# Improving mobile connectivity from the sky and space

## Spectrum for Direct to Device and Mobile Satellite Services

BT's response to Ofcom's Call for Inputs issued on 23 July 2024

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# BT Group

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# Executive summary

1. BT welcomes Ofcom's work on demand for, and supply of, Direct to Device (D2D) and Mobile Satellite Service (MSS) in the UK and associated spectrum requirements. We note the recent technological advances in satellite system and High-Altitude Platform Station (HAPS) technologies and the potential benefits these could bring. We are pleased to provide our views on these matters in response to the "Call for Inputs" and will continue to engage constructively in the domestic and international discussions of the appropriate regulatory approach and the identification of suitable spectrum for these services.

2. Terrestrial mobile networks deliver very extensive coverage of the UK, from multiple operators, providing high speed mobile connectivity at amongst the lowest prices globally. The business case for D2D satellite services in the UK is therefore arguably more limited than some other parts of the world where terrestrial networks are less able to meet consumer and societal needs. Nevertheless, reliable mobile coverage is not available everywhere in the UK, particularly in the very remote rural areas and it is in these places where alternative solutions such as D2D service from satellites and HAPs could have a future role. Given the rapid technological advances and system developments the commercial viability of these alternative solutions continues to improve, and it is timely to address the regulatory issues.

3. BT is following the international regulatory discussions around satellite D2D services and would be supportive of Ofcom taking a position similar to that of the United States Federal Communications Commission (FCC). In facilitating possible use of existing mobile spectrum bands used by national public mobile networks for new satellite D2D connectivity it is important to ensure interference with conventional terrestrial national mobile networks is avoided, potentially by applying a satellite signal power flux density (PFD) limit or threshold for coordination.

4. A secondary mobile satellite service allocation could provide the basis for international regulation of satellites used to provide D2D capability. Access to existing mobile spectrum in the UK should be on a commercial basis where an agreement is reached with the relevant national mobile network operator given shared use of the spectrum is not expected to be feasible in the same area. Licence-exemption regulations could be revised to appropriately cover the transmissions of devices used for satellite D2D services.

5. In the medium term, if devices were to commonly support stand-alone MSS bands, then separate spectrum could be used even where service is integrated to terrestrial networks.

6. For HAPS authorisation (airborne base stations) in bands licensed to national mobile operators, it might be appropriate to specifically provide for deployment of this type of mobile base station in mobile operators' national spectrum licences.

# 1    Introduction

BT welcomes this opportunity to contribute to Ofcom's Call for Inputs to gather stakeholders' views on the potential supply of, and demand for, direct to devices services (D2D) and MSS in the UK, and the associated spectrum needs[1].

In **section 2** we provide our views on the future D2D and MSS services. In **section 3** we address the spectrum authorisation and sharing aspects. Finally, in **section 4** we discuss next steps.

Our responses to the consultation questions are included in the relevant sections below, which follow the structure of the call for inputs paper.

# 2    The future of D2D services and MSS spectrum use in the UK

## Information about D2D services

BT maintains a close interest in the newly emerging non-terrestrial networks (NTNs) such as non-GSO satellite systems and High-Altitude Platform Stations (HAPS). { ✂

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We have, since the advent of satellite communications, also conducted related research and development activities and to this day continue to provide important satellite-based services to our UK and global customers, including for corporate IP data services, mobile network backhauls, TV outside broadcast links and TV distribution.

We recognise the potential complimentary nature of the upcoming non-GSO based satellite services and the role they may play in delivering a converged communication solution to customers. We have examined the capabilities offered by some of the proposed systems to understand how these are evolving and how and when they might play a complimentary role to terrestrial networks. { ✂

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[1] https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-2-6-weeks/call-for-input-improving-mobile-connectivity-from-the-sky-and-space/main-documents/call-for-input-improving-mobile-connectivity-from-the-sky-and-space.pdf?v=370909

We have also evaluated the capabilities of High-Altitude Platform Systems (HAPS) as a means of providing complimentary coverage to terrestrial mobile networks and continue to explore the potential use of such technology as it evolves, and commercial viability improves.

BT is following and contributing to relevant international standards work in 3GPP and international regulatory discussions in ITU, CEPT and GSMA on spectrum requirement and frequency sharing aspects of the non-terrestrial networks.

*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?*

The available extent and quality of coverage of terrestrial mobile networks continues to improve and has now reached very high levels in the UK, particularly outdoors where non-terrestrial network coverage would be technically possible. The cost of mobile services in the UK is amongst the lowest globally[2]. This inevitably limits the market opportunity for D2D services in the UK where up to four existing mobile networks already provide coverage, with much greater capacity density and lower cost than would be possible from NTNs.

Ofcom reports[3] that as of January 2024 outdoor 4G mobile broadband[4] is available from at least one MNO in 93.1% of UK geography and 72.2% from all four MNOs. In terms of outdoor coverage of premises, 99.9% are covered by at least one MNO and 98.1% covered by all four. 5G coverage roll-out only commenced from 2018 and although is significantly less than 4G as of today, it can be expected to continue to rapidly grow and overtake 4G before the end of the decade. In buildings where terrestrial network coverage is poor or unavailable, D2D connection from satellite NTNs is unlikely to  be viable in most cases, and fixed network Wi-Fi would generally be a good solution.

This said, even though coverage is extensive and continually improving, the terrestrial mobile networks do not cover everywhere. And there are many very remote parts of the UK where terrestrial mobile network coverage is likely to be economically viable, and it would be unreasonable for government to require or fund such coverage from terrestrial networks.  It is these areas where D2D coverage from satellites or HAPS is better placed and could have the best chance of a viable business case. It is these areas where terrestrial mobile spectrum is not in use and may therefore be possible to use for D2D satellite or HAPS.

Where there is no mobile coverage, the ability to just receive a text or make a voice call or use even low speed data could have significant value to consumers and may be important for society, for example to summon emergency services in case of an accident. It is these areas of the UK where from BT's perspective the addition of NTN capability could bring greatest benefits to UK consumers over and above what terrestrial mobile networks already deliver today.  The magnitude of these benefits is difficult to estimate; to many mobile customers who

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[2] Chart: The Cost of Mobile Internet Around The World | Statista

[3] Connected Nations, Spring 2024 update, Mobile coverage as at Jan 2024, https://www.ofcom.org.uk/siteassets/resources/documents/research-and-data/multi-sector/infrastructure-research/connected-nations-spring-2024/data-downloads/202401_mobile_coverage_uk_and_nations_r01.zip?v=356120

[4] With at 95% probability of at least 2Mb/s download speeds.

mainly or exclusively use mobile devices in areas of good outdoor coverage the value of a D2D service from an NTN will likely be low or zero. On the other hand, mobile consumers who live or frequently travel to areas with no outdoor mobile coverage and want to use their mobile device in those places the value to them may be significant, but the service to them would be costly if the D2D service costs were apportioned to them and not all customers on the terrestrial mobile network.

There are several industry sectors that could benefit from coverage of remote rural areas and national waters of the UK, e.g., agriculture & fisheries, water, mining, oil & gas, and construction. In addition, the requirements of the military and emergency services are another example of where satellite and HAPS connectivity could be a valuable complement to terrestrial connectivity. Many of these entities use existing fixed satellite and MSS services and they would likely adopt a satellite D2D capability if it met their requirements for application support, performance and price.

NTNs may also have application in the IoT space, backhaul of other networks and other novel applications, However, we assume these are outside of the scope of this call for inputs.

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***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?***

D2D services provided in outdoor locations where no terrestrial mobile network has coverage, and no fixed networks are present, would have societal benefits such as the ability to summon help from emergency services as well as other benefits such as social wellbeing as well as supporting possible industrial or business requirements.

The areas that have no mobile coverage today, or planned, are generally where provision of coverage is less economically unviable, and Government does not see a case to subsidise the costs of such provision. Ofcom has also moved away from requiring potentially loss making coverage to be provided by one or more spectrum licensees in auctions, e.g., no such requirement was used in 700/3600 MHz award in 2021.

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*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?*

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**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?*

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**We're aware that different technologies and network architectures will have different costs, performance, and spectrum efficiency trade-offs.**

***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?***

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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?***

We are aware that in order to benefit from the large population of existing mobile devices that are in use the D2D system proponents would like to use existing mobile air interface technologies and existing licensed spectrum bands that the handsets can support.  In the medium term, if standards developments and implementation of new MSS bands in devices is commonly supported, it could be more efficient if D2D systems had separate spectrum to the existing terrestrial mobile bands.

Where there is good terrestrial mobile coverage, we think the market for D2D service from satellites/HAPSs will be very limited as consumer requirements are already being met by the four existing mobile networks (and the MVNOs that use those networks).  In these areas the terrestrial mobile spectrum is anyway all or mostly in use (or will be as capacity demand increases), particularly in the urban areas.

In remote rural areas some or all terrestrial mobile spectrum may not be in use, and it is these areas where D2D solutions would need to be relied on and could play a complementary role to terrestrial networks. However, D2D service provision in those areas would have the potential to cause interference to terrestrial mobile networks that provide coverage in areas some distance from the D2D service area and a geographic "buffer zone" will be needed where the spectrum used for terrestrial network cannot be re-used for D2D service.  The size of this zone will depend on the technical parameters of the NTN platform and networks concerned and the size of the zone would be determined by a coordination process that is a matter of current international discussion but could be specified as a Power Flux Density (PFD) level that must not be exceeded by the D2D system at the service area of the terrestrial mobile network.

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*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?*

BT does not have relevant information to share on this question.

## Non-D2D services in MSS spectrum

*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?*

There are several areas of potential future demand for existing and new non-D2D services using MSS spectrum. The introduction of IoT is one possible application.

Mobile backhaul and mobile broadband applications to fixed locations are probably more suited to FSS bands given the bandwidths needed.

# 3 Spectrum authorisation and spectrum sharing

## Co-channel MSS sharing

*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.*

The development of ever larger and more sophisticated antennas on satellites and HAPS could increase overall spectral efficiency and coverage flexibility. Feasibility of sharing of MSS bands with other applications in future, including HAPS, could be studied.

*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.*

No comments.

# Potential UK authorisation of D2D services

*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?*

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*Question 12: Are there any mobile bands that should be prioritised for satellite based D2D?*

Satellite D2D services cannot operate in the same spectrum in the same geographic area as terrestrial mobile networks as the systems would be disrupted by interference. In fact, the service areas would need to be frequency coordinated and typically separated by many tens of km. This leads to the initial conclusion that in the UK the D2D systems would need to operate in mobile spectrum bands that are not yet deployed in the areas of the country where D2D services are of interest. In turn this means that the D2D opportunity will be in the more remote areas where mobile data traffic density is low, and the spectrum bands would be those that are not typically deployed in low traffic areas.

Unpaired (TDD) spectrum would give rise to additional interference scenarios and is therefore likely to be more problematic than paired FDD mobile spectrum bands.

The most suitable existing mobile bands for D2D may vary from operator to operator, but in general the higher frequency paired spectrum bands deployed for additional capacity may be lightest used in the more remote areas. See also response to Q6 for further information.

*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?*

TDD spectrum raises particular problems, probably effectively ruling out unpaired 2.6GHz and 3.5GHz bands at least for initial systems. This issue was recently raised and is being discussed in WP4C and WP5D in the ITU.

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# Future authorisation of airborne base stations operating in mobile bands

*Question14: Do you have any views on how spectrum for [airborne services] [D2D services] should be authorised? Does this vary by band, or type of NTN? Please explain the reasoning behind your preference.*

We note that Q14 is worded slightly differently in the Annex A5 and in the main part of the document. The main document refers to authorisation of spectrum for airborne services whereas in the main document there is reference to D2D services.

On reading the text in the document we understand that what is being asked about is views on how airborne base station transmissions, and transmission from mobile devices to these airborne base stations, should be authorised.

For the airborne base stations Ofcom mentions two options: issuing specific licences for airborne base stations or modifying MNO licences so that the MNO manages the interference risks related to HAPS.

The document mentions at para 5.25 that if Ofcom introduces "a new framework to authorise satellite D2D services in mobile bands, there could be benefits from a similar authorisation regime for airborne platforms – i.e., a new licence specifically covering transmissions from airborne platforms." We are not clear what the similarity is here as our understanding is that Ofcom does not licence satellite space stations in the current ITU regulatory framework.

Given the increased potential for interference across international borders from mobile base stations located on a high altitude platform as well as the need to consider out of band emissions into other services, there could be a case that it may be best if Ofcom were to licence these separately at the request of the MNO holding a national mobile spectrum licence (or where the HAPS is not part of the MNO's network, with the agreement of the MNO holding the national spectrum licence). This would be somewhat similar to the approach used to authorise Drones on national mobile networks, although those are mobile terminals not base stations.

On the other hand, we think it is quite unlikely that, given MNOs have the rights to use the spectrum that they hold a licence for anywhere at any time, there would be interest in operating a HAPS not in conjunction with an MNO as the HAPS investment would be risky. Since ultimately the MNO would need to be satisfied that interference with its conventional terrestrial network can be managed, it might be more efficient just to clarify within the MNO spectrum licence that base stations may be airborne and to introduce any necessary additional coordination requirements.

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For the devices, licence-exemption regulations could perhaps specify that the mobile device must form part of a terrestrial mobile network whose base stations are operated under a WT act licence and may be on the ground or airborne.

# 4    Next steps

*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.*

BT notes the ongoing work in ITU for the WRC-27 Agenda Item 1.13 and considers that although this is addressing the international framework for D2D it may generate relevant information for national considerations, for example on the suitable criterion for protection of mobile networks from interference.

We would ask that Ofcom continues to participate in the relevant international work and works with stakeholders when developing contributions and briefing for these meetings. If there is consideration of additional mobile satellite service allocations in the existing bands used for terrestrial mobile networks as part of developing an international regulatory framework for D2D services, we recommend that this should be on secondary rather than primary allocation basis. This would be consistent with a position of only allowing D2D services in existing mobile bands on the basis that the satellite service shall not cause interference to nor claim protection from the incumbent mobile services that are in operation. Given the enormous investments that have been made in terrestrial mobile networks and their long-term role in providing critical national infrastructure, we consider such a regulatory position to be appropriate. It would also be consistent with the position being developed by the FCC.

We furthermore consider that the agreement of the mobile operator holding the relevant existing nationwide mobile spectrum licence and operating the national mobile network should be obtained before D2D services are permitted in terrestrial spectrum.

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