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Nominet Response to Ofcom's consultations on "Award of the 700 MHz and 3.6-3.8 GHz spectrum bands" and "Enabling opportunities for innovation"

Non-confidential

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Contents

1. Introduction.

1. This is Nominet's response to Ofcom's consultation on the release of the 700MHz and 3.6-3.8GHz bands, as well as Ofcom's consultation on enabling innovation through spectrum sharing, both published on 18 December 2018.

2. This response should be read in conjunction with Nominet's answers to the specific questions asked in both consultations, which are set out in Annex 1 and 2 below.

1.1 Ofcom's decisions on the release of 700MHz and 3.6-3.8Ghz come at a critical juncture.

3. The efficient release and management of radio spectrum to the benefit of all users is one of Ofcom's most important functions as an economic and competition regulator.

4. Spectrum is the lifeblood of the UK's digital economy. As such Nominet welcomes the opportunity to respond directly both on the release of these two important bands, and Ofcom's wider ambitions and roadmap towards a Dynamic Spectrum Access (DSA) model. The latter is essential to ensuring efficient utilisation of spectrum to meet the UK's connectivity needs.

5. We note that Ofcom's decisions take place at a critical moment for connectivity in the UK. The licensing structure for both the 700MHz and the 3.6-3.8GHz bands will determine the shape and reach of 4G and 5G networks for the next decade or more.

6. Ofcom has also been asked to enable the ambitious Department for Digital, Culture, Media and Sport (DCMS) Future Telecoms Infrastructure Review (FTIR). We note the FTIR findings around the importance of addressing a digital divide that inhibits productivity and growth in many parts of the country. We also welcomed the FTIR's recommendation of a Market Expansion Zone model, to extend the reach of mobile connectivity beyond what can be achieved through a competitive Mobile Network Operator (MNO) led delivery alone.

7. As 4G networks have reached their maturity, incremental improvements in coverage have slowed, and many communities are still left without connectivity. Ofcom's 2018 Connected Nations found that landmass coverage for just one operator stood at 84%, yet coverage from all operators stood only a fraction higher at 91%.[1] With the MNO's pursuing similar business models needed to secure return on investment from national license conditions, it is no surprise that the shape and reach of networks has extended, but often through convergence that addresses partial 'not-spots' rather than extending connectivity to new areas to tackle full 'not-spots'.

[1] Ofcom Connected Nations Report, 2018, p6, https://www.ofcom.org.uk/__data/assets/pdf_file/0020/130736/Connected-Nations-2018-main-report.pdf

8. Deployment of 5G will commence in Autumn 2019, but it is already clear that industry will approach rollout with a "demand-led" strategy alone,[2] which risks an even greater digital divide in the medium to long term. Ofcom's release of new spectrum is a unique opportunity to address this, with innovative licensing terms and methods.

1.2 Nominet has a unique contribution to make to Ofcom's decision-making in this area.

9. Nominet is driven by a commitment to use technology to improve connectivity, security and inclusivity online. For 20 years, Nominet has run the .UK internet infrastructure, developing an expertise in the Domain Name System (DNS) that now underpins sophisticated network analytics used by governments and enterprises to mitigate cyber threats.

10. Nominet is also a profit with a purpose company. We support initiatives that contribute to a vibrant digital future and Nominet has donated over £45 million to tech for good causes since 2008, benefitting more than 10 million people.

11. We continue to explore applications for a range of emerging technologies including autonomous vehicles and new tools to support Dynamic Spectrum Access, designed to respond to the rapid expansion of demand on spectrum in the coming years. We believe this is closely aligned with Ofcom's commitment to ensuring the quality, choice and reach of wireless connectivity.

12. Crucially this also includes support to Ofcom directly through the TV White Space database. Nominet has a proven track-record of operational competence and expertise in enabling this coexistence and opening radio spectrum in multiple regulatory regimes, most recently in the United States through the Federal Communications Commissions TV White Space database.

13. We therefore have unique insight to offer and welcome the opportunities to engage with Ofcom directly on these issues, including at the recent Ofcom stakeholder event on spectrum sharing.

1.3 Application of DSA with the release of new bands is essential to meeting Ofcom's objectives.

14. Nominet fully shares Ofcom's ambitions of extending network reach through 700MHz and capacity through 5G at 3.6-3.8GHz. We call on Ofcom though to enable progress toward wider spectrum sharing, and a model of DSA that also applies to one of both of these important bands. If got right this could kick-start the development of a wider ecosystem around shared access and open the means to connect communities who sit well beyond the reach of a competitive rollout.

[2] The Telegraph, EE to roll out 5G in 16 cities next year in 'demand-led' strategy, 13 November 2018, https://www.telegraph.co.uk/technology/2018/11/13/ee-roll-5g-16-cities-next-year-demand-led-strategy/

Our response therefore sets out our views in three parts:

- First, establishing the opportunity for sharing at the 700MHz and 3.6-3.8GHz band. We urge Ofcom to integrate its sharing and spectrum release workstreams to ensure an outcome consistent with Ofcom, Government and the FTIR's coverage ambitions.

- Second, offering our insights around Ofcom's proposed administrative model for spectrum sharing at the 1800MHz, 2.3GHz and 3.8-4.2GHz bands. We urge Ofcom to consider how this model might be streamlined. We also identify potential process and market challenges that Ofcom will need to address to support this model.

- Third, we set out an alternative approach in which Ofcom might advance toward its objective of enabling DSA across bands more quickly and efficiently. We urge Ofcom to reconsider the need for the design and build of transitionary arrangements, when a DSA solution is readily obtainable.

15. With the release of key new bands, it is vital that Ofcom adopt fresh thinking around the release of this vital resource to ensure its greatest possible utilisation and meet these goals. We hope our response will provide useful insight to support this.

2. The opportunity of DSA at 700MHz and 3.6-3.8GHz.

16. Ofcom's consultation sets out its thinking behind proposals for the release of the 700MHz and 3.6-3.8GHz bands. Nominet notes Ofcom's recommendation that these address network coverage and capacity respectively. We also welcome Ofcom's ambitions in this regard.

17. However, the proposed approach of addressing these as two separate challenges (to be addressed by specified bands) does not reflect user expectation of the full potential of the 3.6-3.8GHz band in particular. Limitations around capacity and network reach are inextricably linked. For example, through 'cell shrinkage' where the effective reach of a cell site reduces under demand.

18. Addressing the digital divide will require a properly joined-up approach. Ofcom's long-term ambition of a DSA model is an important foundation of this. However, we set out below our view that Ofcom risks missing an opportunity for sharing at 700MHz and 3.6-3.8GHz, that could otherwise have a transformative impact on rural communities and enterprise.

2.1 We are likely approaching the threshold of competitive network rollout.

19. Ofcom's historic approach of licensing on a national basis has been an effective means of getting spectrum to market to players with the means to deploy at significant scale. MNO deployment is an important part of the wider fabric of connectivity, enabling continuity as consumers move between fixed broadband and Wi-Fi access points. For the core competitive market that Government identified in its FTIR, licensed rollout on a national basis has been effective in many places.

20. However, as the four MNOs' 4G networks have reached maturity, it is increasingly clear that we are approaching a threshold of competitive rollout form the business models currently offered. Incremental gains in coverage are smaller year after year, with coverage footprints converging as as function of their common business model and full integration and sharing of their physical infrastructure. EE and H3G's network share through MBNL, and O2 Telefonica and Vodafone's network share through CTIL, have been in place for over a decade now.

21. Improvements have been enabled through extensive reforms to the site rental market, planning regime, backhaul and wider regulatory frameworks to remove the bottlenecks MNOs identified to deployment. This has included extensive reforms to the Electronic Communications Code through the 2017 Digital Economy Act, significant increases in mast height under Permitted Development in 2016, the Scottish and Welsh Government's ambitious Mobile Action Plans and Ofcom's work to improve access to BT Openreach's network of ducts, poles and fibre through the Business Connectivity Market Review (BCMR).

22. Collectively these represent coordinated work between industry, Government and Ofcom to address a shared concern around coverage. Yet the benefits have only been incremental.

Efforts to extend coverage in new areas, most notably through the £150m Mobile Infrastructure Project have enabled further improvements but at considerable cost.[3]

23. These interventions came about as a result of disappointment at the pace and reach of 4G rollout by industry. In 2016 the National Infrastructure Commission found that the UK was ranked only 54th in the world for 4G deployment.[4] In the event that 5G disappoints again, there is every possibility that further targeted and costly interventions will need to be retrofitted to rollout.

2.2 Despite these reforms, the release of mobile spectrum to market remains largely unchanged.

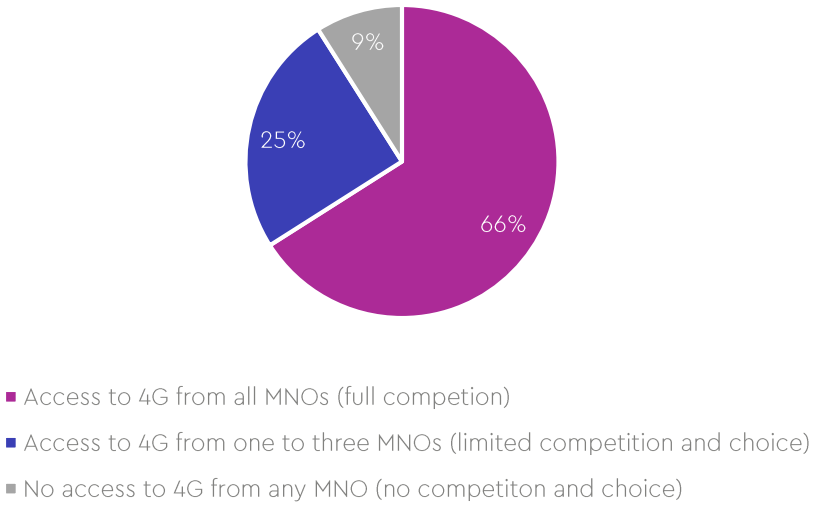
24. There has been considerable reform enabling the build and deployment of physical infrastructure. Until now there has been little for the licensing of spectrum though. This is despite spectrum being an MNO's most important asset, one which MNO decisions around investment in new sites and physical infrastructure is made around.

25. Ofcom has historically made targeted interventions on license conditions to enable desired market outcomes, such as reserving allocation for a new entrant at the 3G auction in 2000 and reserving low frequency spectrum for coverage at the 4G auction in 2013. These interventions were designed to enhance competition on pricing and bundles available to consumers. Yet these benefits have eluded segments of the market who are beyond the reach of competitive rollout.

26. Ofcom's recent Connected Nations report showed that for more than a third of the UK landmass, one or more MNOs have yet to deploy the 4G spectrum they won access to in 2013. Consumers and businesses in these areas are unable to benefit from the considerable resource that Ofcom committed to the clearance of spectrum for their use, meaning that this vital and finite national resource is in many places left idle where it might otherwise be productive.

[3] Mobile Infrastructure Project Impact and Benefits Report, DCMS, October 2017, https://www.gov.uk/government/publications/mobile-infrastructure-project-impact-and-benefits-report
[4] National Infrastructure Commission, Connected Future – Completed Study, March 2016, https://www.nic.org.uk/our-work/connected-future/

Fig 1 - For more than a third of the UK landmass, 4G spectrum remains unused



27. For this segment of UK users, not only those who are resident but those who rely on mobile data while travelling to, from or through full not-spots, this is sign of market failure that needs to be addressed.

28. We recognise that nationwide and exclusive licensing has been a historically important means of making spectrum useful and accessible and generating revenue for Government. Yet it is also clear that it is failing to meet the needs of 21st century users in many places. We should take the opportunity to rethink the century-old approach to spectrum allocation and update the methodology for our new digital age.

2.3 DSA is the most efficient means of allocating and utilising mobile spectrum.

29. Spectrum is a national, and finite resource. Ofcom's Mobile Data Strategy highlighted the need for spectrum to be utilised as efficiently as possible, not least given the 60% year-on-year growth in demand for mobile data.[5]

30. Ofcom will be aware of Nominet[6] and other stakeholders'[7] view that Dynamic Spectrum Access (DSA) represents not only a viable alternative, but the most efficient means of managing spectrum in the interest of all consumers.

[5] Ofcom, Mobile Data Strategy, June 2016, p6, https://www.ofcom.org.uk/__data/assets/pdf_file/0033/79584/update-strategy-mobile-spectrum.pdf
[6] Nominet, 5G Spectrum Sharing, 2018, https://media.nominet.uk/wp-content/uploads/2018/09/17142340/5G-Spectrum-Sharing-Whitepaper.pdf
[7] IET 5G Further Faster, A 5G spectrum initiative at 3.6-3.8 GHz in support of the Government's proposed "market expansion" model, 2018, https://www.theiet.org/media/2589/5gff-main.pdf

31. DSA is an approach to improve the efficiency of spectrum usage with a centrally co-ordinating database. Applying an opportunistic Dynamic Spectrum Access layer across all of the auctioned spectrum in the 3.6-3.8GHz band would open up the potential for sharing the spectrum asset that would otherwise lie idle.

32. DSA is a robust and proven technology. Ofcom has overseen the successful implementation of DSA databases for TV White Spaces (TVWS). Using DSA to manage usage of the spectrum, TVWS radios offer broadband speeds over several kilometres, and the signal can travel through permanent obstacles such as trees, as well as across challenging terrain. Today, DSA is being used in several countries to ensure that spectrum can be used more effectively, with no interference towards incumbent licensed users.

33. The TVWS experience has ensured DSA is now a tried and tested method of enabling a tiered sharing framework. This means we have a proven effective solution at hand; one that would take little time to implement in other bands as a result of Ofcom's and our own extensive experience. The work being undertaken in the US under the CBRS framework provides further confidence in database management technologies to support spectrum sharing.

34. Crucially DSA allows an otherwise scarce spectrum band to be brought into play at every location, rather than those areas which are of commercial priority to incumbent MNOs. This allows new players to use the spectrum on an opportunistic basis, in areas the MNOs are not operating. This delivers a gain in geographic spectrum efficiency.

2.4 DSA could open greater opportunities for new coverage at the 700MHz band than coverage targets alone.

35. Ofcom has proposed that coverage be addressed by the 700MHz band through new obligations for two of the licenses – to include a 90% landmass coverage and commitment to build new cell sites. These proposals are certainly welcome; however, the benefits may be only incremental and at the edge of existing commercial rollout.

36. The 2014 Coverage Agreement between the MNOs and Government resulted in a 90% landmass coverage obligation that was officially met by all four MNOs in 2017. There is a risk that Ofcom's proposals for a similar target may be congruent with this, particularly in light of proposed conditions that would allow MNOs to satisfy the target with existing spectrum rather than utilising the 700MHz band being licensed. The proposed thresholds for signal strength for of coverage are also similar to those used for assessment of the MNO coverage agreement.

37. Ofcom is correct that the low frequency 700MHz band has highly desirable qualities for coverage, which is why opportunistic DSA, complementing any coverage obligation for the MNOs will be well suited to extending landmass coverage in new areas.

38. Crucially, implementation of DSA is already delivered at 700MHz through TVWS and can be easily extended for the full band.

2.5 Our experience shows DSA can thrive at 3.6-3.8GHz and will be essential for 5G.

39. We believe that these learnings from TVWS at 700MHz can also be applied to the licensing of the 3.6-3.8GHz band.

40. 5G will be a driving force behind the digital economy of the future: supplying smart cities, factories and farms and greater automation and productivity. 3.6-3.8GHz is therefore highly valuable and offers better opportunities for the development of a robust DSA ecosystem to complement competitive rollout. It has also established the tools and technology needed to ensure a framework for coexistence between new players and incumbent users of the same band.

41. Ofcom has been clear that the rationale behind national and exclusive licensing of 3.6-3.8GHz is that 5G can be deployed by MNOs as a nationwide capability. While Nominet appreciates this ambition, in practice this is unlikely to be the case. 5G networks will require considerably greater density and build than 4G, with IET figures indicating an estimated 400,000 cell sites will be required as opposed to the 15,000-25,000 each MNOs has today.[8]

42. The majority of these will be small cells. However, this will still need considerable resource in new build and deployment, as opposed to the lower cost cycle of upgrading an existing network with 4G spectrum. The challenge is of an order of magnitude greater than previous generations that failed to deliver for many.

43. Given competing demand for finite skills and contracting resource, and the scale of deployment needed, it is therefore unlikely that 5G will achieve a nationwide footprint even in the medium to long term. Enabling 5G deployment at scale is a desirable goal, but it is also vitally important that high-capacity, low-latency spectrum ready to be used to new applications is accessible even in the absence MNO led rollout.

44. 5G and the 3.6-3.8GHz band is ideally suited to a DSA arrangement that recognises that ubiquitous deployment cannot be achieved by the MNOs alone. In many places 5G will be unobtainable without new and innovative business models, which stand to complement incumbents and stimulate competition.

45. We remain firmly of the view that Ofcom's stated goal of DSA can facilitate this and be a key component of ensuring the UK's status as a world-leading 5G economy.

[8] The Telegraph, 400,000 extra phone masts needed to bring 5g network to rural Britain, March 2017 https://www.telegraph.co.uk/science/2017/03/30/400000-extra-phone-masts-needed-bring-5g-network-rural-britain/

3. Proposals for administrative sharing at 1800MHz, 2.3GHz and 3.8-4.2GHz.

46. Given the challenges set out above, Nominet welcomes Ofcom's decision to publish proposals for a new, Ofcom-led, administrative sharing process and the eventual transition to a Dynamic Spectrum Access model across all bands.

47. We recognise this is a welcome step forward toward a modern model of spectrum management.

48. We also have concerns we wish to share around Ofcom's proposals for an administrative sharing as a transitionary measure, that risks either unintentionally dampening demand or making a transition to a DSA model more difficult at a later date.

3.1 The three sharing bands may be of limited value for the provision of connectivity.

49. Nominet welcomes Ofcom's proposals that identify three 'sharing bands' of unused spectrum at 1800MHz and 2.3GHz that are already in use by the MNOs, and the proposed release of 3.8-4.2GHz spectrum for 5G in 2020.

50. Our response above, setting out challenges relating to TVWS has already identified that the properties and quantity of spectrum available is critical to the success of sharing. This also applies to the wider ecosystem supporting sharing at particular bands. In this regard we recognise that Ofcom's proposals for 1800MHz and 2.3GHz are intended to take advantage of these bands' presence in mobile handsets.

51. While this is welcome, the narrow bandwidth offered is likely to inhibit potential applications, such as provision of an effective 4G mobile data service. It may be possible to use the sharing bands to carry voice, and indeed we note that for many communities this may be a desirable outcome in the absence of any mobile coverage at all. However, we also believe this falls well short of Ofcom's ambition and would not enable new and innovative players to have the business models to offer genuine alternatives.

52. The 3.8-4.2GHz band may present greater opportunities, not only in its bandwidth but applications. However, this is likely to be over considerably longer timeframes and there is currently no ecosystem in place to support these bands. The 3.8-4.2GHz band is likely to be marginal to the 3.4-3.8GHz bands in provision of 5G services, which is why we urge Ofcom not to restrict sharing to band of lesser value where they are inevitably least able to meet consumer needs.

53. Ofcom's motivations in opening up this unused spectrum to new players are clearly welcome, however it is clear that for DSA and sharing to have every possible success it will need to

support the most valuable and useful bands, not just restricted to gaps between existing allocations and in more marginal bands.

3.2 An administrative sharing process needs to be designed to achieve scale and confidence.

54. Ofcom's proposals also set out an administrative process for the release of these bands. Nominet recognises and appreciates Ofcom's rationale for doing this as an interim measure; adapting existing processes for Testing & Development licenses. We also welcome Ofcom's ambition, set out in the stakeholder event that it hopes to be 'inundated' with such requests, and that the £950 license fee is applied to ensure the costs involved are properly recouped in this event.

55. Ofcom's hopes for high demand are certainly to be welcomed and will be an encouraging sign to those wishing to take advantage of access to this vital resource.

56. However, we are concerned that as proposed, any form of administrative sharing may introduce capacity and resourcing limitations on Ofcom's ability to grant and manage these licenses. Ofcom's ambitions are for the bands to take-off and to support a sharing ecosystem at scale. We would urge Ofcom to set out on delivering this with a back-end infrastructure and supporting database fit for this purpose, not least when redesign of a sharing process would take greater resource later.

57. For DSA to be a success it is important that Ofcom uses tools designed to enable scale and confidence. This is critical to any burgeoning ecosystem that might surround and support sharing. If Ofcom's ability to back sharing at scale is in question, the long-term investment needed to support new business models may not be forthcoming.

3.3 The proposed role of MNOs in sharing approval risks undermining Ofcom's ambitions.

58. An important step of Ofcom's proposed administrative process is consultation with MNOs to confirm coexistence with an MNO's existing network or planned deployment. We are concerned that an unintended consequence of this will be to greatly reduce the sharing opportunities readily available as a result of difficulty obtaining MNO consent.

59. The MNOs have historically been reluctant to commit to specific rollout plans at named locations. There are a number of valid reasons for this, including commercial confidentiality, local or third-party contingencies around a deployment (such as power or transmission, approval from local authorities and the MNOs relationship with a site landlord). In practice even acting in good faith it is unlikely that any MNO would wish to explicitly set out its plans to Ofcom over a three-year timeframe, views that were raised to Ofcom directly by the MNOs at its stakeholder event. The default position is likely to be to decline any such request, in the absence of adequate incentive and accountability.

60. Ofcom's proposals should clarify how Ofcom would raise a sharing request to the MNO. This includes the required timeframes for the MNO's response and measures for accountability in the event a sharing request is denied, but the spectrum remains undeployed over those three years.

61. Ofcom should therefore consider use of the granular data available to it through its annual Connected Nations data requests, made under Section 135 and 136 of the Communications Act 2003. This data has been invaluable in supporting both Ofcom's Connected Nations reports and the provision of Ofcom's coverage checker app and could represent the underpinning of a clear and data driven approach to approval.

62. We would urge Ofcom to develop an objective approach to assessment of coverage utilisation and would be happy to discuss our views on the data and tools available to allow effective coexistence, without the need for pre-approval by incumbent providers. An approach such as this would also align with Ofcom's ambitions of "transparency and good regulatory practice", set out in its 2019/2020 Draft Annual Plan.

3.4 Ensuring licensing terms create opportunities for innovative business models.

63. We would also urge Ofcom to think creatively around the licenses it offers and their terms. Ofcom's proposals for licenses to be granted on three-year terms risks limiting the ability of licensees to secure certainty around return on investment. In other cases, a three-year license may not be proportionate for a time limited connectivity solution – for example at a high-footfall event which is unsupported with temporary installations by the MNOs.

64. Ofcom's thinking around differentiating high and low power licenses is welcome and reflects the varied applications that unused spectrum can have; this needs to be applied to license terms too.

4. Transitionary measures and the roadmap toward DSA.

65. Ofcom's proposals recommend interim measures (Ofcom-led administrative sharing) to enable an eventual transition to DSA. Nominet fully supports Ofcom's objective of enabling DSA across bands set out on the consultation and hopes to offer our insights on a roadmap to enable this.

66. We therefore seek to address Ofcom's concerns below, by setting out why the transitionary arrangement described is not needed and might introduce unintentional complications in progress toward DSA. We also set out a clear alternative that might allow Ofcom to operationalise an administrative process supported by a database model. We believe that this would support transition to DSA and help ensure that Ofcom is able to manage requests quickly and effectively.

4.1 DSA solutions are market ready and can be offered without delay.

67. Ofcom's consultation set out a clear long-term commitment to DSA; in line with the FTIR. However as set out in sections 2.2-2.5 of this response, technical implementation of DSA need not be a barrier to its timely delivery. The TVWS framework is well established in the UK and elsewhere and can form the basis of an effective dynamic spectrum regulation for the 700MHz, 3.6-3.8GHz and other bands.

68. In the United States work being undertaken in the US under the CBRS framework will also provide confidence in database management technologies to support spectrum sharing. The CBRS framework is based on three-tiered spectrum sharing and is designed to ensure coexistence with incumbent users who cannot provide any information *a priori* to a central database, and other users, where some might require priority over others. Incumbents are generally military services using networks operated close to coastal areas. It's worth noting that the system in use in the CBRS was originally designed for usage in a specific frequency band, but the basic operational principles are "frequency agnostic" and can be used in other bands.

69. This is why in key respects, delivery of DSA for 3.6-3.8GHz 5G would be easier than TVWS, with considerable advances in both the technology supporting coexistence and learnings from TVWS. Even material barriers, for example confidence in the ecosystem supporting TVWS regulation, are lesser for 5G, with carrier equipment already being available.

We have contrasted these in Figure 2 for reference below.

Fig 2. Learnings from TVWS for DSA at 5G

TVWS	5G
TVWS was the first Dynamic Spectrum regulation in the UK and one of the first in the world based on geo-location databases – needed to find out the problems before solving them all from scratch	Dynamic Spectrum challenges are now well understood, and good solutions are already in place
No certainty around whether the database approach would work, whether database providers would come forward, and what they would be capable of.	Database approach is now proven, Nominet are established in the UK and internationally (and provide other services to government), and are proven to be capable of far higher complexity of coexistence modelling than for TVWS.
Designed primarily to protect existing use of UHF band and its many socially and economically important incumbent stakeholders.	Opportunity to add sharing framework to newly available spectrum at 3.6-3.8GHz.
Protecting short notice, short duration incumbent use added complexity (e.g. PMSE for breaking news events).	The majority of cases will be MNOs deploying for a longer duration, therefore reducing complexity.
TVWS did not have robust and market ready equipment available to support a developing ecosystem.	Carrier grade equipment is available now.
Coexistence between domestic TV and TVWS devices needed extensive testing to understand, and a framework to be derived from scratch.	Coexistence between mobile network base-stations is thoroughly understood, and a coexistence framework can be developed (and is already being standardised in the USA).
Multiple-database model has inhibited the development of a TVWS ecosystem	A robust, open and competitive tender process for a single database provider can provide certainty to the ecosystem.

4.2 Shifting from a manual to an automated process will be more difficult than building an automated one.

70. As noted above, confidence is a key criterion to the success of any sharing ecosystem. Ofcom has been clear in its long-term objective: implementation of a DSA solution for sharing. However, the implementation of a transitionary measure may pose additional challenges that could inhibit that transition to DSA.

71. We fully appreciate Ofcom's rationale behind adaptation of its Testing and Development Framework to enable an off the shelf measure for sharing in the short term, however we also believe that DSA can be similarly market ready and applicable to the Sharing Bands or any other band without delay.

72. In the charts below we set out provisional timeframes for DSA implementation based on three starting points – Ofcom's proposed model of sharing, Ofcom's proposed model of sharing with support from a database to enable partial automation, and a DSA solution implemented from the outset. It is out view that the latter allows the most effective and beneficial transition.

4.3 An administrative process could be facilitated by a database or DSA infrastructure, enabling transition.

73. As set out above, it is our view that some elements of the design of an administrative process will be made redundant by transition to DSA. We therefore urge Ofcom to consider its DSA objective at the outset of this workstream, and in particular how support for an its proposals with a database might enable to own and manage an 'Ofcom-led' sharing programme while supporting technical delivery of a DSA framework fit for the long term.

74. This would help lower the administrative burden on Ofcom, with much of backend process being automated through the database but still managed and determined by Ofcom. This could help address concerns set out in 3.3 around any unintended spoiler role that MNO approval may play in an administrative process, allowing approvals to be confirmed based on the objective data Ofcom already collects from MNOs.

75. We would welcome greater clarity around Ofcom's plans for backend support for its administrative process and ask Ofcom to consider carefully how even an adaption of the current Testing and Development license framework might be built to be future proofed.

4.4 Ofcom needs to set out a clear roadmap for transition from administrative sharing to DSA.

76. Finally, we note our concern that Ofcom's proposals as drafted to not specify clear timeframes or milestones for a transition to DSA, Ofcom's key objective. There is a risk that Ofcom's interim solution may become a technical cul-de-sac that will need to be rebuilt to accommodate a

dynamic approach, and that in light of this administrative sharing with a number of limitations might become an established rather than temporary measure.

77. The technology is available to support a DSA arrangement, Ofcom and Government's preferred option, today – and we would welcome any opportunity to provide further demonstration to support this and to discuss in further detail.

5. Conclusions

78. Ofcom is taking welcome steps toward a DSA model that will be critical to the competitive utilisation of spectrum in the long-term. We welcome Ofcom's strategic objectives and we hope our response set out above offers supportive evidence in helping Ofcom reach this destination. We will continue to offer any insights or learnings we can to support this.

79. However, progress toward this goal is potentially fragile. Our learnings from TVWS showed that confidence and, valuable and high capacity spectrum are key components to delivering a functioning sharing ecosystem. It is vital that Ofcom considers this when making decisions both around sharing for innovation, and the release of 700MHz and 3.6-3.8GHz. Integration of both these workstreams stands to strengthen each of them.

80. Sharing should not be limited to marginal bands or unused frequencies that have been undervalued by the MNOs. DSA can and will thrive if attached to desirable bands, such as 700MHz and 3.6-3.8GHz, and similarly DSA will support the efficient and beneficial usage of those bands. Ofcom has an opportunity to champion DSA to add considerable value and utilisation to the spectrum it licenses, and in doing so to ensure the UK's place as a world-leader in 5G.

81. We are clear as well that technical implementation need not be an inhibitor to Ofcom's progress. The database isa proven and tested technology for TVWS and any such approach for 5G stands to complement not inhibit a competitive rollout in the core market, in line with the Government's FTIR proposals.

82. The key challenge will be Ofcom's policy decision and roadmap toward DSA. We urge Ofcom to take advantage of the opportunity available to it and to adopt DSA both at the 700MHz and 3.6-3.8GHz band bands.

Annex 1 – Nominet Responses to questions in 'Award of the 700 MHz and 3.6-3.8 GHz spectrum bands' consultation

Question	Your response
Question 1: (Section 4) Do you agree with our proposals on the coverage obligations as set out in this section? Please give reasons supported by evidence for your views.	Confidential? – N Nominet's views on Ofcom's proposed coverage obligations for the 700MHz license are set out in paragraphs 35-38 of our response. While Nominet supports any initiative to improve coverage, we are clear Ofcom can be more ambitious in this with support for a DSA arrangement at 700MHz.
Question 2: (Section 5) Do you agree that we have identified the correct competition concerns?	Confidential? – N Ofcom's competition concerns reflect competition in only a segment of the core multi-operator served market. For many rural communities, competition remains an abstract concept. Ofcom needs to consider competition in respect to particular places rather than as a national capacity that in practice may be unobtainable.
Question 3: (Section 5) Do you agree with our assessment of these competition concerns, and our proposed measure for addressing them? Please give reasons supported by evidence for your views.	Confidential? – N No. As noted in our response to Question 2, Ofcom needs measures that open up competition in specified locations of market failure – i.e. those where the MNOs have failed to deploy valuable mobile spectrum.

Question 4: (Section 6) Do you agree with our proposal to proceed with a conventional assignment stage?	Confidential? – N We disagree with Ofcom's proposals for a conventional assignment and would urge greater consideration of flexibility for use of 700MHz and 3.6-3.8GHz by users other than auction bidders. Our views are set out in further detail in paragraphs 29-45 of our main response.
Question 5: (Section 7) Do you agree with our proposal to use a CCA design for this award?	Confidential? – N Nominet does not take a view as to Ofcom's specific auction structure, beyond our views on the need for license conditions that enable the flexible and shared use of spectrum.
Question 6: (Section 7) Do you have any comments on the proposed detailed rules for our CCA design?	Confidential? – N Nominet does not take a view as to Ofcom's specific auction structure, beyond our views on the need for license conditions that enable the flexible and shared use of spectrum.
Question 7: (Section 8) Do you agree with our proposed approach to coexistence in the 700 MHz band?	Confidential? – N As set out in paragraphs 35-38 of our main response; Ofcom should consider use of a DSA model to enable coexistence in the 700MHz band.
Question 8: (Section 8) Do you have any comments on the proposed licence obligation and guidance note (annex 19)?	Confidential? – N Nominet does not have any comment in response to this question.

Question 9: (Section 9) Do you agree with our proposed approach to managing interim protections for registered 3.6-3.8 GHz band users?	Confidential? – N As set out in paragraphs 39-45 of our main response, Ofcom should consider use of a DSA model to enable coexistence in the 3.6-3.8GHz band, which would better facilitate protections for existing registered 3.6-3.8GHz band users.
Question 10: (Section 9) Do you agree with our 3.6-3.8 GHz in-band restriction zone proposals?	Confidential? – N Beyond our comments set out in response to Question 9 above, Nominet does not have any comment on these restrictions.
Question 11: (Section 9) Do you agree with our view that we do not need to include any specific conditions in 3.6-3.8 GHz licences to mitigate the risk of adjacent band interference?	Confidential? – N Yes, this position broadly reflects the qualities of the band and is a reasonable view to take.
Question 12: (Section 10) Do you agree with the non-technical conditions that we propose to include in the licences to be issued after the award of the 700 MHz and 3.6-3.8 GHz bands?	Confidential? – N Ofcom needs to learn from the experience of 4G rollout that ensuring wording is clear about the possibility of both operator and regulator led sharing is key to ensuring both are possible. As noted in paragraphs 58-62 of the main response, this will need to be accompanied by a clear policy decision and robust action on Ofcom's part. However, the specific license conditions proposed are clearly beneficial in supporting this and Ofcom's longer-term goal of supporting DSA across multiple bands.

Question 13: (Section 11) Do you agree with the technical licence conditions we propose?	Confidential? – N Our views in response to this question are set out above in response to Question 12.

Annex 2 – Nominet Responses to questions in 'Enabling opportunities for innovation' consultation

Question	Your response
Question 1: (Section 3) Do you agree with our proposal for a single authorisation approach for new users to access the three shared access bands and that this will be coordinated by Ofcom and authorised through individual licensing on a per location, first come first served basis? Please give reasons supported by evidence for your views.	Confidential? – N Ofcom's proposals represent a welcome first step toward sharing and the more efficient use of mobile spectrum, that will help support the UK digital economy. Ofcom has a duty to ensure it manages this vital resource as efficiently as possible in the interests of all users, and as such opening up this unused spectrum to new and independent players is a welcome change. Separately in its consultation Ofcom sets out its long-term ambitions to support greater sharing and flexibility in allocation of spectrum, including Dynamic Spectrum Management. While Ofcom's proposals for sharing are a welcome step forward, we would also urge greater ambition for 5G and the 700MHz band. Our views in this regard are ret out in paragraphs 29-45 and 67-72 of our main response.
Question 2: (Section 3) Are there other potential uses in the three shared access bands that we have not identified?	Confidential? – N Ofcom are correct in identifying uses, however we would also note that the spectrum bandwidth being made available at 1800MHz and 2.3GHz is narrow and may limit some of the potential usages or the end users experience in the case of mobile handsets. Our views in this regard are set

	out in paragraphs 50-52 of the main response.
Question 3: (Section 3) Do you have any other comments on our authorisation proposal for the three shared access bands?	Confidential? – N Our views on our concerns and the limitations of the Shared Access Bands are set out in paragraphs 49-64 of the main response.
Question 4: (Section 3) What is your view on the status of equipment availability that could support DSA and how should DSA be implemented?	Confidential? – N Carrier grade equipment is available to a support robust and market ready equipment ecosystem to support DSA, however as noted in Fig 2 of our main response, the supporting ecosystem will be more robust for the 3.6-3.8GHz band.
Question 5: (Section 4) Do you agree with our proposal for the low power and medium power licence? Please give reasons supported by evidence for your views.	Confidential? – N Ofcom's proposals for both sets of licenses are proportionate and welcome. However alone they do not represent a foundation for longer term evolution of the policy and ultimately Ofcom's ambition to support DSA. Many of the provisions Ofcom set out in relation to both low and medium power sites could be better accommodated for with a DSA model, as set out in paragraphs 73-77 of the main response.
Question 6: (Section 4) Are there potential uses that may not be enabled by our proposals? Please give reasons supported by evidence for your views.	Confidential? – N Our concerns in this regard are set out in paragraphs 51-52 of the main response.
Question 7: (Section 4) Do you agree with our proposal to limit the locations in which	Confidential? – N

medium power licences are available? Please give reasons supported by evidence for your views.	Our views in response to this question are set out in paragraphs 73-75 of the main response.
Question 8: (Section 4) Do you have other comments on our proposed new licence for the three shared access bands?	Confidential? – N Our views in response to this question are set out in paragraphs 46-64 of the main response.
Question 9: (Section 4) Do you agree that our standard approach to non-technical licence conditions is appropriate? Please give reasons supported by evidence for your views.	Confidential? – N We support Ofcom's proposals around licensing terms, however we also urge greater flexibility, in line with our views in response to this question are set out in paragraphs 46-64 of the main response.
Question 10: (Section 4) Are you aware of any issues regarding numbering resources and Mobile Network Codes raised by our proposals which we have not considered here?	Confidential? – N Nominet does not express a view in response to this question.
Question 11: (Section 5) Do you agree with the proposed technical licence conditions for the three shared access bands? Please give reasons supported by evidence for your views.	Confidential? – N We note our response to Question 9, however we also wish to emphasise the risk of a potential MNO spoiler role set out in paragraphs 58-62 of the main response.
Question 12: (Section 5) Are there other uses that these bands could enable which could not be facilitated by the proposed technical licence conditions? Please give reasons supported by evidence for your views.	Confidential? – N To note Ofcom's proposals for innovation need to focus on connectivity that enables innovation in general – rather than specific solutions or application outcomes.

Question 13: (Section 5) Do you agree with our proposed coordination parameters and methodology? Please give reasons supported by evidence for your views.	Confidential? – N Our response to this question is set out in paragraphs 65-77 of the main response.
Question 14: (Section 5) What is your view on the potential use of equipment with adaptive antenna technology (AAS) in the 3.8-4.2 GHz band? What additional considerations would we need to take into account in the technical conditions and coordination methodology to support this technology and to ensure that incumbent users remain protected?	Confidential? – N No technical considerations; however, we reiterate that Ofcom should bringing forward its ambitions for DSA supported by a database, which would be well placed to enable such AAS technologies.
Question 15: (Section 5) Do you agree with our proposal not to assign spectrum to new users in the 3800-3805 MHz band and the 4195-4200 MHz band?	Confidential? – N Nominet does not take a view on Ofcom's specific proposal however we do reiterate our view that sharing across both the 3.6-3.8GHz and 3.8-4.2GHz band would be best suited to enabling efficient use of mobile spectrum.
Question 16: (Section 6) Do you agree with our fee proposal for the new shared access licence? Please give reasons supported by evidence for your views.	Confidential? – N In principle yes however, Ofcom need to consider how any fee they charge aligns with their overall policy objective. For new adopters making use of this spectrum we would urge that this fee be as low as possible so as not to deter appetite to use this spectrum in new and innovative ways. Our thoughts are set out in further detail in paragraphs 54-57 of the main response.
Question 17: (Section 7) Do you agree with our proposal to change the approach to authorising existing CSA licensees in the	Confidential? – N

1800 MHz shared spectrum? Please give reasons supported by evidence for your views.	In principle, yes. However, we remain concerned around the specific provisions that are set out in paragraphs 49-53 of the main response.
Question 18: (Section 8) Do you agree with our proposal for the Local Access licence? Please give reasons supported by evidence for your views.	Confidential? – N Ofcom's proposals are welcome, however greater clarity would be needed as to what constituted a reasonable objection by an incumbent MNO. There is a risk such objections could be made on a blanket basis. These concerns are set out in further detail in paragraphs 58-62 of the main response.
Question 19: (Section 8) Do you have any other comments on our proposal?	Confidential? – N Additional comments on Ofcom's proposal, in particular the roadmap needed to enable DSA at 5G, are set out in paragraphs 54-77 of the main response.
Question 20: (Section 8) What information should Ofcom consider providing for potential applicants in the future and why would this be of use?	Confidential? – N Nominet does not have a firm view as to specific content, however Ofcom should adopt an approach that provides applicants with a simple process and to encourage wider confidence.
Question 21: (Section 8) Do you agree with our proposal to have a defined licence period and do you have any comments on the proposed licence term of three years?	Confidential? – N While we support this in principle, Ofcom need greater flexibility. In some cases, for temporary installations and events, a shorter license may be more appropriate. In others, a longer term one may reflect a) local context and b) the need for certainty

	before investing in supporting equipment and infrastructure.
Question 22: (Section 8) Do you have any other comments on the proposed Local Access licence terms and conditions?	Confidential? – N Nominet does not have any additional comments in this regard.
Question 23: (Section 8) Do you agree with our fee proposal for the new local access licence? Please give reasons supported by evidence for your views.	Confidential? – N Yes, with the provisos set out above in response to question 16 and paragraphs 46-64 of the main response.