

ATLAS: Leveraging Software to Achieve the Competitive Advantage in GSaaS



The move from hardware to software in satellite ground infrastructure is more than just digital transformation for greater efficiency - it opens the door to a future of new revenue and growth opportunities, cost savings, and a level of competitiveness not seen before in the industry. ATLAS Space Operations is a leader in leveraging network virtualization and modernization to capture these opportunities.

ATLAS and the -as-a-Service Model

ATLAS Space Operations is a rapidly growing Ground-Station-as-a-Service provider



developing the largest US-owned and operated global federated antenna network. ATLAS provides managed networks services for their increasingly diverse commercial and defense customer base focusing mainly on Earth Observation (EO) and Remote Sensing (RS) missions.

Many satellite operators and service providers are choosing a GSaaS model as an alternative to building their own ground systems and to simplify the process of providing services for their customers. The GSaaS model can allow for quicker entry to the market and a faster way to get new services operational for satellite operators and service providers. The approach removes the CAPEX necessary for building a new ground system and maintaining it.

ATLAS is leveraging advanced software signal processing to support customer demand for ever-higher data rates and more efficient modulation and coding (modcods) that has outpaced the capabilities of their existing hardware modems and older software defined radios (SDR).

ATLAS' network, comprising over 50 antennas and 34 active ground stations, is providing its customers secure access to



"We selected Kratos because they provided the most comprehensive solution with options to add future capability, their solution was immediately available without requiring additional time or development risk, and they had a cost-effective solution, saving us millions of dollars, which is doubly important for a growing company with multiple expansion plans such as ATLAS."

John Williams, CEO, Atlas Space Operations

space for EO/RS applications supporting multiple frequency bands including S, X, Ka, and UHF. They are redefining Ground Segment-as-a-Service to Ground Software-as-a-Service™ which encapsulates how ATLAS leverages its network as a foundational data conduit and emphasizes the value that can be delivered through a software-centric approach.

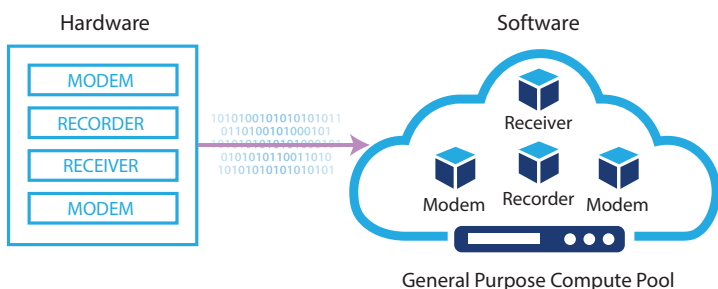
The Challenges in Legacy Ground Technology

ATLAS uses a variety of hardware modems and older SDRs depending on specific customer requirements at a given site. Previous attempts at modernization were slowed by limited modem capabilities and costs associated with customization.

Some ATLAS sites were performing to their specific missions but could not adapt to higher bandwidth mission requirements easily without increasing the hardware footprint which in turn would increase space, power and cooling requirements and costs.

The Solution in quantum Virtual Signal Processing

EO/RS is the first satellite market segment to digitally transform, and ATLAS is a pioneer in this effort. For this modernization project, they explored many options to grow their business, but ultimately decided that the best way forward was to adopt virtual signal processing that included the most advanced software modems and other applications to replace existing hardware.



Virtualization in satellite ground systems includes the transition from proprietary hardware to software that performs the necessary functions virtually on general purpose computers.

During the selection process, ATLAS found Kratos' OpenSpace® quantum products to have the most complete and cost-effective solution to meet their customers' growing demand for advanced capabilities. Against competing solutions, Kratos' quantum solution saved ATLAS millions of dollars. ATLAS implemented quantum at 9 ground station sites, a test lab, and two RF-Compatibility Test Kits, replacing older SDRs.



ATLAS site map depicting the 9 sites that have migrated to Kratos quantum in purple and 4 sites planned for migration in red.

Kratos is a ground system infrastructure provider leading the digital transformation of satellite ground systems. Kratos' quantum signal processing solutions are individual virtualized network functions that replace traditional hardware or legacy SDRs. These solutions currently run in more than a hundred organizations and take thousands of passes per month.

ATLAS' modernized ground sites now include software modems, FEPs, and Recorders, as well as digitizers all implemented while maintaining the service quality that their customers expect.

Virtualized Data Downlink & TT&C

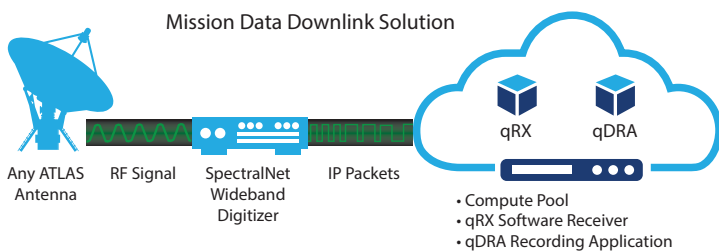
To run a virtual ground system, satellite signals communicating to the ground must first be converted into IP packets through digitization. ATLAS' network uses SpectralNet digitizers to achieve this conversion. Digitized VITA-49 DIFI compatible data streams are then ready for

processing by quantum virtualized products running on high-end general-purpose computers.

ATLAS has implemented two quantum signal processing solutions – one for mission data downlink and one for TT&C.

The wideband mission data downlink solution includes SpectralNet digitizers, quantumRX (qRX) wideband software receivers and quantumDRA (qDRA) recording applications. This solution is ideal for new satellites and ground stations due to its performance and economic efficiency. The solution enables ATLAS to:

- Use multiple waveform demodulation and decoding options
- Leverage industry standard interfaces
- Lower cost by using generic x86 compute resources
- Deploy flexibly on bare metal, virtually or in the cloud
- Scale on demand by spinning virtual instances of modems up and down



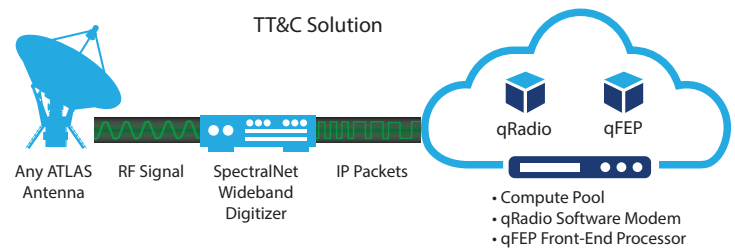
ATLAS' system architecture for wideband satellite signal processing in software for mission data downlink.

"Kratos offers everything necessary to meet and exceed our customer requirements in a scalable and future-proofed package capable of operating from a few hundred bps TTC to more than 1 Gbps Payload downlinks."

Steve Jackson, RF Solutions Engineer

For TT&C, the Kratos solution consists of SpectralNet digitizers, quantumRadio (qRadio) software modems, and quantumFEP (qFEP) front-end processors.

Kratos' TT&C solution supports hundreds of thousands of satellite passes per year for hundreds of companies worldwide and:



ATLAS' system architecture for narrowband satellite signal processing in software for TT&C and narrowband payloads.

- Work with most widely used satellite radios
- Are configurable as mission requirements change
- Support simplified integration with existing infrastructure
- Can be hosted on-prem, in private cloud or with a cloud provider
- Minimize footprint and cost with a pure software implementation

Maximized Network Flexibility & Agility

A digitally transformed ATLAS ground network can now scale elastically with demand. Operations staff can make updates over the air and add additional software modems in minutes without increasing their general-purpose compute footprint.

The quantum virtualized solutions provide the ability to spin up and spin down capacity based on demand and are configurable and reconfigurable over the air and on the fly. They ensure efficient utilization to capture downlinks from



ATLAS' newest enterprise ground site in Rwanda.



ATLAS' ground station site in Barrow, Alaska.

any satellite and any orbit rather than sitting idle between passes for a specific satellite, antenna, or orbit. Because multiple modems can run on one general purpose server, power, space and cooling are optimized and result in a small footprint ideal for pre-launch testing and integration.

ATLAS' customer missions are prepared for success with industry leading integration support and pre-launch RF compatibility testing with their ATLAS-in-a-box (AIB) test set, which contains Kratos quantum solutions that mirror the production network. AIB is an end-to-end RF compatibility test using real baseband equipment, an RF chain, and ATLAS' patented Freedom® software which provides both control and data interfaces, and makes the network appear hardware-agnostic for ease of integration across many remote antenna types

ATLAS recently showcased their agility by providing launch-day integration for a customer to expand UHF coverage less than two hours after the request was made. This achievement could only have been possible with a software-based ground system.

Migration & Quality of Service

ATLAS' carefully planned migration process consisted of pre-configuring software on the qRadio modems and qRX receivers in the lab to the extent possible before shipment,

transcribing any existing configuration files, loading them, and testing against customer signal recordings taken during RF compatibility testing. This ensured a smooth transition with minimal interruption to operations at even their busiest sites.

Future-Proofed for Changing Technology

ATLAS can now incorporate new higher modcodes and waveforms and respond quickly to changes in demand which was not possible with previous legacy technology. Because they are virtualized with quantum, ATLAS has a foothold on competitive advantage in the market. They can ensure maximum efficiency in signal processing, deliver the highest quality of service to their customers, and provide new services at the time of need.