spectrum in specific circumstances. This includes where provision has been included in the licence with the consent of the holder of that licence for subsequent fees to apply.

A8.9 Section 13 of the Wireless Telegraphy Act provides that Ofcom can set fees at an amount that is higher than the cost to us of carrying out our radio spectrum functions, if we think that is appropriate, in particular in light of our statutory duties in section 3 of the Wireless Telegraphy Act.

A8.10 Section 122 of the Wireless Telegraphy Act is a general provision about matters relating to Ofcom's powers to make statutory instruments (including fees regulations under section 12 of that Act). It includes a requirement that where we are proposing to make regulations we must publish a notice setting out the general effect of the regulations and give a period of at least one month within which representations on the proposed regulations may be made to us.

UK Government's Statement of Strategic Priorities

A8.11 Under section 2B(2) of the Communications Act, when exercising our functions relating to telecoms, management of radio spectrum and postal services, we are required to have regard to the UK Government's Statement of Strategic Priorities (SSP). The SSP for telecommunications, the management of radio spectrum, and postal services was designated on 29 October 2019, having been laid in draft before Parliament on 18 July 2019. We set out in Section 6 further details of how we have done this.

The desirability of promoting economic growth

A8.12 In exercising our regulatory functions, we are also required to have regard to the desirability of promoting economic growth (the "**growth duty**").[193] In particular, we must consider the importance for the promotion of economic growth of exercising the regulatory function in a way which ensures that regulatory action is taken only when it is needed, and any action taken is proportionate. Section 110(3) of the Deregulation Act 2015 requires us to have regard to the "Growth Duty: Statutory Guidance" (revised by Government in May 2024).

[193] Section 108 of the Deregulation Act 2015, which was extended to Ofcom's regulatory functions by The Economic Growth (Regulatory Functions) (Amendment) Order 2024.