Introduction

Nokia welcomes the opportunity to respond to Ofcom's consultation providing views and comments regarding the proposed use of mmWave bands for new uses.

The wide bandwidths available in mmWave bands are key in delivering the extreme performance associated with 5G. Our Nokia products support a wide variety of use-cases and deployment requirements, enabled by compact form-factors and optimized performance characteristics.

Nokia's AirScale mmWave Radio portfolio includes products for the various mmWave bands, which are ideally suited to deployment in dense-urban locations and large public venues such as shopping-malls, concert halls and sports arenas, where there are typically many users.

To address the challenging propagation conditions of indoor environments, our 360 High Gain mmWave technology captures a 360 mmWave fingerprint, picks up direct and reflected signals from any direction and adapts to the changing environment, through advanced analytics.

However, today's mmWave technology is not only for dense, urban, small cell deployments. As part of a mixed deployment strategy, mmWave can be deployed in urban, suburban and also rural areas, where in combination with other frequency bands it is possible to achieve more robust FWA services and cost-effective deployments. Our technology paves the way for 5G mmWave solutions that can accelerate broadband connectivity around the world.

Our detailed response and comments to the Ofcom mmWave consultation can be found in the following section.

Your response

Question	Your response
Question 1: (section 3) Do you have any further comments on the approach we are minded to take to authorising the 40 GHz band?	*Is this response confidential? – No* In our view, while making the 40 GHz band available at the same time as the 26 GHz band would be good to have to promote innovation, we think that the 26 GHz band should, at this stage, be the priority band since the ecosystem around it is more mature.
Question 2: (section 5) Do you agree with the method that we have outlined in annex 16 for identifying which licences authorising the use of fixed links around high density areas will be subject to revocation on the basis that the authorised links would be likely to suffer interference from new users in the high density areas? If not, please give reasons.	*Is this response confidential? – Y / N (delete as appropriate)*
Question 3: (section 7) Do you agree that the licence fee for fixed links that we allow to remain in the 40 GHz band should be the same as the fee in place for the 26 GHz band? If not, please give reasons.	*Is this response confidential? – Y / N (delete as appropriate)*
Question 4: (section 9) Do you have any comments on the proposed rules of our auction?	*Is this response confidential? – Y / N (delete as appropriate)*
Question 5: (section 9) Do you have an interest in bidding for specific high density areas in this award? If so, please provide evidence that you have a credible intention to do so.	*Is this response confidential? – Y / N (delete as appropriate)*
Question 6: (section 9) Do you consider it appropriate to have one or two 26 GHz lot categories?	*Is this response confidential? – Y / N (delete as appropriate)*
Question 7: (section 10) Do you agree with our proposed approach to coordinating Shared Access	*Is this response confidential? –No*

users in the 26 GHz band? If not, please give reasons.	We agree with Ofcom's proposals to assume the proposed fixed separation distances among low power deployments in the 26 GHz band. We also agree with Ofcom's proposal to undertake a technical assessment when coordinating Medium/Medium and Medium/Low power licences, as these cases will likely need to include more specific parameters and characteristics of the Medium power deployments. However, we note that the BS levels limited to EIRP values of 49dBm/200 MHz and 58dBm/200 MHz may potentially hinder the coverage envisaged by operators for some applications. Comparing the 26 GHz Medium Power EIRP levels (for a 100MHz channel) with the relevant EIRP levels of the Medium Power BS in the 3.8-4.2 GHz band (for a 100 MHz channel), the actual different in power is only 6 dB. At the same time, even at a worst-case scenario of assuming free space path loss propagation, for the same distance, signals in the 26 GHz band will attenuate by approximately 15 dB more than those in the 3.8-4.2 GHz band. As a result, the realisation of benefits of the use of mmWave bands in e.g., low density areas for FWA applications for licensees is probably likely to come primarily through the use of large (e.g. 800 MHz) channels. In general, for the coordination of mmWave licences, we understand that effectively, Ofcom proposes to coordinate mmWave licences on the basis of EIRP, consisting of a default pre-defined antenna gain and a user defined TRP. More specifically, regarding the coordination with other mobile and non-mobile services we welcome Ofcom's consideration of an average antenna gain (for mobile-mobile) and the 12dB reduction factor (for mobile-non mobile) in the coordination calculations. Nevertheless, for an even more efficient spectrum management and greater spectrum availability, we would like to propose that, in the case that potential licensees don't wish to provide 3-sector coverage, to notify Ofcom and have their applications considered on a case-by-case basis, using more detailed deployment information, preventing further spectrum inefficiencies that could be caused through generic assumptions such as the use of Omni antennas. Furthermore, regarding the consideration of the 2dB added to the EIRP (footnote 556), it is slightly unclear whether Ofcom considers that outdoor low power BS will operate with 2dB higher EIRP than indoor low power BS. If the consideration of 2dB added in the EIRP, as a proxy, applies also to the coordinated EIRP levels of low power outdoor base stations, then we think that this is a more suitable assumption for the shared access outdoor low power BS above 25.05 GHz. The limitation of the number of outdoor

	low power BS to three per 300km^2 per licence together with the likelihood of licensees aiming for a 3 sector coverage (rather than deploying BS pointing to the same direction), makes the consideration of the 2dB added, as a proxy, in the EIRP used in the coordination of outdoor low power services in the 24.45-25.05 GHz a probably less suitable assumption. Regarding the limit set for the protection of EESS below 24GHz, we believe that the way this limit is assumed, applied and calculated, effectively sets an upper limit in the number of BS that can be deployed in the long term in the 24.45-25.05 GHz.
Question 8: (section 10) Do you agree it would be appropriate to coordinate Shared Access users in the 40 GHz band in a similar way to the 26 GHz band if we make it available in 5 years time (noting we would consult on the detail of this coordination). If not, please give reasons.	*Is this response confidential? – No* Considering the technology evolution in the upcoming 5 years, we believe that Ofcom should envisage a future consultation regarding the coordination of the Shared Access users in the 40 GHz band to take into account the specifications of equipment in that band at that time, assess the effectiveness of the 26 GHz framework in place at that time, and consult accordingly. Such consultation may equally include possible revisions that would allow for a more effective spectrum sharing and use.
Question 9: (section 10) Which of the proposed options for coordinating award winners and existing licensees during the (5-year) revocation period do you think would be most appropriate? Do you think alternative approaches to coordination would be more appropriate?	*Is this response confidential? – No* Our view is that more degrees of freedom given to award licensees will allow the authorisation of their deployments to be granted faster. Operators are likely to have simulation tools that they currently use to plan their networks. Therefore, we would expect that award licensees would prefer to know the protection requirements for existing licensees and have the flexibility to plan their networks in a way that meets the protection criteria during the 5-year revocation period. So, we are of the view that the coordination options that allow faster authorisation of BS deployments for operators, even though they might result in slightly higher resource utilisation from their side, might be a more beneficial solution for them. That said, maybe not all award licensees have the tools or the resources needed to provide results of the complete coordination assessment for their candidate deployments. In that case, one option could be for Ofcom to let award licensees decide which of the (e.g., 2 most suitable) options from within the a,b,c,d,e list they wish to follow in coordination.

Question 10: (section 10) Do you agree with our proposal to protect the radio astronomy site at Cambridge (42.5-43.5 GHz) from new mobile users using the 40.5-43.5 GHz band using technical assignment coordination? If not, please give reasons.	*Is this response confidential? – Y / N (delete as appropriate)*
Question 11: (section 10) Do you agree with our proposed approach to coordinating at the boundary of high and low density areas? If not, please give reasons.	*Is this response confidential? – Y / N (delete as appropriate)*
Question 12: (section 10) Do you agree with our proposed approach to international coordination? If not, please give reasons.	*Is this response confidential? – Y / N (delete as appropriate)*
Question 13: (section 11) Do you agree with the non-technical conditions that we propose to include in the award licences to be issued following the award of the 26 GHz and 40 GHz bands? If not, please give reasons.	*Is this response confidential? – Y / N (delete as appropriate)*
Question 14: (section 12) Do you have any comments on our proposal to award fixed term licences with a 15 year term?	*Is this response confidential? – No* The potential licensees are better placed to comment on the licences duration. As a technology provider, Nokia is of view that transparency of the process and clear terms of licensing conditions are essential for the certainty of investments and operations of the band. Longer – indefinite or 20-year licences with renewal possibilities – licence durations and transparent and well-in-advance communication on the renewal conditions will create the necessary certainty for licensees to invest in their infrastructure and networks, enabling in parallel suitable conditions that promote further the ecosystem development.
Question 15: (section 13) Do you agree with the proposed technical licence conditions for award licences and local access licences in the 26 GHz and 40 GHz bands? If not, please give reasons.	*Is this response confidential? – No* We agree with Ofcom's proposal to define the power levels of the 26 GHz and 40 GHz licences based on TRP rather than EIRP and we would like to suggest that Ofcom should also follow the same approach when revising the framework of the low/medium power licences using AAS BS in the rest of the shared access bands (i.e. in 3.8-4.2 GHz).

	Regarding the actual TRP levels, we note that the difference between medium and low power BS as proposed by Ofcom is only 5 dB. At the same time, we note that the difference between the proposed EIRP (per 100 MHz) of medium power licences in the 26 GHz and 40 GHz band and the EIRP of the existing medium power licences in the 3.8-4.2 GHz band is only 6 dB, while admittedly the mmWave signals will attenuate significantly more than the 6dB difference in power for the same distance. This may hinder the ability of operators to provide services for specific use cases and will likely shift the focus towards applying for licences with the maximum available channel bandwidths. We are of the view, considering the nature of mmWave signals in terms of propagation and the capabilities of equipment in being able to accommodate higher TRP powers than those proposed by Ofcom, that consideration of higher TRP levels, at least for medium power BS, should be taken into account by Ofcom. Furthermore, while we understand Ofcom's reasoning to limit the BS antenna height for low power shared access licences, so that more licensees can have access in the band, we don't see the reason why Ofcom proposes to limit the antenna height of outdoor low power BS for award licences. Since award licences will have their spectrum acquired through auction, since there will be no availability of low power shared access licences in the 25.1 – 27.5 GHz in high-density areas, since medium power licences are also available for award licensees in high density areas and since Ofcom proposes limits applicable at the border of low and high density areas, the limitation of antenna height for the outdoor low power BS of the award licences doesn't seem to have any reasonable justification. We propose Ofcom to revisit this proposal. Finally, we agree with Ofcom not to impose frame structure synchronisation and allow licensees to cooperate with each other to resolve and mitigate any interference issues if and when they arise.
Question 16: (section 13) Do you have any comments on our proposed licence conditions relating to antenna elevation?	*Is this response confidential? – No*
Question 17: (section 14) Do you agree with our proposal to make available channel sizes of 50 MHz, 100 MHz, 200 MHz, 400 MHz and	*Is this response confidential? – No* Yes, we agree that such channel sizes are suitable to deliver the use cases envisaged for the mmWave bands. We also highlight that Ofcom should reconsider the PSD levels

800 MHz? If not, please give reasons.	proposed for these bands, so that channel bandwidths of all the available sizes can address the significant benefits that equipment in the mmWave bands can deliver.
Question 18: (section 14) Do you have any further comments on the proposal to limit low power outdoor deployments in 24.45-25.05 GHz to three base stations in any 300km2 area in order to comply with the EESS protection requirements?	*Is this response confidential? – No* We welcome Ofcom's revised proposal to increase the number of outdoor BS included in each low power licence from 2 to 3. We also agree with Ofcom that this condition should be monitored and revised to a higher number if necessary in the future, if it is found to create significant coverage obstacles for licensees in the band, especially since Ofcom proposes to set up a height limit of 10m for low power BS. We also note that the above condition, together with the way Ofcom proposes to calculate the levels to protect the EESS operation in each 300km^2 will eventually act as setting up an indirect upper limit of the total number of Shared Access BSs that can be deployed in each 300km^2 in the 24.45-25.05 GHz. Such limit may also reduce or cap the availability of licences in specific areas in the long term.
Question 19: (section 14) Do you have any further comments on the proposed level of fees for the Shared Access licences in the 26 GHz and 40 GHz bands?	*Is this response confidential? – Y / N (delete as appropriate)*
Question 20: (section 14) Do you have any further comments on the proposed extension of the Shared Access licensing framework (including its standard non-technical licence conditions) to the 26 GHz and 40 GHz bands?	*Is this response confidential? – Y / N (delete as appropriate)*

Please complete this form in full and return to mmWave.allocation@ofcom.org.uk.