ATCA Increases Ground Control System Scalability and Serviceability

Case Study

Industry/Market
Military equipment manufacturer.

The Challenge
Migrate from a rackmount server platform to AdvancedTCA® (ATCA), while meeting stringent MIL-STD-810G environmental testing.

The Business Environment
Military customers are transitioning to universal ground control stations capable of controlling multiple unmanned aircraft, land vehicles or surface vessels.

The Solution
AAI built a universal ground control system (UGCS) on an open standards-based ATCA platform comprising solutions from Radisys and its ecosystem partners, including LCR Electronics.

The Benefits
The ATCA platform increased scalability, serviceability and availability, and simplified power supply requirements over the prior generation equipment.

Customer Profile
AAI Corporation supplies aerospace and defense equipment, including ground control stations, tactical unmanned aircraft systems, armament systems, and training and simulation systems.
Until recently, every type of unmanned aircraft had a specialized ground control station, as well as a unique version for each military branch, which resulted in a proliferation of single-purpose equipment. AAI, with more than 50 years in business, decided to develop a UGCS architecture designed to satisfy U.S. joint services requirements, including simultaneous mission control of multiple unmanned aircraft.

**COTS Platform Requirements**

AAI focused on improving its One System ground control system, a VME based server platform that delivered hundreds of thousands of combat operational hours. It was necessary to meet the interoperability requirements of the U.S. Army and joint services, as well as UAS joint information exchange capabilities for command, control, communications, computers, intelligence, surveillance and reconnaissance, or C4ISR. The next generation platform, based on commercial off-the-shelf (COTS) hardware, needed to address the following areas of improvement:

- **Greater Scalability**: With VME servers, the computing performance is fairly fixed, and adding additional cards to increase performance wasn’t an option.
- **Higher Availability**: The redundant design of ATCA provided the ability to reach 99.999 percent availability with greater fault identification using the rack manager.
- **Voltage Supply Compatibility**: The server requires 120 volts (AC), which isn’t consistent with the 24 volts (DC) battery voltage of a military vehicle.

**AAI Evaluates ATCA**

AdvancedTCA architecture, a standard that is widely accepted by many major telecom equipment manufacturers, is now being considered for high performance military systems. This carrier-grade specification supports at least 99.999 percent availability which is attributable to a highly redundant, bladed platform.

For the UGCS architecture AAI weighed the trade-offs between ATCA architecture and rackmount servers, which are relatively low cost and preassembled. ATCA is a bladed platform that easily scales features and performance by adding blades that support new applications or more computing power. With its roots in telecom, ATCA was designed to maximize serviceability and availability, leveraging hot swappable components and redundancy (e.g., boards, switches, fans and power entry modules). In the field, an ATCA chassis is powered by stepping up the military vehicle battery voltage to 48 volts, thus avoiding the 120 volt (AC) supply required by a rackmount server.

*ATCA gives us the scalability we need to design a universal ground station controller capable of responding to the needs of a wide range of unmanned aircrafts and multiple military branches.*

Tom Bachman  Vice President of New Products and Technologies at AAI
Tough Enough?
A key component of the solution was the Gemini ruggedized military ATCA chassis, supplied by LCR Electronics. With AAI engineers alongside, LCR conducted MIL-STD-810G compliance testing—shock and vibration—by loading the chassis with 14 blades and running a series of environmental tests. The chassis was tested and passed over a frequency spectrum of 1 to 500 Hz in multiple axes for time durations up to 90 minutes. The results of the testing demonstrated that very low G loads were transmitted to the electronics/blades in the chassis due to the ruggedized construction of the chassis.

The Gemini chassis is constructed differently than a commercial-grade ATCA chassis, incorporating many enhancements such as:

- Machined card guides in lieu of sheet metal stamped card guides
- Thicker, stronger material for chassis metal parts
- Different cooling designs for fan trays and fans
- Thicker gold plating on all connectors used

Special System Features
The migration of AAI’s ground control system from a VME based server platform to ATCA required display screen and real-time clock upgrades. Foremost, the system needed a very high quality LCD panel to simultaneously display maps, targets and intelligence, surveillance and reconnaissance data. However, the ATCA system didn’t have an available PCI Express slot for adding high end graphics card. A solution was provided by VadaTech, a board design and manufacturing company who developed a video bus adapter in an ATCA blade form factor that interfaced to a thin client.

The thin client had a high resolution 30 inch screen and delivered the performance needed to run X Windows and MetaVR Virtual Reality. X Windows provides a graphical user interface (GUI) for networked computers, and MetaVR software creates virtual worlds using real-world photographic imagery, elevation and feature data.

Bringing It All Together
During their investigation, AAI replicated the capabilities of their rackmount server with a single ATCA blade, the Radisys Promentum ATCA-4300 Compute Processing Module. The blade ran MonteVista real-time Linux and VMware virtualization software in the Gemini ruggedized military ATCA chassis, which also housed storage blades from Astute Networks.

Applying their experience from developing application-ready platforms, Radisys engineers helped AAI perform platform integration, and thermal testing Radisys was able to make recommendations on platform configuration to provide more thermal head room for the systems.
One of the unique features of the UGCS system is the complete system might have to move several times a day requiring a complete start up and shut down of the system. Radisys working closely with AAI engineering were able to find ways to quickly power up and power down the system.

A lesson learned for AAI was that for future designs, they can minimize up-front engineering costs by starting with a validated ATCA platform populated with available COTS components.

**Robust Integration Test Methodology**

As AAI saw first hand, it’s a considerable engineering effort to piece together and validate all the components needed to create a functional system. One advantage of developing ATCA-based platforms is equipment manufacturers have the option to outsource many complex tasks, such as system integration testing.

Radisys has over 20 years of solid experience in the embedded communications market, and its engineers know how to rigorously test systems and resolve interoperability issues. Many of them have worked with ATCA since its infancy and contributed to the foundation specifications. They can track down and fix unexpected interactions between hardware, drivers, operating systems and middleware, even if it means assembling the necessary vendors to find the underlying problem. AAI observed how Radisys engineers work closely with other suppliers, enabling them to efficiently drive cross-vendor resolution of system issues while keeping the customer’s best interest in mind.