

CASE STUDY

Custom Antenna Control Systems for High-Performance SATCOM Installations



A U.S. related program, managed through multiple contractors, required a custom high-precision antenna control solution for a new multi-band antenna.

The mission profile demanded monopulse radar tracking accuracy in the ten-thousandths of a degree range across multiple orbital regimes, including GEO, MEO, and LEO. It also required the flexibility to support laser-based links and deep space targets for future applications.

Radeus Labs, operating as both a control systems integrator and engineering partner, delivered a multi-phase deployment of its **RL-9000 ACS** control solution. This included:

- Hardware customization
- Software development
- Extended on-site commissioning

The system was engineered to handle:

- Multi-motor elevation control
- Dual azimuth drives
- Significant mechanical inertia from a large reflector

All while maintaining pointing precision in variable wind and load conditions.

During an eight week on-site engagement, Radeus engineers worked closely with the prime contractor and antenna manufacturer to:

1. Integrate the control hardware with a unique pedestal design
2. Calibrate for fine-grain motion under real-world load
3. Deploy a custom designed scheduler application to coordinate signal acquisition across multiple antennas

The result: Two fully deployed, high-performance antenna systems, with a completed design ready for subsequent deployments.

The Challenge Detailed

The prime contractor needed to bring three large diameter antenna systems online at a brand-new teleport facility.

The mission required sub-arcsecond pointing accuracy, ten-thousandths of a degree, to reliably acquire and track satellites across multiple orbital regimes. These performance demands were compounded by several challenges:

- **Precision Motion Requirements:** Quad-motor elevation control and dual azimuth drives had to work in perfect synchronicity, accounting for significant inertia and wind loading from large reflector surfaces. Motion needed to be fine-tuned in real time to maintain signal lock on fast-moving or narrow-beam targets.
- **Unique Pedestal Design:** The antenna gantry design was non-standard, requiring a control system that could adapt mechanically and electronically without a full redesign.
- **Environmental Load Factors:** Operation in the higher frequency bands is particularly sensitive to environmental conditions, with even minor deviations affecting link quality. The system needed to hold precision through gusts, temperature variation, and structural flex.
- **No Site Survey:** With no pre-install survey conducted, the control system had to be adaptable to as-built conditions, cabling variances, and real-world pedestal tolerances.
- **Integrated Operations:** The teleport required a unified control and scheduling capability across all antennas, reducing operator burden and enabling coordinated link acquisition.

The original vendor was unable to meet both the performance requirements and the delivery schedule. This opened the door for Radeus Labs to compete, and win, in a highly competitive bid process.

Why Radeus Labs Was Selected

Radeus Labs' proposal succeeded based on a combination of:

- **Availability and Lead Time:** The 9000 ACS platform was ready for adaptation without the extended wait times of competing systems.
- **Lower Total Cost of Ownership:** Customization was built into the scope without requiring a complete system redesign.
- **Control Systems Expertise:** Radeus specializes in high-precision control solutions capable of integrating with a wide range of pedestal designs.
- **Proven Track Record:** Radeus has deployed multiple systems of similar type and kind for a variety of different antenna manufacturers.
- **Custom Engineering Capability:** Willingness to develop new features, such as quad-motor elevation support and integrated scheduling software, to meet the mission's exact needs.

The Solution

A. Hardware: 9000 ACS Customization

Radeus Labs customized a configuration of the 9000 ACS control system to meet the precision and load requirements of the antennas. Key hardware adaptations included:

- **Quad-Motor Elevation Control:** Implemented to handle the reflector's mass and parasail-like wind load while maintaining pointing accuracy within $\pm 0.0001^\circ$. This required precise torque balancing and phase alignment across motors to prevent structural stress and positional drift.
- **Dual Azimuth Motors:** Configured for coordinated motion to support fast LEO passes while retaining fine-grain stability for GEO tracking.
- **Pedestal Integration:** Mechanical and electronic interfaces were custom-designed to mate with a custom designed gantry and elevation assembly, eliminating the need for costly redesigns to either the pedestal or reflector support.
- **Factory and Field Fine-Tuning:** Pre-deployment factory testing was completed, to the extent possible, prior to the on-site calibration to match as-built conditions and dynamic load behavior.



B. Software: Custom Scheduler Application

Recognizing the operational requirement to control and schedule multiple antennas simultaneously, Radeus Labs developed **a custom scheduler application**, a proprietary software layer fully integrated with the 9000 ACS.

- **Native 9000 ACS Integration:** Eliminated the need for third-party scheduling tools, reducing latency and complexity in command execution.
- **Automated Acquisition Planning:** Operators could pre-program acquisition windows for multiple satellites, with the system dynamically allocating resources to minimize idle time and operator intervention.
- **Support for Multiple Orbit Types/Missions:** Enabled seamless switching between LEO, MEO, and GEO profiles, adjusting slew rates, acceleration curves, and tracking modes automatically.

C. On-Site Engineering Support

The installation and commissioning process was executed with Radeus engineers embedded on site.

1. Trip 1 – Cable Landing & Initial Integration

- Landed and dressed all motor, sensor, and control cables.
- Integrated control hardware into existing teleport infrastructure.
- Verified mechanical alignments against as-built tolerances.

2. Trip 2 – Motor Calibration & Initial Commissioning

- Performed staged calibration of quad elevation motors and dual azimuth drives.
- Conducted motion profiling to identify and compensate for inertia effects.

3. Trip 3 – Final SAT and Scheduling Integration

- Executed Site Acceptance Testing with customer witness.
- Configured and validated Scheduler application for multi-antenna coordination.
- Completed fine-grain tuning to achieve sub-arcsecond accuracy across all operating modes

Throughout all phases, Radeus Labs functioned as a partner with our customer's integration team. The team adapted to field conditions, solved unforeseen design and cabling issues, and maintained open collaboration with the prime contractor and antenna OEM.

Key Technical Highlights

- **Sub-Arcsecond Tracking Accuracy**
Achieved pointing precision within $\pm 0.0001^\circ$, across all operational modes.
- **Quad-Motor Elevation Synchronization**
Implemented coordinated drive control for four elevation motors, balancing torque and phase to eliminate structural loading imbalances and positional drift.
- **Multi-Orbit Capability**
Configured 9000 ACS to handle the acceleration demands of LEO passes, the stability requirements of GEO targets, and adaptable profiles for MEO and potential deep-space tracking.
- **Environmental Load Compensation**
Integrated wind, inertial, and temperature compensation algorithms to sustain signal level stability under real-world conditions.
- **Non-Standard Pedestal Integration**
Adapted control interfaces and mounting systems to match unique gantry geometry without requiring pedestal redesign.
- **Software-Integrated Scheduling**
Custom scheduler application development enabled coordinated multi-antenna operations, dynamic resource allocation, and reduced operator workload.

The Impact

- **Two High-Performance Systems Commissioned**
Two antennas were brought online and passed Site Acceptance Testing on schedule, with no major rework required.
- **Reduced Timeline Risk**
The 9000's adaptability allowed integration and tuning without the delays often seen when interfacing with custom pedestal designs.
- **Enhanced Operational Capability**
The combination of hardware precision and the scheduler application software reduced manual intervention, enabling operators to manage multiple simultaneous links efficiently.
- **Customer Confidence Secured**
The end user validated the system's readiness for operational use, setting the stage for additional deployments.
- **Repeatable Deployment Model**
The control system configuration, tuning procedures, and integration scheduling are now ready for other sites with similar requirements.
- **Capability Beyond Scope**
Radeus Labs delivered not only the control system but also custom software, photogrammetry integration, and on-site engineering support that extended beyond the initial contract, reinforcing their role as a capable technical partner.

Why It Matters

SATCOM projects operate under uncompromising performance requirements and tight delivery schedules. Standard, off-the-shelf control systems often fail when faced with unique pedestal designs, multi-motor configurations, and the precision required for high frequency systems.

Radeus Labs brings:

- **Specialized Control Systems Expertise**, Engineering depth across mechanical, electrical, and software domains to handle complex motion and integration challenges.
- **Custom-Fit Solutions**, Ability to adapt the 9000 ACS to non-standard hardware without material delays.
- **Operational Reliability**, Proven ability to deliver sub-arcsecond tracking in real-world conditions.
- **Partner-Level Engagement**, A track record of keeping programs on schedule and mission-ready, including expertise in high-precision motion calibration under operational loads.

For program managers, integrators, and contractors, this means fewer integration risks, predictable commissioning timelines, and higher operational readiness from day one.

Your Next Precision-Control Project Starts Here

If your SATCOM program requires a control system that can meet mission-grade precision, adapt to non-standard designs, and deploy on schedule, Radeus Labs is ready to engage.

Contact our Sales team to discuss how a custom **9000 ACS** deployment can meet your operational requirements and give your program a proven, repeatable path to success.

ABOUT RADEUS LABS

At Radeus Labs, we deliver advanced, purpose-built solutions that empower our clients to excel in the most demanding environments. With a steadfast commitment to innovation and reliability, we specialize:

- Ruggedized computing systems,
- Precision-driven satellite communication solutions
- Custom-built technology designed to meet unique challenges

Our products are engineered for longevity, with a lifecycle exceeding 10 years, ensuring exceptional performance and cost efficiency.

From concept to deployment, we manage the entire process in-house—offering engineering, manufacturing, and end-to-end support to maintain the highest standards of quality and consistency. At Radeus Labs, we don't just build technology—**we build solutions that last.**

Contact Us | (+1) 858-391-1210 | Radeus Labs.com

