

Ground Segment Innovates to Enable the New Space Renaissance

With dramatic jumps in bandwidth, the emergence of multi-constellation networks, 5G NTN and software-defined payloads, 2023 is the year for standards-driven transformation and a pivot to Ground as a Service.

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The days of the ground satellite segment trailing space capabilities are fast disappearing with a wave of new ground advances that support multi-orbit

constellations and the specifications that both 5G and a new generation of high-bandwidth satellites require.

The ground segment – from electronically steerable antenna and modem companies to integrators and network providers – is abandoning siloed, standalone systems in favor of software-defined architectures and ground-as-a-service offerings. Along the way, they're collaborating on common standards for interoperability needed for the new breed of flexible Low-Earth Orbit (LEO) constellations to achieve scale and broad market growth.

"We're in a space renaissance period with significant innovation at the space layer over the last three to five years – much more bandwidth, software-defined payloads and multi-constellation networks," says Greg Quiggle, senior vice president of Product Management at Kratos.

Historically, Geostationary Orbit (GEO) satellites carried a fixed payload for 15 years. Now, software-defined payloads expect to change their payload configuration, even as often as every 15 minutes, Quiggle explains. "Given how dynamic the space layer is, we need ground systems to be equally as dynamic," he says.

Kratos knows a lot about making networks dynamic: it was one of the first ground segment players to see value in orchestration, or dynamically tracking the movement and demands of LEO satellites through its OpenSpace platform. Initially focused on the Earth observation ground segment, Kratos' platform is now targeting the mainstream satcom arena.

Aiding ground advances is support for interoperability standards like DIFI (Digital Intermediate Frequency Interoperability), an open digital interface/radio frequency (IF/RF) standard that will allow RF equipment to talk to antennas digitally without analog hardware.

3GPP Release 17, the latest 5G standard to support non-terrestrial network (NTN) connectivity, was defined and, for the first time, provides a framework for 5G into the satellite world, driving new alignment between satellite and handset and mobile network operator (MNO) players.

"While the standard was approved in 2022, all the implementation on the first devices will come out in 2023," says Lluç Palerm-Serra, principal analyst with NSR, an Analysys Mason company.

"We see a lot of convergence on the terrestrial side – convergence between cellular networks, wireline networks and now satellite networks," observes Frederik Simoens, CTO of ST Engineering iDirect, which has dubbed this transformation the "New Ground" movement. "It's new space, it's the cloud, it's the telco and IT convergence, and that's what the New Ground movement needs to answer."

Leading ground players see 2023 as the year transformational ground infrastructure gets fielded to support newly operational LEO and Medium-Earth Orbit (MEO) constellations.

However, a key barrier for LEO/MEO growth remains the cost of the terminal.

"Flat panel antennas are definitely one of the key enablers for LEO services, so reducing cost but also providing the performance that enterprise customers want is going to be key to those constellations," says Palerm-Serra. "With OneWeb and mPOWER entering service, these constellations really need the technology on these antennas to sell the services to customers. Otherwise, it's going to be very difficult to scale for these constellations. The industry is reaching a point where flat panel antennas need to perform," he adds.



The All.Space smart terminal offers a multi-link capability that the company says is needed in today's contested space environment.

Ground Innovations a Theme at SATELLITE

Several companies will leverage SATELLITE 2023 to launch new or enhance current capabilities critical to a more open and agile ground segment.

One company promising to be a game-changer on the antenna and terminal front is London-based All.Space, which is announcing its smart terminal that offers a true multi-link capability that is needed in today's contested space environment, says CEO John Finney.

"The moment that the Russia ASAT [anti-satellite] missiles were fired to destroy one of their own satellites in November 2021 it confirmed the ability of near-peer rivals, China and Russia, to take out assets in the sky, military or commercial. NATO, particularly the U.S. Space Force, now recognizes that satellites are no longer on the invulnerable high ground they once were," Finney says.

All.Space's terminal can defend against such attacks by "meshing" multiple satellites together in multiple orbits.

"We have a unique capability to harness the power of multiple links to multiple satellites, running all of them simultaneously," says Finney.

The platform includes software packages to sense, locate, analyze and act on data — a capability Finney calls "intelligent resilience."

"It will allow us to easily integrate third-party best-in-class hardware, and then layer that in software that creates an AI edge to intelligent decision-making."

In a defense scenario, this could involve using additional links to not only communicate but also to map the sky. Finney says the terminal supports intelligent routing by driving decisions users make at the terminal level such as enforcing policies on the terminal to decide on what basis to route traffic from one link to another.

Following successful multi-orbit field tests, All.Space plans to begin shipping its terminal to defense customers in June, followed by a new terminal announcement for commercial mobility markets in the third quarter. Finney says early orders already have met half of the company's revenue targets for 2023, totaling "several tens of millions of dollars."

In addition to All.Space, Kymeta and military commercial systems integrator Fairwinds Technologies also plan big splashes at the show.

Kymeta is focusing on the enterprise mobility market and advancing its strategic collaboration with OneWeb, slated to begin global coverage this year.

"We continue to produce a very streamlined, easy-to-use product that's enterprise-grade for the OneWeb network," says Lilac Muller, vice president of Product at Kymeta.

Military and government users in particular need multi-orbit solutions, "very much like what we demonstrated in April of last year at an event in Dallas switching between OneWeb and our GEO capacity," Muller says.



An electronically steered flat-panel platform, the u8 antenna has no moving parts and is built leveraging metamaterials technology. Kymeta also offers a managed global network for both satellite and cellular capacity offering users the ability to manage their experience via the Kymeta Access app. Or partners can leverage Kymeta's suite of APIs to create custom experiences.

"We want to provide customers with the ability to add accessories and customization options so that the Kymeta platform can be a purpose-built solution for their customers," Muller says.

Kymeta will offer its u8 product to OneWeb users in two configurations – satellite only and hybrid satellite-cellular. Both configurations will support fixed and on-the-pause use cases immediately. The product also is "mobility ready" via a software update once OneWeb's constellation can support mobility applications. OneWeb's global mobility service for aviation and land mobility, will be available in early 2024.

Fairwinds Technologies' long-touted Global Link multi-modem antenna management system will launch at SATELLITE. Global Link addresses the military tech acquisition challenge of how to transition to MEOs and LEOs while still supporting current GEO systems.

Fairwinds' answer is a solution that is both antenna and modem-technology agnostic.

CTO and co-founder Timothy Hillner, who comes from the Army acquisitions world, explains that it takes years for the military to adopt new technology and the U.S. Department of Defense (DoD) has multiple GEO-only systems that it will continue to use.

When adding a new LEO or MEO service, the DoD can now use Global Link "to plug the service in with their legacy systems, effectively enabling a multi-domain scenario integrated into the network."

That capability is important given that the DoD's next-generation tactical satcom network will include many different types of terminals, from mechanical gimbal reflector antennas, to electronically pointed antennas, in addition to commercial and DoD-deployed modems, each with their own waveforms and protocols.

"This disparate set of equipment must act as a single system to provide resilient transport and network operations," explains Hillner. "Global Link provides this capability and enables these systems to be utilized by a general-purpose end user."

Fairwinds has successfully tested its system with L3Harris parabolic antennas and with Ball Aerospace phased array antennas. Applying digital beamforming techniques to modems and terminals, the solution allows warfighters to use the equipment, frequencies and satellites available to them in the moment, so they can quickly shift to meet mission requirements, Hillner says.

Platforms Support New Ground Vision – Dynamic and 5G-Ready

On the network front, Kratos plans to announce new satcom applications for its OpenSpace platform that will "deliver additional dynamic, orchestrated operations," including laying the foundation for the eventual delivery of 5G-type services through OpenSpace, says Neil Oatley, Kratos' vice president of Marketing.

ST Engineering iDirect will unveil an upgrade to its Mx-DMA MRC return technology, which now can support 300 megabits of return link speeds combined with 800 megabits outbound reaching throughputs over 1 gigabit in a VSAT mode, while mixing high-throughput users and very low data consumer users on the same beam. The technology, part of iDirect's New Ground positioning, shares the same capacity, multiplexing different terminals into one capacity pool, says Simoens, who calls it "the ultimate scalable return technology."

The Mx-DMA MRC, says iDirect's chief technologist, can serve higher end customers like cruise networks as well as backhaul links or broadband-access customers using the same return technology on a single network with no segmentation.

In the VSAT market, Hughes Network Systems has unveiled its JUPITER System Series 3 ground platform. JUPITER already serves half of the global VSAT market since launching a decade ago, supporting both consumer and enterprise broadband users. Developed to enable services on the company's JUPITER 3 satellite, which will launch this year following multiple delays, the Series 3 platform is the newest generation of the ground system the company markets to other operators.

According to Adrian Morris, executive vice president of Engineering at Hughes, the satellite will have between two and three times more capacity compared to JUPITER 2 and features a software-defined architecture, 5G-ready design, and virtual, cloud-enabled network management – capabilities that are built into the

Series 3 ground platform. Hughes' higher speed gate arrays are programmable; its wideband modems support up to 500 megahertz and its RF hardware supports up to 50 gigahertz in throughput.

"With the increasing capability in GEO satellites, both in total capacity and capacity density, our gateway technology has likewise advanced," says Morris, explaining that the higher capacity density allows Hughes to place more subscribers in a given coverage area. "The latest GEO VHTS satellites can provide more and smaller beams, and therefore, the gateway technology can now deliver more capacity density and more beams."

HughesNet Fusion, Hughes's consumer service that combines GEO and LTE capacity, has expanded nationwide since launching a year ago, reports Morris. The combination takes the best attributes of both networks, he says, noting that it is especially attractive to users who consume a lot of videos, which account for 70 percent of all broadband traffic. The service automatically switches a streaming video feed on a wireless connection to GEO, giving the user a more responsive experience.

Industry Embraces Software, Interoperability Standards

The satellite industry agreeing to standardize around common modems and terminals is gaining widespread traction as evidenced by the strong response of the industry to the DIFI Consortium, [formed in August 2021](#) to advance standards critical for the industry's transition to a digital-based ground infrastructure.

With 54 members from across the commercial satellite operator and vendor community as well as government and military members, the consortium released the first DIFI spec last year for free download to any U.S. company or

organization. The standard was validated after the U.S. Army included the spec in two RFIs and a recently released RFP.

"2023 is all about adoption," says Stuart Daughtridge, DIFI Consortium chairman. "DIFI is about enabling the move from an analog-based ground system architecture to a more digital infrastructure, with more software-defined, virtualized networks like that in the terrestrial world."

Kymeta's Muller is excited by the industry momentum around DIFI. "There is definitely a grassroots shift that I'm seeing. We need critical mass. We need everybody on board and that will allow us to really offer software-defined solutions," she says.

But while momentum for DIFI is strong, some experts don't see it being integrated into products this year.

"I don't expect any commercial product to fully utilize DIFI this year," says NSR's Palerm-Serra. "It's not just about technology adoption; it's about the business model as well — how you partner with a cloud provider, how the satellite operator adopts the technology, and who takes responsibility for the different elements of the network. All these points are currently still being sorted out."

One issue that DIFI will help eliminate is vendor lock-in, or dependency on specific hardware that isn't compatible with other products and makes it hard to take advantage of advances or features offered by competing vendors.

Today, companies are "locked" into specific modem hardware, says Muller. To illustrate, she points to Kymeta's GEO services and OneWeb's satellite, which each use their own modem. Only by adding a third piece of hardware in between the two can the networks switch and communicate. Muller says the problem is solved with software orchestrating these hand-offs, stressing that multiple hardware components are unnecessary once the industry deploys a

compute platform and cross-licenses waveform and software-defined capabilities.

In addition to DIFI, the satellite ground segment is also rallying around the third 5G standard – 3GPP Release 17, the first technical specifications for integrated, direct-to-device 5G over satellites.

The standard's release signaled to the world that satellites are critical components of the global 5G ecosystem, spurring new cooperation between space and terrestrial service providers.

"There's a lot of direction on implementing 5G release 17 on smartphones," says Palerm-Serra, citing Apple's agreement with Globalstar and recent announcements from Qualcomm and Iridium as well as Mediatek, Skylo, and Bulitt.

Kratos's Quiggle summarizes the significance of this milestone well: "5G NTN allows us to operate as a peer group with MNOs and in doing so, we can drive significantly more revenue and adoption for the space industry." **VS**