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 Note: This response addresses D2D as direct-to-device transmissions, where the device is not a handheld device (or mobile phone or similar), but rather a device that is capable of transmitting small amounts of data, i.e. a “classical” IoT device. By the end of 2023 there were approximately 16 billion connected Internet of Things (IoT) devices globally, which represented a 15% growth from 2022, and by the end of 2024 this number is expected to grow by another 13%. When translating such statistics to economic value, by the end of 2024 the IoT market is expected to reach a value of $948 billion US Dollars (USD), and between 2024 and 2029 said value is anticipated to grow at a Compound Annual Growth Rate (CAGR) of 10.5%, which is expected to result in a $1,560 billion USD market value by 2029. Remote uses cases are not covered by terrestrial IoT networks and could be served by satellite-IoT systems, which would extend the existing IoT ecosystem. Some of the main remote uses cases are agriculture, forestry, logistics, tracking, climate monitoring.

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 Note: See Q1 note. The terrestrial IoT market cannot connect "the unconnected", i.e. regions where terrestrial infrastructure is not feasible, either for logistical or economic reasons. This will bridge the digital divide and foster greater inclusivity, improve quality of life and economic/ business opportunities. Satellite IoT can assist in monitoring and managing natural disasters (e.g. wildfires, floods, landslides) and act as early warning systems. 999 services cannot be provided by low-data rate satellite-IoT systems, however there are use cases for tracker devices that help to locate people that are in distress situations in remote regions lacking connectivity. Satellite IoT will also play a key role in the fight against climate change and towards net zero.
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	Confidential? – N Note: See Q1 note.

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segments, devices and use cases would be served? Would your D2D service complement or compete with services delivered over existing mobile?	Yes, as a UK-based company Lacuna Space wants to offer satelliteIoT connectivity in the 862-870 MHz band. The focus on this band is because devices that are already used in this band can be easily upgraded to connect to satellite-IoT systems using the same band. Lacuna Space has a secondary interest in MSS S-Band spectrum, which we use with our partner Omnispace in other regions. S-Band use cases mainly address end users that do not have deployments in the 862-870 MHz band. Lacuna service is ready as of now, having now placed gateways on ten satellites. It is noteworthy that satellite-IoT can be conducted in the 862-870 MHz band without interfering with terrestrial IoT, as current studies, trials and reports in ECC groups have proven.

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? – N Note: See Q1 note. Satellite-IoT in the 862-870 MHz band uses LEO satellites with typical orbit altitudes between 400 and 600 km. The devices transmit LR-FHSS modulated signals. LR-FHSS is a LoRa-based FHSS modulation that is optimized for high-density applications, reducing collision risk when receiving many messages simultaneously. FHSS will guarantee spectrum-efficient use and robustness against interference, allowing even co-channel use by multiple operators.
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? – N Note: See Q1 note. Low-data rate systems are typically not measured by their throughput/capacity or by their latency. Typical use cases only require 1-4 messages per day, and latency is not of highest priority. It is more important that devices can operate over multiple months without human interaction, and that the connectivity is global. Lacuna Space (and other Satellite-IoT systems) can cover both aspects. Indoor use cases are (in most cases) not of interest.

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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? – N 862-870 MHz as the primary band. Initial service can be provided with less than 500 kHz, which can be shared on a non-protection, non-interference basis with other IoT applications. As stated above, S-Band MSS allocations will be of interest for some current use cases and for the future expansison of IoT, where typically ~1MHz would be required, and co-channel sharing would be possible.

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? – N Satellite IoT is a largely scalable technology. A few satellites can already cover thousands of devices. More satellites will decrease latency. No additional infrastructure in target countries is required.
Question 8: What are the use cases and the benefits these services would deliver? What technology, network infrastructure and frequencies would be required to deliver the service? What are the advantages of using this MSS spectrum compared to other bands?	Confidential? – N As mentioned above, the main use cases are remote use cases that cannot be covered with terrestrial infrastructure. Accordingly, no additional local infrastructure is required. The use of 862-870 MHz is advantageous because it is the same frequency band that is also used by devices that are connected via terrestrial infrastructure and which are already part of such an ecosystem. IoT is a low-cost mass market that becomes viable through the bare number of deployed devices. If remote use cases require significantly modified device hardware, this would increase device cost and with that foil commercial viability.
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? – N LoRa has been proven to have excellent sharing capabilities, using low power and duty cycle restrictions. Today millions of devices share 8 MHz of spectrum in Europe, which works on an uncoordinated, non-protection and non-interference basis. The extension to satellite connectivity has been proven to be feasible in ECC Report 357.

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	Sharing would also work in “licensed bands”, against claims of license holders that no technology can effectively share on a cofrequency basis.

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? – N Yes, as stated above, co-channel sharing is possible with other solutions, as long as (low) power limitations and potentially duty cycle restrictions (for the uplink case) are implemented.
Question 11; Do you expect D2D services to be available prior to WRC27? What services and benefits do you think an authorisation prior to WRC-27 might bring to UK consumers and businesses?	Confidential? – N Note: See Q1 note. Yes. The technology has been proven in orbit for over 5 years now. The satellites (infrastructure) and user terminals are available now. Service can be provided as of now.
Question 12: Are there any mobile bands that should be prioritised for satellite based D2D?	Confidential? – N Note: See Q1 note. For the specific case of LoRaWAN (or other LPWAN technologies), the 862-870 MHz spectrum should be used, as long as the operational parameters which are in place for terrestrial ShortRange Devices (low power, duty cycle, …) are met for device-tosatellite transmissions. For satellite-to-device transmissions, PFD limits as proposed in ongoing ECC discussions should be applied.
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 Note: See Q1 note. In the 862-870 MHz band, no increased risk of harmful interference by low-power satellite IoT was seen in studies or trials. It has been shown in ECC Report 357 that terrestrial devices that can be kilometers away from a potential victim will have a larger impact that satellite transmissions.
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? – N Note: See Q1 note. In the 862-870 MHz band, satellite IoT should be authorised in the same way as terrestrial IoT, i.e. on a license-exempt basis.
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	Transmissions in the space-to-Earth direction should be conducted under RR Art. No. 4.4, given that no space service allocation is available in this band. Operators that conduct transmissions in the space-to-Earth direction should be committed to not exceed power limits, e.g. PFD limits as proposed in an ongoing Work Item towards an ECC Decision.
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? – N Satellite-IoT in SRD bands has been proven to be technically feasible and there are multiple operators that can provide a global service as of now. Regulatory challenges have been discussed and first administrations have granted (commercial) authorisations for such systems. There have been no interference issues reported, and field trials through internationally recognised satellite monitoring stations have been conducted. There are multiple use cases that have a high demand for a solution as soon as possible (see climate monitoring, wildfire monitoring, …), and only regulatory indecisiveness is holding up their implementation.

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