



Virgin Media O2 response to Ofcom Consultation:

Award of 1492-1517 MHz spectrum for mobile services

Consultation on Ofcom's proposed competition assessment

September 2025

Non-confidential version

INTRODUCTION

Virgin Media O2 (“VMO2”) welcomes the opportunity to respond to Ofcom’s consultation on its proposed competition assessment for the Award of 1492-1517 MHz spectrum for mobile services (“Competition Assessment”). We previously submitted responses to the consultation of the award process in April 2025 (“Part 1 Response”) and July 2025 (“Part 2 Response”).

GENERAL COMMENTS

The shift from a four-MNO to a three-MNO market has changed the competitive dynamics in the UK. To a greater extent than in a four-player market, robust competition in a three-player market depends on all three mobile operators continuing to be effective competitors. Access to spectrum is one of the critical inputs that determines the competitiveness of each operator and having enough spectrum, both in general and in specific frequency ranges (low, lower mid and upper mid), to compete effectively is crucial to maintaining relative competitiveness.

Access to spectrum is one of the ways that Ofcom influences the development of the mobile market. While it is up to each MNO to be an effective competitor, Ofcom must make sure that the factors under its control, including access to spectrum, are not creating a barrier for any MNO to thrive.

The primary rationale for running an auction is that it should provide an effective method to identify the most efficient user or users of newly available frequencies. Auctions achieve this by awarding spectrum to the bidder(s) that values it the most, subject to three critical assumptions:

1. Higher willingness to pay of bidders is broadly correlated with the economic and social value that users will generate for society at large.
2. For all potential winning bidders, the ratio of their willingness to pay to underlying valuations are broadly similar.
3. Valuations are driven by technical cost savings and innovative business propositions, and not distorted by anti-competitive motivations, or legal, regulatory, or technical factors that prevent a level playing field between bidders.

For this award, the first two assumptions obviously hold. Mobile is the best use case for this spectrum. And the consultation has identified three strong bidders, the MNOs, all large, effective entities, none of which should face financial constraints in pursuing this spectrum.

Where Ofcom’s competition assessment is deficient is in its exploration of the third assumption. The consultation correctly identifies that the available spectrum is small and by itself, allocation should not impact downstream competition. Therefore, it is reasonable to assume that bids will not be grossly distorted by anti-competitive goals. The problem is that

Ofcom's analysis stops here. It fails to consider how valuations could be impacted by control of adjacent spectrum. And it makes no attempt to consider the long-term implications for downstream competition if this factor prevents spectrum from being allocated to the user(s) with highest general value for incremental spectrum and associated network capacity.

Other things being equal, one would normally expect bidders entering an auction with less spectrum to have the highest value in an auction. On this basis, one may reasonably anticipate that either VMO2 (with the smallest overall holdings) or BTEE (with the smallest low-band holdings) will be the strongest bidders for incremental L-band spectrum. However, under Ofcom's proposed award design [X].

As we argued in our Part 2 response and reiterate below, existing spectrum holdings in the UK are already relatively asymmetric compared to other European countries and close to the limit of acceptable asymmetry. If Vodafone-Three wins this spectrum, asymmetry will get worse. This would presumably be the opposite of what the Competition and Markets Authority (CMA) anticipated in its review of the *Vodafone/Three* JV when it identified future spectrum awards, including this one, as a long-run remedy to competition concerns associated with spectrum imbalance.¹

The standard tool in spectrum auctions to constrain spectrum asymmetry is spectrum caps. This is too blunt a tool to address the problem at hand. It may be that Vodafone-Three is the most efficient user of more L-band spectrum provided that VMO2 and BTEE secure a sufficient share of future spectrum allocations. And a partial cap on Vodafone-Three could do more harm than good because a fragmented assignment is unlikely to be efficient unless the entire L-band is reconfigured.

Fortunately, there are remedies other than caps available for this award. Ofcom should design the award carefully so that it allows bidders to express fully their values for the spectrum and the design itself does not exacerbate asymmetry. As BTEE has made clear in its response, it is interested in buying all the spectrum, not a partial chunk. And, as we have made clear, our interest in smaller quantities is contingent on there being reasonable certainty that the band can be reconfigured so that all licensees will (in due course) have contiguous spectrum. Ofcom should recognise these legitimate requests, driven by technical value, in its auction design.

We also seek reassurance from Ofcom that it will be vigilant going forward in the context of a three-MNO market, where it is important that all three MNOs have enough spectrum to thrive and have a fair opportunity to expand their spectrum holdings. While incremental awards such as this one may be small on their own, each incremental award can contribute cumulatively to a larger asymmetry in spectrum holdings. In other words, small incremental changes in asymmetry might not on their own weaken competition but might cumulatively

¹ CMA, [Anticipated joint venture between Vodafone Group plc and CK Hutchison Holdings Limited concerning Vodafone Limited and Hutchison 3G UK Limited, Final report](#), 5 December 2024, paragraph 8.300(b).

have a much larger impact on competition than the sum of their parts taken in isolation. It would be a valuable signal to the entire industry if Ofcom makes clear that spectrum caps may be needed for future spectrum awards and that the likelihood of such action will increase if this award produces an outcome that increases spectrum asymmetry.

RESPONSE TO QUESTION 1

Question 1: Do you agree with our assessment of these competition concerns, and our view that there is no need for specific competition measures? Please give reasons supported by evidence when providing your answers.

Ofcom's competition assessment fails to grapple with the core conundrum concerning this award: how to allocate the spectrum in an efficient pro-competitive manner when the MNO that likely has the least value for incremental capacity [~~X~~]. We broadly disagree with the competition assessment because it fails to consider how Ofcom could use auction design and market signalling to promote a more level playing field for bidders, thereby reducing the likelihood of future competition concerns stemming from asymmetric spectrum holdings. However, we do narrowly agree that a spectrum cap is not required for this award because the amount of spectrum available is small and, by itself, its allocation is unlikely to have an immediate impact on downstream competition.

Our view is that the current distribution of mobile spectrum in the UK is far from efficient and that asymmetries in holdings between operators are at or close to the acceptable limit from a competition perspective.

In support of our position, the remainder of our response is structured around five points:

1. The academic literature on spectrum holdings highlights the risk to competition if spectrum holdings are unduly asymmetric.
2. The UK mobile market is close to the limit of acceptable asymmetry in spectrum allocation.
3. Spectrum allocation between UK MNOs is more asymmetric than most European markets, implying that Ofcom should be vigilant about the threat to downstream competition.
4. There is a material risk that this award produces an allocation outcome that exacerbates existing spectrum asymmetries between MNOs owing to Vodafone-Three's incumbency advantage in the L-band.
5. Ofcom can take intermediate steps short of spectrum caps to ease the risk that this award produces an outcome that is ultimately detrimental to competition.

The academic literature on spectrum holdings highlights the risk to competition if spectrum holdings are unduly asymmetric

There is an emerging economic literature that highlights the risks to competition that flow from undue asymmetries in spectrum holdings between mobile operators, in particular in the context of three-player markets. The literature warns that significant asymmetries in frequency holdings between MNOs tend to reduce incentives to compete on price and infrastructure rollout, thereby harming consumers.

We asked NERA to summarize this literature for us, and they reported the following to us:

- Peha (2017) develops a model that explores how to divide spectrum resources among MNOs considering the economies of scale from deploying more spectrum to service rising demand for data, a trend that has continued through the 4G and 5G eras. He identifies two competing objectives for policymakers: increasing downstream competition (through having operators with viable spectrum holdings); and lowering the cost of capacity (which requires scale in spectrum holdings). This paper indicates that it *“is Pareto optimal with respect to these two objectives”* if *“spectrum is divided fairly evenly among MNOs, regardless of whether the number of competing MNOs is large or small.”* On this basis, Peha concludes that *“Large disparities in spectrum holdings are therefore not in the public interest.”*²
- Peha’s findings aligned with earlier warnings in Cramton et. al (2011), which address the need for pro-competitive measures in auction design that prevent excessive concentration in spectrum holdings.³
- Rey and Salant (2019), in a theoretical optimal auction (mechanism) design model, argue that consumer surplus will tend to be maximized if spectrum is allocated in a way that equalizes MNO costs.⁴ If all MNOs are nationwide full-service operators, this will typically require that mobile spectrum holdings are reasonably balanced, and undue deviation from this could lead to a lessening of downstream competition.
- Elliott et al. (2025) extend that Peha analysis by estimating the optimal mobile market structure using a structural model of demand, in which consumer choice depends on both price and quality, and network build costs.⁵ They find that the optimal market structure should also limit the number of firms with spectrum to three or four, and

² Peha, J. M. (2017). Cellular economies of scale and why disparities in spectrum holdings are detrimental. Telecommunications Policy.

³ Cramton, P., E. Kwerel, G. Rosston, and A. Skrzypacz (2011). Using spectrum auctions to enhance competition in wireless services. The Journal of Law and Economics 54(S4), S167–S188.

⁴ Rey, P. and Salant, S., Allocating Essential Inputs, Working Paper, available at: <https://www.tse-fr.eu/publications/allocating-essential-inputs>

⁵ Jonathan T. Elliott, Georges V. Hounghonon, Marc Ivaldi, and Paul T. Scott (2025); “Market Structure, Investment, and Technical Efficiencies in Mobile Telecommunications,” Journal of Political Economy.

that asymmetric spectrum allocations have an adverse effect on social welfare (defined as the sum of consumer and producer surplus).

In summary, it is widely recognized that significant asymmetries could result in operators with larger holdings establishing an unreplicable advantage with respect to network build cost, capacity and quality of service, and operators with smaller holdings being constrained in their ability to compete for customers. And operators with too little spectrum may be reluctant to engage in price competition, owing to concern that they will not be able to accommodate the increased traffic if they are successful in expanding market share.

Notwithstanding such concerns, we agree with Ofcom that it is not required for operators to have exactly the same spectrum holdings. As Ofcom has argued, some heterogeneity in holdings may encourage differentiation in network design and go-to-market strategies, and this could improve competitive choice for consumers.⁶ In this respect, the regulator has a key role to play in ensuring that spectrum asymmetries remain within an acceptable range.

In the past, Ofcom has attempted to define a specific spectrum share below which an operator is no longer an effective competitor. However, identifying such an inflexion point is challenging, as it may be impacted by many market factors, not just spectrum holdings. Operators with weaker holdings will attempt to compensate for having less spectrum with other measures, such as investment in networks and great marketing (as we did in the 2010s). However, there are limits on what operators can do to compensate for less spectrum. Ofcom should not assume that just because O2 prospered in the past relative to some rivals despite having a very low share of spectrum, that spectrum shares do not matter much. [X].

As Ofcom recognizes, its previous total spectrum share thresholds indicating possible competition concerns were determined based on a four-MNO market and are no longer appropriate in a three-MNO market.⁷ We do not consider it necessary, for the purpose of this award, for Ofcom to determine new spectrum share thresholds that would be appropriate in a three-MNO market. As Ofcom notes, the amount of spectrum in this award is relatively small⁸ and, by itself, the outcome of this award is not going to have an immediate impact on downstream competition.

Nevertheless, we think the minimum spectrum share threshold necessary to avoid asymmetry concerns in a three-player market should be much higher than in a four-player market. A key reason for this is that there is no longer any room in the market for operator failure given the view of Ofcom and the CMA that robust competition between three big players is necessary

⁶ Ofcom, [Award of the 2.3 and 3.4 GHz spectrum bands, Competition issues and Auction Regulations, Statement](#) 11 July 2017.

⁷ Ofcom, [Award of 1492-1517 MHz spectrum for mobile services, Consultation on Ofcom's proposed competition assessment](#), 18 July 2025, paragraph 3.23.

⁸ Ofcom, [Award of 1492-1517 MHz spectrum for mobile services, Consultation on Ofcom's proposed competition assessment](#), 18 July 2025, paragraph 3.18.

to ensure good outcomes for consumers. This view is supported by the CMA in its review of the *Vodafone/Three JV*.⁹ Determining new thresholds may be necessary for a larger award (such as 6 GHz or 600 MHz) in the future.

The UK mobile market is close to the limit of acceptable asymmetry in spectrum allocation

In our opinion, the asymmetry in spectrum holdings between the three UK MNOs is at or close to an acceptable limit from a competition perspective, based on the following evidence:

- Spectrum allocation between UK MNOs is more asymmetric than most European markets. This is not a problem *per se* but is a warning flag that Ofcom needs to be vigilant about spectrum shares going forward.
- The current distribution of spectrum between the three MNOs is an historical accident, determined primarily by mergers and only partially by competitive awards. There is no good reason to believe it represents the most efficient, pro-competitive distribution of spectrum between three strong MNOs. Rather, it is a distribution that regulatory bodies have deemed acceptable from a competition perspective.
- To secure their merger, Vodafone and Three offered undertakings that included selling 78.8 MHz of spectrum to VMO2. One may reasonably suppose that Vodafone-Three divested only the minimum quantity of spectrum necessary to secure regulatory approval for the merger, and therefore it is now at or close to a maximum level of spectrum holdings, above which there may be concerns for downstream competition.
- This forthcoming award of L-band spectrum was cited by the CMA as one of the reasons why further undertakings involving radio spectrum were not required.¹⁰

Spectrum allocation between UK MNOs is more asymmetric than most European markets

Analysis of MNO spectrum shares in European countries reveals that the distribution of spectrum between UK operators is relatively asymmetric.

In Figure 1, we set out the future distribution of spectrum under 6 GHz across the three UK MNOs, once our acquisitions of spectrum from Vodafone-Three are complete. Vodafone-Three will have the largest share of spectrum at 39%, ahead of BTEE with 32% and VMO2 with 29%. As we illustrate in subsequent figures, this distribution is asymmetric relative to other European three-player (and four player) markets, with Vodafone-Three enjoying a significant advantage over BTEE and O2. It should also be considered that VMO2 will not actually be in

⁹ CMA, [Anticipated joint venture between Vodafone Group plc and CK Hutchison Holdings Limited concerning Vodafone Limited and Hutchison 3G UK Limited, Final report](#), 5 December 2024, paragraph 8.300(b).

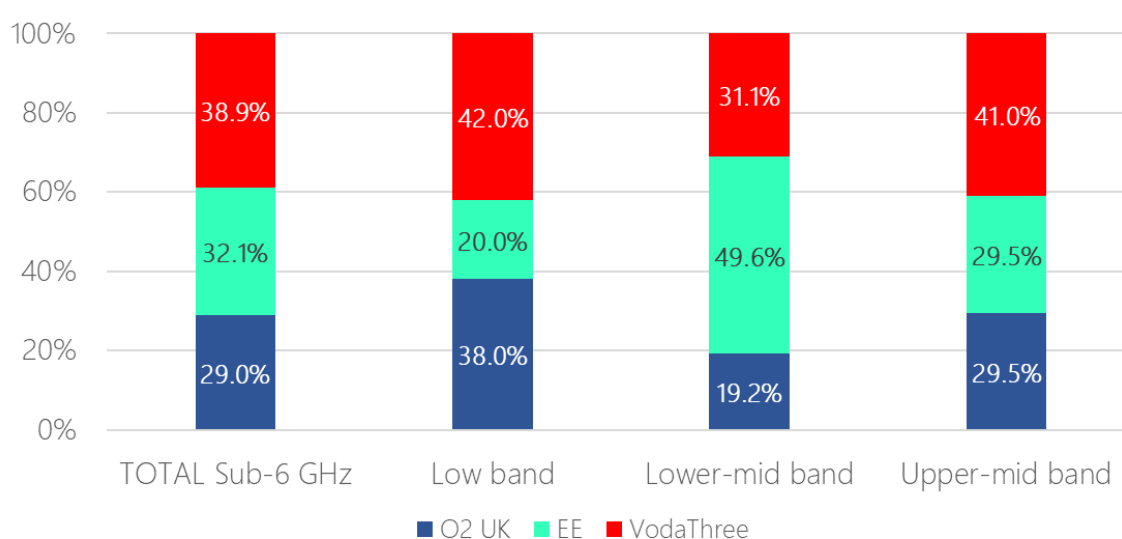
¹⁰ CMA, [Anticipated joint venture between Vodafone Group plc and CK Hutchison Holdings Limited concerning Vodafone Limited and Hutchison 3G UK Limited, Final report](#), 5 December 2024, paragraphs 8.309 and 14.249.

possession of all its newly acquired spectrum until September 2031, so this graph understates Vodafone-Three's holdings and overstates VMO2's holdings in this period.

Vodafone-Three's advantage is focused on the lower and upper parts of the core frequency ranges used for mobile:

- In low band (sub-1.5 GHz), Vodafone-Three (42%) has a modest lead over VMO2 (38%), but is well ahead of BTEE (20%);
- In lower mid-band (1800 & 2100 MHz), BTEE (50%) has a large lead over Vodafone-Three (31%) and an even larger lead over VMO2 (19%); and
- In upper mid-band (2300, 2600 & 3500 MHz), Vodafone-Three (41%) has a large lead over both VMO2 (29.5%) and BTEE (29.5%).

Figure 1: UK mobile spectrum holdings by band type (post forthcoming spectrum trades)*



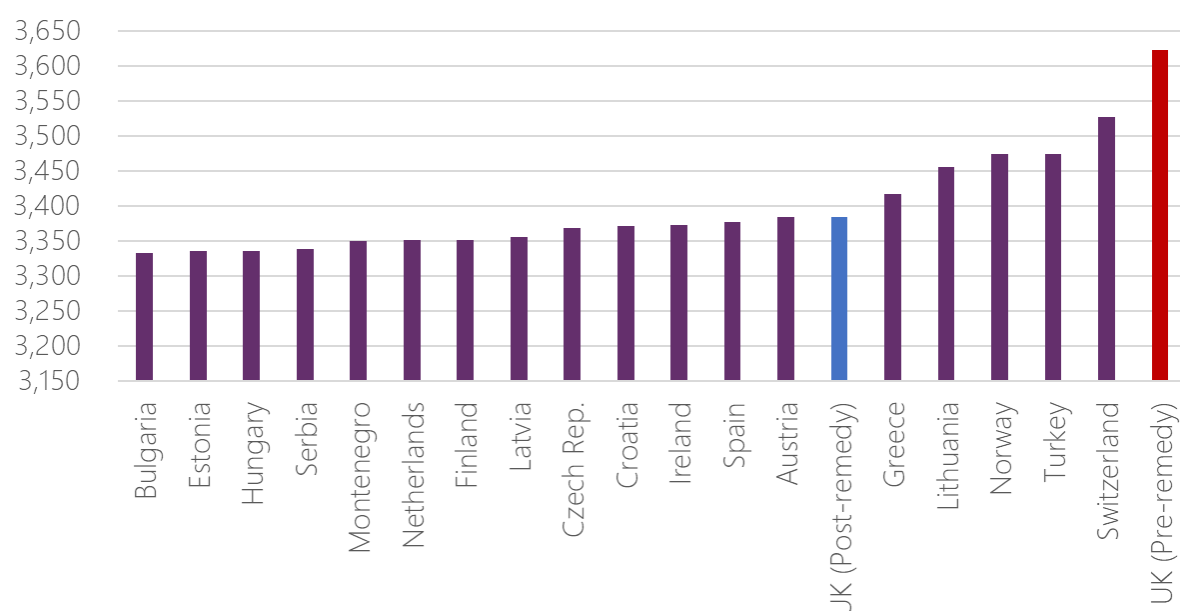
Notes: Excludes 5 MHz at the top and bottom of 2600 MHz TDD which is subject to low power restrictions to protect adjacent FDD use. *Includes future trades of spectrum between Vodafone-Three and VMO2 which are staggered across the period from September 2025 to September 2031.

Overall, it is clear that Vodafone-Three has a significant spectrum advantage. However, the strength of its rivals in key frequency ranges (VMO2 in low-band and BTEE in lower mid-band) may ease concerns that this could translate into an unmatched competitive advantage.

Compared to other European three-player markets, this is a relatively high concentration of spectrum in the hands of a single operator. The Herfindahl-Hirschman Index ("HHI") is a common measure of market concentration that is used to determine market competitiveness. It is typically applied to market shares in downstream mobile markets. In Figure 2, we use HHI to compare concentration in spectrum holdings across European three-player mobile markets. If the Vodafone-Three merger had proceeded without undertakings, the HHI would have been the highest in Europe at 3,623. Even after all spectrum divestments are complete, the UK, with a spectrum HHI of 3,385, will still have a more concentrated market than 13 of 19 European countries.

If Vodafone-Three were to win all spectrum available in this award (i.e. 20 MHz of usable spectrum out of a total allocation of 25 MHz), the UK spectrum HHI would increase to 3,404.¹¹ While this would not change the UK's position in Figure 2, it would move the UK closer to a group of five European markets where spectrum is particularly concentrated. These countries typically have clear market leaders (labelled by some observers as “preponderants”), such as Cosmote in Greece (52% market share), Swisscom in Switzerland (53%) and Telenor in Norway (46%), and often have relatively small third players, such as NOVA in Greece (17%), Salt in Switzerland (19%) and ICE in Norway (17%).¹²

Figure 2: Spectrum HHI for three-player mobile markets in Europe



Notes: Calculations exclude 5 MHz at the top and bottom of 2600 MHz TDD which in Europe is either unallocated or subject to low power restrictions to protect adjacent FDD use. Figures for Czechia and Spain exclude spectrum held by Nordic Telecom and Digi Spain respectively, as they are not established as MNOs. UK is shown both before and after Vodafone-Three's pending spectrum transfers to VMO2.

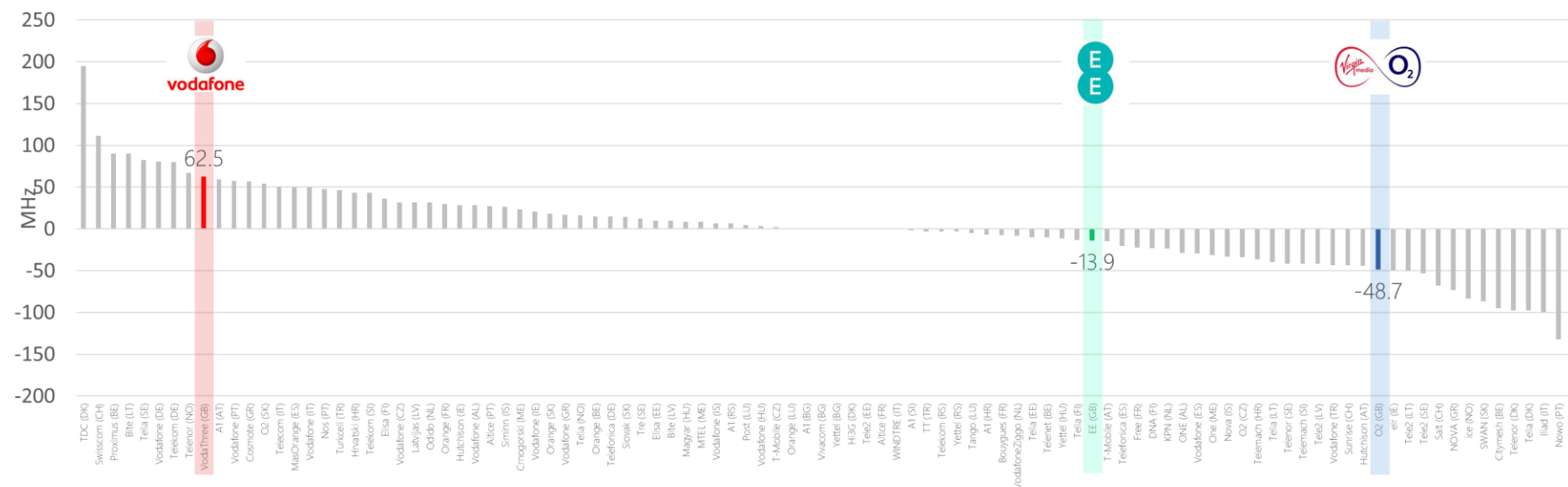
Source: The Gigabase, NERA's database of spectrum prices and holdings.

In Figure 3, we show the difference in sub-4 GHz spectrum holdings for all operators in Europe relative to a fair share split of spectrum between operators in their country. We highlight that, after spectrum divestments, Vodafone-Three will still hold over 60 MHz more spectrum than what would be required for an equal share, whereas VMO2 is almost 50 MHz below. This disparity between two major operators is very high when compared to MNOs in 25 other European countries. If Vodafone-Three were to secure an extra 20 MHz of usable spectrum, it would be more than 80 MHz above fair share and move further to the left in this chart.

¹¹ For the purposes of defining spectrum shares and spectrum HHI, we only consider “usable” full power allocations. Accordingly, consistent with our Part 1 and Part 2 Responses, we exclude the upmost 5 MHz in this award, as its use will be significantly restricted owing to adjacent band coordination requirements.

¹² All market shares were provided by NERA using latest available data from Telegeography.

Figure 3: Difference in sub-4 GHz spectrum holdings relative to equal split between operators for 26 European countries



Note: Survey included 100 operators across 26 European countries. The sample excludes very small new MNOs. The graph shows the delta in sub-4 GHz spectrum holdings in comparison to an equal split. The position of UK operators has been adjusted for all future spectrum transfers from Vodafone to VMO2, so understates actual asymmetry in the intervening period.

Source: The Gigabase, NERA's database of spectrum prices and holdings.

L-band spectrum allocation could contribute to future competition concerns

As Ofcom points out, the amount of spectrum in this award is a small proportion of all mobile spectrum. It offers up to 20 MHz usable of additional downlink spectrum, which is only an additional 2.8% of total downlink capacity below 4 GHz. It does offer excellent signal propagation, potentially expanding the volume of low band downlink by 12.9%.¹³ BTEE has argued that it is disadvantaged in respect to access to low-band spectrum, although we note that it has a huge quantity of 1800 MHz spectrum, which is the next closest band moving upwards.

On balance, we agree that the allocation of spectrum in this award to any operator does not raise immediate concerns regarding downstream competition, as, in our opinion:

- all three operators have enough wide-area downlink through 2030;
- all three operators have enough sub-4 GHz capacity through 2030; and
- more spectrum in larger quantities should be coming (600 MHz, 6 GHz).

Nevertheless, we reiterate that allocation of this spectrum could contribute to problems in the future, as operators with smaller holdings approach capacity constraints. In a market with three large operators, competition concerns could become acute if future awards of 600 MHz and 6 GHz do not happen in a timely fashion. And if Vodafone-Three were to make incremental spectrum gains in future awards, it could potentially build an unmatched network quality advantage over its rivals.

As we pointed out in our Part 2 Response, Vodafone-Three has an inherent valuation advantage if this award proceeds according to Ofcom's proposed auction design because it holds the adjacent spectrum. Ofcom should consider that Vodafone-Three made a deliberate decision to keep rather than sell those specific frequencies as part of the merger undertakings. This decision potentially positions Vodafone-Three to immediately raise its spectrum share above the level approved in merger undertakings. This is presumably the opposite of what was anticipated by the CMA in the merger decision when it highlighted the scope for concerns about spectrum imbalances to be addressed through future awards, including L-band.

In its consultation, Ofcom adopts a position that it is not necessary for it to explore "*cost differences in deploying spectrum between operators*":

"We have not considered cost differences in deploying the spectrum between operators. We would expect that bidders will have different valuations for the spectrum and that these may be partly driven, among others, by differences in the cost

¹³ For purposes of calculating downlink capacity, we have assumed that the following proportions of spectrum are available for downlink: FDD bands 50%; TDD bands 75%; and SDL bands 100%.

of deploying the spectrum. However, such differences in spectrum valuations are precisely what the auction seeks to uncover in order to achieve the most efficient spectrum allocation.”¹⁴

We think Ofcom’s position is in error because it fails to consider that the award, as proposed, is not a level-playing field. [X]. Such an outcome might be narrowly efficient in the context of Ofcom’s award design while reducing the overall efficiency of spectrum allocation across the three MNOs.

Given the small size of this award, an intervention that precluded Vodafone-Three from bidding for this spectrum seems too strong. And an intervention that only allowed them to bid for part of the spectrum could do more harm than good, as they might win a subset, leaving residual spectrum that is too small to interest rivals. Fortunately, as we discuss below, there are other actions that Ofcom can take short of spectrum caps that would reduce Vodafone-Three’s advantage in this award and ease concerns about long-term imbalances in spectrum holdings.

Good auction design and market signalling are appropriate remedies to address risks to competition for this award

We agree that a spectrum cap is not necessary for this award, but we disagree that this is because there is no competition concern. In our opinion, the distribution of spectrum is unduly asymmetric and likely inefficient, and this is a source of future risk for competition. We highlight here three intermediate measures that Ofcom could adopt to promote a more level playing field for this award and future awards.

[X]. Ofcom could substantially mitigate this issue by building a defragmentation process into the award design, so that VMO2 no longer faces the possibility of a permanent split assignment if it wins spectrum in this award. We explored how to do this in our Part 2 Response.

Secondly, Ofcom could [X]. In our Part 2 Response, we argued that if Ofcom adopts defragmentation and a variant of its Option A (a Clock auction with four 5 MHz abstract lots), it might consider spectrum floors, so bidders are not exposed to winning unwanted subsets of its demand. If Ofcom does not adopt defragmentation, we favour a single lot, multi round auction (Option E), to remove aggregation risk. These design approaches would be pro-competitive because [X].

Finally, we are concerned that Ofcom’s approach to its competition assessment in this award is too static. We ask Ofcom to adopt a more dynamic approach, recognizing and clarifying that

¹⁴ Ofcom, [Award of 1492-1517 MHz spectrum for mobile services, Consultation on Ofcom’s proposed competition assessment](#), 18 July 2025, paragraph 3.13.

the outcome of this award could have an impact on the risk of competition concerns arising and the potential need for competition measures in future awards.

Explicit recognition of the following could provide a positive signal to all market participants that Ofcom will be vigilant about spectrum holdings and their impact on downstream competition:

1. The existing distribution between MNOs is asymmetric and that this could become a concern in the future, even if it is not an immediate concern.
2. While each incremental award may be small, successive awards may end up contributing to a larger asymmetry that is undesirable.
3. If the L-band award results in greater spectrum asymmetry than is currently the case, this would increase the likelihood that competition measures, including spectrum caps, are required in future awards.

Taking together, such statements would incentivise operators with large holdings to be prudent when bidding for spectrum in smaller awards, such as this one, to avoid compromising their ability to acquire spectrum in future, larger, awards.