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NTN Forum

The Future of Satellite Networks is Now

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"Non-Terrestrial Network (NTN) adds a vertical dimension to the 3GPP defined mobile systems, enabling a three-dimensional(3D) architecture. The NTN Forum aims at fostering the development and deployment of NTN technology and solutions which are expected to contribute to the overarching goal of providing connectivity anytime, and anywhere." — NTN Forum Steering Board.

Mobile connectivity should no longer stop at the edge of coverage of cell towers. With the 3GPP defined Non-Terrestrial Networks (NTN) standard, satellite and aerial platforms-based networks can collaborate with traditional mobile networks to connect people and devices anywhere, and anytime. This document explains, in plain language, what NTN is, how it differs from other satellite communication solutions, and about the readiness of the related deployments and services.

NTN technologies are currently moving from pilots to commercialisation. By August 2025, there were 170 publicly announced mobile/satellite network operators' partnerships across 80 countries and territories, and 34 operators in 25 markets who had already launched commercial services, confirming that integration of Non-Terrestrial Networks with mobile systems is accelerating beyond isolated trials. (Source: GSA - https://gsacom.com/paper/5g-satellite-connectivity-september-2025-summary/).

1 What is NTN?

Non-Terrestrial Network (NTN) refers to telecommunication networks based on at least satellite and/or High-Altitude Platform Systems (HAPS) network node addressing fixed and/or mobile devices.

This term has been introduced in 3GPP (www.3gpp.org) to differentiate from terrestrial mobile networks. As part of the "NTN standard", 3GPP has defined the necessary features enabling the 5G New Radio (NR) and the 4G IoT access technologies to be used in satellite and HAPS-based networks. This includes all necessary features to address NTN specifics such as:

- Extended and variable propagation delays and Doppler shifts
- Wider, possibly moving radio cells, and potentially located across borders
- Mobility and Service continuity between Terrestrial Network (TN) and NTN.
- Propagation impairments including the payload
- Satellite service allocated frequency bands within a range from ~1 GHz to ~30 GHz

The NR-NTN (New Radio NTN) is expected to support enhanced Mobile Broadband (eMBB) and Highly Reliable services, while the IoT-NTN (NB-IoT/eMTC) can be used to provide massive Machine Type services and possibly voice services. NTN is a global standard able to support all types of satellite communication systems whatever the targeted devices (IoT, smartphones, automotive and flat panel antenna terminals on moving platforms), the orbit (GSO and Non-GSO), the frequency bands (L, S, Ku, or Ka), the payload types (transparent, regenerative) and the beam size and type (earth fixed and earth moving). NTN is supported by the whole 3GPP ecosystem (satellite and mobile stakeholders).

In 3GPP, the “NTN standard” has been subject to a study phase across Releases 15 and 16 and then a normative phase which started in December 2019 as part of the Release 17 with continuous enhancements in the subsequent releases (Release 18, 19 and now Release 20).

In March 2025, the work on 6G started and NTN is considered from day one.

2 Key benefits of NTN

2.1 General benefits of NTN

The satellite communications industry has traditionally been characterized by low production volumes, resulting in high terminal costs and a strong dependency on proprietary vendor solutions with each deployment of a satellite operator not interoperable with any other satellite operator. The adoption of 3GPP-compliant NTN technologies marks a significant paradigm shift. For the first time, the sector can leverage the economies of scale inherent in the broader 3GPP ecosystem, particularly through mass-produced chipsets. Simultaneously, 3GPP NTN introduces fully globally standardised terminal interoperability, reducing fragmentation and enabling seamless integration across vendors and platforms.

2.1.1 Economy of scale

Economies of scale are typically driven by high-volume use cases. In the context of NTN, the integration of satellite connectivity into commercial smartphones – particularly in Direct-to-Device (D2D) scenarios operating in frequency bands below 7.125 GHz – represents a transformative opportunity. Additionally, automotive, aviation and maritime applications as well as fixed consumer broadband services are expected to drive volume adoption in frequency bands above 10 GHz further reinforcing the cost-efficiency and scalability of NTN deployments.

2.1.2 Interoperability

The 3GPP framework ensures interoperability through a chipset-centric approach. Chipsets serve as the foundational element of terminals, delivering complete modem functionality. Compliance and standardisation are maintained through rigorous certification processes involving base station and network vendors, chipset and devices vendors. This ecosystem allows terminal manufacturers to focus on innovation and feature development without the burden of ensuring cross-vendor compatibility – interoperability is inherently guaranteed by the inclusion of a certified chipset.

Through this integration in 3GPP, NTN allows the development of a large interoperable ecosystem with no lock in.

Moreover, 3GPP NTN technologies are designed to integrate seamlessly and natively with terrestrial mobile networks. This capability enables continuous connectivity in scenarios where terrestrial infrastructure is sparse or unavailable, such as remote, rural, or disaster-affected areas. The result is a unified communications experience that bridges terrestrial and non-terrestrial domains.

As depicted in the figure below, the 3GPP 5G NTN component is added to the 3GPP 5G TN component to provide service continuity and reinforced reliability and availability.

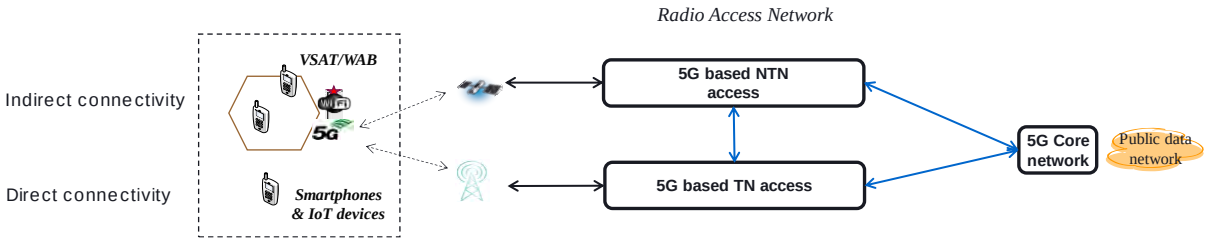

Figure 1: 3GPP 5G NTN access component added to the 3GPP 5G TN access component

Furthermore, as part of the 3GPP ecosystem, the spectrum for NTN is well defined with the availability of dedicated frequency bands for both NR NTN and IoT NTN and each band working at a global level. These bands designated by 3GPP correspond to Mobile Satellite Service (MSS) bands such as S band (n256, n252), L bands (n255, n253, n251, n250) or a combination of both (n254) as well as Ka bands (n512, n511, n510) and Ku bands (n248, n247 & n509, n508).

3 NTN technology deployment status and perspective

With major and prominent players emerging in US, Europe and China, global satellite network initiatives based on the 3GPP NTN standard are increasing rapidly and redefining the future of satellite connectivity. The following table and figure attempt to provide a timeline of the 3GPP NTN technology roll-out per deployment scenarios.

Table 1: NTN deployment scenarios

NTN deployment scenarios	A	B	C	D	E	F
Services	Messaging, Voice, Narrowband data			Wideband	Broadband	
NTN Radio Access Technology	IoT-NTN	IoT-NTN	IoT-NTN	NR-NTN	NR-NTN	NR-NTN
Orbit	GSO	NGSO	NGSO	NGSO	GSO	NGSO
Duplex mode	FDD	FDD	TDD	FDD	FDD	FDD
Payload	Transparent	Transparent/Regenerative			Transparent	Regenerative
Bands	Below 7.125 GHz (e.g. L/S bands)				Above 10 GHz (e.g. Ku/Ka band)	
Targeted devices	Internet of Things & Smartphones			Smartphones	Fixed and Mobile VSAT	

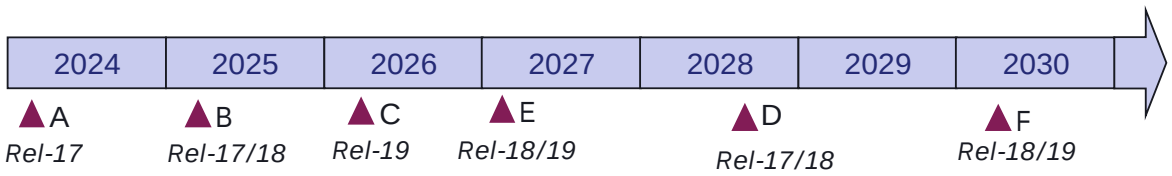

Figure 2: Earliest service opening for each NTN deployment scenarios (and related 3GPP releases)

Industry momentum around satellite networks is clear and undeniable. Mobile and satellite network operators are forming dozens of partnerships and agreements to develop novel satellite networks. For example, Apple, T-Mobile/Starlink, Vodafone/AST SpaceMobile, SES/Lynk Global/Omnispace, Space42/Viasat, Geespace/China Unicom, Sateliot, Ovzon, Eutelsat, Hispasat, SpaceRise, JSAT, KTSAT… Among these industry initiatives and partnerships, many are already committed to roll out 3GPP based NTN considering the ecosystem reach and the benefits associated.

In the near term, we start seeing that narrowband services are being provided to IoT and smartphone devices to support messaging, telemetry and possibly basic voice services. Some use cases are:

- Global asset tracking (logistics),
- Public safety and resilience,
- Remote surveillance and monitoring of industrial assets and utility infrastructures.

In the mid term, wideband and broadband services will be provided to smartphone and moving platform mounted devices. Possible use cases are:

- Everyday mobile coverage, anywhere on hiking routes, ferries, remote roads or islands,
- Maritime operations and crew welfare,
- Aviation passengers entertainment,
- Advanced MSS services including maritime and aero safety,
- Automotive use cases both for passenger entertainment as well as for safety,
- Data collect with drones,
- Rapid restoration and pop-up capacity,
- Broadcast at scale (updates and alerts),
- Enterprise operation continuity.

END