Introduction

techUK is pleased to provide its views on Ofcom's proposals for enabling satellite direct to device services in Mobile spectrum bands. We recognize the diverse interests surrounding access to the MS bands for delivering Direct-to-Device services. Our response seeks to highlight key considerations for techUK's members as reflected in this proposal.

Notably, techUK's **position paper on Network Convergence** explores the transformative potential of integrating terrestrial and non-terrestrial networks (TN-NTN) to create a "network of networks." This approach can help bridge the digital divide, unlock economic opportunities, and strengthen the UK's position as a global telecommunications leader.

This position paper is the product of extensive engagement, including roundtables, workshops, stakeholder consultations, and research conducted in collaboration with member companies across the mobile and satellite sectors. It presents critical insights and actionable recommendations to advance network convergence. Key takeaways include:

1. Leveraging Mobile Spectrum for Satellite Services
Utilizing mobile spectrum through agreements with MNOs presents an efficient way to expand satellite connectivity, including bands between 698MHz to 2600 MHz. However, this requires:

- **Interference Management:** Ensuring that satellite operations do not disrupt terrestrial IMT services.
- **Regulatory Harmonization:** Aligning requirements for lawful intercept and emergency calling to enable seamless satellite-mobile integration.

2. Future Spectrum Expansion and mmWave Opportunities
The increasing demand for bandwidth necessitates further spectrum allocations. While 3GPP has expanded licensed spectrum in recent releases, additional measures are required, such as exploring mmWave bands (e.g., 17, 20, 28 GHz) to address capacity challenges.

3. Managing Coexistence Between LEO and GEO Systems
As LEO systems expand, ensuring coexistence with GEO-dominant networks is vital. In L-band, where terminals struggle with interference, collaborative spectrum-sharing approaches should be developed.

Balancing spectrum efficiency, interference mitigation, and regulatory compliance is essential to supporting the continued growth of satellite communications. We encourage regulators to adopt policies that promote collaboration between satellite operators and MNOs, enable the efficient use of mobile and mmWave spectrum, and facilitate the coexistence of LEO and GEO systems. Additionally, accelerating regulatory approvals where feasible will help meet urgent connectivity needs while maintaining protection for existing users.

techUK members stress the need for international compatibility within the UK to ensure the success of Direct-to-Device (D2D) services, which requires economies of scale to reduce terminal costs and enable seamless integration with cellular networks.

We provide comments in response to Ofcom's consultation questions below.

Question	Your response
Question 1: Do you agree with our assessment of the business models that could potentially emerge?	Confidential? – No The assessment of business models that could emerge from network convergence is comprehensive and aligns with industry trends. techUK members acknowledge that the consumer experience of using D2D networks may vary by operator and evolve over time, starting with SMS text and potentially expanding to voice and data services. This evolution could impact how consumers contact emergency services. Members also note that the consumer experience with voice services may vary depending on the business model between the satellite operator and the MNO. Some models may offer seamless switching between terrestrial and satellite networks, while others may treat satellite connectivity as a distinct service, similar to international roaming. techUK members also agree with early trials and commercial deployments of D2D in other countries, where the satellite operator provides a wholesale service and the MNO offers a retail service to end users. This model is expected to emerge in the UK in the short term,

Question	Your response
	with proposals being neutral regarding specific business models. The proposals enable D2D services to be provided by MNOs and satellite operators working in partnership, reflecting market developments and responses to the consultation.
Question 1(a): Are there any other business models that you think could deliver benefits for people and businesses in the UK?	Confidential? – No Additional business models could play a crucial role in maximizing the benefits of D2D services for people and businesses in the UK. One such model is Public-Private Partnerships (PPPs), which leverage collaboration between government and private sector entities to drive innovation and extend coverage. Given the potential of D2D networks to provide supplementary coverage, especially in rural and remote areas, government involvement could help accelerate deployment by providing incentives, subsidies, or regulatory support. These partnerships could facilitate infrastructure development, ensuring broader connectivity while managing the risks of harmful interference to existing spectrum users. As D2D services are expected to supplement rather than replace existing terrestrial networks, flexible pricing structures could encourage adoption, ensuring affordability while driving investment in the sector. This model aligns with Ofcom's mission to promote innovation and consumer choice while supporting efficient spectrum use. There is increasing confidence that satellite technology will play a larger role in private mobile networks, enabling seamless global roaming. IoT and Smart City Solutions present a forward-thinking business model by integrating D2D services with the Internet of Things to support urban development. Smart

Question	Your response
	city applications—such as connected infrastructure, remote monitoring, and real-time data collection—could benefit from the resilience and extended reach of D2D networks. This model could help improve urban management, emergency response services, and overall connectivity for businesses and residents. Given that stakeholder responses to the July 2024 CFI emphasized the importance of resilience and emergency services, leveraging D2D for IoT applications could further enhance public safety, efficiency, and innovation in the UK's digital infrastructure. Integrating NTN-IoT into IoT SIM can support seamless roaming between terrestrial and satellite networks, improving connectivity for IoT assets worldwide. Additionally, dedicated antenna devices with NTN capability can provide global asset tracking. As private networks grow in industries with limited terrestrial coverage, integrating satellite connectivity becomes essential. A recent study confirms satellite networks as the top choice among alternative technologies for private 5G customers. This enables greater interoperability and user experiences similar to terrestrial networks. These business models, combined with the proposed authorisation framework, can help unlock the full potential of D2D services. While the immediate benefits may be limited due to the UK's relatively high 4G coverage, the long-term impact—especially for rural communities, emergency services, and innovation-driven industries—could be significant. Lastly, the 3GPP consortium is already investigating 6G, with NTN anticipated to be a key component of the new standard.

Question	Your response
Question 1(b): Are there any business models that could not operate under our proposed approaches?	Confidential? – No No comment.
Question 2: Do you agree with our assessment of the benefits that could be realised through authorisation of D2D services?	Confidential? – No The introduction of D2D services is expected to significantly enhance rural connectivity in several ways. D2D services can extend voice, messaging, and data coverage beyond the reach of existing terrestrial networks, potentially achieving ubiquitous outdoor coverage across the entire UK landmass. In the UK, Ofcom reports that 9% of the country lacks mobile connectivity. Enhanced internet access can support remote work, online education, and telehealth services, improving quality of life and economic opportunities for rural residents. Better connectivity can stimulate local economies by enabling rural businesses to access broader markets and digital services. Additional benefits for UK citizens and businesses could include: • Enhanced Connectivity for Remote Work: Improved internet access in remote areas can support remote work and education. • Economic Opportunities: Stimulating local economies by providing better connectivity for businesses in very hard to reach areas. • Environmental Monitoring: Better data collection for environmental and agricultural applications, supporting sustainability initiatives. This is particularly beneficial for rural areas where terrestrial network coverage may be limited or non-existent. D2D services can provide backup coverage during power outages

Question	Your response
	or network faults affecting terrestrial base stations, ensuring continuous connectivity during emergencies or extreme weather events. In addition to improved access to emergency services in rural areas, enhancing safety and response times. Overall, the rollout of D2D services is expected to bridge the digital divide, providing rural communities with reliable and high-quality connectivity, fostering innovation, and supporting growth.
Question 2(a): Are there any other benefits for UK citizens and businesses that could be realised?	Confidential? – No There are several upcoming markets that can benefit from ubiquitous connectivity provided by satellites. For instance, Uncrewed Aircraft Systems (UAS), driven by advancements in autonomy and artificial intelligence, are rapidly integrating into various aspects of modern life. As regulations evolve and compliance frameworks mature, these technologies hold immense potential to enhance—or even replace—traditional methods of transportation, surveillance, and beyond-visual-line-of-sight (BVLOS) operations. Projections suggest that the global drone economy could surpass $90 billion by the decade's end, as industries ranging from logistics and enterprise to emergency response and defence discover transformative applications. However, as the market expands, so must the infrastructure supporting it. This includes physical components like take-off and landing sites, air traffic management systems, and critical services such as cybersecurity, insurance, and fleet financing to ensure safe and efficient operations amidst growing traffic volumes and complexity.

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	UAVs leveraging regulated cellular networks operate on LTE/4G, utilizing frequencies below 6 GHz, or on 5G, which provides dramatically faster speeds. This makes 5G ideal for bandwidth-intensive tasks, such as streaming real-time HD footage during autonomous missions. Yet, even with advancements in telecommunications—from high-speed 5G to cost-effective low Earth orbit (LEO) satellite systems—no single network can meet the ever-growing demand for seamless, mobile connectivity. The solution lies in systems that combine multiple communication technologies, such as 3G, 4G, 5G, Wi-Fi, and satellite, to create a resilient, always-on connectivity solution. Smart networking dynamically selects the best available operator based on location, cost, or quality of service, allowing assets to maintain uninterrupted connections as they traverse different coverage zones. This capability is further enhanced by software-defined network technology, which enables seamless integration of current and future connectivity services. This ensures optimal connectivity regardless of carrier, location, or operational needs—a previously untapped potential. Hybrid connectivity empowers drones and other assets to transition effortlessly between networks, adapting to predefined criteria to ensure reliability and efficiency. Military applications, such as drone swarms or distributed systems, rely heavily on this robust connectivity. Without it, their full capabilities remain out of reach. In the civilian sector, leveraging heterogeneous networks unlocks even greater possibilities. By enabling UAVs to perform a wide range of tasks safely, efficiently, and

Question	Your response
	cost-effectively across industries, hybrid connectivity has the potential to revolutionize operations and drive innovation in ways that were previously unimaginable. The potential intervention from the UK Government could capitalize on opportunities for the public sector, implementing centralized safety regulations under a single authority (such as the CAA), ensuring robust support for AI, PNT, and drone demonstrators, and prioritizing better integration across sectors. These steps would drive progress while maintaining safety and fostering innovation. In summary, while hybrid networks and software-defined technologies offer promising solutions, business models heavily reliant on single-network connectivity may face challenges under the proposed approaches. The integration of multiple communication technologies is essential to meet the demands of modern device operations.
Question 3: Do you have comments on how emerging D2D technology should support 999 service provision?	Confidential? – No Rather than continuously overhauling systems to address the cost and operational challenges of network convergence, the sector should focus on optimizing existing resources, workflows, and business models. This approach should allow for the seamless integration of new communication methods and technologies as they emerge. The evolution of networks toward convergence enhances overall energy efficiency through optimal resource allocation, such as transmission power, and improved data transmission. This can reduce the total energy consumption of communication systems while ensuring latency tolerance and maintaining quality of service.

Question	Your response
	Network as a service (NaaS) has been used to improve the technology base of emergency services, such as the East of England ambulance service. By addressing cellular blackholes with LEO services, it maintains active data exchange between medical facilities and teams on the road, even in areas with limited or no cellular coverage. This satellite service provides bandwidth to maintain operations, offering resilience and continuity when dealing with human lives. It has shown that 15% of callouts could be dealt with onsite, reducing logistics, costs, and keeping customers confident. Independent of the underlying infrastructure, NaaS is attractive to both customers and service providers relying on communications regardless of the state of technology in particular regions. This applies to diverse markets including defence, government, healthcare, drones, connected vehicles, and rural communications. The migration to 4G, 5G, and satellite networks for emergency services, such as the NG eCall system, demonstrates the potential for enhanced emergency response capabilities. This system automatically contacts emergency services in the event of a serious accident, sending location and sensor information. The integration of LEO and GEO satellite communications technology can provide positive features, especially in remote or rural areas where cellular services are not available. Early adoption of cross-industry standards for network convergence can accelerate the evolution of emergency services and unlock new business opportunities, ensuring robust and reliable 999 service provision.

Question	Your response
Question 4: Are there any mobile spectrum bands not in scope of our proposals that you think we should consider?	Confidential? – No The potential use of mmWave spectrum (beyond 15 GHz, such as 17, 20, and 28 GHz) could help address capacity challenges. These bands offer hundreds of MHz, which can significantly enhance bandwidth for high-capacity applications. Establishing agreements with Mobile Network Operators (MNOs) to access their licensed spectrum for satellite services is a key opportunity to scale up satellite service adoption. This approach optimizes the use of available spectrum to deliver more services and connectivity. However, it requires close coordination between mobile and satellite operators to protect terrestrial mobile network operators and their users from harmful interference. Approaches such as dedicating parts of the spectrum solely for satellite use or sharing spectrum by dividing it geographically can help avoid interference with IMT bands. This method ensures efficient use of spectrum while minimizing interference risks. Other technological advancements, such as dynamic spectrum sharing, offer potential solutions. While these innovations may ease concerns, regulatory limitations could still restrict initial availability. Alternatively, satellite operators in Europe can leverage dedicated L- and S-band spectrum from established geostationary-Earth-orbit providers. This approach enables virtualized RAN and core integration with certified smartphones using standardized technology, ensuring compatibility without interfering with IMT spectrum. Spectrum sharing and frequency reuse in the L-band range (1-2 GHz) are challenging due to

Question	Your response
	the omnidirectional nature of many terminals. However, systems that can collaborate with other operators and make real-time decisions to mitigate conflicts can be considered. GEO satellites will continue to play a crucial role in providing safety and critical services. Any LEO system will need to coexist within a GEO-dominant environment, ensuring that both systems can operate without causing interference. By considering these additional spectrum bands and approaches, the UK can optimize spectrum use, enhance connectivity services, and support the integration of emerging technologies.
Question 5: Does deployment in supplementary downlink spectrum (SDL) present any challenges in comparison to other bands? Is there interest in deploying in this spectrum?	Confidential? – No No comment.
Question 6: Do you agree with our proposal to limit this authorisation to the UK mainland and territorial waters? If not, please explain why.	Confidential? – No No comment.
Question 7: Do you agree that our proposed technical conditions for D2D satellite emissions will protect mobile services delivered by other operators in adjacent areas and in adjacent spectrum?	Confidential? – No Satellite operators may utilize mobile spectrum by partnering with Mobile Network Operators (MNOs) to access terrestrial mobile spectrum. This approach requires close coordination to ensure that satellite services do not interfere with terrestrial mobile network operations. Ofcom's Local Access Licence framework allows third parties to use spectrum licensed to an MNO in areas where it is currently unused or not planned for use within three years. This framework provides a structured approach to manage spectrum use and minimize interference risks.

Question	Your response
	Introducing D2D services or High-Altitude Platform Stations (HAPS), particularly High-Altitude Internet Base Stations (HIBs), into terrestrial mobile bands involves higher interference risks and technical complexities. Therefore, the use of a Local Access Licence would be contingent upon an agreement between the MNO and the satellite or HAPS operator, along with a coordination agreement. The proposed technical conditions aim to manage these risks by ensuring that satellite emissions do not cause harmful interference to existing mobile services. This includes measures such as geographic spectrum sharing and dedicated parts of the spectrum for satellite use. The frequency separation between incumbent services and D2D satellite transmissions is considered. Larger frequency separations improve coexistence and reduce the risk of interference. Systems operated indoors may be shielded from D2D satellite transmissions, further reducing interference risks. Successful implementation requires close coordination between mobile and satellite operators to protect licensed terrestrial mobile network operators and their users from harmful interference. This includes approaches such as dedicating parts of the spectrum solely for satellite use or sharing spectrum geographically to avoid interference with IMT bands. Satellite services must adhere to regulatory requirements, including lawful intercept and emergency calling, to ensure that end users can make emergency calls and roam onto any available mobile network. These requirements help maintain the integrity and reliability of mobile services.

Question	Your response
Question 8: Do you agree with out high-level co-existence assessment for other services in adjacent spectrum to D2D?	Confidential? – No No comment.
Question 9: Are there other services co-channel or in adjacent spectrum that you think we should take into account when assessing coexistence? If so, please provide evidence of the nature of interference and what level of protection you consider is necessary.	Confidential? – No Interference risks from adjacent users or entities sharing the spectrum, such as Earth Observation (EO) satellites or offshore services, are considered. Effective management of these risks is crucial to maintaining network performance.
Question 10: Do you agree with our preferred authorisation approach (option 2)? If not, please set out your reasoning.	Confidential? – No Members have different views on which of the three options that Ofcom has set out may be preferable. Option 1 outlines licence-exemption of terminals, which is a simple approach. An important condition would be that the terminal is used with a valid SIM issued by a UK MNO to connect to a satellite on the relevant frequencies and in accordance with any terms and conditions specified by the MNO. Option 2 allows for a structured yet flexible framework where MNOs seeking to provide D2D services must vary their existing spectrum licenses. This ensures regulatory oversight while streamlining the process without introducing unnecessary bureaucratic burdens. There are concerns however, such as what happens when an MNO ceases a commercial relationship with a satellite network operator. By including 'D2D coordination clauses' in MNOs' varied licenses, Ofcom retains the ability to enforce technical conditions directly with the MNOs. This provides a strong mechanism for addressing interference issues effi-

Question	Your response
	ciently and ensures that any harmful interference can be swiftly mitigated. It does however stretch Ofcom's powers, arguably beyond what is intended as Ofcom has no power to directly authorise emissions from satellites. The discretionary exemption for mobile handsets simplifies consumer access to D2D services while keeping regulatory complexity manageable for stakeholders. Given the high costs historically associated with satellite-based services, this approach could encourage more affordable solutions through commercial competition and innovation in satellite connectivity. The approach aligns with ongoing efforts toward standardization, interoperability, and software-defined capabilities, which are crucial for integrating satellite and terrestrial networks efficiently. With the industry moving towards mobile broadband and IoT expansion (as seen in 3GPP Releases 18 and 19), this regulatory framework ensures that future developments are supported without unnecessary constraints.
Question 11: Are there any alternative authorisation options, not discussed here, that you believe are worth considering?	Confidential? – No There are alternative authorisation options that could be worth considering to deploy testing and performance, particularly those that leverage network convergence, shared infrastructure, and industry collaboration to enhance the rollout and management of D2D services. A key challenge in NTN-5G integration is the lack of comprehensive testing tools and methodologies, making it difficult to accurately assess performance, identify bottlenecks, and optimize configurations. The integration of

Question	Your response
	NTN with next-generation Radio Access Networks (NG-RAN) requires thorough testing under realistic conditions, yet replicating the complexities of satellite and terrestrial networks remains difficult. Factors such as latency variations, packet loss, and interference can significantly impact performance, demanding rigorous testing to ensure seamless operation. Overcoming this is crucial for the widespread adoption of NTN-based 5G services. Successful NTN and NG-RAN convergence depends on high-fidelity network simulations that allow engineers to test cluster configurations, convergence strategies, and scalability under real-world conditions. Identifying and addressing issues early in development helps reduce risks, optimize performance, and accelerate time to market. High-fidelity network emulators are increasingly used in convergence projects to enhance test environments. By leveraging existing centres of excellence, along with support from innovation hubs and private-sector expertise, governments can foster collaboration with industry leaders. Raising the visibility of technology clusters would further drive the integration and testing of cutting-edge advancements in satellite communications, such as Positioning, Navigation, and Timing (PNT), artificial intelligence (AI), and quantum technologies. Uniting these capabilities will accelerate convergence, fuel innovation, and create new opportunities in transformative fields.
Question 12: Do you agree with the proposed conditions?	Confidential? – No The proposed conditions are reasonable and necessary to ensure the successful deployment and operation of D2D services. They

Question	Your response
	provide a structured approach to managing interference, spectrum usage, and regulatory compliance while enabling innovation and investment in this area. That said, there are some key areas where further clarification and refinement may be needed. The consultation appears to be at a late stage in Ofcom's decision-making process, yet it does not fully address device availability and the complexities of bringing satellite and mobile networks together, particularly in terms of Quality of Service (QoS). Given that device manufacturers, such as smartphones, have required regulatory clearance in every country where they might be used, it would be beneficial for Ofcom to outline a clearer strategy for device certification and approval. Additionally, while the coverage benefits of D2D services are clear, the consultation lacks detail on the user environment—especially in scenarios such as trains and cars. These subsectors of rural and remote areas present unique challenges that need to be accounted for, including signal handover, interference mitigation, and performance in motion. Similarly, there is limited discussion on satellite IoT, which has the potential to enhance connectivity for industrial and agricultural applications but requires clear regulatory and operational guidance. Finally, it is important to ensure that all relevant industries, including aviation and transport, are adequately consulted to avoid regulatory gaps. A more comprehensive stakeholder engagement process, along with additional details on how Quality of Service (QoS) will be managed across different environ-

Question	Your response
	ments, would strengthen the proposed conditions and improve industry confidence in the rollout of D2D services.
Question 13: Do you have any other comments on the proposals set out in this document?	Confidential? – No As the satellite industry continues to grow in importance, taking a proactive approach to integrating these technologies is essential. Strengthening collaboration between the satellite sector and traditional telecommunications providers will play a key role in expanding coverage and connectivity, ultimately supporting the UK's economic and societal objectives. Building strong commercial partnerships will be a critical step in driving this convergence forward. In addition, with satellite and terrestrial networks becoming increasingly integrated, ongoing industry engagement with regulators like Ofcom will be crucial to unlocking the full potential of 5G, 6G, and IoT technologies. This will help ensure seamless and resilient connectivity across both urban and remote areas. At the same time, striking a balance between adopting new solutions and maintaining support for existing workflows is essential to facilitating smooth transitions for businesses while sustaining operational efficiency. The launch of the Regulatory Innovation Office (RIO) marks an important milestone in fostering a pro-innovation regulatory environment. By reducing regulatory barriers, streamlining approvals, and encouraging investment in emerging technologies such as AI, autonomous vehicles, space, and healthcare, RIO has the potential to accelerate the deployment of satellite communications and network convergence. To maximize its impact, it is important

Question	Your response
	that RIO remains focused on addressing the key challenges facing the industry. Achieving the goals of the UK Industrial Strategy will require a greater emphasis on coverage and network convergence. To remain internationally competitive, the UK would benefit from a comprehensive Convergence Plan that attracts investment and keeps pace with global advancements. This is not just about improving data speeds but ensuring equitable access to reliable connectivity—whether in homes and offices, at sea, in connected vehicles and transport systems, or in rural and hard-to-reach areas. The UK's leadership in the space and telecommunications sectors will depend on streamlined regulation, sustainable practices, and strong industry-government partnerships. By fostering innovation, supporting economic growth, and enhancing global competitiveness, this approach will position the UK at the forefront of next-generation connectivity solutions, ensuring its infrastructure meets the demands of future social and economic development.

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