

# Advancing Next-Generation Connections for Tomorrow



LIGADO NETWORKS MARKET VISION

September 2016

[Ligado.com](http://Ligado.com)

# OVERVIEW

Ligado Networks is planning to deploy an advanced satellite-terrestrial network that will enable mission-critical IoT applications and emerging 5G use cases that require pervasive, highly secure and ultra-reliable connectivity.

## WHAT IS AN ADVANCED SATELLITE-TERRESTRIAL NETWORK?

As mobile communications evolve, connectivity infrastructures have developed from a collection of protocols and gateways to a standard packet-based architecture. This enables high-quality services to be delivered over all-IP networks to form a platform for continued innovation and advanced capabilities. The next-generation of wireless technology, known as 5G, will vastly increase network speeds, support massive connection density and markedly improve network reliability.

While mobile networks will eventually implement 5G technology, various next-generation use cases—particularly in the emerging Internet of Things (IoT) market—can be enabled with the deployment of advanced networks, which require unencumbered greenfield spectrum. Thanks to a combination of technological advancements as well as engineering and commercial breakthroughs, there is an immediate opportunity to expand combined satellite and terrestrial uses of mid-band spectrum—the frequencies between 1500 MHz and 1700 MHz—while protecting important existing users. Mid-band spectrum represents a prime greenfield opportunity to meet the needs of these advanced networks and enable emerging 5G use cases by delivering pervasive, highly secure and ultra-reliable connectivity.

## CREATING AN ADVANCED SATELLITE-TERRESTRIAL NETWORK FOR MISSION CRITICAL IOT

Evolving our satellite network into a model that integrates terrestrial connectivity is a “best of both worlds” approach that will increase network capacity, support higher speeds and expand network capabilities to deliver end-to-end security, high-precision location capabilities and ultra-reliable mobile connectivity.

Based on satellite and terrestrial use of mid-band spectrum, Ligado’s advanced mobile network will enable seamless connectivity no matter what part of the network is utilized. Our all-IP architecture will ensure effective delivery of high-quality services over both narrowband and broadband channels. Our terrestrial deployment model will allow Ligado’s partners to design networks customized for their unique requirements.

---

**“As mobile networks in the United States evolve to serve the emerging 5G market, Ligado’s vision for an advanced network—one that will enable satellite and terrestrial use of mid-band spectrum—represents an innovative way to accelerate delivery of next-generation connectivity to serve the demands of mission-critical industries that benefit our entire country.”**

—IVAN SEIDENBERG Chairman of the Board, Ligado Networks

---



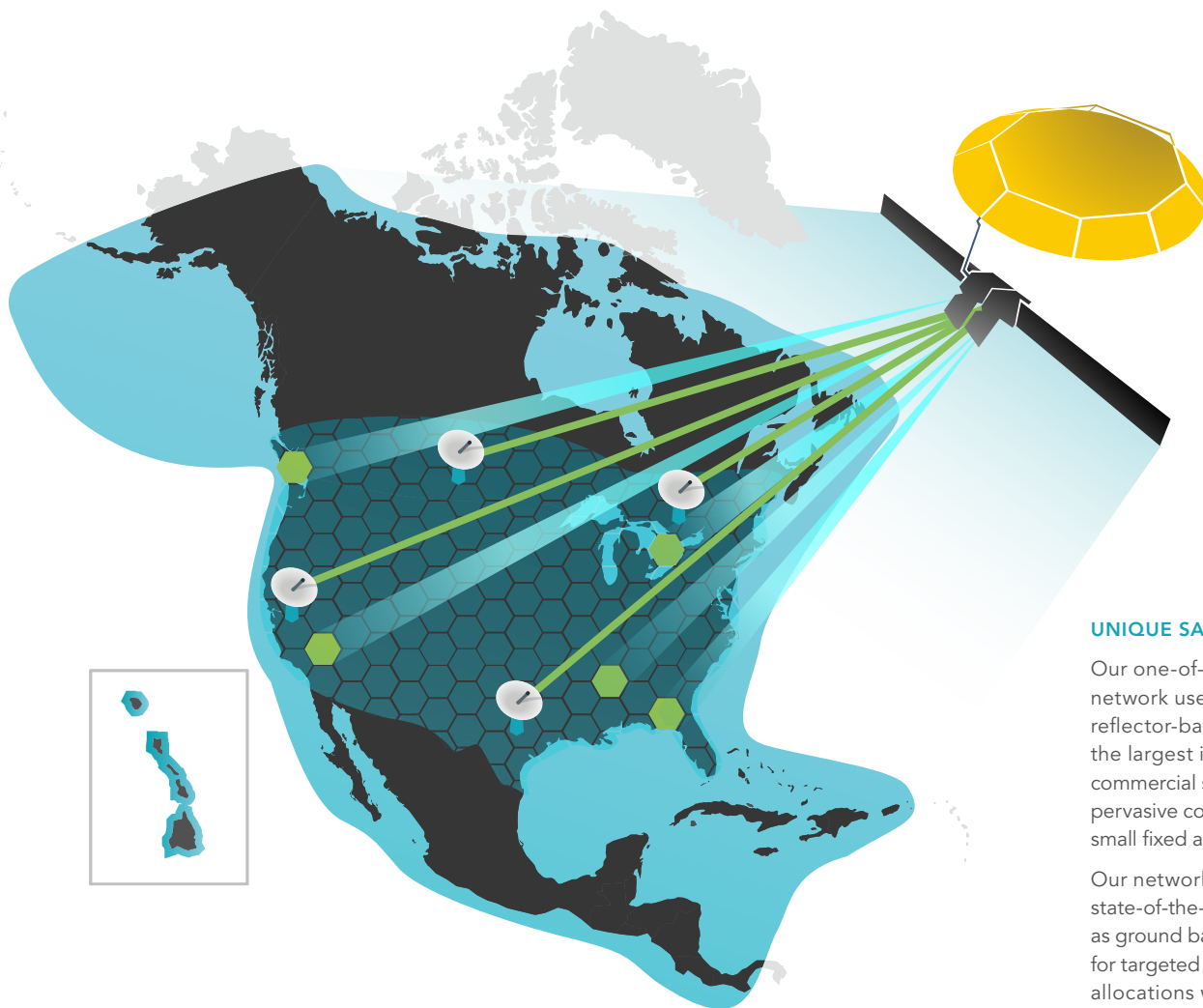
# THE LIGADO SATELLITE NETWORK OF TODAY

Ligado currently provides mobile satellite services to such critical industry and government sectors as rail, aviation, public safety, commercial transportation, maritime, oil & gas, and utilities that depend on remote voice and data connectivity.

Today, Ligado's one-of-a-kind satellite network enables communications through our use of a 22-meter reflector-based antenna—the largest reflector in service on a commercial satellite. This capability allows us to deliver robust data services to both fixed and mobile devices,

which creates economies of scale as smaller and less expensive devices are ideally suited for an array of applications that require high-quality data connectivity supported by the versatility of mid-band spectrum.

Our satellite network also enjoys state-of-the-art capabilities such as ground based beamforming with targeted resource allocation, which provides enhanced flexibility to manage network capacity and support stronger mobile connections.

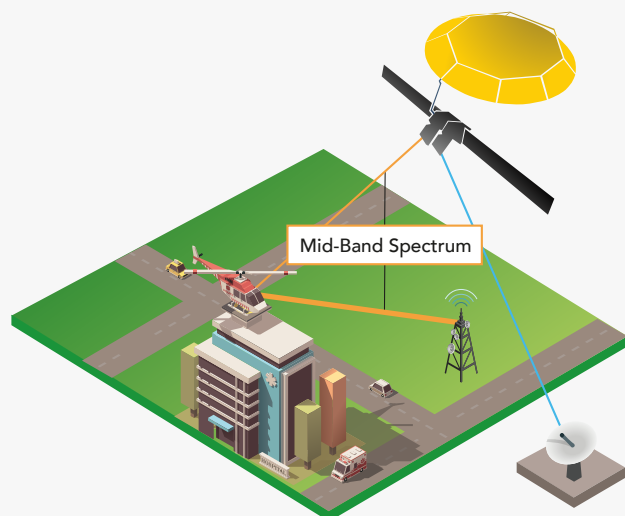


## UNIQUE SATELLITE SYSTEM

Our one-of-a-kind satellite network uses a 22-meter reflector-based antenna—the largest in service on a commercial satellite—to enable pervasive communications to small fixed and mobile devices.

Our network also employs state-of-the-art capabilities such as ground based beamforming for targeted bandwidth resource allocations which lead to stronger mobile connections and greater flexibility in managing network capacity.

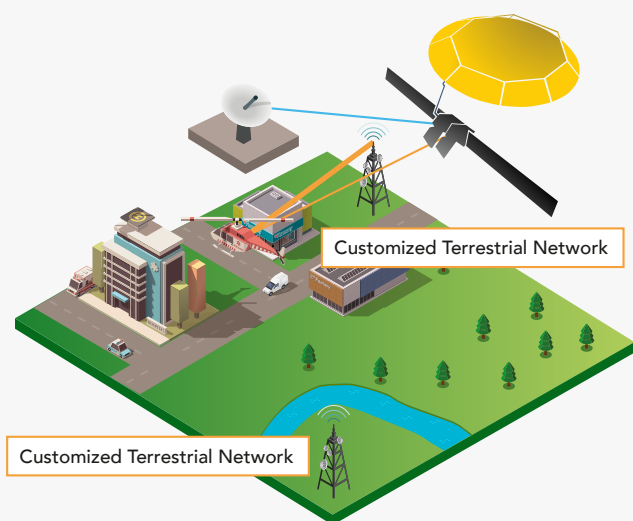
# ADVANCED SATELLITE-TERRESTRIAL NETWORK



## MID-BAND SPECTRUM

Regardless of what part of the satellite-terrestrial network is used, its advanced capabilities always can be accessed thanks to the seamless connectivity enabled by utilizing mid-band spectrum.

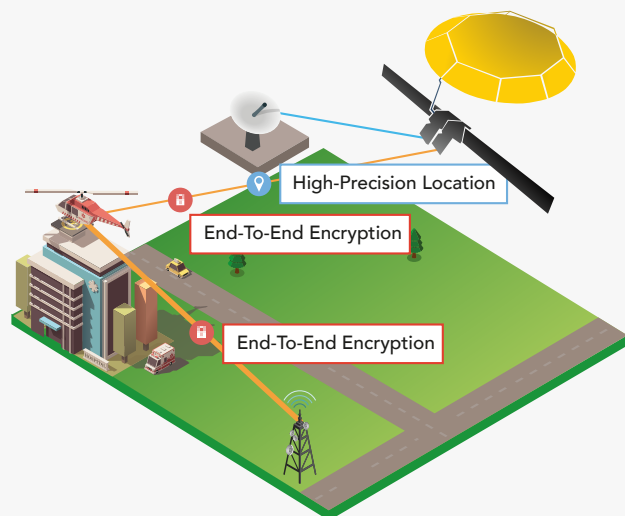
For example, using the same mid-band spectrum would allow an in-flight helicopter taking advantage of satellite connectivity at higher altitudes to also access terrestrial elements of the network when closer to the ground.



## CUSTOMIZABLE GROUND NETWORK

Because they are purpose-built, extremely flexible and designed to meet specific customer requirements, custom networks deliver seamlessly connected, ultra-reliable and highly secure services.

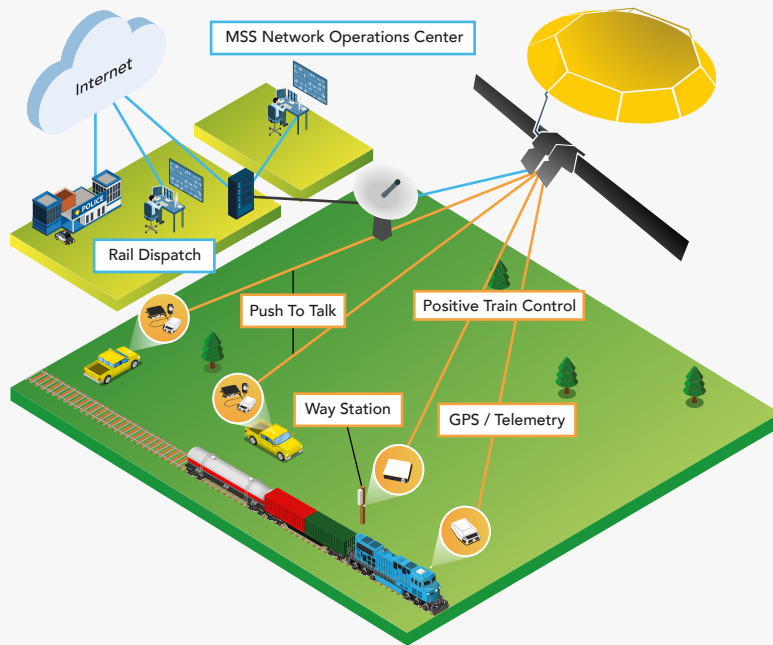
Business and government customers have the opportunity to work with Ligado to install custom network sites at the exact ground locations where additional bandwidth is needed. These sites would enhance Ligado's "always-on" satellite coverage at higher altitudes and in remote areas.



## PRECISION LOCATION, SECURITY AND RELIABILITY

Ligado's advanced satellite-terrestrial network will lead to expanded deployments of new technologies that can take advantage of a network that provides high-precision location down to centimeters, end-to-end security, and ultra-reliable mobile connectivity.

# ADVANCED SATELLITE-TERRESTRIAL NETWORK



## RAIL USE CASE TODAY WITH SATELLITE SOLUTION

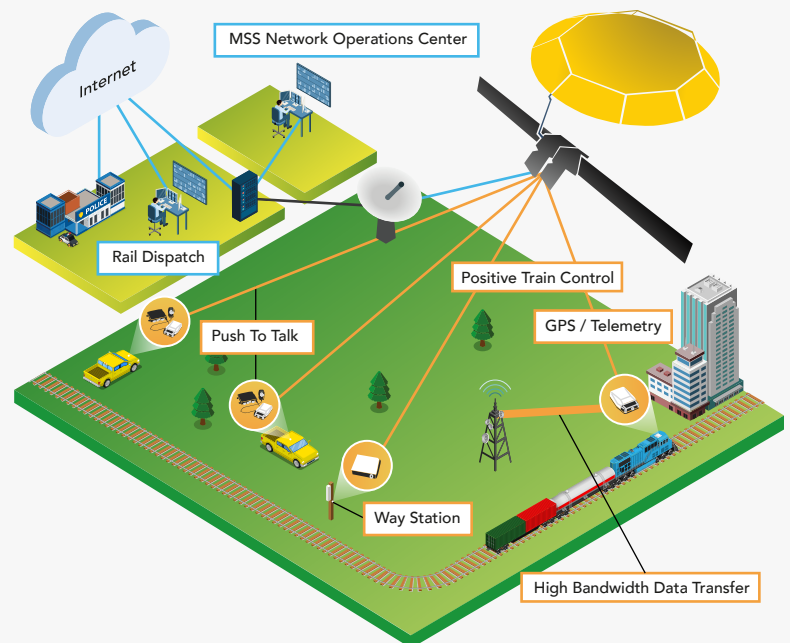
To enable higher levels of operational efficiency, security and worker safety, human communications and machine connectivity technologies must be pervasive, robust, and dependable.

The Ligado satellite network currently serves freight and passenger trains across North America, driving operational efficiencies. With the introduction of an all-IP service platform and device ecosystem from our partners, Ligado can further serve the rail industry by helping it meet worker and passenger safety mandates.

## RAIL USE CASE OF TOMORROW WITH SATELLITE-TERRESTRIAL SOLUTION

With the Ligado advanced satellite-terrestrial network in place, the rail industry will benefit from more precise location tracking, increased capacity and coverage for real-time data monitoring and pervasive, highly secure and ultra-reliable connectivity.

Real-time narrowband and broadband data from both trains and tracks will be transmitted securely to dispatch, other trains and maintenance workers. This will enhance critical operational decision-making and improve the ability to avert devastating collisions, derailments and other life-threatening issues.



# REAL BENEFITS FOR VITAL INDUSTRIES

Our partners in government and industry rely on Ligado to provide real-time location-based services, remote monitoring of fixed and mobile assets, and proactive management of critical operations. These low-latency and reliable data communications are ideal for applications such as mobile asset tracking, fleet management and telematics, Supervisory Control and Data Acquisition (SCADA), oil, gas, and water pipeline flow monitoring, and power distribution and transmission monitoring. With Ligado's advanced satellite-terrestrial network, these industries will increasingly be better served, improving outcomes in areas such as:

## PUBLIC SAFETY

Highly pervasive and ultra-reliable communications are critical for many areas of public safety, from accident avoidance and recovery, to fire prevention and targeted response, to rescue operations and large-scale disaster response. Ligado's advanced mobile network will be optimized for continuous operations and redundancy in situations where either terrestrial or satellite communications alone might not suffice due to weather, structural outages or network capacity.

## RAIL

Ultra-reliable communications are a critical requirement for the railroad industry to monitor and control train and track assets as well as worker and passenger safety. With extensive industry regulations around Positive Train Control (PTC) to improve safety throughout the system, Ligado's advanced satellite-terrestrial network will provide pervasive, highly secure and ultra-reliable connectivity that supports transmission of mission-critical data that ensures safe train speeds, avoids collisions and

provides for wayside safety of railroad workers. Ligado's advanced mobile network will be uniquely suited to provide seamless coverage between terrestrial-covered areas and so-called dark territories that can only be reached by mobile satellite coverage.

## AVIATION

Both fixed-wing and rotary aircraft currently use Ligado's satellite network to navigate more precise routes and maintain real-time communications to air-to-ground logistics. Ligado's advanced satellite-terrestrial network will expand capabilities, improve emergency response time, reduce downtime, and enable improvements in telemetry and logistics to better serve flight and maintenance crews. Some of the many aviation applications that can be optimized with an advanced satellite-terrestrial network include location tracking, route optimization, passenger and freight identification, air-to-ground communications, fuel consumption and monitoring.

## COMMERCIAL TRANSPORTATION

Commercial transportation relies on both predictive and responsive applications to manage fleets and freight at all points in the transportation process. Complex logistics such as geopositioning and asset tracking, alarms and alerts, fuel management, emergency response and situational awareness help commercial transportation companies improve employee and public safety, increase efficiency, reduce insurance premiums and repair costs, and improve asset management overall.

## OIL & GAS

With enhanced monitoring capabilities enabled by machine-to-machine communications over an advanced satellite-terrestrial network, pipeline operations can be optimized to reduce repair delays and costs and to improve overall pipeline safety. Additional applications for telemetry, infrastructure and consumption monitoring, and logistics management can be supported on a customized ground-based network that provides additional bandwidth contributing to improved efficiencies in supply chain and financial management throughout the system.

# THE FUTURE IS NOW

As we begin to deploy next-generation connectivity, a vision emerges of enabling mission-critical IoT applications and accelerating many 5G use cases that improve industrial efficiency, increase worker safety and optimize critical infrastructure serving business and government.

That's why we are focused on providing an advanced satellite-terrestrial network and partnering with industry leaders to serve an array of mission-critical applications in the emerging IoT market.



Ligado Networks is committed to making the most of our one-of-a-kind technologies and capabilities. We are prepared to build an advanced network unlike any that currently exists in North America to provide ultra-reliable and highly secure services to critical industries anywhere, all the time. Learn more at [ligado.com](https://ligado.com).