Advanced Wireless Technology Group, Ltd., Response to Ofcom Consultation on "Enabling Opportunities for Innovation"

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About the Advanced Wireless Technology Group, Ltd. (AWTG)

The Advanced Wireless Technology Group, Ltd. (hereafter referred to as "AWTG") is an end-to-end engineering services and technology solutions provider for companies in Telecommunications, Technology, Smart Cities, Industry 4.0, Smart Health, New Media, Internet, and other markets that employ digital technologies. AWTG's technology solutions cover Digital Transformation, Rapid Prototyping, Artificial Intelligence, Internet of Everything, and Software. AWTG pioneers in 5G and other related deployments at the forefront of mobile technology, including the development and provisioning of software solutions, ultra-reliable low-latency and massive machine-type communications, connectivity solutions, emergency services, and spectrum optimisation and sharing initiatives. It also continues to be the leading services company providing 5G solutions equipped with Artificial Intelligence for the various market verticals. AWTG delivers successful government projects such as the Worcestershire Lab and Millbrook Autonomous Vehicle Test bed, and performs government audits on the UK emergency communications service the Emergency Notification System (ENS). AWTG has deployed thousands of WiFi access points and small cells, as well as 3G and 4G sites, across three continents of the world over the past 12 years.

AWTG provides services and solutions for enterprises, cities and communities. Founded in 2006 by a group of industry experts initially to provide advanced professional services catering to the specific needs of the telecommunications industry, AWTG has built a strong reputation by focusing on customer satisfaction, utilizing its considerable skills and expertise to deliver industry-leading results and returns-on-investments for its customers. It delivers innovations and solutions in Communications, Technology, Digital Transformation and the Connected World, and is involved in creating new business models for 5G, IoT and Industry 4.0 in the UK, in collaboration with various government, industrial and technology leaders. It continues to be a leading thought provider; there is much demand for its consulting services among leading communications and technology investment companies.

General Thoughts

AWTG thanks Ofcom for its vision in bringing forward this consultation. AWTG broadly supports the proposals for the three shared access bands, but has mixed feelings about the proposals in Section 8 for a new license giving local access to locally-unused existing mobile spectrum.

Regarding the three shared access bands, we note that spectrum sharing will have a vastly-increased importance to play in the wide achievement of emerging and future communication scenarios, use cases, and indeed systems in general. This is especially where it comes to realising sufficient spectrum

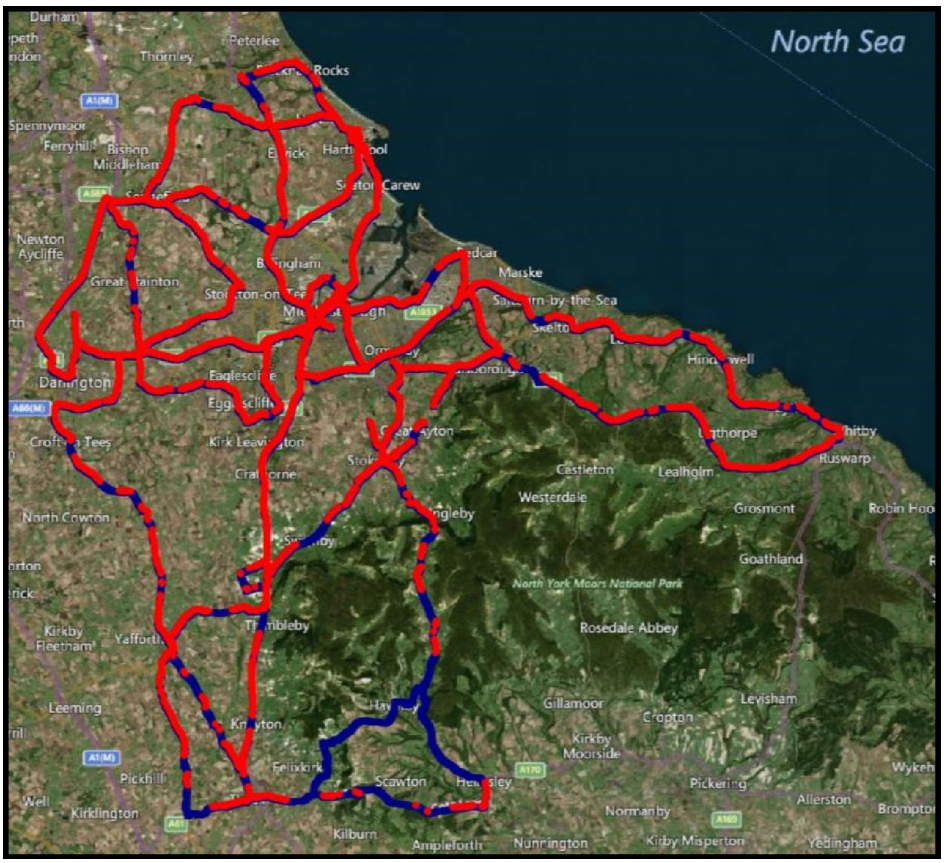

Figure 1: Areas where 4G coverage at a signal strength of at least -95 dBm is available (red) and is not available (blue), for at least one of the operators, for an area of Northern England.

at lower frequencies. It is noted that many of the key use cases and scenarios proposed for 5G require very high data capacities that might only be achievable using mm-wave spectrum—due to the significantly increased channel bandwidths at such frequencies, among other factors. Even in ideal situations, such mm-wave transmissions will only propagate several-hundred metres or perhaps around 1km at most, so will not be viable in many rural cases. This is because it will not be economically justifiable or even possible to deploy an access point including 20 Gbps+ backhaul every few hundred metres, in locations with low population density where there is, e.g., one person or a small number of people per base station. The alternative usage of increased available bandwidths at lower frequencies through spectrum sharing will significantly mitigate such issues through improvements in propagation.

Regarding the proposal in Section 8 of the consultation to create a new local license with access to existing mobile spectrum, we acknowledge the immense importance and contributions of mobile network operators towards achieving the communications systems of today. Further, we acknowledge the relevance of the business models of such operators, and particularly the importance of spectrum and infrastructure investment strategies based on expectations of future revenue that justify the investments. Such strategies have underpinned the creation of the mobile/wireless communications deployments that we have today, and are vitally-dependent on certainties on the performance, and also the exclusivity, of spectrum. We therefore believe that developments such as presented in this

consultation must be taken forward in a way that is also beneficial, and agreeable, to operators—realising the *complementary* involvements of such new technologies and new entrants to enhance the UK's communications infrastructure in challenging locations. The proposals in Section 8 of the consultation, which might be seen by some as eroding the "exclusivity" of access to the spectrum for the awarded mobile operator, should be refined to bring the operator and its approval more tightly into the process—beyond the current "reasonable objection" scope of involvement offered in the consultation. The solution for such locally-licensed shared spectrum deployments could be, for example, a mutually agreeable plan and revenue-sharing model between the incumbent and new entrant, taken forward on a per-case basis and with arbitration if necessary.

The challenges around the achievement of rural coverage, and expenses in tandem with economic justifications/motivations in providing that coverage, are ongoing issues. This can be observed in 4G coverage, for example, as illustrated in Figure 1. This Figure, derived from drive-testing performed by AWTG showing the roads where at least one of the four operators achieves a minimum received signal strength threshold of -95 dBm, touches on the edges of large areas in and near the North York Moors where none of the operators achieve 4G coverage at the given quality threshold.

With these broad high-level thoughts in mind, as follows are our responses to the specific questions asked in the consultation.

Responses to Specific Questions

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.

While we support the approach in general, we think that there should be a differentiation between the bands in terms of authorisation approach. This is because characteristics such as propagation across the three bands are substantially different, with signals in the lower-frequency two bands and particularly the 1,800 MHz band being able to propagate further. Given other aspects such as the 42 dBm per-sector-per-carrier "medium-power" option at 1,800 MHz taken along with the first come first served nature of authorisation, we think the situation will relatively-easily arise where large areas are effectively "bought-out", not able to be used by others. At 3.8-4.2 GHz we think this will be less of a concern due to the greatly-reduced propagation performance in this band.

We note that Ofcom states that such situations will be kept under review to avoid "sterilisation" of the spectrum by any individual entity or group of entities. However, we think that more certainty and detail is required, including discussion on codified ways forward per possible cases of competition for the spectrum—particularly at lower frequencies. Moreover, we believe that more flexibility, e.g., in allowed EIRPs, would be beneficial should the situation in the local spectrum become busy.

Our views are formed here based on expectations of new narrowband usages that could apply in such spectrum (please see our comments on the completeness of the considered applications in response to Question 2).

Question 2: (Section 3) Are there other potential uses in the three shared access bands that we have not identified?

Per the response to Question 1, we believe that the lower-frequency bands could and should be able to support other relatively narrow-band applications, including IoT and sensor networking, and "smart-X" applications among others. This is because, given the reduced bandwidths available at these frequencies and the increasing bandwidths becoming available today in other realms and in many pioneering end-user software applications, such low-bandwidth options will become of lesser importance. They may indeed even not be supported or supportable by future widely-adopted end-user software applications. Sensor networking, smart-X, and some IoT applications among other alternative such uses, must therefore take greater prominence—especially for the 1,800 MHz band.

Our opinions are formed in realisation of the better propagation achieved in such bands, suitable for the longer-distance links that might be required in such applications. Further, we believe that mobile private networks in such narrow bandwidths will become of lesser importance as time progresses, based on general improvements in technology requiring larger bandwidths referred to above, as well as the proliferation of alternative private communication solutions that have become and will continue to become available.

We also acknowledge in this response that the paired downlink/uplink offering in 1,800 MHz spectrum is not compatible with many conventional IoT deployments—which are using a single frequency typically time-shared among downlink/uplink (or indeed, all) transmissions. However, minor flexibility in this consultation and its required constraints could make the paired spectrum offering viable.

Question 3: (Section 3) Do you have any other comments on our authorisation proposal for the three shared access bands?

Nothing more to add.

Question 4: (Section 3) What is your view on the status of equipment availability that could support DSA and how should DSA be implemented?

We support the database-driven approach to DSA. We see it to be a good solution to realise DSA technology as practically as possible, minimising the burden on DSA equipment and allowing continued overall regulatory oversight and control (in real-time, if necessary). Other approaches are complicated. Sensing, for example, implies the burden of additional radios on devices, or alternatively building sensing considerations into the MAC of the radio interface. It also likely implies the need for very challenging technical and regulatory requirements, such as around sensor sensitivity and/or the provisioning for distributed sensing. These requirements are because of the need to address the hidden (and indeed exposed) terminal problem, among other reasons. Beaconing, for example, implies the burden on the incumbent (and/or the regulator, and/or others), of setting up and maintaining such beacons.

The step-up of equipment to achieving DSA based on such a database approach is very minor, if such equipment is already designed to access the bands in question. The communication with the database and the following of instructions in response are essentially software issues, requiring a software update—providing that some form of rudimentary data connectivity is already present to communicate with the database. Further, in many cases GPS will already be present or already

deployable, noting that GPS achieves better assurance of correct information provision from the devices to the database. In other cases fixed manual-input information will be appropriate, and given that the devices are licensed with an approved licensee under the proposals in this consultation, a high-assurance on the accuracy of the installation can be built into requirements and followed in a professional installation process.

Most of the difficult aspects in the realisation of DSA are around the database, including its creation, propagation modelling, availability of and access to utilised data sources, and (if applicable) selection and certification of an appropriate entity (or entities) to host the database.

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.

The proposals seem broadly reasonable. However, we believe the permitted power levels should be different among for the three shared bands—due to propagation differences and differences in implied interference, service coverage areas and indeed geographical areas effectively being "claimed" through the license. Further, we believe that scope should be given for the permitted power level to be variable on a per-license-application basis, in order to maximise the potential for new entrants. For instance, if a new entrant would be refused a license because the proposed 42 dBm EIRP limit would cause 2 dB too-high interference to another pre-existing licensee's deployments at the edge of the implied interference area, the allowed power for the new applicant could be reduced to 40 dBm EIRP thereby allowing the license to be issued. The license fee for the new applicant could be reduced accordingly, perhaps by the same proportion as the proportion of coverage-area lost at the new reduced power, as calculated by Ofcom using pre-agreed models.

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.

Of course, there are very many potential uses requiring higher-powers and a more extensive coverage area and certainty of coverage. But we believe this question is framed in the context of uses that are appropriate for only local-area licensing.

The limitation of the medium-power license to rural scenarios does, we believe, greatly reduce in-building penetration and perhaps in-building provisioning in urban areas. It might also have implications for some industrial IoT applications, e.g., in larger factories in urban industrial areas—especially given that aspects such as reliability/availability of coverage and performance are paramount in many industrial IoT applications. We state this noting that the 3.8-4.2 GHz spectrum in particular is argued as suitable for IoT applications (including industrial IoT) in the consultation. We also note that the medium-power option might be applicable to applications such as (infrastructure-based) autonomous vehicles, which should not be limited to rural-only scenarios.

Question 7: (Section 4) Do you agree with our proposal to limit the locations in which medium power licences are available? Please give reasons supported by evidence for your views.

We do understand the limitation in terms of the greatly-increased proportion of population of a town/city that would be covered through a single such medium-power deployment. It could limit the number of new entrants that could deploy in the town/city—as a large area would be covered by a single deployment. This is particularly in the context that the medium-power licensed deployments

are not height limited. Further, we acknowledge that some of the other key reasons for having such a license, such as to increase broadband availability/performance, will far less apply in urban areas as broadband availability and performance are already relatively good there.

On the other side of the coin, such medium-power licensing in urban areas could better encourage new entrants. And given this, in conjunction with our arguments in response to Question 6, on balance we believe that medium-power licensing should be also allowed also in urban areas. The absence of a height limit in this case, perhaps as well as some other aspects, would need to be reconsidered.

Question 8: (Section 4) Do you have other comments on our proposed new licence for the three shared access bands?

The 50m radius for the low-power license seems somewhat overly restrictive. Propagation at 24 dBm, 10m height, is likely to be far more than that in most scenarios. It seems that the 50m limit might overly-constrain deployment use cases.

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.

We believe that spectrum trading should be allowed at least also in the 2.3 GHz band.

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?

We are not aware of any issues.

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.

The difference between the powers of the two types of licenses is huge. We believe that more consideration or justification should be given to why these values is chosen. Further, we think it unnecessary to limit the license in the case of 3.8-4.2 GHz to a maximum of 100 MHz bandwidth. Upcoming (e.g., 5G) communication systems will use channel bandwidths of 200 MHz or more, and it is vital to address the increasing disparity in available spectrum between urban and rural scenarios through making more lower-frequency spectrum (and wider carriers thereof) available, as has been discussed in the introductory text and elsewhere in this consultation response.

As a further comment, with the increase in practicality and size reductions of multi-antenna-element systems, the justification for using “Total Radiated Power” as an emissions limit could become questionable—particularly in the shorter-wavelength 3.8-4.2 GHz band.

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.

Very-narrow bandwidth applications such as sensor networks, and perhaps “smart-X” and some forms of IoT, are neglected in the awarded bandwidth options. They are also less compatible with the proposals, or achieve far less efficiency, in view of other aspects such as the fixed downlink/uplink ratio and proposed frame structures. This could particularly effect solutions such as industrial IoT,

which might in many cases have very challenging and strict latency requirements, and which are indicated as a key use case, e.g., for the 3.8-4.2 GHz spectrum in the consultation Although new note again here that we below IoT should also be a prime target for the other bands.

Question 13: (Section 5) Do you agree with our proposed coordination parameters and methodology? Please give reasons supported by evidence for your views.

We broadly agree, although we note again that larger-bandwidth options of at least 200 MHz, and perhaps more, should be allowed in the 3.8-4.2 GHz band.

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?

Especially at frequencies such as 3 GHz and above, multi-antenna-element related solutions will perpetuate more in coming years, and in more-compact form factors. Emissions modelling needs to take this into account.

Far-greater spectrum use efficiency and sharing potential could be achieved if antenna orientations and gain patterns were considered in modelling of interference, particularly among the new entrants but potentially also when considering interference risk on incumbents. If, e.g., the certainty on correct deployment re. antenna orientation were insufficient, then antenna orientation and emissions patterns might still be considered but only for interference modelling among the new entrants.

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?

We believe it is prudent to not assign to new users in these bands in order to avoid interference to adjacent services—especially given the time-division duplex nature of transmissions and implications in terms of frequency spread of interference that might have.

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.

The fee proposal seems reasonable to support new services. It is within the range of affordability for local operators building communication networks based on these offerings. However, in conjunction with some of our proposals around power scaling to, e.g., maximise sharing opportunity and efficiency, we might suggest that fees are scaled accordingly—perhaps based on the resulting area covered.

Question 17: (Section 7) Do you agree with our proposal to change the approach to authorising existing CSA licensees in the 1800 MHz shared spectrum? Please give reasons supported by evidence for your views.

The proposal seems reasonable; we have no reason to believe that it will cause issues or interference to the pre-existing local users. In fact, it might benefit current CSA licensees in that it brings the associated management burden, workload and associated costs into the scope of Ofcom.

Question 18: (Section 8) Do you agree with our proposal for the Local Access licence? Please give reasons supported by evidence for your views.

We believe that this proposal, if taken forward, should be adapted significantly. The importance cannot be underestimated of spectrum as a guarantee of market hold for the operator and a firm basis on which to fund large and expensive network build-outs based on expectations of future revenue. Local access licensing, as proposed in the consultation, might risk the perception of loss of "exclusivity" of access—eroding the value of spectrum at least based on auction returns, and reducing operators' willingness to invest in spectrum and infrastructure. To rectify this problem, we propose that the solution should be taken forward on a per-case basis with full agreement of both the operator incumbent and the proposed "new entrant"—likely with some form of revenue sharing agreement to be paid by the "new entrant" to the incumbent operator. Arbitration services might be employed to ensure an agreement is reached and avoid the risk of the process and spectrum in challenging locations becoming (or remaining) "sterile".

Question 19: (Section 8) Do you have any other comments on our proposal?

We would simply like to emphasise again that it is important to protect the operator's business model. At the same time we do agree that new users should able to use unused spectrum, but it should be done in a way that the incumbent operator agrees with and benefits from.

Question 20: (Section 8) What information should Ofcom consider providing for potential applicants in the future and why would this be of use?.

Incumbent coverage maps, incumbent received power level estimations, current incumbent deployment locations, propagation/loss maps and/or models, any information on expected future deployments or plans of the incumbent, and monitoring information on spectrum use in terms of interference and security. This information would assist the applicant in understanding the real potential and performance of the spectrum. It is unclear, however, the extent to which legal constraints might prevent some of this information being shared. Further, some such information would likely have to be shared in agreement with the operator.

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?.

We broadly agree with the definition of a license period. We believe that this will provide a degree of much-needed certainty for the applicant. However, noting that under our proposals this must be done in full agreement and with benefit to the incumbent as discussed elsewhere, we feel that a longer minimum duration of 5 years will be appropriate to further-cement certainty.

Question 22: (Section 8) Do you have any other comments on the proposed Local Access licence terms and conditions?

No other comment.

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.

Broadly agree.

Contact Details

If you have any questions or wish to discuss this consultation response, please email [✂]