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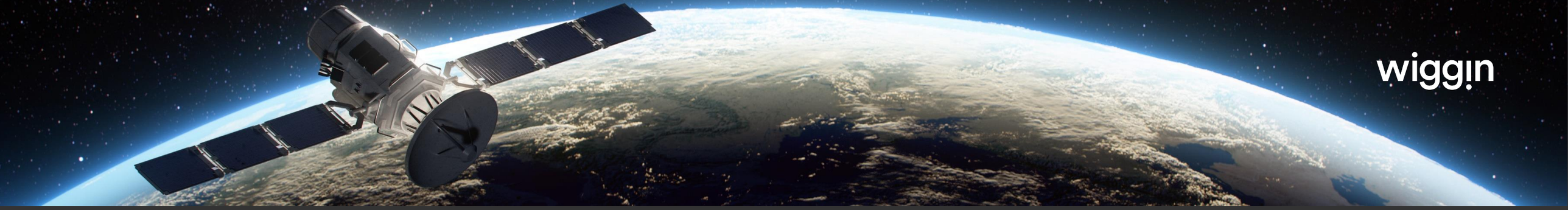
Direct-to-Device satellite connectivity

A comprehensive review of current developments, commercial models, regulatory response and 2025 outlook



Executive summary

In recent years, Direct-to-Device (D2D) satellite connectivity has emerged as a transformative force in global telecommunications, moving from niche use cases to potential mass-market applications. This report reviews current developments, commercial models and regulatory responses and the outlook for the rest of 2025.

UK regulatory landscape & Ofcom's role

In the UK, Ofcom has taken significant steps to support D2D services, including most recently publishing a consultation paper on *Enabling Satellite Direct to Device Services in Mobile Spectrum Bands* in March 2025. Ofcom is currently consulting to define a framework for authorising satellite-based services on existing UK mobile bands below 3GHz. Potential models include licence exemptions, MNO spectrum variations, and new "terminal licences" for D2D connectivity. The UK is on track to establish a regulatory model that could serve as a global template.

Ofcom is concurrently exploring broader spectrum initiatives. These include the 2 GHz MSS band to support space-based mobile services, transitioning MSS satellite terminals to a "light licence" regime, and engaging with European regulators on satellite IoT. With a growing number of non-geostationary satellite orbit operators in the UK, Ofcom is developing frameworks to ensure efficient spectrum and orbital use in an increasingly congested environment. These efforts highlight Ofcom's proactive stance in facilitating innovative satellite-based solutions.

Global D2D enabling satellite networks

Globally, multiple players are investing in satellite infrastructure to support D2D. The European Union's IRIS² project aims to deploy a sovereign, multi-orbit satellite network by 2030, enhancing secure connectivity and potentially enabling D2D services. Eutelsat OneWeb has already begun offering LEO broadband and is exploring D2D in collaboration with telecom operators. Meanwhile, China’s Tiantong-1 and the GuoWang constellation are advancing both GEO and LEO-based D2D services, potentially positioning China as a leading non-US competitor in D2D connectivity.

Outlook for 2025

We expect D2D services to transition from technology demonstrations to commercial services, becoming a standard mobile feature. Technological advancements like improved waveforms, antenna enhancements, and inter-satellite routing will support scalability.

Emergency SOS and remote communication will be the primary use cases initially, and carriers may initially bundle basic satellite texting with regular plans or offer premium tiers for voice and data services alongside an enterprise strategy. However, D2D’s true revenue potential lies in specific user segments, like primary connectivity for remote regions or where demand lies for D2D broadband, eventually expanding to mass scale applications in IoT, vehicle connectivity, and public safety architecture.

Regulatory developments will shape its rollout, with jurisdictions choosing between first-mover advantage or waiting for alignment from key forums such as WRC-27.

The competitive landscape will likely see consolidation as satellite operators seek device compatibility with popular smartphones, where solutions with mass market device access enjoying a natural advantage, and roaming and interoperability arrangements becoming vital.

Conclusion

Commercial D2D services available at scale will mark a significant milestone in the evolution of global mobile connectivity. Technological advances, regulatory frameworks, and innovative commercial models will help pave the way to making D2D a genuinely mainstream connectivity option over the coming years. The UK’s regulatory advancements could set the stage for global adoption, with partnerships between satellite operators and MNOs playing a critical role in expanding satellite coverage worldwide.

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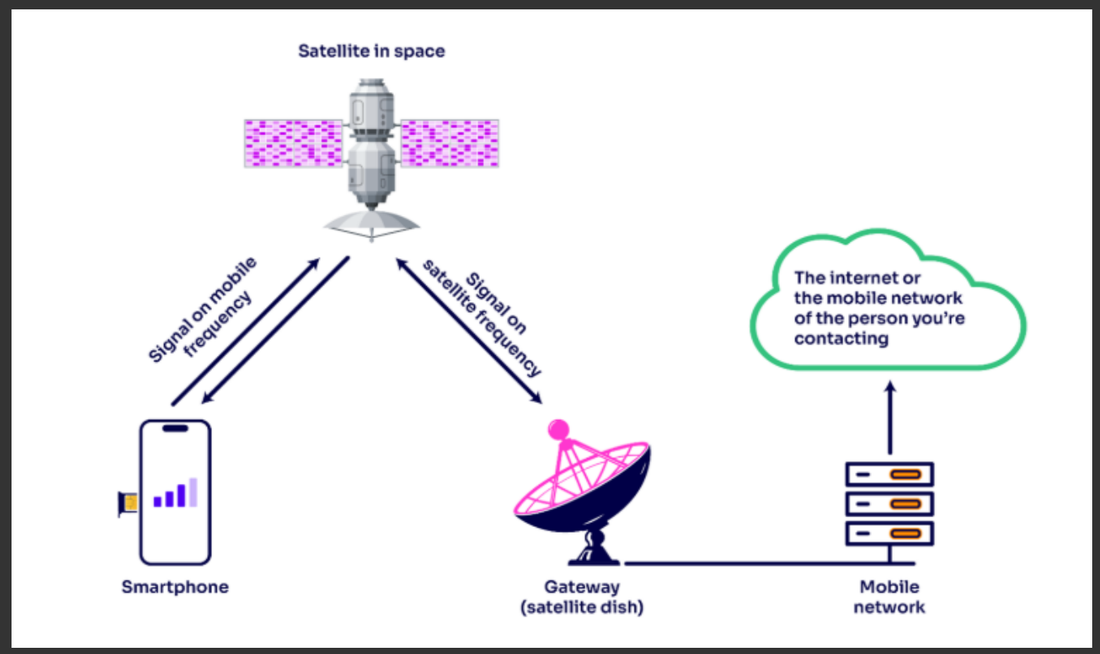
The current landscape

On 20 March 2025, Ofcom issued a groundbreaking consultation on authorising the use of spectrum bands by nationally licensed MNOs in the UK for Direct to Device ("**D2D**") satellite services below 3GHz which, once implemented, will make the UK one of the first European jurisdictions to provide a licensing pathway for mass D2D services utilising mobile spectrum.



Source: https://www.ofcom.org.uk/spectrum/space-and-satellites/standard-smartphones-to-receive-signal-from-space/

With this exciting development, it's a timely opportunity to review the journey so far.

Over the course of 2024 through to Q1 2025, several non-geostationary satellite operators accelerated their development and deployment of D2D service capabilities – connecting ordinary mobile phones via satellite. By providing satellite connectivity to mobile phones, D2D connectivity has the potential to increase outdoor geographic coverage and provide a basic backup service in the event of outages on traditional terrestrial networks, or in areas not covered by traditional terrestrial networks at all. Below are some recent developments:

- **Vodafone and AST SpaceMobile** achieved a world-first by completing a video call from a remote area in Wales to Vodafone's CEO using a standard smartphone and AST's low-Earth orbit (LEO) satellite. This demo – using AST's newly launched BlueBird satellites – showcased full mobile broadband capability (voice, text, video) via satellite with up to 120 Mbps throughput to regular handsets. Vodafone plans to roll out this satellite-to-phone service across Europe in late 2025 and 2026, and has formed "SatCo", a joint venture with AST to offer "space-based mobile broadband" to other European operators. Vodafone is an investor in AST (alongside AT&T, Verizon, and others), reflecting broad telecom support for this approach.
- **SpaceX's Starlink** (already 3000+ satellites strong) also made strides toward D2D. **SpaceX and T-Mobile US** are testing Starlink "Direct to Cell" service using T-Mobile's mobile spectrum – initially for SMS text messaging, with voice and data planned later. In January 2024, Starlink reportedly soft-launched an SMS service for select T-Mobile users. SpaceX began launching next-generation satellites equipped for direct phone links (the first D2D-capable Starlink satellites) in Jan 2024. This partner-centric approach aims to turn Starlink satellites into "cell towers in space" extending coverage for mobile network operators (MNOs) without requiring any changes to phones on the ground.
- Device makers have also jumped in. **Apple's** iPhone 14/15 include satellite SOS messaging via **Globalstar's MSS** (mobile satellite service) network. This *free-to-user* feature allows emergency texts and location sharing when no mobile signal is available. By early 2025, three generations of iPhones offered SOS satellite connectivity, and a flagship Android (Google's Pixel 9) reportedly adopted similar capabilities. Rival chipmakers and phone brands are enabling satellite messaging too – e.g. **Qualcomm's** Snapdragon

Satellite (using **Iridium's** LEO network) is bringing two-way emergency SMS to new Android phones. These narrowband services use dedicated satellite spectrum and are mainly limited to emergency or basic messaging, but they have made the public more aware of D2D possibilities.

- **OneWeb** (now **Eutelsat OneWeb** after a 2023 merger) completed its first-gen LEO constellation of 654 satellites and has focused on broadband connectivity for governments, businesses, and mobile backhaul. While not yet offering D2D services, OneWeb is testing 5G integration with satellites. In Feb 2025, Eutelsat OneWeb ran a successful trial of a 5G Non-Terrestrial Network (NTN) link, connecting a 5G device through OneWeb satellites to a core network using 3GPP Release-17 standards. Eutelsat considers 5G NTN a key feature of the **IRIS²** constellation (the EU's planned network) and is positioning OneWeb to seamlessly complement terrestrial networks for IoT and future smartphone connectivity. While this differs from Starlink/AST's approach (which directly connect satellites to existing phones using mobile spectrum), it signals OneWeb's intent to support D2D via standards-based tech in the future.

Here is a summary of current large constellations as of February 2025:

Operator	Constellation size	Frequency bands	Orbit (km)	Segment
Eutelsat OneWeb (European)	634 launched 648 planned	Ka, Ku	1,200 (LEO)	B2B
SES O3b (European)	8 launched 13 planned	Ka	8,063 (MEO)	B2B
Starlink (US)	>6,800 launched ~40,000 planned	Ka, Ku L band MSS requested	550 (LEO)	B2C, B2B
Telesat Lightspeed (Canada)	198 planned	Ka	1,000 (LEO)	B2B
Amazon Project Kuiper (US)	2 launched 3,236 planned	Ka	600 (LEO)	B2C, B2B
China SatNet Guowang	10 launched ~13,000 planned	Ka, possibly V, Q	590-600, 1145 (LEO)	
China G60 Qianfan	72 launched ~14,000 planned	Ku, V, Q	800 – 1160 (LEO)	
Skif (Russia)	640 planned	Ka	8,070 (MEO)	

The reaction to D2D developments from terrestrial operators so far has been broadly positive, seeing satellite connectivity as a way to fill coverage gaps (see further below). According to a recent GSMA satellite and NTN tracker, by late 2024 nearly 100 mobile operators worldwide had joined the "satellite race" via partnerships or investments, covering ~70% of global mobile subscribers. What was once theoretical is now becoming reality: "This isn't theoretical, it's out there now" said Globalstar's CEO, pointing to real customers being rescued via satellite-linked phones. Early D2D services remain limited (mostly messaging), but there's critical momentum after 2024's milestones.

As these D2D systems currently stand, none of them are yet a like-for-like replacement for ground based infrastructure, so they won't be wholly replacing terrestrial networks any time soon for the majority of traffic. The initial promise of D2D is ubiquitous coverage, which will at least initially serve as a complement for remote areas or in emergency situations.

Comparison of current D2D connectivity models

Several D2D connectivity models have emerged, each with distinct strategies and approaches. The table below compares two major models **– D2D in MSS spectrum**, and **Satellite Operator – MNO partnerships** – highlighting their spectrum use, advantages, limitations, commercial viability, and regulatory considerations:

D2D Model	Spectrum approach	Key advantages	Key limitations	Commercial & regulatory outlook
D2D in MSS	Uses MSS satellite spectrum (L-band ~1.6 GHz). Devices have a custom chipset to transmit directly to LEO satellites. Service is *proprietary*.	**Seamless to user:** Built into the phone's software (no extra device), works if no mobile signal available. **No carrier needed:** Works independently of mobile operators for emergency use. **Free for emergencies:** users don't pay for SOS messages (a value-add to sell devices). **Existing spectrum:** Leverages established MSS band – minimal interference with mobile bands.	**Limited service:** Only supports low-bandwidth messaging (SOS texts, location) – *no voice or internet* browsing, not intended for routine communication. **Device-specific:** Only latest phones can use it; not a broad solution for all handsets. **Capacity constraints:** MSS spectrum is narrow; if usage expanded beyond emergencies, network congestion could occur.	**Commercial feasibility:** Currently a free emergency feature for users; indirectly monetised by enhancing device appeal. Widespread two-way consumer messaging or broadband via satellite would require a new business model (potentially subscription or carrier integration). **Regulatory:** Uses existing or modified licences in existing allocated MSS bands. Regulators mostly view SOS services favourably, though expanding to general messaging or data services might invite scrutiny.
Satellite operator – MNO partnerships	Uses an MNO's licensed terrestrial mobile bands to transmit from LEO satellites. The satellite effectively acts as a space-based cell tower. Standard 4G/5G phones connect using normal SIMs and protocols. Service depends on the satellite provider partnering with the local MNO.	**No handset changes needed:** Existing phones work seamlessly on normal mobile bands. **Extended coverage:** Can fill in dead zones, remote areas, or provide backup when terrestrial sites are unavailable. **Potential broadband capability:** Some systems aim beyond basic SMS enabling higher throughput (voice/video/data). **Integration with MNO core:** coverage is "handed off" seamlessly from terrestrial to satellite.	**Spectrum & interference coordination:** Must secure regulatory approval in each country to use the MNO's terrestrial band from orbit. Risk of interference if not managed carefully. **Service gaps:** Until sufficient satellites are launched, coverage can be spotty. Relies on MNO willingness in each market. **Technical hurdles:** MNOs may be involved in significant engineering and ongoing financing obligations with new satellite operators to support D2D.	**Business model:** add-on or premium feature for MNO customers ("satellite roaming" or "universal coverage"), generating new revenue streams and ARPU if enough users adopt it. **Investment feasibility:** High initial costs require scale or strategic partnerships; success hinges on user willingness to pay for occasional off-grid coverage or broadband in dead zones. **Regulatory:** Growing number of regulators (e.g. FCC, Ofcom) are creating rules to approve D2D in mobile bands. The MNO generally retains control of its licensed spectrum while the satellite operator abides by power/interference limits. Regulators are increasingly supportive of expanded mobile coverage without needing more terrestrial masts while balancing the needs of existing spectrum users.

There are hybrid approaches too in addition to those main models above. For example, some LEO players like Lynk Global follow the Satellite operator-MNO partnership model on a smaller scale (aiming to offer basic text connectivity by piggy-backing on operators' spectrum). Alternative MSS-based services exist beyond Apple-Globalstar – e.g. Qualcomm/Iridium's satellite messaging for Android phones, or China's use of GEO satellites and custom phones (see below).

Ofcom’s role and the UK regulatory context

D2D specific initiatives

The UK regulator, Ofcom, has been proactively laying groundwork for D2D services. In July 2024 it issued a detailed call for input on *Improving mobile connectivity from the sky and space* seeking industry views on D2D satellites and on mobile-satellite spectrum needs (“**D2D CFI**”). Ofcom noted that D2D capabilities have evolved from niche MSS use cases into potential mass-market services. The D2D CFI explored the benefits (extended coverage, network resilience, IoT connectivity) and asked whether current UK licensing frameworks are adequate. The D2D CFI garnered a strong response from industry- 29 stakeholders including MNOs, satellite firms, and government bodies weighed in.

In November 2024, Ofcom published a statement on *Improving mobile connectivity from the sky and space* summarising feedback and outlining next steps (“**D2D Statement**”). Notably, Ofcom planned to consult in early 2025 on a specific authorisation framework for D2D services in mobile bands.

Following the D2D Statement, on 20 March 2025 Ofcom published its consultation paper on *Enabling Satellite Direct to Device services in Mobile Spectrum Bands* (“**D2D IMT Consultation**”). This consultation, open until 20 May 2025, sets out three potential options for authorising D2D satellite services on existing UK mobile bands below 3 GHz (i.e. 700 MHz through 2.6 GHz):

1. **A licence exemption** for handsets, provided the D2D satellite transmissions fully comply with Ofcom’s specified technical conditions (e.g. power limits, beam angles), but with no direct regulatory tie back to the mobile operator.
2. A **variation to an MNO’s existing spectrum licence** to incorporate satellite connectivity. Consumer handsets would then be licence-exempt, on condition that the MNO-Satellite Operator partnership complies with Ofcom’s coordination and interference-mitigation requirements.
3. A **new ‘terminal licence’ for satellite-to-device connections**, jointly held by the MNO and Satellite Operator, rather than relying solely on handset exemption.

In the D2D IMT Consultation, Ofcom has indicated a preference for Option 2, which it believes provides a clearer enforcement route (via the MNO’s licence) while still letting handsets remain licence exempt. The D2D IMT Consultation also proposes a set of technical rules regarding aggregate PFD (power flux density) limits, a minimum 20-degree satellite elevation angle, and a “non-interference / non-protection” condition to protect adjacent users and avoid cross-border interference.

The D2D IMT Consultation tentatively excludes UK TDD mobile bands above 3 GHz from immediate D2D authorisation, highlighting the complexities of time-synchronising satellite transmissions with terrestrial systems.

Ofcom intends to finalise this D2D authorisation framework by late 2025. Establishing a D2D framework could allow the use of MNO spectrum for D2D services with satellite operators under agreed conditions, potentially making emergency and off-grid coverage to mobile devices a standard feature by late 2025–2026 and allowing the UK to become the first European jurisdiction to do so.

Broader spectrum initiatives

Ofcom has a number of concurrent streams of work relevant to spectrum management for D2D:

1. Considering the use of satellite spectrum in the **2 GHz MSS band**. This S-band (around 1980–2010 MHz uplink/2170–2200 MHz downlink) is of interest because it could support new space-based mobile services. The European Commission's Radio Spectrum Policy Group (RSPG) issued recommendations in Feb 2024 on how to authorise 2 GHz MSS after 2027. As it stated in the D2D CFI, Ofcom is now weighing its own approach – likely aiming to ensure continuity of MSS while allowing new entrants or technologies to use that band, noting confidential respondents to the D2D CFI highlighted a need for the 2x 15MHz blocks in 2GHz MSS to enable D2D services. Ofcom plans to review the use of MSS spectrum prior to the expiry of existing licences in 2027.

2. Also mentioned in the D2D CFI, Ofcom is considering transitioning currently l**icense-exempt MSS satellite user terminals to a "light licence" regime** to provide greater options for managing the spectrum environment particularly in anticipation of increased growth of MSS spectrum use (including for D2D), and to potentially authorising additional bands under these light licences. Ofcom is expected to review its approach to MSS authorisations in FY2025/26.

3. Ofcom is actively engaging in ongoing work in Europe about a draft ECC Decision on **satellite IoT transmissions** in 862–870 MHz Short Range Device Bands. As it mentioned in the D2D Statement, these are expected to be finalised in July 2025, after which Ofcom will determine recommending their implementation in the UK.

4. In March 2025 Ofcom released a consultation on updates to procedures for the **management of satellite filings,** which contains a number of international rules it proposes to bring to WRC 2027 such as new equivalent power flux density masks to ensure NGSO systems protect GSO operators, orbit deviation disclosures, and milestone obligations on NGSO constellation to ensure the efficient use of spectrum and orbital capacity. This latest consultation reflects an increase in the number of NGSO operators applying through the UK and the increase in the range of services, including D2D, requiring a clearer and more internationally aligned framework.

These initiatives from Ofcom, together with the D2D IMT Consultation, overall indicate a supportive stance toward D2D in the UK. By clarifying the regulatory path, it can help address uncertainty for satellite operators and MNOs who are testing and aiming to commercialise D2D services. Indeed, Ofcom already granted test licenses - for example, it authorised Amazon's Project Kuiper to trial in the UK and limited trials of NGSO-based services serving remote locations, signalling its openness to supporting satellite innovation.

Emerging global D2D enabling satellite network alternatives

While SpaceX's Starlink (US) has dominated LEO broadband and is expanding into D2D, and AST SpaceMobile (US) is pioneering satellite-cellular fusion with global partners, several non-US initiatives are underway to ensure alternatives and address growing network sovereignty concerns.

IRIS²

In late 2022, the European Union approved IRIS², a €6 billion+ multi-orbit secure connectivity constellation. The project is a public-private effort: a consortium of European satellite operators (France's *Eutelsat*, Spain's *Hispasat*, Luxembourg's *SES*) will build and operate IRIS². In December 2024, the EU awarded contracts to kickstart this program in response to Starlink's rapid rise. IRIS² will comprise ~280 satellites across LEO and Medium Earth Orbit (MEO), with the first launches by 2029 and full deployment by 2030. Its primary aim is to provide an *encrypted government communications backbone* for Europe – ensuring European militaries, governments, and critical infrastructure have a sovereign satellite network, as well as envisioning commercial services and integrating new technologies.

The presence of IRIS² could very likely influence EU spectrum policy, including to reserve certain frequencies or orbital slots for its use, and require interoperability or roaming arrangements with commercial constellations to benefit EU users. In the near term, while IRIS²'s development will *not* immediately fill the D2D gap, it will reassure European stakeholders that an alternative to Starlink is coming, potentially reducing dependence on US networks for critical coverage.

Eutelsat OneWeb

Even before IRIS², Europe gained an operational LEO network through the merger of France-based *Eutelsat* and UK-based *OneWeb* (completed in 2023). Eutelsat OneWeb now offers global broadband coverage with 600+ satellites. Its Gen1 satellites target enterprise, aviation/maritime and mobile backhaul uses rather than D2D links. OneWeb has partnered with telecom providers (e.g. BT in UK, Orange in France/Africa) to use LEO for remote cell tower backhaul and rural broadband. However, the combined company has ambitions in the D2D arena: Eutelsat's leadership emphasises integrating mobile 5G into future constellations. The successful tests of 5G NTN connectivity via OneWeb satellites in 2023–24 (in collaboration with partners like the University of Surrey and MediaTek) demonstrate that it can serve as a platform for D2D tech, even if it requires a new generation of payloads or waveforms. From a spectrum perspective, while OneWeb uses Ku/Ka bands for its current services, that could change if S-band spectrum gets repurposed post-2027, which would enable a Europe-led satellite network providing D2D services in competition with AST/Starlink.

China

China's strategy to compete in the satellite internet and D2D field, driven by both commercial and strategic motives. Unlike Europe's longer timetable, China is already operational in some respects.

Tiantong-1 GEO MSS

China operates the Tiantong-1 geostationary satellite system (3 satellites so far) which provides D2D communications across China, Asia-Pacific, and parts of Africa. China Telecom offers this as a service to mobile users via special handsets or dongles. In 2023, Huawei and other Chinese OEMs released smartphones with proprietary *built-in satellite antennas* to use Tiantong-1 for messaging and voice. In May 2024, China Telecom expanded this satellite phone service to Hong Kong - the first step in offering it beyond the mainland pitched to consumers who travel between urban and remote areas (e.g. Hong Kong to mainland hinterlands) and for maritime and emergency use. China's success here shows an alternative approach: using powerful GEO beams and custom devices to skip the need for a LEO constellation.

LEO "GuoWang" Constellation

To rival Starlink directly, China approved the GuoWang constellation by ChinaSatNet. Also called "China's Starlink", it involves a planned total constellation of 12,992 LEO satellites to provide global broadband and IoT connectivity. While details are limited at this stage, capabilities are expected to support 6G connectivity and inter-satellite capability, implying D2D connectivity in the future. By January 2025, the first 10 satellites of the GuoWang constellation have been launched.

With a near-term GEO D2D with proprietary phones, long-term massive LEO network for broadband and possibly standard smartphone links, this could make China a significant non-US D2D contender by the late 2020s, with the advantage of a huge domestic user base and device vendor ecosystem to drive adoption.

Operator reactions and current industry dynamics

The advent of D2D connectivity is already reshaping relationships between traditional satellite operators, mobile network operators, and OEMs. Below we examine how different stakeholders are responding - from incumbent GEO satellite firms to terrestrial mobile carriers - and the collaborations or frictions emerging between stakeholders in the D2D ecosystem:

GEO satellite operators: the need to adapt

Legacy satellite operators are pivoting strategies to stay relevant, with many choosing to integrate rather than compete from the sidelines. For example, Inmarsat (a longtime GEO operator of mobile satellite services, now merged into US-based Viasat) has embraced D2D from GEO using its L-band assets. In 2023, Inmarsat announced that its future *Orchestra* network will combine GEO, highly elliptical orbit, and terrestrial 5G to enable seamless coverage. In October 2024, Viasat/Inmarsat successfully tested two-way texting from a standard smartphone to a GEO satellite in India with BSNL using a regular Android phone equipped for NTN and Inmarsat's I-4 satellite. Viasat stated the test followed new 3GPP Release-17 NTN standards in one of the earliest demonstrations by a GEO operator. Inmarsat has argued that GEO L-band can be "just as viable" for certain D2D needs as LEO constellations. Eutelsat / OneWeb also exemplifies a GEO operator transforming into a multi-orbit operator to cover both broadband and mobility markets (see further above).

These capabilities demonstrate how part of the strategy by traditional MSS operators involves pivoting to position themselves as complementary to the massive LEO broadband players, potentially focusing on handling narrowband and safety-critical applications.

Mobile network operators (MNOs): opportunities and threats

MNOs have generally embraced the D2D trend as an opportunity to enhance their service footprint, though with an eye on controlling the customer relationship.

Revenue and ARPU

Many MNOs recognise satellite connectivity as a way to achieve 100% geographic coverage, something many are unlikely to achieve with terrestrial towers alone particularly in uneconomic or challenging geographies. If D2D connectivity moves beyond emergency use or to fill coverage maps, operators could charge end users for it. One question emerging is whether it will be a **premium add-on** (e.g. recurring monthly charge for satellite coverage, or pay-per-use) or **included by default** for all end users with qualifying devices. Ongoing sentiment analysis on whether mobile users are willing to pay more on mobile tariffs that included satellite connectivity remains mixed.

Despite current consumer sentiment, several first-mover operators are willing to bundle satellite connectivity into their mobile offerings as a key differentiator from other text-only services. AST (unsurprisingly) argues that only satellite data plans for off-grid use D2D will allow carriers to actually capture value, as opposed to just giving away slow texts. If that proves true, MNOs could see meaningful ARPU from subscribers who frequently rely on satellite in remote regions using D2D broadband. On the enterprise side, use cases such as connected vehicles, long-distance mass transport, maritime, and commercial IoT at scale represent significant potential markets where MNOs could extend their SIM services using satellite broadband capability and charge accordingly. The GSMA Intelligence report noted up to 2-3 billion IoT devices could be served by satellite by the 2030s - a huge opportunity if operators integrate those into their managed connectivity offerings.

Standards and interoperability

MNOs have been driving standardisation to ensure satellites integrate cleanly. Through bodies like 3GPP and GSMA, Release-17 5G standards (finalised in 2022) now support 5G-NR NTN and NB-IoT waveforms for satellite. This is intended to ensure that phones and network equipment communicate with satellites as if they were just another terrestrial tower. MNOs favour this standards-based approach because it keeps them in control of the ecosystem (as opposed to proprietary solutions controlled by OEMs and other vendors).

Other operator-led initiatives include the GSMA's Open Gateway setting out a global framework for mobile network interoperability via a common set of APIs, as well as the numerous Open RAN initiatives underway supporting disaggregation, standards-based compliance, interoperability and implementation neutrality. These approaches could be extended to satellite-based networks to improve the security and resilience of critical network infrastructure and addressing vendor risks.

Moreover, Ofcom noted in its D2D CFI that using shared standards should lower costs and enable mass-market devices for NTN. It therefore shouldn't be surprising to anyone that MNOs are insisting that regulations and standards are also being developed to support interoperability and reduce costs when it comes to D2D. Release 18 concluded in mid-2024 further enhanced terrestrial-NTN convergence such as supporting lower latency and enhancing mobility management, while Release 19 includes regenerative payload architectures for deploying mobile base stations onboard satellites.

Concerns and caution

Despite the enthusiasm regarding D2D, MNOs are also conscious of potential downsides:

Disintermediation

MNOs do not want to be bypassed by D2D services. A scenario where a satellite company offers service *directly to end users* without involving the local MNO would be perceived as a threat. To preclude end-runs, operators are striking deals so that any two-way services to smartphones happen through them, emphasising that partnerships are essential for the successful implementation of D2D services.

Spectrum investment protection

MNOs paid dearly for national spectrum licenses, and are protective of those frequencies. An MNO wants assurance that D2D services won't interfere with their terrestrial network. In responses to the D2D CFI above, some MNOs argued for conditions on satellite use such as requiring the satellite downlink to not overspill into areas where terrestrial signal is present, requiring any satellite use in a band is with consent of the license holder, or even the complete prohibition of any D2D use in the same spectrum band or geographic area as terrestrial networks.

Economics

Many operators remain sceptical about the cost-benefits of D2D. The economics of providing meaningful data bandwidth over satellite to standard devices is challenging, and raises the question of when (or possibly whether) will it ever be cost-effective to enable data intensive applications ubiquitously. In the near term, the focus is therefore on less valuable low-bit-rate D2D use (albeit in critical use cases like emergencies where mobile coverage is unavailable). Operators in countries with mostly urban populations see less need to invest in D2D satellite partnerships and do not need to spend capital on addressing coverage gaps in rural or underserved areas, focusing instead on improving performance and reliability with other fixed line and wireless technologies.

On balance, terrestrial operators largely frame D2D as a growth opportunity and a customer retention tool. The question is more about when and with whom they partner, rather than if. By the end of 2025, it's anticipated that many MNOs will include basic satellite messaging in their service plans, either bundled or as an option, to keep up with peers.

Over time, a tension clearly arises: device OEMs integrating satellite features for differentiation vs carriers wanting those features to be part of their network offerings. However, because any full-featured service (voice/data) likely needs the carrier's spectrum/core network, the tension (at least for now) is limited to niche features.

Outlook

2025 will be a pivotal year as D2D services move from technology demonstrations to initial commercial services. By the end of 2025, D2D is expected to become an increasingly standard mobile feature, building on proven feasibility and growing consumer interest.

Technology readiness and scaling

Although D2D's feasibility has already been demonstrated as described above, achieving widespread, reliable coverage remains challenging. Key enablers include coverage density, throughput and latency improvements, and ongoing technological progress (such as more efficient waveforms, antenna enhancements, and inter-satellite routing). In 2025, the focus turns from small-scale trials to genuine commercial viability, emphasising smooth integration into consumer smartphones and ensuring robust, always-available connectivity.

User demand & commercial models

High profile disaster rescue situations in 2024 aided by satellite SOS have helped raise public awareness of D2D. In 2025, many consumers, particularly in developed markets, will likely regard satellite connectivity on compatible smartphones as a form of "free insurance". However, genuine ARPU potential lies in user segments that have a clear need, and urban customers might seldom require satellite coverage. Carriers are therefore likely to use bundling to drive initial adoption - for instance, including basic (slow) satellite texting in all plans so that it's simply available when needed, while offering a premium tier for voice or data via satellite. Some operators may test a pay-per-use model (e.g. a set fee per satellite SMS) to keep barriers low. In remote regions, D2D could serve as the primary coverage and be priced into standard tariffs alongside broadband options. Ultimately, the success of these commercial arrangements hinges on partnerships between satellite operators and MNOs. By the close of 2025, several pricing strategies may be on trial, obtaining real world feedback on which models resonate with users.

Regulatory environment

Regulation will continue to shape how D2D services launch and evolve during 2025. In the UK, the D2D IMT Consultation may produce a final decision by late 2025 that enables commercial D2D services under adjusted MNO licences. Elsewhere, the EU's approach varies: some member states might wait for WRC-27 for a pan-European policy, whereas others could grant interim licences. Developing countries, keen to expand connectivity, may fast-track D2D approvals if incumbent telcos support it. Spectrum allocation remains crucial, involving questions about the 2 GHz MSS band in Europe or possible new bands for NTN at WRC-27.

Generally, regulators appear supportive of D2D's growth, but stakeholders must remain engaged to ensure workable guidelines. Newer satellite operators like AST and Starlink will probably push for flexible spectrum use, while existing players seek safeguards. If successful, the UK's approach could provide a template for other regions.

Competitive landscape & partnerships

With multiple satellite operators now entering the D2D arena, significant consolidation opportunities will likely be realised in 2025. Device compatibility will be pivotal: services requiring special satellite phones (e.g. older Iridium-based hardware) will remain niche, whereas solutions integrating seamlessly into popular handsets (Apple, Samsung) will have a natural advantage. For operators, roaming and interoperability agreements could prove vital. By late 2025, we can expect to see arrangements allowing a handset to switch to whichever satellite network is overhead - if commercial deals and regulatory support align. Such global coverage would be a strong selling point, but hinges on MNOs and satellite operators working in concert.

Evolving use cases

Emergency SOS and not-spot communication represent the immediate applications for D2D. If these early use cases run smoothly, additional segments are poised to benefit, including IoT, vehicle connectivity, public safety and disaster response. In the near future, mobile end users might barely notice whether their phone is connected to a tower or orbiting satellite - it will simply "just work" everywhere. The technological, regulatory and commercial groundwork laid in 2025 will be crucial to realising this vision, paving the way for D2D to become a genuinely mainstream connectivity option in the coming years.

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