Introduction

Nokia welcomes the opportunity given by Ofcom, through this Call for Input, to provide comments and views, regarding the evolution of the UK's Shared Access Licence framework.

At Nokia, we create technology that helps the world act together. We are an innovation leader in networking bringing together the world's people, machines and devices to realise the potential of digital in every industry, amplifying the opportunity to transform business, industry and society.

Digitalization is a catalyst for change. For industries, digital transformation brings the massive productivity, resilience and sustainability benefits of the Industry 4.0 era. Enterprises across all industries are embracing digitalization to make their operations safer, greener and more efficient.

For governments, digitalization brings the tools needed to evolve economies for the digital age and create greener, safer, more inclusive communities. Industry 4.0 helps governments use digital-era technologies to connect underserved areas and close the digital divide. When every citizen is connected and services are made more accessible, economies thrive and communities can be more sustainable and inclusive.

Moreover, digitalization fuelled by the industry's goals for efficiency, productivity and agility, brings new ways to connect people and workplaces, accelerate the shift to more sustainable business practices and measure environmental impacts with greater intelligence.

At Nokia, we recognise Ofcom's initiative to promote digital innovation becoming the first regulator within CEPT to have developed a Shared Access Framework. This has also been recognised from CEPT, with ECC PT1 proposing to use the UK Shared Access Framework in the 3.8-4.2 GHz band as the baseline for the studies towards the EC Mandate for 3.8-4.2 GHz local area connectivity.

More than three years after the launch of the Shared Access licencing framework, we believe that the timing is appropriate for Ofcom to consider possible revisions that could improve the way the Shared Access bands are licenced and utilised.

For example, improvements in the licencing and the authorisation process, consideration of higher licencing powers (CEPT has already agreed in studying 51dBm/100 MHz EIRP) and introducing more realism in the coordination process are some of the are elements that won't only improve efficiency in the use of the Shared Access Bands, but also enable the ecosystem to further develop to address the emerging use cases, while also making the deployment of networks in this band more affordable.

We provide more specific comments to the Call-for-Input questions, in the relevant sections below.

Your response

Question	Your response
Question 1. How do you think demand for Shared Access is likely to change in future and why; Which use cases do you think are likely to emerge or grow, and which decline? Please provide a view on the bandwidth you would consider the minimum and optimal requirement for growth use cases, and timelines you would expect for their development	*Is this response confidential? - No* **3.8-4.2 GHz** As highlighted in the call-for-inputs paper, several national administrations within CEPT but also around the world have started or have consulted towards authorising local area licences in the 3.8-4.2 GHz band. Furthermore, the resulting harmonised conditions of the ongoing discussions in CEPT are likely to enable further ecosystem development, equipment availability and innovative use cases to emerge. In parallel, the above conditions will likely result to an increase of the number of players entering the market as well as an increase of the number of offerings for Private Networks. Webscalers, Systems Integrators and CSPs will look to address their customer basis and this will drive the demand. Nevertheless, we see that success in using this band will not be measured only on the basis of connectivity, but on how the industry will be able to define and demonstrate the outcomes. Regarding the use cases, we see increasing demand for video applications, driving the Uplink bandwidth, in contrast with what the traditional mobile services offer. We should see emerging REDCAP ecosystem development, which however will likely be at a slow rate (3-5 years) and price sensitive. Furthermore, we see interest for applications in ports. Some examples are ABP Southampton, DPWorld London Gateway, which are now getting to the first phase of commercial deployments. However, many potential users are still waiting for one of their peers to go first before committing. **2300 MHz** In the 2300 MHz (3GPP B40) band we also see interest from ports to deploy 4G services, however it is still unclear whether Ofcom has made available licencing applications for outdoor Base Station in this band.

	1800 MHz We currently don't see demand for emerging services that will be possible to materialise in this band from the industry. There seems to be interest from wearable devices but the available bandwidth (3.3 MHz FDD) doesn't make the use of state-of-the-art mobile technologies such as 5G NR suitable and attractive. (More details in our response to Q2).
Question 2. Are there elements of the current framework that complicate the use of Shared Access licences for specific use cases? If so, please provide specific examples and indicate the changes that would be required to facilitate this and how this might co-exist with other use cases.	*Is this response confidential?* – [CONFIDENTIAL ✂] An overall comment regarding the current framework is that the process of determining whether a location can be candidate/suitable for Medium Power licences feels like a "post code lottery". This is because the candidate licence location is considered in isolation from the actual/up-to-date surrounding environment (clutter), the directivity and the orientation of antennas or the probability of demand from other licensees in that specific location. This creates unnecessary complications when for example, licensees of large private land cannot be authorised to deploy Medium Power BSs without using the exception process. **3.8-4.2 GHz** When it comes to the deployment of AAS or non-AAS antennas for Medium Power licences, the EIRP limits of the current framework do not present suitable or attractive conditions for significant advancement in equipment development and hence the take up in deployment and adoption of use cases such as e.g. FWA. Limitations based on EIRP levels, together with increased antenna gain, results in requiring significant attenuation of the power that is being fed into each MIMO port. Reduced power can often only be achieved with the use of external attenuators, as equipment is manufactured to adhere to acknowledged industry capabilities of Femto, Pico, Micro and Macro. The use of external attenuators results also in attenuation of the received power, which reduces the effectiveness of the site and results in cell shrinkage, hence more equipment will need to be deployed to achieve the customer desired outcome.

	1800 MHz band There is demand for wearable devices, for example “man down” alarm at a manufacturing plant, but it is not possible to address them with the current framework. The current generation of devices rely on FDD spectrum, and normally require at least 5MHz to get LTE-M or NB-IoT to work. Thus, whilst the 1800 MHz could be used for NB-IoT the combination of 3.3 MHz channel offering, together with the limited use cases, can’t justify the expenses in development. As a result, the entire sensors and low power world of use-cases is excluded from the current Shared Access framework. **2300 MHz band** We see many requests for projects that want to use existing 4G devices outdoors. To get acceptable throughput we would look to the 2300 TDD (B40) Shared Access band, but we have seen no updates of the potential availability of those services for outdoor usage. [CONFIDENTIAL ✂]
Question 3. Do you have any comments on the power restrictions currently in place, particularly in urban/high density areas, under the Shared Access licence? Please explain what benefits could be delivered using a higher operating power (e.g. medium power in urban areas), or any concerns you sharing with such operations).	*Is this response confidential? – No* Below we provide comments regarding the power levels of Medium and Low power licences under the current shared access framework: a) As mentioned in the previous question, the possibility of authorising medium power licences is currently assessed based purely on a post code, i.e. in isolation from all the other aspects associated with the nature of the candidate location. For example, a port or a wholly owned airfield is forced to use low power licences purely based on their location postcode. Suggestion: When cases such as the examples detailed above make use of the exception process, Ofcom often offers a combination of custom power and less bandwidth. We believe that in those cases licensees should have the opportunity to provide technical justification using commercial radio planning tools, including appropriate sectorisation and antenna tilts as well as information regarding the specificities of the

	environment associated with the licence request, which will allow more accurate use of information during the process of authorising Medium Power licences. Another example would be FWA players in rural areas. Medium power levels do not provide enough coverage to meet Gigabit fibre equivalence. Typically, these operators do not compete in the same regions and they cannot afford to have so many BS locations to cover the needed whitespots to secure funding. Suggestion: Consider the possibility of higher powers in specific/given areas for FWA applications. Such higher EIRP powers could be accommodated e.g. by permitting higher powers for AAS antennas, considering that the directivity of their beams could enable better coexistence. For further information, Nokia has developed a study[1] presenting a comparison of the required separation distances to protect incumbent services when using AAS BS with higher EIRPs and non-AAS BS with EIRPs under the UK Shared Access framework. b) Regarding the low power BS when MIMO antennas are used, the EIRP being "the sum of all the MIMO pipes" is challenging. The goal seems to be not to encroach on other neighbouring licence holders. The contradiction of the current framework is that while it is not permitted to deploy e.g. 4x31 dBm pipes, at the same Base station, there is no limitation in the number of transponders that can be deployed within the 50m licenced location. So while the framework permits to deploy 4 boxes feeding 4 separate antennas with 31 dBm power within the licence area, it does not permit to use a single 4x31 dBm MIMO BS. This contradiction can cause significant issues, especially of performance, resulting in possible financial penalties when potential licence holders plan coverage of their networks. As a result, licensees may need to deploy additional Low Power BSs within the licenced area, instead of

[1] 5G in the 3.8-4.2 GHz Band. Coexistence with Fixed Satellite Service Earth stations In-Band and IMT-2020 in Adjacent Band

	just being able to increase the power fed into a single Low Power BS product with 4T4R configuration. This is a consequence which increases significantly the deployment cost to achieve the same performance and undermines the business case. Products tend to fall into categories from all manufactures, e.g. femto, pico, micro, macro etc, which usually have capacity and power as the differentiating criteria. Femto and pico products are often designed with integrated antennas and can work with the Low Power but, they are normally indoor products. Micro and macro are outdoor products and usually defined with higher powers. The latest micro platforms can transmit with minimum 1W (30dBm) per pipe, without an antenna. Therefore, Low Power outdoor is a big challenge as equipment would need to be attenuated, most likely with the use of external attenuators, which will result not only in reducing the emissions on the DL, but also the received powers on the UL, effectively shrinking the cell. Suggestion: Consider revising the power levels of low power licences, taking into account the use of MIMO antennas.
Question 4. Do you have any comments on the exceptions process, and how some of its benefits could be maintained within more standardised and automated assessments?	*Is this response confidential? - No* The exceptions process can be very unpredictable, and thus very difficult to work with a potential licensee when planning a network. When there is uncertainty of what powers or how many products can be deployed in specific locations such as e.g. a chemical plant, a port or a car factory, it makes it very difficult to budget and hence even more difficult to secure funding for a project. Furthermore, there are locations which fall under the ”urban” definition, while they have many of the aspects of “rural” locations and thus, request for exception is needed for authorising medium power BS. Usually, providing justified results with planning outputs, heatmaps etc, can increase the likelihood of granting an exception, however not always. Often the answer from Ofcom is that it is possible to have higher powers but with less bandwidth. This can undermine the business case since throughput performance and capacity requirements demand more bandwidth. We would like to seek clarification

	whether the reason behind such response from Ofcom is to ensure that sufficient spectrum can still be left to share among users?
Question 5. Do you have any views whether and how the coordination approach should be modified? If yes, please provide comments in light of the issues set out above.	*Is this response confidential? - No* More accurate planning in the coordination process would be decisive for improving the authorisation of licences in the 3.8-4.2 GHz band. This involves: a) Taking into account more specific details of BS deployments, such as e.g. antenna sectorisation and azimuth, down-tilt and others rather than assuming omni antennas. Coordination of licences based on the sole assumption of an omni antenna is not efficient as a single directional sector can be engineered to avoid spill over. This has direct effect e.g. when planning a network and the precise number of Low Power BS is not known in advance. Due to the coordination assumptions in the current framework, there is a risk that the overall network would need to be designed based on multiple frequencies, which is not ideal. When using AAS antennas the above consideration of more accurate assumptions in coordination could somehow be achieved based on the assumptions made in Ofcom's recent consultation for the mmWave bands[2]. In the coordination process of local licences in mmWave bands, Ofcom suggested the use of average and peak antenna gains, differing by 12 dB when coordinating mobile to mobile services due to the dynamic pointing of AAS BS. Similarly, Ofcom suggested the use of a 12 dB reduction factor when modelling interference from AAS mobile deployments and non-mobile services. We see that a similar approach could be taken in the coordination of AAS deployments in the 3.8-4.2 GHz band too. b) taking into account the surrounding environment (e.g., up-to-date artificial clutter) as well as the context associated with the licence application, such as whether the licenced locations are on large private lands or whether there is likelihood of demand for more

[2] Statement and consultation: Enabling mmWave spectrum for new uses (ofcom.org.uk)

	than one licence in the same frequency band in the same or surrounding location.
Question 6. Do you have views on whether newer or emerging technologies can support coexistence between additional users in the band, and if so, how?	*Is this response confidential? - No* Different spectrum access technologies deployed around the world may have their own benefits and challenges in supporting more efficient coexistence and spectrum sharing in the band. Some examples include: **CBRS**[3]: In the USA, CBRS extends spectrum sharing dynamics through an opportunistic third license-by-the-rule layer, county-based spectrum allocation and sensing. The complexity of the SAS servers can be a challenging element, however the ability to acquire a licence decision in seconds unlocks many use cases. A chemical plant can bring a CBRS system on a trailer and enable a whole site network for a few weeks, while a manufacturing line is being rebuilt. A festival can have card payment terminals that work, even when the public networks are congested. NASCAR can have live telemetry and the NFL can have coach voice communication that can't be overhead or jammed. **AFC**: AFC is a two-tier spectrum sharing framework which allows sharing between incumbents and opportunistic users. Similarly to TVWS and CBRS, AFC makes use of a centralised system to allocate channels. AFC is implemented to protect incumbents such as FSS from potential harmful interference coming from Wi-Fi Access Points. AFC is a network resident server that coordinates the use of the 6 GHz band in the US with objectives to provide protection for the incumbents, to provide a list of available channels and maximum permissible power and a list of permissible frequencies or a list of prohibited frequencies where a standard power device can operate. The general technical requirements can be found in FCC 47 CFR § 15.407[4]

[3] Citizens Band Radio Service (CBRS) | Federal Communications Commission (fcc.gov)
[4] eCFR :: 47 CFR 15.407 -- General technical requirements.

	2-Tier LSA: The two-tiered LSA builds on scale and harmonization of traditional exclusive licensing-based regulation and standardization. It also leverages existing assets and capabilities of Mobile Network Operators (MNOs). ETSI studied LSA evolution towards 5G spectrum, localisation of spectrum for novel 5G use cases, and enabling horizontal sharing and sub-licencing for efficient use cases. LSA is particularly defined in for 3GPP band 40 (2.3-2.4 GHz) by CEPT[5] In ETSI [6] (in cooperation with the WinnF), a shared spectrum framework is being created based on the experience gathered from eLSA, AFC and CBRS (SAS) technologies. Such framework is envisaged to bring the same quick response to spectrum demands, with far lower complexity, avoiding unnecessary complexity such as ESC and the need to avoid non-cooperative incumbent.
Question 7. Please outline any comments on the current licensing process (e.g. ease of application, time taken, the information we require). If relevant, please note aspects you are currently content with and areas which could be improved.	*Is this response confidential? - No* Various multinational industrial companies are issuing tenders for private mobile networks at their sites around the globe. They typically ask for responses in four to six weeks. In order for companies to have time to design and price the radio networks, they would ideally need to be able to know if spectrum is available at the requested location or whether a power exception could be granted, within a week. The current licensing response time means that bidders for those tenders have to provide a tender response long before Ofcom replies. Suggestion: Utilising the existing spectrum portal it should be possible to identify what licences are currently active in an area. By doing so, especially for Low Power licences where the authorised radius is 50m, a licensee could have the ability to register the candidate location in the portal. Then based on a simple rule such as e.g. if the requested location is “x” metres from the other neighbouring licences, the application could be immediately accepted

[5] ECC Decision (14)02

[6] TR 103 885 - V1.1.1 - Reconfigurable Radio Systems (RRS); Feasibility study on existing spectrum sharing frameworks for temporary and flexible spectrum access (etsi.org)

	and the licensee can pay the Low Power licence fee directly in the portal. For Medium Power licences, the process could be further assisted and the processing time potentially be reduced if licensees could attach outputs from acceptable commercially available planning tools in their application.
Question 8. Do you have any comments on the suitability of available spectrum for your use cases? Please consider the relevance of the additional bands we are proposing for the framework, and the impact of any limitations on existing bands.	*Is this response confidential? - No* **1800 MHz band** As mentioned previously, the 3.3 MHz FDD available spectrum in the 1800 MHz band, does not make the band suitable for the range of use-cases demanded by private wireless customers in either 4G or 5G NR . **3.8-4.2 GHz band** Many companies target for 100 MHz because of its low price and the possibility of higher throughput. However, some of the use-cases do not demand such high throughput. **mmWave band** Typical private networks are being deployed as Standalone, as that involves one set of radio equipment. mmWave Standalone equipment are likely to arrive at a later stage in 2024.
Question 9. Do you have any comments on equipment availability limiting deployment options in 3.8-4.2 GHz? Please comment on the impact of any experiences you have had, and where relevant, your expectations for when more equipment will be broadly available across the band.	*Is this response confidential? –* [CONFIDENTIAL ✂] While we see that the ecosystem is generally improving, there are still some significant issues. Some of the equipment manufacturers still don't activate the 3.8-4.2 GHz part of band n77, even the datasheets indicate support of the whole band. [CONFIDENTIAL ✂] In addition some equipment do not support the Standalone (SA) mode or the 999 xx PLMN range. The ecosystem has not matured to offer many simple devices or more specialised equipment such as ATEX category devices which limits its suitability in more challenging environments
Question 10. Do you have any other general comments on the Shared Access framework? Please consider any areas where future	*Is this response confidential? – No*

innovations could further support Ofcom's policy objectives for this spectrum, and/or improve the experience for users.	As mentioned at the introduction, we suggest that Ofcom should consider revisiting the Shared Access framework and consider the potential of using higher powers for AAS antennas. We highlight that in the discussions of the 3.8-4.2 WI in CEPT, ECC PT1 has currently agreed in studying higher EIRP values for medium power BS (51dBm/100 MHz). We are of the view that even higher EIRPs can be permitted with the use of AAS antennas, provided that the coordination process is applied effectively. Enabling the authorisation of licences with increased power, is likely to enable the band to address more emerging use cases and increase industry adoption. By doing so, the ecosystem is likely to evolve, enhancing the capabilities of existing equipment. Regarding the introduction of more realism in the coordination process, we suggest that Ofcom should take into consideration the adjustments made in the coordination process of the mmWave local area licences (12dB factor and peak/average antenna gain). Finally, regarding the possible improvements in the licencing process, we are of the view that the utilisation of existing tools (such as Ofcom's spectrum portal) can be a very good starting point that can deliver immediate improvements in the process.