Next Generation Space Defense

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For over 30 years, SpaceBridge has striven to provide C4I over SATCOM connectivity by being an innovator, leader, and trusted provider of bold tactical solutions in the military ground segment Satellite technologies.

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Redwire is awarded a contract to manufacture Link-16 antennas for a national security LEO constellation

Redwire Corporation (NYSE: RDW) has been contracted to deliver 42 high gain antennas for an undisclosed national security customer for an LEO satellite constellation with significant follow-on potential.

Scheduled to be delivered within the next 18 months, the antennas will enable beyond line-of-sight (BLOS) communications for the warfighter using a secured tactical network.

Earlier this year, Redwire successfully delivered antennas for the initial phase of this constellation.

This production lot will be manufactured in Redwire's recently expanded Longmont, Colorado, facility, which uses modular array work cells that enable a factory capacity well in excess of 120 antennas.

The award builds on years of development of advanced antenna systems for industry and military customers. Redwire's antenna technology was selected for the original pathfinder mission to demonstrate this waveform from space.

Redwire's antenna technology delivers unmatched gain performance over an ultra-wide bandwidth and also interfaces to radios that support wideband, frequency-hopping, tactical networking.

The antenna technology was demonstrated in part under an *Air Force Commercialization Readiness Program.*

"Redwire is proud to continue to develop critical, enabling antenna technology for our national security customer," said ***Dean Bellamy***, Redwire's Executive Vice President of National Security.

"This antenna product line encompasses years of research and development of advanced antenna systems alongside industry and military customers. Redwire has already begun investing in the development of future mission critical antenna technologies for future phases of this constellation, as well as other Department of Defense and Intelligence Community missions."

Redwire Corporation (NYSE: RDW) is a leader in space infrastructure for the next generation space economy, with valuable IP for solar power generation and in-space 3D printing and manufacturing. With decades of flight heritage combined with the agile and innovative culture of a commercial space platform, Redwire is uniquely positioned to assist its customers in solving the complex challenges of future space missions.

For more information, please visit ***www.redwirespace.com.***

SKYWAN – THE NEW DIMENSION IN AIRBORNE SATELLITE COMMUNICATION

Northrop Grumman to build multi-level space mesh networking prototype for DoD's connected battlespace vision

Northrop Grumman Corporation (NYSE: NOC) and ***Aeronix, Inc***. have been selected to build a secure, connective, networking layer in space that will help enable the U.S. Department of Defense (DoD) vision for the joint force.

Northrop Grumman collaborated with Aeronix to incorporate high-speed encrypt/decrypt firmware, designed and tested to ***National Security Agency*** standards.

Leveraging a crypto development kit, Northrop Grumman proved that third-party developers can further contribute to the already rich library of cryptographic algorithms.

As part of this new award, this capability will be implemented onto the Space ECU prototype for delivery in 2024.

Recent demonstrations of the *Software Programmable Open Mission Systems Compliant* radio terminal have successfully connected third-party industry providers and securely shared information in a platform agnostic, all-domain environment.

"Our open architecture space mesh networking prototype enables new capabilities in Space Layer Networking to address emerging and evolving customer needs," said ***Kevin Berkowitz***, director, network solutions, Northrop Grumman. *"This offering provides data, communications connectivity, and cryptographic processing at mission speed – a critical element of connecting the joint force."*

The companies will develop a *Space End Crypto Unit* (ECU) prototype that will connect platforms and weapons in LEO across common architecture, providing added network security to critical missions for the Space Force.

Northrop Grumman's prototype is a flexible, high throughput design based on a single chip, reprogrammable solution and is expected to provide a connected network solution that helps warfighters make decisions faster across a full range of platforms.

As the DoD seeks to connect the joint force, Northrop Grumman's networking capabilities play a vital role in providing secure global connectivity.

www.northropgrumman.com

Raytheon Intelligence & Space's success with machine-to-machine communications exercise before Valiant Shield 2022

JADC2 is the ***Department of Defens***e's vision for a future command and control operating construct that connects the battlespace across every domain — sea, air, land, space, cyber and the electromagnetic spectrum.

Raytheon Intelligence & Space, (RI&S) a Raytheon Technologies business, successfully demonstrated ***machine-to-machine*** (M2M)communications across multiple assets during a communications exercise.

During the exercise, RI&S relayed data securely in seconds between the ***Raytheon Multi-Program Testbed*** (RMT-727), an airborne KC-135, a ground station located at ***Beale Air Force Base,*** California, and a satellite to address a set of joint warfighting mission requirements in the multi-domain battlespace.

This exercise served as risk-reduction preparation ahead of the company's participation in the Valiant Shield 2022 exercise in Guam.

Valiant Shield is a U.S. only, biennial field training exercise with a focus on integration of joint training among U.S. forces. This training enables real-world proficiency in sustaining joint forces through detecting, locating, tracking, and engaging units at sea, in the air, on land and in cyberspace in response to a range of mission areas.

At Valiant Shield, RI&S will demonstrate multi-domain, multi-intelligence, edge-based processing in an operationally representative and contested environment, emphasizing capabilities in advanced analytics, ***artificial intelligence/machine learning*** (AI/M2M), and machine-to-machine operations. Valiant Shield occurred from June 1 to 17 at ***Andersen Air Force Base***.

JADC2 is the Department of Defense's vision for a future command and control operating construct that connects the battlespace across every domain — sea, air, land, space, cyber and the electromagnetic spectrum. RI&S is contributing its multi-domain capabilities in space systems, resilient communications, sensors, AI/ML, and mission software to the DOD JADC2 architecture.

"*This successful communications exercise sets up our team — spanning our military and industry partners — for success in advance of Valiant Shield*" said ***Conn Doherty***, vice president of Future Assured Systems Technologies at RI&S. "*During the exercise we will collaborate in a truly, experimental environment to strengthen that partnership and demonstrate the critical capabilities required to enable elements of Joint All-Domain Command and Control (JADC2) for the joint force.*"

ratheonintelligenceandspace.com

Raytheon Intelligence & Space

U.S. Indo-Pacific command joint forces participated in exercise Valiant Shield (VS) 2022, on Guam, the Commonwealth of the Northern Mariana Islands, Palau and at sea around the Mariana Island Range Complex.

Participants include *USS Ronald Reagan (CVN 76)* and *USS Abraham Lincoln (CVN 72) Carrier Strike Groups*, **USS Tripoli (LHA 7),** *94th Army Air and Missile Defense Command (AAMDC)*, I and *III Marine Expeditionary Force (MEF)*, ***36th Wing***, 15 surface ships, more than 200 aircraft and an estimated 13,000 personnel from the U.S. Navy, U.S. Air Force, U.S. Army, U.S. Marine Corps, and U.S. Space Force.

VS22 is a U.S.-only, biennial *field training exercise* (**FTX**) focused on integration of joint training in a multi-domain environment. This training builds real-world proficiency in sustaining joint forces through detecting, locating, tracking, and engaging units at sea, in the air, on land, and in cyberspace in response to a range of mission areas. Exercises such as VS22 allow forces across the Indo-Pacific the opportunity to integrate Navy, Marine Corps, Army, Air Force, Space Force, and Special Operations to train in precise, lethal, and overwhelming multi-axis, multi-domain effects that demonstrate the strength and versatility of the Joint Force.

Sailors launch a MK18 Mod 1 unmanned underwater vehicle (UUV) in the vicinity of Tinian Harbor from a commercial maritime support vessel in support of Valiant Shield 22. U.S. Navy photo by Lt. Tyler Baldino

VS22 FTX prepares the Joint Force to rapidly respond to crises and contingencies across the spectrum of operations from humanitarian assistance and disaster relief to armed conflict.

VS22 assists U.S. forces in developing regional and global power projection capabilities. Integrated training provides a full range of options to succeed in defense of U.S. interests and those of its allies and partners around the world.

This is the ninth iteration of the VS series that began in 2006

COMMS ON THE MOVE

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Easy to maintain

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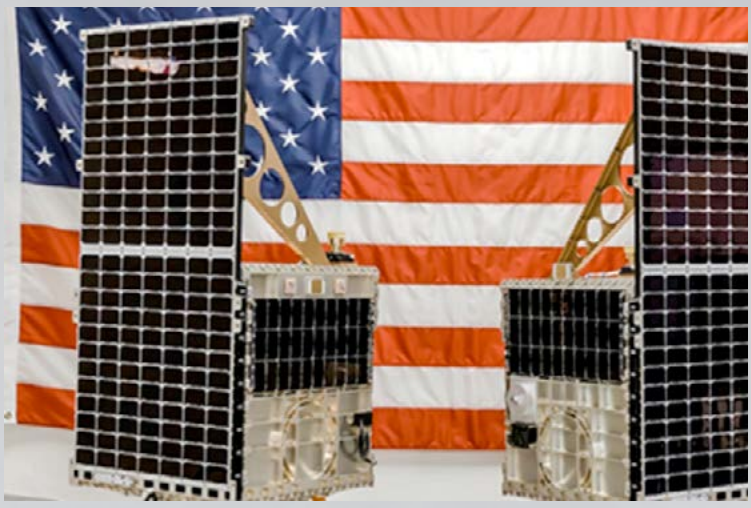
Artistic rendition of optical comms between two DARPA Mandrake 2 satellites. Image is courtesy of SEAKR.

Inter-optical links successfully demo'd by SEAKR Engineering in space between two DARPA Mandrake 2 satellites

SEAKR Engineering, LLC, a wholly-owned subsidiary of ***Raytheon Technologies***, announced a successful demonstration of optical inter-satellite links between two ***Defense Advanced Research Projects Agency Mandrake 2*** satellites.

During the first test, more than 280 gigabits of data were transferred at a range of 114 kilometers during a period of more than 40 minutes.



"*This was a demonstration not only of optical communications in space but also a closer look at some of the foundational building blocks needed for a networked space architecture,*" said ***Jeff Schrader***, president of SEAKR Engineering and Blue Canyon Technologies.

Under DARPA's Blackjack project, two Mandrake 2 spacecraft were launched last year to demonstrate advanced laser communications.

The satellites, named ***Able*** and ***Baker***, were outfitted with ***SA Photonics*** optical links onboard an ***Astro Digital*** bus. ***ASI*** provided the satellite software needed to operate the vehicles.

SEAKR, the prime contractor, led the system integration of both satellites.

Originally scheduled for a January 2021 launch, a pre-launch incident damaged both Able and Baker satellites.

SEAKR was able to repair and rebuild the satellites, and then deliver them for launch in less than six months.

"*This recent on-orbit demonstration was the culmination of several organizations working in tandem to solve a number of challenges,*" said ***Scott Lowery***, SEAKR Mandrake program manager.

SEAKR also led the ***Mandrake 1*** program that completed its mission, establishing **Technical Readiness Level 9** for some of the highest performing CPUs to ever fly.

These processing elements are the building blocks for DARPA's ***Pitboss*** and future systems.

Like Mandrake 2, the schedule for Mandrake 1 was nine months from program award to launch integration.

The new ThinAir® Ka1717 antenna extends ThinKom's product line with a model designed for the regional jet market .

ThinKom + CarlisleIT combine tech to offer a new phased-array satellite antenna for regional jet IFC

ThinKom Solutions and Carlisle Interconnect Technologies (CarlisleIT) plan to bring to market a new, fully integrated, phased-array Ka-band satellite antenna solution to meet the increasing demand for high-speed in-flight connectivity (IFC) on regional jet fleets.

The ThinAir Ka1717 uses the proven **VICTS** (*Variable Inclination Continuous Transverse Stub*) technology that is currently in use on thousands of narrow- and wide-body aircraft. The new lightweight, low-profile VICTS antenna system has been designed to meet the specific weight and space requirements of regional jet fleets and to optimize fuel efficiency.

The complete antenna subsystem, including the antennas, solid-state power block (SSPB) amplifier, adapter plate, fairing, and radome, is six inches high and weighs under 160 pounds (73 kgs). ThinKom has integrated the *Ka antenna networking data unit* (**KANDU**) and the *Ka radio frequency unit* (**KRFU**) functionality inside the crown-mounted radome to accommodate the in-cabin space limitations of regional jets.

The system's low power draw ensures gate-to-gate operation, even under conditions of high thermal and solar loading.

As with all of ThinKom's VICTS antenna systems, the Ka1717 has been designed to meet the ITU Article 22 and WRC 5G earth station in motion (ESIM) requirements to ensure the system does not interfere with GEO satellites when operating on NGSO networks or with 5G terrestrial networks that share the same Ka-band spectrum.

ThinKom and CarlisleIT are collaborating on development and certification of a fully integrated Ka1717 package, including the radome, adapter plate, fairing, power supply, connecting cables and installation kits for the regional jet market.

The full SATCOM system, including installation hardware, connecting cables, and in-cabin networking equipment, will be comfortably below 250 pounds (115 kg).

"Until now, it has been impractical for regional jet operators to offer their passengers the same level of in-flight connectivity experience as larger passenger jets, mostly because of the size, weight and drag of existing aero antenna systems," said ***Bill Milroy***, CTO and chairman of ThinKom Solutions. *"The Ka1717 addresses this need with an antenna system that is the ideal form factor for regional jets, designed to operate on any Ka-band constellation the customer chooses and is based on ThinKom's existing, highly reliable and efficient VICTS antenna designs. This system is a key enabler to contracting with airlines to a very high service level agreement."*

Chris Rawley, CarlisleIT product line manager for connectivity, said, *"The Ka1717 form factor has enabled CarlisleIT to optimize the installation footprint for the narrower fuselages of regional aircraft. This supports a dorsal mounted SATCOM solution without the typical drag penalties of larger antennas."*

THE BENEFIT OF FLEXIBLE MODEMS FOR TACTICAL MILSATCOM OPS

Authors: Chad Gatlin, Chief Executive Officer, NIC4, and Dave Meadows, Division Vice President, Advanced Programs, NIC4

Maintaining resilient and secure satellite communications is one of the most important capabilities needed by deployed warfighters, whether on land, at sea or in the air. The ability to communicate critical data can be achieved with secure satellite communications systems that are resilient to cyber-attack and deliberate or accidental jamming.

Having multiple data transport channels (*e.g.*, multiple satellites, teleports, frequency bands, waveforms, and so on) can enable deployed forces to fight through contested or congested MILSATCOM environments. This approach offers various benefits across multiple MilGov applications.

This article will look at the benefits of a flexible terminal and the associated supporting MILSATCOM enterprise infrastructure as well as the requirements to successfully deploy this type of system in the field.

IMPROVED RESILIENCY, ROBUSTNESS, FLEXIBILITY AND MANAGEABILITY

In today's cyberwar environment, the desire for multi-transport, flexible, terminal technologies are crucial for any successful, global mission. Whether the user is tasked with a defense-related mission or even a disaster response/first-responder reaction, critical communication solutions are imperative to the success of the mission and/or response.

Multi-transport, flexible communication solutions will be necessary to ensure SATCOM links can survive to support mission-critical MILSATCOM services.

In the *U.S. Department of Defense* industry, the ***U.S. Space Force*** (USSF) released their "*fighting SATCOM*" operational vision in January 2020. Referring to the USSF SATCOM Vision, General ***John W. Raymond*** said, "*Adversaries understand the advantage SATCOM brings our warfighters and are working to deny, degrade and destroy these capabilities. Despite the global, instantaneous reach of our SATCOM capabilities, which includes both military (MILSATCOM) and commercial (COMSATCOM) capabilities, the enterprise needs to improve its resiliency, robustness, flexibility and manageability.*

"For the United States to maintain its asymmetric advantage of global space-based communications, the SATCOM enterprise must evolve quickly. We must prepare now to fight SATCOM as a single enterprise through a contested, degraded and operationally limited (CDO) environment, prevent or withstand loss, and continue to deliver effects to warfighters.

"The objective of the USSF's SATCOM Enterprise Management and Control (EM&C) program is to 'provide resilient, effective management and visualization of a heterogeneous enterprise SATCOM environment, including both MILSATCOM and COMSATCOM resources'."

This capability will deliver significantly enhanced situational awareness across all MILSATCOM domains to provide leadership and operations personnel with the information they need to react to threats and initiate rapid recovery.

An important part of the mitigation and recovery will be to enable deployed wideband MILSATCOM terminals to "*roam*" between satellites and networks very rapidly.

This is particularly true for commercial SATCOM services that do not have the inherent protections that purpose-built MILSATCOM systems provide.

The EM&C program will also develop open standards for use by the industry and the government to enable rapid integration of the capabilities into terminal modernization and development efforts, making it widely and promptly available to DOD users.

In the near future, the EM&C program will comprise of several application suites and tools including *Situational Awareness*, *Terminal Registry*, *Service Provider Registry*, *Service Planning*, *Service Orchestrations*, *Security Management* and a *Data Warehouse*. The EM&C architecture is evolving as prototype systems are developed in an agile manner, bringing the functional and data requirements and workflows features into clear focus.

The application suites mentioned above will allow for ease of forecasting and planning, MILSATCOM resource allocation, terminal provisioning, terminal activation and network acquisition, monitoring, all contributing to and benefiting from a comprehensive situational awareness capability.

These application suites are envisioned. Prototypes are being developed for some of this at this time under USSF sponsorship.

Forecasting and Planning — The military leadership for a particular mission or set of missions, engaged with COMSATCOM satellite and services providers, uses a variety of planning and resource allocation tools and processes available within the enterprise to develop specific configurations of carriers and/or managed network service requirements needed to fulfill the mission's MILSATCOM communications requirements. These requirements can also include several contingent carriers and potential network accesses that represent possible surge solutions, and/or provide solutions to address potential loss of satellite resources as the result of failures or attacks (*i.e.*, a SATCOM PACE plan).

SATCOM Resource Allocation — This process allocates resources available from the various SATCOM Service Providers to specific terminals, appropriate to the terminal capabilities, mission roles and priorities. The output of this is a set of ***Service Configuration Packages*** (SCPs) for each terminal, enabling its access to its allocated networks. This process enables strategic load balancing and contingency planning to mitigate network attacks or failures. A full suite of SCPs represents a machine-readable PACE plan for a given terminal.

Terminal Provisioning — SCPs are loaded into a database within the ***Terminal Manager*** (TM). The TM is a software application that can be hosted on a small micro-server integrated with the terminal. Terminals already equipped with a control computer may be able to host the TM software on the existing compute platform.

The initial SCPs can be loaded prior to deployment, and then continuously updated via secure network communications between the *Terminal Manager* and *Regional/Theater Network Element Managers* anytime the terminal is online using the ***Flexible Terminal Interface*** (FTI). The FTI is a messaging protocol that provides two-way, M&C communication between the Terminal Manager and the local Network Element Manager. This allows rapid reallocation of MILSATCOM resources to address evolving battlefield requirements.

Terminal Activation/Network Acquisition — Terminal operators acting under appropriate command authority activate one of the carriers or network accesses available in the terminal's SCP library. The *User Interface* (UI) provided by the Terminal Manager makes this a simple selection from a menu.

In response to this selection, the Terminal Manager accesses its database of SCPs and loads the corresponding data into each manageable device (*e.g.,* ACU, modem, router) within the terminal. This loading is performed automatically by the Terminal Manager. Once all terminal device configurations are complete and the Terminal Manager verifies their correctness, the TM proceeds with acquisition of the desired carrier or managed network.

Once the terminal is successfully online and passing wideband IP traffic, the TM uses the FTI M&C link to receive SCP updates, and for the Terminal Manager periodically to provide terminal status and network performance/utilization data visible from its perspective in the network. This provides a rich set of real-time status, performance and use data to the *Situational Awareness* element.

Situational Awareness — Real-time data feeds are provided from a variety of sources to populate displays and feed data analytics functions. These capabilities provide commanders and operators at various echelons the information they need to make informed command decisions and react appropriately to threats or system failures.

ADVANTAGES OF SATCOM ENTERPRISE M&C ARCHITECTURE

Enables SATCOM Roaming
Easy, rapid movement between different networks, satellites and service providers brings significantly improved resilience of SATCOM operations to a broad spectrum of impairments, providing reduced mission vulnerability to EMI/RFI, satellite/network failure, congestion and cyber-attack.

Improved Mission Effectiveness
Access to other networks enables rapid response to changing mission requirements including throughput, geographical reach, look angle restrictions, etc.

Improved MILSATCOM Resource Efficiency
With EM&C-enabled MILSATCOM, network stovepipes are eliminated, and resource pools can be managed for load balancing and surge support.

Provides Full End-to-End Network Situational Awareness
This reduces time to address network failures or attacks, provides objective measures of system performance and informs future planning and resource allocation for future missions.

Provides Enhanced Support to Tactical Terminal Operators
This includes faster terminal service acquisition and troubleshooting by terminal operators, as well as a reduction in training requirements. It also enables remote support by expert SMEs shared across all terminals in a region or theater.

Delivers Enhanced Logistics and CM/QC Support for Sustainability
Real-time terminal asset management and configuration management are provided with terminal status reporting.

Cost-Effective
The proposed approach is very economical to implement relative to any alternative.

Timely and Low-risk
The proposed approach can be deployed quickly and accrue large benefits in the near-term to meet immediate needs. It is very amenable to spiral development and deployment.

SUMMARY

An integrated MILSATCOM M&C enterprise will deliver unparalleled options to joint warfighters for mission success. Enhanced performance and resilience are necessary to address a 21st century contested space domain.

We must move faster than our adversaries to ensure warfighters receive the operational benefits of a SATCOM enterprise capable of delivering MILSATCOM effects in CDO environments.

We must adopt faster acquisition processes and faster command and control constructs to maintain the advantage in *any* conflict.

www.networkinv.com

NIC4
Network Innovations Group

Chad Gatlin

Authors: Chad Gatlin, Chief Executive Officer, and Dave Meadows, Division Vice President, Advanced Programs, NIC4

Dave Meadows

ADVANTECH
WIRELESS
A Baylin Technologies Company

Summit versus Summit II

Though the features between Summit and Summit II are similar, Summit II incorporates the latest in RF and control technologies.

The Summit II systems are comprised of modules that are housed in our Taurus SSPA package. As a result, Summit II is approximately 30% smaller and lighter – the perfect solution for antenna-platform mounting.

Taurus provides optimized thermal management and high-efficiency waveguide combining that includes transistor isolation.

Advantech's latest CANBus operating system provides fast inter-component communications as well as the ability to perform device-level diagnostics.

TRANSFORMING FORWARD COMMAND POSTS...

...With transportable tracking terminals

A Conversation with Kevin McMahon, Senior Director of Sales for Government + Defense Solutions, Cobham Satcom

Cobham Satcom has released a new range of multi-orbit, MIL-STD tracking terminals capable of rapid switching between LEO, MEO, GEO, and HEO satellite constellations with a single antenna and ready to meet Future Advanced Satcom Terminals (FAST) needs.

Forward command posts are vital to the relay of real-time data and decisions between the front line and operational command centers. As a former U.S. Marine (USMC), and now Senior Director of Sales for Government and Defense Solutions at Cobham Satcom, experience has shown that existing systems have limited flexibility and can lead to less efficient operations.

Cobham Satcom's new ***Tactical TRACKER*** range of transportable terminals expands flexibility and ensures real-time information and is always available to decision makers, whether they are physically located in a forward command center or further back from the front line in regional centers.

The benefits also extend to modern *unmanned aerial vehicles* (UAVs) that generate increasing amounts of data through higher resolution imagers and a growing range of sensors. High speed, resilient data relays are critical, and the ability to use multi-band connections and lower latency constellations offers more control loops and more time on target. In short, the better the satellite relay, the greater the advantages."

The tactical TRACKER range is an evolution of the company's existing TRACKER systems already in wide use by search and rescue organizations, *Earth Observation* (EO) and imagery companies, as well as emerging satellite *Internet of Things* (IoT) and *machine-to-machine* (M2M) providers.

The tactical series is easy to deploy. They are battlefield ready and tool-free to setup and operate: 30 minutes from box to bird. And now, finally, thanks to Cobham Satcom ingenuity, there is a single tactical tracking antenna for MEO, GEO, and HEO networks.

Why would anyone take two antennas to the field when a single, Cobham Tactical Tracker can track satellites? The rapid deployment and connection time of the company's Tactical Tracker series allows users to be prepared in mission-critical scenarios where every second counts. From

a **ConOps** (*concept of operations*) perspective, it means fewer antenna operators and shorter logistics tails.

The new terminals provide unmatched deployment flexibility and ultra-resilient battlefield communications by combining highly accurate, multi-orbit tracking with a rugged but lightweight design. The baseline Tactical TRACKER systems comprise 1.3, 1.5 and 2.4 meter antennas. Each antenna is easily broken down into several elements, sized for two-person carry in customized, rugged transport cases.

Feedback from the U.S. Army has so far been positive, particularly because the systems meet *Future Advanced Satcom Terminals* (**FAST**) requirements. FAST is a U.S. Army initiative to boost digital resilience by taking advantage of LEO and MEO constellations to reduce latency and reliance on single GEO connections.

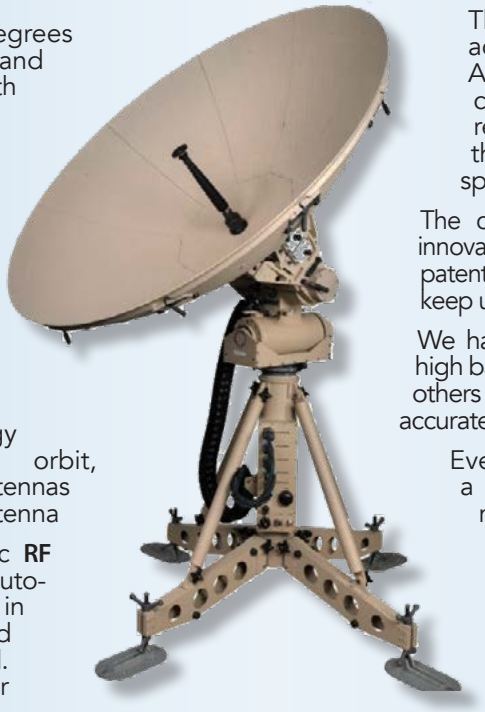
Our company's terminals are FAST-ready today and we are seeing this requirement increasingly appear in tenders. New LEO and MEO constellations will transform tactical operations, so it's vital to have future-ready terminals that can leverage these constellations and help our users maintain their communications advantage. Governments and defense do their due diligence to determine which gateways are best. They understand the technology, and that's good news for Cobham Satcom.

With more than 25 years of experience with SATCOM technology, there's no doubt that the constellations I see coming online now are a gamechanger — the type of technology jump that only arrives every few decades. Cobham Satcom has been a developer of radio and satellite communication equipment for land and maritime sectors for more than 40 years and is part of a history of more than 80 years of innovation.

The firm's Government and Defense Solutions team offer broad experience across government and defense programs and procurement vehicles. We work closely with prime contractors, integrators and end users to supply optimized solutions —whether established products, system level solutions or new technology developments. My new role at the company reflects Cobham Satcom's overarching strategy to focus and accelerate their efforts in the government and defense space, facilitating greater market access and value for those working in the world's most challenging conditions.

The new Tactical TRACKER series leverages Cobham Satcom's prior experience with government and enterprise solutions We are already doing low-latency, multi-orbit tracking in the maritime environment — now we're now bringing that technology to land.

Our maritime antennas track at 90 degrees per second over three axes (x, y and z) and we can track in less than six seconds with our new Tactical Tracking Antennas (*see image to the right*).



We have the fastest retrace speed for a single tactical antenna, giving the warfighter a tactical advantage.

The Tactical TRACKER series is modular and easily configured to support different missions across a range of GEO, MEO, and LEO satellites and constellations. With our TRACKER technology you have reliability across any orbit, any band, anywhere. All TRACKER antennas are delivered ready to go with antenna controller, feeds and customer specific **RF** (*BUC and LNB*) as well as built-in auto-tracking. The systems are available in several apertures and can be configured with different RF packages as required. They can also be modified later to add or change performance.

Cobham Satcom's 3-axis, inertial balanced technology, developed on its land tracking solutions that feature radomes, stabilizes the system for effortless tracking and very low power consumption when compared to more traditional X/Y platforms.

This is a solution where the center of gravity is co-located with the center of rotation, resulting in an effortless track that consumes almost no power. This solution requires minimal maintenance, affords high reliability and outperforms the competition.

The new range supports reflector sizes from 65 centimeters to 7.3 meters, all with built-in auto-tracking functionality and all capable of withstanding hurricane force winds. The antenna and radome are robust and resilient in all environmental conditions and yields higher tracking accuracy and throughput, with high reliability.

Cobham Satcom claims that capital outlay on infrastructure can be reduced by nearly 90%. Traditional X/Y land tracking antennas require substantial foundations (*up to 15 feet deep*) to support the operational wind loading requirements. Reducing costs dramatically, Cobham Satcom's inertial balanced technology allows TRACKER antennas to be installed on a rebar reinforced concrete pad typically only 12 inches deep. Smaller systems will even deliver flawless operation on a simple compacted gravel footing.

Power consumption is typically reduced by 90% when compared to more traditional platforms. Cobham Satcom land TRACKER antennas consume just 200 Watts of power (*excluding RF*), regardless of size (*from 65cm to 6mm*). And note that other gateway antennas in the market can consume as much as 5,000 Watts.

While focused investment and innovation is enabling a new era of global communication based on lower-cost spacecrafts and launch vehicles, the overall system economics of a contemporary satellite network is highly dependent on efficiencies in the ground segment.

The level of reduced power consumption achieved by Cobham Satcom Land Tracking Antennas is a game changer for satellite constellation owners, as it significantly reduces the total cost of ownership over the life of the network operation which can span decades.

The company possesses a broad legacy of technical innovation with software intellectual property and hardware patents, and that means it is difficult for competitors to keep up with Cobham Satcom's offerings.

We have a durable advantage in an industry that has high barriers to entry. We already have the software when others are struggling to find their software solutions for accurate tracking requirements.

Every step change we empower is the result of a series of incremental disciplined, hard-core mathematics and engineering, inspired by a working environment based on years of experience, a mindset of constant learning and a genuine sense of excitement of doing something that has never been done before. These competencies lay the perfect foundation for us to take on every new challenge that a changing satellite communication landscape brings, and we are proud to be a mission-critical part of the game.

Constantly delivering on tracking and pointing accuracies and innovation, our contribution to the entire communication ecosystem is of paramount importance to us.

Cobham Satcom has scaled its global manufacturing and logistics capabilities to meet the needs of the thousands of new satellites ready for launch and ensure that orders can be produced and delivered according to demand. The company claims industry-leading *Mean Time Between Failures* (**MTBF**) and, therefore, fewer service visits are required. The simplified overall system architecture streamlines many standard maintenance tasks so that they can be completed in less than an hour, while service issues can be handled remotely to boost lifetime cost savings.

Satellite communications are an increasingly important part of modern military operations that are often asymmetric, mobile and focused around advanced platforms.

Cobham Satcom is proud to be leading in this time of significant transformation, where connectivity is dramatically changing the global communication landscape. We always have one foot in the future.

cobham-satcom.com

COBHAM SATCOM

Kevin McMahon is the Senior Director of Sales for Government + Defense Solutions at Cobham Satcom

BAE Systems' M-Code GPS receiver enables precision strike capabilities in contested environments

At the ***Joint Navigation Conference*** in San Diego, California, ***BAE Systems*** unveiled their newest advanced M-Code GPS receiver for guided weapons and other small applications, enabling precise geolocation and strike capabilities in highly contested battlespaces.

The ***Strategic Anti-jam Beamforming Receiver – M-Code (SABR-M)*** delivers accurate position, velocity, altitude, and timing data, as well as strong protection against GPS signal jamming and spoofing – critical capabilities for unmanned aerial vehicles (UAVs), precision-guided munitions (PGMs) and missiles in threat environments.

SABR-M integrates receiver technology with advanced antenna electronics in a small, hardened package designed to meet challenging performance requirements, such as weapons applications.

It is the most capable integrated anti-jam GPS receiver and the first integrated M-Code receiver available for weapon systems.

The compact (4.5 x 6 x 1 inch) SABR-M meets size, weight, power, cost (SWaP-C), and thermal requirements for space-constrained military applications. It uses advanced beamforming technology to improve GPS signal reception and counter threat signals.

SABR-M is form-compatible with previous generations of the field-proven SABR receiver, which are currently integrated on low-cost precision weapon systems and long-range cruise strike missiles.

SABR-M will be fully qualified for production by the end of 2022. Production will take place at BAE Systems modern facility in Cedar Rapids, Iowa, which is in the final stages of construction. The purpose-built 278,000-square-foot factory and research center will be home to 700 military GPS experts in BAE Systems' Navigation and Sensor Systems business.

"We're making our full portfolio of military GPS solutions M-Code-compatible to meet warfighters' need for reliable positioning, navigation, and timing data to achieve their missions," said ***Doug Lloyd***, director of weapon systems GPS at BAE Systems. *"SABR-M enables small platforms with challenging environmental conditions to get where they're going despite interference."*

www.baesystems.com

Globalstar's SPOT Gen4 deployed by UK MOD for RAF Force Protection Training

Globalstar Europe Satellite Services Ltd., a wholly owned subsidiary of ***Globalstar Inc.*** (NYSE American: GSAT), has announced that the ***UK Ministry of Defence (MOD)*** has deployed ***SPOT Gen4*** satellite GPS messengers to track and provide safety for ***Royal Air Force (RAF) Force Protection*** personnel during training exercises at ***RAF Honington***.

RAF Force Protection is responsible for protecting the RAF at home and abroad, and RAF Honington Station in Suffolk is its headquarters. The Station hosts initial and ongoing specialist training for the RAF's entire Force Protection capability.

As of April 2022, every Force Protection service person participating in training exercises, which are carried out in rugged and isolated areas, is safeguarded by reliable tracking and SOS support thanks to their SPOT Gen4 devices and Globalstar's enabling fleet of satellites in LEO. RAF Force Protection previously used a tracking system based on GSM mobile technology, but it was deemed to have insufficient reach across all remote training locations. Additionally, the GSM-based system was not cost-effective.

Other satellite-based systems were also evaluated, but SPOT Gen4 was determined the ideal solution due to its ruggedness, ease of use, and economy. The flexibility, cost-efficiency and convenience of Globalstar's unlimited airtime packages were also strong influencers in the MOD's procurement decision. In the event of an emergency, one press of SPOT's SOS button instantly sends an alert along with the user's GPS co-ordinates to an operations centre to facilitate speedy rescue.

The deployment was facilitated by Globalstar's specialist partner, ***Centerprise International***. Established in 1983, Centerprise has long been a key and trusted supplier of IT software and hardware to the UK MOD.

SPOT Gen4 is the newest member of Globalstar's award-winning SPOT device family. Launched in EMEA in August of 2020, latest generation SPOT Gen4 offers enhanced mapping interfaces, more display options, improved water resistance, and geofencing, among other improvements.

The buttons on SPOT Gen4 can be flexibly configured to send pre-programmed messages, with options for transmission types. Users can check in with colleagues via the OK button and SPOT can be used for other non-emergency communications using the Help button.

www.globalstar.com/en-us/

RADIO FREQUENCY INTERFERENCE (RFI):

New solutions for new challenges

Author: Carlo Rizzo,
Chief Commercial Officer, QuadSAT

Radio Frequency Interference (RFI) has been a longstanding challenge within the satcom industry. In recent years, discussions surrounding the issue have faded; new solutions have created an environment in which RFI incidents are quickly identifiable and relatively easy to mitigate.

With predictability at the ground and the adoption of RFI management technologies, the industry has seen a marked fall in RFI incidents during the last decade. However, the last year has seen a change in trends.

Anecdotally, there has been an ascendancy in the number of RFI incidents being identified within satellite communications (SATCOM). Questions are now being raised as to whether new technologies within the space are driving the rise in incidents — identifying the cause is key in preparing mitigative solutions. *How is the expansion of the usage of the RF network impacting on its users?*

IS MULTI-ORBITAL SPACE A CAUSE OF RFI?

The drastic change in use of Lower and Medium Earth Orbits is delivering new challenges to the industry. The ground segment for LEO is a more complex environment, with tracking and switching through multiple gateways being standard practice.

The dynamic and intricate ground network requires high accuracy, as a small error could lead to significant ramifications for services. Tracking accuracy and satellite acquisition quality during the ground segment handovers will need to be tested and monitored to safeguard the integrity of the system.

These actions will be critical in ensuring that the satellites are handed over smoothly within a set window of action. The testing of LEO ground segments requires a full raster view of the antenna and not just principal cuts; the entire performance of the dish will be used for tracking, and therefore needs observing. Subtle changes at the pointing can have a large impact on RF signals.

Additionally, LEO mega constellations are primarily using Ku and Ka-bands, as they offer greater throughput in smaller dishes. The need for test and measurement increases with greater directivity as it increases the likelihood of RFI and the severity of its impact on services. With this in mind, the ground segment must prioritize its testing and monitoring capabilities to ensure that RFI is minimized.

COULD LEO + MEO INTRO A LARGER PROBLEM WITHIN THE MULTI-ORBITAL LANDSCAPE?

In GEO, there is normally one entity in a frequency band per orbital slot, which means that the equivalent of border issues is satellites in adjacent slots, and therefore coordination mitigates interference. With LEO, however, we have potentially multiple constellations using the same frequency bandwidth.

Each constellation is in multiple orbits and orbit heights. This could potentially lead to valid transmissions from authorized satellites causing interference at any given spot on the earth with the interference being intermittent and different at any given location. Up until now, this has been actively prevented by the LEO operators currently active, but that could of course change.

5G + THE SATELLITE GROUND SEGMENT

One of the most talked about aspects of RF spectrum in recent years, 5G has introduced a new perspective when considering RF management. With two industries working relatively closely within C-band for the first time, there has been a lot of interest surrounding the technological and logistical challenges of sharing spectrum.

With the high number of 5G cells being required within its ecosystem, RF noise must be monitored and managed to ensure that signals within the wider spectrum are not overloaded. Filtering products have been developed to mitigate the impact of 5G signals on satcom's use of C-band.

Despite the introduction of this technology, anecdotally, satellite operators have seen incidents wherein signals are impacted by 5G responders. This has not been exclusive to SATCOM; 5G responders have caused RFI within their own industry, with telecom operators affecting each other's services.

CAN MANAGING TELEPORTS BE IMPROVED?

Perhaps the most obvious solution is by ensuring that the ground segment has access to suitable testing and monitoring technology is key in enabling successful management of the ground segment.

As the technologies around the teleport evolve, the need for access to improved RF management and testing tools increases.

Environmental factors have a significant impact on the success of RF up/downlinking, and therefore reviewing the antenna on-site is critical in managing potentially damaging reflections.

Geographical and infrastructural features can cause RFI and, therefore, reviewing a teleport within its own environment is the most effective way of understanding the hazards surrounding it.

The challenge surrounding antenna testing has always been its inaccessibility; geographically and financially. The capabilities of on-site testing have improved in recent years; unmanned aerial systems can now be used to provide flexible and accurate antenna testing and calibration.

As ground segments can be tested in their own environments, the quality of results is more accurate. With an increase in potential external factors, such as neighboring usage of spectrum and complex ground networks, identifying a true picture of how an antenna is working and how its environment is impacting on its efficiency is key to maintaining a successful service without signal disruption.

By making on-site testing available and cost effective, teleport operatives can use accurate results to take the necessary steps to mitigate disturbances with the knowledge that amendments are cost-effective, necessary and will be successful.

IN-FIELD RFI MANAGEMENT OF MILITARY COMMUNICATIONS

RFI is a problem for all SATCOM users. However, RFI within military satellite communications (MILSATCOM) use can introduce significant operational risks.

LEO and 5G are great opportunities within communications; however, with these new technologies cause spectrum to be far more crowded and mitigating the risk of RFI is essential.

The use of high-quality equipment reduces the risk of signal disruption and it is crucial that equipment is tested regularly to review any changes to the environment, including other nearby users of RF.

As the industry moves forward into a direction of new and exciting communication methods, it must remain focused on RFI and its potential impact on services. Great quality equipment, paired with rigorous and thorough testing and monitoring solutions for MILSATCOM and SATCOM is going to be key in mitigating incidents and maintaining reliable communication channels for all parties concerned.

quadsat.com

Author *Carlo Rizzo, is the Chief Commercial Officer at* ***QuadSAT.***

Collins Aerospace brings next-gen SDR to Five Eye and NATO nations

Collins Aerospace's next generation, software-defined, ***airborne communication system*** – ***ARC 210*** Gen6 – is now authorized for delivery to Five Eye and ***NATO*** nations.

This advanced airborne radio features the latest satellite capability (MUOS), anti-jam technology, embedded high-power output as well as the latest modernized cryptology for enhanced ***situational awareness*** (**SSA**) and seamless communications in challenging/contested environments.

The ARC-210 Gen6 integrates a next-generation networking capability and variants can be reprogrammed and customized as needed, without sacrificing performance or security. It also expands its frequency range from 30 MHz (Tactical VHF) to 1850 MHz (L-band).

Variants of ARC-210 are the most widely fielded airborne military V/UHF radio in the world, with more than 50,000 delivered units operating on more than 200 platforms in over 50 countries. The ARC-210 Gen6 is now available through Foreign Military Sales (FMS) to authorized countries.

Collins' international variant of this architecture — the AR-1500 — is deployed across the globe with customers in Europe and the Asia-Pacific region.

Fully software defined, the AR-1500 provides the same frequency range and RF performance as the ARC-210 Gen6, but with a selection of waveforms and capabilities unique to the direct commercial sale (DCS) market, including electronic protection and embedded cryptography. It also features AES256 embedded encryption.

"*The ARC-210 family of radios has enabled millions of critical messages to be exchanged for more than 25 years, providing U.S. and allied military forces with reliable and secure communications when it's most essential*," said ***Ryan Bunge***, vice president and general manager, Communication, Navigation and Guidance Solutions for Collins Aerospace. "*It is fully software-defined to bring tomorrow's technologies to the battlespace today and deliver the latest in SATCOM, encryption and anti-jam technologies, ensuring customers' mission success now and as requirements advance in the future.*"

Collins Aerospace, a Raytheon Technologies business, is a leader in technologically advanced and intelligent solutions for the global aerospace and defense industry. Collins Aerospace has the extensive capabilities, comprehensive portfolio and broad expertise to solve customers' toughest challenges and to meet the demands of a rapidly evolving global market.

www.collinsaerospace.com

UK armed forces operations in Mail with SlingShot technology support. Photo is courtesy of Spectra Group.

SlingShot Satellite Communications adds capability to UK Peacekeeping Mission in Mali

Spectra Group in partnership with ***Inmarsat*** is enabling strategic communications for the UK peacekeeping mission in Mali (***Op Newcombe***) with its ***SlingShot*** SATCOM system.

This announcement coincides with ***Eurosatory*** taking place June 13 to 17 in Paris. Spectra Group's SlingShot is on display at the **AADS stand (Hall 5A Booth No F-668)** fitted to a protected **AADS J8 Command Vehicle** to demonstrate this fully integrated, satellite communications capability.

Winner of the *Queen's Award for Innovation* in 2019, the SlingShot system is low in ***size, weight and power*** (**SWaP**) and can be integrated with current, in-service, UHF and VHF tactical communications systems.

With minimal training and investment, a user can extend radio range from 30 to 1000(+) km. and deliver true *Beyond Line of Sight* (**BLOS**) and *Communications on the Move* (**COTM**) on all platforms and in all conditions with one system.

Op Newcombe is the UK contribution to the United Nations Multidimensional Integrated Stabilization Mission in Mali (MINUSMA) and is in support of *UK Defence Priority Outcome 3* – Enhance global security through persistent engagement and response to crises.

Since October 2020, the United Kingdom has deployed a long-range, reconnaissance task group, using the ***Supacat Jackal 2 reconnaissance vehicle*** to provide detailed reconnaissance information to the UN mission, to enhance security for the Mali population and deter insurgent activity.

SlingShot was developed for, and is used by, specialist forces globally and is operationally proven in conventional scenarios.

As such, it is well suited to the demands of long-range reconnaissance in Mali, where personnel are deployed in remote locations. The use of such innovative technology as SlingShot also perfectly aligns with the **UK's Defence Strategic Enabler Objective 2** – Use of Innovation, Technology and Data.

In addition to robust BLOS voice capability, SlingShot has sufficient bandwidth to carry critical data to support essential applications such as: *Situational Awareness tools*; *GPS tracking; reporting and other data messaging* without the need for a ground-based, line-of-sight, re-broadcasting architecture.

Finally, SlingShot's omnidirectional antennas provide manpack, land, sea and air platforms with real-time COTM, rather than having to be static, as experienced with traditional TACSAT systems.

These capabilities combine to provide a "battle winning" strategic enabler for UK forces deployed in support of UK Defence objectives, while also showcasing British innovation and technology to global defence markets.

Simon Davies, CEO of Spectra Group, said, "*We are immensely proud that SlingShot is described by our users as a battle-winning capability, and in how successful it has been in solving the communications challenges faced by both specialist and regular forces. It is truly plug and play, converting any in-service tactical radio system into a BLOS and COTM satellite communications system, with minimal training, so that users can fully focus on the task in hand.*"

spectra-group.co.uk

SPACE SYSTEMS COMMAND — STREAMLINED ACCESS TO SPACE —

SSC Assured Access to Space Mission Manifest Office Helps Satellites Find Their Ride into Orbit Faster

Author: Space Systems Command

Space Systems Command's (SSC) Assured Access to Space (AATS) Mission Manifest Office (MMO) is providing satellite vehicles affordable rides to orbit by maximizing multi-manifest (think rideshare) opportunities while ensuring security, safety and mission success.

Colonel Chad Malone

"*The mission is to survey all National Security Space (NSS) Launch missions for multi-manifest opportunities*," said Col. ***Chad Melone***, Director, SSC's Mission Solutions acquisitions delta. "*In support of SSC's Operations directorate, we assess mission parameters along with the capability of the launch vehicle to identify the performance available for additional capability.*

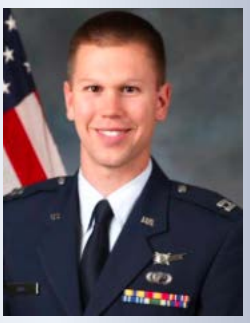
"*After that has been identified, we coordinate across the government space enterprise — the Department of Defense, NASA, and the intelligence community to locate potential manifest opportunities that may integrate on that particular mission,*" Melone added. "*The goal is to maximize capability to orbit for (NSS) Launches to most efficiently use government resources and benefit our space community.*"

In the past, ***National Security Space (NSS***) satellites were usually launched by themselves — partly due to security concerns and the need to eliminate any integration risk to the mission, said Maj. ***Julius Williams***, chief, *Mission Manifest Office (***MMO***)*, SSC.

Major Julius Williams

"*We had a lot of satellites that were very high value, and if a customer was flying a billion-dollar satellite, they understandably preferred to have the rocket all to themselves*," Williams explained. "*They didn't want to take the risk of flying with someone else who could have contamination issues or simply be late to the mission and slow their ability to get capability on-orbit.*"

However, SSC has been able to provide that assurance of mission success through partnership and innovation, in order to use the excess performance available on these launch vehicles, said Major ***Christopher Box***, MMO mission manager at SSC.



Major Christopher Box

"*There is definitely an increase in mission complexity when we're going down the road of putting additional payloads on a mission*," Box said. "*However, as space becomes increasingly congested and contested, it is critical to maximize our space capability in a flexible and responsive approach.*"

"*Our goal is to ultimately benefit the warfighter and the taxpayer: putting the taxpayer's dollar to the best use in providing the best capability for the warfighter*," said Capt. ***Carmen J. Riazzi***, one of the MMO program managers who worked on two coming missions — ***EZIO*** on ***SBIRS GEO-6*** and ***BLAZE***, flying on the ***USSF 62***.

Captain Carmen J. Riazzi

In September of 2021, Space Systems Command's (SSC) Production Corps achieved a major milestone with the completion of the final Space Based Infrared System (SBIRS) satellite, SBIRS Geosynchronous Earth Orbit (GEO)-6 on Sept. 2 at Lockheed Martin's Sunnyvale, California production facility. Photo is courtesy of Lockheed Martin.

The first multi-manifest mission for the MMO (*which was stood up in 2018*) was the *EZ-1 Flight System* on the ***Advanced Extremely High Frequency (AEHF)-5*** that was launched in 2019.

"*Since 2018, through multi-manifest efforts, SSC has successfully provided assured access to space for an additional 10,000 lbm (mass equivalent to one pound of force on Earth) of capability with more than another 24,000 lbm planned through 2024*," Riazzi said. "*That additional capability has enabled launching more than 40 additional satellites that would have otherwise required an additional launch.*"

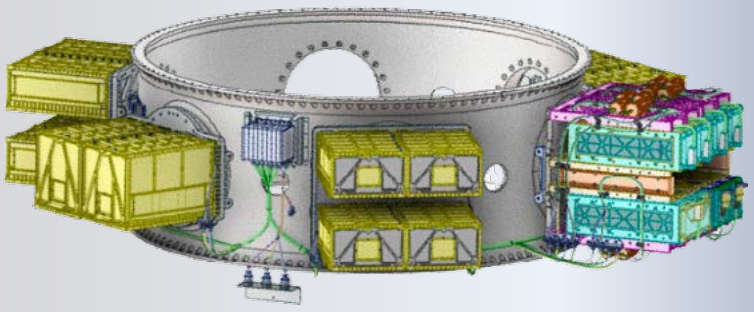
"*Customers provide a wide range of hardware, including satellites, hosted payloads, propulsive tugs, and other technologies*," Williams said. "*All capability manifested by the MMO requires a U.S. government sponsor. This requirement does not exclude commercial partnerships and collaboration, it just ensures that any capability flown is meeting vetted government requirements.*"

Multi-manifest launches involve a lot of complexities that various engineering and integrations teams must work through to make sure each mission is successful, Williams said.

Some satellites, particularly those headed for a ***Geosynchronous Earth Orbit (GEO)*** or higher than ***Medium Earth Orbit (MEO)*** or ***Highly Elliptical Orbit (HEO)*** may require substantial battery power or thermal power continuously from the launch pad to the point where they're deployed, Williams said. Other satellites may need additional access doors in the fairing — the smooth protective cover surrounding the space vehicle and its payloads — in order for technicians to access the payload directly until launch.

"*There are some satellites that have very strict anti-contamination requirements and need to have the same clean-room environments for the other satellites riding along with it*," Williams added. "*Furthermore, when you're stacking and integrating a lot of satellite vehicles on top of each other via the various adapters, adequate coupled loads and center of gravity considerations are a must.*"

ESPA (***Evolved Secondary Payload Adapter***) rings that are used to transport satellite vehicles can be propulsive, separating from the launch vehicle and taking smaller satellites out to where they need to be positioned on-orbit, Williams said. They also can provide the battery power, electricity and thermal conditions necessary for certain missions. Other types of rings are non-propulsive and do not separate from the upper stage, and deploy the satellites attached to them into whichever orbit the launch vehicle inserts them.



The Landsat 9 EFS – This Evolved Expendable Launch Vehicle Secondary Payload Adapter (ESPA) Flight System (EFS) shows how additional satellite vehicles can be integrated on a launch vehicle to get more capability on orbit. The USSF-developed EFS flew with NASA's Landsat-9 Earth observation satellite in September 2021. Illustration courtesy of SSC.

Under the *Launch Manifest System Integration* contract, SSC has engaged with ***Parsons Corporation***, which acts as the *Multi-Manifest Systems Integrator* and partners with SSC to help identify satellite vehicle customers who require a ride to space. To date, Parsons has successfully integrated four missions with the MMO and will be partnering on the ***SBIRS GEO-6*** launch later this summer.

"*Under the leadership of an assigned MMO mission manager, compatible satellite vehicles are finalized and Parsons works with various subcontractors to meet all necessary requirements for launch*," Melone said.

The ***AATS Mission Integration Branch*** houses the *Government Mission Integration Manager* team that performs integration between the *Launch Service Providers* and the traditional satellite program offices to ensure mission success.

Melone explained, noting, "*Transparency, communication, and collaboration across agencies is critical to mission success; no one can afford to have a launch go catastrophically wrong or miss any opportunity to launch critical capability. The MMO, along with other SSC entities like the Space Test Program, Innovation & Prototyping, SSC staffs, and the newly minted Space Systems Integration Office are working in sync to ensure DoD priorities are met.*"

The MMO also is developing the ***Multi-Manifest Design Specification*** (***MMDS***) as a resource to small satellite builders and integrators looking to attain a multi-manifested ride to space, Melone added.

The MMDS is being developed in collaboration with the ***Small Payload Rideshare Association (SPRSA)***, Parsons Corporation, and numerous academic, commercial and government space organizations to specify recommended design requirements for smallsats to maximize flight opportunities.

The open-source document is analogous to the *CubeSat Design Specification* but for slightly larger smallsats with masses of up to about 700 kilograms (1,543 pounds). A common, bounded MMDS design will allow the MMO and other multi-manifesting organizations more flexibility to perform a late-stage satellite swap out.

Box said, adding, "*The current reality is that not all satellites manifested to launch are able to make their scheduled launch date, and the current mitigation is to utilize a mass simulator with the same mass and fit as the intended satellite to ensure the launch mission remains on schedule,*" Box said. "*The ultimate goal is to be able to replace a de-manifested satellite with another satellite that is ready to launch, as opposed to utilizing a mass simulator. The MMDS paves the way to eventually being able to accomplish that goal.*

"*The MMDS is intended to make it easier for small satellites to find rides, which means it can swap among medium to large-class launch vehicles like the SpaceX Falcon 9 and the ULA Vulcan, or switch between a medium to large-class vehicle and a small dedicated vehicle,*" Box added. "*The launch manifest is getting busier. Therefore, we anticipate an increase in NSS Launches and commercial missions which opens up flight opportunities for satellites of all sizes.*"

The MMDS provides numerous benefits to the small satellite community, Box said. These benefits include: *standardized multi-manifest terminology*; *consolidation of medium- and small-launch vehicle environments to bound small satellite designs*; *recommended design requirements to interface with common multi-manifest carriers; appropriate testing and documentation requirements*; *"best practices" for logistics and launch site ground operations*; as well as *links to a repository of more detailed references.*

For more information on the MMDS, or to provide feedback, interested parties may contact the ***Small Payload Ride Share Association*** or ***MMO*** team via email: ***mmds@sprsa.org*** or through the website at ***www.sprsa.org***.

Contact **Space Systems Command** at ***SSC@spaceforce.mil*** follow on ***LinkedIn***.

SPACE WEATHER FORECAST: NEW CHALLENGES AHEAD

One factor humanity must consider in all its space endeavors - from successfully launching a rocket into space, to designing satellites, to plans for future space exploration – is space weather.

"*Just like terrestrial weather is the dynamics of the changing atmosphere, space weather is the dynamics of the space environment: changes in the plasma conditions, the electric and magnetic fields, the electromagnetic radiation, energetic particles,*" said ***Terry Onsager***, physicist, the ***National Oceanic and Atmospheric Administration (NOAA)***.

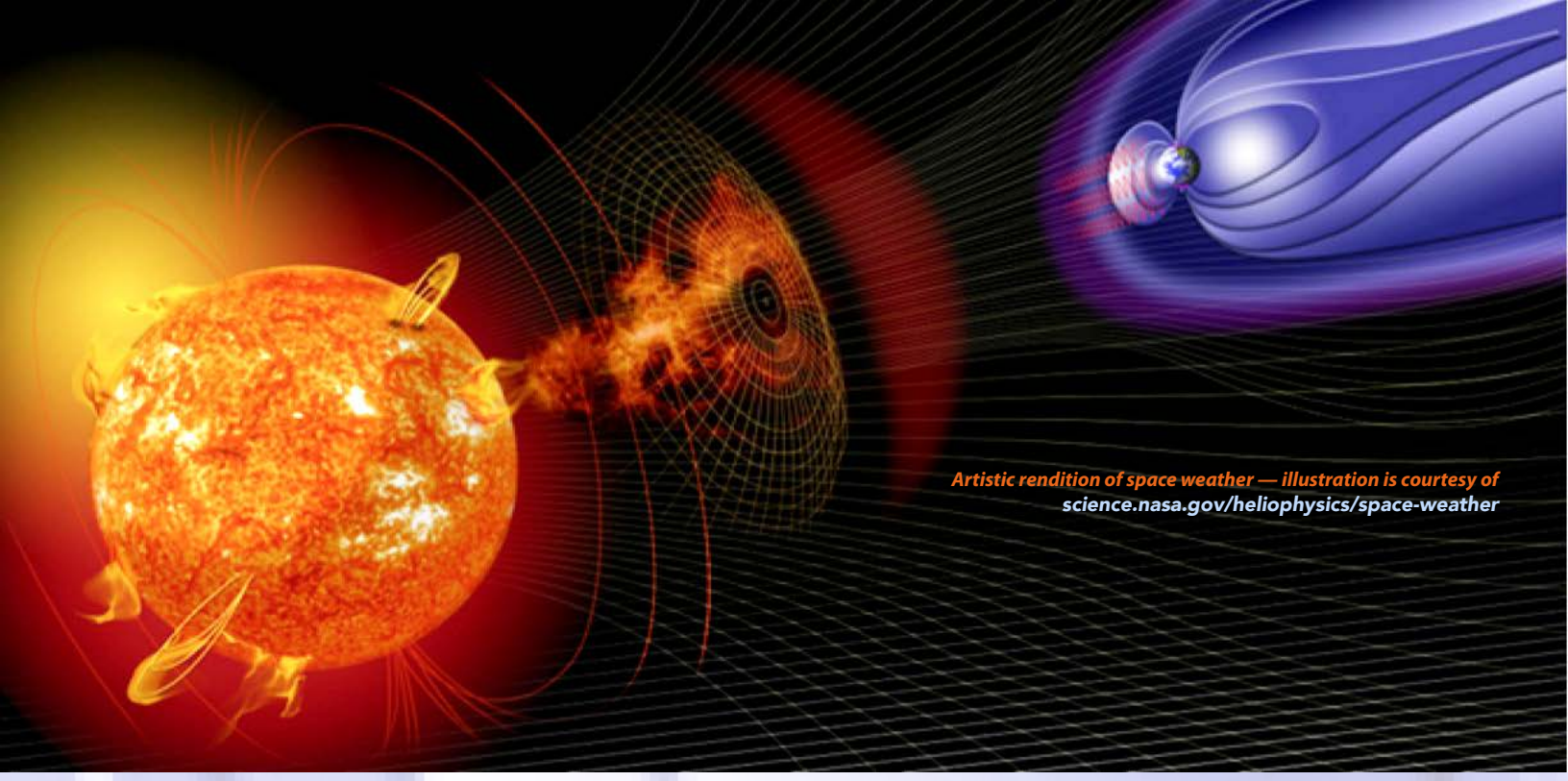
"*The space environment is mainly a plasma: a charged particle gas consisting of electrons, protons, and some heavy ions,*" Onsager said. "*The sun is constantly releasing this plasma into space, which is referred to as the solar wind.*

"*The solar wind is flowing roughly a million miles per hour and fills interplanetary space. In addition, the sun occasionally releases dense portions of its corona, called coronal mass ejections, that flow through the solar wind and can cause the largest space weather storms at Earth.*"

This solar wind is electrically charged and magnetized, Onsager said. When the solar wind hits Earth's ionosphere and upper atmosphere, those electrical currents couple with Earth's magnetic field, creating the aurora borealis and also heating the upper atmosphere and the ionosphere.

Most people do not notice the effects of space weather, let alone change their daily behavior as they would for a terrestrial weather event, such as a thunderstorm.

Onsager added, "*But space weather affects our infrastructure, our satellite fleet, our power grids, airlines,*" Onsager explained. "*So many of the important things that happen in space weather are behind the scenes, in the resilience of our economic and national security infrastructure, rather than the things we see clearly every day.*



Artistic rendition of space weather — illustration is courtesy of science.nasa.gov/heliophysics/space-weather

We will continue to use space more and more, and as we do, knowing the conditions of the environment that you're operating in will become more and more important."

Bryan Davis

At ***Space Systems Command*** **(SSC)**, space weather is factored into everything, from satellite and ground system design, to when satellites are launched, to how data collected by satellites is evaluated and analyzed, said ***Bryan Davis***, physical scientist for SSC's *Space Domain Awareness* acquisition delta.

"The sun can accelerate protons up to nearly the speed of light in a solar flare," Davis said. *"They're atomic particles, but once you accelerate them to nearly the speed of light and they hit spacecraft, they can do physical damage to the solar panels or cause internal damage."*

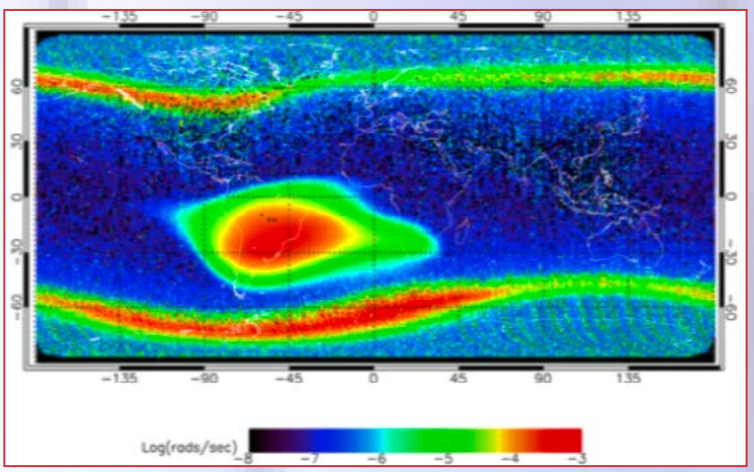
Numerous agencies monitor space weather, including ***NOAA***, ***NASA***, the ***National Science Foundation***, the ***U.S. Space Force***, the ***Air Force Research Laboratory*** **(AFRL)** and other U.S. ***Department of Defense*** (**DoD**) agencies. All of these have varying roles but all work closely together, Onsager said.

Predicting space weather and its effects can be challenging. Because the sun's output isn't steady, all of the interaction between the sun, the solar wind, the Earth's magnetic field, Earth's ionosphere and upper atmosphere, is constantly changing, Onsager explained.

For satellites, space weather poses four main threats, said ***Bob Rutledge***, director of ***The Aerospace Corporation***'s *Space Sciences Department*.

Atmospheric drag in *Low Earth Orbit* (**LEO**) that can cause orbital decay; satellite degradation over time from the total amount of radiation it receives; surface or deep charging that can cause parts to fail or corrupt electronic signals, including the ones that command and control the satellite; and single event effects that can severely damage or even destroy satellites.

"There's a host of radiation hazards for satellites, and they do vary, depending on where you're flying," Rutledge said.



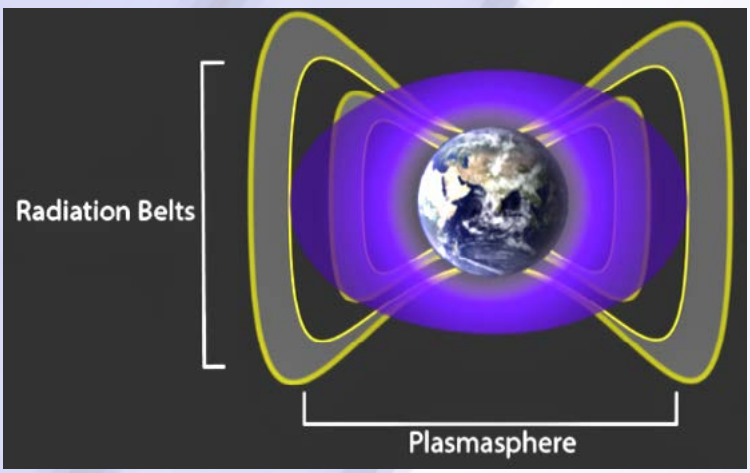
Radiation intensities at 780km as measured on the SSC-funded Responsive Environmental Assessment Commercially Hosted (REACH) Project, a hosted radiation environment payload on the Iridium NEXT satellite constellation. The program was developed to monitor Earth's radiation environment in low Earth orbit. Consisting of 32 hosted sensors on the Iridium NEXT constellation, REACH is a partnership between the U.S. Air Force, The Aerospace Corporation, Johns Hopkins Applied Physics Laboratory (APL), Iridium Communications and Harris Corporation. Artwork courtesy of The Aerospace Corporation.

"*If you drop a rock in a pond, you see ripples emanate from it,*" Onsager said. "*When the ionosphere gets disturbed, it has the equivalent of ripples so that when you try and send your signal to a satellite or receive a signal from one, it can distort your signal and either make it impossible to receive or lose some of the accuracy. For GPS accuracy, it's very important to know if your signal is potentially degraded and your information could be inaccurate.*"

Most people on earth won't notice a temporary glitch in their GPS, but people who use GPS for precise measurements — such as precision agricultural equipment or a bulldozer using precise coordinates — could be affected, Rutledge said.

With GPS satellites, "*one nanosecond of error equals about a foot of error on the ground,*" Davis said. "*So if you change the timing of the satellite or change the position and it's thrown off by just a nanosecond, that changes the ground accuracy by a foot. And that's just one nanosecond. If you go 100 nanoseconds, you're off by a hundred feet.*"

Earth's magnetic field — which is compressed on the sunward side and extends like a comet's tail on the anti-sunward side —acts as a protective barrier for people on Earth, Onsager said. But Earth also is circled by the ***Van Allen radiation belts*** comprised of trapped energetic charged particles from the solar wind, Rutledge said. These radiation belts can affect everything from GPS satellites to the *International Space Station* (**ISS**).



A cloud of cold, charged gas around Earth, called the plasmasphere and seen here in purple, interacts with the particles in Earth's radiation belts — shown in grey— to create an impenetrable barrier that blocks the fastest electrons from moving in closer to our planet. Image is courtesy of NASA/Goddard.

"*The radiation environment across that space domain, although it differs, can be really challenging for systems,*" said Rutledge, who also previously was the lead of the *Space Weather Forecast Office* at ***NOAA's Space Weather Prediction Center***, and worked at ***NASA's Johnson Space Center*** as the *International Space Station Radiation System Manager*.

"*If you put more energy into the upper atmosphere, it's going to get hot and expand,*" Onsager said. "*This is only a factor for Lower Earth Orbit (LEO) satellites, the ones that are fairly close to Earth and in the upper atmosphere. If the atmosphere gets hot and expands upwards, the density of the atmosphere increases where these satellites are, and that can cause increased drag. Either require maneuvers or the orbit decays and the satellites fall into the atmosphere and burn up.*"

In January of 2022, ***SpaceX*** launched 49 ***Starlink*** satellites into LEO, but around the time they were launched, a geomagnetic storm warmed up the atmosphere and made it denser than anticipated, increasing the drag on the satellites, Rutledge said. Despite attempts to maneuver the satellites by putting them into a low-drag configuration "*safe mode*," 40 of them were lost.

The SpaceX launch of 43 Starlink satellites aboard a Falcon 9 launch vehicle in January of 2022. Image is courtesy of SpaceX on Youtube.

"*They flew lower than they usually do, and the margins are small in that orbital regime,*" Rutledge said. "*The small storm that was well-predicted occurred, and it just ate into that margin. In subsequent launches since that time, they've gone back to higher altitudes. This highlights the sensitivity of the space environment: going to space is hard and there are lots of factors that have to be accounted for,*" said Rutledge.

Satellites in higher orbits, such as GPS satellites in GEO, are not as affected by this atmospheric variability, but space weather there can pose other dangers.

Satellites can start to degrade from the total amount of radiation they receive over time, Rutledge said. There's also spacecraft charging, which occurs when a charge builds up on the non-conducting material on a spacecraft's surface or deep inside. Such a charge can lead to a spark, which can either create a false signal or damage the satellite.

Onsager said designers are constantly working on ways to make satellites more resistant to spacecraft charging, but with new innovations such as higher-voltage solar panels and more parts miniaturization; it's a constant effort to keep up.

"*These charging events occur, and when they do, it's very important to the satellite industry to try to understand what the cause was of this anomalous behavior,*" Onsager said. "*Was it the space environment, was it some issue with my equipment, or could it have been an adversary? Having knowledge of the space environment in the vicinity of a satellite helps you to be able to attribute that to whatever the most likely cause is,*" Onsager said.

Space weather — specifically, solar energetic particles — will also be a critical factor as humanity seeks to extend space exploration to cislunar regions and beyond. Solar energetic particles — very high energy protons and heavy ions that can be accelerated near the sun and in interplanetary space — are often associated with coronal mass ejections from the sun, Onsager said.

"*There are two aspects of radiation that are important,*" Onsager said. "*One is the galactic cosmic rays that are always there, and there's not much you can do about them. The levels go up and down fairly smoothly with the 11-year (solar) cycle. That would be a concern for the Mars missions, when you're going to be out of the protection (of Earth's magnetic field) for a long time.*"

"*And then there are the occasional solar energy particle bursts — so there's a slowly varying background, and on top of that are these episodic solar energy particle events that get accelerated near the sun and through the coronal mass ejections as they propagate out into the solar wind.*"

The sun began a new solar cycle in 2019 and the peak is predicted for the summer of 2025, Onsager said. While large solar storms can occur at any time during the solar cycle, they are more likely to occur during the solar maximum, which could mean more large solar proton events that will affect spacecraft operations.

"*We're not very good at predicting the exact timing or intensity of solar cycles,*" Rutledge said. "*Usually, what you see is a fast rise to solar maximum and then a slow decay to solar minimum. However, when you look at the very big space weather events, the takeaway is that big events can happen at any time and* independent of *solar cycle size. Even though the overall trend in solar activity is up, exactly when a big or notable space weather event will happen is still anybody's guess, because those aren't well-correlated.*"

Onsager said there remains an enormous amount to discover about space weather, with many phenomena that still puzzle scientists. One such puzzle is trying to accurately predict when a coronal mass ejection will occur.

"*You can see these sunspots, these regions where you know a lot of energy is building up, but we can't predict accurately exactly when that energy will be released,*" Onsager said. "*When it does erupt, we have measurements that can get a pretty good estimate of the initial trajectory of the coronal mass ejection as it's leaving the sun. However, once it gets out of the field of view of these instruments, then we have no measurement until it gets just upstream from Earth, and that can be a couple of days.*"

Exactly how much of that coronal mass ejection gets coupled with Earth's system also depends on the direction of the magnetic field in the ejection, but that's difficult to predict as well, Onsager said.

"*We don't know for sure what the magnetic field is going to be until it hits the L1 Lagrange point which, in a fast solar wind, could be 30 to 40 minutes lead time before it really starts impacting our near-Earth environment,*" Onsager said.

NASA, NOAA, the United Kingdom and the European Space Agency (ESA) are working to develop a spacecraft that would be stationed at the ***L5 Lagrange*** point in order to observe coronal mass ejections from the side, to provide better warnings, Onsager said.

"*One of the things that makes space weather very challenging, but also very exciting, is so much of it is still in the basic research mode,*" Onsager said. "*Over the past 20 years or so, as space weather has gotten more and more important, it's really emphasized the effort needed to take the basic science knowledge we have, and to extract as much actionable information as possible from it.*"

The sun launched this coronal mass ejection at some 900 miles/second (nearly 1,500 km/s) on Aug. 31, 2012. The Earth is not this close to the sun; the image is for scale purposes only. Image credit: NASA.

ATLAS SPACE OPERATIONS

ATLAS Space Operations receives a Defense Innovation Unit award for federated network demo

***ATLAS Space Operations** has announced that the **Defense Innovation Unit** awarded the company the Hybrid Space Architecture (**HSA**) contract to demonstrate a federated network.*

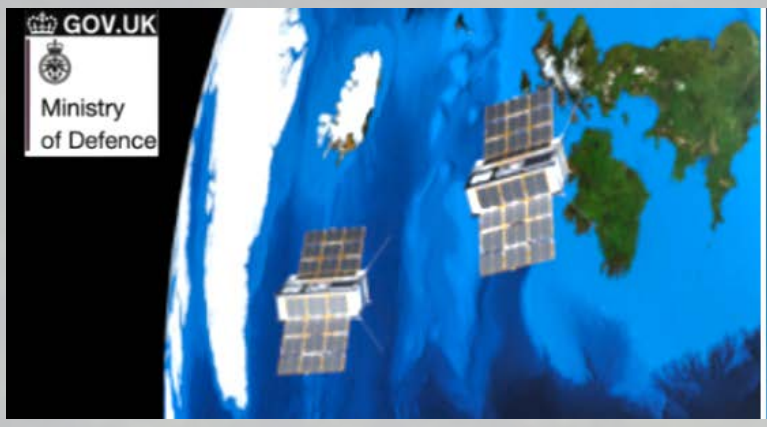
Leveraging its operational experience and prior development activity, the HSA capability represents a major advancement in network management, which is particularly meaningful for aging communications infrastructure. Building on ATLAS' proprietary technology to easily integrate complex disparate systems, the federated network invites new possibilities that meet the evolving needs of DoD and commercial clients.

Whereas ATLAS' prior work with disparate networks enabled easy intra-network communications, its HSA initiative introduces capabilities that are fully federated — allowing communication to flow across disparate government and commercial networks. Now, spacecraft and antenna operators have the opportunity to make use of any participating network regardless of the site owner or hardware.

Leveraging its cloud-hosted **Freedom™ Network Management Platform**, ATLAS enables the seamless transfer of data streams across DoD, Civil, and commercial platforms. The inter-network operability provided by Freedom™ allows each of these operators to conduct their communications across a newly available slew of infrastructure, enabling easy offloading of expiring infrastructure.

The future of sustainable space communications includes a mix of existing and new infrastructure. ATLAS' Hybrid Space Architecture offers a solution that enables new and old technologies to operate across the same platform, creating new opportunities for the entire domain of ground-space data transfer. To address the hardware constraints of varied clients, growing satellite counts, and expanding applications, ATLAS is applying its innovative Freedom™ software at a crucial point for the industry.

atlasground.com



The NRO is partnering with the UKMOD for the 1st commercial rocket launch from the UK

The National Reconnaissance Office (NRO) is partnering with the United Kingdom's Ministry of Defence (UK MOD) on the historic, first commercial rocket to be launched from the UK, as announced at Defence Space 2022 by Defence Procurement Minister Jeremy Quin.

Virgin Orbit will send nine, multi-national rideshares to orbit using the LauncherOne small launch platform via a modified Boeing 747 aircraft later in 2022. This mission—launching ***UK MOD Defence Science and Technology Laboratory***'s two ***Prometheus 2*** smallsats—is the latest example of increased UK and international space cooperation.

This is the first launch from British soil and will also be the first commercial launch from Western Europe. Launching from the UK marks a continued expansion of NRO's overseas launch locations in addition to New Zealand providing NRO with the ability to launch from three continents.

LauncherOne expands NRO's innovative launch capabilities as the agency's first, horizontal launch

A modified Boeing 747 aircraft, Cosmic Girl, with the LauncherOne rocket will take off from ***Spaceport Cornwall*** located at **Newquay Airport** in Cornwall, England.

Additional information on launch timing will be made available from the **UK Space Agency** and **UK Civil Aviation Authority**.

"Since its inception more than 60 years ago, NRO has been pushing the boundaries – finding ever-more innovative ways to leverage space in order to secure and expand our intelligence advantage, and protect and defend the United States and our allies," said NRO Director, Dr. ***Chris Scolese.***

"It's an honor to join the United Kingdom's Ministry of Defence in announcing this historic enterprise. We look forward to this remarkable achievement as the foundation of an even stronger collaboration between our nations."

"This is a great example of the power of international collaboration – a key tenet of our Defence Space Strategy," said UK MOD Director Space, Air Vice-Marshal ***Harv Smyth***.

SILICON VALLEY

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