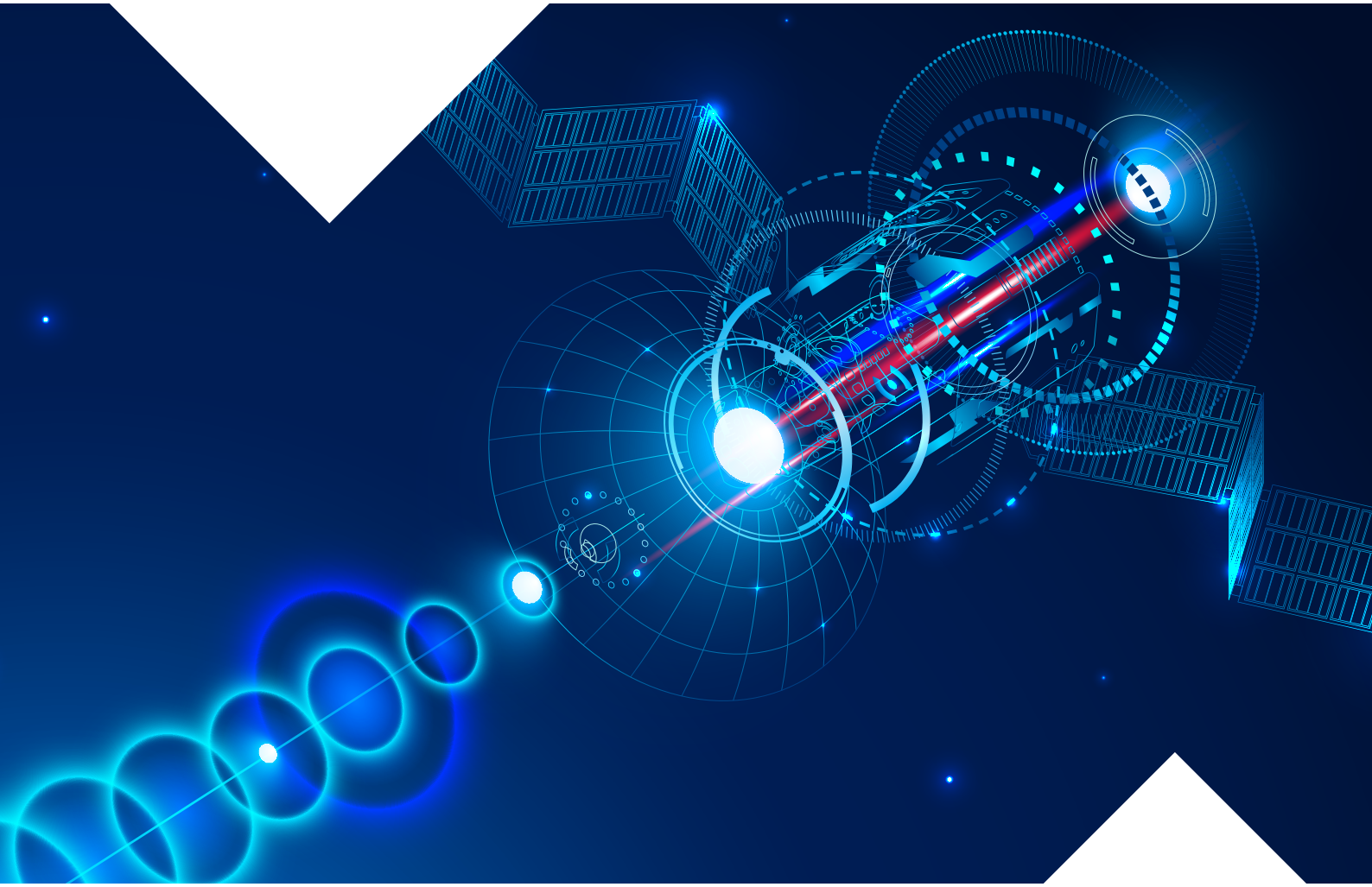
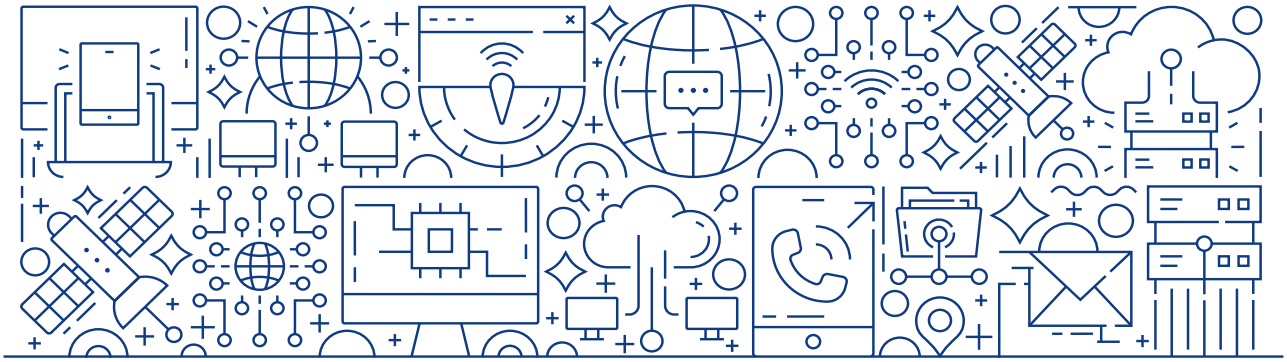
Turning Satellite Connectivity into Operator Revenue:

Why Standards-Based Solutions Are the Key to Unlocking Non-Terrestrial Networks



IN CONJUNCTION WITH SKYLO



Executive Summary

Once regarded as niche and high-cost, satellite connectivity via non-terrestrial networks (NTNs) is now a strategic priority for the global mobile industry. Four main factors are driving the shift toward satellite services: growing demand for differentiated features, rising expectations for ubiquitous coverage, advances in multi-orbit strategies embracing both geostationary-Earth-orbit (GEO) and low-Earth-orbit (LEO) satellite technology, and the integration of satellite networks into 3GPP mobile standards.

- To unlock the full potential of direct-to-device satellite services beyond early adopters in the US, manufacturers must broaden NTN support across price tiers and device types as NTN-enabled chipsets proliferate, and mobile operators must embrace satellite as a complement to existing terrestrial networks. With increased momentum behind standards-based solutions using mobile-satellite services (MSS) spectrum for scaling NTN services, and a growing ecosystem of certified chipsets, modules and devices, the building blocks are in place.

- The pace of satellite service adoption among operators is accelerating. As of mid-2025, mobile network operators in the US, Canada, Germany, Japan, Australia and New Zealand have transitioned from trials to fully commercial direct-to-device services. Early usage statistics are promising: KDDI in Japan reports over 1 million users, and over 2 million messages have been sent on One NZ's satellite network. Skylo has reported 10 million devices on its global NTN network spanning 36 countries. Operators are experimenting with using direct-to-device services to generate additional revenue, improve average revenue per user (ARPU), reduce churn and differentiate against rivals — without the cost of building out additional terrestrial networks in hard-to-reach locations.

- The Asia–Pacific region accounts for nearly three-quarters of the world's mobile subscribers. Despite strong population coverage, landmass coverage gaps remain significant, with 54% of Indonesia and 72% of Australia remaining unconnected. Satellite connectivity provides a cost-effective solution to address these gaps, strengthen resilience in disaster-prone regions and meet universal service objectives. Latin America is also an underserved market, with Brazil well-positioned to capitalize on the increased coverage and revenue opportunities that stem from NTN services.

- Services using standards-based solutions have momentum, because they are included in 3GPP protocols, globally harmonized and supported by a regulatory framework established decades ago. In 2025, Starlink and AST SpaceMobile moved to secure their own MSS spectrum rights, aligning with the model already deployed by those such as Globalstar, in partnership with Apple, and Skylo, which has partnered with the likes of Google, KPN, Tele2, Telefonica and Verizon. Mobile network operators are likely to favour the scale benefits which standardization helps them to achieve. However, device-makers will need to move quickly to establish a wide-ranging ecosystem that can ensure long-term viability of this strategy.

- Device readiness is progressing. NTN-standards based chipsets and modules with native MSS support are commercially available from leading providers such as Qualcomm, MediaTek and Samsung across smartphones, wearables, IoT and automotive products.

- More than 400 million smartphones are now satellite-capable, with over 80% of these being iPhones. Apple has led the charge in integration and investment, with satellite services available on the iPhone 14 range and later models. Android support remains limited to flagship models in selected regions such as the US, Europe and Australia. Expanding availability in mid-tier and entry-level devices will be critical for scale. Chinese brands such as Huawei, Xiaomi and Honor have begun to add satellite support to domestic models, but the greater opportunity lies in extending satellite support to international portfolios and enabling global satellite connectivity for roaming. This will unlock demand not only in the Asia–Pacific region but also in Africa, Europe and Latin America.

Why Satellite Connectivity Is Becoming a Critical Theme in the Mobile Industry

Direct-to-device satellite connectivity has evolved rapidly, shifting from a specialized, high-cost solution to a mainstream priority for the mobile industry. There are four drivers of this shift:

1 DEMAND FOR NEW FEATURES

Manufacturers and operators are under growing pressure to find the next breakthrough technology that can differentiate offerings and unlock new revenue. The arrival of 4G brought a wave of innovation that transformed business models for operators, device-makers and app providers. In contrast, despite heavy investment, 5G has yet to deliver the same impact.

Satellite connectivity stands out as one of the few technologies offering something genuinely new — one for which revenue strategies are not yet established. When 4G arrived, operators already had per-gigabyte rate plans in place. Today, satellite connectivity is a way to add value to existing contracts. The ability for a smartphone, smartwatch, IoT device or automobile to remain connected in previously unreachable locations is a new revenue opportunity. From a consumer perspective, this represents a step-change in expectations of what a "connected device" should be. For businesses, the reduction of inefficiencies caused by lost connectivity can be incredibly valuable.

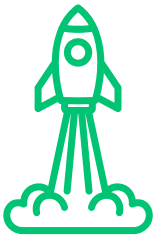
2 RISING EXPECTATION FOR UBIQUITOUS COVERAGE

In today's world, connectivity is no longer optional. From emergency SOS in life-saving situations to keeping a software-defined vehicle always online, people expect to be always connected. Governments and regulators worldwide are prioritizing universal coverage as a matter of national resilience and competitiveness.

Satellite is the only technology that can truly close the coverage gap across mountains, oceans, suburban dead zones and disconnected rural communities. This role has been recognized by the mobile industry because ubiquitous connectivity is highlighted as one of the pillars of the vision for 6G.

Consumers and governments will expect that devices and chipsets with these enhanced safety should be broadly available.

3 SPACE AS A NEW FRONTIER AND POTENTIAL COMPETITIVE THREAT



Rocket launch innovations have transformed the economics of satellites and satellite connectivity. Multiple private companies have entered the market, increasing competition and offering more launch slots. Reusable rockets pioneered by companies like SpaceX, but with increasing competition from companies like Blue Origin and Rocket Lab, have dramatically lowered launch costs.

Similarly, there has been innovation in fuels, with kerosene- and methane-based engines. Improvements in electronics miniaturization have led to a new generation of small and light LEO satellites that deliver far better performance in latency, capacity and throughput than was previously possible.

Beyond additional launch slots and lower launch costs, the cost of new satellites has also fallen, with satellites now smaller, lighter and less expensive to produce. This combination of reduced launch costs and more-compact satellites is driving plans for more comprehensive NTNs at lower orbits, offering fast speeds, greater bandwidth and increasingly sophisticated services.

In addition, with SpaceX, Amazon and Apple investing heavily in space-based telecom services, the prospect of vertical integration, although unlikely in the short to mid-term, raises important questions about their longer-term ambitions. Understanding and addressing strategic implications for mobile operators in this rapidly developing landscape is vital.

4 3GPP NTN MOBILE STANDARDS

3GPP™ A GLOBAL INITIATIVE

At the same time, mobile standards are aligning. Industry bodies such as 3GPP are embedding NTNs into the 5G and 6G road map, ensuring satellite is no longer a parallel system but a seamless extension of the mobile ecosystem. NTN support first arrived in 2022, with Release 17, and was extended in 2024 with 5G-Advanced, also called Release 18. Further work is continuing in Release 19 and into the 6G era. Standardization is key to achieving scale, ensuring satellite services are economically viable and sustainable.

DIRECT-TO-DEVICE SERVICES FOR PREMIUM SMARTPHONES

Apple's introduction of satellite connectivity in the iPhone 14 in 2022 marked a turning point, with satellite messaging no longer requiring a dedicated satellite phone and SIM card. Since then, all new iPhone models have included satellite SOS functionality.

The latest Google Pixel 9 and Pixel 10 phones, as well as Samsung's Galaxy S25 series, Galaxy Z Fold7 and Galaxy Z Flip7 in the US also have satellite SOS and satellite messaging, powered by Skylo. This has set consumers' expectations that satellite will become a standard feature on all smartphones.

Although it was initially focused on the US and Canada, Apple has since expanded its satellite messaging feature to over 50 global markets, including several in Asia–Pacific. In this region specifically, Samsung phones do not support satellite connectivity and Google Pixel devices only support satellite features in Australia.

North America has led early adoption, but the need for satellite connectivity is even greater in the Asia–Pacific market. The region has some of the world's most advanced mobile networks, delivering fast, consistent and widely available connectivity in South Korea, Japan and China — but it also faces some of the toughest coverage challenges.

There are vast remote geographies such as Australia's outback, China's deserts, South Korea's maritime trade, the rainforests and jungles in south-east Asia and Japan's mountainous interior. The region also suffers from typhoons and numerous earthquakes in the Ring of Fire that encompasses Japan's coastal cities. Additionally, countries with numerous islands, such as Indonesia and the Philippines, make universal land and maritime coverage impossible with terrestrial networks alone. For these markets, direct-to-device satellite services add a crucial dimension for being always connected.

Challenges in Approaches to Supporting Satellite Connectivity

As direct-to-device satellite services enter the mainstream, two distinct approaches have emerged. Each comes with its own opportunities and challenges for device-makers and mobile operators.

	Spectrum	Partnerships	Device support
MSS spectrum with 3GPP NTN standards Globalstar, skylo, Tiantong-1, Qianfan, Viasat, iridium	Dedicated satellite bands owned by providers: **L-band, S-band**	Mainly device-makers, chipmakers, infrastructure providers	Some satellite spectrum devices
Direct-to-device using shared mobile spectrum STARLINK, AST SpaceMobile, LYNK	Sharing with operator-owned spectrum: **Less than 3 GHz**	Mobile network operators, systems integrators	Most mobile spectrum-only devices

APPROACH 1:
MSS SPECTRUM WITH 3GPP NTN STANDARDS

This approach uses the 3GPP-defined NTN framework to connect devices using existing GEO and LEO constellations, such as those operated by Viasat, EchoStar, Terrestar Solutions, Globalstar and Iridium. These networks deliver narrowband services on L- and S-band spectrum (1600 MHz, 2100 MHz and 2400 MHz), supporting uses from consumer SOS and SMS to industrial IoT and automotive connectivity, including:

- **Remote sensors in agriculture and mining**
- **Smart utility meters in hard-to-reach areas**
- **Asset trackers for logistics and vehicles**
- **Messaging services for smartphones and cars.**

This approach is already in commercial use today at global scale, thanks to the existing regulatory framework that has been in place for decades. This regulatory certainty holds a strong appeal for rapid service deployment. Using MSS frequencies also does not require the use of mobile operator spectrum for service delivery. This means operators do not have to dedicate their valuable spectrum assets to enable NTN services. Skylo operates a virtualized core that uses GEO satellites from partners such as Viasat, EchoStar, Terrestar Solutions and Ligado. Apple and Globalstar also rely on MSS for satellite features in smartphones and wearables.

These standards-based solutions require small hardware additions — typically an extra antenna path and modem support — but these are already supported by many chipsets from Qualcomm, MediaTek, Samsung and Sony Altair. Importantly, MSS is included in 3GPP Release 17 and beyond, meaning deployments are standardized and scalable. This is critical to ensure long-term economic viability for many mobile operators.

This approach also shows potential for expansion into more advanced services such as voice. Skylo has already trialled voice calls over MSS and is working with operators including Verizon, Deutsche Telekom and KPN to bring commercial services to market. Flagship Samsung Galaxy and Google Pixel smartphones, as well as many IoT devices, already support this path in some regions. Skylo and its partners submitted a joint proposal for NTN native voice calling, which was formally approved as a 3GPP work item for Release 20.

The main challenge is device availability. Standards-based solutions require modest hardware changes and operator validation, which increase the device's bill of materials. For device-makers, the question is whether these costs are outweighed by the strategic value of regulatory certainty and time-to-market advantages for operators

and consumers. So far, support on smartphones has been limited to iPhones and the premium end of the Android market in limited regions. Adoption by a broader segment of Android device manufacturers is increasingly likely as Starlink has signalled support for this standards-based approach.

APPROACH 2:
DIRECT-TO-DEVICE USING SHARED OPERATOR SPECTRUM

The second model bypasses MSS spectrum altogether. Instead, satellites use existing mobile spectrum — such as 4G LTE bands — already owned by operators. From a device perspective, this is attractive: no hardware modification is required, as the satellite essentially acts like a "cell tower in the sky". Therefore, almost all of the world's 7 billion smartphones are compatible.

Services available today are also narrowband, such as SOS and texting, but voice and data connectivity are also possible with improvements in satellite networks. However, scaling satellite services in this way presents significant challenges:

- **Greatly increased satellite deployment:** Although Starlink has established an initial direct-to-cell constellation, more satellites will be required for consistent coverage and capacity to support more users or higher speeds. Similarly, AST SpaceMobile currently has only six large satellites in orbit, and global coverage for its constellation requires nearly 70 satellites, as well as a costly ground station network.

- **Access to mobile spectrum:** Mobile operators must share or cede some of their existing spectrum rights, but such mobile spectrum is scarce and valuable. There is a significant opportunity cost for operators. Giving it up means handing over more control of their operations to a third party and reducing service quality for terrestrial services where there are existing users and revenue.

- **Interference risks:** Using terrestrial spectrum for satellite connectivity has the potential to interfere with other radiofrequency users. To mitigate this, geographic exclusion zones and power restrictions have been required by regulators in ways that vary by region, complicating service delivery and time-to-market expectations in key markets worldwide.

- **Regulatory hurdles:** Each country requires a separate approval, which creates long lead times and heavy bureaucracy. This is a main reason for the limited availability of Starlink in major markets around the world. No regulator has approved this approach anywhere in the world outside the US, Japan and New Zealand.

Despite these challenges, partnerships are already emerging, such as T-Mobile with SpaceX Starlink in the US and Vodafone forming a joint venture with AST SpaceMobile in Europe, which demonstrates the level of interest in satellite connectivity. Even with the above barriers, mobile operators are still agreeing deals for eventual direct-to-device satellite services that use this approach.

Most partnerships in Asia–Pacific are taking this approach, such as KDDI's au in Japan, Telstra in Australia and One NZ in New Zealand, which have all commercially launched in collaboration with Starlink in late 2024 and 2025 to some users. AST SpaceMobile also has public agreements with Rakuten in Japan, 2degrees in New Zealand and Vodafone Idea in India, although the latter has not announced a regulatory pathway for this service.

Lynk, another satellite network operator using shared mobile spectrum, also has several partnerships in the region, with an intermittent SMS service launched in partnership with network operators in the Solomon Islands and Cook Islands.

Despite the benefits of device compatibility, the uncertainty of this model remains a major concern, especially for mobile operators. Timelines for satellite launches, regulatory approvals and the economics of spectrum sharing all add risk. For device-makers, betting on this path means relying on unproven infrastructure and fragmented operator deals with uncertain timelines.

Recent Industry Momentum behind MSS Spectrum

MAJOR PIVOTS FROM AST SPACEMOBILE AND SPACEX STARLINK

In January 2025, AST SpaceMobile announced an agreement with Ligado for access to 40 MHz of L-band MSS spectrum in the US and Canada. This marked a pivot from AST SpaceMobile's original plan to rely exclusively on mobile operator spectrum. The company highlighted how combining MSS spectrum with cellular frequencies from partners such as AT&T and Verizon could help deliver additional capacity and deliver broadband speeds of up to 120 Mbps in remote areas. However, it is unclear when these combined frequencies will be commercially available, given that many of its first-generation satellites are already in production and awaiting launch. The company has not announced a timeline for an updated MSS-compatible line of satellites. Ligado, notably, is also a key Skylo partner.

AST SpaceMobile has extended this standards-based strategy internationally. In August 2025, it secured International Telecommunication Union (ITU) priority rights for S-band MSS spectrum (1980 MHz to 2010 MHz and 2170 MHz to 2200 MHz). The company has signalled its intent to pursue additional S-band holdings in Europe, with a keen eye on spectrum renewals in 2026, which will be hotly contested.

Surprising many, SpaceX Starlink has also adjusted its strategy. Following a long regulatory dispute, it agreed to acquire EchoStar's MSS spectrum rights in a huge $17 billion deal in September 2025. This provides access to exclusive, interference-free MSS spectrum that could significantly expand Starlink's network capacity and global reach. It is unclear in which regions EchoStar's spectrum has been sold, but SpaceX has stated its global ownership and shows ambitions to use it beyond the US in Europe and Asia. Starlink has not yet announced a plan on when MSS-compatible satellites and services will be available.

GROWING ECOSYSTEM SUPPORT FOR STANDARDS-BASED NTN

This pivot toward NTN standardization is being reinforced by the wider ecosystem. The Mobile Satellite Services Association now counts 22 members, including Qualcomm, Viasat, Mavenir, MTN, MDA Space, Capgemini and Ericsson. Its mission is to advocate for MSS integration in devices, chipsets and networks worldwide, and collaboration between suppliers will be crucial to success.

At the device level, more products supporting MSS spectrum are becoming available. For example, Skylo's certification programme already covers 15 commercially available devices, including flagship models from the Samsung Galaxy series and Google Pixel series, positioning it as one of the most advanced and proven standards-based satellite connectivity providers today.

Certified devices include:

- Samsung Galaxy S25, Galaxy S25+, Galaxy S25 Ultra, Galaxy S25 Edge, Galaxy Z Fold7 and Galaxy Z Flip7 (for Verizon, Xfinity and Spectrum Mobile in the US)

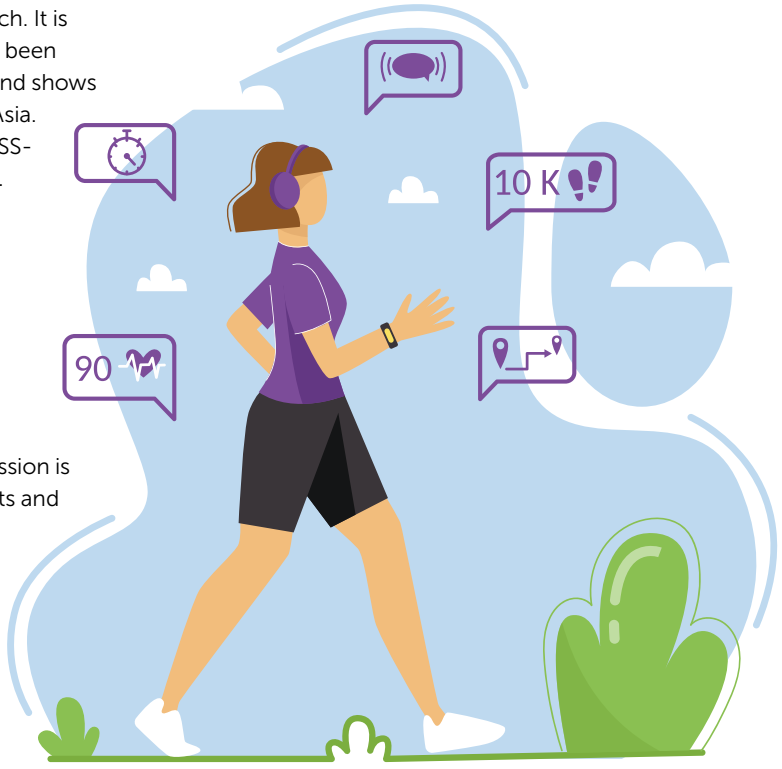
- Google Pixel 9, Pixel 9 Pro, Pixel 9 Pro XL, Pixel 9 Pro Fold, Pixel 10, Pixel 10 Pro, Pixel 10 Pro XL, Pixel 10 Pro Fold and Pixel Watch 4

- Garmin fenix 8 Pro

- A growing portfolio of IoT modules and vertical-specific devices, such as 701xTPro, APAL Hestia, Quectel BG770A-SN, BG95-S5, CC660D-KLS and Compal RMM-T1

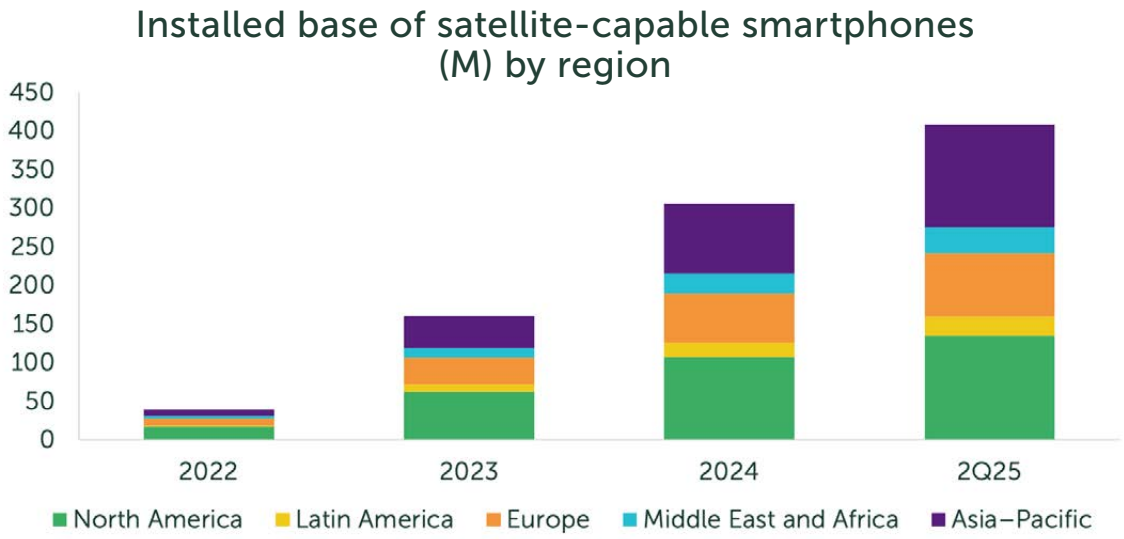
- Automotive telematics control units (TCUs) in development, such as the Harman Ready Connect (Samsung), Continental TCU and Valeo 5G Premium Telematics Unit.

In addition, 13 leading 5G and IoT chipsets from Qualcomm Snapdragon, Samsung Exynos and MediaTek are certified for use on Skylo's standards-based satellite network. The Snapdragon Auto 5G Modem-RF Gen 2 — namely, the SA522M and SA525M models — is certified for automotive and the Snapdragon W5+ Gen 2 Wearable Platform is certified for wearables.



In 2025, Google's Pixel Watch 4 became the first wearable to enable bidirectional NTN support. The Garmin fenix 8 Pro followed, with bidirectional NTN for SOS and messaging without a smartphone, available in the US, Canada and Europe. Qualcomm announced NTN support in its Snapdragon W5+ and W5 platforms. Apple also added it to its Watch Ultra 3.

The impact of that availability is becoming evident. According to CCS Insight data, the global installed base of MSS satellite-capable smartphones surpassed 400 million in 2Q25, with a growing subset enabled for satellite SOS and SMS services. This provides a strong foundation for mass adoption.

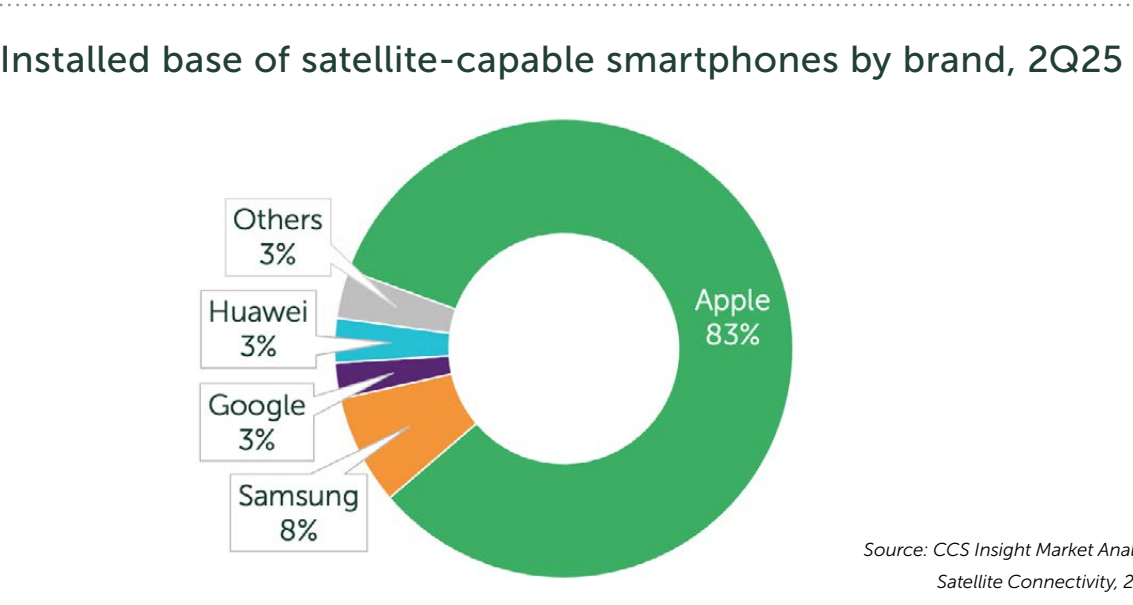


CCS Insight Market Analysis: Satellite Connectivity, 2Q25

For Device-Makers

BRAND LOYALTY AND FEATURE DIFFERENTIATION IN SMARTPHONES

Although the number of devices with support for satellite services has been steadily increasing, the brand landscape is still dominated by Apple, reflecting the firm's dominant market share overall and its early investment and strategic focus in this area. In 2Q25, Apple accounted for over 80% of the global installed base of MSS-capable smartphones. Even its entry-level iPhone 16e is satellite-enabled, making it the most-affordable satellite smartphone on the market.



Source: CCS Insight Market Analysis: Satellite Connectivity, 2Q25

Apple has successfully positioned satellite connectivity as an extension of its core brand pillars — privacy, safety and reliability. Services such as emergency SOS, iMessage over satellite and roadside assistance have strengthened its perception as a dependable smartphone brand in premium markets. Apple recently built on its earlier introduction with an additional $1.5 billion investment and 20% stake in Globalstar to solidify its long-term commitment to satellite connectivity.

We expect Apple will continue to support these satellite features on iPhone and Apple Watch and may look to expand further. In its predictions for 2026 and beyond, CCS Insight indicates that by 2027, Apple will enable satellite calls on iPhone by using its control over end-to-end capabilities such as iMessage and FaceTime, and routing internet-based voice and video calls through satellite links as a seamless extension of its existing communication stack.

By investing in satellite feature and safety, Apple has reinforced its reputation for technology leadership and deepened customer loyalty, giving it another competitive edge over rivals such as Samsung, which has yet to introduce satellite features outside the US.

CCS Insight has observed increasing support for satellite connectivity among Chinese device-makers such as Huawei, Xiaomi and Honor in some premium and flagship models. However, these features are typically limited to domestic model variants, designed to connect with China's Tiantong-1 satellite system.

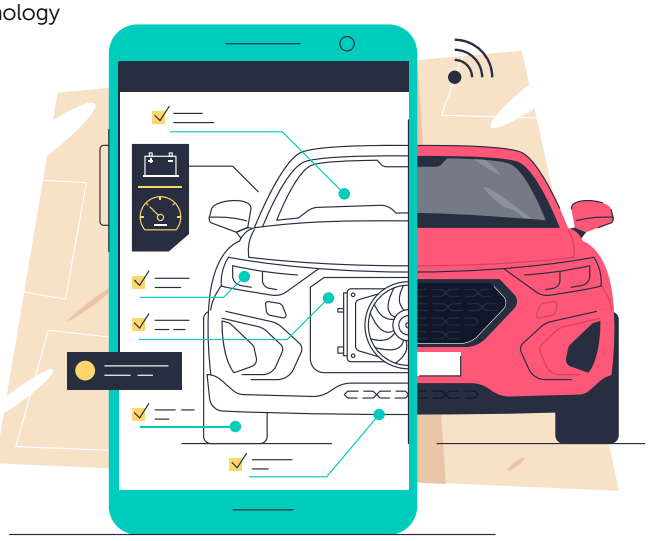
The real growth potential for NTN penetration in markets worldwide lies in Chinese manufacturers' adoption of NTN in their international models. As Chinese manufacturers extend MSS-based NTN features to their global portfolios, they will stimulate significant demand beyond Asia to Africa, Europe and Latin America. This will strengthen their competitiveness and unlock new opportunities to differentiate through MSS features and experiment with new subscription or over-the-top service models.

NEW USES AND DEVICE TYPES

Manufacturers have started incorporating satellite connectivity into other devices. There has been a flurry of activity in the wearable device category, with the inclusion of satellite services on the Apple Watch Ultra 3, Google Pixel Watch 4 and Garmin fenix 8 Pro. For athletes, hikers and active individuals, satellite integration in wearables offers resilience when a smartphone is unavailable or undesirable to carry along while running, biking, kayaking or engaging in similar sporting activities. In an increasingly competitive smartwatch market, satellite connectivity is a meaningful differentiator.

Similarly, the automotive sector is an attractive opportunity for satellite connectivity, especially with the increased activity in software-defined vehicles and direction toward autonomous driving. Several global and European automotive carmakers, such as BMW Group, are already demonstrating embedding satellite functionality into vehicles, enabling always-on connectivity in partnership with Skylo, Qualcomm, LG and Harman. Initial deployments focus on narrowband applications such as remote-control features and telematics services, but this will evolve toward more-advanced capabilities, including teleoperated driving support, high-volume data collection and sharing for high-definition mapping, over-the-air software updates or, with the addition of phased-array antennas, infotainment screens or autonomous driving.

For carmakers in the Asia–Pacific region, the strategic risk of delay is significant, with automotive product development cycles being as long as five years. As satellite connectivity becomes mainstream, early implementations will shape consumer expectations and capture first-mover advantages. Beyond technology leadership and product differentiation, satellite integration also creates opportunities to upsell high-value connectivity packages. Manufacturers should view this as a pathway to new revenue streams and brand positioning at the cutting edge of innovation.



The value of satellite-enabled connectivity extends beyond passenger vehicles. Specialist applications, ranging from enterprise-grade phones to IoT devices, present significant opportunities to connect and collect more data, resulting in cost savings and efficiencies. Remote workers, first responders and sectors such as agriculture and utilities represent important niches where continuous, reliable connectivity is critical. For manufacturers targeting these markets, satellite functionality is becoming a decisive differentiator.

For Mobile Network Operators

EXTENDING COVERAGE AND RESILIENCE

Mobile network operators have invested billions in terrestrial infrastructure. In most Asia–Pacific markets, 4G networks are fully built out and population coverage is excellent. However, landmass coverage remains incomplete even in advanced economies. Japan still has gaps covering up to 35% of its territory, and larger countries see even higher figures: 54% in Indonesia and 72% in Australia.

Additionally, satellite networks can offer connectivity to maritime areas for fishing, transportation and passenger ferries. This is especially important for countries with large coastlines like Indonesia, the Philippines and Japan, as well as the numerous small island nations across the Pacific.

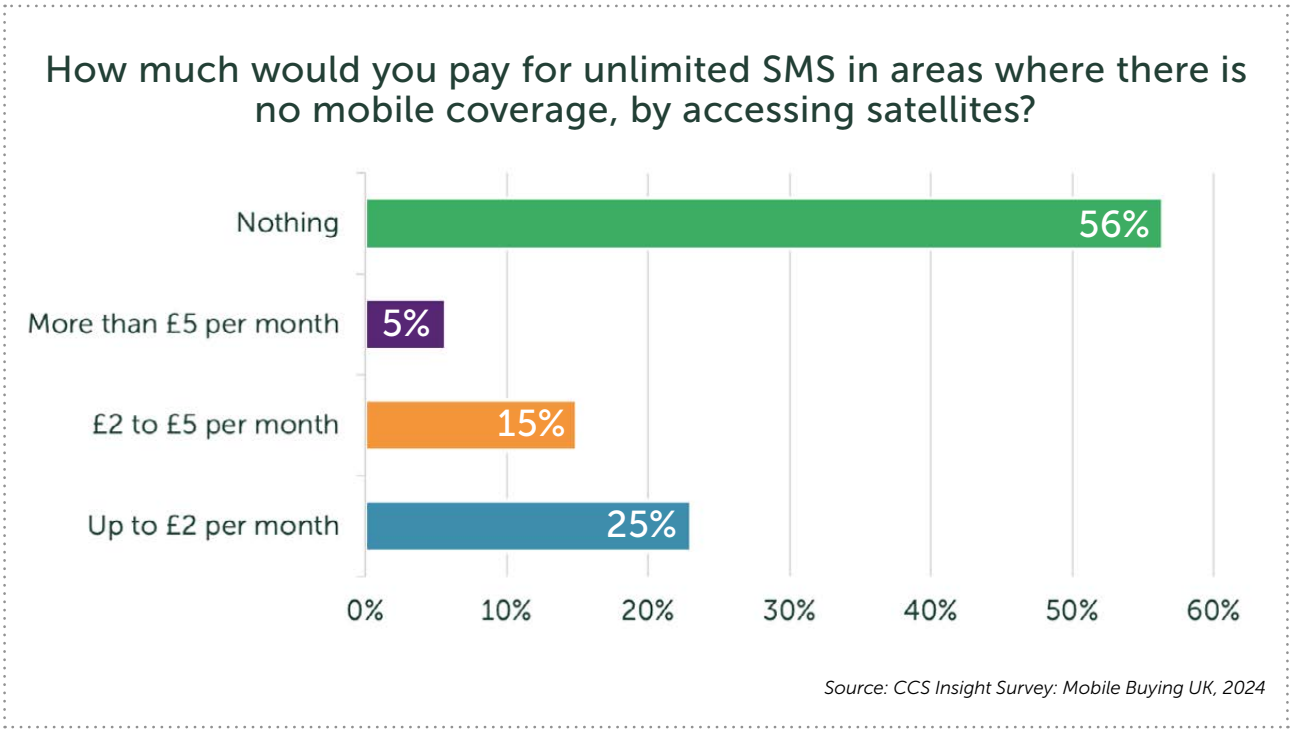
Although many of these areas are sparsely populated, there is still clear demand for coverage from remote workers, tourists and rural communities. In these cases, expansion of the terrestrial network is rarely viable. Satellite networks allow operators to extend coverage at a fraction of the cost of rural base stations, supporting universal service obligations and providing "blanket coverage".

Satellite connectivity also plays a role in network resiliency. Natural disasters frequently disrupt terrestrial networks by damaging cell sites and power lines. Japan, for example, experiences more than 1,000 earthquakes annually, and Australia faces an average of 38,000 wildfires each year. With climate change intensifying such events, the ability to stay connected during crises will become an increasingly vital differentiator.

REVENUE GENERATION

Satellite services not only save costs but also generate revenue, demonstrated by early commercial deployments. In Japan, au by KDDI offers satellite connectivity for $11 per month and, in July 2025, reported that it already exceeded 1 million subscribers. This validates consumer demand and shows the potential for direct-to-device satellite services to contribute meaningfully to operator revenue despite strong population coverage.

Moreover, consumer research indicates a strong willingness to pay for safety and coverage. CCS Insight's recent survey found that 44% of UK respondents would pay extra for satellite SMS, with one-fifth of those willing to spend more than £2 ($3) per month, equivalent to 10% of ARPU. This high level of interest is especially notable because the UK has fewer coverage and natural disaster challenges than most Asia–Pacific countries.



Source: CCS Insight Survey: Mobile Buying UK, 2024

Improved coverage and reliability give operators new tools to reduce churn and attract new users. Early adopters such as T-Mobile with Starlink and Verizon with Skylo are already using satellite features as a marketing differentiator, positioning themselves as offering "coverage everywhere". These features are currently available and encouraging ARPU increases worldwide.

INDUSTRIAL, ENTERPRISE AND PUBLIC

The enterprise segment is another compelling opportunity. According to CCS Insight's Spotlight: *Enterprise Market for Telecom Operators, 2024*, businesses now contribute nearly one-quarter of global operator revenue, and this share is rising. Satellite connectivity is particularly relevant for industries operating in remote or outdoor environments, including:

- **Utilities and energy**
- **Agriculture and forestry**
- **Logistics and transport**
- **Maritime and offshore sectors**
- **Public safety and emergency responders**
- **Construction**

Using NTN, operators can create hybrid networks with existing terrestrial IoT, seamlessly extending coverage across entire regions and enabling uses such as remote monitoring, asset tracking and predictive maintenance. This is a focus for Deutsche Telekom in Europe, which has recently agreed a deal with Iridium in Europe.

Mobile network operators also stand to benefit in the public sector. Governments increasingly expect national emergency networks to remain operational during crises to enable emergency responders and critical infrastructure, such as energy grids, to continue to operate. If outages persist, it is important to ensure economic productivity can continue.

Another leading adopter of satellite connectivity is the defence sector. There is increased usage of cellular technology in defence markets: Nokia's acquisition of Fenix group in 2023 has led to a new range of tactical battlefield radios using 4G and 5G combined with optional SatCom backhaul.

By integrating satellite connectivity into existing telecom networks, operators can meet requirements for national resilience effectively. Creating such robust multitechnology networks will also strengthen their role as trusted partners in national infrastructure.

For Consumers

Mainstream adoption of satellite networks allows users to stay connected anywhere. Initial benefits are centred on safety, security and resilience, providing a vital lifeline when terrestrial networks fall short. Looking ahead, progress in 3GPP standards from narrowband NTN toward New Radio-NTN opens a path for consumers to maintain seamless broadband connectivity, even off the grid.

Parts of the Asia–Pacific region are home to underserved communities. In these areas, satellite connectivity is more than convenience: it is a driver of digital inclusion, extending essential services and opportunities to consumers, enterprises and governments.

The ecosystem must provide a wide range of satellite-enabled devices, from smartphones to wearables, vehicles and IoT devices, at all price tiers. This requires device-makers to collaborate on building open, scalable and sustainable solutions.

FOR DEVICE-MAKERS:
BROADEN SUPPORT ACROSS PORTFOLIOS

The MSS ecosystem depends on device-makers and chipset suppliers. To unlock mass adoption, manufacturers in the Asia–Pacific region must:

- Expand satellite support beyond flagship smartphones into mid-tier and entry-level devices, particularly for emerging markets.
- Integrate direct-to-device satellite connectivity into device categories such as wearables, automotive systems and IoT devices.
- Collaborate with chipset partners and local mobile operators to ensure broad availability of MSS-ready platforms.

FOR TELECOM OPERATORS:
EXTEND REACH AND DIFFERENTIATE

Despite high population coverage, many Asia–Pacific countries still lack full landmass coverage. Satellite networks offer a cost-effective way to address this gap and support objectives for universal connectivity. Operators should:

- Harness satellite partnerships to offer nationwide blanket coverage without costly terrestrial expansion.
- Use satellite connectivity to enhance resiliency, ensuring continuity during natural disasters that frequently affect the region.
- Develop consumer and enterprise service packages to increase ARPU and reduce churn, taking lessons from early adopters.
- Position themselves early in the enterprise and public sector markets, where demand for reliable satellite IoT and emergency networks is rising.

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