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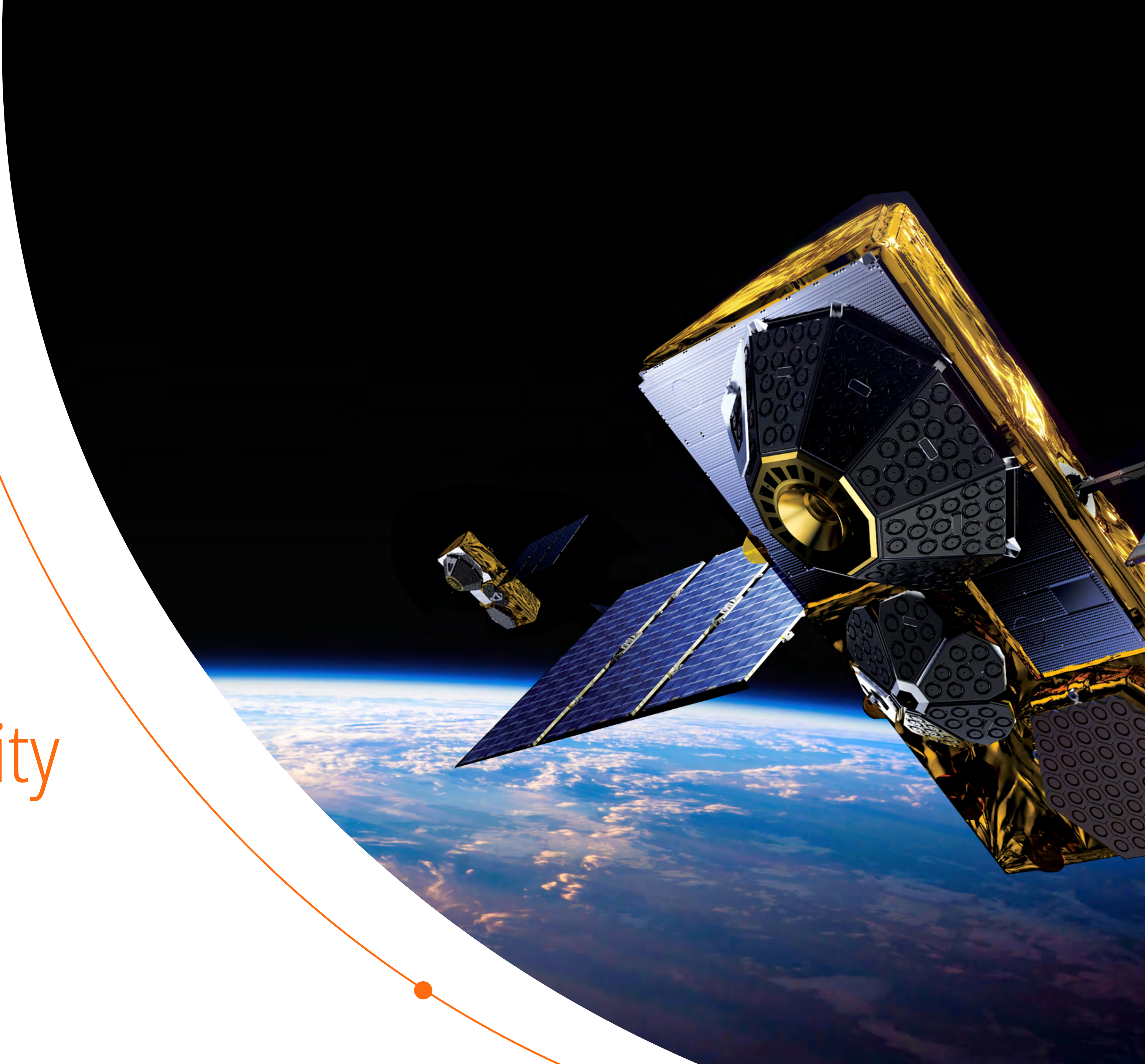
Satellite for IoT: A World of Affordable, Repeatable Connectivity

The Internet of Things (IoT) has revolutionized industries by enabling real-time monitoring, automation, and data-driven decision-making. However, one of IoT deployments' most significant challenges is connectivity – ensuring that devices remain online regardless of location, network infrastructure, or environmental conditions. Traditionally, cellular networks have been the default option for IoT connectivity, but satellite technology has emerged as an affordable, scalable, and reliable alternative that can provide coverage even in the most remote locations.

With advancements in Low Earth Orbit (LEO) satellite technology, satellite connectivity is no longer an expensive, complex option limited to government and enterprise applications. Today, it is an accessible, repeatable, and cost-effective solution for many IoT deployments, from low-complexity one-way communications (Massive IoT) to highly interactive, two-way mission-critical IoT applications.

The Evolution of Satellite Connectivity: Affordability and Accessibility

Historically, satellite connectivity was associated with high costs, bulky infrastructure, and complex integration requirements. Geostationary (GEO) satellites, positioned 35,786 km above Earth, required large, expensive ground stations and suffered from high latency and signal degradation. However, the rise of LEO satellites, which orbit at 500-1,500 km altitudes, has drastically reduced costs and improved performance.

Traditional satellite networks, not low-power IoT devices, were designed for high-bandwidth applications, such as broadcasting and military communications. IoT sensors operate on minimal power, and earlier satellite solutions drained batteries too quickly, making them inefficient for long-term deployments.

Additionally, early satellite networks required custom integration, lacked plug-and-play compatibility with IoT platforms and did not support industry-standard protocols. This created a significant barrier to adoption – making cellular and Wi-Fi the preferred options for IoT deployments.

Today, advancements in LEO satellite networks and reduced costs have eliminated many of these challenges, making satellite connectivity a viable, scalable, and affordable option.

LEO satellite technology has reduced the cost and size of satellite-connected devices by simplifying antenna requirements. Because LEO satellites orbit closer to Earth, compatible devices can use lower-power signals, thereby less complex antennas, eliminating the need for larger, more complex, omnidirectional antennas for GEO-compatible devices.

Less complex antennas create a cheaper, more compact device, which helps to reduce hardware costs overall and improve portability. This low-energy approach helps optimize battery power, which also boosts the benefits of compact, lower-cost devices well suited for IoT applications.

A Quick Overview of How Satellite Works

Satellite communications enable wireless data transmission by relaying signals between a ground-based sender and receiver using orbiting satellites. This technology allows for global connectivity, overcoming the limitations of terrestrial wireless networks.

The Key Components of Satellite Communications

Satellite communication involves three main components:

Ground stations
These Earth terminals are fixed or mobile units that send and receive signals to and from satellites

Satellites in orbit
Satellites act as relay stations, transmitting signals between ground stations and user devices

User equipment
Devices such as IoT sensors, GPS receivers, and tracking systems communicate via satellite

The Communication Process

Communication between satellite, device, and ground station works in three stages:

1 **Uplink**

The user device sends a signal to a satellite in orbit

2 **Relay**

The satellite receives, amplifies, and redirects the signal to and from a ground station (s)

3 **Downlink**

The signal is transmitted from the satellite to the user device.

This process enables data transfer over vast distances without requiring terrestrial infrastructure.

The Different Types of Satellites

There are three main types of satellite orbits:

Low Earth Orbit (LEO), highly compatible with IoT	**Medium Earth Orbit (MEO),** which is well-positioned for GPS and navigation systems	**Geostationary (GEO),** for broadband applications

How Globalstar's Satellite Works

Globalstar's satellite connectivity leverages low-latency, low-power, small-packet data to enhance battery life and ensure better efficiency for IoT devices. It leverages mid-band spectrum for optimized coverage capacity and data speed.

This is delivered through a LEO satellite constellation, which allows for smaller, lower-cost terminals and less signal latency than other networks.

Globalstar uses a bent-pipe architecture, which enables easier data processing and technology upgrades at the ground stations. This keeps raw data secure over the air and allows network enhancement without the need to launch new satellites, thereby improving network operability.

What is Bent-Pipe Architecture in Satellite Connectivity?

Bent-pipe architecture is a satellite communication model where a satellite acts as a passive signal relay, transmitting data between ground stations and user terminals without processing or altering the signal. The satellite simply receives, amplifies, and redirects the signal to Earth, similar to how a mirror reflects light.

The advantages of this type of architecture include:

✓ **Low complexity:** The satellite does not process data, which reduces design complexity and data security.

✓ **High throughput:** Since the satellite only relays signals, it can handle data efficiently.

✓ **Reliable and cost-effective:** Satellites using this architecture are easier to develop and maintain without onboard processing.

Why Satellite Connectivity Can Outperform Cellular Connectivity in IoT Applications

While cellular networks (LTE and 5G) are widely used for IoT, they have significant limitations, especially in remote, high-mobility, or mission-critical applications. Satellite connectivity is a powerful alternative, offering global coverage, reliability, and resilience where cellular networks struggle in case of natural disasters or when cellular networks are offline.

Global Coverage Without Dead Zones

One of the biggest challenges with cellular connectivity is coverage gaps. Cellular networks depend on terrestrial infrastructure, including towers, fiber optics, and base stations, limited to populated areas.

This creates dead zones in:

- Remote locations, such as deserts, oceans, and rural areas

- Industrial sites, including mines, oil rigs, offshore platforms, and pipelines

- Logistics and fleet operations, like global cargo shipping, aviation, and trucking

Satellite networks, particularly LEO constellations, offer borderless, continuous coverage anywhere in the world. This makes satellites indispensable for industries that require real-time connectivity, no matter how remote their operations.

Reliable, Disaster-Proof Connectivity

Cellular networks are highly dependent on physical infrastructure, making them vulnerable to:

Natural disasters, like hurricanes, earthquakes, floods, and wildfires

Power outages that disrupt network towers

Cyberattacks targeting centralized telecom providers

Satellite connectivity, by contrast, can be more resilient than cellular infrastructure, particularly in emergencies. Globalstar offers unprecedented network resiliency by having multi-path satellite capability and multiple redundant ground stations to eliminate single points of failure.

This allows IoT devices using satellite connections to continue to transmit data, track assets, and coordinate responses, creating a major advantage for:

- ✓ Disaster recovery teams
- ✓ Disaster relief logistics
- ✓ Critical infrastructure monitoring
- ✓ Military and defense operations

Flexibility in Regulatory and Cross-Border Deployments

Cellular connectivity is subject to local spectrum regulations and licensing agreements, which can complicate cross-border IoT deployments. Companies operating across multiple countries must navigate roaming agreements, compliance issues, and coverage inconsistencies when leveraging cellular, with multiple Mobile Network Operator or Mobile Virtual Network Operator agreements that must be patchworked to create coverage, leading to operational complexities.

While satellite operators must navigate authorization per country, it is a less complex problem and is the onus of the satellite operator, not the end user. Globalstar's satellite spectrum is globally coordinated, which helps deliver consistent, borderless, and scalable connectivity.

For businesses operating across multiple regions, leveraging a satellite connectivity provider instead of relying on cellular networks simplifies cross-border operations and reduces administrative overhead. Satellite connectivity enables a ubiquitous network quality across the entire coverage footprint, predictable monthly data costs, eliminating the need to work with multiple roaming partners and adjust for billing discrepancies that often arise when using different regional cellular providers. This reduces costs and saves time and resources that would otherwise be spent reconciling varying network charges, negotiating new agreements, and troubleshooting inconsistent service coverage. With satellite connectivity, businesses can achieve seamless, uninterrupted communication and network reliability, ensuring operational efficiency regardless of geographic boundaries.

Predictable, Repeatable Connectivity

Reliability in IoT isn't just about staying connected – it's about ensuring consistent and predictable network performance.

Cellular networks can suffer from fluctuations in connectivity and bandwidth available due to:

- Network congestion from high user demand

- Interference from nearby signals and spectrum limitations

- Changing regulatory conditions and licensing restrictions

Satellite connectivity provides repeatable network performance by maintaining consistent coverage across all connected devices, regardless of location. Unlike cellular, which may experience dropped connections and fluctuating bandwidth, satellite ensures steady, predictable data transmission.

Scalability Without Infrastructure Limitations

Expanding a cellular-based IoT network can require building new towers, expanding fiber networks, or navigating complex regulatory approvals.

Satellite connectivity can eliminate these barriers, allowing businesses to:

- Scale operations globally without infrastructure buildout or roaming agreements

- Deploy IoT devices anywhere without needing network expansion

- Ensure seamless, repeatable connectivity across regions

One-Way or Two-Way Satellite Communications

Satellite connectivity can offer either one-way or two-way communications. Both technologies have been on the market, but two-way has become a more viable option due to its greater affordability compared to the past.

One-Way Satellite Communication: Reliable, Cost-Effective, and Scalable

Advantages of One-Way Satellite

✓ **Highly reliable**
Simple, efficient transmission with minimal failure points

✓ **Cost-effective**
Low power coupled with inexpensive hardware requirements make it ideal for large-scale IoT deployments

✓ **Energy efficient**
One-way devices run on low power and can last for years on battery power

✓ **Well-aligned with Massive IoT**
Best suited for applications where real-time control isn't necessary, but continuous data monitoring is important

Use Cases for One-Way Satellite Communication

Asset tracking
Monitoring vehicle fleets, shipping containers, wildlife or livestock

Environmental monitoring
Sending periodic updates on temperature, air quality, or weather conditions

Industrial monitoring
Reporting pipeline pressure levels, structural integrity, or seismic activity

Remote industrial control

Adjusting pipeline flow, turning equipment on/off, or managing energy distribution remotely

Disaster response and emergency services

Enabling two-way communication when terrestrial networks fail, allowing for coordinated rescue efforts

Use Cases for Two-Way Satellite Communication

Two-Way Satellite Communication: Real-Time, Actionable, and Interactive

Advantages of Two-Way Satellite

✓ **Enables real-time decision-making**
Devices not only transmit their data but can receive commands to adjust operations dynamically

✓ **Support automation and AI-driven processes**
Smart systems can react to changing conditions without human intervention

✓ **Increases operations efficiency**
Reduces downtime by allowing remote troubleshooting and adjustments

✓ **More affordable than ever**
Technological advancements have lowered costs, making two-way communication viable for broader use cases

Why Two-Way Satellite Communication is on the Rise

Due to their cost and complexity, two-way satellites were previously limited to mission-critical applications. However, advances in low-cost satellite modules, LEO networks, and efficient power management have made two-way satellites far more accessible. Businesses and industries can now leverage real-time control without excessive costs, driving new automation, security, and efficiency innovations.

That said, one-way satellite communication remains a crucial, cost-effective, and scalable solution for many IoT applications. The key is choosing the proper communication based on operational needs – whether continuous monitoring through one-way or real-time action through two-way. As satellite technology continues to evolve, the future of connectivity will be shaped by combining both approaches, ensuring industries stay connected wherever they operate.

Satellite Use Case Roundup

Cellular and wireless connectivity work well in many IoT use cases, but there are also use cases where satellite connectivity outperforms cellular or wireless networks, ensuring reliable, global, and uninterrupted communication:

Remote Industrial Operations
Oil and gas pipelines, for example, can monitor flow rates, detect leaks, and adjust pipeline operations in areas beyond cellular reach

Maritime and Offshore Connectivity
In commercial shipping and fishing applications, satellite connectivity can be used to track vessels, send catch data, and enable emergency communications far from shore

Disaster Response and Emergency Services
Search and rescue teams can maintain critical communications when terrestrial networks fail due to natural disasters
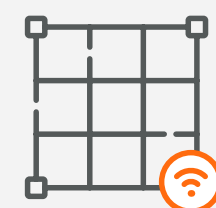
Critical Infrastructure Monitoring
Power grids and utilities can be equipped with satellite-connectivity-based IoT devices to remotely manage substations, detect faults, and optimize energy distribution

Global Supply Chain and Logistics
Cargo and fleet tracking can use satellite-connectivity IoT solutions to monitor shipments in transit across borders and remote highways without reliance on local cellular networks

Agricultural Monitoring
Numerous components of agriculture can be tracked, including soil moisture, weather conditions, and livestock in remote farms where cellular networks are unavailable or unreliable
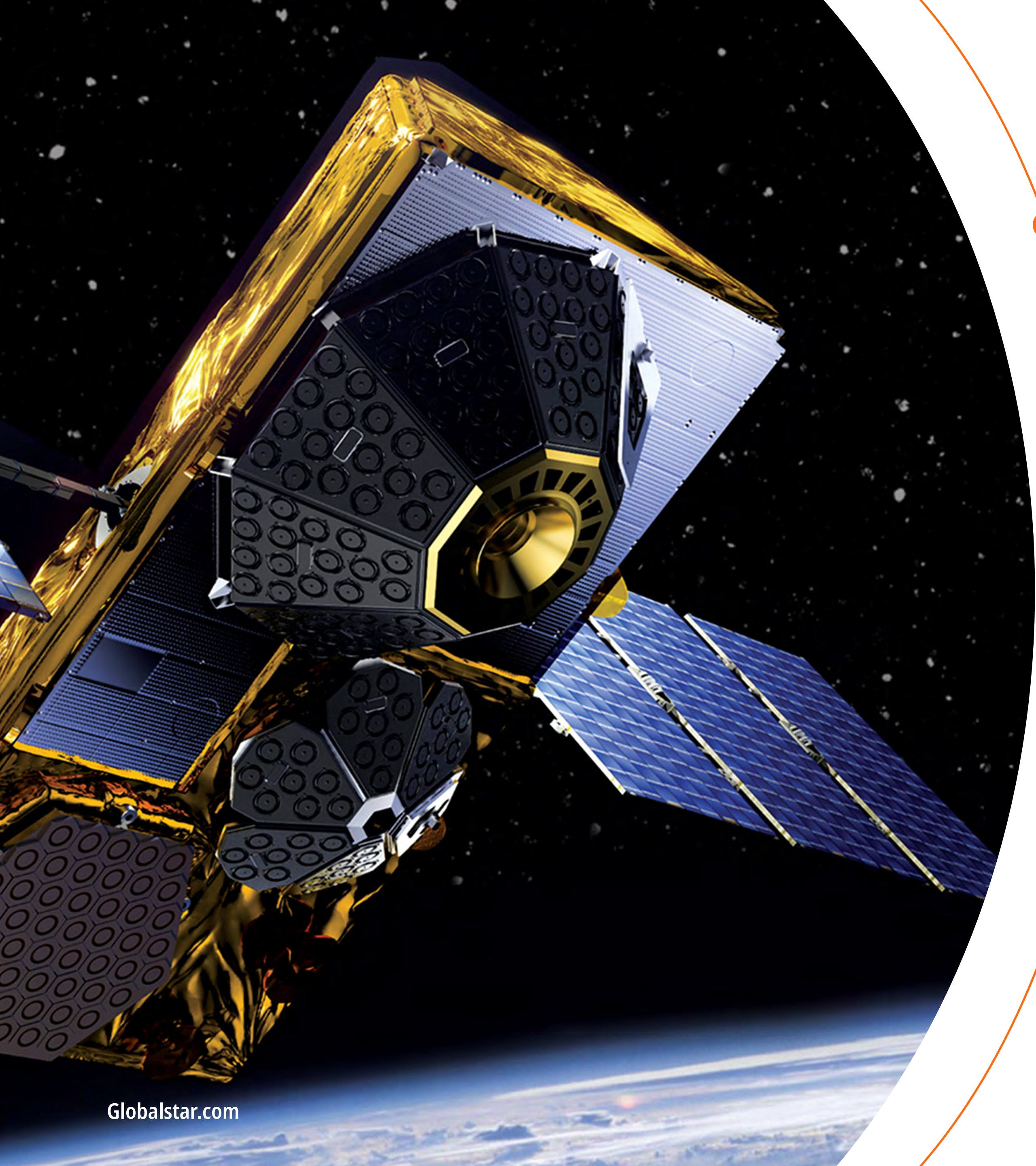
Mining
Worker safety can enable real-time tracking in remote open pit mining sites without terrestrial network dependencies

Military and Defense Communications
Secure, resilient command-and-control communications in areas with no terrestrial

A Look at Globalstar's Robust Satellite Offering

Globalstar operates a robust and reliable LEO satellite network, delivering unparalleled application connectivity. With industry-leading reliability, low-latency performance, and global coverage, Globalstar's satellite solutions empower businesses, governments, and individuals with seamless communication in the most remote and challenging environments.

Our network excels in asset tracking, IoT solutions, emergency response, and mobile satellite services, providing cost-effective and scalable connectivity. Whether enabling critical safety operations or powering innovative industrial applications, Globalstar's LEO technology ensures always-on, mission-critical connectivity where it matters most.

Here are a few examples of where Globalstar's satellite connectivity made the difference.

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Revolutionizing Pipeline Monitoring with Globalstar Connectivity

Millions of miles of underground pipelines transport critical resources, yet corrosion threatens their integrity daily. While cathodic protection (CP) systems extend pipeline life, traditional monitoring methods require costly, time-consuming site visits – especially in remote areas – leading to delays in detecting potential failures.

MOBILTEX, a leader in Industrial IoT, provides wireless CP monitoring solutions that deliver real-time performance data and remote-control capabilities. Its CorTalk products install easily in CP system cabinets, automatically alerting operators to issues and enabling synchronized testing via the CorView cloud platform. However, many pipelines extend beyond cellular coverage, requiring a more reliable connectivity solution.

By integrating Globalstar's STX3 satellite transmitters, MOBILTEX ensures seamless data transmission from CP systems worldwide. Globalstar's low-cost, low-power satellite technology allows continuous monitoring without field visits, reducing operational expenses and improving data accuracy.

Globalstar's satellite network delivers affordable, always-on connectivity, empowering industries to enhance safety, efficiency, and infrastructure longevity. Whether monitoring pipelines, remote assets, or critical infrastructure, Globalstar ensures businesses stay connected when it matters most.

Enhancing Ocean Current Tracking with Globalstar Connectivity

For over a decade, NOAA has relied on coastal Doppler radar to track ocean surface currents, which is critical for Coast Guard search-and-rescue operations and for monitoring hazards like oil spills. However, radar accuracy is increasingly challenged by large vessels and offshore wind farms, requiring new verification methods.

The Woods Hole Oceanographic Institution (WHOI) launched a study comparing Doppler data with real-time ocean drift patterns to address this. Researchers deployed wooden "drifters" equipped with Globalstar's SmartOne C GPS trackers, which provided continuous position updates via the Globalstar satellite network. These trackers offered a reliable, low-power, cost-effective solution for transmitting data, even in remote offshore environments.

WHOI assessed how wind turbines impact radar accuracy by overlaying GPS-tracked drift patterns onto NOAA's radar data. The findings will help NOAA refine its tracking methods and ensure reliable ocean current monitoring as offshore infrastructure expands.

Globalstar's satellite technology enabled precise, real-time ocean monitoring, supporting vital research that enhances maritime safety and environmental protection. Whether for ocean studies, asset tracking, or critical communications, Globalstar delivers the dependable connectivity needed to explore and protect the world's waters.

Smart Ranching: How Ceres Tag and Globalstar Revolutionize Livestock Management

Ranching is a high-risk industry with unpredictable weather, labor shortages, and financial uncertainty. Modern ranchers need digital solutions to monitor their widely dispersed livestock efficiently.

Enter Ceres Tag, an Australian company that developed the world's first IoT-enabled ear tag for cattle. This small, lightweight device tracks GPS location and motion through an accelerometer, analyzing data to provide insights on feeding efficiency, weight gain, health, and even methane emissions. Ranchers access this data via a secure cloud platform, enabling smarter herd management, regulatory compliance, and alerts for unusual activity like injury or theft.

At the heart of Ceres Tag's success is Globalstar's ST150 satellite transmitter chip, which ensures affordable, low-power global connectivity. Ranchers receive real-time, reliable data on each animal, not just herd averages. The platform's open API extends its reach beyond ranching, supporting band insurers, conservationists, and wildlife tracking for over 30 species worldwide.

Now operating in 36 countries, Ceres Tag is transforming livestock management and wildlife monitoring, proving that smart data leads to smarter decisions. With Globalstar's connectivity, even the most remote ranches can stay ahead in a rapidly evolving industry.

Ready to Learn More?

Globalstar's powerful LEO satellite connectivity and hardware can drive new innovations, support existing solutions, and help scale worldwide.

[Contact our team](#) of connectivity experts to learn more.

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