Nokia

Connectivity should be considered an essential service, like water, electricity or gas and everyone should be able to have access to broadband services. Nokia, has a long history of delivering connectivity solutions that have had a major and positive impact on society[1]. From the world's first GSM call[2], to the world's first immersive voice and audio call[3] and now to building the first cellular network on the Moon[4], we stay focused in our vision to create technology that helps the world act together.

Looking forward and committed to finding real-word solutions to expand universal coverage and close the digital divide around the world, we have partnered with AST SpaceMobile to eliminate connectivity gaps and connect underserved communities across the six continents. Nokia's AirScale Single RAN equipment aims to enable AST SpaceMobile in providing mobile services to new and existing subscribers in regions currently not served by terrestrial communication networks. Nokia will provide equipment from its comprehensive, energy-efficient AirScale portfolio including its AirScale base stations powered by its latest generation of Nokia's ReefShark System-on-Chip (SoC) chipsets, allowing AST SpaceMobile to add capacity where it is needed, offering flexibility and efficiency. Nokia will also provide its NetAct solution for network management and seamless daily network operations as well as optimization and technical support services.

Nokia's innovation leadership also extends to international standardisation and regulatory forums. We have been active contributors in key technology areas of 3GPP with top-quality standardisation inputs, and we have been closely collaborating with the rest of the industry and national administrations in developing the regulations that govern wireless communications globally. To that extent we are actively participating in the ITU-R WRC-27 AI 1.13 discussions with the objective to study potential new allocations for satellite based direct-to-device services to complement the terrestrial IMT network coverage.

It is therefore important to emphasise that while the satellite based direct-to-device services demonstrate a promising potential to extend the coverage of terrestrial IMT networks, achieving universal coverage, it is also vital to ensure that such services do not cause interference to existing IMT terrestrial networks. Our view is that for the broader benefits realisation for businesses and consumers, satellite based D2D deployments should take place in MS spectrum bands, through business and operational agreements between MNOs and SNOs, facilitated through a regulatory framework that ensures the protection of incumbent services.

[1] Our history | Nokia

[2] from the call that transformed how we communicate | Nokia

[3] orld's first immersive voice and audio call | Nokia

[4] showcases cutting-edge research on lunar networks and 6G at #MWC23 | Nokia

Your response

Question	Your response
Question 1: What is the market opportunity for D2D services? What is the nature of the benefits that could be delivered to people and business in the UK and what do you estimate the magnitude of the benefits to be?	Confidential? – N Satellite based direct-to-device services could allow to bridge the connectivity gaps in areas that are underserved. According to Ofcom's Connected Nations report (2023), *"the proportion of UK landmass covered by at least one MNO is now at 93%".* The figures from the Connected Nations report indicate that broadband mobile coverage is well positioned in the UK. Nevertheless, mobile connectivity should be considered an essential service for people. Thus, in the case where no other alternatives are feasible e.g. in difficult to reach areas, in locations where deployment of terrestrial infrastructure poses difficult-to-overcome challenges etc, the deployment of satellite based D2D services could close the coverage gap, offering the opportunity for people to stay always connected.
Question 2: Are there any wider citizen or societal benefits that D2D services could deliver that the market might not deliver? What is the nature of these benefits and why might the market fail to deliver them? For example, what role could D2D have in improving the availability of 999 services in the UK?	Confidential? – N The example of improving availability of 999 services could indeed be one likely benefit that the D2D services may deliver. Emergency (SOS) connectivity in remote areas where terrestrial network infrastructure is missing could be proven crucial in safety of life situations. Regarding other societal benefits, D2D services may also, depending on the deployment architecture, allow applications such as voice, text or data, however, the by-default link budget limitations of the D2D service (e.g. latency, doppler shift, reduced spectral efficiency, etc) are likely to pose challenges to the broader expansion of D2D use-cases.
Question 3: Subject to suitable regulatory frameworks being in place, do you have an interest in offering D2D services or expanding an existing service, in the UK? Which customer segments, devices and use cases would be served? Would your D2D service complement or compete with services delivered over existing mobile?	Confidential? – Y / N

Question	Your response
If you have considered launching or expanding a D2D service in the UK: **Question 4:** What technology and network architecture do you consider appropriate to use to deliver D2D services? For example, what altitude and how many HAPS, LAPS or satellites would be required to deliver an initial service? **We're aware that different technologies and network architectures will have different costs, performance, and spectrum efficiency trade-offs**.	Confidential? – Y / N
Question 5: What capacity (e.g., Mbps/Km_2/MHz) and quality of service (e.g., latency) could be delivered with the D2D service you are proposing? What percentage of the UK landmass could be covered, and would coverage be provided indoors?	Confidential? – Y / N
Question 6: To inform our future policy development, which spectrum band would you like to deploy the service in? How much bandwidth would be required to provide the service at launch?	Confidential? – Y / N
Question 7: What take-up profile do you assume in your planning? For example, the number of active devices, monthly calls made, and data transferred per device. What is the roadmap for enhancing your network to meet anticipated future growth? What additional infrastructure and/or spectrum would be required? When?	Confidential? – Y / N
Question 8: What are the use cases and the benefits these services would deliver? What technology, network infra-	Confidential? – Y / N

Question	Your response
structure and frequencies would be required to deliver the service? What are the advantages of using this MSS spectrum compared to other bands?	
Question 9: What current, or future, technology developments will offer the opportunity for more efficient use of MSS spectrum? E.g., more spectrally efficient, or greater ability to share spectrum.	Confidential? – Y / N
Question 10: Could your existing, or proposed, service coexist with other users of the same frequencies within the MSS spectrum bands? If so, how is coexistence achieved? If not, please explain why sharing is not possible.	Confidential? – Y / N
Question 11; Do you expect D2D services to be available prior to WRC-27? What services and benefits do you think an authorisation prior to WRC-27 might bring to UK consumers and businesses?	Confidential? – N Following the international developments in the D2D landscape it is likely that some D2D services around the world would, in general, be available prior to WRC-27. This of course depends on the willingness of regulators to authorise such service prior to WRC-27 as well as in the willingness of operators (mobile and satellite) to develop business agreements that enable such service. There are already examples of handset manufacturers who have started offering limited D2D services after partnering with satellite operators, in MSS bands. However, our view is that the broad realisation of benefits of this D2D service, both for UK consumers and businesses will take place through the utilisation of MS bands (i.e. through SNO – MNO agreements). This is because on one hand, the utilisation of MS bands will enable consumers to use the D2D service with their existing (as well as with their future) handsets, and on the other hand the MNOs will have the opportunity to monetise their nationwide spectrum in locations where it not underused. WRC-27, under AI 1.13 studies the development the technical, operational and regulatory conditions for MSS services to utilise the M.1036 bands (i.e. the mobile spectrum) in 694/8 MHz to 2.7 GHz for satellite based D2D services. Therefore, the decisions of WRC-27 will provide the regulatory certainty for operators to ensure

Question	Your response
	that their terrestrial networks are sufficiently protected. In addition, the decisions of WRC-27 will also offer clarity to satellite operators, regarding the conditions which their systems/networks will have to comply with so that they can offer D2D services globally. Therefore, our view is that there is a valid justification for Ofcom to wait for the decision of WRC-27 on AI 1.13 before authorising D2D in the UK, as this, will not only offer the regulatory certainty for businesses but also will set the conditions for the development of D2D services in a way that provide a wider benefit realisation for consumers.
Question 12: Are there any mobile bands that should be prioritised for satellite based D2D?	Confidential? – N Nokia's view is that the mobile bands under WRC-27 AI 1.13 should be the starting point for satellite based D2D services. We would like to highlight that among those, there are bands that are FDD-only, FDD and TDD and TDD-only bands. Our view is that from the above bands, the ones which include FDD frequency arrangements are likely to present the highest potential for satellite based D2D and thus, should be prioritised. TDD over satellite presents significant challenges. The guard periods needed to accommodate the high latency and the round trip delay, are likely to require modifications to existing handset protocols, limiting in that way the availability of D2D services to users with existing handsets. In addition, the technical mitigations to accommodate the challenges of TDD, are likely to reduce the overall D2D spectral efficiency, limiting even further the use-cases that such services can deliver.
Question 13: Are there existing systems that you consider could be subject to an increased risk of harmful interference from the introduction of satellite based D2D using mobile bands? If yes, are there specific mobile bands that you consider should be avoided to reduce this risk?	Confidential? – N D2D services utilising MS spectrum, pose the risk of interference in public mobile networks. At the same time, D2D services deployed in MS bands offer the greatest opportunity for benefits realisation by consumers. WRC-27 AI 1.13 studies possible new allocations of MSS services in MS bands, ensuring in parallel the protection of incumbent services, one of which is IMT terrestrial networks. Therefore, significant consideration should be given during the development of the D2D technical and authorisation framework, to ensure

Question	Your response
	that UK's and also neighbouring countries' D2D operators do not cause interference to UK public mobile networks. Towards addressing the potential interference risk, a starting point for D2D service authorisation should be that the directionality and pairing of (FDD) UL/DL should be the same as the directionality and pairing UL/DL of existing public mobile networks. The nature of TDD bands, where the same frequency spectrum is being used for both transmission and reception poses increased risk of interference to existing public terrestrial mobile networks and thus, in our view should be avoided for D2D services.
Question 14: Do you have any views on how spectrum for D2D services should be authorised? Does this vary by band, or type of NTN? Please explain the reasoning behind your preference.	Confidential? – Y / N
Question 15: Are there any other points that you think would be useful in our considerations? In providing your response, please provide as much evidence as possible.	Confidential? – Y / N

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