# Vodafone Response to Ofcom Consultation:

# "Mobile networks and spectrum: Meeting future demand for mobile data"

# Executive Summary

Vodafone welcomes the opportunity to comment on Ofcom's discussion paper regarding mobile demand for spectrum. This response should be read in conjunction with our response to Ofcom's Mobile Market Review.

We agree with Ofcom's assessment of the growth of mobile demand, which in broad terms equates to a doubling of demand every two years for the central case.

We do not agree with Ofcom's conclusions that meeting this demand is best accomplished via densifying networks with existing and pipelined (1.4 GHz, 26 GHz) spectrum. We do not believe that such a densification approach is achievable technically, and there is no sensible investment case for introducing up to 50,000 new cells to UK mobile networks, unless consumers are willing to pay considerably more for mobile service.

The only realistic prospect of satisfying demand is via deployment of further mid-band spectrum, by making the upper 6 GHz band available for mobile usage. Absent this, the alternative is not mass deployment of mm-wave as Ofcom foresees, but instead that networks will go into congestion in busy areas. Although we foresee some deployment of mm-wave, this will be in very targeted scenarios.

Cost reduction via mast sharing is already widespread in the outdoor macro network. We agree that shared coverage solutions present an opportunity to improve indoor coverage, but these are undermined by regulatory initiatives such as the liberalisation of mobile repeaters. We believe that there may be a role for neutral hosts, but the economics need to be examined very carefully to ensure that the benefit in terms of cost sharing are not outstripped by the commercial return that a neutral host provider will wish to achieve.

Notwithstanding indoor coverage solutions, we foresee greater pressure on sub-1 GHz spectrum for providing macro coverage that extends in-building. Some of this may be addressed by refarming to the latest technology and potentially trading to consolidate sub-1 GHz holdings, but ultimately Ofcom must review whether it is appropriate for Digital Terrestrial Television (DTT) to continue to utilise spectrum without paying fees reflective of mobile usage being excluded by its presence.

# 1. Introduction

Vodafone welcomes discussion paper on future mobile industry demand for spectrum. This response should be read in conjunction with our response to the associated Mobile Market Review consultation, in which we raise fundamental issues around the structure of the mobile market, and network operators' ability to invest at a sustainable rate of return.

There is much to commend in Ofcom's analysis; we broadly agree with the growth scenarios presented and that Ofcom is on the correct track in looking at the precise geography of demand. From a technical perspective we agree with Ofcom's observations on refarming spectrum to the latest technologies, including using the most efficient antennas such as M-MIMO technology. A degree of network densification would be an option in seeking to fulfil demand, albeit one that brings with it a lot of technical issues. However, as we set out in this response, the densification envisaged by Ofcom is simply economically and practicably unfeasible. It is incompatible with industry revenues and profitability; Ofcom's analysis has failed to recognise the need for investors to secure a return on investment. Competition will incentivise investment, but only to the extent that said investment results in a profitable outcome.

# 2. Demand Growth

Estimating the growth in demand for mobile services, hence potential increase in spectrum demands, is complex. A "bottom up" approach of analysing likely applications hence demand is doomed to failure, because the industries supported by mobile services are so innovative that it is impossible to say with any confidence what services will be driving demand in anything but the short term. A decade ago, whilst the success of the smart phone was reasonably established, few could have predicted that such devices would become the default choice to access the digital world, or that the digital world would become as important as face-to-face contact, whether in a commercial context, or access to media, or access to public services, or person-person communications. So, while today we can point to potential applications which will depend on mobile connectivity such as augmented reality, connected vehicles, connected healthcare and the metaverse, and we can attempt to quantify the likely data requirements of such applications, we cannot realistically know the "killer applications" hence holistically derive what networks will need to support. Further, taking a "bottom up" approach renders any analysis vulnerable to quarrels around the detail of what network demands each individual application could drive – a case of being duped into examining the detail of the bark on an individual tree rather than the task at hand, which is to assess the overall size of the forest. Therefore, a better approach is to rely on trending existing demands, with one eye on known likely applications to sense-check the growth trajectories that are envisaged.

Against this backdrop, we broadly agree with the growth rates for mobile demand set out in the discussion paper. We assume a base case of demand continuing to double every two years as we see today, recognising that data throughput is a somewhat blunt instrument that masks, for example, the need to

prioritise applications requiring low latency and also that growth is not uniform either geographically or on a time-of-day basis, as illustrated during the pandemic where traffic both increased outside cities and changed its profile during the day.

The approach used by Ofcom of examining demand in specific locations based on Connected Nations data is a simplified version of that which is already adopted by mobile network operators. We already monitor demand on our network on a geographic pixel-by-pixel and technology-by-technology basis, in order to assess the best mix of technology and spectrum in each area, and determine when new sites are desirable and cost-effective. We maintain complex "heat maps" which show where and when (as busy hours shift) our network would benefit from optimisation. Importantly we also distinguish indoor and outdoor locations which require different solutions. The techniques presented by Verizon at the associated conference to this consultation exercise are business-as-usual for Vodafone, and have been for some time – we would be surprised if this were not to be the case for our competitors. Where Ofcom's analysis suffers is in the static nature of the input data, representing a snapshot of network demand. In contrast, we generate heat maps that reflect the dynamic nature of demand, and these show that hot spots vary over time, even within a day. Further, patterns are not always consistent or regular over time, for example exhibiting seasonal variations, and variations due to incidents or events.

Ofcom's analysis points to a need to densify networks with tens-of-thousands of additional extra small cells, potentially using mm-wave spectrum, if no additional mid-band spectrum is to be made available. This reduces to thousands of extra small cells if more mid-band spectrum can be made available. Vodafone has been at the leading edge of innovative deployment of small cell solutions, for example trialling the usage of phone boxes[1] and manhole covers[2]. However, widescale adoption of small cells assumes static demand, rather than the demand hotspots varying: it is for this reason that macro network deployment of spectrum that covers a relatively wide area and provides relatively high capacity is essential – mid-band spectrum meets this sweet spot.

There are issues with the deployment of small cells that the discussion paper fails to address. As we set out below, mm-wave is unlikely to be technically or economically feasible except in specific limited scenarios. However, re-using existing frequency bands on both macro and small cell deployments in a given area present problems. This means that using a given band for small cell purposes effectively quarantines its usage at the macro layer. We are then faced with a choice between converting an entire area to small cell coverage (which is unlikely to be practicable), or accepting a degradation in the wider area served by the macro layer.

Further, as we set out in the following section, scenarios of mass network densification are detached from commercial reality because current industry profitability cannot support the suggested level of investment.

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[1] Vodafone installs 4G on phone boxes across four UK towns and cities
[2] Vodafone lifts lid on manhole covers to improve mobile coverage

A more realistic question is therefore at what point mobile networks will go into congestion in some areas if suitable spectrum is not made available, and what can be done to mitigate this.

# 3. Investment Reality

Our response to Ofcom's companion consultation reviewing the mobile market lays bare the challenging economics of building and operating mobile networks in the UK. Over recent years Return on Capital Employed (ROCE) has either lagged the industry cost of capital, or barely exceeded it. Ofcom seeks to refute this by highlighting that returns vary between operators, and that using its preferred metric, which strips out goodwill and spectrum, returns are healthy. However, stripping out the historic cost of spectrum auctions from the cost of operating a mobile network is the equivalent of deluding oneself that one's household finances are healthy if the cost of the mortgage is ignored. Investors cannot simply forget the sums that mobile network operators spend at auction. To raise funds, we must ask investors to continue to put their money into an industry that has to-date generated meagre returns.

It is abundantly clear that an industry that is barely profitable based on two mast share arrangements of around 20,000 masts each, will not be able sustain an increase of 30,000-50,000 cells based on existing revenue levels. It is a myth to suggest that such densification is feasible.

The discussion paper suggests that competition will drive such densification, but competition only drives investment to the extent that investors can yield a positive return. Unless the densification provides significant new revenue streams, it is difficult to see how it could ever be justified. The paper also posits various ways in which densification could be made more commercially viable, for example by greater mast sharing, via neutral hosts, or via innovative new entrants. These are somewhat illusory though:

- Operators already extensively share masts to reduce costs, in the case of Vodafone and VMO2 on a MORAN basis, sharing active radio equipment in many parts of the country; BT and Three similarly share, on a more passive basis. Via the Shared Rural Network (SRN), operators are deploying a sharing solution to hundreds of new sites over the next few years. The scope for further sharing is therefore limited – operators are already yielding these build efficiencies.
- Neutral hosts could ease the investment case in that it would combine a four-way sharing arrangement with the administrative ease of a turnkey solution. However, in a world of finite revenue streams, dividing this income between extra market participants (i.e. the neutral host provider) could worsen individual investment returns.
- Similarly, unless new market entrance serves to increase overall revenue streams, the result will be to dilute revenue across more market players, worsening returns. Unfortunately, many new entrant innovations that we have experienced in recent years have not introduced new revenue streams, but instead aimed to substitute a portion of incumbent operator revenues.

In setting out its vision of network densification, Ofcom has pointed to other markets and shown Verizon in the USA as an exemplar of how this can be achieved. As we set out below, there are specific local issues which drove Verizon's strategy, but notwithstanding this we must highlight that profit margins in the US market are considerably higher than in Europe, giving the confidence required to invest the huge sums involved. For investors, the markets are simply not comparable.

As we set out in our companion response to the mobile market review, there are measures that Ofcom could take to address the industry investment climate, not least evolution of the spectrum Annual Licence Fee (ALF) regime so that the £300M+/yr which is currently siphoned out of the mobile industry is instead reinvested into the rollout of sustainable communications networks.

# 4. Fulfilling Mobile Demand

### The spectrum pipeline

Ofcom's discussion paper concludes that the current spectrum pipeline is sufficient to meet demand for mobile services. However, in making this statement, Ofcom is less than clear of what it envisages the spectrum pipeline containing – clearly there is reference to further release of 1.4 GHz and 26 GHz, but although the provision of further mid-band spectrum via the upper 6 GHz is discussed, it is unclear whether Ofcom was including that when asserting that was sufficient spectrum. Further, no mention was made of sub-1 GHz spectrum.

To be clear, Vodafone cannot agree with Ofcom's assertion that there is sufficient spectrum to meet mobile demand, unless the assumption was that the upper 6 GHz would be made available for mobile usage.

In any case, discussion of whether there are adequate spectrum stocks is meaningless unless it is combined with considerations of the economic feasibility of deployment. To take an extreme example, mobile spectrum demand could be fulfilled by making a single spectrum band available, if mobile operators were to build networks at the density of multiple cells per customer premises. Clearly, building at this density would be economic madness with no hope of making a reasonable return on the investment, but it would meet the criterion of there being sufficient spectrum. Any assessment of the adequacy of spectrum supply must therefore factor in the level of network build that is commercially viable, but in asserting that the pipeline is adequate so long as perhaps 50,000 cells are deployed, the discussion paper fails to address whether mobile industry revenues are sufficient to support that build. They are not, so Ofcom is wholly wrong to assert that a pipeline which doesn't contain provision of additional mid-band spectrum is adequate.

### The case for mm-wave spectrum

Vodafone believes that mm-wave spectrum has potential applications, particularly in high footfall areas such as shopping arcades and sporting venues. A much-cited application has been at the Super Bowl in the USA, and we certainly foresee similar applications in British sporting stadia. Further, there may be scope for usage in industrial applications, although we note that indoor shared usage spectrum made available by Ofcom has

thus far failed to attract many users. Fixed Wireless Access (FWA) is frequently mentioned as a use case for mm-wave spectrum, but there are challenges in that such applications require good, line-of-sight coverage to households and typically professional installation of external antennas, making the overall economics and investment case for mm-wave FWA very challenging.

In summary, we believe that we could make targeted usage of mm-wave spectrum, but as we will elaborate in Ofcom's consultations on the 26 GHz award process, the business case for such usage is sufficiently shaky that it could not support any significant costs to acquire rights of access to the spectrum. Our experience in the European market is that where mm-wave has been awarded via auction, it has sold at reserve pricing.

Where we fundamentally differ from Ofcom is around the prospects for mass adoption of mm-wave spectrum across the network. At a technical level, the propagation characteristics of mm-wave are significantly inferior to mid-band spectrum, meaning inter-site distances would need to be very small, transmission into buildings is impossible, and blackspots of coverage would be created by urban clutter. More significantly, there is no workable investment case for deployment of mm-wave outside extremely high footfall areas as there would be massive deployment costs with no associated incremental revenue stream. Given a stark choice between uneconomic investment in mass rollout of mm-wave, and the alternative of networks going into congestion in demand hotspots, the rational decision will be to tolerate congestion.

Mm-wave has notably been deployed by Verizon in the US market. However, as we noted above, this is a market which exhibits higher profit margins hence can support greater investment levels, when compared to European markets. Further, we note that at the point when Verizon deployed mm-wave spectrum, it did not have access to mid-band spectrum in the 3.5 GHz band, so deployment of mm-wave was required to offer a 5G service rather than necessarily being a technical choice on their part. We note that US operators paid over $100Bn to secure 3.5 GHz spectrum, and once this was available deployment focussed on this rather than higher frequency spectrum. Lightreading[3] notes that analysts are now questioning the wisdom of mm-wave deployment:

> *Nonetheless, most financial analysts have concluded that operators' interest in mmWave is mostly over. The financial analysts at Sanford C. Bernstein & Co dubbed Verizon's investment into mmWave a "staggering whiff."*
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> *"The lie of millimeter wave is dead," agreed the financial analysts at New Street Research after hearing of Verizon's latest mmWave buildout targets. After all, a Google study from 2019 indicated it would take roughly 13 million transmitters and $400 billion to deliver 100Mbit/s to 72% of the US population using 5G in mmWave spectrum.*

[3] "The age of mmWave 5G sputters to a dusty death", Lightreading, July 2021

In short, we believe that deployment of mm-wave was born of necessity rather than choice. We note that as a consequence, Verizon's 5G reach lags that of competitors who were able to focus on mid-band deployment from the outset[4].

Deployment of mm-wave could also prove costly to the consumer. It is our understanding that typically only high-end handsets contain the necessary chipsets. According to PCMag[5], incorporating mm-wave support to a mobile handset typically adds $50-100 to the retail price. It is unclear at this stage whether this is an issue of early adopter premium, but as Verizon is a scale player, we would have expected that to have been largely competed away. The danger is that if mm-wave is not widely supported in the mobile device ecosystem, it would not provide the relief to lower frequencies that Ofcom might envisage.

In summary, mm-wave deployment has its place, but widescale rollout as envisaged by the discussion paper is not something that we foresee. It would require huge capital investment while the industry is facing economic challenges; this is not in the best interests of consumers, network operators or investors.

### Provision of mid-band spectrum

Along with operators from over 50 countries globally, Vodafone considers it essential that additional mid-band spectrum is made available for mobile usage. GSMA suggests that provision of additional mid-band spectrum will drive over $200Bn of global GDP increases by 2030[6]. We consider that Ofcom should be in the vanguard of lobbying for allocation of the upper 6 GHz band for mobile at WRC-23, as the only prospective mid-band spectrum for the UK market.

Our modelling projects that the current 3.5 GHz stocks of spectrum will start to exhaust on a 6-7 year timeframe, even allowing for refarming of spectrum to the latest technologies. At this point, absent access to the upper 6 GHz band, mobile operators will be faced with a choice of allowing networks to be congested in high demand areas, or deploying mm-wave spectrum. As we have set out above, the investment case for deployment of mm-wave in all but the highest footfall areas is not commercially sustainable, so overwhelmingly the outcome will be congestion. Contrary to Ofcom's suggestion, competition does not represent a magic wand that will stimulate investment, because investment will only occur to the extent that it is profitable, and the current UK market revenues cannot support densification of networks.

We are concerned about the unintended consequences of regulation in this scenario. A rational approach to coping with network congestion is to invoke traffic management measures, so that the most prolific users do not hog the available bandwidth. However, it is debatable whether current net neutrality rules would allow such management to be invoked: although the congestion would be temporary in that it would occur only at certain times of day, it would be permanent in that with no viable upgrade path, the pattern of congestion

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[4] Opensignal 5G Experience Report January 2022, Verizon 5G Reach score 3.7/10, compared to AT&T 5.2/10 and T-Mobile 7.4/10. We in no way intend this as a criticism of Verizon or its strategies, more that it reflects the difficulty of providing widespread coverage with mm-wave spectrum.

[5] "MediaTek Pegs $300-$500 Range for Millimeter-Wave Phones", PCMag, November 2021

[6] The socio-economic benefits of mid-band 5G services, GSMA, Feb 2022 – mid-band will drive more than $610Bn of growth, of which 40% could be jeopardised if no additional mid-band spectrum is made available.

would persist. But Article3(3) of the Open Internet Access Directive[7] sets out that traffic management is only to be deployed to address temporary network congestion, so it is questionable whether proportionate measures could be taken to ensure access is maintained for all users. Further, Article3(3) prevents sensible commercial negotiations between network operators and content providers to recover any particular costs of supporting their content, which may well be the difference between a network upgrade being commercially viable or not. As we set out in our response to the mobile market review consultation, Vodafone considers it essential that at the least there is clarity of interpretation of the net neutrality rules, and preferably reform of these rules.

With no ability to traffic manage congestion within the regulation, and no ability within the regulation to incentivise content providers to internalise the externality of congestion via recovering costs from them, network operators' only choices will be to tolerate congestion, or to manage via retail prices (e.g. to increase the price or restrict availability of unlimited packages).

Provision of the upper 6 GHz band for mobile service would allow network operators to economically upgrade their existing network of microcell sites to support the forecast demand, staving off the prospect of networks going into congestion. With M-MIMO antenna technology that is already well established globally for 5G, higher antenna gains for higher frequency bands means 6 GHz spectrum can achieve similar levels of coverage as 3.5 GHz services today. We have already proved this through field trials with prototype 6 GHz equipment from our suppliers, and will continue these trials with pre-commercial equipment later this year – Ofcom is welcome to witness these trials. Our network suppliers have indicated that should a positive decision around 6 GHz spectrum be made at WRC-23, commercial network equipment can be provided one or two years later.

It is our understanding that dual band 3.5 GHz and 6 GHz equipment will be viable in a similar form factor to existing 3.5 GHz 5G equipment, facilitating graceful upgrades and more flexible deployment options. Mm-wave would still be deployed where commercially and technically viable.

From an environmental sustainability perspective, we consider this approach would have a lower carbon footprint than deploying large volumes of small cells. The energy and materials required to build out tens of thousands of small cells would be extreme, followed by the energy to operate and maintain these sites over time – for example when examining FWA, Forzati[8] suggested a 55-75% uplift in power consumption for mm-wave in comparison to macro-networks using mid-band spectrum.

We are concerned that Ofcom believes incumbent usage presents significant barriers to the upper 6 GHz being allocated for mobile, such that it will be impossible to clear the band until it's too late. We disagree; Ofcom has a long history of managing spectrum by clearing bands where a higher value user has been identified. Coexistence studies are ongoing. In the event that existing users need to be cleared to facilitate

[7] Open Internet Access Directive
[8] "Cost, performance and energy consumption of 5G fixed wireless access versus pure fiber-based broadband in Sweden", Forzati, June 2020, Tables 24 & 24

mobile usage, then Ofcom could issue the usual 5 years' notice, then award the spectrum for mobile use with deferred access terms where that is required to protect incumbents. It would then be possible for market measures to prevail, i.e. if mobile operators wished to utilise the spectrum before the notice period had expired, they could negotiate with incumbent to accelerate their clearance (similarly, if the incumbent needed longer than 5 years, that could be open to negotiation with the new mobile licensee).

As a European operator with both fixed and mobile services, we are disappointed that the debate on mid-band has descended into an either/or type conversation between mobile usage and licence-exempt. There is need for equilibrium in the provision of spectrum, with neither licensed nor licence-exempt spectrum users facing congestion. Vodafone's fixed service customers rely upon Wi-Fi for delivery of applications within the home. It is not in our interests for there to be congestion of such services and we believe that the spectrum already made available in the 5 GHz and lower 6 GHz bands will ensure that this does not occur. If this does exhaust, then fundamentally as an indoor use case, we consider that further Wi-Fi expansion should occur in higher frequencies such as 60 GHz. However, we do not preclude local indoor licensing of the upper 6 GHz bands for applications that can coexist with mobile (for example, in geographic areas where provision of additional mid-band spectrum hasn't been necessary on our part).

We urge Ofcom to recognise that absent provision of mid-band spectrum, the mobile industry faces a capacity crisis in the medium term, with consequent impact on the British economy.

### Indoor usage

We perceive a somewhat false dichotomy in Ofcom's analysis between an "outdoor-in" approach to serving indoor customers (i.e., serving indoor customers via the macro network) and an "indoor-in" (i.e., using licence-exempt spectrum or indoor coverage solutions to serve indoor customers). Both strategies are sensible in the correct environment, and providing a comprehensive quality service at a commercially viable cost involves a mix of the two.

Mobile operators already adopt an "indoor-in" approach via offload to available Wi-Fi networks, and in commercial environments, deploying coverage solutions either unilaterally or on a shared model such as JOTS.

Wi-Fi

Offload to Wi-Fi does not meaningfully affect the growth rates that Ofcom has identified. Inherently, the baseline wide-area mobile network data levels from which Ofcom sets its trends are already reflective of a significant proportion of traffic being offloaded to Wi-Fi. As such, unless the degree of Wi-Fi offload varies over time, it will not affect the growth rate of mobile. Whilst there is a certain degree of ebb and flow in the level of Wi-Fi offload, we have not seen any evidence to support a position that more traffic (in percentage terms) will be offloaded from the mobile network. If anything, the ebb and flow at present points to a marginal decrease in offload – when COVID restrictions resulted in much of the population being confined to their homes which on the whole have Wi-Fi networks, we saw a change to the location of demand on the mobile network, but we did not see a reduction in that demand (indeed, traffic actually increased). We are

also seeing some evidence of customers modifying behaviour, for example not downloading content via Wi-Fi prior to leaving the home, but with the greater prevalence of unlimited data packages, streaming via the public network in real time instead. Further, in some cases even where mobile handsets are connected to home Wi-Fi networks, they prioritise the public mobile network because it can deliver faster data rates.

Indoor coverage solutions

In some commercial environments an indoor coverage solution is a sensible approach, either unilaterally or shared with other mobile networks. We are not opposed to the usage of neutral hosts, so long as security fundamentals are maintained such as our having control of the RAN equipment (which also aligns with the licensing requirements of the Wireless Telegraphy Act). However, absent additional revenue, usage of neutral hosts can only make sense where the savings that they deliver (e.g., in providing a single point of contact to facilitate deployment) outstrips the margin/slice of the revenue pie that they consume: otherwise, sensible cooperation between the mobile networks to mutually deploy is more cost effective. We believe that Ofcom should be alert to the issue of deployment foreclosure via the awarding of franchises to neutral hosts – one man's exclusive franchise is another man's monopoly, which could act as a barrier to further deployment.

Vodafone is also concerned about the unintended consequences of Ofcom regulation to the deployment of coverage solutions. Where we are designing a coverage solution for a non-domestic environment such as a shopping centre, enterprise campus or public sector building, it is only correct that the owners of the site contribute to the cost of the indoor coverage solution, as beneficiaries of it. We do not seek to profiteer in such environments, simply to recover our costs so they don't fall on the wider community of Vodafone customers. However, we have been repeatedly undercut by vendors offering arrays of cheap mobile repeaters. Not only do these deliver an inferior service, but they serve to overload the outdoor macro network. Where we can, we provide upgrades to the public macro network to address this (at cost to either our profitability or our retail pricing), but as set out elsewhere in this response, our ability to upgrade the macro network when spectrum stocks are constrained will be limited.

There will be indoor locations where only an "outdoor-in" approach is realistic, and like other use cases, we anticipate increasing demand in these locations over time. This implies more intense usage of sub-1 GHz spectrum over time. There are changes that the mobile network operator community can make to improve efficiency, for example re-farming spectrum to the latest technology, and potentially trading of spectrum so that individual operators' spectrum holdings are concentrated in the 700MHz, 800MHz or 900MHz bands as appropriate. However, even with these measures, Ofcom does need to review whether it is appropriate to transition more spectrum from Digital Terrestrial Television (DTT) usage to mobile.

Such a review would need to carefully examine the evolving evidence base. It is clear that linear television viewing is declining, and there is increasing plurality in the available mechanisms to view television with broadband (whether fixed or mobile) now being a viable alternative to terrestrial and satellite delivery. For

example, Sky's Glass[9] offering provides their suite of channels without the need for a satellite dish. We believe that it is a reasonable challenge whether the full suite of channels that are currently delivered terrestrially need to be accessible via three separate delivery mechanisms (four if mobile is included), or whether terrestrial should be focussed on Public Service Broadcast (PSB) channels.

At this stage we do not assert that there should be a clearance exercise for DTT, but we do believe that Ofcom needs to consider whether the entirety of the remaining band should be used for DTT. If the current spectrum usage is to prevail, then in the interests of regulatory consistency, DTT should pay spectrum fees reflective of the excluded user being mobile. It may well be that this results in a "wooden dollars" exercise with PSB channels being subsidised from the public purse, but a) it would focus attention on the true cost of maintaining terrestrial delivery and b) the plethora of non-PSB channels would no longer get a free-ride on highly valuable spectrum.

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[9] Sky Glass