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Founded in 1983 by Jocelyn Hay CBE

VLV RESPONSE TO THE OFCOM DISCUSSION PAPER

MOBILE NETWORKS AND SPECTRUM: MEETING FUTURE DEMAND FOR MOBILE DATA

April 2022

INFORMATION ABOUT THE VLV

The Voice of the Listener & Viewer (VLV) is an independent, not for profit membership-based charity, free from political and sectarian affiliations. VLV supports high quality broadcasting which maintains the democratic and cultural traditions of the UK. We support the independence and integrity of the BBC and encourage work which demonstrates commitment to the principles of Public Service Broadcasting (PSB). VLV is a charitable company limited by guarantee (registered in England and Wales No 4407712 - Charity No 1152136).

Summary

1. VLV welcomes the comprehensive review provided by this discussion paper, especially Section 5 which presents a sound technical analysis of system performance and opportunities for improvement. We concur with many of the points made and have some additional emphasis to offer on some points which we set out below.
2. It is clear that any Mobile Data Service (MDS) attempting to provide a reliable service with high Quality of Service (QoS) and Quality of Experience (QoE) to compact and battery-powered mobile devices is a significant challenge requiring state of the art engineering systems which exploit both spectrum and radio wave characteristics to the limit.
3. VLV agrees that additional spectrum is not necessarily the only way to meet future needs. We also strongly agree that there is much that the Mobile Network Operators (MNOs) can do to improve performance across their networks by using new technologies and techniques and by better exploitation of the spectrum they already have.
4. VLV believes that the MNOs should be pressed to do this before demanding additional spectrum, particularly if that spectrum will need to be recovered from existing users without providing them with adequate alternative means of delivery. All costs of clearance and establishment of alternative delivery means should be carried by the MNOs.
5. VLV has a special interest in supporting Public Service Broadcasting (PSB) in the communications market. We are keen to ensure that the PSB services fulfil their purposes, as set out in the Communications Act 2003, and that the spectrum supporting them remains available. We are therefore concerned by the erosion of the spectrum allocated to Digital Terrestrial Television (DTT) in recent years and remain concerned about its future, given the demands of the MNOs.
6. Considering the public value of DTT to the UK public we urge Ofcom to resist any attempt by the MNOs to gain access to the 600 MHz band in the UK and more widely in Europe. The UK has a strong and successful media industry which should not be compromised by loss of DTT spectrum.

7. VLV looks forward to Ofcom's consultation on its approach to the World Radio Conference to be held in November 2023 (WRC23) and will provide a response in due course.

Comments on the Discussion Paper

8. The VLV welcomes this opportunity to respond to the Ofcom discussion paper "Mobile Networks and Spectrum: Meeting future demand for mobile data".
9. We also welcome the discussion paper on Mobile Markets and the Plum report, accompanying this discussion paper. They are useful and comprehensive market reviews of mobile networks and the criteria to be used in assessing network performance at a general level. We recognise the concepts of Quality of Service (QoS) and Quality of Experience (QoE) as vital parameters that summarise consumer experience of mobile data networks.
10. The discussion paper under review here addresses in particular the many technical issues that have a direct and fundamental impact on network performance and its spectrum requirements. VLV's response is therefore focussed on those technical issues.
11. Spectrum is a limited resource therefore its allocation to applications which serve the public must be managed with care and its exploitation must be efficient in all those applications, not least by MDS managed by MNOs.
12. VLV agrees that MDS have contributed to UK social and economic well-being and that their future use of spectrum is important in delivering new and innovative services. We agree that new services will probably emerge in the next decade. These are likely to lead to an increase in demand for more capacity. Nevertheless we believe that the MNOs must recognise that some of the additional spectrum that they aspire to is already occupied and it provides valuable services in the public interest. We do not believe that commercial interests should prevail in spectrum allocation over those of highly valued public services when those commercial interests have alternative means of improving their network performance.
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14. VLV has for some years responded to Ofcom and DCMS consultations on spectrum use, highlighting the importance of retaining spectrum to ensure future provision of PSB services. For over 25 years broadcasters world-wide have dramatically improved their use of spectrum by developing and standardising digital technologies dedicated to broadcasting applications - Digital Terrestrial Broadcasting (DTT) and Digital Audio Broadcasting (DAB) - and the replacement of spectrally inefficient legacy systems. As pointed out in

the discussion document, mobile services are now old enough to have legacy systems whose spectrum efficiency is in need of improvement.

15. It must be recognised that replacement of legacy systems requires advanced planning because the process is costly, lengthy and disruptive especially to consumers. Any plans to improve any networks using spectrum must be signalled well in advance and be thoroughly researched and evaluated before any action is taken. Any further radical change to public services such as PSB must be subject to public discussion.
16. Since 2012 broadcasters have made significant contributions to additional mobile spectrum by their own use of efficient technology (DTT) that has allowed a considerable increase in the range and quality of television services whilst using less spectrum. All UK DTT services now occupy only the “600 MHz” band (470-694 MHz = 224 MHz) having been cleared progressively from the bands above 700 MHz allowing 168 MHz, 43% of its original pre-switchover allocation of spectrum, to be given to the MNOs. For some years the MNOs have demanded, and continue to demand, that the whole of the 600 MHz spectrum be re-allocated to them. Before consideration of such a step VLV believes that the MNOs must make significant improvements to the efficiency of their own spectrum usage.
17. This discussion document is welcomed for its comprehensive review of the opportunities that the MNOs have to make better use of their current spectrum allocations. In sections 3 and 4 the document explores reasons why the MNOs may require additional spectrum in the future. But it also expresses some concerns about the uncertainty of if and when these requirements may emerge. We also have doubts about the growth projections asserted by the MNOs, not least about the affordability of the implied investment rate given the current roll-out of 5G.
18. Figure 15 illustrates the disparity between the three models used to estimate future growth as far as 2035. It is particularly noticeable in the case of the High Growth assumption, which is considerably greater than that for the Medium Growth scenario. Estimated growth rates have an immediate impact on the economics of further investment by the MNOs which depend upon the state of financial markets over that period and the potential increase in interest rates in the coming decade.
19. We are gratified to note that the document states at the very beginning of Section 5: *“Networks will need more capacity, but more spectrum is not the only way to deliver this”*. We strongly concur with this view and urge Ofcom to press the MNOs firmly on this point.
20. We are gratified to note Clause 5.34 that refers directly to the 600 MHz DTT band and note that the UK government has provided some security for DTT, at least to 2034. This will not deter the MNOs from demanding access to this band at the next International Telecommunications Union (ITU) World Radio Conference (WRC) to be held in November 2023 (see Clause 30 below).

21. The capacity of a communications network depends not only on the amount of spectrum it uses – Bandwidth - but also on the transmission quality expressed by the parameter Signal to Noise Ratio (S/N). This in turn depends on the frequency bands chosen and their propagation characteristics. In a mobile network S/N at a mobile User Terminal (UT, ie a handset) is highly variable for a number of reasons, only some of which can be mitigated.
22. Higher frequencies offer greater bandwidths as illustrated by Figure 16 in Clause 5.10 which lists the opportunities for spectral efficiency improvements over time and with the use of spectrum bands above 1 GHz. Furthermore, QoS at any particular UT is more dependent on S/N than it is on bandwidth; the further the UT is from a Base Station (BS) the worse is performance. This argues in favour of small cells and high frequency bands to reduce distances between UTs and BSs. Such an arrangement better suits meeting peak demand for service.
23. Communication data rates, expressed in Bits per Second (B/S), are directly related to bandwidth which is a well-defined resource. However, there is considerable room for a network's S/N and its spectrum efficiency (B/S per unit bandwidth) to be optimised using a number of techniques that promise greater capacity gains than additional spectrum. There is a trade-off between bandwidth and S/N and so the MNOs continued aggressive demands for more spectrum strongly suggests an inability or unwillingness to make improvements to the S/N available in their Radio Access Networks (RAN).
24. The RAN is that section of a mobile data network that uses spectrum most. It is the bi-directional link between the User Terminals (UT, ie consumer handsets) and the network BS. It is here that MNOs can do much to improve spectral efficiency as described in the discussion paper.
25. The link between UTs and BSs is not a connection between equals because the resources available in each are disparate. One of the significant areas addressed by the discussion document is the transmission performance of antenna systems. At the BS antenna techniques such as Beam Forming and Multiple Input Multiple Output (MIMO) can be used simply because they are fixed and have room on the masts to deploy more than one antenna system which can dynamically direct their beams to particular places in the coverage area where demand for service may be located. This demand is dynamic requiring flexibility in BS design and during peak demand compromise may be necessary involving reduced QoS.
26. Any BS site can serve its area more efficiently by re-use of its allocated spectrum in several beams dedicated to different directions – effectively reducing cell size. This ability improves significantly at higher frequencies because antenna design, being directly dependent on wavelength, is more flexible, e.g. by allowing smaller structures. Propagation at the higher frequencies implies smaller cells leading to greater density of BSs and, hence, more network capacity.

27. These techniques are not as readily available at UTs because of severe limits on cost, size and cosmetics (the consumer UT has to be handled easily and have a pleasing appearance) which means that the antenna is hidden and constrained in its dimensions. Antenna performance is heavily dependent on its size relative to the operational wavelength. The antenna system in the UT may also have to function well across a range of frequencies from 700 MHz (wavelength 40 cm) to several GHz (wavelength 6 cm). This is a design challenge as is the fact that a small, densely packed UT using high speed digital circuits will suffer from self-noise, limiting its ultimate performance.
28. These issues are eased at higher frequencies but UT antenna performance remains as a major limitation to system performance and has therefore a direct corresponding impact, limiting spectrum efficiency. Handset designers have much to contribute to spectrum efficiency but work within extremely demanding circumstances. It is not known yet what additional demands might be made on UT design by the new services envisioned in traffic growth projections.
29. Applying beam forming methods at the UT is impractical because the orientation of a mobile device is constantly changing. Similarly MIMO requires several antennas suitably spaced within the body of the UT where space is very intensively used. There would also be interconnections needed between these antennas and an implied computational load to manage the collective response. This loads the battery power as does the use of a UT at the edge of an extensive service area where it has to use more power to communicate with its BS. UT performance could be usefully improved if a facility to attach an external antenna was provided as is the case with WiFi routers.
30. It is a natural feature of radio waves that propagation performance varies with frequency and with terrain and geography. Shorter wavelengths (higher frequencies) do not travel as far or penetrate buildings as well as longer ones which means a greater density of BS sites. In densely populated urban areas this may not be an issue because the expense of more BSs can be offset by more revenues from more traffic. In rural areas BS density may be sparser implying that lower frequencies may be appropriate.
31. This argument is one used by the MNOs to support their demands for more spectrum specifically the 600 MHz DTT band. MNOs have for years pressed their case at WRCs and will do so at the next one in November 2023. One objective of the MNOs at the last WRC in 2019 was to achieve Co-Primary status with DTT (and PSME and White Space) in Region 1. Whilst DTT does share the 600 MHz spectrum with PMSE and White Space services, similar opportunities for sharing with mobile networks as presently designed are limited by major incompatibilities in network topology and signal structures eg frequency plans. Mobile network frequency plans within their current band allocations are not very efficient.
32. Considering the public value of DTT to the UK public we urge Ofcom to resist any attempt by the MNOs to gain access to the 600 MHz band in the UK and more widely in Europe. The UK has a strong and successful media industry which should not be compromised by loss of DTT spectrum.

33. We look forward to Ofcom's consultation on their approach to WRC23 to which we will respond in due course.