TRANSFORMA INSIGHTS

Rethinking satellite IoT: how spectrum, architecture and technology define addressable markets

White Paper

October 2025

Sponsored by

Globalstar™

Satellite IoT: a segmented landscape

The use of satellites to connect IoT devices is nothing new. Historically this has been focused on the tracking of high value assets in remote areas where there are no options for using terrestrial cellular networks. In recent years the technology capabilities have evolved significantly and the cost to serve highly geographically remote use cases has fallen, resulting in a continued growth in the adoption of satellite IoT.

However, such an assessment misses the immense diversity. There is a wide array of different IoT applications that might be effectively addressed with satellite connectivity, each with their own characteristics. At the same time there are also a diverse set of technologies and propositions that are delivered via satellite.

In this report we propose a rethink of the segmentation of the satellite IoT market based on two key dimensions: application characteristics and vendor propositions to address them. Any assessment of the space must take account of this application/proposition fit.

In the first section of the report we examine the diverse use cases that comprise satellite IoT. The next section looks at the main characteristics of those applications that will dictate the degree to which they are addressable, or not, by different satellite propositions. Finally, we consider the third key element: what are the characteristics of vendor propositions (and particularly the technologies that they use) that make them appropriate for addressing those requirements.

Key use cases

Satellite networks are increasingly seen as a critical component in enabling the expansion of the Internet of Things (IoT). Their ability to deliver connectivity to remote and underserved regions makes them especially valuable for use cases where terrestrial coverage is limited, intermittent, or impractical to deploy. While the exact requirements differ across applications, several clear sectors are emerging where satellite IoT will play an essential role.

Agriculture and environmental monitoring

Agriculture is one of the most cited areas for satellite-enabled IoT. Farms, particularly in large rural regions, often sit outside cellular coverage. IoT devices placed across fields and livestock enclosures can deliver data on soil moisture, crop health, and water levels. Satellite connectivity ensures that farmers can monitor and optimise irrigation, fertilisation, and pest control, even in remote areas.

Environmental monitoring represents a related use case. Devices can be deployed to track weather conditions, forest growth, or wildlife movements, supporting both commercial and conservation activities. For example, sensors can warn of forest fires, detect illegal logging, or track endangered species. Because these devices are often spread over vast areas with no alternative connectivity, satellites are the only viable option.

Maritime tracking and safety

The maritime sector has long relied on satellites for communication, but IoT is extending these capabilities. Ships, fishing fleets, and even individual containers can be fitted with sensors linked via satellite. This allows constant monitoring of vessel location, cargo conditions, and fuel consumption.

Fishing vessels, particularly small boats that operate far from shore, can be tracked to ensure crew safety and to help enforce regulations against illegal, unreported, and unregulated fishing. Similarly, cargo shipping benefits from satellite IoT through real-time updates on temperature or humidity inside containers, which is critical for perishable goods. These use cases combine safety, regulatory, and commercial drivers, making them a strong fit for satellite.

Logistics and asset tracking

Global supply chains depend on visibility. IoT sensors attached to vehicles, containers, or valuable assets enable organisations to track movements across continents. However, supply chains often traverse regions with no cellular coverage, such as deserts, oceans, or remote highways.

Satellites fill this gap, ensuring uninterrupted monitoring of location, security, and environmental conditions. For example, mining equipment moved between countries, or medical supplies shipped to disaster zones, can be monitored consistently. This increases security, reduces theft, and allows firms to optimise logistics planning. Hybrid solutions that use cellular where available and satellite as a fallback are particularly effective in this sector.

Energy and utilities

Energy companies operate in some of the most remote locations in the world. Oil rigs, offshore wind farms, pipelines, and remote power substations all need to be monitored for safety, efficiency, and compliance. IoT sensors linked through satellites allow operators to track pressure levels, detect leaks, and monitor structural integrity.

For utilities, satellites can support the rollout of smart metering in areas with poor cellular coverage. Power, water, and gas utilities benefit from the ability to collect data from rural or isolated communities without costly terrestrial infrastructure. In both energy and utilities, safety and regulatory compliance are key drivers for adopting satellite IoT solutions.

TRANSFORMA INSIGHTS

Key use cases

Emergency response and humanitarian aid

In disaster zones, terrestrial networks are often damaged or completely unavailable. Satellite connectivity can provide a resilient backbone for IoT devices used in emergency response. For instance, IoT sensors can be deployed to assess building safety, monitor environmental hazards, or coordinate the delivery of aid.

Humanitarian organisations also use satellite IoT for asset tracking, ensuring that food, medicine, and equipment reach the intended locations. In refugee camps or other temporary settlements, IoT devices can monitor water usage, sanitation facilities, or health supplies. The independence of satellites from local infrastructure makes them uniquely suited to such situations.

Transportation and connected vehicles

While connected cars are typically associated with cellular networks, satellite connectivity is an important complement. Long-distance freight vehicles often travel through sparsely covered areas. IoT devices using satellite links allow fleet operators to monitor vehicle health, fuel efficiency, and cargo conditions at all times.

For aviation, satellite IoT supports real-time tracking of aircraft, which has become a regulatory and safety priority in recent years. Small aircraft in particular, which may not have access to advanced communications systems, benefit from lightweight satellite-enabled trackers that provide continuous updates on their location and performance.

Mining and natural resources

Mining operations frequently occur in remote or underground locations. Surface operations can benefit from satellite IoT through monitoring of machinery, worker safety, and environmental impacts. For example, vibration and pressure sensors can detect risks of collapse or equipment failure.

Resource exploration is another application. Devices deployed in harsh and isolated terrains can send geological and seismic data directly via satellite, supporting exploration campaigns for minerals, oil, or gas. This avoids the need for costly terrestrial connectivity deployments in challenging environments.

Smart cities and infrastructure in remote areas

While most smart city applications rely on terrestrial connectivity, certain infrastructure projects in remote areas are well-suited to satellite IoT. Examples include bridges, dams, or remote transport hubs. Sensors monitoring structural health, water flow, or traffic in such places may depend on satellite links when cellular coverage is absent.

Furthermore, satellite IoT can support national infrastructure monitoring, such as border control, by enabling surveillance devices and drones in sparsely populated regions. These applications highlight the complementary role of satellite in extending the reach of smart infrastructure.

Military

Satellite connectivity supports secure, resilient operations across defence and intelligence domains. It enables encrypted command and control across dispersed units, facilitates intelligence, surveillance and reconnaissance (ISR) by relaying data from UAVs and remote sensors, and augments GNSS for precision navigation in contested environments. Satellites underpin strategic communications in denied or degraded theatres, support space domain awareness, and enable early warning systems. They also enhance maritime and border surveillance, enable remote asset monitoring, and provide global reach for defence logistics and mission planning. Crucially, satellite links ensure operational continuity independent of terrestrial infrastructure, reinforcing sovereignty and tactical agility across multi-domain operations.

Characteristics of use cases that determine technology options

In order to determine the best approach to addressing the key use cases identified in the previous section, it is important to consider the deployment characteristics of the application. Different use cases making use of satellite will have different requirements, including in areas as covered in the sub-sections below.

Geographic deployment

While satellites can deliver coverage of most parts of the world, the requirements of each individual use case will vary between those that need truly global connectivity, through to those with requirements limited to just a single country, or part of it. Furthermore, some deployments will be expected to use terrestrial connectivity for the majority of their deployment, with satellite used only as a fallback. And even within territories, there is a question about requirements for in-building coverage.

This variation has implications for choice of satellite provider. This takes several forms. GEO satellites have very specific fixed coverage areas, which might be regional through a single satellite or limited constellation, or might be more-or-less global through a bigger constellation (notwithstanding that GEO satellites generally provide poor coverage in very high or low latitudes). LEO constellation coverage will depend on the number of satellites deployed, although in general they support ostensibly global coverage albeit often with long gaps in the ability to send/receive, meaning that the required latency (as discussed in the 'Latency' section, below) becomes much more of an issue.

There is also a question of spectrum licensing. Some satellite providers hold global spectrum, while others have more limited national (or multi-national) spectrum. In many cases, increasingly with the LEO satellites and particularly for 3GPP NTN, the spectrum is not held by the satellite operator at all, but effectively borrowed from other spectrum licensees, most obviously Mobile Network Operators.

Even for unlicensed spectrum, for instance where used for LoRa-based connectivity, the frequency bands – as well as rules about power and duty cycle – are slightly different between regions. This means that different device SKUs are required for certain regions. This is an absolute requirement as the use of other bands is often explicitly prohibited by regulators. It also creates a requirement to adapt the satellite coverage accordingly.

Data volumes

IoT applications vary tremendously in terms of the volume of data that needs to be transmitted, ranging from video cameras and connected cars generating many gigabytes of data per month, through to simple trigger devices that may only generate a few bytes of data on an occasional basis. This will have substantial implications for the

Characteristics of use cases that determine technology options

choice of communications protocol, and therefore provider. The options are discussed in 'Protocols' section, below.

We should also note that IoT applications may well be adapted to reflect the fact that they are making use, permanently or temporarily, of satellite connectivity. For instance, the frequency of reporting of an environmental monitoring device might be extended, or a video camera might switch to sending still images or a video feed of lower resolution when using satellite.

Latency

As well as the data rate, there is a related topic of latency, i.e. the amount of time it takes for data to traverse the network. Some applications have a requirement for real-time, or near real-time, communications, such as for remote monitoring of fresh food transportation. Whereas for others, e.g. some types of environmental monitoring, a delay of hours or even days might be acceptable.

Latency considerations in satellites take two forms. Firstly, the latency from device to satellite, which will be mostly a function of the distance to the satellite, meaning that in the case of GEOs it will be 100-300 milliseconds, and for LEOs 20 milliseconds. Secondly the availability of satellites and ground station connections. GEOs will be permanently available, at least in areas of coverage. LEOs, however, may not be, due to being non-geostationary. Unless the LEO constellation is dense it will require the transmitting device to wait for an appropriate LEO satellite to pass overhead. And, similarly, it will be necessary to wait until the LEO satellite passes over a ground-station and can deliver its payload. This depends on the architecture of the constellation. With a sufficiently dense LEO constellation, latency can be as low as 20ms but could be as high as several tens of minutes for low density constellations of just a few satellites, allowing for the wait time for a satellite to pass.

Cost and complexity

Using satellites to connect remote assets, i.e. use cases that we might describe as IoT, is nothing new. However, the cost has tended to mean it has been focused on high value assets or processes. However, the evolution in the satellite connectivity landscape has resulted in more cost-effective satellite options coming available. As prices decline it opens up the potential use cases that can be addressed.

There is some complexity when thinking about the cost of satellite. It is not just the fees that might be charged by the satellite providers, or the hardware cost, that are relevant. There is also a question of the impact that a certain technology choice might have on the complexity of a solution's devices, deployment and operations, which will have knock-on effects on the cost.

The cost of connectivity essentially comes down to spectral efficiency. Technologies that are designed specifically for satellite, i.e. mostly the proprietary protocols discussed in the 'Protocols' section below, will tend to be cheaper. Device cost, however, is a different matter. Here the cost disparity is likely to be minimal between proprietary technologies and standards-based. However, in circumstances where the device is expected to operate on both terrestrial cellular and satellite, the incremental cost of adding satellite connectivity to cellular (i.e. in the form of NTN) is minimal. Therefore, there is a BOM cost benefit in selecting NTN rather than attempting to combine cellular with some other proprietary satellite protocol.

There are several other considerations here too. Having to produce multiple SKUs to reflect using different frequency bands, for instance, will reduce production scale and add additional cost. The scale of deployments also has implications for sales volumes and therefore unit costs. The key thing to note is that there are frequently cost trade-offs.

In the context of an application segmentation, the key consideration is the extent to which declining costs might make a use case more viable using satellite. There is a no simple answer and each application and unique deployment will have its own dynamics.

Energy efficiency

Many IoT devices do not have access to main electricity and will run on limited batteries, or through the use of solar cells or even energy harvesting, making them highly sensitive to power consumption. This makes choice of connectivity protocol a very relevant consideration for some use cases. Indirectly this might translate into a financial cost, e.g. of having to replace batteries or might also act to render some use cases non-viable in scenarios where the chosen protocol might be too power hungry.

Characteristics of satellite offerings

In the previous section we discussed the characteristics of IoT applications that might dictate which satellite technology and provider might be most appropriate for them. In this section we examine the capabilities of the various protocols, architectures and approaches. A segmentation according to three of the characteristics is presented in the Figure to the right.

Protocols

In this section we examine the two main aspects of a segmentation of the satellite technology landscape, firstly whether the protocol is proprietary or standards-based, and secondly whether it is targeted at 'messaging' type applications or 'IP-based', i.e. larger volumes of data. Each are explored in the sub-sections below.

Furthermore, we note that there has been some evolution in the 3GPP NTN standard since the previous report was published. We explore the implications of that in a further sub-section, below.

Proprietary vs standards-based

This is possibly the most fundamental split within a segmentation of the satellite space. There is a range of proprietary technologies, for instance from eSAT Global, Globalstar, Myriota, and Starlink, which were developed explicitly for satellite. There are also several standards used, including 3GPP NTN, for instance by OQ Technology, Sateliot, Skylo, and Viasat as well as LoRaWAN, as deployed by EchoStar Mobile and Lacuna Space.

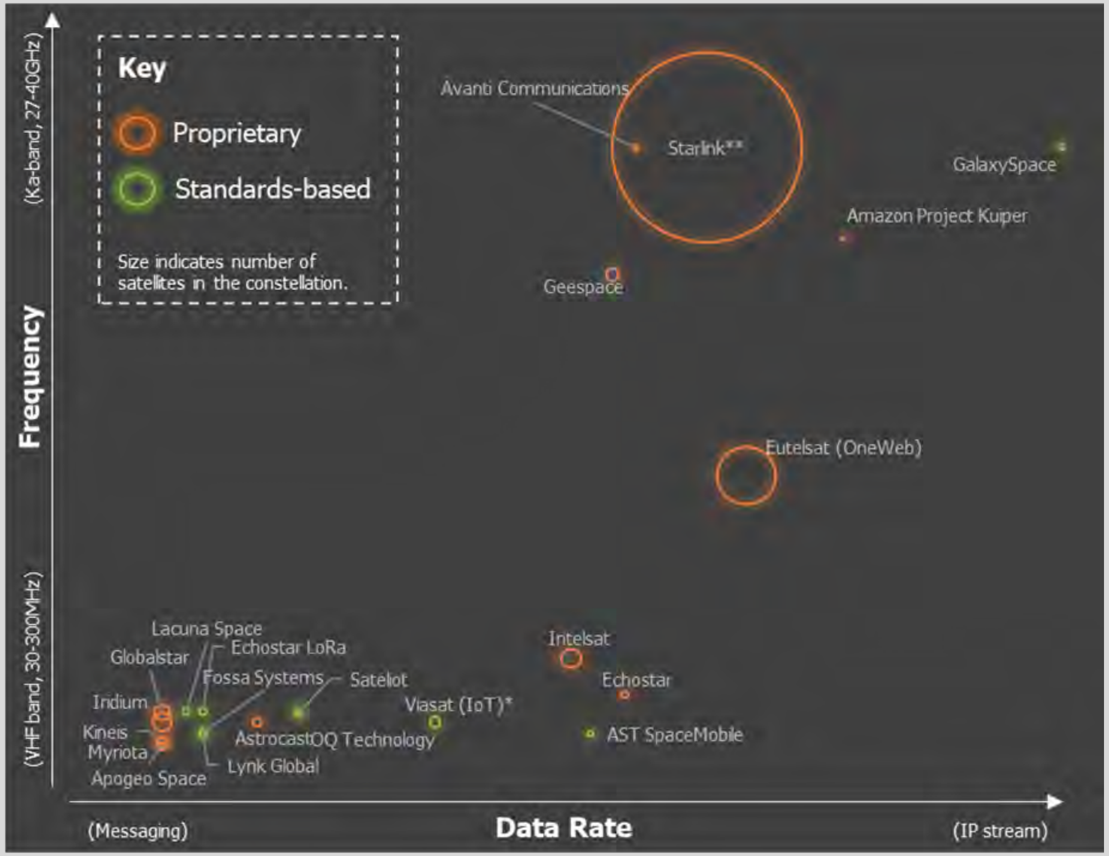
The benefit of proprietary technologies is that they tend to more spectrally efficient, making the connectivity cheaper, for instance by having much less packet overhead. They also tend to be less power hungry than the standards, which have to adapt an existing technology rather than being optimised for satellite from day one. The downside is that they are tied to a specific provider, and often they will lack the scale of the standards, with notably fewer hardware makers and other vendors supporting.

The strength of the standards-based approach is the interoperability and interchangeability between different vendor hardware and networks. It also therefore translates into greater choice of providers and suppliers. Specifically in the case of NTN there is also the benefit that it offers almost zero incremental cost to add satellite to the relevant cellular technologies (NB-IoT or 5G NR). However, the standards-based approach will typically involve higher connectivity costs compared to proprietary technologies. Also it is an adaptation of a cellular technology meaning it is less optimised for satellite use cases. There is also a consideration that the development roadmap maybe slow.

Implications for addressing different application requirements: Proprietary technologies are largely more optimised for satellite connectivity and therefore cheaper and/or more energy efficient in terms of the cost of connectivity. However, the use

Figure: Satellite connectivity provider segmentation

[Source: Transforma Insights, 2025]



Note: the categorisation of each satellite operator is indicative only. Several provide services using a variety of frequency bands and technologies. The aim of the chart is to illustrate the general market landscape rather than to provide a definitive view of the capabilities of a single provider.

Characteristics of satellite offerings

of standards-based 3GPP and LoRaWAN provide for cheaper devices. As a result, the optimum technology will directly reflect the split of total cost between ongoing connectivity and hardware costs (including indirect costs such as integration and SKU variants. We see LoRaWAN using LR-FHSS as much more akin to a proprietary technology in terms of hardware cost, being closer to the proprietary satellite technologies for efficiency and power consumption than to the 3GPP technologies. Furthermore, for devices requiring multi-mode (i.e. satellite and terrestrial connectivity), the use of the satellite version of the standards-based terrestrial technologies is typically more cost-effective. In contrast, for a satellite-only deployment, the use of specific protocols designed for satellite, is likely to be the optimum choice.

Messaging vs IP-based

Satellite protocols are typically optimised for either connecting high data rate services ('IP-based'), such as the broadband connections addressed by Starlink, or low bandwidth, small data packets ('messaging'), such as services provided by Globalstar. There is quite a strong correlation between the bandwidth being delivered, and the frequency band being used, with broadband offerings typically gravitating towards higher frequencies where there is more spectrum available. However, this picture is set to be somewhat diversified by the imminently arrival of NTN-NR capabilities, delivering (potentially) broadband connectivity.

Implications of addressing different application requirements: *Some satellite technologies are optimised for sending short data messages, often in a very efficient way. That neatly meets the requirement of some IoT applications, such as metering, basic remote monitoring, and so forth. Others are focused on broadband connectivity, but often with complex hardware requirements. At one end of the spectrum, in terms of being ultra-constrained, is something like Myriota, then LoRaWAN, all the way up to broadband services in the tens of Mbit/s. The optimum, of course, depends what services need to be delivered, but with the added complexity that the 3GPP technologies now introduce, in terms of potentially delivering both narrowband and broadband services to existing cellular terminal equipment.*

Power consumption

The power consumption of different technologies will vary significantly, with implications for their use to address particular use cases. For instance, those use cases that rely on battery or solar power will demand much greater energy efficiency. Broadband technologies, e.g. Starlink and OneWeb, tends to be very high power consumption. But even for messaging-based technologies there is some variation. Proprietary technologies tend to be more energy optimised than NTN, for instance.

Implications of addressing different application requirements: *Deployments that are power constrained due to their location (i.e. without access to mains power) will almost certainly be limited to messaging-based protocols and potentially only a sub-set of those which are highly optimised for low power consumption.*

Figure: Proprietary vs standards-based technologies for satellite IoT

[Source: Transforma Insights, 2025]

	Proprietary	Standard
Advantages	▪ More spectrally efficient, with less packet overhead ▪ Cheaper connectivity ▪ Less power hungry being purely optimised for satellite ▪ Greater degree of customisation possible to address application requirements.	▪ Interoperable and interchangeable ▪ Greater choice of providers and suppliers ▪ No lock-in ▪ Minimal hardware cost for multi-mode satellite/terrestrial deployments
Disadvantages	▪ Less widely deployed in the long-term, eventually, although today not many standards-based options. ▪ Tied to a specific provider ▪ Fewer vendors supporting	▪ Higher connectivity costs for satellite-only deployments ▪ Not optimised for efficient support of satellite connections ▪ Potentially slow development roadmap
Examples	eSAT Global, Globalstar, Myriota, Starlink	OQ Technology, Skylo, Viasat (all NTN), EchoStar (LoRa)

Characteristics of satellite offerings

Integration with terrestrial

The integration of satellite and terrestrial connectivity is increasingly central to the evolution of IoT architectures. While 3GPP's Non-Terrestrial Network (NTN) standards offer a formalised pathway for convergence, they represent just one approach among several. In practice, hybrid connectivity models, blending cellular and satellite technologies, are already being deployed across diverse sectors, often using proprietary protocols, dual-mode devices, or gateway-based aggregation.

NTN-based integration remains the most seamless from a hardware perspective. By extending NB-IoT and 5G NR capabilities to satellite, NTN allows terrestrial cellular chipsets to operate over satellite links with minimal incremental cost. This is ideal for deployments where terrestrial coverage is dominant and satellite is used as a fallback. However, NTN performance is constrained by latency, spectral efficiency, and power consumption, making it less suitable for ultra-low-power or high-throughput applications.

Dual-mode devices offer another integration path. These combine cellular and satellite radios in a single unit, switching between networks based on availability or policy. For example, Globalstar-enabled asset trackers often include LTE-M or NB-IoT modules, using satellite only when cellular is unavailable. While this increases bill-of-materials (BOM) cost and complexity, it provides robust coverage and operational flexibility.

Gateway aggregation is common in industrial and remote deployments. Local IoT devices connect via short-range protocols (e.g. Bluetooth, Zigbee, LoRa) to a gateway that supports both cellular and satellite uplinks. This model is prevalent in agriculture, mining, and energy, where edge gateways relay data from multiple sensors to the cloud using whichever link is available. It allows for protocol diversity and centralised management, though it introduces latency and single-point-of-failure risks.

Alternative satellite-cellular hybrids include Starlink's use of LTE for backhaul or direct-to-device experiments, and LoRaWAN deployments that combine terrestrial gateways with satellite uplinks (e.g. EchoStar Mobile). These models offer flexibility but often require bespoke integration and careful spectrum coordination.

Implications for addressing different application requirements: *In summary, while NTN offers a standards-based path to integration, real-world deployments are embracing a broader toolkit. The optimal approach depends on application requirements, cost constraints, and operational environments. Hybrid models, whether dual-mode, gateway-based, or cloud-integrated, are likely to dominate in the near term, especially for mission-critical or geographically dispersed IoT systems.*

Frequency bands and spectrum access

There is quite a wide range of frequency bands used by satellite operators, as listed below:

- VHF – 30-300MHz – Limited use today, for low data rate uplink and downlink, amateur satellite activity, some military and aviation uses, and CubeSats utilising amateur radio frequencies.
- UHF – 300MHz-1GHz – Limited use today. Used by some communication and meteorological/ environmental satellites and amateur.
- L-band – 1-2GHz – Used for low bandwidth communications (e.g. satellite phones, LEOs, IoT) and navigation systems (GPS, GLONASS, Galileo and Beidou). Lower frequency means less atmospheric interference.
- S-band – 2-4GHz – Communications satellites and weather radar. VSAT terminals. Good under adverse weather conditions. Higher power. So-called MSS (mobile satellite service) operations are run in the S-band, both using LEO and GEO.
- C-band – 4-8GHz – Used typically for satellite communications and TV feeds, and for maritime.
- X-band – Largely for military use, including 7.25GHz-7.75GHz (for space to earth uplinks) and 7.9GHz-8.4GHz (for earth to space downlinks).
- Ku-band 12-18GHz – Used largely for satellite communications and satellite broadcasting. This is the other major maritime band.
- K-band 18-27GHz – High levels of attenuation due to water vapor absorption at this frequency make it largely unusable for satellite communications.
- Ka-band 27-40GHz – Communications satellites, typically uplink. Large frequency range at high frequency makes for better support of higher bandwidth services, but more susceptible to atmospheric attenuations (e.g. rain fade). Also typically uses more targeted beams, necessitating higher pointing accuracy of devices. Generally, this is the preferred band (along with Ku-band) for LEOs.
- Bands above 40GHz – Large amounts of this spectrum have been identified for use with high bandwidth satellite services.

Some parts of the bands are allocated globally for satellite (so-called mobile satellite service, or MSS, spectrum). Some is allocated by national regulators or 'borrowed' from mobile network operators. In other cases the spectrum is license exempt and may be usable in certain strict circumstances.

The International Telecommunications Union (ITU) is responsible for assigning radio frequencies, including for satellite. Holders of MSS spectrum include Globalstar, Echostar, and Viasat. Satellite operators register with their local regulatory authority, e.g. the FCC in the US and the European Commission in Europe. MSS spectrum holds an advantage that it is consistently available, is licensed and therefore only to be used by the spectrum licensor, and is not subject to reliance on a third party. We should note also that MSS licensees do not hold spectrum in perpetuity. For instance the 2GHz MSS band licences held by Vi-

Characteristics of satellite offerings

asat and Echostar (and subsequently Starlink since its acquisition in September 2025) is due for renewal in 2027. The European Commission asked the RSPG (Radio Spectrum Policy Group) to look into the use of the 2GHz it, and it identified M2M/IoT ecosystem as a future possible usage. It also recommends a technologically neutral stance.

Other satellite operators that do not hold spectrum will be highly dependent on receiving permission from terrestrial providers to access their spectrum. Other than MSS, spectrum allocation is highly geographically specific, with national regulators responsible for allocating licences. This can lead to satellite providers being completely or partially reliant on third parties for spectrum. Furthermore, in many cases, such as with Release 17 NTN, they will be able to provide connectivity only in a patch-work of countries based on individual country licences.

Even for licence-exempt spectrum there is often variation in the frequency bands allocated. For instance, in the case of LoRaWAN, in June 2025 the CEPT approved the use of the 862-870MHz frequency band for satellite connectivity to low power devices, for instance LoRaWAN. This is subject to some limitations, such as duty cycle and power, and that downlink messages only be multicast. However, this is not a band that is consistently available globally, being allocated for other purposes (and therefore not usable on a licence-exempt basis, or in many cases usable at all).

Implications of addressing different application requirements: *The choice of satellite provider will be strongly dictated by the geographical countries/regions they can cover matching the required geographical coverage of the application. There may also be some cost implications of a proposition being based on leased capacity, being typically more expensive than licensed capacity; although this is of course dependent on commercial negotiations. There are also some geopolitical considerations to consider, for instance regarding which satellite providers may be allowed to access licensed spectrum in certain geographies. The EU, for instance, has recently been exploring support for alternative satellite constellations. The upshot is that there is a significant counter-party risk challenge, notwithstanding whether the approach provides for an appropriate price point, bandwidth or geographical coverage.*

LEOs vs GEOs

The most obvious split when segmenting satellite constellations is between those operating in Low Earth Orbit (LEOs) and those in Geostationary Orbit (GEOs). This is quite a fundamental difference.

LEOs operate between 160km and 2,000km and do not stay located over the same geographical point. The lower orbit means hundreds are needed to cover the surface of the earth with constant coverage. However, the fact that they are not geostationary means that a small number of satellites can cover large amounts of the earth during a 24-hour period for non-real-time communications. Being close to the earth makes for lower latency communications (~20ms) assuming that there is a satellite overhead when data communication is

Characteristics of satellite offerings

required and the large number of satellites increases the capacity relative to small numbers of GEO satellites. However, with LEO satellites, much will depend on the density of satellites, which will dictate how long the device will need to wait before a satellite is overhead. This could range from negligible time for a constellation of hundreds of satellites to potentially several hours for a single LEO.

GEOs, in contrast, are located 35,786km above the earth's surface, in a fixed location. As such, just a few satellites can cover the majority of the earth's surface, and with high availability. The other big up-side of GEOs is that the satellite is always located in the same place relative to the terminal means that expensive tracking antennas are not required. However, the long distance means high latency. LEO satellites themselves are individually much cheaper, to the order of hundreds of thousands of dollars versus hundreds of millions for a GEO. But a much larger number of LEOs are required for the same coverage, the constellations are much more expensive to run, the devices are often more complex and expensive (requiring steerable antennas).

Many companies operate both, either as their own constellations or in some cases operating LEOs while renting capacity on GEOs.

Implications of addressing different application requirements: *Applications with the highest latency requirements will face a challenge. Do you go with GEOs, which have greater delays due to the distances involved, or LEOs where latency will depend on the number of satellites deployed and the current position in the sky? The correct answer depends on the nature of the constellation. Device cost and complexity will likely be lower with GEO satellites, while the economics of operating a LEO constellation should mean that in the long run the connectivity costs will be lower.*

Maturity

Communications satellite technologies vary widely in maturity, with legacy constellations offering proven reliability and newer systems still evolving. Globalstar, founded in 1991, launched its first satellites in 1998 and began full commercial service in 2000. Its second-generation constellation began deployment in 2010, supporting IoT and direct-to-device services with off-the-shelf hardware readily available. Iridium, conceived in the late 1980s, launched its original 66-satellite constellation between 1997 and 1998, and its Iridium NEXT upgrade between 2017 and 2019.

In contrast, Starlink only began launching satellites in 2019, and has yet to really evolve the proposition to support IoT devices. Devices supporting 3GPP Release 17 NTN, particularly for LEO constellations, are still in early development, and NR-NTN remains several years from commercial readiness.

Implications of addressing different application requirements: *Long-established satellite technologies offers proven reliability, predictable costs, mature support, regulatory familiarity, and lower technical risk, making operations more predictable. New, unproven systems, such as NTN, carry greater uncertainty, operational risk, and potential unforeseen costs, requiring careful assessment before adoption, at least in the early deployments.*

Architecture

There are several different architectures that can be used for satellite connectivity, which is typically dictated by the protocols being used.

The traditional approach with satellites is sometimes referred to as 'bent pipe', whereby the satellite simply acts as a relay station. Whatever you send up from a device gets amplified and relayed immediately to a ground-station (or vice versa). As such it is effectively protocol agnostic. It also has the ability to integrate new software protocols without having to make any changes to the satellite itself. This flexibility is further explored in the 'Bent pipe as a platform for innovation' section, below.

The main other alternative to the bent pipe architecture is termed 'regenerative'. The capabilities here are typically dictated by the specific protocols being used. The satellite demodulates, processes, and re-encodes the signal on board before re-transmission. It allows advanced functions like routing, switching, error correction, and sometimes protocol translation. But it is tied to the protocols being used and is a more complex and expensive approach.

A variant is 'store and forward' whereby the satellite holds the messages until within range of a ground station and then transmits (and in reverse for messages from the ground station, where that is appropriate). This is viable only where the communications have very low sensitivity to latency. That certainly applies to many IoT solutions, particularly those connected to small LEO constellations.

Some architectures may make use of 'crosslink' which sends messages between satellites until it reaches one that can send it to an appropriate ground station. Crosslink depends also on having on-board processing, i.e. demodulating and decoding the incoming data rather than just retransmitting.

Implications of addressing different application requirements: *The bent pipe approach typically means lower satellite costs and easier integration, but probably with a trade-off in terms of latency. Bent pipe is also inherently more flexible, allowing for evolutions in propositions on existing infrastructure. This is explored further in the section 'Bent pipe as a platform for innovation', below.*

Bent pipe as a platform for innovation

In the context of satellite communications, bent pipe architectures are often seen as simple or limited compared with regenerative designs. A bent pipe payload is essentially a transparent repeater: it receives a signal from the ground, amplifies it, shifts frequency, and re-transmits it back to Earth without onboard processing. At first glance, this might seem less sophisticated. However, when examined as a platform for innovation, bent pipe offers distinctive advantages, particularly for IoT and emerging non-terrestrial network (NTN) services.

The defining characteristic of bent pipe is that it leaves intelligence on the ground. This separation of responsibilities between satellite hardware and ground-based software is very significant. Because all protocol handling, routing, and service logic are performed terrestrially, new features and applications can be introduced without modifying satellites already in orbit. In other words, bent pipe creates a more agile environment for service development. By contrast, regenerative payloads move much of this functionality into the satellite itself. While powerful, this design introduces rigidity: once the satellite is launched, updating or adapting its onboard processing is difficult, costly, and constrained by the hardware available at launch.

This distinction mirrors patterns seen in other technology domains. The personal computer revolution accelerated when hardware and software development became decoupled. When the same company controlled both, innovation tended to be narrow and incremental. Once hardware became a broadly available platform and software could be developed independently, innovation flourished. The open platform enabled countless applications that the hardware designers could never have anticipated. A similar dynamic applies in satellite systems. Bent pipe satellites provide a transparent, stable platform, while innovation happens in ground-based systems and applications.

For IoT, this flexibility is especially valuable. IoT requirements vary widely in terms of latency tolerance, data rates, power budgets, and security needs. With bent pipe, new protocols and optimisations for these diverse requirements can be developed and deployed on the ground. Start-ups and operators can innovate in device design, gateways, and software platforms without waiting for satellite manufacturers to build or update regenerative payloads. In effect, bent pipe reduces the barrier to experimentation.

Another important point is interoperability. Because bent pipe does not constrain communication to a specific onboard processing stack, it can be made to support multiple standards and proprietary protocols in parallel. This is particularly useful at a time when the IoT landscape is fragmented across 3GPP NTN, LoRa-based systems, and other specialised approaches. Regenerative systems, by embedding a particular standard, may limit flexibility and slow adaptation as technologies evolve.

Of course, bent pipe has technical trade-offs. It places more responsibility on ground infrastructure, requiring a denser network of gateways and more sophisticated terrestrial processing. For applications needing ultra-low latency or seamless global coverage, regenerative payloads with inter-satellite links may be more effective. Yet from the perspective of fostering innovation, these limitations are often outweighed by the benefits of openness and adaptability.

The underlying principle is that the more open and general-purpose the platform, the greater the scope for innovation. Bent pipe satellites offer precisely this kind of open platform. By keeping the satellite itself simple and focusing development effort on the ground, they allow a wide ecosystem of developers, service providers, and device manufacturers to experiment, adapt, and create new applications. Just as the separation of hardware and software in the PC industry unlocked decades of innovation, separating satellite infrastructure from service intelligence may prove equally powerful for the IoT era.

TGI Connect: Transforming transportation through IoT innovations

TGI Connect, a pioneer in the IoT sphere, is driving significant innovations in the transportation industry in partnership with Globalstar's robust satellite network. With a strong focus on creating sensors for trailers, collecting valuable data, and offering efficient automation for actionable business decisions, TGI Connect is reshaping how transportation companies operate.

The Challenge

Creating Smart Sensors for Trailers

TGI Connect's trailblazing innovation lies in its cutting-edge sensors for trailers. These sensors are equipped with state-of-the-art technology, enabling frequent data collection from trailers while in transit. By employing a robust sensor network, including edge computing and AI technology, businesses gain critical insights into their trailer performance. A few of the business challenges TGI focuses on are location, temperature, door open, cargo and other crucial parameters. The accuracy and precision of these sensors ensure that companies can monitor their assets more effectively and reduce potential risks during freight transit.

Future-Ready Sensors

TGI Connect embraces the potential of AI learning and edge computing, harnessing these technologies to establish a forward-looking framework for data acquisition. By integrating AI learning, it addresses unforeseen challenges, allowing TGI to solve unique solutions such as allowing detection of handbrake activation in the rail car environment. Leveraging Globalstar's dependable satellite network, the future of asset data collection through IoT is both resilient and easily accessible.

Efficient Data Collection and Automation

Collecting and processing data can be a daunting task in the transportation sector, because trucks and trailers on the move pass in and out of cellular coverage. Due to the limited cellular coverage footprint, TGI chose Globalstar's satellite technology to provide an efficient data collection system that simplifies this process. Its integrated platform automatically gathers information from trailer sensors and other relevant sources. Periodically, the onboard solar-powered Globalstar device transmits it in short, data-rich bursts over the Globalstar Satellite Network to TGI.

With the power of AI and automation, TGI Connect efficiently analyzes this sensorlearned data, transforming raw unusable information into valuable insights that can be leveraged for decision-making.

Actionable Business Decisions from Data

Data without actionable insights and reliability is of limited value. TGI Connect understands this, and that's why its platform excels at turning reliable data into actionable business decisions. By interpreting the collected data, businesses can identify trends, minimize downtime, right-size their fleet of assets and even drive revenue through captured trailer detention. With these insights at their disposal, transportation companies can drive operational excellence, resulting in significant cost savings, as well as future predictive analytics for preventing costly events.

Seamless Integration Opportunities

The transportation industry thrives on seamless integration. TGI Connect facilitates easy integration with existing systems, ensuring a smooth transition to its IoT solutions. It does this by providing multiple paths to integration giving its customers increased flexibility. Integration options include REST APIs, direct feeds to customer or partner endpoints, and the TGI Integrator. The TGI Integrator is an easily installed middleware that handles TGI API access, placing data returned into a customer or partner database in a highly configurable manner. Using the TGI Integrator, a customer can generally have a working integration within an hour or two at zero cost. This flexibility provides interoperability enabling businesses to enhance collaboration among various stakeholders, including drivers, dispatchers, and warehouse managers. By bringing together diverse data streams, TGI Connect's integrated approach empowers companies to achieve streamlined operations and make data-driven decisions with confidence.

The Solution

TGI Connect's relentless pursuit of IoT innovations is making a profound impact on the transportation sector. Through its advanced trailer sensors, efficient data collection, and actionable insights, businesses can make smarter decisions, reduce operational inefficiencies, and enhance overall performance. The reliability of data captured through Globalstar, positions TGI to provide a strong IOT future for its customers. With a focus on seamless integration, TGI Connect empowers transportation companies to stay ahead in a fast-paced and data-driven industry. As IoT continues to reshape transportation, TGI Connect remains at the forefront, leading the way towards a more connected and optimized future.

Spotter: Monitoring free-roaming horses across the vast Central Asian region

The Challenge

Horse ownership is deeply rooted in the Central Asian region. Equines have played a huge part in Mongolian, Kazakh and Kyrgyz history and culture for millennia. The prized animals – numbering about four million in Mongolia, three million in neighbouring Kazakhstan, and 0.5 million in Kyrgyzstan – range free and fenceless across the vast steppe grasslands.

Herd owners across the region need a way to keep tabs on where the animals range. This is important to help owners understand where their herds are finding good grazing, and to help ensure their security, health and well-being.

The vast expanses of the Central Asian region are very sparsely populated, with rugged terrain and very little telecom infrastructure. Relying on terrestrial telecommunications technology to reliably deliver tracking information is simply impossible.

To add to the challenge, winters in the region have become longer and more severe in recent years due to global warming, with temperatures dropping as low as –40°C/F. As a result, the horses often need to travel much further than usual to find grassland to graze on.

The Solution

Founded in 2014, Mongolia-based Value Added Reseller Spotter has developed highly innovative solutions to satisfy the region's unrelenting demand for capable, reliable and far-reaching technology solutions that can monitor the location of millions of horses. The company created an animal-tracking collar based on Globalstar technology.

Each Spotter collar is fitted with Globalstar's SmartOne C satellite IoT transmitter, so the solution helps herd owners keep tabs on their valued equines wherever they travel in this desolate region, even when well beyond the reach of GSM mobile signals.

With SmartOne C's small size, versatility, and low price, Spotter is seeing rapid uptake of its lightweight, rugged, and economical tracking collars.

The horses typically roam in herds of around 30-50, with one lead stallion keeping the animals together and providing protection. As a result, the group can be effectively monitored with just one collar.

Thanks to Spotter, and the enabling power of Globalstar's Low Earth Orbit satellite network, over a million animals are now being reliably tracked.

There's a growing understanding among the horse owning community of the value and reliability of the satellite IoT technology solution, according to Spotter Co-Founder Tsogbadrakh Surenjargal. "People are becoming aware that terrestrial telecoms infrastructure like mobile networks are simply unable to provide the ubiquitous and always-on tracking capability of satellite."

SmartOne C: long battery life for minimal maintenance

A further key differentiator of the solution is its low maintenance, and the long battery life, thanks to SmartOne C and Globalstar's Low Earth Orbit satellite architecture. With alternative GSM based systems, batteries need changing every two months, on average, and may require use of a hefty power bank. Globalstar-enabled

Spotter, on the other hand, can continuously monitor the animals for up to one year or even more without the need to replace batteries.

Expansion of Eurasian Gateway

Spotter's customers are further benefiting from recent expansion of Globalstar's Eurasian ground station gateway network, now providing even greater reach and network resilience.

Outcomes

Customer trust and satisfaction

The Spotter system's reliability and robustness have particularly demonstrated their worth during the extraordinarily harsh 2023-24 winter. Extreme weather and inaccessibility did not impede Spotter's capability to keep concerned herd owners updated on the animals' whereabouts, which can be monitored on users' smartphones.

The principals of Spotter often hear from the herd owners themselves about how much they value the system's accurate tracking, particularly when climatic conditions have been extreme. This Facebook post from one Mongolian herd owner was typical of many others: "My horses usually graze in the Southern Gobi, but because of the extreme snow, they migrated over 1,000km eastward to find grazing. The inaccessible location and frequent storms meant I wasn't able to check on them until Spring, but I trusted Spotter Horse Tracker to monitor my herd. Just yesterday I travelled to the horses' location, indicated by the system, and I'm so overjoyed to say that all my horses are well and healthy. I greatly appreciate Spotter Horse Tracker and its excellent support."

Accelerated take-up

Spotter has seen sales of its satellite IoT-enabled horse tracking collar more than double in 24 months. Spotter has reached a milestone of over 31,000 animal collars deployed, enabling the reliable monitoring of free-roaming horses across Mongolia and Kazakhstan. Describing sales uptick of nearly 160% since October 2022, Spotter Co-Founder Tsogbadrakh Surenjargal says "the growth has been phenomenal."

Lonestar Tracking: Tracking assets from oil fields to snow fields

The Challenge

Business gets done every day and everywhere – not just downtown, but also beyond line of sight and outside the range of cellular coverage. From oil wells and snow-covered mountains to ranches spanning thousands of acres, businesses run on information. Their data may be as basic as where an asset is located. It may be confirmation that a remote machine is doing its job.

That's why remote asset tracking and monitoring by cellular, LoRa and satellite have become a growth industry. The need is met by companies with expertise in industries from energy and utilities to agriculture and leisure. But they have a few things in common. Faced with a jumble of cellular carriers and data plans, they struggle to make things simple for their customers. They are also under constant pressure to provide the data their customers need at a price that makes sense.

The Solution

Lonestar Tracking is a Texas-based company founded in 2016 to deliver IoT services to the oil and gas industry. Its founders had worked in the business and knew its needs: to track costly, complex equipment going to remote regions anywhere in the world, collect data from it and send that data in real time to Houston or another energy capital for processing. They also knew their former colleagues didn't want or need to understand the technology: they wanted to pick devices, receive and activate them and have them work right out of the box.

Modular Solution

To provide the IoT connectivity the energy business needed, Lonestar chose the ST100 satcom module from Globalstar. "We absolutely love that board," says cofounder and CTO Thomas Remmert. The self-contained transmitter and modem add low-cost satellite connectivity to any OEM product. The ST100 features an ultra-light, compact design that includes GPS, an accelerometer, Nordic processor and Bluetooth connectivity. Without external antenna, it connects to the Globalstar low-Earth orbit satellite network and, through more than 20 ground stations, to Globalstar's processing system, which prepares the data and forwards it to Lonestar in real time.

Keeping the Slopes Covered

Serving oil and gas, however, was only the beginning for Lonestar. The company also uncovered a niche serving ski resorts, where snow-making equipment is increasingly called upon to make up for shortages in the snow that nature provides for free.

It is a big operation, with machines scattered across multiple slopes on mountain sides and enormous amounts of piping to supply them with water. With so much of the operation out of sight, resorts depend on IoT data to know if a machine is operating, if it is generating snow, and what the water supply and flow rates are. Beyond making snow, resorts operate vehicles, snowmobiles and other mobile equipment that vanish from sight behind tree cover and they need remote tracking to coordinate operations productively.

Globalstar's SmartOne devices fill the gaps where a rugged landscape makes cell service and LoRA connectivity unreliable. The SmartOne Solar is powered by sunlight and certified Intrinsically Safe for hazardous environments. Virtually maintenance free with up to 10 years of usable service, it provides GPS location and inputs for sensors. The SmartOne C is a small, easy-to-mount unit that is the market's most affordable and feature-rich tracker, powered either by batteries or line power. Lonestar integrates the data stream they provide directly into the applications that resorts use to manage their operations. It enables geofencing that triggers alerts when vehicles or equipment are moving into areas marked as hazardous – even triggering an audio call to handheld radios to warn drivers. And when search-and-rescue teams head into the mountains, the data stream can make the difference between life and death for those lost in the snowfields.

From the Ranch to the Sea

The SmartOne C is also working for Lonestar Tracking on the ranch. Integrated into collars worn by guardian dogs, it reliably reports the location of the sheep or goats they herd across ranchland that may extend over 50,000 to 300,000 acres. The savings in time and labor are substantial, and the greater ability to locate herds translates over time into greater safety and health for animals and people alike.

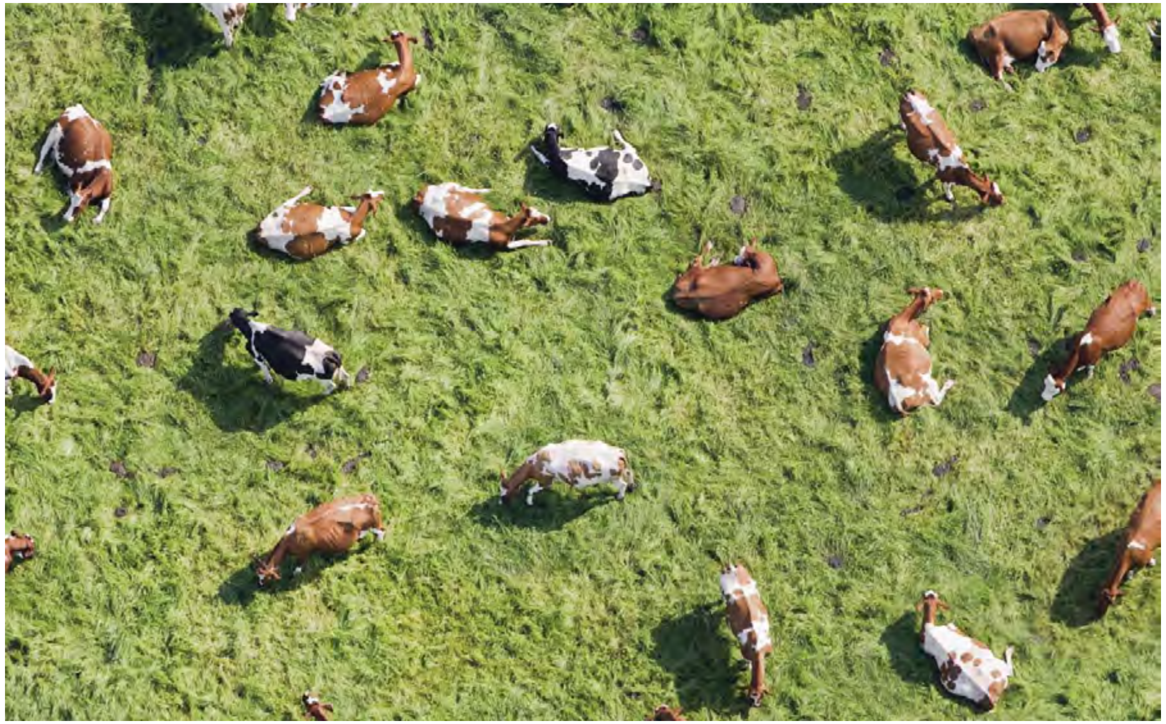
The SmartOne Solar also goes to sea. Oceanographers deploy buoys offshore equipped with hydrophones to listen and record underwater sounds, as part of research into how human-made noise affects whales and other wildlife. The buoys need frequent retrieval to download the recordings and the SmartOne Solar turns sunlight into GPS data feeds that guide the researchers to them. Other scientists are tracking currents, winds and water conditions, and the SmartOne Solar reports on the current position of those drifting buoys and makes them easy to find when it's time to download the full data set.

Why Globalstar?

Why was Globalstar technology the right choice for Lonestar Tracking? "Performance for price," says Thomas Remmert. "We didn't need a continuous stream of data. We didn't need two-way communications or coverage at the poles. When we stripped away those requirements, Globalstar was the most cost-effective solution, without sacrificing anything we did need. The technology and service worked the way it was supposed to, and they opened up a host of opportunities we couldn't get from the other players in the market."

IoT connectivity has been on a downward cost curve for a decade, Remmert adds. "A lot of today's new satellite IoT technologies sound promising – but when you're talking real value, it's about IoT connectivity from a device that works in the back of a metal FedEx truck. That's Globalstar."

Ceres Tag: Managing animal health on the ranch by satellite



The Challenge

Ranching is a risky business. Between buying or birthing livestock and bringing it to market, ranchers take on big debts for animals, feed, machinery and maintenance. They face unpredictable weather, mounting regulatory demands and volatile prices for their end product. Old ranchers are dying off or leaving the industry in large numbers. The next generation, better educated, wants digital solutions that help them cope with a shrinking labor pool.

But what digital solutions work on a ranch? Even small ranches are big. It takes one acre of land (0.4 hectares) to support just one cow, or two sheep or up to three goats. As a result, animals are out of sight most of the time, except for the 100 or so days they spend in a much smaller feedlot.

The Solution

Ranchers find their answer with a company called Ceres Tag. This young Australian company makes the world's first IoT device small enough to serve as an ear tag on cattle. It tracks the GPS location of the tag and the motion reported by an onboard accelerometer. From those numbers, software characterizes each animal's behavior, from feeding to running to resting, second by second. Data analytics turns the behavioral data into estimates of feeding efficiency (a key measure for ranchers), weight gain, milk production, health and even how much methane its digestion produces.

Ranchers access this information through a secure, cloud-based platform. It helps ranchers figure out how much land they need for a herd of a certain size – based not on guesswork but on the actual activity of their cattle. It provides information on carbon emissions that regulators in many markets require, and can trigger alerts to unusual activity, from lack of motion to too much of it, signaling possible injury or theft. By identifying cattle that are most efficient at feeding themselves and bulking up, ranchers can also select them for breeding high-performing calves. All in all, they learn more about their cattle than if the animals were in the barn.

To accomplish all this, Ceres Tag packs more into its small, lightweight device than a GPS and accelerometer. Careful engineering analysis led the company to integrate a microprocessor, memory and machine learning software as well. These enable the tag to learn an animal's behavior patterns, which inevitably vary from one to the next, and make decisions about what data to report. The average Australian cattle herd has more than 1,500 head and large ranches herd more than 5,000. The company's business depends on giving ranchers reliable data on each animal, not just averages across the herd. Those considerations made it imperative to put the smartest possible tag on the ear of every cow.

Ceres Tag also integrate a small satellite transmitter chip from Globalstar. According to CEO David Smith, Globalstar's ST150 chip was exactly the product they needed. It is small and consumes little power. Transmission is highly affordable and reaches most of the world with a single platform. Ceres Tag has been a roaring success, operating in 36 countries after just three years on the market, and Smith credits the large number of countries in which Globalstar is licensed as a major contributor to the company's ability to scale up so fast. It currently delivers its services in half the nations where Globalstar is licensed.

The company can not only gather data from just about anywhere, it can deliver information to just about anyone. Its open platform uses application programming interfaces (APIs) to deliver information to IT at banks, insurers, sustainability analysts, ranch management software companies, government food-security agencies and park services. It has also branched out beyond ranches to monitor tortoises on the Galapagos islands, bison in US national parks and giraffes in Africa. More than 30 species of animal are sending Ceres Tag data on their health, welfare and location that shapes decisions made around the world.

About Ceres Tag

On returning to the family farm after 20+ years working as professionals in industries including energy, construction and education, David and Melita Smith founded Ceres Tag to allow livestock producers better access to data-driven decision making tools. Ceres Tag is the world's first animal monitoring information platform with direct to satellite capability through a proprietary smart ear tag. Integrating with software partner platforms, the Ceres Tag platform offers opportunities to improve productivity across the livestock industry and provide a richer range of information to guide effective decision-making.

Conclusions

Transforma Insights makes the following conclusions on the state of satellite IoT connectivity:

- **Declining costs and evolving standards are expanding satellite IoT viability.** As satellite connectivity becomes more affordable and standards mature, previously unviable use cases, especially in agriculture, logistics, and energy, are becoming addressable, though deployment complexity remains a key consideration.
- **Satellite IoT is not a monolith and application diversity demands tailored solutions.** The market must be segmented by both application characteristics and vendor proposition fit, as use cases vary widely in data volume, latency tolerance, power constraints, and geographic deployment.
- **Legacy satellite providers offer mature, reliable platforms for IoT.** Mature providers of satellite connectivity, such as Globalstar and Iridium, have decades of operational experience, with proven hardware ecosystems and regulatory familiarity. Their proprietary protocols are optimised for low-power, low-data messaging applications.
- **New entrants like Starlink and NTN offer scale but lack IoT-specific maturity.** While Starlink has rapidly deployed thousands of satellites, its broadband-centric architecture and high power consumption make it less suitable for constrained IoT deployments. Standards-based NTN capabilities remain in early development.
- **Bent pipe architectures enable faster innovation and protocol flexibility.** By keeping intelligence on the ground, bent pipe systems allow for rapid evolution of services and support multiple protocols, unlike regenerative payloads which are harder to update post-launch.
- **3GPP NTN standards offer seamless terrestrial-satellite integration, but with trade-offs.** While NTN-IoT and NTN-NR promise low incremental hardware cost and interoperability, they are less spectrally efficient and more power-hungry than proprietary alternatives, making them better suited for hybrid deployments.
- **Spectrum access and licensing are critical determinants of service viability.** MSS spectrum holders like Globalstar enjoy consistent global access, while others depend on fragmented national licensing or third-party agreements, introducing counterparty and geopolitical risks.
- **LEO vs GEO trade-offs hinge on latency, coverage density, and device complexity.** LEOs offer lower latency and higher capacity but require dense constellations and steerable antennas. GEOs provide stable coverage with simpler devices but suffer from higher latency.

Satellite IoT in a Hybrid Era

Satellite connectivity has shifted from a niche utility to a strategic component of the global IoT ecosystem. Where once its value was confined to broadband, government, or narrow positioning applications, today satellite IoT is diversifying rapidly, embedding itself across logistics, agriculture, energy, and industrial operations.

The market no longer views satellite as a last resort or single-segment use case, but as a flexible layer of connectivity that complements and extends terrestrial networks.

Spectrum as the Foundation

What distinguishes long-term leaders in this space is not only orbital assets or throughput, but spectrum. Globalstar has approached this market as a spectrum-first telecom operator, uniquely positioned with L- and S-band holdings for its LEO constellation and Band 53 (n53) for terrestrial private LTE/5G. This dual foundation creates infrastructure optionality: satellite when needed, terrestrial when ideal. In a segmented market where many players pursue single-dimensional strategies (LEO-only, data-only, or space-only), Globalstar is building bridges between segments.

Hybrid Architectures for Real-World Demands

Hybrid architectures are emerging as the critical enabler for NTN. Enterprise and government customers do not operate in “satellite-only” or “cellular-only” environments. They require seamless, cost-effective infrastructure that allows them to build networks where and when needed. Globalstar’s bent-pipe architecture is a differentiator here: it supports cost-effective scaling and allows ground infrastructure to be upgraded without relaunching satellites. That translates into rapid innovation cycles and direct compatibility with both terrestrial and satellite deployments.

This matters because real-world deployments can’t wait for standards to catch up. While some NTN providers are betting heavily on full standardization before deployments scale, Globalstar’s model is standards-aware, not standards-constrained. Band n53 is standardized under 3GPP, giving it global legitimacy, but Globalstar’s infrastructure supports NTN-aligned architectures today. This flexibility enables enterprises to begin deploying solutions now, while ensuring alignment with future global standards.

Diversification Across Verticals

The market’s verticalization is one of the most striking shifts since even a decade ago. Satellite IoT is no longer confined to asset tracking in remote areas. It is underpinning safety in construction, compliance in energy, visibility in logistics, and precision in agriculture and forestry. These applications depend on low-power, reliable devices, and affordable connectivity – areas where Globalstar’s portfolio is built to compete.

By combining low SWaP-C (size, weight, power, cost) devices with global LEO coverage and terrestrial spectrum for high-capacity environments, Globalstar enables both broad reach and dense deployments. This is especially valuable for enterprises experimenting with hybrid digital twins, condition monitoring at scale, and real-time decision-making across fleets or field operations.

The Strategic Lens

The real differentiators in satellite communications are shifting. Orbital position and raw throughput are no longer the only metrics that matter. Instead, the focus is on how spectrum is leveraged, how hybrid networks are enabled, and how enterprises can scale deployments without undue cost or complexity.

Globalstar’s positioning as both a satellite operator and spectrum holder allows it to function less like a niche satcom provider and more like a telecom infrastructure player. This approach acknowledges that IoT is not monolithic: it is a segmented, highly distributed market with different connectivity needs by geography, vertical, and application. By building bridges between satellite and terrestrial, and by offering flexible, spectrum-backed options, Globalstar is aligning itself with the way enterprises and governments are actually deploying IoT today.

Looking Ahead

As this report has explored, the satellite IoT market is evolving rapidly, with new entrants, constellation launches, and partnerships reshaping the landscape. But the companies that will define the next decade are those that can transcend single-technology bets and deliver hybrid, resilient, and standards-aware solutions.

Globalstar’s infrastructure optionality, spectrum-first strategy, and bent-pipe architecture provide the foundation for this next phase. In a fragmented market, Globalstar is uniquely focused on building the bridges that enterprises, governments, and integrators require, which is delivering connectivity not as an abstract capability but as a practical, scalable tool for real-world IoT applications driving safety, productivity, and resilience.

This report was produced by Transforma Insights in collaboration with sponsors Globalstar

TRANSFORMA INSIGHTS

Transforma Insights is a leading research firm focused on the world of IoT, AI and Digital Transformation (DX). Led by seasoned technology industry analysts we provide advice, recommendations and decision support tools for organisations seeking to understand how new technologies will change the markets in which they operate.

www.transformainsights.com

Globalstar™

Globalstar is a global telecommunications provider connecting what matters most. Through our industry-leading low Earth orbit (LEO) satellite constellation and licensed Band 53/n53 spectrum, we deliver reliable satellite and terrestrial connectivity solutions that empower customers worldwide to connect, transmit, and communicate smarter.

Our comprehensive connectivity ecosystem includes software-defined, purpose-built private wireless network platform, coupled with Globalstar Band 53 in XCOM RANTM and trusted GPS messengers Saved by SPOTTM for safety and personal communication for business and enterprise applications.

Serving business, enterprise, and consumer markets across the globe, Globalstar supports applications that track and protect assets, enable automation, enhance operational efficiency, and safeguard lives. With un-matched reach and a relentless focus on innovation, and mission-critical performance, we're redefining what's possible for global connectivity.

To learn more, visit www.globalstar.com.