SPECIAL REPORT

High-Precision Gearboxes in **Ground-Based Satellite Communication Systems**

Key Opportunities and Benefits

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Reliable connectivity in modern communication systems is driving significant growth in all sectors of the global space economy and satellite industry. From satellite television, radio, and broadband services to ground equipment, satellite manufacturing, and launch activities, the entire satellite industry is in a strong growth phase. According to the Satellite Industry Association's May 2025 report, $293 billion in revenue can be attributed to this economic sector. As the main portion of this industry—53% with $155.3 billion in revenue—ground equipment growth is benefiting from several recent trends.

These developments include greater than ever on-the-move connectivity, satellite-enabled smartphones and other connected devices, increased use of both aviation and maritime terminals, TV viewing moving away from traditional delivery, trial runs of satellite-to-cellular service, and much more. Between commercial applications and new or upgraded military/defense capabilities, the satellite industry is booming along with the pieces and parts that make it all work—ground-based satellite communication products that facilitate the operational link between Earth-based facilities and satellites.

According to Goldman Sachs Research, as many as 70,000 low earth orbit (LEO) satellites are expected to be launched over the next five years. Installed at altitudes of 100 to 1,200 miles, and circling the Earth every 90 minutes, these satellites will be used to supplement cell phone, broadband, maritime, and aviation data requirements.

Motion Control Considerations

Although seamless communication systems can seem like magic when they work well, each component requires thoughtful engineering design and teams of people working together to make it happen. Nowhere is this more evident than in the motion control of antennas and other ground-based equipment where sophisticated drivetrains including servomotors, sensors, and specialized gearing enable antennas to track satellites as they move across the sky. Multi-axis positioning for nondestructive antenna testing and qualification is another application area where correctly specified motors and gearboxes can make a crucial difference.

The Space Economy

According to the nonprofit Space Foundation, "The Space Report 2025 Q2" puts global space economy revenue at an unprecedented $613 billion in 2024, reflecting 7.8% year-over-year growth. The report defines the commercial sector as comprising 78% of the global space economy, with government budgets contributing the remaining 22%. Further, government space spending grew 6.7% to reach $132 billion, with the United States investing $77 billion in both national security and civil space programs.

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The latest Space Report also highlights the record pace of space launch in the first half of 2025: Liftoff to orbit occurred every 28 hours from January through June, six hours faster than the annual record set in 2024. With 81 launches, SpaceX accounted for more than half of the world's 149 launches through June 30. Most launches carried communications satellites to orbit.

Earth observation (EO) satellites, another sector poised for growth, are playing a critical role in disaster response and enhancing predictive capabilities for natural disasters. U.S. military spending is also forecast to achieve rapid growth, with increased spending on programs such as the proposed Golden Dome for America missile shield. Signed into law on July 4, 2025, the "One Big Beautiful Bill Act" authorized a $25 billion initial investment in the Golden Dome and allocated another $500 million to improve military space launch infrastructure.

The Space Foundation projects that the global space economy could surpass the $1 trillion mark as soon as 2032, driven by a robust commercial market that is quickly monetizing new technologies in communications and EO satellites. Among the most vital systems making modern communications possible are a wide range of ground-based antennas used to communicate with their space-based satellite counterparts.

Within these antennas, sophisticated gearboxes are critical to achieving the fine positioning needed for antennas to send and receive signals from satellites. Precision servo gearboxes are used in ground-based satellite antenna systems to precisely control the movement of large, heavy dish antennas in two key rotational axes: azimuth and elevation. This allows the antenna to accurately track and maintain contact with orbiting satellites, ensuring a stable and clear communication link.

Antenna Types and Technologies

Ground-based satellite communication (SATCOM) products primarily include components for satellite ground stations such as antennas, transceivers, modems, and amplifiers that enable a two-way exchange of data, voice, and video signals between Earth and orbiting satellites. More specifically, SATCOM antennas are often large, parabolic dish-shaped antennas used to transmit signals to the satellite and receive signals in return. However, when it comes to antennas, large is a relative term. A variety of antenna types and sizes are used for many different tasks in a wide range of settings, many of them facing harsh environments and extreme temperature fluctuations.

The satellite antenna market is estimated to be $6.36 billion in 2025 with growth projected to $12.52 billion by 2030, a CAGR of 14.5%, according to a new market report from Mordor Intelligence. Within this market, antennas are often categorized in a few ways—by frequency band, reflector system, application, and end user. Regarding frequency band, the Ku band held 29% of satellite antenna market share in 2024, although the Ka band has the highest growth forecast at 15.2% through 2030. Depending on the specific antenna, supported bands can include the L, S, C, X, Ku, K, Ka, and V bands, ranging from 1–100 GHz.

GLOBAL SATELLITE ANTENNA MARKET TRENDS AND INSIGHTS

Driver	% Impact on CAGR Forecast	Geographic Relevance	Impact Timeline
Proliferation of LEO broadband constellations	+3.9%	North America, Europe, global underserved regions	Medium term (2-4 years)
Rapid militarization of space (MilSATCOM)	+2.8%	North America, Europe, Asia Pacific	Long term (≥ 4 years)
High-throughput satellite (HTS) adoption	+2.6%	Global	Medium term (2-4 years)
Commercial in-flight connectivity boom	+2.4%	North America, Europe, Asia Pacific	Short term (≤ 2 years)
ESA flat-panel cost curve deflation	+1.7%	North America, Europe first; global thereafter	Medium term (2-4 years)
Lunar and cislunar communications demand	+1.2%	North America, Europe, China, India	Long term (≥ 4 years)

Source:
Mordor Intelligence,
www.mordorintelligence.com/industry-reports/satellite-antenna-market

By type, parabolic reflector systems comprised 38% of the satellite antenna market in 2024, although flat panel ESA products (electronically steerable antennas) are forecast to grow at 18.4% CAGR through 2030. Notably, unlike traditional satellite dishes that must physically move to track a satellite, an ESA uses a phased array of many small antennas that require no mechanical motion.

With respect to applications, the maritime market held 28% of market revenue share in 2024, while airborne connectivity is forecast to achieve 15.4% CAGR through 2030. The maritime market includes end user segments such as cruise ships, commercial vessels, and offshore oil and gas rigs. By user, 54% of the satellite antenna market was attributed to government and defense applications in 2024, although commercial uses are forecast to achieve a 14.9% CAGR through 2030.

Growth Drivers for Satellite Antennas

In the short term, within the next couple of years, an explosion of commercial in-flight connectivity is expected including reliable WiFi with streaming capabilities on most flights. The goal is for pilots and passengers, as well as aircraft and air traffic control, to be constantly connected to improve flight safety and performance and achieve a significantly improved flight experience. According to a new report from Honeywell Aerospace Technologies, connectivity will play a crucial role in air traffic management transformation by driving the shift from analog, voice-based, and manual processes to a digitalized, data-driven ecosystem based on real-time communication, precise tracking, dynamic routing, and integrated airspace management. Improved connectivity is poised to enable real-time data exchange, predictive analytics, and a seamless coordination between aircraft, air traffic control, and ground operations.

Over the medium term of the next two to four years, low-earth orbit (LEO) broadband constellations are expected to proliferate along with adoption of high-throughput satellite (HTS) platforms that boost spectral efficiency with spot beams and frequency reuse. In the longer term—more than four years from now—militarization of space (MilSATCOM) is expected to progress at a rapid pace. These applications all require rugged and reliable ground-based antennas and tracking systems.

Base Station Antennas Poised for Growth

The global base station antenna market size was estimated at $9.71 billion in 2024 and is projected to grow at a CAGR of 17.9% from 2025 to 2030, according to analyst reports from Grand View Research. Market growth is based on the rising deployment of 5G networks that are driving demand for advanced base station antennas capable of supporting the higher frequency bands and complex beamforming techniques associated with 5G technology. In addition, the rise of "smart cities" and Internet of Things (IoT) applications is boosting the need for base station antennas that can handle incredibly demanding connectivity requirements.

5G networks rely on massive MIMO (Multiple Input Multiple Output) technology, which requires many antennas to increase capacity, enhance spectral efficiency, and improve network performance. Specialized base station antennas are being developed to support massive MIMO deployments, enabling the transmission and reception of multiple data streams simultaneously.

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Full-motion antennas for broadband constellations can track satellites across the entire visible sky, including very low-Earth orbit (VLEO), low-Earth orbit (LEO), medium-Earth orbit (MEO), geosynchronous orbit (GEO), and highly elliptical orbit (HEO) satellites. A key feature of these antennas is their ability to move continuously and independently in both azimuth and elevation axes, enabling complete hemispherical coverage. Featuring dual-axis rotation, the antenna mount allows the dish to swing through 360° azimuth and typically from 0°–90° elevation. This kind of complex and precise antenna movement calls for close attention to the related motion control design and components.

Gearboxes for Fine Angular Positioning

Servomotors, precision servo gearboxes, and/or worm and ring gears are often used in full-motion ground station antennas to achieve fine angular positioning. Whether a dish uses a planetary gearbox (or any reduction gear at all) depends on torque requirements, precision, and how the mount is designed, not just the diameter alone—although a general guideline exists. Gearing needs are largely determined by antenna size and weight, with heights typically ranging from about 2 to 24 meters and dish diameters from less than 1.2 to greater than 13 meters:

- **Very Small Aperture Terminals (VSATs)** are compact, ground-based satellite stations, typically with an antenna dish anywhere from about 0.75 to 2.4 meters in diameter that enable two-way data, voice, or video links via a satellite network. Portable VSATs (under 1.2 m) are lightweight enough that direct drive stepper or servomotors can slew them without gear reduction.
- **Large VSATs and small fixed earth stations feature heavier reflectors** (1.8 to 2.4 m diameter) and face higher wind loads. Gear reduction is used frequently to supply the motor with enough torque and to maintain fine pointing, especially for Ka-band use. Precision servo gearboxes are often specified because they are compact and low backlash.

- **Small earth stations and many C-band antennas** (3.8 to 6.3 m diameter) almost always use gear reduction, as the antenna mass and inertia are too large for direct drive motors alone. Gear reduction either uses worm gears or planetary stages feeding a worm gear. For smoother control, precision servo gearboxes are often used on the azimuth or elevation jacks.
- **Gateway and teleport antennas** (7 to 13 m diameter) feature dishes that weigh several tons and have huge moments of inertia. A standard approach is to use multi-stage gearing including planetary gears plus a final worm or ring gear to achieve arcmin or arcsec accuracy and handle high wind loads.
- **Deep space and major teleport antennas** (over 13 m diameter) employ sophisticated gear trains, hydraulic or harmonic drives, and counterweights. Planetary gear stages are often used somewhere along the drive train to manage the massive torque requirements and achieve precise control.

As a rule, small VSATs can do their jobs without a gearbox. Antennas with greater than 1.8-diameter dishes can benefit from gear reduction, with larger antenna sizes requiring a geared approach. Planetary stages are commonly used where compact, low-backlash, and high-torque drive is needed.

Government and Defense Needs

Within the defense market—54% of 2024 satellite antenna market share—major applications include providing secure and reliable links for command and control, ISR (intelligence, surveillance, and reconnaissance), electronic warfare that involves disrupting enemy communications while protecting allied signals, and better navigation by enhancing GPS capabilities and positioning.

Anti-jamming, rapid beam switching, and rugged design are among the stringent design requirements for satellite antennas used in the defense industry. The military antenna market, including ground-based satellite communication applications, is a large and growing sector. Fortune Business Insights forecasts the global military communications market to reach $60.40 billion by 2032, with a notable portion dedicated to SATCOM.

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Military and defense applications frequently require antennas that can stand up to shock, vibration, and environmental conditions such as moisture, dust, and extreme temperatures. Beyond the dish itself, each component of the antenna's drive system—including the servomotors, sensors, and gearboxes—must be rugged enough to survive a military deployment. Compactness and weight are another concern: For mobile and tactical deployments, every ounce makes a difference. The high torque-to-weight ratio of precision servo gearboxes means they are well suited for antenna systems on vehicles, ships, and aircraft.

Precise positioning needs for ISR call for gearboxes with extremely low backlash. Military applications, particularly for tracking LEO satellites, require very accurate and stable pointing to maintain connectivity with fast-moving targets and prevent interference. Long-life component designs are also a key factor in military applications to keep maintenance to an absolute minimum.

As one example, GAM Enterprises' GPL Robotic Planetary Gearbox achieves 3x longer life than standard gearbox options—20,000 hours versus roughly 6,000 hours for a cycloidal gearbox. The GPL also features 10x greater precision, maintaining 0.1 arcmin backlash for the life of the gearbox. Further, the GPL operates flawlessly in temperature extremes from -40°C to 70°C by using specialized oils and coatings. It is therefore well suited for use in both polar and desert environments, where similar gearboxes offer much tighter temperature ranges.

In addition to other antenna types, government organizations use earth observation (EO) antennas for applications such as remote sensing, TT&C (telemetry, tracking, and control), and satellite communications. The growing need for durable base station antennas that can handle harsh settings and function reliably in extreme environments is a critical element driving growth in the defense market.

GAM's GPL robotic planetary gearbox maintains 0.1 arcmin backlash for the life of the gearbox and provides vibration-free, smooth controlled path movement.
Source: GAM Enterprises

Benefits of Working with U.S. Manufacturers

For U.S.-based suppliers to military and government entities, working with U.S. manufacturers of drivetrain components can minimize confusion around specifying rightsized components and significantly shorten lead times for critical parts. Avoiding confusion around tariffs is another key benefit of working with U.S. manufacturers.

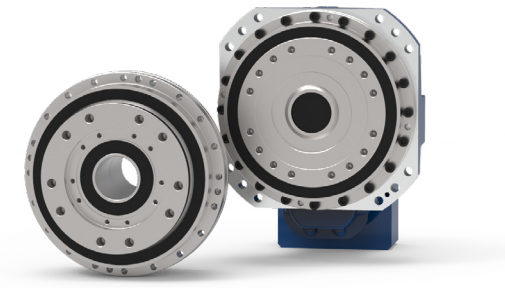
When it comes to building antenna systems, U.S. manufacturers such as GAM Enterprises also have the capability to act as an extension of an antenna supplier's hands-on engineering team. Being in the same country, and often the same time zone, means faster answers to engineering questions and much speedier delivery schedules.

MOTION CONTROL REQUIREMENTS

Regarding ground-based satellite communication components—especially within antenna systems—the motion control aspect should not be treated as an afterthought. While much attention is necessarily paid to the antenna's reflector system, selection of drivetrain components is every bit as important. Specifying the best motor, sensors, and gearbox for the application at hand can make the difference between a good and great outcome. Let's explore the considerations that go into selecting appropriately sized gearing.

Importance of Gearboxes

One of the most critical components of an antenna's motion control system is the gearbox—the sets of gears that act to transmit power from motors to change the speed, torque, or direction of the azimuth and elevation axes. Designers and developers of antenna systems, working alone or together with a reputable and trusted gearbox supplier, can enhance the capabilities of their antennas with thoughtful engineering of gearbox systems.



GAM's GPL robotic planetary gearbox is available as components (left) or fully enclosed with motor adapter (right). Source: GAM Enterprises

Multi-axis positioners (MAPS) have similar requirements when used in antenna testing systems: the need for the gearbox to provide enough torque while maintaining precise angular positioning. Precision servo gearboxes are often selected because they minimize backlash and can achieve arcsec-level pointing precision—crucial for avoiding errors in pattern measurements of antennas under test (AUTs).

Gearboxes are used to accomplish these important functions in antenna systems:

- **Torque Multiplication** – One of the chief functions of a gearbox is to multiply torque, the rotational force required to move objects into position. Gearboxes, especially those with higher reduction ratios and higher torque capacity such as GAM Enterprises' GPL Robotic Planetary Gearbox, make it possible for antenna drive systems to move large, heavy antenna reflectors into precise position without increasing motor size or power consumption.

  As an example, a prominent satellite antenna manufacturer recently chose the GPL to drive the elevation and azimuth axes based on its superior torsional stiffness, available high reduction ratios, and cost. The manufacturer noted that the cost per Nm of torque is half the price of other gearboxes on the market that could provide the torque required by the application.

- **Strength and Precision** – Gearboxes, especially those with high precision gearing, enable antenna positioning drivetrains to achieve small, smooth, and accurate movements even when handling heavy payloads such as large parabolic dishes. High precision gearboxes also allow for finer control over torque distribution, helping to prevent slippage or overloading during the handling of heavy objects such as large reflectors. Precision servo gearboxes provide the fine-tuned control needed to track satellites, especially those in fast-moving low-Earth orbit. This level of precision is crucial to maintain a strong signal.

- **Accurate Movement of Antenna Dishes** – Motion control of an antenna dish involves azimuth and elevation axes. The azimuth axis is the horizontal rotation that enables the antenna to turn left and right, spanning a full 360° degrees. The gearbox for the azimuth axis lives in the antenna system's pedestal or base. For high-performance systems, the gearbox may have a hollow shaft that allows signal cables to pass through the center, preventing tangling during continuous rotation. The elevation axis is the vertical rotation that allows the antenna to tilt up and down, adjusting for the satellite's height in the sky or space. The elevation gearbox is usually located in the arm or yoke that supports the main dish.
- **High Shock Load Absorption** – Cycloidal gearboxes are often used because they are sturdy enough to handle the stress from sudden environmental factors, such as high winds. Compared to planetary gearboxes, cycloidal gearboxes are known for their higher shock load absorption, robust design, and near-zero backlash, which is critical for the most precise antenna movements. The choice between a planetary and cycloidal gearbox depends on the specific needs of the antenna system, including the dish size and weight, required precision, and budget. For many applications, the compact size, high efficiency, and precision of a planetary gearbox achieves an ideal balance.
- **Reliability is Key** – In satellite communications, interruptions can be costly. Gearboxes are designed to be ultra reliable, with some styles offering enclosed weatherproof housings to protect components from the elements. Precision servo gearboxes are often used in satellite communication antenna systems, especially for smaller to medium-sized dishes, because they provide high torque density and high speed reduction in a compact package. This makes them adept at managing the precise, high-speed adjustments required to track moving satellites.

Why Choose a Planetary Gearbox?

In a planetary gearbox, the power and load are spread across multiple gear teeth instead of a single point. This design reduces wear and stress, contributing to the gearbox's high torque capacity and durability. Within satellite antenna systems, planetary gearboxes feature several important benefits over other gearbox types:

- **High Torque Density in a Compact Size** – The coaxial, concentric design of a planetary gearbox enables significant torque multiplication in a small footprint. This is critical for satellite antennas where space and weight are usually part of the design equation.
- **High Efficiency** – Planetary gearboxes are known for their high efficiency, which often exceeds 95% per stage, thereby minimizing power loss and heat generation.

- **Low Backlash/High Rigidity** – The load-sharing design with multiple contact points results in very low backlash and high torsional stiffness. This enables excellent positional accuracy and stability, essential for maintaining a strong and consistent satellite tracking signal. For example, GAM Enterprises' GPL Robotic Planetary Gearbox was recently specified by a well-known satellite antenna manufacturer for its superior torsional stiffness. In addition, the cost per Nm of torque is half the price of other gearboxes on the market that could provide the torque they needed for the application.
- **Suitability for Different Satellites** – Precision servo gearboxes can handle the demanding motion requirements of LEO satellites, which move quickly across the sky, as well as the slower and more precise adjustments needed for geostationary (GEO) satellites.

Multi-Axis Positioners for Antenna Testing

Multi-axis positioners (MAPs) are used to help conduct antenna and radome testing in controlled measurement environments such as anechoic chambers. MAPs are often designed to accommodate heavy payloads while maintaining accurate and repeatable positioning during performance evaluations of antennas, radomes, and related radiofrequency (RF) components.

These specialized test positioners typically include two to five axes, depending on testing needs: azimuth or yaw axis, elevation or pitch axis, roll axis, offset linear axis, and a floor slide axis for linear motion. Not all MAPs include each of these axes. Notably, motors and gearboxes that are easily removable enable simple maintenance routines without interfering with test setups.

When placed in a measurement or anechoic chamber, five-axis MAPs can achieve highly repeatable tilt, rotation, and linear positioning. This precise motion control supports thorough characterization of antenna radiation patterns and radome performance across multiple orientations. Recording key performance data under simulated real-world conditions, MAPs can help optimize designs for communication systems, radar applications, and other RF-related technology that relies on high-fidelity measurements.

Lighter duty MAPs may simply consist of a rotating turntable base with a mounting mast. This type of MAP is designed to take measurements of things like spherical antenna patterns or the effective isotropic radiated power of wireless handheld devices. Within the compact form factor of many MAPs, space is at a premium and each component of the test setup must be evaluated with this in mind. Among those components are rightsized gearboxes. For example, GAM's GSL Strain Wave Gearbox uses harmonic type gearing for high precision and high torque density and is easy to integrate in applications such as compact MAPs used for antenna testing.

GAM's GSL strain wave gearbox uses harmonic type gearing for high precision and high torque in a small lightweight gearbox. Simple design with many configurations for easy integration.
Source: GAM Enterprises

Precision Servo Gearboxes for Antenna Test Ranges

Precision servo gearboxes are typically used when an application calls for high torque transmission in a compact form factor, precise and smooth motion control, low backlash for positioning accuracy, and durability for repeated or continuous motion. For antenna test ranges, a precision servo gearbox would be useful in the following scenarios:

- **Positioners for Antennas and AUTs** (Antenna Under Test) – Antenna test systems typically rotate the AUT (or probe antenna) through azimuth and elevation angles to measure the radiation pattern. The motors driving heavy loads such as large dishes or phased arrays need gearboxes to provide enough torque while maintaining precise angular positioning. Precision servo gearboxes are often specified because they minimize backlash and can achieve arcsec-level pointing precision, which is critical for avoiding errors in pattern measurements.
- **Probe Scanners in Near-Field Systems** – In planar, cylindrical, or spherical near-field scanners, probes are moved with extreme precision across a surface or along a path. Choosing the right scanning method depends on the antenna being tested. Planar is often used for directional, high-gain antennas, such as those found on satellites. Cylindrical is well suited to antennas with specific fan-beam patterns used in specialized antennas. Spherical is considered best for obtaining a full-sphere radiation pattern, especially for low-gain antennas or when the antenna is too large or fixed to be moved into the far-field. Linear actuators are commonly used in addition to rotational stages that sometimes require compact, high-torque gear reductions. Precision servo gearboxes help ensure smooth, controlled probe movement without introducing positioning error or vibration.
- **Compact Range Reflector Adjustment** – In compact antenna test ranges, large reflectors sometimes must be finely aligned or rotated. Using planetary gearboxes with stepper motors or servomotors enables precise adjustment while handling the reflector's weight. For example, GAM's GPL and GSL Robotic Planetary Gearboxes offer high precision, high torque density, and easy integration into test setups.
- **Heavy Device Under Test (DUT) Fixtures** – Satellite antennas, radomes, and automotive radar units are usually extremely heavy. A precision servo gearbox helps motors handle these loads when rotating or tilting the DUT through large angular sweeps during testing.

In summary, precision servo gearboxes are critical in antenna testing for rotational stages, especially in azimuth/elevation positioners, as they provide compact, high-torque, low-backlash gearing to ensure precise, repeatable antenna orientation during test measurements.

OPPORTUNITIES FOR GROUND-BASED SATCOM SYSTEM PROVIDERS

Within the booming ground-based satellite communications market, antenna system manufacturers and related component suppliers can look forward to several years of steady year-over-year growth. For example, ground antenna systems and mobile satellite antennas for a variety of orbits (GEO, MEO, LEO) are critical in high-capacity broadband applications.

Whether an application requires long life for reduced maintenance, the ability to survive in extreme temperatures, or high precision, each component must be rightsized and carefully specified to meet inevitable budget constraints and project timelines. These needs present several ongoing opportunities to suppliers of ground-based SATCOM products including antenna system manufacturers.

Many of these systems require full-motion antennas: motorized, dual-axis ground station antennas that continuously track satellites throughout the visible sky. These specialized antennas differ from limited-motion or fixed VSATs because they can support fast LEO/MEO tracking, deep-space links, and test or measurement environments where unlimited pointing is required—offering additional opportunities to system suppliers.

The market is also wide open to suppliers who can meet the needs of rapidly growing 5G networks that are driving demand for advanced base station antennas, as well those who can provide antenna hardware to support milSATCOM needs such as command and control, ISR, electronic warfare, and enhanced GPS capabilities. In-flight connectivity is another significant new area of opportunity for those who can provide the ground-based SATCOM products to serve the needs of this market. Finally, manufacturers of multi-axis positioners for applications such as antenna and radome testing/qualification are in demand to serve this closely related industry segment.

RECOMMENDATIONS

Within the ground-based satellite communication products marketplace, numerous hardware providers are finding success—including both established and new suppliers of antenna systems and multi-axis positioners. Yet the industry is in a strong growth phase and many opportunities abound for both new and established players who can meet the needs of satellite-based, 24/7 connectivity requirements on land, at sea, and in the air. Both the consumer and military markets are wide open for business.

The most direct path to market for suppliers of antennas and positioners within the ground-based SATCOM products industry is to build and maintain close working relationships with trusted supply chain partners. These partners and component suppliers can often serve as collaborative engineering resources on an as-needed, project by project basis.

Motion Control Highlights

The world is an increasingly digitized environment. From 5G cellular networks to electronic warfare to satellite communications between Earth and various space orbits, modern society is quickly moving toward an always on, always connected mindset and reality. Yet the transmission of digital signals for instant communication is very much made possible by physical components such as antennas and other ground-based SATCOM products.

Central to many of these SATCOM systems are the motion control components that make precise movement possible in the physical world. The vital importance of motion control technologies for antenna systems and multi-axis positioners cannot be overemphasized.

The right gearbox technology can deliver unmatched control over the movement and power transmission within actuation components. For antenna dish axes specifically, precision servo gearboxes are crucial for converting the rotational power from motors into the required output speed and torque that are necessary for tasks such as finely moving a heavy parabolic dish along both azimuth and elevation axes.

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Key Considerations

Engineers must thoroughly assess factors such as torque, speed, size, and weight, along with precision/backlash, lifespan, ability to handle temperature extremes, and of course, cost per Nm of torque when choosing gearbox solutions for antenna systems and multi-axis positioners.

Instead of considering gearbox selection as an afterthought, early and meticulous specification can make all the difference in an antenna system's overall functionality. Beyond developing a working SATCOM system, engineers must also weigh each component's influence on overall system durability, operating costs, and maintenance requirements.

Selecting a Supply Chain Partner

When choosing a gearbox manufacturer, it is important to look for providers with comprehensive knowledge and experience in multi-axis motion control. They should also be able to supply a full catalog of configurable, off-the-shelf products. Bonus points for U.S. manufacturing, which translates into fast answers to any questions, speedy delivery dates, and avoidance of tariff headaches.

Another checkmark is the ability to offer some degree of product customization, along with engineering services, to ensure that gearbox solutions meet the specific requirements of the systems under development. Developers of ground-based SATCOM products should also seek out gearbox providers that offer flexible manufacturing services such as the ability to offer small production runs, and to generate solutions with short lead-times.

Your Extended Engineering Team

The best assurance that actuation components within antenna systems will meet the requirements and exceed expectations is to work in close partnership with reputable, full-service suppliers of gearbox solutions or other motion control technologies. The right match can be much more than a supply chain partner and instead may be counted on as an extension of in-house engineering teams.

Sources: Satellite Industry Association, May 2025 report; Goldman Sachs Research, "The global satellite market is forecast to become seven times bigger," March 5, 2025; The Space Foundation, The Space Report 2025 Q2; Mordor Intelligence, Satellite Antenna Market Size & Share Analysis - Growth Trends & Forecasts (2025 – 2030); Congress.gov, Golden Dome: Funding in the 2025 Reconciliation Law; Honeywell Aerospace, Future of Aviation: Connected Beyond Boundaries; Grand View Research, Base Station Antenna Market (2025 – 2030); Fortune Business Insights, Base Station Antenna Market Size, Share & Industry Analysis (2025 – 2032).