aetha

Why spectrum values are falling

Report on behalf of BT

25 February 2025

Contents

1. Executive summary

Ofcom is conducting a review of the annual licence fees (ALFs) for 900MHz, 1800MHz and 2100MHz spectrum, and detailed its proposals in a consultation published in December 2024.

Ofcom's proposed approach involves calculating lump sum values (LSV) for the ALF spectrum and then annualising these values over a 20-year period. A key assumption made by Ofcom in determining the LSVs is that the value of spectrum – both in the UK and across Europe – has been stable in real terms over recent years. This assumption leads Ofcom to inflate past auction prices using CPI.

Ultimately, the proposed LSVs are heavily reliant on the 2018 and 2021 UK auction results. Inflating the prices from these awards results in LSVs 23-27% higher than if an inflation adjustment was not applied. This report, written on behalf of BT, challenges Ofcom's assumption of stable real terms spectrum value.

Ofcom's flawed justifications for inflating past spectrum prices

Ofcom justifies its assumption of stable real terms spectrum value by arguing that operators factored future spectrum supply and technological developments into their past valuations.

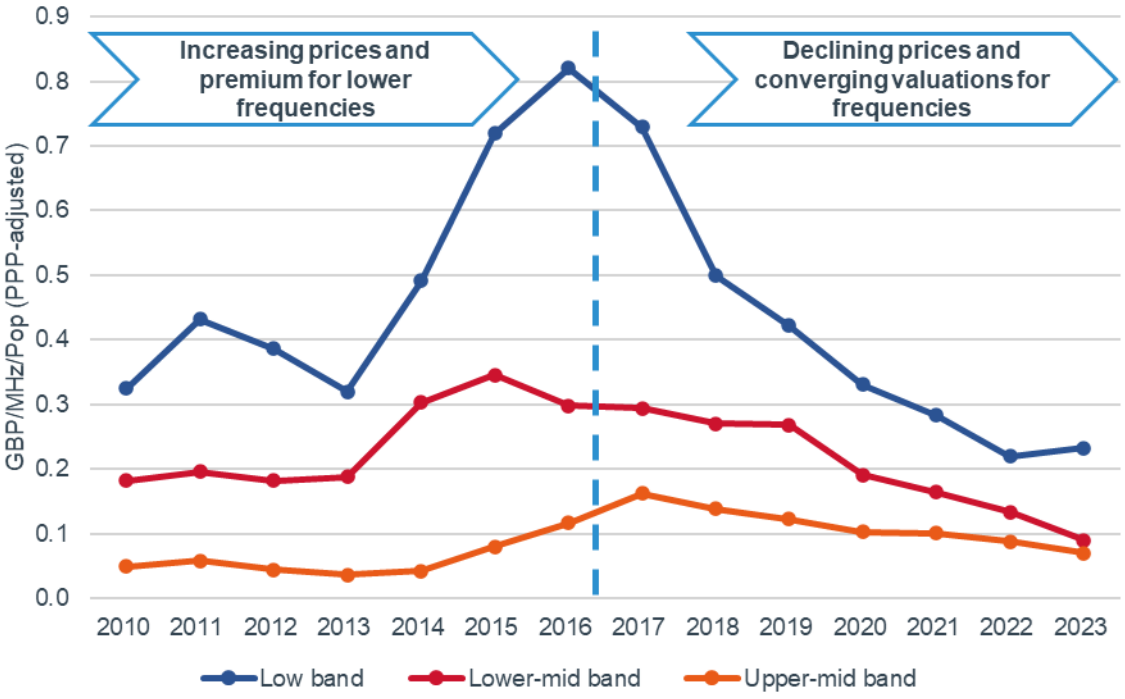
Mobile operators constantly learn new information regarding the supply and demand conditions related to the spectrum market. This influences their valuations for spectrum. Critically, this flow of information did not stop at the time of the two UK spectrum auctions in 2018/2021. Mobile operators' expectations of spectrum supply, technological advances and traffic growth are continually evolving. In recent years, the impact of each of these changing expectations has overwhelmingly been to reduce spectrum value.

Benchmark evidence of declining spectrum value

To demonstrate that spectrum prices are declining, we have analysed global evidence from our own database of spectrum prices and European evidence from Ofcom's database, focussing on awards that Ofcom believes to be most informative of spectrum value.

Our global dataset encompasses 217 awards across 75 countries and reveals a clear downward trend in spectrum prices since circa 2016. These benchmarks are shown in Figure 1 below. A similar trend is observed in European auction data, sourced from Ofcom's own database. Together, these datasets constitute compelling empirical evidence against Ofcom's assumption of stable real terms spectrum value.

Figure 1: Global benchmark of auction unit prices (nominal, three-year moving average)[1]



Drivers of declining spectrum value

The decline in spectrum value over recent years has been caused by three main factors:

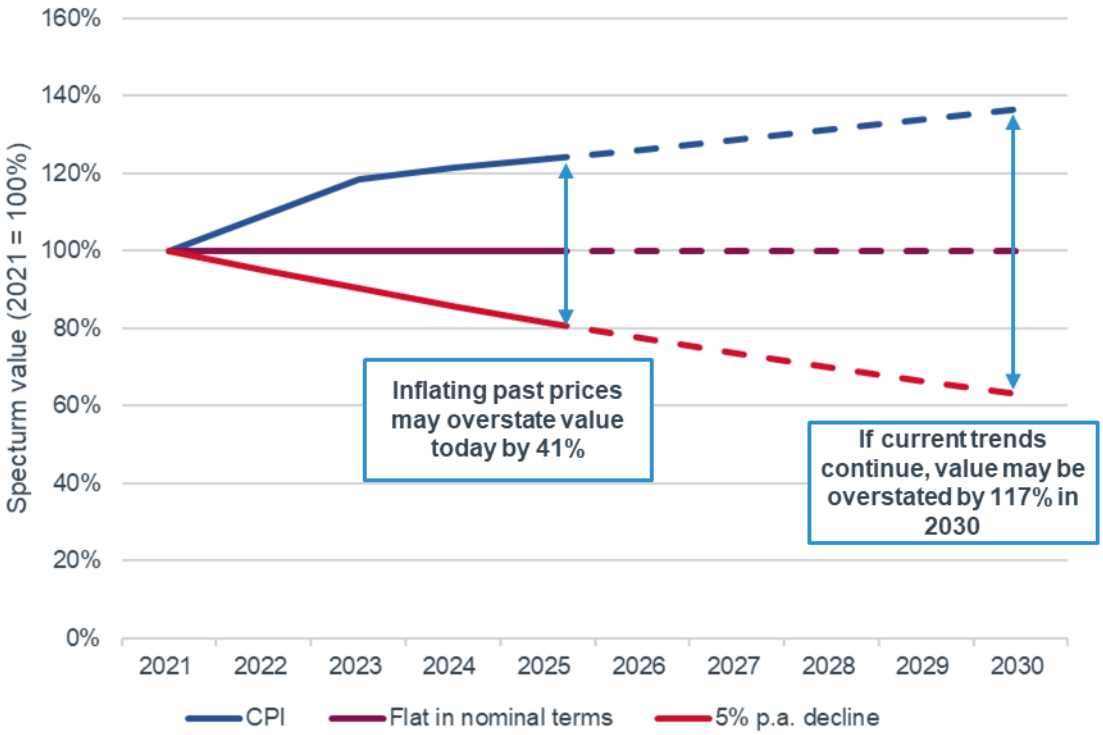
- Increased spectrum supply expectations
  - Since the 2018 and 2021 auctions, operators' expectations of future spectrum availability have increased substantially, including the emergence of the upper 6GHz band. This increased supply expectation has applied downward pressure on spectrum valuations.
- Increased confidence in technological advancements
  - Advancements in technologies like massive MIMO have enhanced the utility of higher frequency spectrum, further contributing to the convergence of spectrum values across different bands.
- Revised mobile traffic growth forecasts
  - Finally, operators have revised their mobile traffic growth forecasts downwards in recent years, reducing their demand for spectrum.

Implications and recommendations

Figure 2 below shows the possible impact of Ofcom's proposal to inflate past auction prices. Ofcom proposes setting the 900MHz LSV equal to the 700MHz price from the 2021 UK auction. This could overstate its value by 41%, assuming that spectrum value has fallen by 5% p.a. (nominal) over that period, which we believe to be a conservative estimate. There is a similar impact on the 1800MHz and 2100MHz LSVs.

[1] Equivalent GBP/MHz/Pop fee for a 20-year licence, adjusted for PPP.

Figure 2: Change in the value of spectrum awarded in 2021[2]



Ofcom states that its intention is to adopt a conservative approach when setting ALFs to reflect the asymmetric risk on the efficient management on spectrum from setting ALFs above, rather than below market value. Consistent with this approach, our view is that Ofcom should reconsider its position regarding inflating prices from past auctions, in light of evidence that spectrum prices have fallen in nominal terms in recent years.

2. Introduction

Following a request from BT to review the Annual Licence Fees (ALF) for 1800MHz spectrum, Ofcom commenced a review of the ALFs for 900MHz, 1800MHz and 2100MHz spectrum in July 2024 and published its proposals in a consultation published in December 2024.

Ofcom's approach to setting ALFs is unchanged from the approach it developed for 900MHz and 1800MHz spectrum in 2018. Ofcom first determines lump sum values (LSV) of the ALF spectrum, which it then converts into annualised fees over a period of 20 years.

A key assumption made by Ofcom in determining the LSVs is that the value of spectrum – both in the UK and across Europe – has been stable in real terms over recent years (i.e. that it has increased with inflation). Critically, Ofcom inflates the prices from the 2018/2021 UK spectrum auctions, the results of which directly scale the LSVs. This approach results in the LSVs being 23-27% higher than if the prices of past auctions were not inflated.

This report, written on behalf of BT, challenges this assumption. We demonstrate with extensive evidence that spectrum prices (globally, regionally and in the UK) have declined in both real and nominal

[2] From 2026 onwards we assume that ALFs increase with the Bank of England target inflation rate of 2%.

terms in recent years and, most importantly, since the 2018 and 2021 UK auctions. Our evidence corroborates similar benchmark evidence already provided to Ofcom in stakeholder submissions (e.g., NERA's report on behalf of VMO2).

We then explain in detail the drivers behind this decline and why recent trends in spectrum prices are the result of changes to supply and demand conditions. Finally, we examine each of Ofcom's justifications for its view that the value of spectrum has remained constant over time in real terms, presenting evidence that this assumption does not hold.

Aetha is the global leader in valuing mobile spectrum. Since our formation in 2011, we have supported operators with valuing mobile spectrum ahead of over 100 award processes globally. We spend much of our time at the 'coalface' of spectrum valuation and are therefore uniquely positioned to understand trends in mobile spectrum value.

3. Ofcom's proposals for the ALFs

As mentioned, Ofcom's approach to setting ALFs begins with the determination of the lump sum value (LSV) of the ALF spectrum.

For the 900MHz band, Ofcom proposes setting the LSV equal to the auction price of the 700MHz spectrum from 2021.

There is no recent directly comparable UK auction evidence for the value of the 1800MHz and 2100MHz bands. Ofcom has therefore again used the 'distance method' to construct LSV benchmarks based on European evidence for the relative price of the ALF bands to comparator bands for which the UK has recent auction evidence (2018/2021).

In its benchmarking, Ofcom adjusts the prices of all past auctions with UK inflation, using CPI. This adjustment impacts LSVs predominantly via increasing the prices of the 2018 and 2021 UK auctions.[3] Both of Ofcom's methods ultimately derive LSV benchmarks based on the results of the 2018 and 2021 UK auctions (2.3/3.4GHz and 700MHz/3.6GHz). Since 2018/2021, CPI has increased by 27/23% and this directly feeds into the benchmarks, and Ofcom's proposed LSVs for the ALF spectrum.

As explained above, Ofcom's LSV benchmarks are based on the assumption that spectrum value has remained constant in real terms over recent years. It provides two main justifications for inflating past auction prices with UK CPI:

- Operators knew about future spectrum supply and technological developments and factored this into their valuations:
  - *"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."*[4]

[3] There is a secondary effect on the LSV benchmarks in cases where the auctions of different bands used in the distance or ratio methods took place in different years. However, this impact is generally much less significant on the final LSVs. Each impacted benchmark can be shifted in either direction, and the time gaps between auctions are typically relatively short and occurred during low inflation periods.

[4] Ofcom, "Proposals for revised Annual Licence Fees for 900, 1800 and 2100 MHz spectrum", Paragraph 3.54 c), 13 December 2024.

  - *"It was known in 2018...that the 700 MHz and 3.6 GHz spectrum bands were going to be made available for mobile… As such, we expect that that increase in supply of spectrum was factored into the unit values of spectrum at that time."*[5]

- Mobile operator aggregate EBITDA has been relatively constant in real terms since 2018.

We believe that these justifications for adjusting past auction prices with inflation are flawed.

Mobile operators constantly learn new information regarding the supply and demand conditions related to the spectrum market. This influences their valuations for spectrum. Critically, this flow of information did not stop in 2018 or 2021. Mobile operators' expectations of spectrum supply, technological advances and traffic growth are continually evolving. In recent years, the impact of each of these changing expectations has overwhelmingly been to reduce spectrum value, as we explain in Section 5.

BT highlights the issues of using EBITDA as a measure of economic profit for mobile operators in its consultation response and we agree that EBIT per MHz would instead be a valid measure.

However, even if EBITDA was a good metric, this evidence is not consistent with stable real-terms spectrum value over this period. The EBITDA evidence suggests that the value to mobile operators of access to spectrum in totality has remained the same. However, ALFs are charged per unit (MHz) of spectrum, rather than on spectrum in totality and the level of ALFs should therefore reflect the value of spectrum on a per unit basis.

Total spectrum assigned to mobile operators has almost doubled since the beginning of 2018, but there has been no indication of a sustained increase in real mobile operator EBITDA.

Benchmarking evidence also shows clearly that spectrum value has declined per MHz in recent years, globally and in Europe and we demonstrate this in Section 4.

Ofcom acknowledges in Paragraph 4.3 that there is an asymmetric risk on the efficient management of spectrum from setting ALFs above, rather than below market value. If ALFs are set too high, this would create barriers to trading and distort price signals, leading to inefficient spectrum use and sub-optimal investment. Ofcom therefore aims to take a conservative approach to interpreting evidence.

In the following sections, we present evidence that spectrum value has declined in recent years. Our view is that inflating past prices is therefore inconsistent with trends in spectrum value and with Ofcom's conservative approach, and risks setting LSVs above the spectrum's market value.

4. Benchmarks illustrate that spectrum value has declined

In this section, we present benchmark evidence demonstrating that spectrum prices have declined in recent years. We consider global evidence from our own database of spectrum prices and European evidence from Ofcom's database, focussing on awards that Ofcom believes to be most informative of spectrum value.

[5] Ofcom, "Proposals for revised Annual Licence Fees for 900, 1800 and 2100 MHz spectrum", Paragraph 3.56, 13 December 2024.

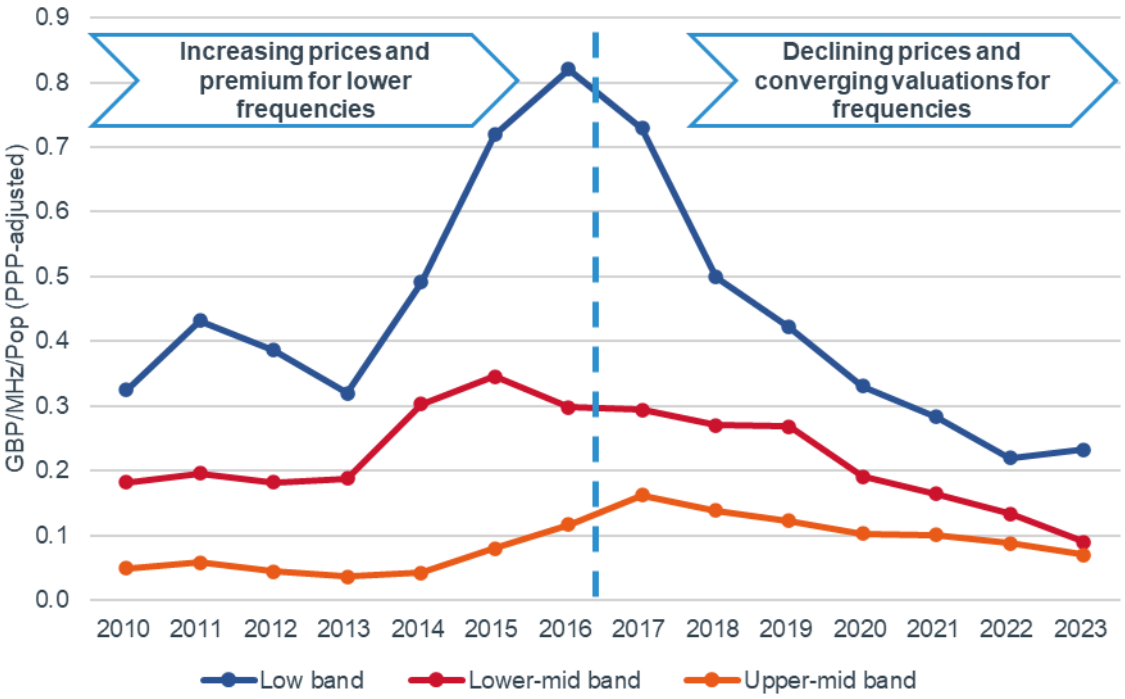
Our global dataset has the advantage of containing a very large number of awards, allowing trends to be observed clearly and reducing the impact of outliers. Meanwhile, the European benchmark provides confidence that global trends are aligned with trends in Europe.

Our benchmark of global spectrum unit prices is shown in Figure 3 below. It was produced from a total of 217 awards between 2009 and 2024, across 75 countries. We have adjusted the benchmarks to represent 20-year licences, and we have also adjusted for PPP. We have not adjusted for inflation e.g., with CPI, and we are therefore showing nominal prices. We show a three-year moving average to reduce the impact of noise.

We have grouped the bands into three categories, combining bands with similar characteristics:

- Low band (700MHz, 800MHz, 850MHz, 900MHz)
- Lower-mid band (1800MHz, 2100MHz, PCS, AWS)
- Upper-mid band (2300MHz, 2500MHz, 2600MHz (both FDD and TDD), 3.5GHz).

Figure 3: Global benchmark of auction unit prices (nominal, three-year moving average)[6]



The benchmarks show a clear trend of declining spectrum prices since circa 2016. The trend is more pronounced in low bands, which has led to a convergence in value between low and mid bands. If we also adjusted the benchmarks for inflation, this declining trend would be even more pronounced, because prices further in the past would be increased relative to recent prices.

The above evidence demonstrates the trend globally. However, when determining the ALFs, Ofcom is rightly concerned with spectrum value in Europe, which it perceives as more closely comparable with the UK. To investigate whether the global trend of declining prices is aligned with European evidence, we have also analysed Ofcom's own European auction price data. The results of this analysis are shown in Figure 4 below.

[6] Equivalent GBP/MHz/Pop fee for a 20-year licence, adjusted for PPP.

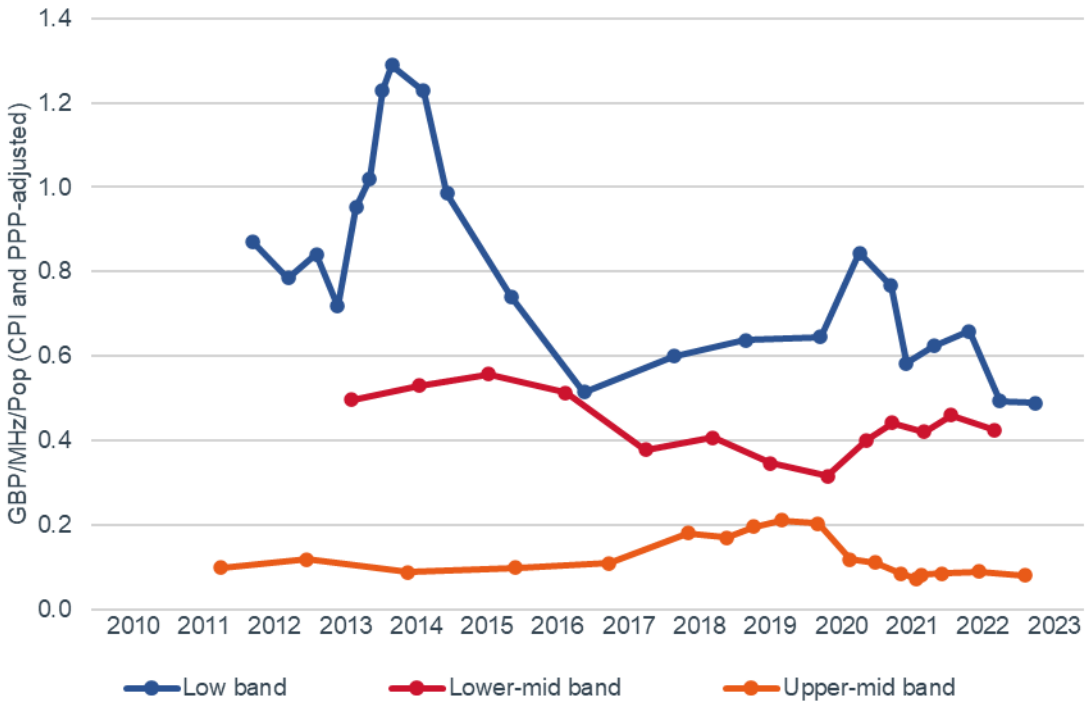
In our analysis, we have included all auctions which are included in at least one "Tier 1" benchmark in Ofcom's consultation, which Ofcom believes are the most informative of spectrum value. We have made no adjustments to the LSVs for each band/auction determined by Ofcom, except to convert them to a per MHz price. Therefore, we are presenting the equivalent LSV for a 20-year licence, adjusted for both wealth (PPP) and inflation (CPI).

Limiting the sample to Tier 1 European auctions produces a relatively small data set. We therefore show a five-auction, rather than three-year, moving average i.e. each data point shows the average price of a central award and the two previous and two following awards. Auctions are not evenly distributed over time, and this approach allows consideration of the density of auctions when interpreting the data. For example, it shows that there were fewer low band awards between 2015 and 2018 than 2020 and 2023.

We have used the same band groupings as for our global benchmark:

- Low band (700MHz, 800MHz, 900MHz)
- Lower-mid band (1800MHz, 2100MHz)
- Upper-mid band (2300MHz, 2600MHz (both FDD and TDD), 3.5GHz).

Figure 4: European benchmark of auction unit prices (real terms, five-auction moving average)[7] [Source: Ofcom's auction database]



As mentioned, there are significantly fewer data points available for comparison than in our global dataset and trends therefore suffer from more noise. However, we can observe a similar trend in both benchmarks, although the peak in low and lower-mid band prices may have occurred 2-3 years earlier than globally.

Whilst the European benchmarks provide evidence that is most directly comparable to the UK, it can only be used to demonstrate a long running trend of declining prices, and individual peaks and troughs are not meaningful, and can occur due to a small number of outliers. For example, the peak in lower-

[7] Equivalent GBP/MHz/Pop fee for a 20-year licence, adjusted for CPI and PPP.

mid band prices in 2021/2022 is partly driven by an 1800MHz auction in Hungary in 2021, for which reserve prices were particularly high.

Stakeholder submissions prior to Ofcom's consultation on the ALFs also presented evidence of the recent decline in spectrum prices. NERA's evidence included global and European benchmarks showing a decline in low band and lower-mid band spectrum prices since the beginning of the 5G era. This evidence is consistent with the analysis presented in the section, and our experience of conducting a large number of spectrum valuations, both globally and in Europe, over recent years.

5. Drivers of falling spectrum value

Like any market, spectrum prices are sensitive to supply and demand factors. A spectrum licence is a long-term investment, and operators must therefore consider both the present conditions, and their expectations of future supply and demand.

In this section, we explain that operators' spectrum supply expectations have increased substantially in recent years (and specifically since 2018/2021) whilst traffic forecasts have fallen, reducing the demand for spectrum. At the same time, operators have gained increased confidence in technological advances including massive MIMO and have increased expectations of its applications in the future.

We believe that these factors are the main drivers of declining spectrum value in recent years, which is clearly visible in benchmark data. As certainty grows of increased future spectrum supply, utility of expected technological advances and reduced expectations for traffic, it is likely that the current trend will continue.

5.1 Spectrum supply expectations have increased

In Paragraph 3.56, Ofcom gives its provisional view on whether it should account for an increase in spectrum supply when adjusting past auction outcomes:

"…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."[8]

Ofcom is correct that mobile operators consider the impact of future spectrum awards when valuing spectrum. However, this assessment is inevitably limited to the information available to them at that point in time. Over time, mobile operators a) gain more certainty in future awards that they already expect, and b) learn about new spectrum awards.

Crucial to the current assessment of ALFs, mobile operators have gained new information about future spectrum awards since the auctions in 2018 and 2021.

[8] Ofcom, "Proposals for revised Annual Licence Fees for 900, 1800 and 2100 MHz spectrum", paragraph 3.56, 13 December 2024.

5.1.1 Expectations ahead of the 2018 UK auction

Ofcom is correct that in 2018 mobile operators expected that the 700MHz and 3.6GHz bands would become available in the future. However, an expectation – even a strong expectation – is not foreknowledge. There is a long history of spectrum awards being delayed, in many cases by several years. For a current example, in its 2022 consultation on making mmWave spectrum available for mobile technology, Ofcom stated:

"At present, we are aiming to make mmWave spectrum available for new uses by 2024."[9]

Several delays – largely due to the VF3 merger – have prevented this from being possible.

Therefore, whilst in 2018 operators did account for future awards in their valuations, they did so cautiously, factoring in uncertainty. The award of 700MHz and 3.6GHz became a certainty in 2021, and only at this point could it have been fully factored into valuations of other spectrum.

5.1.2 Expectations in 2021 compared to today

Since 2021, operators now have far more confidence in future spectrum, and this has reduced their valuations for spectrum on a per MHz basis. For example, today, mobile operators have strong expectations of upper 6GHz spectrum being assigned in the near future.

It was not until WRC-23 that the upper 6GHz was identified for mobile use and ahead of that conference, Ofcom's position was to favour a "no change" outcome, wanting to keep its options open for the band.[10] Operators could not have taken this future spectrum into account ahead of the 2021 award as they can today.

In a recent consultation, Ofcom describes the characteristics of the 6GHz band as similar to those of the 3.4–3.8GHz band.[11] Ericsson responded to Ofcom's 2023 consultation on the upper 6GHz[12] and explained that the band is expected to be used on the same site grid as the 3.5GHz, and will be able to cover both indoor and outdoor locations using advanced antennas.[13] Mobile operators also expressed confidence in the coverage capabilities of the band.

Mobile operators can now assume that hundreds of MHz of upper 6GHz spectrum will become available and expect this band to serve as a near substitute for existing spectrum. This expectation inevitably reduces mobile operators' valuations for other spectrum on a per MHz basis. However, under Ofcom's current proposals, it is unclear even today the exact quantity of spectrum to expect, further illustrating the impossibility of operators fully accounting for the award of this spectrum many years in the past.

As demonstrated in our global benchmarking evidence, and Ofcom's European benchmarking data, the value of spectrum bands has been converging throughout the 5G era, driven predominantly by a decrease in the value of low band and lower-mid band spectrum. This has partially been driven by technical developments that have improved the utility of upper-mid band spectrum, which can serve a greater proportion of traffic than before the 5G era.

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[9] Ofcom, "Enabling mmWave spectrum for new uses", 9 May 2022.

[10] Ofcom, "Update on the upper 6 GHz band", 6 December 2022.

[11] Ofcom, "Expanding access to the 6 GHz band for mobile and Wi-Fi services", 13 February 2025 (page 7).

[12] Ofcom, "Hybrid sharing: enabling both licensed mobile and Wi-Fi users to access the upper 6 GHz band", 6 July 2023.

[13] Ericsson, "Ofcom Consultation – 6 GHz hybrid sharing licensed mobile and Wi-Fi", 15 September 2023.

It can therefore be expected that an increased supply of upper-mid band spectrum will decrease the value of all spectrum, consistent with the pattern observed over recent years, as the proportion of traffic served by the upper-mid bands continues to grow.

There are further expectations of perhaps over 1GHz of 7-8GHz spectrum in the upper-mid bands and the award of 25MHz of L-band spectrum is also under consultation. This spectrum was also not factored into 2021 valuations and these expectations further reduce valuations.

5.1.3 The 2021 auction is a better indication of C-Band spectrum

Comparing the 2018 and 2021 auctions in detail, we believe that there is good reason for Ofcom not to place equal weight on the prices for the 3.4GHz and 3.6GHz UK awards.

Even if, in 2018, bidders had total certainty that the 3.6GHz would be awarded in 2021, it may still have been rational for them to value the 3.4GHz higher, as it enabled them to commence their C-Band deployment earlier (or to offer higher 5G speeds in the 2018-21 period).

Therefore, in 2018, 3.4GHz and the future 3.6GHz were not perfect substitutes. However, after the 2021 auction, they became functionally equivalent and thus very close substitutes.

Figure 5 below compares the 3.5GHz awards used to generate Ofcom's Tier 1, post-2015 LSV benchmarks for the 1800MHz and 2100MHz bands.

Figure 5: Available MHz for 3.5GHz awards used in Tier 1, post 2015 LSV benchmarks

Award	Available 3.5GHz
Austria (2019)	390MHz
Belgium (2022)	370MHz
Germany (2019)	300MHz
Hungary (2020)	310MHz
Netherlands (2024)	300MHz
Slovenia (2021)	380MHz
Sweden (2021)	320MHz

In each case, at least 300MHz of spectrum was available and the UK supply at the time of the 2018 award was therefore much more limited, which will have increased prices. At the 2021 auction, UK supply of 3.5GHz spectrum increased to a level comparable with the available spectrum at the awards used in the benchmarks.

When considering the 1800MHz and 2100MHz LSV benchmarks, we believe that there is a strong case for Ofcom to only consider those based on the UK 3.6GHz benchmarks, which are a more reliable indicator of spectrum value today and are more comparable with the European benchmark awards.

5.2 Technological advances are not wholly 'baked in' past auction prices

In Paragraph 3.54 c), Ofcom gives its provisional view on whether it should account for the impact of technological advances when adjusting past auction outcomes:

"…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"[14]

It is true that mobile operators account for their expectations of technological developments when valuing spectrum, and therefore, past auction prices reflect these expectations. However, for the impact of technological advances on spectrum value to be accurately reflected in past prices, operators would have to be wholly confident and accurate in their assessments of future developments.

Our view is that technological advancements can never be fully reflected in past auction results, and that Ofcom should consider its assumption further. If instead, mobile operators over-expected technological advances, they may have undervalued spectrum. Whereas, if mobile operators generally under-expected technological advances, or were not wholly confident in new technologies, they may have overvalued spectrum.

As explained in Section 3, the most important award prices for setting LSVs are those from the 2018 and 2021 UK auctions, as the LSVs are based on a direct scaling of these results.

In 2018, massive MIMO antennas had already been developed, and operators will have expected them to provide substantial improvements to both spectral efficiency and coverage. However, the technology had not yet been widely deployed. This had changed by the time of the 2021 auction, and operators were more confident in the performance of the technology.

Today, mobile operators have even greater expectations for massive MIMO, and the technology is expected to be widely deployed in FDD bands including the 1800MHz and 2100MHz bands. This will significantly improve the capacity available from these FDD bands. We expect that this development was not fully factored into operators' valuations in 2018/21.

The main impact of massive MIMO has been to increase the relative utility of higher frequency spectrum and therefore its relative value. As described in Section 4, this is clear in the auction benchmark data, which shows a growing convergence between band valuations on a per MHz basis.

5.3 Expectations of mobile traffic growth have fallen

The majority of spectrum value typically arises from network cost savings, driven by the spectrum enabling a reduction in the number of site and equipment deployments required to serve network traffic. A more aggressive traffic forecast increases the network investment required to serve future demand, typically driving higher valuations for spectrum.

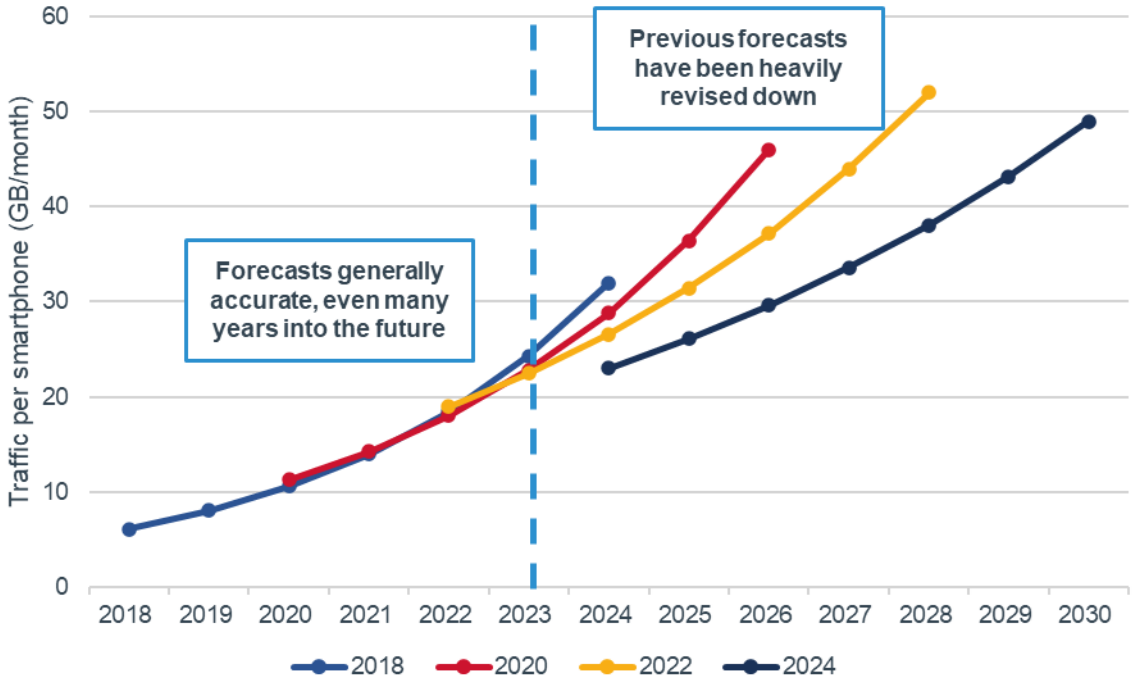
Over the course of conducting over 100 mobile spectrum valuation exercises, we have analysed the traffic data of mobile operators across Europe and the world and discussed expectations of traffic growth with each operator. In recent years, we have observed that mobile operator's expectations of future traffic growth have been revised downwards.

The key driver of data growth in the 4G era was the mass market adoption of smartphones, which drove increased consumption of video. As smartphone penetration has plateaued and video consumption growth slowed, as has the growth of data consumption. Mobile operators expected this to some degree, however, the extent of the slow-down in growth was generally not fully factored into mobile operators' forecasts. Many operators assumed that new use cases would arise to drive growth in the 5G era, but this impact has so far been limited.

[14] Ofcom, "Proposals for revised Annual Licence Fees for 900, 1800 and 2100 MHz spectrum", paragraph 3.54 c), 13 December 2024.

We are obviously not able to share commercially sensitive forecasts from our clients, however, third party forecasts also align with our observations. Ericsson publishes its “Mobility Report” each year in November, in which it estimates the current monthly mobile traffic per smartphone in Western Europe and forecasts this forward for six years. For clarity, we have shown the forecast from every other year since 2018 in Figure 6 below.

Figure 6: Forecasts of monthly mobile traffic in Western Europe 2018–2030 [Source: Ericsson Mobility Reports 2018-2024][15]



Ericsson’s forecasts were generally accurate in the late 2010s and early 2020s. For example, there is only a ~3% difference between the forecast for 2022 from 2018 and Ericsson’s estimate of present traffic in 2022.

However, as clearly illustrated in the chart, Ericsson has revised downwards its forecasts for the mid and late 2020s. The industry overestimated today’s traffic in the recent past, and the latest expectations of future traffic growth are more conservative than they were a few years ago.

[15] Ericsson reports a current year figure and a forecasted figure for six years’ time. We have assumed a constant CAGR in our analysis.

Figure 7: Forecast of monthly mobile traffic in selected years

Year of forecast	Monthly mobile traffic forecast (GB) / Percentage of 2024 forecast		
	2024	2026	2028
2018	32 (139%)		
2020	29 (125%)	46 (155%)	
2022	27 (116%)	37 (126%)	52 (137%)
2024	23	30	38

Spectrum valuations ahead of the 2018 and 2021 auctions were justified by expectations of traffic growth which have now been revised downwards. It therefore seems unlikely that operators' value for spectrum per MHz has remained the same in real terms since these auctions.

Today's expectations of traffic growth are more modest in relative terms, however, in absolute terms, expectations are generally similar. For example, Ericsson is forecasting a further 26GB of traffic per smartphone of growth over the next 6 years, approximately the same as it forecasted for the 2018-2024 period. Therefore, mobile operators still have value for additional spectrum which will be required for them to cost effectively serve this demand.

6. Implications and recommendations

The value of spectrum on a per MHz basis has declined in both real and nominal terms through the 5G era. This is apparent in both large global data sets and a subset of Tier 1 European benchmarks, which Ofcom considers most relevant to UK prices.

In this paper, we have described in detail the main drivers that have caused this reduction in value. Specifically, we have explained why spectrum valuations have fallen since the 2018 and 2021 UK auctions.

Ofcom's proposal to inflate past auction prices with UK CPI impacts LSVs predominantly via increasing the prices of the 2018 and 2021 UK auctions. Our global benchmark of spectrum prices indicates a substantial yearly decline in nominal spectrum prices from 2018/2021 to 2023, shown in Figure 8 below.

Figure 8: Global average yearly change in nominal spectrum prices [Source: Aetha global benchmarks][16]

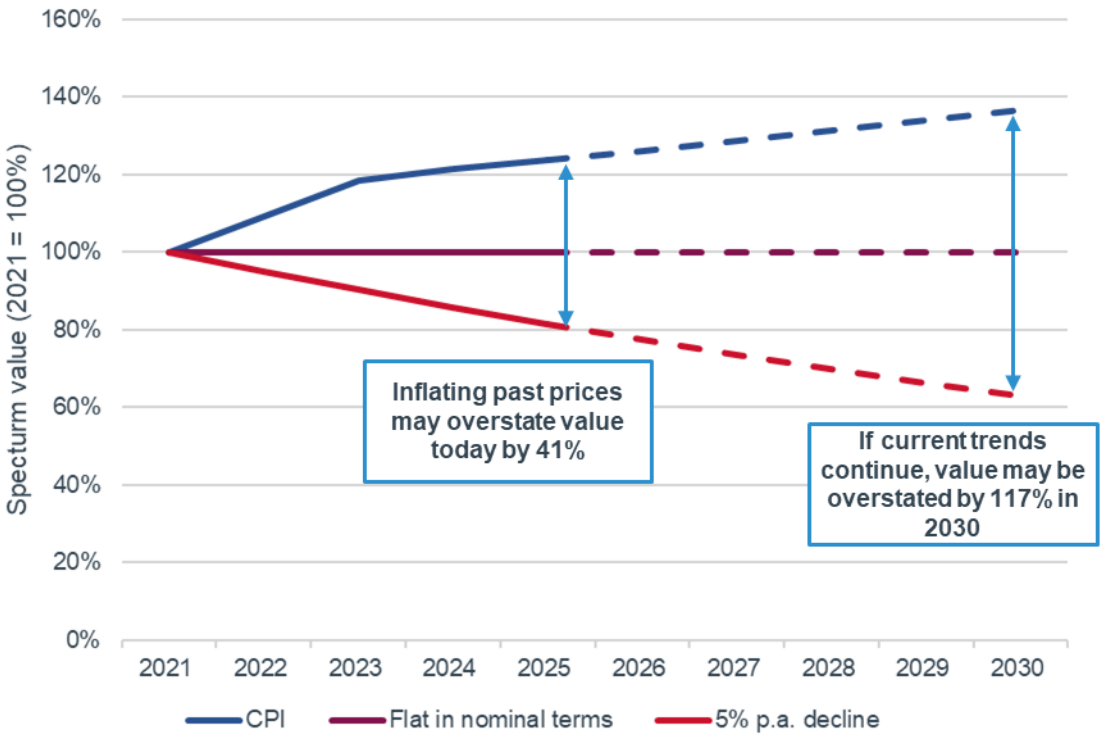
	Low band	Lower-mid band	Upper-mid band
2018 – 2023	-14%	-20%	-13%

The slowest average yearly decline since 2018 in percentage terms is in the upper-mid bands at 13% p.a. Even assuming a much more modest 5% p.a. nominal reduction in UK spectrum value since 2018/2021, Figure 9 below demonstrates that there is now a substantial delta between estimates of the

[16] Figures calculated based on 3-year moving averages for auction prices.

value of the 2018/2021 UK auction spectrum based on observed trends in spectrum prices, and the inflated prices that Ofcom has proposed using in its LSV calculations.

Figure 9: Change in the value of spectrum awarded in 2021



Ofcom has proposed inflating the 2018/2021 auction prices by ~27% and ~23% respectively, whilst assuming a 5% p.a. (nominal) decrease in spectrum value would result in a ~26% and ~14% reduction.

Ofcom has proposed setting the 900MHz LSV equal to the UK value of 700MHz from the 2021 auction. Comparing the inflated value of the 700MHz spectrum from 2021 with a value based on observed price trends, Ofcom's proposed 900MHz LSV may be 41% above the actual current value of the 700MHz band.

Ofcom uses its judgement of benchmarks to determine LSVs for the 1800MHz and 2100MHz ALF spectrum. The benchmarks are produced using the 2018/2021 auction results, and therefore the overestimate for these bands is of a similar magnitude as for the 700MHz – i.e. in the order of 40%.

The 900MHz and 1800MHz ALFs have remained unchanged for seven years, since they were set in 2018. It is likely that the ALFs set by this current process will be in place for several years and Ofcom proposes inflating ALFs each year with CPI. If spectrum value continues to decline at 5% p.a., ALFs may overstate spectrum value by 117% by 2030.

Ofcom states that its intention is to adopt a conservative approach when setting ALFs to reflect the asymmetric risk on the efficient management on spectrum from setting ALFs above, rather than below market value. Consistent with this approach, our view is that Ofcom should reconsider its position regarding inflating prices from past auctions, in light of evidence that spectrum prices have fallen in nominal terms in recent years.

Annex A About the authors

Throughout the recent unprecedented growth of wireless services, Aetha's staff have been at the forefront of spectrum policy. We have assisted regulators to develop frameworks for managing spectrum allocations, pricing spectrum and assigning spectrum e.g. through auction processes. We have also supported operators to understand their spectrum needs, value spectrum and bid in auctions. We also support industry associations with major policy issues.

Aetha is the global leader in undertaking spectrum valuation assessments for both mobile operators and regulators. We have supported mobile operators to value spectrum ahead of over 100 award process in over 50 countries. We have supported regulators worldwide with both the setting of administratively-set spectrum fees and also the setting of reserve prices for spectrum auctions.

Lee Sanders (Managing Partner) has been at the forefront of spectrum developments for more than 20 years. He has supported mobile operators to value spectrum and develop bid strategies ahead of over 30 spectrum awards worldwide. He has also supported regulators in the design of spectrum auction processes in the UK, South Africa, Slovenia and Denmark.

Amit Nagpal (Partner) has over 25 years of experience in spectrum management having started his career as a graduate engineer with the UK spectrum regulator and most recently through providing policy and valuation advice to telecoms regulators, operators and industry bodies. Amit has led projects on spectrum pricing for regulators across the world, including in Belgium, Mexico, Malaysia, Singapore, Slovenia, South Africa and the UAE. Amit also supported Ofcom to set reserve prices ahead of the UK multiband auction in 2013.

Thomas Pickett (Consultant) has provided end-to-end support to operators ahead of spectrum awards in Europe and worldwide including bottom-up modelling of mobile spectrum value. He has also supported regulators with spectrum pricing and benchmarking studies for mobile and other services.

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