Your response

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.	Nokia see large economical value in the possibilities for enterprises to invest into private wireless networks using 3GPP technologies on their premises. Additional investment into private networks by private enterprises can significantly speed up the overall 5G take-up. Production and automation industry have gathered with Communication Service Providers (CSPs) and the vendor community in 5G-ACIA to express requirements for industrial use of 3GPP technologies. Networks need to be tailored to industry needs in terms of performance, availability and reliability, privacy and security, and meeting their operational requirements. Specifically, stringent performance requirements in terms of guaranteed bandwidth and low latency at very high availability levels e.g. in wireless production control make access to licensed spectrum necessary.[1] Thus, Nokia support individually licensed spectrum on a per location base for local private enterprise use. Access to licensed spectrum for private enterprises shall not preclude any usage scenarios in terms of how such private networks are implemented. Within the German national IT summit process, industry and administration have created a paper on such usage models including standalone private, industrial networks, shared local access networks to private networks implemented as 5G networks slices.[2] In the same way as for mobile networks, the key for the success of technologies in private local enterprise networks is access to global ecosystems for chipsets, devices and network infrastructure based on global standards like 3GPP, i.e. access to harmonised bands. While

[1] 5G-ACIA white paper on 5G for Connected Industries and Automation https://www.5g-acia.org/index.php?id=5125

[2] 5G Focus Group on 5G Usage Scenarios for Industrial Communication https://plattform-digitale-netze.de/publikationen/

	3.8-4.2 GHz is not earmarked a 5G pioneer band in CEPT, 5G New Radio (NR) Band n77 has been defined for 3.3-4.2 GHz covering the proposed range of 3.8-4.2 GHz. With demand also from other regions like US and Japan, Nokia expect a quickly evolving ecosystem for Band n77. The 1800 MHz range is covered by GSM1800, by UMTS Band III and LTE Band 3 with wide support for GSM and LTE, 5G NR Band n3 also has been defined with eco system support to arise quickly once demand becomes visible. CEPT is working on the introduction of 5G-NR technology in the 1800 MHz band, and the barriers to full technology neutrality are expected to be removed in a second step. The 2300 MHz range is covered by Band 40 for LTE widely supported on devices today, a 5G NR band definition can be created in due time subject to market demand. It not only requires radio solutions for private networks, but also scalable, easy to operate core network solutions to allow enterprises to build and operate local networks. With Network Function Virtualization and Software Defined Networks the first solutions exist for small networks tailored to small numbers of base stations and subscribers. The operational efforts and the skills required to run a small network are brought to levels to enable even small enterprises to own networks. As an example, Nokia market these under Nokia Digital Automation Cloud (NDAC)[3] Operating private enterprise network applications within harmonized bands allows for mutual benefits in cooperation of CSPs with private enterprises sharing scarce spectrum resources and potentially pooling their respective resources on shared local RAN infrastructure. Consequently, Nokia see all three bands as relevant and able to meet demand for private local wireless networks enabled by use of global 3GPP standards and welcomes a single authorisation approach that makes it simple for users to access spectrum at the location they intend to provide a service, and with a choice of

[3] Nokia NDAC https://www.dac.nokia.com/

	bands to suit their needs.
Question 2: (Section 3) Are there other potential uses in the three shared access bands that we have not identified?	Nokia concur with Ofcom's views. Production in the audio-visual and creative sector, e.g. movie or music studios and musical theatres, see similar requirements as the manufacturing industry with respect to performance and availability of wireless networks. In Germany, PMSE players like Sennheiser, Arri and Bosch have successfully concluded the research project PMSE-xG[4] on evaluating 4G and 5G technology for their use cases, continued in the project LIPS[5]. Other sectors with requirements similar to the manufacturing ones exist in eHealth for use within hospital campuses, in airport operation, in hospitality etc. Local enterprise private network operation could be seen to also cover geographically larger private networks e.g. in agriculture, forestry, mining, utility, logistic hubs or smart city applications like driverless trams etc. Regarding the 1800 MHz band Nokia agree that the band provides reasonable coverage conditions. The proposed TX power limitations as well as the rather limited bandwidth, however, limit its applicability for significant improvements of rural broadband.
Question 3: (Section 3) Do you have any other comments on our authorisation proposal for the three shared access bands?	Nokia welcome a simple, transparent authorisation process as proposed by Ofcom. For local use and in particular for use on own premises the proposed mechanism of first come – first served seems appropriate. Charging licences by the amount of spectrum, e.g. as proposed per 10 MHz bandwidth, should prevent spectrum hording. Nokia suggest, however, to reconsider the approach of scaling licence cost linearly with the area of the intended application. While this is a simple and transparent mechanism, it may make sparse use over wide areas e.g. in agriculture, forestry or mining, very costly and thus unattractive. Licence fees could consider property rights in a way that on private property there typically is less need to provide

[4] PMSE-xG project http://pmse-xg.research-project.de
[5] LIPS project http://www.lips-project.de

	spectrum access for multiple private enterprise type parties.
Question 4: (Section 3) What is your view on the status of equipment availability that could support DSA and how should DSA be implemented?	Nokia recommend starting early on with licensing spectrum for private local enterprise use as we see increasing demand to use existing ecosystems for LTE (2300 MHz Bd 40, 1800 MHz Bd 3) and quickly emerging ecosystems for 5G NR (3.8-4.2 GHz Bd n77). As Ofocm's proposed approach is rather static, this can be done by manual work for a limited number of licence applications. At a later stage, higher number of licence application may make it necessary to involve databases and automated procedures reducing the efforts to evaluate and approve such applications. In a future step, even dynamic assignments could be envisaged. Nokia are one of the companies at the origin of and has extensive experience with LSA and we are engaged in ETSI RRS in its further evolution to eLSA. Nokia also are one of the proponents of CBRS in US with a tailored solution to the US incumbency situation in 3550-3700 MHz. So, while first solutions for DSA would be even ready today, Nokia believe that DSA schemes for the proposed bands can be introduced at a later stage as specific requirements appear and as appropriate.
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.	Nokia agree with the Ofcom proposal to have both low power and medium power licences. As noted in Figure 4 there may be different scenarios in the deployment of low power licences which include some outdoor use. For those low power licences with outdoor locations it may be necessary to consider different radii to account for the different propagation characteristics of the different spectrums.
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.	Spectrum licensed to CSPs on nationwide base is very well suited for most 4G/5G use cases with wide area coverage requirements and/or mobility requirements. Local spectrum licensing enables 4G/5G use cases with very high performance and availability requirements at limited mobility, i.e. on the local premises only. There are use cases that require such very high performance and availably requirements temporarily in fixed locations, e.g. PMSE during a temporary event, or even in mobile scenarios,

	e.g. PMSE following a sports race through the country. Such use cases seem to justify considerations to further evolve the proposals towards DSA in the future.
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.	Nokia do not agree with the proposal to limit medium power licences, particularly in the 3.8-4.2GHz bands, to rural areas as defined in the consultation. In our view this overly restricts the potential deployment scenarios of this new shared spectrum and is not aligned with similar approaches in other areas of Europe. In Germany, for example, where the process under consideration for 3700-3800MHz with similar deployment scenarios includes: *"No distinction is made between "regional" and "local" networks. In a first step, priority will be given to enabling property-related uses within individual and larger allocation areas, especially for industrial applications. This is to ensure that the frequencies can be used according to the registered requirements, in particular for industrial automation or industry 4.0. Usually, these applications have special requirements, e.g. in the area of security, which cannot be met by regional or even nationwide network operators. These are intra-company applications. There are no plans to offer telecommunications services to the public, i.e. to everyone.".*[6] Nokia do not believe that allowing medium power licences over a wider geographic area for the band 3.8-4.2GHz would restrict in any major way indoor deployments or even low power deployments with outdoor locations in urban or rural areas.
Question 8: (Section 4) Do you have other comments on our proposed new licence for the three shared access bands?	Nokia have no other comments
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.	Nokia see no objection to the proposed standard approach proposed. We acknowledge that the licenses will benefit the same rules and conditions as other licenses such as access to the secondary market. We also agree with the proposal that in case the respective spectrum is subject to reorganisation/different use, a 5-year notice should be given to the licensees

[6] Translated from www.bnetza.de/lokalesbreitband

	concerned.
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?	Even if not offering commercial service directly to consumers, 2G, 3G, 4G, and 5G cellular networks must broadcast a Home Network Identity (HNI) consisting of a Mobile Country Code (MCC) and Mobile Network Code (MNC) to identify the cellular network. As Ofcom notes, the HNI it is a limited resource that is traditionally managed on a per-country basis and limited to those with exclusive use licensed spectrum for providing public networks. ITU-T has recently assigned MCC value of 999 for use by private networks[7]; however there is no guarantee of uniqueness of the MNC. This may cause issues if devices having an IMSI containing Shared HNI can roam or move into the coverage area of other networks using the same HNI value. To support large numbers of private LTE networks in the CBRS shared spectrum in the USA, the CBRS Alliance worked with ATIS IMSI Oversight Council (IOC) to reserve a Shared HNI[8] for CBRS networks. In addition, the CBRS Alliance calls for an additional identifier to distinguish between SHNI networks and guidelines (CBRS-TR-0101 and CBRS-TR-0100) on allocation and proper use of identifiers to prevent issues. Similarly, MulteFire Alliance defines additional identifiers for managing deployment of private LTE networks.
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.	Nokia generally agree with Ofcom proposals for licensing of the three shared access bands. In particular Nokia support the objective of Ofcom to have as simple conditions as possible, while minimizing as much as possible the interference to other services. Nokia concur with the proposal of Ofcom to define two types of licenses depending on the output power requested by the candidate for a license and to adopt a proportionate approach in the regulation. More specific comments on the technical characteristics of the licenses are provided below for each of the bands.

[7] https://www.itu.int/dms_pub/itu-t/opb/sp/T-SP-OB.1156-2018-OAS-PDF-E.pdf
[8] http://imsiadmin.com/cbrs-assignments

	For the 3.8-4.2 GHz band: - Channel size: Among the three bands considered for shared access, the 3.8-4.2 GHz band is the only one allowing enhanced mobile broadband transmission. 3GPP specifies carrier bandwidths of up to 100 MHz for the band and multiple carriers could be aggregated. Thus, Nokia support the possibility to license wide contiguous channels of e.g. 100 MHz in multiples of 10 MHz blocks in this band. - Maximum power and Block Edge Mask limits: the maximum power and BEM limits are defined in terms of EIRP limits and are in accordance with the values stated in ECC Decision (11)06 for non-AAS systems. Nokia support this extension of 3.4-3.8 GHz limits to the 3.8-4.2 GHz band and also considers that, in order to facilitate the implementation of AAS technologies, these limits should also be expressed as TRP limits for AAS systems. The limits provided for AAS systems in the 2018 version of ECC Decision (11)06 should be used for this purpose. As indicated in response to Question 14, we consider that there are no technology obstacles to the introduction of AAS technology in the whole Band n77, including the 3.8-4.2 GHz band, and that regulatory provisions facilitating the introduction of AAS could be defined from now. Nevertheless, Nokia point out that the implementation of RF filters at radio heads is subject to more constraints, especially on size and in the case of AAS systems. We invite Ofcom to carefully review the provisions related to the guard band just above 3800 MHz. - Frame structure: Nokia note that the preferred and alternative frame structures proposed in the consultation are those that have already been proposed for the bands 3.4-3.6 GHz and 3.6-3.8 GHz. Nokia agree that synchronisation of networks is shall be

	encouraged to avoid interference between networks and should also be extended to the band 3.8-4.2 GHz. In the case of low power indoor networks, Nokia encourage Ofcom to consider the possibility to introduce some flexibility, in line with the suggestions in ECC Report 296. We also note that the business models of verticals would be different from those of commercial networks and between different types of verticals and might result in different UL/DL ratios to optimize the use of the TDD channels. For the 2390-2400 MHz band: No specific remark for this band. The BEM is aligned with ECC Decision (14)02. Nokia support this approach. For the 1800 MHz band: - The BEM proposed for this band is unchanged with regard to the current UK regulations in the 2x3.3 MHz spectrum. Nokia support this approach. - Nokia also note that currently BEM has not been defined in ECC Decision (06)13 and will not be introduced in the current revision process, as the technology neutrality principle has not yet been fully implemented in this Decision. This will likely change at relatively short time during step 2 of the revision of ECC/DEC(06)13 and we encourage Ofcom to further align its regulatory framework to the future ECC Decision, if required.
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.	As stated in our response to Question 11, Nokia think that the proposed licence conditions should also facilitate the introduction of AAS technology.
Question 13: (Section 5) Do you agree with our proposed coordination parameters and methodology? Please give reasons supported by evidence for your views.	Nokia support the proposals made by Ofcom in the context of the scenarios and use cases proposed. In particular the proposal to implement two different approaches depending on the maximum output power required, will adapt

	the complexity of the process to the risk of interference to the other users of the band. Nokia also think that more dynamic scenarios should also be allowed at medium term, taking into account that the tools developed to cope with these scenarios could be used, possibly after adaptation to each considered frequency 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?	The introduction of the AAS technology is already planned in the band 3.4-3.8 GHz: standardisation has been completed in 3 GPP and a revision of ECC Decision (11)06 providing the least restraining technical conditions (LRTC) has been published in July 2018 to allow the introduction of 5G systems implementing AAS. The same technologies will be implemented as well in the band 3.8-4.2 GHz, allowing 3 GPP to identify a single frequency band (n77) in the range 3.3-4.2 GHz. In consequence from a technology point-of-view we do not expect particular issues for the introduction of AAS in the band 3.8-4.2 GHz.
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?	Guard band at 3.8 GHz: A 5 MHz guard band is proposed with the assumptions that networks below and above 3.8 GHz would not be synchronized across the bands. The guard band is evaluated based on hypotheses on “realistic” equipment characteristics that would avoid over-estimation. Nokia support this approach, but points out that, especially for AAS systems the RF filter has to be implemented from the beginning and cannot be changed depending on specific characteristics. For this reason, as mentioned above, Nokia invite Ofcom to carefully consider the characteristics of the guard band to be implemented above 3800 MHz in the case of AAS systems. In addition, several countries inside and outside CEPT, will likely implement 5G in the 3.8-4.2 GHz, probably for similar type of use as in UK. Then we think that at a certain point in time harmonization, at least at regional level, will become necessary, as it would be impossible to develop specific requirements for each country. Nokia will support such type of harmonisation and encourage Ofcom, as being

	the first country in Europe developing the use of 5G in the 3.8-4.2 GHz band, to promote harmonisation at a wider level. Guard band at 4.2 GHz Nokia support such an approach based on realistic rather than worst case assumptions. There would be a need for wider harmonization beyond UK as well.
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.	Nokia cannot comment on the absolute value of the proposed licence fees. As described in our response to Question 3, we understand the linear increase of licence cost as the means to control unnecessary spectrum hording. A linear increase of spectrum cost for large geographies e.g. in applications in agriculture, forestry and mining may, however, put undue cost burden on such applications and make them unattractive. We consider that the license fee scheme should take into account the variety of applications that can benefit from accessing shared spectrum and provide a balanced and affordable pricing to multiple type of usages, encouraging several potential users to apply for licenses.
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.	Nokia agree with the approach taken by 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.	Nokia welcome spectrum access models supporting cooperative approaches between CPSs and local enterprises. Local spectrum access to unused CSP spectrum may provide incentives for local enterprise investment into local networks that also CSP services can benefit from. While technically this could be done in sub-leasing agreements between CSP and local enterprise, Nokia understand Ofcom's motivation to manage such usage to be able to directly enforce licencing conditions on the actual user of the spectrum.
Question 19: (Section 8) Do you have any other comments on our proposal?	Nokia have no other comments.
Question 20: (Section 8) What information should Ofcom consider providing for potential applicants in the future and why would this be	Nokia have no specific comments.

of use?	
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?	Nokia see the need to strike a fair balance between CSP needs with their planning horizons and the need of allowing for return on invest for private local licence owners. Equipment depreciation periods are in the range of 7-10 years. Thus, local private network investors would need to seek agreements with CSPs on the possibility to use CSP spectrum for such periods of time to the mutual benefit.
Question 22: (Section 8) Do you have any other comments on the proposed Local Access licence terms and conditions?	Nokia have no other comments.
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.	Nokia have no specific comments.