



Your response

Note: We are supplying responses to four questions only: nos. 1, 2, 14 and 15.

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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

Scope: Our response refers, except where otherwise noted, to ‘D2D in Mobile Spectrum’ via 3GPP standardisation in the context of non-terrestrial networks (NTN).

Introduction:

In the near future all of Scotland’s connectivity needs could be served by a range of connectivity options, a “Connectivity Tool Kit”, as set out the figure below, that will be available to end users, communities and enterprises, in effect removing the technical existence of ‘not-spots’. The different technologies will have varying levels of cost, capabilities, and resilience to address a wide range of needs.

With the growing capability of wireless technology, mobile and fibre technology will no longer be considered two sides of the connectivity coin. The convergence of capabilities and interoperability means they can be considered under a wider banner of ‘digital connectivity’.

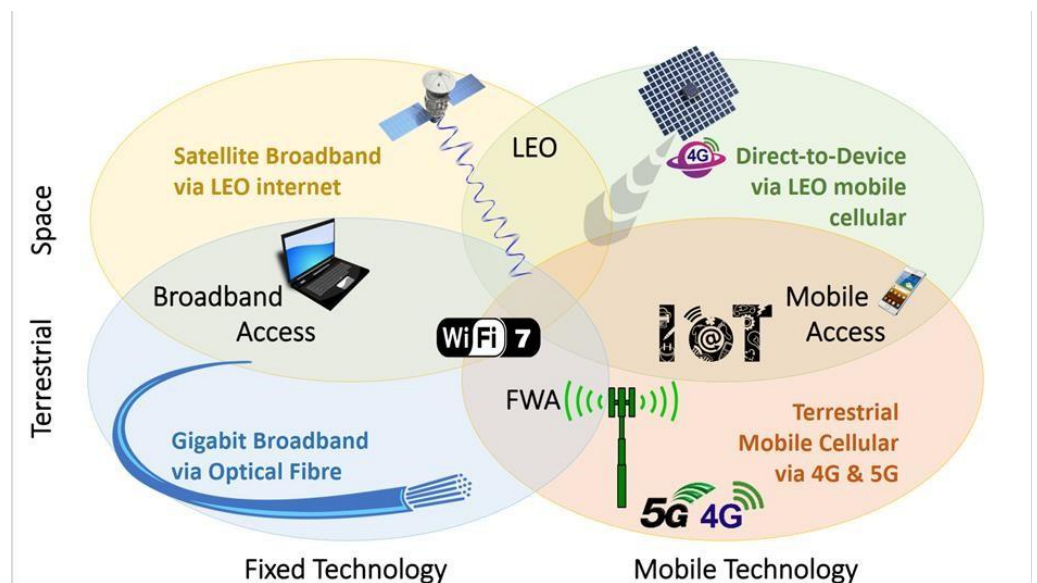


Figure: SFT’s model representation of a ‘Connectivity Tool Kit’ for Scotland

Therefore, if the specification of the need can be identified, there could be a range of potential connectivity solutions available to provide the required service. This turns

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the current connectivity question 'where are the not-spots' to 'what is the need'. Which connectivity solution is applied is then narrowed down based on an assessment of deliverability and cost. This could lead to a more inclusive approach to digital connectivity with options available for all users.

Direct to Device (D2D) technology has the potential to help bridge the digital divide, bringing connectivity to areas that were previously inaccessible, remote, rural or underserved as part of the connectivity toolkit. This has the potential to support activity on stemming depopulation in some areas and this form of connectivity service has the potential to establish itself as a critical lifeline, similar to many rural bus, train and ferry services.

It is an exciting technology development to expand global connectivity and unlock new opportunities for communication, commerce, and innovation. However, it still all relies on the same asset – spectrum – which has already been 'committed' for certain uses and to certain organisations.

One important challenge for Ofcom is to orchestrate the availability of sufficient, appropriate frequency bands to allow it to be utilised by the emerging technologies as well as for the existing ones.

Another challenge will be to ensure fairness for new service providers and existing service providers alike. Owing to its neutral host nature, D2D could enable a new operator holding useable spectrum to provide mobile coverage to all or parts of the UK.

Coupled with new D2D coverage, it will be important for Ofcom to ensure the availability of up-to-date, authoritative mobile coverage mapping to assist policymakers in understanding the remaining coverage and capacity challenges and to enable targeted government interventions.

Market Opportunity Constraints: The market opportunity for D2D services will be governed by a number of constraints:

- (1) the capex / opex cost ratio of delivering services and cost to users compared to terrestrial infrastructure,
- (2) the amount of spectrum made available,
- (3) the capacity of the spectrum,
- (4) on-the-ground virtual cell size,
- (5) coverage interruptions owing to topographical obstructions (prevalent in hilly/mountainous areas when combined with sparse constellations).

D2D Market Opportunity: Given the nature of the constraints listed above, we envisage that the primary market opportunity will lie in the development of rapid, low-cost

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	<p>provision of modest-speed and modest-capacity mobile cellular connectivity in locations that are under-served by terrestrial mobile coverage, which includes vast swathes of rural and sparsely populated areas around the world.</p> <p>The market opportunity could be sizeable, given that D2D in Mobile Spectrum based on 3GPP standards could facilitate access to approximately 5 billion existing mobile phone customers around the world recognising the need for investment in. technology and infrastructure.</p> <p>Furthermore, the limited capacity of D2D systems (measured in bits per Hertz) conveniently matches the sparse population demographic. However, hills and mountains are liable to interrupt the line-of-sight path to satellites for a few minutes at irregular intervals throughout the day particularly in the case of less dense constellations, which may hamper market opportunities in some locales.</p> <p>Opportunity to Meet or Exceed 2027 Coverage Obligations:</p> <p>Initial D2D constellations will have inclined orbits, that will enable worldwide coverage below circa 58- or 59-degrees latitude. Once completed and authorised, it will be feasible for D2D service to be provided on a continuous basis at any served outdoor location, subject to the proviso below. Indoor locations and outdoor locations with tall buildings or unusual geographical features, such as below steep cliff faces or gorges may obtain reduced connectivity or intermittent coverage, and it would be useful for coverage modelling to be conducted to better understand any such limitations.</p> <p>Despite this, it is probably not an exaggeration that D2D will enable near blanket mobile cellular coverage in rural areas across all participating UK mobile network operators. This will be especially important for the UK's rural and upland areas, which are predominantly in northern and western areas of the UK, which are the primary target of the Shared Rural Network programme. See https://web-cdn.srn.org.uk/green/uploads/2023/07/SRN-Pre-Post-Coverage-UK-Maps.png</p> <p>Interaction with the Shared Rural Network: The indicated SpaceX/Starlink D2C service launch date is in 2025. Furthermore, the current deployment rate of satellites suggests that the required complement of circa 900 to provide global coverage will be completed in the first half of 2026. Assuming any UK-based regulatory issues are resolved in time, it may be that D2D service will be available in time to complement the roll-out plans of the Total Not Spot (TNS) element of the Shared Rural Network, due for completion in 2027. Therefore, D2D may be able to support and extend the SRN coverage obligations between now and this date.</p> <p>Challenge Regarding Service Above 58-/59-Degrees Latitude: Currently planned D2D constellations (i.e. those planned by AST SpaceMobile and SpaceX/Starlink) will not initially serve areas north of 58- or 59-degrees latitude. This will present challenges for northern areas of the Scotland, including the Orkney Islands and the Shetland Islands. We believe that Ofcom and the Government should explore the medium-term provision of D2D in these areas, while simultaneously providing the necessary short-</p>
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	<p>term initiatives and incentives to support an equivalent level of connectivity by other means (e.g. terrestrial infrastructure or high-altitude platform systems [HAPS]) .</p>
<p>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?</p>	<p>Confidential? – N</p> <p>999 Services: Based on the completion constellation per FCC filings in the United States, D2D service will eventually provide close to 100% mobile cellular coverage across the UK for all participating UK mobile network operators, with the potential aforementioned initial limitations in higher latitudes. The CEO of Starlink recently (27 August 2024) announced that “SpaceX Starlink will provide emergency services access for mobile phones for people in distress for free”, adding that this would apply worldwide subject to approval by governments [and their telecoms regulators]. We would anticipate that Ofcom might want to facilitate this service and continue to stipulate that emergency calls would be able to connect to any available operator, as is currently the case for terrestrial mobile cellular coverage.</p> <p>Sustainable Communities: Digital connectivity is recognised as a positive factor in supporting and enabling sustainable communities, enterprise and employment as well as maximising the full potential through tourism and recreation. In particular, the Scottish Government has published an action plan to address depopulation, in which digital connectivity is a key element in rural development, helping to bridge the rural ‘digital divide’, enhance social connectivity, remote-working, well-being and healthcare potentials.</p> <p>D2D mobile cellular technology provides a means by which to quickly enable mobile connectivity in un-served and under-served areas in support of sustainable communities. We would expect Ofcom and the Government to stipulate provisions for connectivity in un-served and under-served areas in the UK as part of D2D enablement in the UK.</p> <p>Resilient Digital Connectivity: D2D mobile cellular technology provides a means by which to deliver disaster-resilient 4G and 5G communications across an affected area. It would be necessary for mobile network operators to have robust mechanisms to quickly enable suitable coverage, including quickly diverting spectrum to D2D in affected areas, and prioritising emergency services usage and 999 emergency calling. We would expect Ofcom and the Government to stipulate provisions for resilient communications as part of D2D enablement in the UK.</p> <p>Ubiquitous Coverage for Industrial IoT Applications: D2D mobile cellular technology may facilitate more widespread adoption and use of IoT and remote sensor applications, given its ubiquitous connectivity properties. This could facilitate important applications in areas such as agriculture, aquaculture, energy, transport, healthcare and environmental monitoring, which could deliver a range of diverse societal benefits.</p>

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	<p>Digital Government Services: D2D mobile cellular technology may facilitate more widespread adoption and use of digital government services, which could lead to cost reductions in their provision.</p> <p>D2D in Support of Targeted Intervention in Digital Connectivity: The introduction of ubiquitous D2D will enable mobile network operators and government bodies to quickly identify locations where additional connectivity is required, with the potential to properly evidence and inform targeted terrestrial infrastructure interventions, reducing the likelihood of deployment of costly digital infrastructure where it might have limited impact.</p> <p>Future Railway Mobile Communication System: The Future Railway Mobile Communication System (FRMCS-5G) is the European railway communication system that will replace GSM-R (2G) by 2035-2040 and underpin future rail system control and operation. FRMCS deployment is liable to cost billions of pounds via terrestrial infrastructure, but D2D technology could provide a rapid, potentially lower capex means by which to enable FRMCS, especially in rural areas where the cost is otherwise hard to justify.</p>
<p>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?</p>	<p>Confidential? – N Not answered.</p>
<p>If you have considered launching or expanding a D2D service in the UK:</p> <p>Question 4: What technology and network architecture do you consider appropriate to use to deliver D2D services?</p>	<p>Confidential? – N</p> <p>Not answered.</p>

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<p>For example, what altitude and how many HAPS, LAPS or satellites would be required to deliver an initial service?</p> <p>We're aware that different technologies and network architectures will have different costs, performance, and spectrum efficiency trade-offs.</p>	
<p>Question 5: What capacity (e.g., Mbps/Km2/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?</p>	<p>Confidential? – N</p> <p>Not answered.</p>
<p>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?</p>	<p>Confidential? – N</p> <p>Not answered.</p>

<p>Question 7: What take-up profile do you assume in your</p>	<p>Confidential? – N Not answered.</p>
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<p>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?</p>	
<p>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?</p>	<p>Confidential? – N Not answered.</p>

<p>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.</p>	<p>Confidential? – N</p> <p>Not answered.</p>
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<p>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.</p>	<p>Confidential? – N</p> <p>Not answered.</p>
<p>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?</p>	<p>Confidential? – N</p> <p>Not answered.</p>
<p>Question 12: Are there any mobile bands that should be prioritised for satellite based D2D?</p>	<p>Confidential? – N</p> <p>Not answered.</p>

<p>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</p>	<p>Confidential? – N</p> <p>Not answered.</p>
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<p>be avoided to reduce this risk?</p>	
<p>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.</p>	<p>Confidential? – N</p> <p>Suitable available spectrum is a key component for the delivery of D2D service. In the UK, MNOs hold licences for various low-band and mid-band spectrum that can support mobile phone connectivity and potentially D2D services. No different to terrestrial communications, different spectrum used for D2D has different capacity and penetration characteristics. Ofcom might consider mandating the use of an appropriate portion of each operator’s spectrum as part of any future licence agreements to ensure that the UK is provided with the best possible D2D coverage and penetration, especially in rural and other sparsely populated areas, ensuring vital access to emergency services.</p>
<p>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.</p>	<p>Confidential? – N</p> <p>Initial D2D services will become available below around 58 or 59 degrees north, according to current infrastructure provider indications. 58 degrees north is a line between approximately Stornoway and Brora in the north of Scotland; 59 degrees north is a line that passes midway through the Orkney Islands. See map below. This suggests that D2D service may not be available in some of the areas within the Scotland/UK that most need mobile connectivity. It has been indicated that it may be possible for the infrastructure providers to “stretch coverage” up by a degree or two, but with some consequences in terms of service capability and system complexity. Ofcom should perhaps pursue this issue, aiming to establish full coverage at the earliest possible time across the entirety of Scotland and its northerly islands.</p>

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