Unlocking new markets with satellite for IoT

Introduction

Satellites are becoming a vital enabler of the Internet of Things (IoT), extending connectivity far beyond the reach of terrestrial networks. By providing global, reliable, and scalable communication links, satellites ensure that IoT devices can operate seamlessly across borders, in remote locations, and during critical situations where other networks may fail. This universal coverage not only unlocks new applications, from agriculture and logistics to environmental monitoring and safety, but also simplifies deployment and management through standardised global solutions. As IoT continues to expand, satellite connectivity will be essential to achieving a truly connected and resilient world.

Introducing satellite connectivity for the Internet of Things

Satellites play an increasingly important role in supporting the Internet of Things (IoT) by providing global connectivity, especially in remote or underserved regions where terrestrial networks are unavailable. They enable seamless data transmission between IoT devices and central systems, ensuring real-time monitoring and control of assets. Crucially, satellite-based communications can be homogenous across multiple geographies, or even potentially worldwide, whereas any terrestrial network that extends across multiple geographies must necessarily be a patchwork combining multiple local, national, telecommunications providers. This global reach helps create a truly connected world, bridging communication gaps everywhere.

Satellite support for IoT devices is particularly beneficial in a diverse set of scenarios. Firstly, some IoT applications are required to operate across national boundaries, or even globally. These include IoT applications such as Container Tracking, Supply Chain Monitoring, Stolen Vehicle Recovery, some Vehicle Telematics Devices, and connections to Fishing Vessels and Pipeline monitoring.

A second group of IoT applications that are well-suited for satellite connectivity are required to operate on the limits of terrestrial cellular coverage, and often in areas that are not covered by such networks. This group includes applications such as Livestock Monitoring, Environment Monitoring, Rail Freight Vehicle Management, some Industrial Process Remote Control devices, Crop Irrigation, and more.

The third group of IoT applications well-suited to satellite connectivity includes connected devices that may not often stray beyond the reach of terrestrial networks, but for which connectivity is particularly valuable when they do. These include applications such as People Tracking Devices (either Assisted Living or for remote activities), automotive eCall, Child Tracking and Pet Tracking.

A final group of IoT applications may potentially benefit from the use of satellite connectivity for control and oversight or for fallback connectivity, for instance in the case of Unmanned Autonomous (broader application which is accurate for sat IoT) Vehicles (UAVs, or 'drones') the operating parameters within which the drone can be operated might be controlled via satellite communications independently of any pilot inputs.

In all of these cases, satellite connectivity for IoT unlocks new potential for the IoT applications in question by ensuring that devices can remain connected irrespective of location, including in very remote locations. Furthermore, the satellite networks providing such coverage can do so in a way that is completely homogenous wherever devices are located in the world, unlocking potential for significantly simpler IoT solutions that do not need to take into account the fragmented nature of terrestrial networks, either as part of solution design or ongoing service management. Critically, it also means that any provider of satellite connected IoT solutions is able to relatively easily address global markets.

Some specific examples of satellite connected IoT applications and associated benefits are highlighted in Figure 1, right.

In these contexts, one-way satellite communication is useful for IoT applications that only require data transmission for monitoring purposes, such as remote sensing, asset tracking, or environmental monitoring. It allows devices to send information from isolated or mobile locations where terrestrial networks are unavailable, offering wide coverage and energy efficiency. However, two-way satellite communication is often more advantageous for IoT because it enables both data transmission and reception. This allows for remote configuration, command control, software updates, and real-time interaction with devices. Two-way connectivity enhances reliability, scalability, and responsiveness which are often critical considerations for industrial automation, smart agriculture, and mission-critical IoT applications requiring feedback loops. The application of two-way satellite services for IoT extends to include solutions such as irrigation control in agricultures, condition management in refrigerated supply chains, traffic control in smart cities, and various grid management applications in utilities contexts.

Figure 1: Satellite IoT: Selected case studies

Name	Benefits
CERES TAG, Remote Animal Health Monitoring	• Ear tag for cattle tracks GPS location and behaviour in remote locations. • Monitors feeding efficiency, weight gain, milk production, health and methane emissions. • Supports pasture allocation, breeding strategy, and regulatory reporting.
Lonestar Tracking, Asset Tracking for Oil & Gas	• Intrinsically safe monitoring devices for mobile assets, with GPS and solar powered options supporting global operations. • Tracks costly, complex equipment going to remote regions anywhere in the world. • Remote monitoring of flow meters, liquid storage, compressors, generators, pumps and more.
Spotter, Monitoring Free Roaming Horses	• Collars worn by horses roaming free on the Asian Steppe. • Location monitoring and boundary control across a vast and sparsely populated terrain. • Animals can be tracked even when they migrate over 1,000km in search of grazing.
TGI Connect, Sensors for Trailers	• Sensors for transportation trailers, enabled by AI and edge computing with no coverage white spots. • Provides insights into trailer performance, including location, temperature, door open, cargo and other crucial parameters. • Supports identification of trends, downtime minimisation, fleet optimisation and new revenue streams.

Source: Globalstar

Artificial intelligence will stimulate the adoption of satellite for IoT

IoT devices can generate significant amounts of potentially valuable data and artificial intelligence (AI) can be applied to this data in many locations, including 'cloud' data centres, various network edge locations, and on board the actual IoT devices themselves. All of these approaches have the potential to unlock significant value and new insights from IoT data.

In this context, artificial intelligence IoT (AIoT) refers to specifically the deployment of AI capabilities onboard IoT devices. This is currently a particularly fast-developing aspect of many IoT application markets and can bring significant benefits, including improved performance, enhanced compliance, privacy and security and potentially reduced operational costs.

In the case of satellite communications in particular, by supporting the execution of sophisticated analyses locally, AIoT can significantly reduce the data communication requirements associated with otherwise data-intensive IoT applications. Accordingly, AIoT can unlock the potential for satellite IoT solutions to be deployed in more diverse and previously marginal situations. For instance, AIoT enabled CCTV cameras can be deployed to monitor locations where activities are expected to be infrequent, potentially to monitor an 'out of bounds' location in a remote industrial complex. Such a solution could be configured to only communicate small amounts of data when activity is detected, so minimising bandwidth costs while reducing the need for security guards to monitor the same location.

Accordingly, the rapidly accelerating adoption of AIoT to enhance today's IoT solutions is likely to further stimulate the adoption of satellite connectivity for IoT by enabling much more effective use of satellite bandwidth and increasing the IoT market opportunity for satellite connectivity.

AIoT can unlock the potential for satellite IoT solutions to be deployed in more diverse and previously marginal situations

Markets for satellite IoT will grow quickly

With such a diverse array of IoT application opportunities for satellite connectivity, it is clear that the market for such connections will grow quickly. Transforma Insights IoT Market Forecasts are based on ultra-granular analysis of approaching 270 IoT applications in each of 196 countries worldwide. As illustrated in Figure 2, below, we forecast that the total number of satellite IoT connections will grow from 8.8 million at the end of 2024 to around 46.1 million at the end of 2034, an annual growth rate of 18%. In 2034, the regions with most connections will be North America, Greater China, and Europe accounting for 30%, 24% and 19% of worldwide connections respectively. The regions with the fastest growing numbers of connections will be India & South Asia, Greater China, and Australasia with annual growth rates of 23%, 20%, and 20% respectively over the period from 2024-2034.

As illustrated in Figure 3, below, the IoT applications associated with these connections will be diverse. In 2034, around 31% of the total 46 million connections will be associated with Unmanned Aquatic & Aerial Vehicles (or Drones), another 14% with Container Tracking, 10% with Vehicle Head Units, and 7% with various Track & Trace applications.

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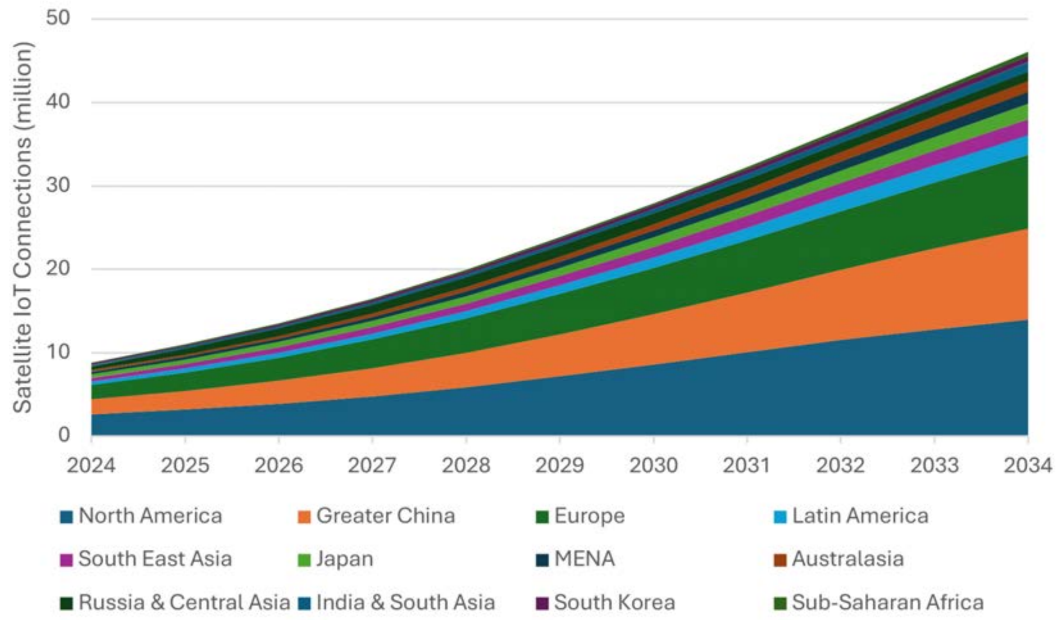
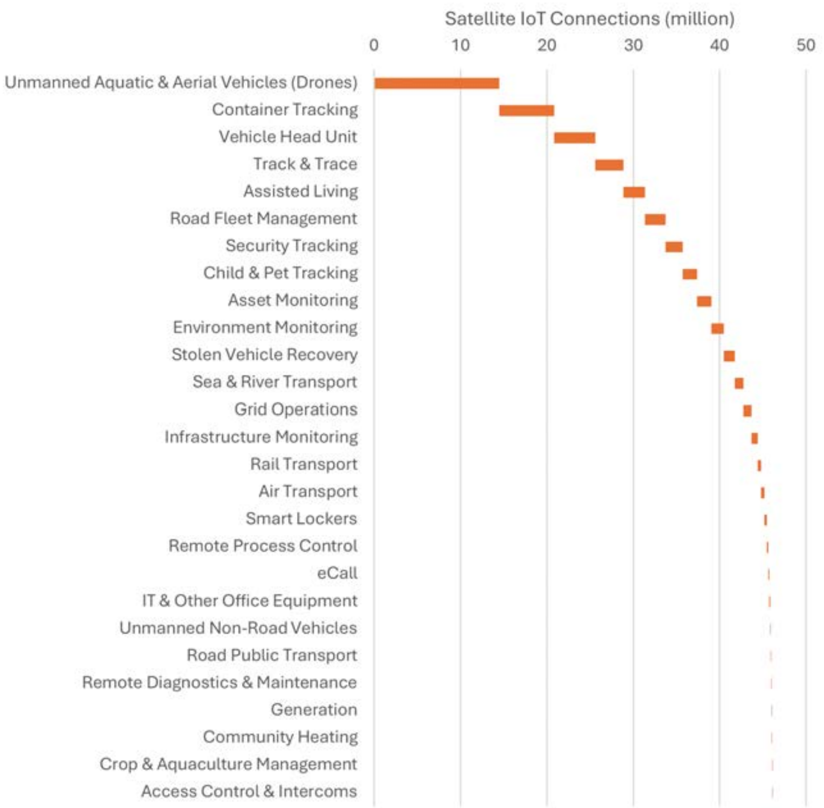
Figure 2: Satellite IoT Connections, by Region, 2024-2034



Source: Transforma Insights

Figure 3: Satellite IoT Connections, by Application, 2034



Source: Transforma Insights

Key aspects of satellite networks for IoT

Supporting satellite communications for Earthbound IoT devices is a complex endeavour, involving satellite constellations that might differ in their orbital altitude, onboard processing capabilities, and also coordination with ground stations. Each of these aspects is discussed in more detail below.

The primary differentiating factor between satellite constellations is that they are typically categorised into one of three different orbital altitude ranges, each with different advantages and disadvantages.

- Low Earth Orbit (LEO) satellite altitudes range from about 160 to 2,000 km and such satellites are used for Earth observation, imaging, and communication networks. LEO satellites benefit from low latency, however, they will move across the sky from the perspective of a fixed location on Earth, resulting in more complex satellite system requirements to support messages sent in either direction between Earthbound devices and LEO satellites.
- Geostationary Orbit (GEO) satellites orbit at approximately 35,786 kilometers (22,236 miles) above the equator, where satellites appear stationary relative to Earth's surface. GEO satellites are ideal for television broadcasting and for communications networks, for which they can offer a fixed point for Earthbound devices to send transmissions to, resulting in a significantly simpler system architecture than for LEO-based communications networks albeit at the cost of higher latency.
- Medium Earth Orbit (MEO) satellite altitudes span from 2,000 to 35,786 km and typically include navigation satellites such as GPS, Galileo, and GLONASS. MEO satellites are only rarely used for communications networks, since they do not offer the benefits of either LEO (low latency) or GEO (fixed location in the sky) alternatives.

Ground stations are essential components of the satellite system. They handle communication with satellites, manage tracking and control, and process received data. Together, satellites and ground stations form integrated networks enabling global connectivity, navigation accuracy, and real-time Earth observation.

Another critical aspect of satellite systems is the functionality of the actual satellites themselves, with two main architecture types: bent-pipe and onboard processing. A bent-pipe satellite simply relays signals from an uplink (ground-to-satellite) to a downlink (satellite-to-ground) without modification, acting as a "mirror in the sky". In contrast, onboard processing can allow the satellite to demodulate, filter, switch, or route signals before retransmission, improving efficiency in transmissions to and from ground stations in particular. However, bent-pipe satellite architectures are easier to design and build and are more flexible in operation since processing control can be managed from ground stations.

The end user benefits of satellite connectivity for IoT

The end-user benefits of satellite connectivity for IoT are manifold. It enables real-time monitoring and supports innovative propositions that would otherwise be impossible, expanding the range of potential IoT applications. By connecting all of an end user's assets, not just those located near populated areas, it delivers comprehensive, end-to-end solutions with holistic inclusion of an end-user's entire device estate.

With global coverage, satellite networks eliminate the roaming challenges often associated with terrestrial networks. This allows for the use of a single global device SKU and potentially a unified solution proposition to address global markets. The resulting homogeneity and simplicity of IoT solutions helps to reduce operating costs while improving efficiency and enables an efficient global marketplace for solutions.

Satellite connectivity also offers excellent scalability, making it ideal for highly distributed operations. It provides reliable connectivity during disasters, when communication can be most critical for certain IoT applications, and is particularly cost-effective for remote areas. Finally, it enhances resilience and redundancy, ensuring that connectivity remains robust and dependable under a wide range of conditions.

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Conclusion

Satellite connectivity is rapidly emerging as a cornerstone of the IoT, enabling devices to remain connected anywhere on the planet. Unlike terrestrial networks, which are limited by geography and infrastructure, satellites provide homogenous and seamless global coverage, ensuring continuous data exchange across borders and in remote or underserved areas. This capability is crucial for industries such as agriculture, transportation, energy, and environmental management, where assets are often widely distributed. Satellite networks offer reliability, scalability, and resilience. By enabling standardised global device configurations supported by a consistent connectivity solution, they simplify deployment and reduce operational complexity. As IoT ecosystems grow and diversify, satellite technology will play a pivotal role in supporting real-time monitoring, automation, and intelligent decision-making in a wide range of contexts.

About 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 RAN™ and trusted GPS messengers Saved by SPOT™ 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 unmatched reach and a relentless focus on innovation, and mission-critical performance, we're redefining what's possible for global connectivity.

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