Ground Control
A CLS Group Company

Decoding NTN:
The Reality Behind Standards-Based Satellite IoT

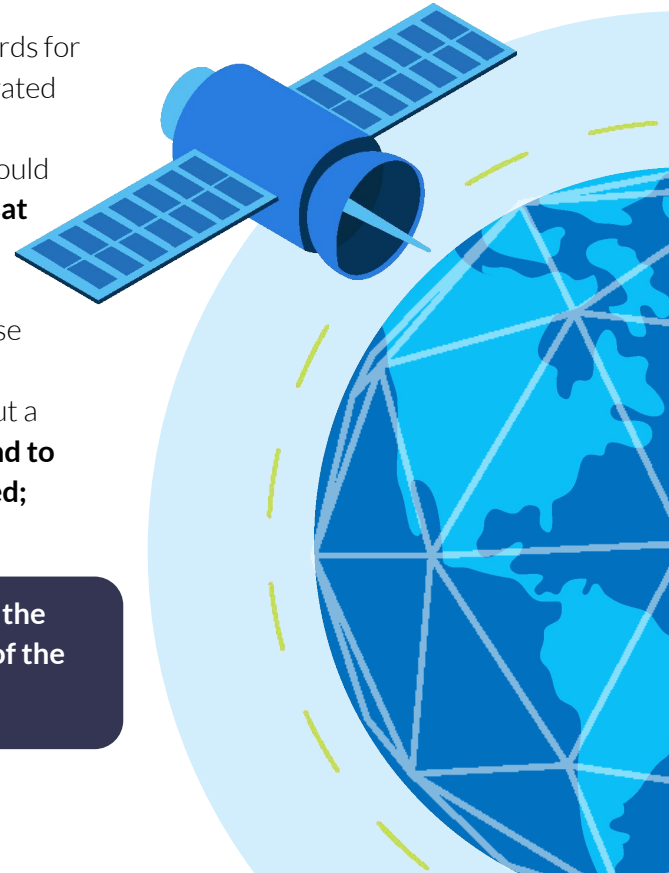
Why So Many Buzzwords?

Bearing in mind that the Ground Control team eat, sleep and breathe satellite IoT, even we sometimes trip over the many different terms being bandied about in the context of standards-based satellite IoT.

So before we get into it, here's a short explanation of what they all mean.

3GPP Standards, or ‘Standards-Based’

The ‘3rd Generation Partnership Project’, or 3GPP, was formed to create global standards for 3G mobile networks in 1998, but it wasn’t until Release 17, in 2022, that they incorporated satellite networks into the standard. Previously, all communication with satellites was delivered via a proprietary standard; if you wanted to talk to an Iridium satellite, you would need an Iridium modem. **If you wanted to talk to a Viasat satellite, you’d need a Viasat modem.**



There are distinct benefits to the proprietary approach; you are using a built for purpose module which can carry a lot of data, quickly, reliably, and efficiently, and not having to manage the compromises that are a consequence of working with a global standard. But a global standard promises several benefits: **the ability to switch satellite networks, and to roam between cellular and satellite networks with no additional hardware required; correspondingly, reduced engineering work, and lower hardware costs.**

Thus, when people refer to standards-based in the context of satellite IoT, **it describes the incorporation of satellites into the 3GPP standard, and is an umbrella term for all of the supported standards – NB-IoT, LTE Cat 1, LTE-M etc.**

Non-Terrestrial Networks, or ‘NTN’

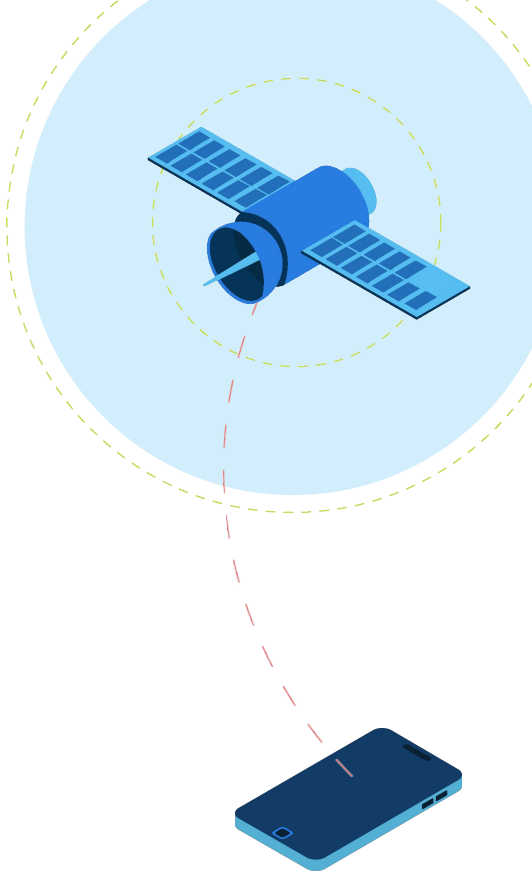
In the context of 3GPP standards, it means using existing cellular standards – NB-IoT or LTE for example – over a non-terrestrial link. That could be a satellite network, but it could also refer to a HAPS (high altitude platform station).

It sometimes causes confusion because taken literally, proprietary satellite connectivity could also be described as a non-terrestrial network, **but NTN is only being used in the context of standards-based connectivity.**

You can treat it as read that if a company is advertising an ‘NTN’ service, it will be using 3GPP standards (i.e. NTN NB-IoT, NTN LTE-M etc.)

In short, until you get into the minutiae, ‘Standards-based’ and ‘NTN’ are largely describing the same thing.

Direct to Device, or ‘D2D’



D2D refers to the ability for an unmodified user device to communicate with a satellite network, but it’s not limited to NTN connectivity. An early example is Apple’s ongoing partnership with Globalstar, which allows iPhone 14 models and above to use the Globalstar satellite network in emergencies. Apple modified their handset to incorporate the Globalstar proprietary standard in order to deliver this, and it’s not standards-based.

Cell phone users are an attractive target for satellite network operators, and a number of new satellite constellations have been launched with the primary goal of providing connectivity to mobile handsets: AST SpaceMobile, Lynk, and Starlink Direct to Cell.

These new constellations are trying to align with NTN, using 3GPP waveforms and core integration, so you may see NTN and D2D used interchangeably, but the latter is a marketing term / service concept, and the former is a 3GPP specification.
They’re different, but can overlap.

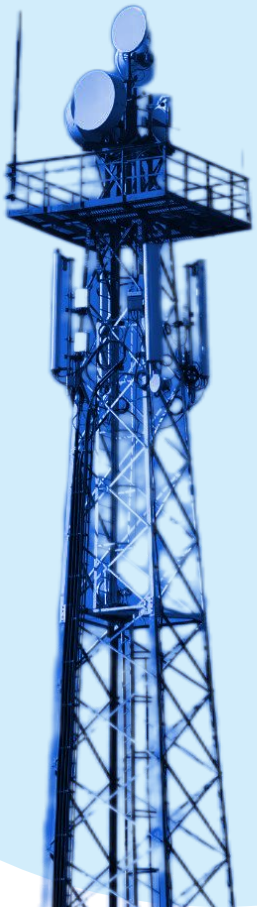
We will stick with NTN for the remainder of this eBook.

What NTN Promises, and What it Really Delivers

3GPP Release 17 extended the radio and core network specifications to handle large Doppler shifts (caused by fast moving satellites); variable latency, higher path losses, **and spot beam-based coverage rather than cell towers.**

The goal is interoperability with existing cellular cores (cellular networks' central software systems) and devices, enabling a common SIM and authentication, roaming between terrestrial and satellite networks, and a shared device ecosystem *(i.e. one chipset which can connect to both terrestrial and satellite networks)*.

Let's have a look at how the promises stack up against a reality check.



2. NTN

Lower Cost Hardware

The Promise

Using the same chipset opens up economies of scale that have never been possible for proprietary satellite connectivity.

The Reality

This one stacks up; removing the need for a stand-alone proprietary module significantly reduces the build cost of a connected IoT device.

Interoperability

The Promise

The ability to move between cellular and satellite networks without needing to reengineer your data.

The Reality

This is unlikely to be friction-free. Systems architects will need to design a system that can manage the limitations of NTN NB-IoT / LTE-M, which include higher latency, extremely small data volumes compared to cellular, and a reduced number of transmissions.

Note: On this last point about transmission frequency; it is possible to send data multiple times an hour from an NTN NB-IoT device, but it is not designed for this sort of application, and will be prohibitively expensive.

"We are in something of a distortion field right now, where there's lots of promise but little reality, just yet."

Greg Pelton, CTO, Iridium
(from the SVSW D2D Panel, Oct 28, 2025)

We'll come back to the topic of when and where to use NTN shortly.

Global Coverage

The Promise

To quote an IoT service provider who has recently started promoting NTN, it is “A Satellite network, providing connectivity around the world.”

The Reality

At the time of writing, Q4 2025, the most advanced satellite network offering NTN – Viasat’s NB-NTN service - has coverage in North America, Brazil, Australia, New Zealand and parts of Europe. There is no coverage over the oceans, Africa, Asia or the polar regions. Of course, we anticipate coverage expanding, but there is a cost to the satellite network for providing the service, so there needs to be sufficient demand. It may be several years before this service matures to the point where there is truly global coverage.

Supplier Switching

The Promise

Like cellular networks, when multiple satellite networks are offering the same connectivity, it will be easy to switch between them, and in doing so, keep your airtime costs down.

The Reality

This is not available today, as NTN is an emerging technology with very few service providers. It's hard to say what will happen when NTN matures, but the physics of satellite communication won't change: it is more expensive to send data into space than for it to remain in a terrestrial network, and the satellite network operators have much higher operating costs than their mobile network counterparts. So while NTN airtime – when used as intended – will be lower cost than proprietary, there's unlikely to be a 'race to the bottom' from network operators to win customers' business.

Bandwidth, Latency, and Cost

While NTN covers multiple cellular standards, the only one currently available with technical and commercial information is NTN NB-IoT, so to caveat this next section, **we are only describing the strengths and limitations of this, as opposed to NTN LTE services.**

	Viasat NB-NTN	Cellular NB-IoT	Iridium Messaging Transport
Protocol	NTN NB-IoT	NB-IoT	Proprietary
Transport Model	UDP/IP or NIDD	UDP/IP or NIDD	Message-Based
Max. Practical Payload	1,200 bytes	1,400 - 1,600 bytes	100,000 bytes
Min. Practical Payload	10-30 bytes	30-50 bytes	25 bytes
Latency	Medium (10 - 60s); MVNO scheduling could increase this to 2 - 5 mins)	Low (1 - 10s)	Medium (c. 10s)
Coverage	United States, Canada, Brazil, Australia, New Zealand and select European markets	Where supported by regional MNOs, and there is terrestrial infrastructure	Global
Cost-Optimized Monthly Data Volume	< 50 KB	< 5 MB	< 1 MB

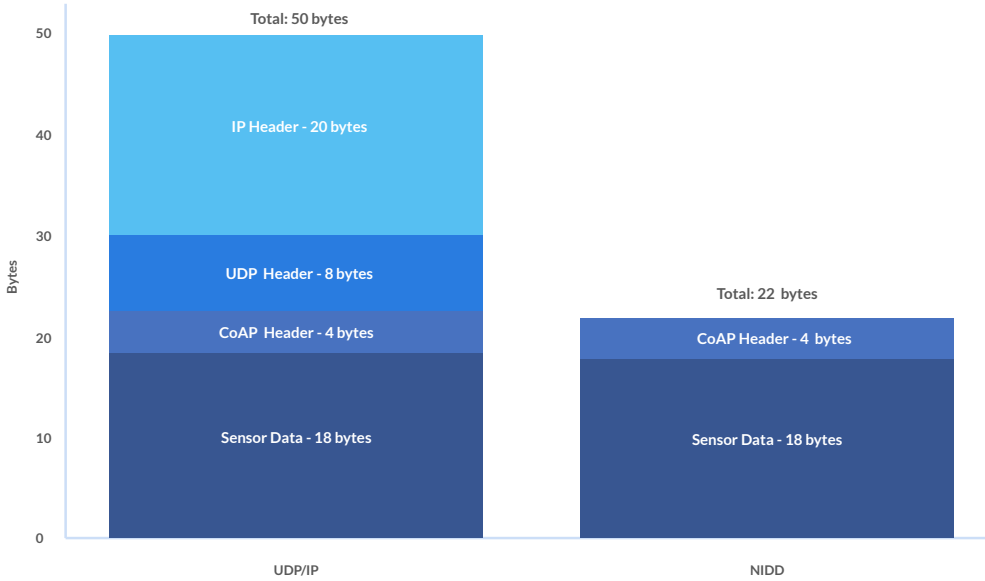
3. NTN IN PRACTICE

There are a few lines on this table that are worth digging into further, starting with the minimum practical payload coupled with the transport model, because this has a significant bearing on the economics.

NIDD, or Non-IP Data Delivery, is a message-based transmission. **Think of it as a text message; once sent, the sender can go back to sleep (with or without a form of read receipt), and will assume that the recipient is acting on the information.** UDP/IP is akin to a telephone call with both sender and receiver actively taking part.

While UDP/IP is much less 'chatty' than TCP/IP, it does still come with considerable overhead.

For example, a sensor with just **18 bytes of data will add 32 bytes of overhead in addition to its payload using UDP/IP. NIDD,** on the other hand, has substantially less overhead – just the raw data, plus anything that the application layer adds in (in our example, CoAP).

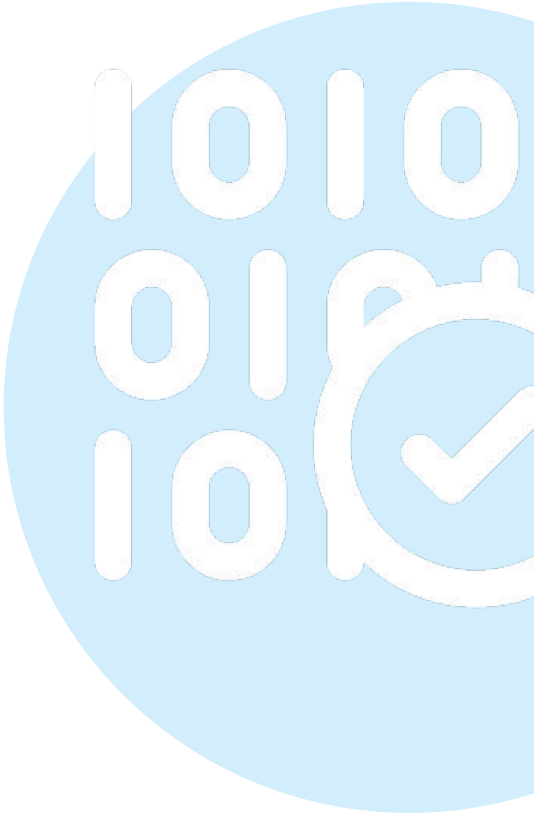


3. NTN IN PRACTICE

Bearing in mind that NTN NB-IoT becomes expensive when data volumes exceed c. 30-50 KB per month, if you have a tiny telemetry application, it may well make sense to leverage NIDD in order to send data more frequently, and benefit from more competitive airtime rates.

However, there are two complications; firstly, currently, **there is a 50 byte minimum session size being imposed by service providers.** This basically wipes out the value of NIDD. Viasat have indicated that this is expected to come down to 10 - 30 bytes with their commercial proposition targeted for Q1 - Q2 2026, subject to change and regulatory/operator approvals, at which point it makes sense to revisit NIDD to reduce overhead.

The second complication is NIDD itself; **it is a 3GPP supported standard, but it hasn't been widely adopted,** with many connectivity providers prioritizing IP (UDP/TCP). This makes sense in the context of cellular NB-IoT as there are fewer data constraints, but in satellite transmissions, every byte counts. But while the upside to NIDD is smaller, leaner payloads; the trade-off is extra setup; NIDD requires SCEF/I-API support and backend changes to map messages to your application.

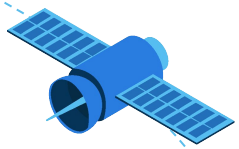


There's also no IP address for cellular roaming; each uplink uses the NTN pathway.

3. NTN IN PRACTICE

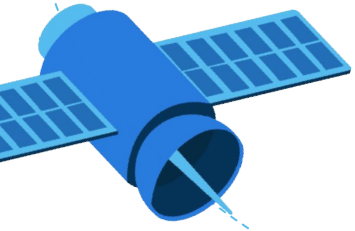
The other main consideration, aside from coverage, is latency.

The basic measurement is the distance the data travels from the sensor to the satellite to the ground station, and from there to your application.



When satellites are in geostationary orbit, such as Viasat's, this takes a little longer than satellites in Low Earth Orbit, simply because the data has to travel further.

In both GEO and LEO cases, the latency will be longer than if you are using a terrestrial network, so some tolerance needs to be built into your application. This is an accepted limitation of satellite connectivity. What's less clear is how the satellite networks will manage the very high number of endpoints that NTN connectivity is anticipated to attract.



Supporting massive fleets of devices over narrow satellite channels requires robust scheduling, interference mitigation and priority handling - features still under development in 3GPP specifications and vendor implementations.

What this means is you should consider the possibility that not every transmission sent will be received, and there could be sustained delays in transmission time if the network is particularly busy.

"Today's messaging-based services for Internet of Things, or Automotive as well as consumers and emergency SOS or on wearables. How people use these is up to their imaginations. We are seeing dramatic increases in messaging services, and there are plenty of new applications being built on top of these services."

Tarun Gupta, CPO & Co-founder, Skylo
(from the SVSW D2D Panel, Oct 28, 2025)

For the most part, NTN **isn't** being mis-sold as a service for mission critical applications that require near-real time transmissions - these remain the mainstay of proprietary satellite IoT services.

As long as potential users are aware of NTN's limitations, it is a matter of pairing the right service to the right application, and network-agnostic service providers like Ground Control can help.

Who's Actually Delivering It?

This is a truncated list of Satellite Network Operators (SNOs) who are either already providing, or working on providing, NTN connectivity.

In many cases they are partnering with Mobile Network Operators (MNOs) to get the appropriate radio spectrum and landing rights needed to deliver services.

Why Some Satellite Network Operators Need MNO Partners

New satellite networks like Starlink, AST SpaceMobile and Lynk ride on licensed mobile spectrum and must be switched on country by country with local approvals.

Partnering with MNOs solves several things at once: **lawful access to the band, national landing rights/market access, device acceptance/whitelisting, numbering/emergency services, and billing/customer care via the carrier's core.** Without those pieces, you can't legally or operationally light up service, even if the satellite link works. This country by country enablement is often referred to as Supplemental Coverage from Space (SCS); operators must secure approvals before switching on service.

By contrast, **Viasat and Iridium already operate in mobile satellite (MSS) spectrum with established landing rights in many markets,** so they don't need the same MNO mediation to deliver IoT.

Note: Starlink's recent EchoStar spectrum purchase strengthens its U.S. position, but it doesn't grant global landing rights. International rollout still depends on local regulators and/or MNO partners in each market.

NTN LTE Services

As a major disruptor, Starlink is already playing a significant role in the D2D market: thanks to SpaceX's in-house build and launch capability, it has deployed 650+ Direct to Cell satellites and is expanding fast, under an FCC authorization for up to 7,500 Starlink satellites.

This scale is intended to deliver low latency, global connectivity for standard LTE phones and IoT devices, with text messaging and data services rolling out with carrier partners.

Service Name: **Starlink Direct to Cell**

NTN LTE Services

AST SpaceMobile has moved from plans to execution, launching its first five commercial BlueBird satellites on Sept 12, 2024, and now reports agreements with 50+ mobile network operators covering ~3 billion subscribers.

Backing includes strategic investments from Google, AT&T, and Vodafone, while Verizon entered a commercial partnership in 2025, together positioning AST as a significant D2D contender as it works toward intermittent U.S. service by the end of 2025 and broader rollouts in 2026.

Service Name: **Services delivered through carrier partners under the carriers' branding**

NTN LTE Services

Lynk has launched operational satellites and secured relationships with mobile network operators spanning 50+ countries (around 60 under contract). Like Starlink and AST SpaceMobile, Lynk uses 3GPP LTE–based standards to connect directly to existing smartphones, with live messaging and recent voice trials alongside regulatory progress.

In 2025, Lynk also announced a strategic partnership with SES and plans to merge with Omnispace to accelerate global D2D rollout.

Service Name: **Services delivered through carrier partners under the carriers' branding**

NTN NB-IoT Services

Now operating under a single brand after acquiring Inmarsat, Viasat's satellites are in geostationary orbit (~35,786 km above Earth), so round trip latency is inherently higher than for Low Earth Orbit (LEO) systems.

On the other hand, NTN NB-IoT suits stationary devices that transmit a few times per day rather than needing real time links, and Viasat's GEO L-band platform emphasizes robust capacity and power efficient operation, positioning the company well to deliver standards-based services in the near term.

Service Name: **Viasat NB-NTN**

NTN NB-IoT Services

iridium® connected

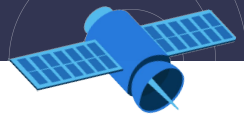
Iridium's Project Stardust signals a move from purely proprietary satellite IoT toward 3GPP standards-based NTN: the company plans to enable NTN on its existing LEO constellation for handset / vehicle connectivity and IoT services. Standards work is tracking with 3GPP Release 19, with lab demos completed and initial devices targeted around 2026.

Service Name: **Iridium NTN Direct**

Globalstar

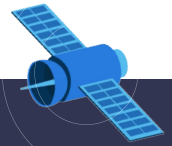
Commenting as part of a D2D panel at Silicon Valley Space Week, October 2025, **Mersad Cavcic, CPO at Globalstar,** cautioned that it might easily be 3 -to-5 years before a truly ubiquitous standard emerged and was adopted.

What's the Difference Between NTN NB-IoT and LTE Cat-1?



The core trade offs you know from terrestrial carry straight into NTN:
Cat-1 still suits richer, higher throughput IoT sessions (with higher power draw), while NB-IoT still excels at tiny, infrequent messages on multi-year batteries.

Satellite conditions don't flip that; they amplify it.
Expect higher/variable latency, scheduled access and coverage windows, and tighter power budgeting. In practice, NTN NB-IoT is the natural fit for delay-tolerant telemetry (meters, trackers, sensors), whereas NTN LTE Cat-1 works for lighter, less time critical IoT where external power or larger batteries are available.



Availability and performance also vary more than on land due to country by country spectrum and operator partnerships, **so validate your target markets!**

What's the Difference Between NTN NB-IoT and LTE Cat-1?

	NTN LTE Cat-1 (e.g., Starlink D2C)	NTN NB-IoT (e.g., Viasat NB-NTN)
What it is	LTE Cat-1 over satellite via MNO partners	NB-IoT adapted for satellite (Rel-17)
Data profile	Moderate throughput for light telemetry/commands	Very small payloads sent infrequently
Power/battery	Higher draw (better on external power or big batteries)	Ultra-low power (multi-year batteries)
Latency feel	Variable but workable for many IoT apps	High/variable, built for bursty, non-urgent data
Availability (2025-6)	Rolling out for IoT data with selected carriers/regions	Early commercial offers focused on industrial IoT
Best IoT fits	Field gateways, fixed sensors needing occasional config/firmware deltas, higher duty telemetry where power is available	Meters, trackers, agricultural/environmental sensors - few small messages/day, long life, cost-sensitive fleets
Not ideal for	Real time control loops or rich data (images/video)	Frequent reporting or large payloads

Target Use Cases

The introduction of NTN NB-IoT services has opened up a new class of satellite IoT:

Low cost, low energy use, and very small data volumes.

NTN NB-IoT lends itself to applications with hundreds of endpoints, where there isn't a need for real time data. You can anticipate receiving your data a few times a day, and the service is intended for very simple sensor readings; it becomes cost prohibitive if you want to send aggregated gateway data.

The low data / high latency trade off is greater affordability (depending on data volumes), and the capability to run off battery power for a substantial period of time.

Target Use Cases

Fleet management & goods tracking:
Where available, NTN expands NB-IoT's reach across remote roads, rail, and sea lanes, and small periodic pings fit NB-IoT well, even with higher latency.

Smart grid management:
Rural meters and substations can send infrequent reads and alarms reliably without terrestrial coverage, using ultra-low power, bursty NTN traffic.

Agriculture & livestock monitoring:
Wide, uncovered fields and rangelands suit battery devices that wake a few times per day to report position, soil, or animal health.

Inventory management:
Pallets and containers can surface location/status at handoffs and checkpoints, where intermittent connectivity is fine and payloads are tiny.

Lower value asset tracking & predictive maintenance:
NIDD keeps airtime costs low per message so long life trackers can report health by exception and periodic heartbeats economically.

Air & water quality monitoring:
Dispersed sensors in hard to reach sites can trickle periodic measurements, with NTN ensuring continuity where no local infrastructure exists.

Where NTN Isn't Suitable

Putting aside current coverage limitations, **here are some circumstances in which NTN isn't the best choice.**

Application	Best Options
If you need to send complex sensor / aggregated gateway data, or images. NTN's small payloads make this an inefficient use of this protocol.	Proprietary Message-Based Proprietary IP-Based
If you need to transmit at short, predictable intervals (.e.g every few seconds/minute). NTN is at its most cost-effective when sending hourly or less frequent updates, and becomes prohibitively expensive for more frequent transmissions.	Proprietary Message-Based Proprietary IP-Based
If you need real time command and control, or interactive sessions, such as with an unmanned application (aircraft, vehicles, vessels). NTN will not work here.	Proprietary IP-Based
If you need to stream video; video streaming currently requires a proprietary IP-based solution.	Proprietary IP-Based

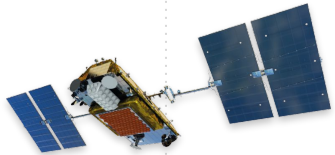
5. NTN AND THE IOT ECOSYSTEM

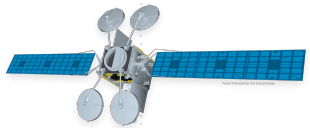
Proprietary Message-Based Solutions

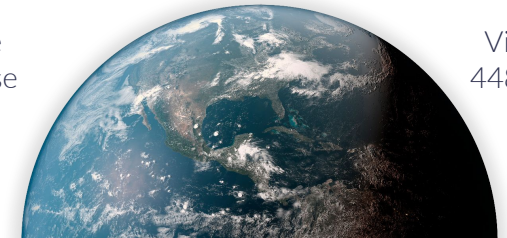
Iridium Messaging Transport
Viasat IoT Nano

These message-based solutions are the proprietary equivalent of NIDD, in that they send your data with much less overhead than an IP-based connection. This in turn means they draw less power, are more economical, and the modules and antennas that deliver the service are small and lightweight.

Iridium Messaging Transport (IMT) allows you to send up to 100 KB per packet, and Viasat IoT Nano currently up to 16 KB (up to 1 MB planned). However, it does require some engineering skill to format your data to use these protocols.







Proprietary IP-Based Solutions

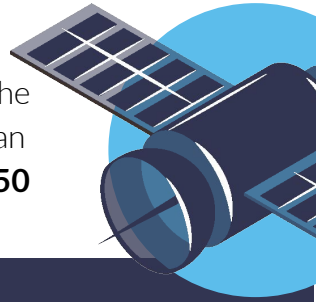
Iridium Certus 100
Viasat IoT Pro

If you need interactive, two way communication, and/or you need an IP-based connection for plug-and-play integration with your existing infrastructure, these are both excellent options.

Iridium Certus 100 offers data speeds of 22/88 Kbps, and the satellites are in Low Earth Orbit, making this service particularly well suited to unmanned applications needing as close to real time command and control as possible.

Viasat IoT Pro allows you to send data at up to 448 Kbps, and is ideal for higher-throughput use cases.

What's Available Now (late 2025)



Skylo, which leverages the Viasat and Ligado satellite networks, has done an incredible amount of work to make the 3GPP standards work for existing satellite networks. They have a number of certified chipsets and devices that can be purchased today utilizing NTN NB-IoT. **Note that Skylo does not currently support NIDD, and they have a 50 byte minimum session size, which is a drawback if you have a tiny telemetry application.**

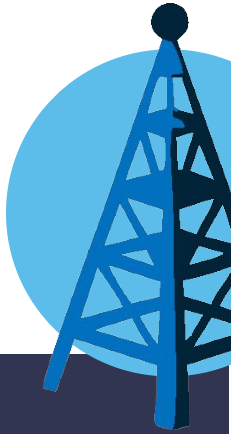
What's Coming in 2026

In Q1 - Q2, Viasat is targeting a direct to market NTN NB-IoT proposition, expected to include NIDD support and (we hope) a lower minimum session size, subject to regulatory/operator approvals. **Ground Control is currently testing the Viasat service in our RockBLOCK RTU device.**

In terms of Starlink - this being the closest to fruition of the NTN LTE networks - expect early IoT offers to run on standard LTE Cat-1/Cat-1bis modules approved by carrier partners, subject to regulatory/operator approvals; there's no special Starlink chipset. It'll work where carriers have the right approvals and plans in place (see previous section about MNO partners). Unlike most cellular installs, you'll need a clear view of the sky and often a better (possibly external) antenna, so enclosure, placement, and mounting matter. If those pieces line up, many existing designs could work with only small tweaks.
Just plan on real world trials to confirm coverage, antenna performance, and carrier acceptance in each market.

Commenting as part of a D2D panel at Silicon Valley Space Week, October 2025, **Kevin Cohen, VP of D2D Strategic Partnerships at Viasat**, observed that while standards progress is real, roaming, spectrum usage and revenue sharing need more work before seamless experiences arrive.

Looking Ahead to 2027



If 3GPP Release 19 'freezes' in December 2025, as planned, and chipset vendors incorporate the NTN NB-IoT features through 2026, Iridium's NTN Direct could begin showing commercial IoT device availability in 2027, delivered through operator integrations already in progress (e.g., Syniverse's MNO platform and a Deutsche Telekom tie-up). In other words: silicon and carrier plumbing first (2025–26), **then broader module/device launches and service ramp from ~2027 onward, aiming at truly global, 3GPP-based NB-IoT over Iridium's LEO network.**

NR (5G New Radio) and what's next with NR-NTN

NR is the 5G radio technology: a flexible air interface that uses wide channels and advanced antennas (beamforming) to deliver higher data rates and lower latency than 4G/LTE. **It scales from small IoT messages to broadband by adjusting its waveform and bandwidth across many frequency bands.**

NR-NTN brings that same 5G radio to satellites. **Expect early, niche deployments to appear late this decade, but the broad, IoT-friendly phase is more likely in the early to mid 2030s,** as chipsets, satellites, spectrum approvals, and certification frameworks mature country by country.

In simple terms: NTN NB-IoT and LTE is the near-term workhorse for tiny, infrequent messages; **NR-NTN is the longer horizon path for heavier IoT workloads (higher rate telemetry, software updates, even video) once ecosystems and costs catch up.**

Conclusion

Standards-based satellite IoT will **unlock massive IoT applications such as livestock tracking and wide scale environmental monitoring,** many of which have been cost prohibitive in the era of proprietary only services. But it's important to understand the strengths and limitations of NTN services, particularly in these early days of service delivery, as many of the benefits have yet to come to fruition.

First off, check coverage in your region. **NTN is currently very localised in its delivery.** Secondly, assess your data requirements; NTN NB-IoT services are designed for very small quantities of data, and become costly over 30-50 KB per month (we don't have commercial information on NTN LTE yet). If you can format your data to utilize NIDD, you'll be able to send more transmissions - c. every hour - **but expect 8-12 transmissions per day with UDP/IP.** Thirdly, if you are utilizing Viasat's NB-NTN service, you will need line of sight to the satellite; this can be challenging in mountainous or forested areas.

If coverage is available, your sensors are out in the open, and your data requirements are small and latency-tolerant, **NTN NB-IoT could well be a great option.** If your set up is not optimal for NTN, proprietary satellite IoT services have greatly diversified in the last two to three years, and there are competitively priced devices and airtime options available.

Ask a network-agnostic service provider like Ground Control for clear, objective advice on the best network and service for your requirements.

Ground Control

A CLS Group Company

- 20 years' experience
- Unbiased network recommendations
- Great airtime rates
- Future-ready IoT insights
- Satellite IoT platform
- Design and build own hardware

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