Three's response to Ofcom's further Consultation on Enabling mmWave spectrum for new uses

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Executive Summary.

Three welcomes the opportunity to respond to Ofcom's further Consultation on enabling mmWave spectrum for new uses.

In our response, we explain that Ofcom must strike a balance between enabling timely access to spectrum and conducting an efficient auction, which requires potential bidders to have a sufficient degree of certainty regarding their mmWave requirements, use cases, deployment methods and valuations.

We consider that conducting the auction in 2024 risks an inefficient allocation of spectrum, particularly for 40GHz, and that Ofcom should delay the auction until mmWave requirements are clearer. Ofcom could allow access to the 26GHz Shared Access Licences from 2024 as proposed. This would allow operators to test mmWave deployments and refine their requirements, use cases, deployment methods and valuations ahead of the auction.

Regarding the auction design, we believe Ofcom should adopt the SMRA format used in the UK's 2018 and 2021 auctions, as the clock auction adds unnecessary complexity and complicates bidders' attempts to change their demand. We strongly support Ofcom's proposal to auction sub-national lots, rather than individual High-Density Areas (HDAs). We believe that Ofcom should set reserve prices at the bottom of its proposed range for all three bands to reduce the risk of unsold spectrum, encourage participation from multiple bidders and provide more opportunities for price discovery.

We argue that Ofcom should award perpetual, tradable licences instead of fixed-term licences, with an initial term of 20 years, and allow licences to be leasable. Lastly, we explain that Ofcom should prioritise licenced use over Shared Access use and allow new and existing users to self-manage any required co-ordination during the revocation period.

Lastly, we set out our support for Ofcom increasing the number of High-Density Areas but explain that Ofcom should go further by increasing the number of HDAs and making them larger to [✂].

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In this Section, we explain that Ofcom must strike a balance between enabling timely access to spectrum and conducting an efficient auction, which requires potential bidders to have sufficient certainty regarding their mmWave requirements, use cases, deployment methods and valuations.

We explain that conducting the auction in 2024 risks an inefficient allocation of spectrum. mmWave spectrum is fundamentally different from other mobile spectrum. Bidders do not yet fully understand their mmWave requirements due to the poor propagation of the spectrum, uncertain use cases and an underdeveloped ecosystem (particularly for 40GHz).

Lastly, we set out our view that Ofcom should delay the auction until mmWave requirements are clearer. This would allow operators to test mmWave deployments and refine their requirements, use cases, deployment methods and valuations ahead of the auction.

Ofcom must strike a balance between enabling timely access to spectrum and conducting an efficient auction

Ofcom must decide the optimal timing of the auction to ensure the efficient allocation of spectrum, in line with its statutory duty. On one hand, Ofcom must weigh up the benefits of making 26GHz spectrum usable more quickly. However, it must also consider the significant risk of the mmWave allocation (especially 40GHz) being inefficient if it proceeds on its proposed timings, particularly as Ofcom does not believe that trading will ensure an efficient allocation of the spectrum.

An efficient auction (and therefore spectrum allocation) can only happen if all potential bidders sufficiently understand their likely mmWave requirements, use cases, deployment methods and valuations, across High-Density Areas (HDAs). Otherwise bidders that are overly optimistic about their mmWave requirements (or valuations) are likely to win too much spectrum, and conversely overly pessimistic bidders are likely to win insufficient spectrum (or none at all).

Auctioning the mmWave spectrum in 2024 risks an inefficient allocation of the spectrum because:

- **Bidders do not yet have a clear view on their mmWave requirements:** due to its poor propagation characteristics, mmWave requires significant investment in densification (e.g. in small cells). After initial enthusiasm in the US and South Korea, global appetite for the spectrum has waned as MNOs have come to

understand its practical limitations in real-world deployments. Furthermore, mmWave spectrum will be used to support many 5G applications that do not currently exist, and the commercial success of which is currently unclear (such as ultra-low latency or high bandwidth applications); and

- **The 40GHz ecosystem is unclear:** As Ofcom notes, the equipment ecosystem for the 40GHz band lags that of the 26GHz band, with no 40GHz consumer devices available on the market for mobile use. Harmonised conditions may arrive in 2023 but will not automatically apply to the UK. Further, in order for consumer devices to be usable with 40GHz spectrum, they would need (i) the relevant chipset and antenna module installed and (ii) the handsets would need to have undergone compliance testing and type approval. Significant uncertainty on how the ecosystem will develop will make understanding requirements and valuations particularly difficult.

In proposing a 2024 auction, Ofcom considers that "*Making both bands available in the UK may help to bring forward deployment timelines, by providing additional incentives for manufacturers to develop equipment and also potentially encouraging other administrations to consider authorising 40 GHz for new uses earlier*".[1] However, we believe Ofcom should be careful in putting too much weight on this aspect. Even if an earlier UK auction did accelerate demand in the UK, there is no guarantee that this would drive a meaningful acceleration in the ecosystem because manufacturers are likely to consider demand across several countries.

We believe that on balance, Ofcom should delay the auction

For the reasons we have described above, we are concerned that, if mmWave spectrum is auctioned in 2024, operators will bid based on uncertain expectations and may leave some (or all) of the spectrum won unused for many years.

We believe Ofcom is most likely to ensure the efficient allocation of spectrum (over the long term) by delaying the auction. Were Ofcom to do so we believe it could help ensure timely availability to the 26GHz spectrum via the Shared Access Licences from 2024 as proposed. This would also have the benefit of allowing operators to test mmWave deployments and refine their requirements, use cases, deployment methods and valuations ahead of the auction.

[1] Consultation, para 2.21

2. Comments on auction design, licence duration and co-ordination.

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In this Section, we explain our view that Ofcom should adopt the SMRA format used in the UK's 2018 and 2021 auctions, as the clock auction adds unnecessary complexity and complicates bidders' attempts to change their demand.

We explain our strong support for Ofcom's proposal to auction sub-national lots, rather than individual High-Density Areas (HDAs). The complexity of valuing and bidding for spectrum in a large number of individual areas would likely lead to an inefficient allocation of spectrum, and Ofcom's proposal to set aside 650MHz of 26GHz spectrum for Shared Access use in HDAs will facilitate new entry in these areas.

We believe that Ofcom should set reserve prices at the bottom of its proposed range for all three bands, to reduce the risk of unsold spectrum, encourage participation from multiple bidders and provide more opportunities for price discovery. We do not share Ofcom's concerns regarding frivolous bids with lower reserve prices and consider that the risk of setting them above or below potential market value is highly asymmetric.

Ofcom should in our view award perpetual, tradeable licences instead of fixed-term licences, as it has traditionally done. We also believe Ofcom should set the initial term to 20 years and allow licences to be leasable, to help address Ofcom's concern that over time the efficient allocation of mmWave spectrum may differ from that awarded in the auction.

Lastly, we explain that Ofcom should prioritise licenced use over Shared Access use and allow new and existing users to self-manage any required co-ordination during the 5-year revocation period.

Ofcom should adopt the SMRA format used in the UK's 2018 and 2021 auctions

Ofcom considers that the clock auction format is likely to be faster and simpler than an SMRA because it lacks the Standing High Bids mechanism.

It is not clear to us why a clock auction would be faster than an SMRA auction, but we disagree that it is simpler. Compared to an SMRA, the proposed clock auction has more complexity regarding prices in each round, with opening and clock prices and potential for intra-round bids at any price between these values.

The Standing High Bids (SHBs) as part of an SMRA auction serve a useful purpose for bidders. In a given round, bids that are not awarded SHBs can definitely be dropped or moved to another band. In contrast, due to the lack of SHBs in the proposed clock auction, any bidder can submit bids to change their demand in every round.

However, a bidder would not have certainty that such a bid would be accepted, which makes internal governance more difficult.[2] Bids to change the level of demand are processed in ascending order of price points (calculated as the ratio of the bid price between the opening and clock prices), making it unclear to bidders that their attempts to reduce or swap demand will be accepted (either fully or partially).

If Ofcom were to adopt an SMRA format and use small price increments, this would remove the need for intra-round bids that are possible in the proposed clock format. We note that the SMRA format worked well in 2018 and 2021 and is well understood by the four MNOs.

We support Ofcom reporting the exact total demand after each round, regardless of whether a clock or SMRA format is used. We agree with Ofcom that this will help bidders (i) identify the amounts of spectrum they are most likely to win, (ii) move demand between different bands and (iii) refine their estimates of spectrum value during the auction.

We support Ofcom's proposal to auction sub-national lots, rather than individual High-Density Areas

We strongly support Ofcom's proposal to auction sub-national lots, where bidders win access to spectrum in all of the High-Density Areas (HDAs). As we explained in our previous response, the complexity of valuing and bidding for spectrum in a large number of HDAs is likely to lead to an inefficient allocation of spectrum.[3] For example, this would risk bidders winning different amounts of spectrum (and/or different frequencies) in different areas.

Ofcom has also decided to set aside 650MHz of 26GHz spectrum for Shared Access use in High-Density Areas, which will be sufficient to enable entry from any new operators that want to deploy in only certain areas. Further, Ofcom notes that it did not receive significant evidence of demand for mmWave spectrum in individual cities in response to its previous Consultation.

[2] For example, two bidders both attempt to drop demand but both cannot be accepted because this would cause total demand to fall below supply in the given band.
[3] Page 66 to 70, https://www.ofcom.org.uk/__data/assets/pdf_file/0025/243556/three.pdf

Ofcom should set reserve prices at the bottom of its proposed range for all three bands

As Ofcom explains, low reserve prices have several advantages. They reduce the risk of unsold spectrum, encourage entrants to participate in the auction and provide more opportunities for price discovery. On the other hand, Ofcom is concerned that reserve prices that are too low could invite frivolous bids and increase the incentive to strategically withhold demand, to gain lower prices.

Ofcom has reviewed benchmarks from other jurisdictions and proposed reserve prices that, in its view, are materially lower than possible market value: between £0.25m and £2m per 100MHz lot. It proposes £1m per lot for both 26GHz bands and £0.5m per lot for 40GHz, reflecting the less developed ecosystem.

We consider that Ofcom should set reserve prices at the bottom of its proposed range for all three bands because:

- We do not share Ofcom's concern regarding frivolous bids – a reserve price of £0.25m per lot is sufficient to deter any such bidding given the large sums involved in bidding for even a modest amount of spectrum;

- Even if Ofcom is correct that lower reserve prices increase the incentive to strategically withhold demand, this may not affect the spectrum allocation and in any case Ofcom should have no regard to auction revenues; and

- The risk of setting reserve prices above or below potential market value is highly asymmetric: if reserve prices are set too low, they can be bid up to market value, but setting them even slightly higher than market value results in unsold spectrum. As explained above, mmWave requirements are highly uncertain so the market value of the spectrum is very unclear.

Ofcom should award perpetual, tradeable licences with a 20-year initial term that can be leased

Ofcom has traditionally awarded mobile licences with an indefinite term and an initial period of 20 years, during which Ofcom cannot revoke the licences or charge Annual Licence Fees. However, Ofcom is concerned that the initial allocation of citywide mmWave licences from the auction may not be efficient in the long term and so proposes 15-year, fixed-term licences.

We believe that Ofcom should issue perpetual, tradeable licences (rather than fixed term) and that the initial period should be extended to 20 years. We discuss these in turn:

- As we have consistently argued, for spectrum that is freely tradeable, trading ensures the efficient allocation and use of spectrum over time. As a result, we do not believe Ofcom is justified in imposing fixed-term licences. While we do not believe Ofcom has grounds to revoke tradeable spectrum, it would be preferable for Ofcom to issue perpetual licences and revoke them if in future it had strong evidence of inefficient use, rather than determining in advance that the licences will be revoked after an initial term; and

- Ofcom must consider the need for potential bidders to have certainty and a sufficient period over which to recover their investments. As a result, we consider that the initial period should be 20 years, consistent with other recent spectrum awards, e.g. 700MHz.

In addition, we believe the awarded licences should be leasable. Ofcom appears concerned that over time the allocation of mmWave spectrum from the auction may not be efficient (this is part of Ofcom's rationale for proposing 15-year, fixed-term licences). The ability to lease spectrum provides a simple market mechanism to address this, if and when it arose.

Ofcom should prioritise licenced use over Shared Access use and allow new and existing users to self-manage any co-ordination issues

Below, we suggest alternative proposals relating to three co-ordination scenarios.

<u>Co-ordination between licenced and Shared Access use on the boundaries of High-Density Areas</u>

Ofcom proposes that both types of users should have field strength limits, covering all medium-power base stations (those of licenced users inside HDAs and Shared Access users outside HDAs).

We consider that licenced use should have absolute priority over Shared Access use, and that in the case of interference the Shared Access user should amend its transmissions to protect the licenced user. This is important to give bidders certainty that they can deploy their mmWave spectrum fully in the HDAs, and therefore derive their valuations appropriately.

Co-ordination between licenced use and existing fixed links in and around HDAs during the revocation period

If Ofcom were to proceed with an auction during the revocation period for existing users, it should allow new and existing users to self-manage any required co-ordination (as it explores in para 10.6a), with escalation to Ofcom as a backup option.

We do not agree that Ofcom should manage such co-ordination, either via a map with power restrictions or exclusion zones (para 10.5a), or via its co-ordination tool (para 10.5b). These are unnecessarily burdensome on both Ofcom and industry, and we have experience of co-ordinating with other users [✂]. Further, we do not agree that during the revocation periods, award winners should have restrictions on what they could deploy on frequencies overlapping existing fixed links in lower 26GHz and 40GHz.

Co-ordination among 26GHz Shared Access Licence users

For low-power base stations, Ofcom proposes minimum separation distances between different Shared Access users in the 26GHz band.

When considering two outdoor Shared Access users, Ofcom proposes a minimum separation distance of 200 metres. We consider that this should be [✂]. Our understanding is that the maximum coverage of 26GHz is approximately [✂], and so two users would need to be [✂] apart to avoid any interference.

For two indoor Shared Access users, Ofcom proposes a minimum distance of 100m. We consider that this should be [✂], due to the same logic as above but accounting for the fact that indoor base stations will transmit using lower power.

In Table 1 below, we show Ofcom's proposals with our alternative suggestions for the two scenarios described above.

Table 1: Minimum separation distances between different 26GHz Shared Access users

	Low power (indoor)	**Low power (outdoor)**
Low power (indoor)	100m (we suggest [✂])	200m
Low power (outdoor)	200m	200m (we suggest [✂])

3. Ofcom should increase the number and scope of High-Density Areas.

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In this Section, we summarise our previous response regarding High-Density Areas and set out our support for Ofcom increasing the number of areas. However, we explain that Ofcom should go further by increasing the number of HDAs and making them larger to [✂].

We show that Ofcom's 68 HDAs exclude [✂] and we present simple, revised proposals that would [✂].

Firstly, we show that by including Ofcom's full list of 107 potential HDAs, this would cover [✂]. Secondly, we show that [✂] sit just outside Ofcom's HDAs, and suggest Ofcom expands certain HDAs or creates new ones to cover these areas. Lastly, we show that by including areas with lower populations, a further [✂] would be included.

Summary of our previous response regarding High-Density Areas

In response to Ofcom's last Consultation, we argued that Ofcom had significantly underestimated the number of High-Density Areas (HDAs) because:

- Ofcom had not taken a forward-looking approach because it did not consider future developments;
- Ofcom inferred too much from the density of existing macro sites (the density of base stations today may not be representative of future mmWave deployments); and
- We forecast significant network congestion in many of the areas Ofcom did not propose as HDAs.

We explained that in our view, the impact of including too many areas is likely to be materially lower than the impact of including too few areas, as Ofcom intends to enable Shared Access Licences in both the 26GHz and 40GHz bands. Further, Ofcom intends to allocate 650MHz of 26GHz spectrum for Shared Access Licences in HDAs.

We argued that Ofcom should err on the side of including more and wider areas as HDAs, reducing the risk that future widespread mmWave deployments are required in areas which operators cannot access spectrum on a licenced basis. If operators cannot access spectrum on a licenced basis in certain areas, they would either have to let these areas congest or make a series of Shared Access Licence requests with little certainty about whether they could access their required frequencies.

Ultimately, we argued that Ofcom should increase the number of HDAs to at least its 80 highest-ranked areas, and probably more.

We support Ofcom increasing the number of High-Density Areas, but believe Ofcom should go further

In Ofcom's previous Consultation, it proposed to only include 40 of the 107 potential HDAs it identified, based on towns and cities which have either a population of at least 75,000 or notably high peak-hour mobile traffic.

We support Ofcom's updated proposal to consider the top 80 areas, which result in 68 HDAs once Ofcom simplifies the boundaries and merges areas that overlap as a result. However, we have compared Ofcom's 68 HDAs to [✂].

In Figure 1 below, we show Ofcom's HDAs (in green) and [✂]. While Ofcom's HDAs cover [✂]. Below, we suggest simple changes that Ofcom could make to its HDAs that would result in [✂].

Figure 1: [✂]

[✂]

Source: Ofcom and Three

We believe Ofcom should retain all 107 potential HDAs

Ofcom generates a list of 107 potential HDAs and then cuts-off the list to include only the top 80. Ofcom does not provide a clear rationale for omitting the additional 27 areas, and our analysis shows that these areas contain [✂]. Were Ofcom to retain the full list of 107 HDAs, this would cover [✂], shown in red in Figure 2 below.

Figure 2: [✂]

[✂]

Source: Ofcom and Three

We believe Ofcom should consider making HDAs slightly larger to [✂]

Considering [✂], we have identified [✂] (in light green) which sit just outside of Ofcom's 68 HDAs (in pink), including [✂], as shown in Figure 3 below. These [✂] are incremental to the [✂] that would be included by Ofcom retaining all 107 HDAs.

We believe that Ofcom should consider making the HDAs slightly larger to align more closely with [✂]. Alternatively, it could create new HDAs to better target these areas.

Figure 3: [✂]

[✂]

Source: Ofcom and Three

Ofcom should use a lower population threshold in considering HDAs

Ofcom included towns and cities with at least 75,000 population and also areas with notably high peak-hour mobile traffic. Our analysis shows that if Ofcom were to use a lower population threshold of 50,000, the HDAs would cover a further [✂]. Using an even lower threshold of 25,000 would cover [✂]. These [✂] are incremental to those mentioned above in our previous suggestions.