Next Generation Space Defense

MILSATMAGAZINE

September 2022

The launch of the USSF / SSC's SBIRS GEO 6 satellite — Photo is courtesy of United Launch Alliance.

CPI
Communications
& Power Industries

Visit CPI at
Silicon Valley Space Week

Stand 28 & 29 and
Conference Room 63

CPI Satcom & Antenna Technologies business focuses on antenna systems, radomes and composite structures used in the transmission and reception of microwave signals for radar, communications and scientific applications.

Today, CPI offers one of the world's broadest satcom and LOS antenna portfolios, serving GEO, MEO and LEO applications from L- band to Q- and V-band.

A worldwide leader in ground station antennas, amplifiers and radomes.

CPI Satcom & Antenna Technologies Inc.
Email: CustomerCareSAT@cpii.com
URL: cpii.com/antennas

CPI
Communications
& Power Industries

PUBLISHING OPERATIONS

Silvano Payne, Publisher + Executive Writer

Simon Payne, Chief Technical Officer

Hartley G. Lesser, Editorial Director

Pattie Lesser, Executive Editor

Donald McGee, Production Manager

Teresa Sanderson, Operations Director

Sean Payne, Business Development Manager

Dan Makinster, Technical Advisor

COLUMNISTS + CONTRIBUTORS

Chris Forrester, Broadgate Publications

Karl Fuchs, iDirect Government

Bob Gough, Goonhilly Earth Station

Rebecca M. Cowen-Hirsch, Inmarsat

Giles Peeters, Track24 Defense

Koen Willems, ST Engineering

Mike Young, Envistacom

AUTHORS

Brian Billman

Jim Cantrell

Jay Chapman

Sergio Gallucci

Roger McGarrahan

Brendon McHugh

David Pesgraves

Bill Pryle

Alvaro Sanchez

Fred Vinezeano

ADVERTISERS

DISPATCHES

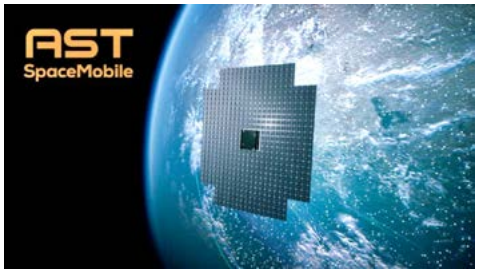
FEATURES

MilsatMagazine is published 11 times per year by SatNews Publishers,
800 Siesta Way, Sonoma, California - 94576 - USA
Phone: (707) 939-9306 / Fax: (707) 939-9235

DISPATCHES

SPACEX LIFTS 34 STARLINKS + AST SPACE MOBILE'S BLUEWALKER 3 TO ORBIT VIA A FALCON 9 ROCKET

On Saturday, September 10th, at 9:20 p.m., ET, ***SpaceX*** launched 34 ***Starlink*** satellites to enhance their constellation, as well as ***AST SpaceMobile***'s ***BlueWalker 3*** satellite, to orbit from *Launch Complex 39A* (LC-39A) at *Kennedy Space Center* in Florida.



This was the 14th launch and landing of this Falcon 9 first stage booster, which previously launched **Crew Demo-2**, **ANASIS-II**, **CRS-21**, **Transporter-1**, **Transporter-3**, and now nine **Starlink** missions.

SPACE SYSTEMS COMMAND ISSUES MILLION$$$ CONTRACT TO SCITEC

Space Systems Command's (SSC) ***Future Operationally Resilient Ground Evolution*** (**FORGE**) program has awarded a Cost-Plus Incentive Fee contract for $272 million to ***SciTec*** Inc. for ***Mission Data Processing Application Provider*** (**MDPAP**).

MDPAP will deliver critical applications for the nation's missile warning mission in direct support of the ***Space Based Infrared System*** (**SBIRS**) and the ***Next-Generation Overhead Persistent Infrared*** (***Next-Gen OPIR***) program.

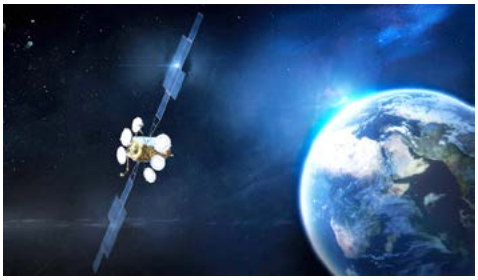
SBIRS, image courtesy of SSC

MDPAP creates applications critical to the OPIR mission, consisting of Missile Warning (MW), Missile Defense (MD), Battlespace Awareness (BA), Technical Intelligence (TI), and Civil/ Environmental (C/E). ***Additional details...***

AIRBUS' SATELLITE COMMUNICATIONS ARE ENLISTED FOR ARMED FORCES OF CZECH REPUBLIC AND THE NETHERLANDS

Satcom UHF. Copyright: Ministère des Armées

Airbus has signed contracts with the ***Ministries of Defense of Czech Republic*** and the ***Netherlands*** to provide satellite communications for a 15-year period. The Armed Forces of Czech Republic and the Netherlands will use 2 and 3 channels, respectively, of the Airbus UHF (Ultra High Frequency) military communications hosted payload on-board the ***EUTELSAT 36D*** telecommunications satellite scheduled for launch in 2024.



Artistic rendition of the EUTELSAT 36D satellite on-orbit, courtesy of the company.

With this new UHF payload, Airbus will be able to offer a new UHF communications service to the armed forces, particularly those of European countries and NATO allies. As the UHF frequency band is a relatively scarce orbital resource, this offering will make up for the capacity shortage around the world. Airbus has already signed several firm orders for this capacity, well ahead of the satellite's scheduled launch.

The UHF payload will be operated from Airbus's Network Operations Center in Toulouse. Its 18 UHF channels will enable up to 200 simultaneous communications over Europe, the Middle East, Africa, large parts of Asia, as well as the Atlantic Ocean (to eastern Brazil) and the Indian Ocean (to western Australia). ***Additional details...***

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.

HAWKEYE 360 SIGNS A CRADA WITH U.S. ARMY SPACE AND MISSILE DEFENSE

HawkEye 360 Inc. has signed a two-year, *Cooperative Research and Development Agreement* (**CRADA**) with the ***U.S. Army Space and Missile Defense Command (SMDC)***. Under the CRADA, HawkEye 360 will develop and demonstrate new commercial overhead RF-sensing capabilities that could provide relevant tactical support for the warfighter. SMDC will assist in the testing of these capabilities in relevant exercises to evaluate the utility to the tactical warfighter.

"We are excited to partner with the U.S. Army to rapidly develop and prove new techniques that can be quickly transitioned into high-value operational capability. This partnership will support the Army's modernization initiative to develop more efficient, effective, and resilient systems that strengthen how the U.S. Army mobilizes, protects, and sustains expeditionary forces leveraging tactically relevant commercial RF information. We aim to seamlessly integrate our space-based RF data into their Multi-Domain Operational environment," said ***Alex Fox***, HawkEye 360 Chief Growth Officer.

SMDC develops and provides current and future global space, missile defense, and high-altitude capabilities to the Army, Joint Force, and our allies and partners, to enable multi-domain combat effects; enhance deterrence, assurance, and detection of strategic attacks; and protect the nation.

SMDC conducts integrated planning and synchronized operations in the execution of their space and missile defense missions and preparing for future conflict. Operating in all domains with allies, partners in the air, at sea, in space, in cyberspace, in the electromagnetic spectrum, and in the information environment.
Additional details...

SCOUT WINS TWO STTR AWARDS FROM USSF'S SPACEWERX

SCOUT Space Inc. has been granted two STTR awards through the ***Orbital Prime*** program by ***SpaceWERX***, the innovation arm of the ***U.S. Space Force.***

SCOUT was awarded two STTRs in collaboration with the ***Stanford University Space Rendezvous Laboratory (SLAB)*** and the ***Florida Institute of Technology ORION Lab***.

SpaceWERX has awarded 125 contracts to develop technologies for orbital debris cleanup and other space services, of which SCOUT was awarded two STTRs (Phase I) for Real-time Autonomous Uncertainty and Risk Monitoring, and Robust Optical Tracking integration into Real-time Orbital Determination (RTOD).

The technical focus areas defined by SpaceWERX for Orbital Prime are on-orbit approach, on-orbit acquisition and on-orbit service. SCOUT provides solutions focused on the first two focus areas, which are recognized by the Space Force to be key enablers for widespread servicing and debris removal. ***Additional details...***

FOLLOW-UP WIN FOR ND SATCOM WITH POLAND'S MOD

On the heels of a significant SKYWAN modem deal earlier this year, ***ND SATCOM*** has received a follow-up order worth 1.5 million euros from its Polish partner, ***GISS Sp.z o.o.,*** to deliver 100+ Manpack systems to the ***Polish Ministry of Defence (MOD)***.

This project is part of the Polish MOD's ongoing process of expanding and upgrading its satellite communication capabilities. Extensive modernization began a couple of years ago with the deployment of an Earth station, followed by the launch of fixed and mobile communication solutions, and will continue with future investment in larger terminals.

Poland's MOD will receive Manpack terminals powered by the latest SKYWAN 5G technology with DVB gateways. This unique SKYWAN solution was customized to the specific needs of the military.

The flexible SKYWAN topology, spanning star to hybrid to pure mesh, is enhanced by a point-to-point mode. All topologies are supported by ACM. In addition, based on customer feedback, the master backup feature was upgraded to be managed manually. ***Additional details...***

Experience Matters

Ask us about Q- and V-band!

Catch the Ka-band wave with CPI

- More than 5,000 Ka-band HPAs and Solid State BUCs fielded
- Largest selection of Ka-band amplifiers available
- Field proven, outstanding reliability
- Worldwide Ka-ready regional service centers

WATTS	BANDWIDTH	TECHNOLOGY
80-160 Ka	Up to 2 GHz*	GaN BUC or SSPA
50-650 Ka	Up to 4 GHz	TWTA
800 Ka	Up to 300 MHz	Klystron PA
180 Q	Up to 2 GHz	TWTA
250 Pk V	Up to 4.2 GHz	TWTA

*Two 1 GHz selectable bands

Download our app! Search: CPI Satcom

Download on the App Store | GET IT ON Google Play

KNOW WHAT MATTERS

CPI Communications & Power Industries

CPI SMP Satcom Products | www.cpii.com | satcommarketing@cpii.com | +1 (669) 275-2744

SPACE SYSTEMS COMMAND IS HEADING UP THE NEW TRI-AGENCY U.S. COMBINED PROGRAM OFFICE TO PREVAIL AGAINST SPACE THREATS

Space Systems Command (SSC) is leading a new, tri-agency, ***Combined Program Office*** (CPO) that is comprised of representatives from **SSC**, ***Space Development Agency*** (SDA) and the ***Missile Defense Agency*** (MDA).

The CPO was established on August 19, 2022, to enhance the United States' ability to deter, defend and win against competitors' challenges in space.

The Space Acquisition Council, established by Congress to manage space procurements across the ***Department of Defense*** (**DoD**), concurred on the CPO proposal, enabling the coordinated development and fielding of capabilities in the ***missile warning*** (**MW**), ***missile tracking*** (**MT**) and ***missile defense*** (**MD**) mission areas.

The CPO will address growing challenges, resulting from the transition of space from a peaceful domain to one that is congested, contested, and competitive. Other nations now challenge access to, and movement in, space, and have demonstrated the capability and intent to hold U.S. and allied space assets at risk.

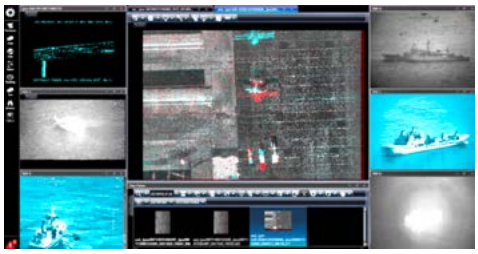
Establishing this partnership among MW/MT/MD acquisition organizations will enhance the interface between requirements, operators, and users, optimizing the delivery of integrated and resilient sensor-to-shooter capabilities for the U.S. and its allies. ***Additional details...***

MISSION EXPERTISE CONTRACT AWARDED TO CACI BY INSCOM

CACI International Inc (NYSE: CACI) was recently awarded a new task order worth approximately $80 million to provide mission expertise to the ***U.S. Army's Intelligence and Security Command (INSCOM)*** and the ***116th Military Intelligence Brigade*** (MIB) in support of the Army's ***Solutions for Intelligence Analysis 3 (SIA-3)*** effort.

Under the task order, CACI will offer tactical intelligence and analytical expertise to assist in the ever-changing landscape of the Army's aerial intelligence, surveillance, and reconnaissance (ISR) missions.

John Mengucci, CACI President and Chief Executive Office, said, "*CACI brings highly-skilled and cleared personnel with a unique understanding of military intelligence operations. This new task order expands our support to INSCOM and the 116th Military Intelligence Brigade with additional expertise to enable mission success. Our support provides critical geospatial and signals intelligence across air, land, sea, space, and cyber domains.*"



STARE screenshot, courtesy of GA-ASI.

Under this task order, CACI will serve as a force multiplier by directly assisting the warfighter with technical, functional, and general support to gather ***geospatial intelligence*** (**GEOINT**) and ***signals intelligence*** (**SIGINT**) in support of ***INSCOM*** and the 116th MIB.

The task order has a one-year period of performance with four one-year option periods. Work will be performed primarily in Ft. Gordon, Georgia.

GENERAL ATOMICS AERONAUTICAL SYSTEMS (GA-ASI) HAS ADDED THE OPTIX PLATFORM

General Atomics Aeronautical Systems, Inc. (GA-ASI) has integrated the Optix platform (screenshot below) into its ***System for Tasking And Real-Time Exploitation (STARE)*** system.

Optix delivers cloud-based, big data processing and analytics to STARE, providing operators with a common operating picture by integrating and displaying wide area surveillance information gathered by GA-ASI Remotely Piloted Aircraft (RPA) and commercial space-based and terrestrial data sources.

tThe new Optix capabilities enable customers to easily task and direct ***Intelligence, Surveillance and Reconnaissance*** (**ISR**) assets in real time, as well as to automatically identify and classify objects of interest using ***Artificial Intelligence and Machine Learning*** (**AI/ML**) techniques.

In addition, it rapidly exploits and correlates data collected from RPA, commercial satellites, and other sources into an easily shared ***common operational picture*** (**COP**). Having multi-source correlated data enables automatic detection of anomalous behaviors, such as dark vessels, ship-to-ship transfers, and **Economic Exclusive Zone** violations.

STARE provides end users with actionable intelligence. When anomalous behaviors are detected from the AI/ML models, alerts will now be generated for the end user to evaluate; these alerts include spatio-temporal location, details of the anomaly and data sources used by the detection. By automating the detections at scale, STARE decreases the number of people required to monitor and decipher all of the various feeds, while increasing the accuracy and delivery of critical intelligence to decision-makers.

Optix was developed by General Atomics' Commonwealth Computer Research, Inc. (CCRi), a company GA acquired in 2021. It has been deployed in production environments globally, for both commercial and government related use cases. ***Additional details...***

NATIONAL SPACE SOCIETY STATEMENT REGARDING THE ORBITAL SUSTAINABILITY ACT OF 2022

On September 12th, the ***Orbital Sustainability Act of 2022 (ORBITS Act)*** was introduced to the Senate — this bipartisan bill, championed by Senators ***Maria Cantwell***, ***John Hickenlooper***, ***Cynthia Lummis***, and ***Roger Wicker***, would "*establish a demonstration program for the active remediation of orbital debris*" and "*require the development of uniform orbital debris standard practices in order to support a safe and sustainable orbital environment*."

The ***National Space Society (NSS)*** applauds the U.S. Government's leadership in orbital debris management. The ORBITS Act strongly aligns with the goals of both the ***National Orbital Debris Implementation Plan*** and ***Space Policy Directive-3***. NSS supports this historic effort and urges Congress to pass this bill as soon as possible.

The ORBITS Act has five key sections.

Section 2 *summarizes the relevant Congressional findings. Here, the Act concludes that the growing amount of orbital debris endangers the safety and sustainability of in-space operations. It asserts that space-based applications critical to the U.S. rely on continued and secure access to outer space.*

Section 4 *prioritizes Active Debris Removal (ADR), which falls under the remediation pillar of orbital debris management. This section directs NASA, the Department of Commerce Office of Space Commerce (OSC), and the National Space Council to publish an unclassified list of orbital debris that poses the greatest immediate risk to in-space operations and spacecraft. It also establishes a NASA Remediation Demonstration Program to make multiple competitive awards for phased technology development followed by future ADR missions.*

Section 6 *requires the National Space Council to update the U.S. Government Orbital Debris Mitigation Standard Practices with multi-agency collaboration and commercial input.*

Section 7 *encourages the Secretary of Commerce to facilitate the development of standard practices for Space Traffic Management (STM) through the OSC. These standard practices would be based on guidelines and best practices used by the U.S. Government and commercial space operators.*

NSS supports these provisions, which emphasize remediation, but also include mitigation and STM. It will be important for the debris list to properly characterize risk through comprehensive trade studies. This will guide investments and research and development.

The debris list should also sufficiently internalize cost-benefit analyses. Ideally, the NASA Remediation Demonstration Program will prioritize the ADR of large derelict satellites and rocket bodies. Further, the updated Orbital Debris Mitigation Standard Practices should reflect the crucial ongoing FCC rulemaking proceedings. These proceedings include the following: Mitigation of Orbital Debris in the New Space Age (IB Docket No. 18-313); Facilitating Capabilities for In-Space Servicing, Assembly, and Manufacturing (IB Docket No. 22-272); and Space Innovation (IB Docket No. 22-271).

It will be necessary to reassess the adequacy of current deorbiting and "*graveyarding*" measures within the Post-Mission Disposal (PMD) regime. ***Additional details...***

BLUE CANYON TECHNOLOGIES + SEAKR ENGINEERING DELIVER 1ST FLIGHT UNIT + PAYLOADS FOR THE DARPA BLACKJACK PROGRAM

Blue Canyon Technologies, LLC, and ***SEAKR Engineering, LLC***, wholly owned subsidiaries of ***Raytheon Technologies***, have announced that they have delivered one, Saturn-class, microsat bus and have also completed acceptance testing of the first two of 12 ***Pit Boss Battle Management Command, Control and Communication*** payloads for the ***Defense Advanced Research Projects Agency's Blackjack Program***.

These buses are BCT's first flight units using the company's new ***Kyber Electrical Power System*** and ***Hyperion Solar Arrays***. Each bus includes advanced electric propulsion, a robust power system, command and data handling, radio frequency communications and dedicated payload interfaces capable of hosting several different ***Department of Defense*** payloads.

SEAKR Engineering has completed acceptance testing of the first two, flight units of the 12, Pit Boss Battle Management Command, Control and Communication payloads for the DARPA Blackjack constellation. These units have shipped for space vehicle Assembly, Integration and Test.

The Blackjack mission will develop and demonstrate critical elements of a global high-speed network in LEO. The goal of the Blackjack program is to show that a constellation of LEO satellites meets U.S. Department of Defense performance and payload requirements, at a significantly lower cost, with shorter design cycles and with easier and more frequent technology upgrades.

The Blackjack program aims to establish an economy of scale not previously available with current National Security space assets, which are large, costly and would take years to replace if degraded or destroyed.

Blue Canyon built and delivered Blackjack's ground test unit to Lockheed Martin in early May of this year. The remaining customized, Saturn-class buses are currently in production at BCT's smallsat factory in Lafayette, Colorado. ***Additional details...***

L3HARRIS SELECTED AS A MEMBER OF THE ADVANCED BATTLE MANAGEMENT SYSTEM CONSORTIUM

The ***U.S. Department of the Air Force's Rapid Capabilities Office*** selected ***L3Harris Technologies*** (NYSE:LHX) as one of five industry partners chartered to design, develop and deploy the digital infrastructure that will enable advanced battle management and command-and-control capabilities for the ***U.S. Air Force*** and ***U.S. Space Force***.

U.S. AIR FORCE | UNITED STATES SPACE FORCE

The newly formed Advanced Battle Management System (ABMS) Digital Infrastructure Consortium, comprising L3Harris and other competitively selected industry partners, will define requirements and standards to inform the development of the Air Force's ABMS Digital Infrastructure to realize the DoD's Joint All-***Domain Command and Control*** (**JADC2**) vision.

The consortium will address the secure processing, resilient communications, data management and open-architecture design criteria that lays the foundation for enabling the Air Force's ***Advanced Battle Management System***. ***Additional details...***

QINETIQ DELIVERS WORLD'S FIRST DEMO OF A LASER CONTROLLED DRONE

World's first demonstration of a laser controlled drone during flight. Photo courtesy of QinetiQ.

DURING FLIGHT

QinetiQ has delivered the world's first successful demonstration of an airborne uncrewed platform being controlled via a laser communication system; strengthening military capability for covert, low detection probability operations in the future.

The innovative demonstration saw a ground based operator control an airborne ***Uncrewed Air System*** (**UAS**), transmitting control commands and receiving sensor and platform information that included ***Free Space Optical Communications*** (**FSOC**) as a bi-directional link in its mission communication system.

FSOC provide very high bandwidth, very low probability of detection communications, low logistical footprint and the potential to negate the considerable investment that adversaries may have made in denying the RF spectrum.

The control of an airborne uncrewed platform has, in the pas,t been enabled via the use of ***radio frequency*** (**RF**) technologies, that are prone to detection and interference.

This was a successful demonstration of an integrated FSOC system as a means of operation in a contested RF environment where there is a need for secure, covert operations.

The demonstration formed part of the **DSTL Air Command and Control** (**C2**), ***Intelligence Surveillance & Reconnaissance*** (**ISR**) and

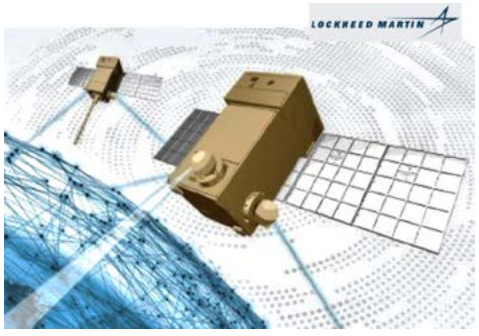
Interoperability project. The project objectives include improving both the digital interoperability and resilience of the communication systems that connect air platforms and associated capabilities (*both current and potential*).

The outputs of the project are supporting exploitation activities within the **UK MOD** Front Line Commands, including Air, Land, Maritime and Joint.

TESAT COMPLETES THE PDR OF THEIR OPTICAL COMMS TERMINAL FOR SDA'S TRANCHE 1 TRANSPORT LAYER

Tesat-Spacecom (TESAT) recently completed the ***Preliminary Design Review*** (**PDR**) of the company's ***Optical Communication Terminals*** (**OCTs**) for satellites as part of ***Space Development Agency's (SDA) Tranche 1 Transport Layer (T1TL)***.

Lockheed Martin, a prime contractor for the agency's ***tranche 0 (TLT0) and TLT1 satellites***, and the SDA were on site at TESAT for the review. The PDR confirmed the TESAT OCT design and specifications are compliant to the SDA's **OCT Standard Version 3.0** requirements.



OCTs use optical technologies to route data traffic between interconnected satellites and will support lower latencies in LEO constellations, a critical improvement for prosecuting time-sensitive targets in today's wartime environment.

As the primary vendor of OCTs to Lockheed Martin for the **SDA Transport Layer Space Vehicles (SV)**, TESAT was able to leverage qualified hardware to rapidly achieve **T1TL PDR**.

Updates for the T1TL design include moving to the V3.0 OCT Standard as well as optimized volume and mass. TESAT's high production OCT manufacturing process continues to deliver OCTs enabling SDA to demonstrate ***Optical Intersatellite Links*** (**OISL**) between LEO satellites.

As part of the T1TL PDR event, TESAT escorted Lockheed Martin, SDA and Naval Research Laboratory personnel to the TESAT OCT test facility. This allowed firsthand demonstration of the "*test as you fly*" processes and tooling used to perform ground validation of space OCTs. ***Additional details...***

TESAT's OCT, the SCOT80.

DISPATCHES

KRATOS RECEIVES U.S. ARMY CONTRACT TO DEMO A VIRTUALIZED SATCOM GROUND SYSTEM

Kratos Defense & Security Solutions, Inc. (Nasdaq: KTOS) has recently been awarded a contract from the ***U.S. Army's Combat Capabilities Development Command*** to demonstrate a virtualized SATCOM ground system.

Based upon Kratos' ***OpenSpace Platform***, the solution will enable the government to field SATCOM networks in line with modernization goals including streamlining gateway and remote terminal capabilities supported by multiple vendors, reducing life-cycle costs and supporting adaptive, dynamic space operations.

Funding for this award was through the ***Network Command, Control, Communication, and Intelligence Cross-Functional Team (N-CFT)*** established by the ***U.S. Army's Future Command***. ***Additional details***

MOU SIGNED BY TWO HANWHA COMPANIES + ONEWEB TO DEVELOP SATELLITE CONNECTIVITY SERVICES FOR THE AUSTRALIAN DEFENSE MARKET

Hanwha Systems Corporation (HSC) and ***Hanwha Defense Australia (HDA)***, two leading defense companies in South Korea, have signed a ***Memorandum of Understanding*** (**MOU**) with ***OneWeb*** to explore the joint provision of connectivity services to the Australian Defence Market.

Hanwha Systems announced that the company had signed a three-party MoU with Hanwha Defense Australia and OneWeb to discuss their potential participation in "*Australian Military Satellite Internet Business*."

The MOU will facilitate discussions between the three companies regarding how they may combine their key capabilities to meet competitive requirements for ***Australian Military Satellite Tactical Internet Program***. ***Additional details...***

U.S. ARMY WRAPS UP THE AIRBUS-BUILT ZEPHYR 8 UAS HIGH ALTITUDE EXPERIMENT

The ***Assured Positioning, Navigation and Timing/Space (APNT/Space) Cross-Functional Team (CFT)*** has concluded a 64 day stratospheric flight demo using ***Airbus's Zephyr 8***, ultra-long endurance, solar-powered, ***unmanned air system*** (**UAS**).

Launched from ***Yuma Proving Ground (YPG)*** on June 15, the Zephyr 8 UAS ascended to more than 60,000 feet into the stratosphere before executing its flight plan over the southern portion of the United States, into the Gulf of Mexico and over South America. Once returning to airspace over YPG, the team conducted multiple assessments.

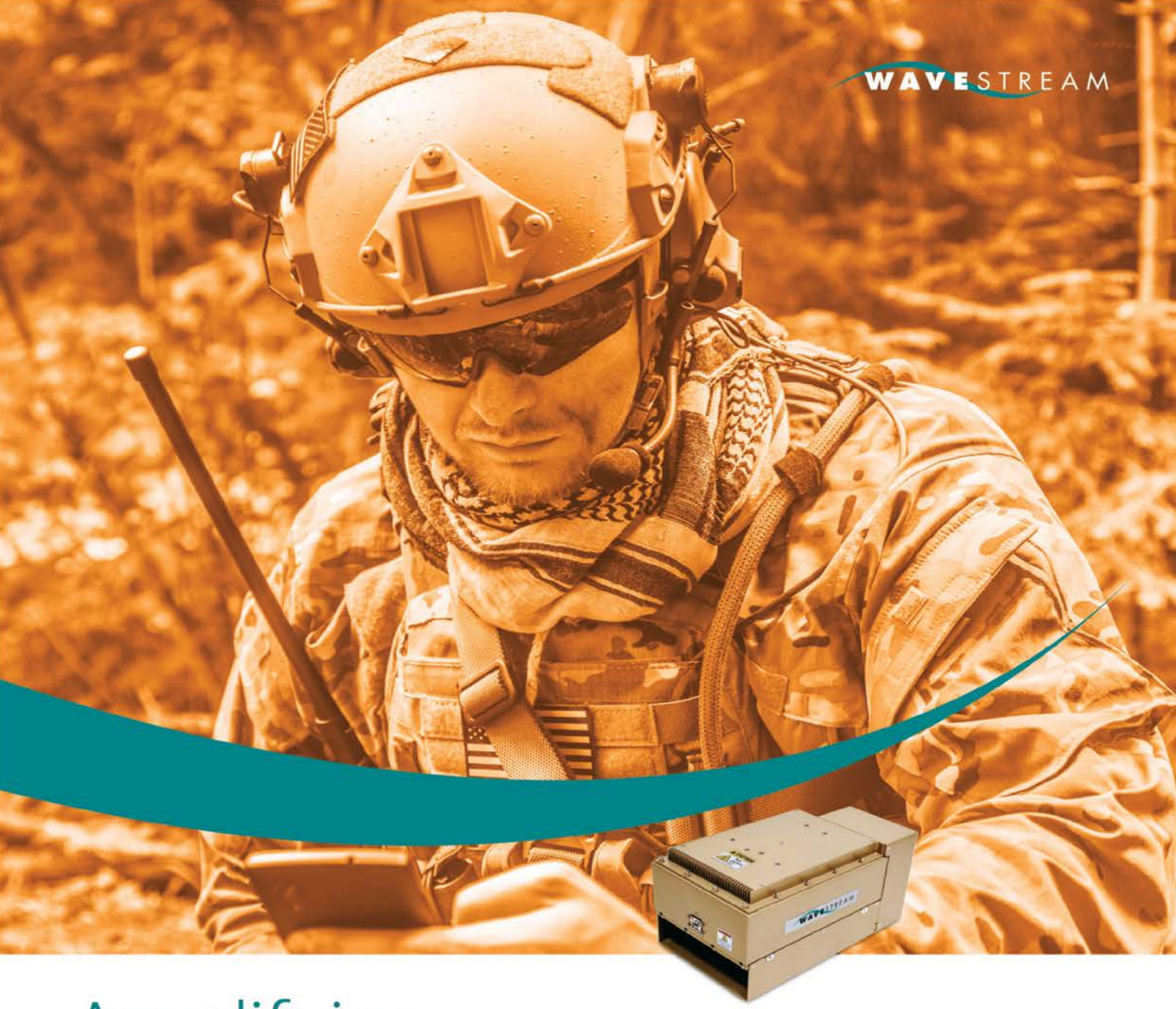
On August 18, around 2100 hours PDT, the prototype aircraft's flight campaign ended when the Zephyr 8 UAS encountered events that led to its unexpected termination over YPG.

These events are under investigation. No injuries or risk to personnel or other aircraft resulted from this incident. Further information will be released following the investigation.

This flight marked a number of firsts for Zephyr 8, including its departure from U.S. airspace, flight over water, flight in international airspace, data collection and direct downlink while outside of U.S. airspace, the longest continuous duration (7 days) using SATCOM, and the demonstration of resilient satellite command and control from three different locations – Huntsville, Alabama; Yuma, Arizona and Farnborough, United Kingdom.

This experimentation successfully demonstrated Zephyr's energy storage capacity, flight endurance, station-keeping and agile positioning abilities. Given the amount of data that was generated during the 64-day flight and the time required to analyze it, as well as the need to investigate the events that led to the termination, further flight demonstrations have been postponed until 2023.

This 64-day test flight was performed in conjunction with government and industry partners who support experimentation that continues to inform Army requirements.



Amplifying Mission-Critical Satellite Communication

50W Ka-Band GaN Wideband BUC
Operates in all commercial and military Ka-Band frequencies

Supporting ARSTRAT-certified Ka-Band units 14 years after initial deployment.

We're ready to support the most critical networks on the planet.

WAVESTREAM. READY FOR YOUR BUSINESS.

www.wavestream.com

SPACEWORKS RED-RESCUE DELIVERS GOODS KEY TO SURVIVAL IN WARTIME

SpaceWorks has successfully demonstrated ***RED-Rescue***, the company's new, low-cost solution in delivering life-saving food, supplies and equipment to downed or isolated Airmen. The flight test was conducted in March near Albuquerque, New Mexico.

The U.S. Air Force had recently challenged industry to develop capabilities that provide on-demand and cost-efficient delivery of ***Personnel Recovery Kits*** (**PRKs**) to downed Airmen.

SpaceWorks' unique solution involving aerial deployment of a large multi-rotor drone was subsequently selected to provide this capability. Designed to be quickly deployed at significant standoff distances, RED-Rescue delivers critical supplies and equipment with extreme precision to a stranded warfighter at their location.

Designing RED-Rescue began in early 2020 when the company won a contract with the ***Air Force Research Laboratory*** to develop its ***Air-launched Drone Delivery Device*** (AD3).

The program began with a concept evaluation study for the operational system design, then moved to detailed design for the prototype system, and finally to flight test demonstrations.

To ensure the proposed PRK delivery device was capable of meeting mission objectives, SpaceWorks planned a two-phase risk reduction effort. Phase I verified its performance in lab and bench level settings, where engineers tested individual components and functions

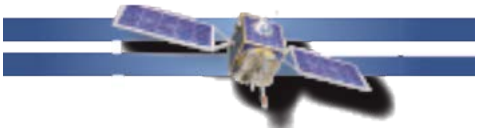
Phase II culminated in March's flight test that validated the descent, deceleration, aerial deployment, and final mile delivery of a PRK in the field.

For the flight test, RED-Rescue capsules were dropped by a **Bell 206B JetRanger** helicopter at an average altitude of 3,000 feet above ground level (AGL).

Once the parachute deployed, the capsule fell and then released the drone, which was guided to deliver the PRK consisting of food rations, medical equipment, and survival gear.

SpaceWorks partnered with ***Watts Innovations*** and employed a modified version of their high-performance PRISM X8 Coaxial Drone for the final mile delivery.

In the field, RED-Rescue is designed to eventually be delivered not from a helicopter but from a military aircraft at speeds up to Mach 6 (six times the speed of sound).



RAYTHEON INTELLIGENCE & SPACE IS UPGRADING AUSTRALIAN BORDER SURVEILLANCE AIRCRAFT WITH ADVANCED RADAR

Raytheon Intelligence & Space, a ***Raytheon Technologies*** business, will equip Australian border surveillance aircraft with the company's latest ***SeaVue Multi-Role radar*** under a contract with ***Cobham Special Mission***.

Under the contract, RI&S will upgrade Cobham's fleet of ***Dash 8 fixed-wing aircraft*** to the most advanced version of its ***SeaVue*** multi-domain surveillance radar in support of Australian border protection operations.

SeaVue MR will bring long-range, high-altitude surveillance capabilities to the special mission fixed-wing aircraft used to patrol the oceans surrounding Australia's shores as part of the world's largest outsourced civil maritime surveillance operation.

"*Long-range detection of small targets from higher altitudes increases surveillance coverage and improves Australia's capability to detect and counter Civil Maritime Security threats*," said ***Denis Donohue***, president of Surveillance and Networks Systems for RI&S.

BAE SYSTEMS PROVIDES ENHANCED GPS TECH FOR F-15 EAGLE FIGHTER AIRCRAFT

BAE Systems has received a $13 million contract for advanced ***Global Positioning System*** (**GPS**) technology to protect U.S. F-15E aircraft from GPS signal jamming and spoofing — the company's ***Digital GPS Anti-jam Receiver (DIGAR)*** will ensure the reliability of military GPS systems for aircraft operating in challenging signal environments.

DIGAR technology offers the best available airborne GPS jamming protection, featuring two form factor options for legacy retrofit and forward fit applications.

DIGAR uses advanced antenna electronics, high-performance signal-processing, and digital beamforming – a capability that combines 16 steered beams – for better GPS signal reception and superior jamming immunity. These capabilities are critical for high-speed aircraft as they maneuver through the battlespace.

The F-15 Eagle is the second U.S. Air Force fighter platform to receive DIGAR GPS upgrades, following the F-16 Fighting Falcon. DIGAR also provides advanced GPS capabilities for intelligence, surveillance, and reconnaissance aircraft as well as multiple unmanned aerial vehicles.

"*Modern airborne missions require accurate positioning and navigation data, and GPS systems must be able to withstand adversaries' best disruption efforts,*" said ***Greg Wild***, Navigation and Sensor Systems product line director at BAE Systems. "*Our DIGAR antenna electronics are trusted to protect these platforms in contested environments*."

SES + SES GS ACQUIRE DRS GLOBAL ENTERPRISE SOLUTIONS FROM LEONARDO DRS

SES and its wholly-owned subsidiary, ***SES Government Solutions (SES GS)***, have completed the acquisition of ***DRS Global Enterprise Solutions (GES)*** from ***Leonardo DRS*** for $450 million after obtaining all the necessary regulatory approvals.

The DRS GES business will be combined with SES GS to create a scaled solutions provider serving the multi-orbit satellite communications needs of the US Government and supporting missions anywhere on land, at sea, or in the air.

With the combined businesses operating as SES Government Solutions, the new organization will comprise a cross-functional workforce with deep technical expertise and a proven ability to integrate and manage multi-orbit geostationary and ***Medium Earth Orbit*** (**MEO**) services as well as multi-operator network solutions.

In particular, SES GS will offer highly flexible second-generation MEO services – via SES's soon-to-be launched ***O3b mPOWER*** system – with a unique combination of low latency and high throughput per terminal for high-value missions, to an expanded government customer base. SES GS will also leverage essential tools and expertise in cybersecurity operations, customer support, governance and compliance.

The combined business will continue to serve US Government customers under the direction of the SES GS Proxy Board of Directors.

The consolidation of DRS GES with SES GS is expected to unlock $25 million of annualized run-rate synergies, with government becoming SES's largest data business segment in terms of revenue.

The combined business will be led by David Fields, who assumes responsibilities on August 1, 2022, as appointed by the SES GS Proxy Board.

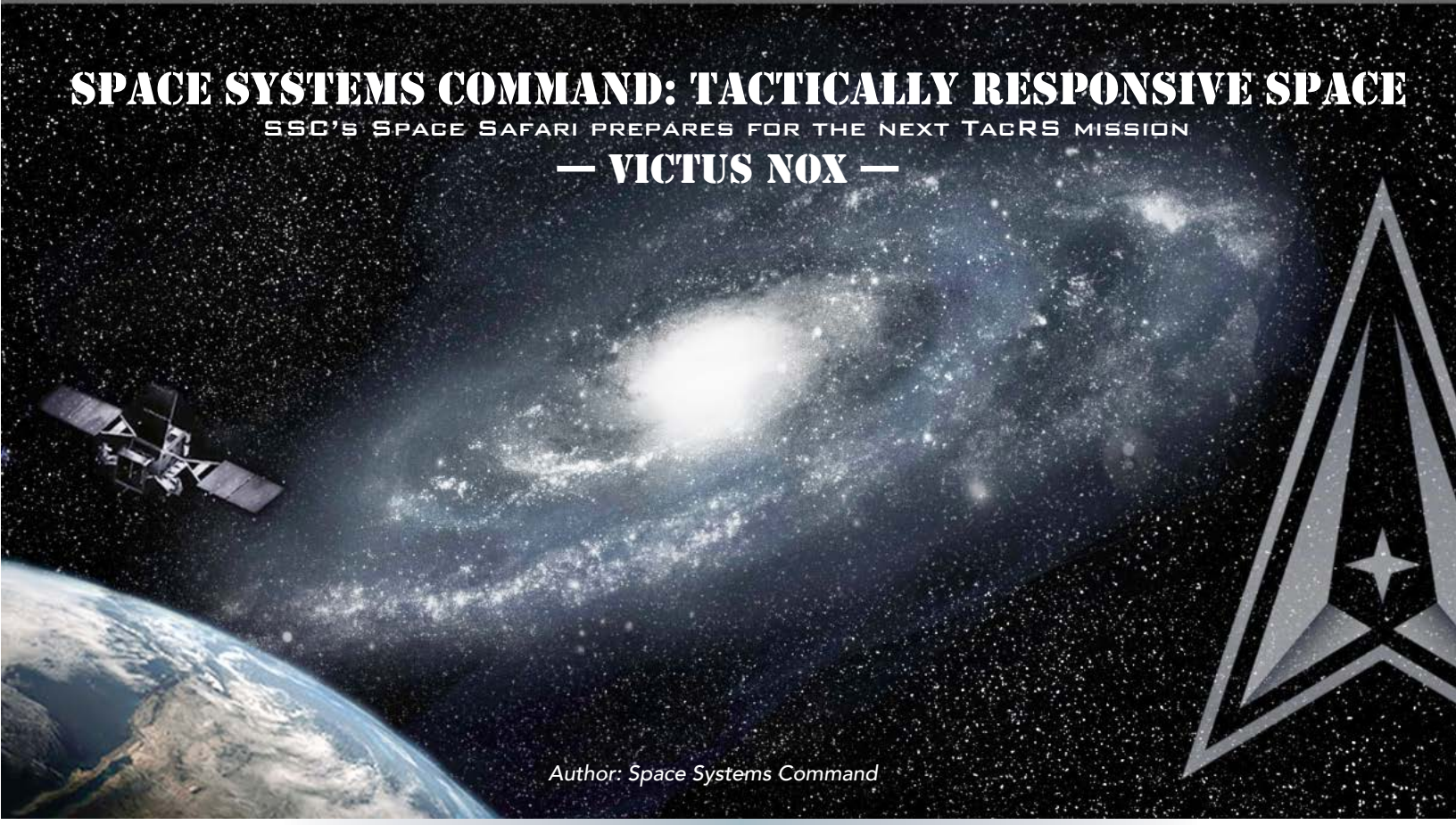
Fields has more than 30 years of experience in the satellite communications and information technology (IT) services industries and joins SES GS from DRS GES.

He succeeds Brigadier General Pete Hoene, USAF (Retired), who, after 11 years at the helm of SES GS and decades of dedicated service in the satellite communications arena, will take his retirement. ***Additional details...***

SPACE SYSTEMS COMMAND: TACTICALLY RESPONSIVE SPACE

SSC's Space Safari prepares for the next TacRS mission

— VICTUS NOX —



Author: Space Systems Command

Years ago, many space missions had the luxury of time: years could be spent developing and then launching a series of satellites to ensure mission success.

However, in today's contested and congested space environment, the ***U.S. Space Force***'s (USSF) ***Space Systems Command*** (SSC) understands that time is not a luxury it can afford. If a vital satellite becomes damaged — either by a natural phenomenon, such as space charging, or through the actions of an adversary —- the U.S. and its allies can't wait months or years to replace or augment that capability.

That's where SSC's Space Safari Program Office comes into effect. Space Safari, which responds to high-priority, urgent space needs by rapidly acquiring, integrating and executing missions, is gearing up for its next (TacRS) mission. Space Safari works closely with multiple organizations across SSC and the USSF, including a strong partnership with the Assured Access to Space (AATS) team and their Rocket Systems Launch Program (RSLP) office.

The goal behind TacRS is to quickly respond to on-orbit adversarial threats and provide the ability to rapidly augment existing satellite capabilities during a conflict or crisis. One method to meet that goal is to improve the USSF's ability to build, launch and begin operating on-orbit as quickly as possible, using spacecraft buses, payloads and commercial launch vehicles that can be rapidly integrated and launched on very short timelines.

Lt. Col. Mackenzie Birchenough

"When we talk about Tactically Responsive Space, we're talking about much more than just launch," said Lt. Col. Mackenzie Birchenough, Materiel Leader for SSC's Space Safari. "It is really the end-to-end capability that allows us to respond to on-orbit threats or to augment our on-orbit capabilities at the time of need. It's everything from how we go about our acquisition process, to how we build our space and launch vehicles, to how we set up our ground infrastructure, and how we quickly launch and conduct on-orbit operations in order to get the data to the warfighter as soon as possible."

The Lt. Col. added, "The normal acquisition process for a space mission is typically years long. But with TacRS we're getting after how we drastically shorten that timeline. Our goal is to get through the acquisition phase in a matter of months and ultimately be on orbit in less than 24 hours from a notification to launch."

The USSF originally referred to this capability as TacRL, for Tactically Responsive Launch, but the name was changed to TacRS to indicate that the effort is broader than just launch and also focuses on spacecraft buses, payloads, ground infrastructure and on-orbit operations.

Space Safari's first mission, TacRL-2, involved launching a satellite called Odyssey using ***Northrop Grumman's Pegasus XL*** air-launched rocket that was deployed from ***Vandenberg Space Force Base*** in June of 2021. That satellite is still on-orbit, conducting a Space Domain Awareness (SDA) mission. But where TacRL-2's launch campaign timeline was 21 days, the next mission, VICTUS NOX, plans to compress that to 24 hours.

VICTUS NOX (Latin for "conquer the night") will involve the launch of a Low Earth Orbit (LEO) SDA satellite. This operational demonstration, culminating in a launch sometime in mid to late 2023, involves building the space and launch vehicles and preparing the ground segment in a 12 month period of time, then placing the mission on a "hot standby" until an "activation" order is given, followed by a short activation window. At some point in the following six-month alert period, a "*notice to launch*" order will be given, starting the clock for the team to successfully launch the satellite within 24 hours.

The mission preparation began in April of 2022; ***Millennium Space Systems*** was awarded the contract for the space and ground segments, and the launch service contract will soon be awarded, Birchenough said. The next phase — the ***"hot standby"*** — "is designed to make it as representative of a real-world conflict scenario as possible," she explained. "*The entire point is to be able to launch when the need arises, not on a predetermined date."With the activation order, the space vehicle will be shipped to the launch site and final preparations will begin — similar to a real-world scenario in which there might be some warning signs, increased tensions or an indication that a particular capability might be needed. Even the exact orbit has not been pre-determined as of this writing.*"

"*We're not going to schedule the range and launch on X date*," said Maj. ***Jason Altenhofen***, Deputy Chief for Space Safari. "*We're going to be in stand-by mode and the entire team then has to be able to move quickly to make VICTUS NOX the priority and enable a launch within 24 hours. Within those 24 hours, we expect the*

GET IN TOUCH WITH OUR NEW HIGH POWER AMPLIFIERS

sales.eu@ndsatcom.com

The U. S. Space Force successfully launched the Tactically Responsive Launch-2 (TacRL-2) mission on a Northrop Grumman Pegasus XL rocket from Vandenberg Space Force Base on June 13, 2021, at 4:11 a.m. EDT, delivering a technology demonstration satellite to Low Earth Orbit.

space vehicle will be encapsulated, all final checkouts will be conducted, the launch will be completed and VICTUS NOX will be on-orbit," Altenhofen said.

The Major added, "Once we're in the correct orbit, we have a goal of being mission-capable within 48 hours. Just getting into orbit isn't enough — we need to be getting the data into the hands of the warfighter as fast as we can."

Maj. Jason A. Altenhofen

What makes the mission especially challenging is the sheer number of steps and the multiple policies and procedures that have to be followed to ensure a successful launch, Birchenough said: how to integrate a payload and a satellite bus for a specific need in a short time period; acquiring approvals such as spectrum management and security as well as determining how to quickly transport the space and launch vehicles to the launch pad are all things we need to consider.

"It's really breaking down the problem into many smaller problem sets that all need to be condensed. Each one of those areas presents its own challenges, depending on what aspects of the end-to-end mission you're talking about," Birchenough said.

TacRS missions are not centered around major space programs with billion-dollar assets, Birchenough said, but unique capabilities designed to fill a certain gap or respond to a specific threat. Part of condensing the timeline includes designing space vehicles with shorter lifespans, not building assets designed to last multiple years.

Birchenough said there are two main types of missions TacRS could be used for: responding to some type of new, on-orbit adversarial threat and providing a short-term, gap-filler capability when an asset is somehow damaged, degraded or destroyed. Launching a new satellite isn't the only way Space Safari is preparing to respond to these situations though: the USSF also has the ability to modify missions for military assets already on orbit or purchase commercial capabilities, when possible.

To make certain the USSF has access to the most innovative technology the world has to offer, SSC has been sponsoring monthly Industry Days and Reverse Industry Days to bring together commercial space industry companies and government officials. The most recent one, held August 24-25 in El Segundo, California, was centered around TacRS, with more than 230 industry attendees,

Photo of a recent, and well-attended, USSF/SSC Reverse Industry Days event.

representing more than 160 companies, participating in moderated panel discussions and one-on-one meetings with senior Department of Defense (DoD) officials.

"*The intent for our Reverse Industry Days is not for the government to go out and tell industry exactly what we want,*" Birchenough said. *"It's to relay to industry where we think we need to be heading and then collect feedback from industry about what innovative ideas they are working on, what challenges or limitations they see going forward, and what suggestions they can offer to improve our processes and help get to the desired end state.*"

Partnering with industry is a key component in staying ahead of the threat, she said. "*We've seen both Russia and China advancing their space capabilities, and from our standpoint, we need to make sure we are always ready to respond to whatever those threats or urgent needs may be.*"

Space Systems Command (SSC) is the U.S. Space Force field command responsible for rapidly developing, acquiring, equipping, fielding and sustaining lethal and resilient space capabilities. SSC mission capability areas include launch acquisition and operations, communications and positioning, navigation and timing (PNT), space sensing, battle management command, control and communications (BMC3), and space domain awareness & combat power. SSC is headquartered at Los Angeles Air Force Base in El Segundo, Calif. Contact Space Systems Command at ***SSC@spaceforce.mil —*** also *follow SSC on* ***LinkedIn****.*

SPACE FLIGHT LABORATORY

SMALLER SATELLITES

FOR ESSENTIAL MISSIONS

Commissioned during the Covid-19 Pandemic:

- **16** Communications CubeSats
- **12** RF Mapping Microsatellites
- **5** Greenhouse Gas Monitoring Microsatellites
- **1** Earth Observation Microsatellite
- **1** Atmospheric Monitoring Microsatellite
- **1** Maritime Tracking Microsatellite

UTIAS SFL

www.utias-sfl.net

@SFL_SmallerSats

THE "COLOR" OF SPACE MONEY

Author: Space Systems Command

Talk to space defense acquisition specialists, and you'll often hear references to the "color" of money.

In the ***U.S. Department of Defense*** (DoD), the term "color of money" refers to an appropriation category for a DoD financial account.

Michael S. Wood

"*The 'color of money' is a term that is used to highlight the fact that we don't execute 'green money' in the appropriated funding lanes*," said ***Michael S. Wood***, Space Systems Command/ FM technical director and chief, Financial Analysis Division. "**Congress appropriates different funding in different appropriations and within specific line items that set legal limitations on the use of those funds.**"

Joy M. White

"*Unfortunately, 'colors of money', while important for fiscal oversight, can limit acquisition agility*," said ***Joy M. White***, executive director for at SSC. "*Funding strategies are structured for a five-year period and approved annually, which means that it may be challenging to rapidly pivot to confront a new threat posed by an adversary or adopt a new commercial technology with speed," she said, continuing, "Adopting a new strategy in the middle of a budget cycle requires extensive justification and approvals," White added. "It's my hope that the Congressionally established Planning, Programming, Budget and Execution (PPB&E) commission will include some recommendations that enable greater flexibility and speed in the budgeting process, so that we, as a nation, can beat the threat.*"

The ***Purpose Statute 31 U.S. Code Sec. 1301*** requires funds to be used only for the purposes and programs for which the appropriation was made. Legally, the USSF — and SSC — cannot spend congressionally appropriated funds outside the definition of that appropriation. Money is legally available only for the purpose for which it was appropriated.

"*We don't have one big pot of funding to execute*," Wood said. "*If we want to move funding between different line items, it's a reprogramming action, subject to prior approval at certain thresholds - and movement between appropriations requires the use of general transfer authority, which is also limited by Congress. Appropriations have a lifecycle, in terms of their availability for obligations and expenditures. The body of fiscal law and policy around use of appropriations is massive.*"

Potential fiscal law violations can fall into three categories: violations of time, purpose or amount, Wood said that spending money after a particular time period has expired, for the wrong purpose or in the wrong amount, the penalties for such violations can range from fines to prison time.

Funding categories include: **Military Personnel (MILPERS)**; **Operation & Maintenance (O&M)**; **Procurement (PROC/SCN)**; Research, Development, Test & Evaluation (RDT&E); and **Military Construction (MILCON)**.

MILPERS is used to fund the salaries of active and reserve duty military; O&M covers civilian salaries, travel, training, facility maintenance and operational support.

PROC/SCN funds the purchase of goods and non-construction items. RDT&E funds research and development of equipment, materials, computer software and their testing and evaluation.

MILCON funds major construction projects.

It all begins with the ***National Defense Authorization Act*** and the ***Appropriations Act***, bills approved annually by Congress that provide the U.S. Department of Defense with funding.

Early in the year, the President of the United States submits the federal budget request — including the portion for the DoD — for the following year to the authorizing Congressional subcommittees.

The ***House Armed Services Committee*** and the ***Senate Armed Services Committee*** debate and mark up the bills. Eventually, the House and Senate vote on a unified appropriations bill, which the President then signs into public law.

OMNETICS
CONNECTOR CORPORATION

MISSION CRITICAL QUALITY MINIATURE CONNECTORS & CABLE HARNESSES

Connectors from Omnetics have been deployed on space missions ranging from Low Earth orbits to deep space exploration. Designers can make the most of their PCB space with Omnetics' extremely small, rugged, and lightweight connectors and cable assemblies.

WWW.OMNETICS.COM | SALES@OMNETICS.COM | +1 763-572-0656

"The NDAA is setting parameters around what funds can be used for," Wood said. *"If the NDAA is like opening a checking account, the Appropriations Act is like making a deposit."*

SSC currently has an $11 billion space acquisition budget and the USSF's FY 2023 budget request is $24.5 billion, compared to roughly $773 billion budget request for the entire U.S. Department of Defense.

At a recent visit to SSC, the Chief of Space Operations, Gen. ***Jay Raymond*** noted that USSF's budget makes up only 2.5 percent of the total U.S. Department of Defense's budget, but the information the USSF provides from its space assets benefits all of the other military services.

"I agree with Gen. Raymond – it's a misnomer to say that space is expensive," Wood said. *"If you look at the capability that that we bring to bear, both for our national security, other federal agencies, our national infrastructure and our allies – it's a tremendous return on investment."*

The world of defense acquisitions can be extremely complicated, and space acquisitions no less so. It's not a matter of just filling out a purchase order and handing it over to one of the large "prime" defense contractors, Wood said.

In the nearly three years since the U.S. Space Force was created, it — and SSC —have been working to shape a more streamlined approach to space acquisitions that reflects the reality that space is no longer a benign environment, but a contested, congested and challenged area with adversaries keen on surpassing the United States' supremacy in space.

As the USSF is part of the U.S. Air Force, at the top is the newly-appointed ***Assistant Secretary of the Air Force for Space Acquisitions and Integration***, (**SAF/SQ**) the Honorable ***Frank Calvelli***, who serves as the *Service Acquisition Executive (SAE)*, the decision-maker for space acquisition programs for the U.S. Space Force, said Col. ***Neal Roach***, SSC Core Team Lead.

Frank Calvelli

SSC's five Program Executive Officers (PEOs) serve as the execution arm of developing the capabilities the USSF needs and report to Calvelli.

Lt. Gen. Michael Guetlein

SSC Commander, Lt. Gen. ***Michael Guetlein***, is charged with integrating those capabilities for the SAE to ensure that SSC has consistency across the entire enterprise, Roach said, adding, *"The PEO interface with the SAE reinforces and highlights that the flat, streamlined organization of the U.S. Space Force allows for capabilities to be developed between mission areas at the speed needed for the U.S. Space Force."*

Another critical element of how SSC is developing space acquisitions is the use of commercial services, Roach noted. *"In order to take advantage of commercial and partnership opportunities, we need to consider the color of money available to execute."*

"SSC's financial management community has been leading the charge to promote fiscal policy reform to increase agility and speed in the allocation of resources to address emerging threats and opportunities," Wood said.

SSC has been contributing to ***Department of the Air Force*** (**DAF**) and congressional panel discussions on acquisition reform, including the ***DAF Management Initiative*** (**MI**) ***#7 for Tech Transition Pipelines and Mechanisms*** and the ***DoD Planning Programming Budgeting and Execution (PPBE) Commission.***

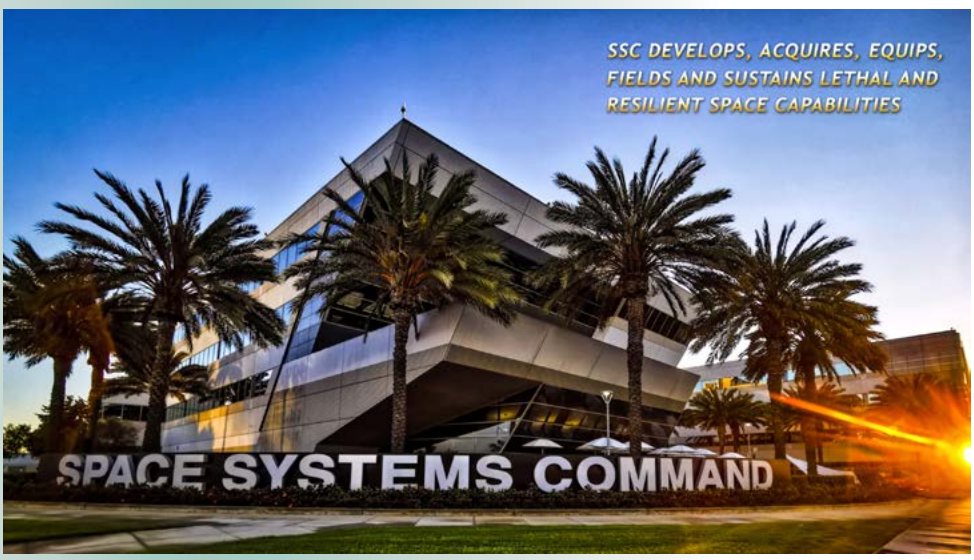
"It remains a key focus area for us to enable Space Force objectives," Wood said. *"Our financial apparatus has got to support the breaking down of stove-piped materiel solutions in closed architectures against a perceived static threat and requirements. We have to shift to an environment of constantly evolving threats that will drive agility in our requirements process and our openness to alternative materiel solutions and the ability to fund an integrated system of systems. That requires agile funding solutions."*

SSC also has been focusing on partnering with commercial space industry and allied partners early in the process, to help translate operational requirements into system requirements and exploit technological advances to address warfighters' needs, Wood said.

At the same time, because of federal acquisition regulations, it can be an arm's length partnership.

"From a financial perspective, the most exciting thing going on right now in SATCOM is the approval from OSD Comptroller of the 'Enterprise Space Activity Group (ESAG)' working capital fund that SSC will manage," Wood said. *"This fund will offer government and allied access to the EMSS and COMSATCOM Solutions business lines, thus providing unlimited access to the global commercial Iridium constellation and COMSATCOM capabilities."*

Want to know more? The U.S. Government Accountability Office (GAO)'s The Principles of Federal Appropriations Law (aka "The Red Book") can be accessed online **here.** This multi-volume work covers federal fiscal law.



DUAL ACQUISITIONS BY SLINGSHOT AEROSPACE INCLUDE NUMERICA'S SPACE DIVISION + UK-BASED SERADATA

Slingshot Aerospace's dual acquisitions transform spaceflight safety and sustainability for satellite operators at a time of unprecedented and growing risk on-orbit.

The acquisition of ***Numerica Corporation***'s ***Space Domain Awareness (SDA)*** division includes the world's first and only, commercial, LEO to GEO, daytime and nighttime, optical sensor network for satellite tracking.

The acquisition of ***Seradata*** brings the company's industry-leading ***SpaceTrak*** satellite and launch database into Slingshot's portfolio and establishes Slingshot's footprint in the UK/European market.

Both of these acquisitions fast track Slingshot's ability to drive the space economy toward sustainability by providing satellite and launch operators with the most robust and authoritative space situational awareness (SSA) and space traffic coordination solutions available today.

Today, satellite operators across the commercial, civil, and defense sectors rely on siloed tools and data that significantly limit the efficiency of day-to-day operations.

Both of these acquisitions accelerate the development of ***Slingshot Digital Space Twin***™, a virtualization of the space operating environment that fuses data together from multiple sources, providing an accurate live, historical, and future representation of objects in orbit, space weather like geomagnetic storms, and the radio frequency spectrum.

These acquisitions also enhance the world's first space traffic coordination solution, Slingshot Beacon, used by satellite operators to cut through the noise of conjunction alerts and facilitate coordination to prevent collisions.

Slingshot's Digital Space Twin reflects the current state of space at any given moment, enabling users to simulate various scenarios and identify the best approach to accomplishing missions.

The product combines real-time mapping of objects in orbit and space weather data with physics based simulations to show users how planned missions will behave in the real space environment. Slingshot Aerospace has spent the last two years developing the Digital Space Twin, which attracted the government's attention. ***Additional details...***

RESILIENT COMBAT DRONES

FIGHTERS FOR THE NEW WARFARE

Author: Alvaro Sanchez, Chief Executive Officer, INTEGRASYS

Nowadays, one of the crucial nerve centers of military offensives resides in commanded UAV fleets and large numbers of drone units that are ready to attack, as well as engage in rescues and perform intelligence, surveillance and reconnaissance (ISR) missions to evaluate the enemies' strengths and locations.

The small weight and size of drones make them a powerful and seamless weapon — current military scenarios have proven that the use of drones during armed conflicts offers enhanced command and control over armies.

According to ***Research and Markets***, the ***Military UAV Market*** was valued at $10.9 billion in 2019 and is projected to grow at a CAGR of 3.14% over the report's forecast period and is projected to reach $14.8 billion by 2029.

Some of the reasons why combat drones have become popular are their flexible and adaptable capabilities, the main ones being reconnaissance as they are extremely accurate when engaged in surveillance missions.

Command and control is another of their strengths as they are able to accurately target an enemy's position. The also identify and target attacks as well as detect potential targets. For logistics, drones can assist in delivering valuable supplies to the front lines as well as assisting in managing evacuations.

In order to unlock the potential of UAVs and their complete capabilities, their need for ***satellite communications*** (**SATCOM**) for a higher data rate to acquire ***Global Navigation Satellite System*** (**GNSS**) and ***Global Positioning System*** (**GPS**) are mandatory, as they provide a high degree of positioning accuracy for a variety of applications that include *mapping, surveillance and search and rescue*.

These on-orbit, constellation systems are composed of numerous satellites that can track positions on Earth at any time to assist warfighters.

UAVs can be equipped with radars and cameras to collect data and obtain geographic references as such is critical in knowing the exact position and time when UAV captures measurements or acquires photos.

When a drone communicates with its controller across *radio frequency spectrums*, an RF sensor passively listens to those frequencies. To identify the signal transmitted by a drone and its controller, the sensor identifies a communication protocol and compares that to a database of communication protocols.

Even though UAVs have revolutionized the military sector and war strategies, drones can also be interfered with, enabling an enemy to potentially command and control the drone as well as alter the unit's position — or even provoke in-air collisions.

The drones available on today's market have greatly improved their security to counter jamming attacks; however, there aren't enough highly developed drones that rely on SATCOM and other technologies for control and navigation and that can actually withstand radio interference and GPS jamming.

Photo of a General Atomics MQ-9 Reaper UAV in-flight.

The threat of GPS and GNSS jamming to military UAVs and satellite networks continues to grow — interference with a satellite network reduces the drone's retransmission capabilities, such as the transmission of real time videos (*one of the main advantages of drone fleets for military ops, as they are accurate and provide real-time images for rapid decision-making processes*).

Beyond visual line of sight (**BVLOS**) and autonomous drone platforms require GNSS — the proliferation of inexpensive, readily available, jamming technologies endangers UAVs that are used for security, monitoring, reconnaissance, delivery, and other purposes.

As a GNSS satellite's signal is an RF wave and loses power as the signal travels to the Earth's surface, every transmission is inherently vulnerable to a variety of purposeful and inadvertent threats.

There are a few intentional techniques that are especially dangerous to military UAVs. These hostile capabilities can partially, or completely, block the reception of the target signal.

The jamming assault is a deliberate, interference technique, that involves the intrusion of RF signals that possess characteristics and higher power than the target signal.

Another deliberate interference technique is spoofing, wherein a device transmits a satellite-like signal at a higher power — the GNSS receiver starts to retrieve the false signal instead of the true signal. This causes the receiver to calculate a position or variable that is totally inaccurate.

The only way to combat interference is by acquiring the correct technologies to increase a UAV's security and to ensure a resilient network.

UAV companies' proprietary technologies to fight interference have not proven to be totally effective, as has been witnessed by the latest events with the ongoing European conflicts that have identified the potential threats for drones fleets.

INTEGRASYS' CLEANRF is the only technology that has proven to be a real defense against jamming and spoofing. In fact, this technology was awarded by the ***Mobile Satellite Users Association*** (**MUSA**) at ***Satellite Show 2022*** as the "***Government Mobile Innovation 2022***".

The smart tool enables receivers or transceivers operating on satellite links to detect, identify, separate, and cancel RFI sources that impact the service signal.

The technology makes it possible for secure and reliable connections, while shielding the network terminals from the most frequent and dangerous sources of interference.

The newly developed ***interference canceler*** maximizes the amount of usable, clean spectrum by providing an intuitive, completely automated interface to address the most common and harmful interference issues.

Users who control crucial infrastructure, government resources, communications for security personnel, and so on, are typical users of this technology.

Modern warfare demands viable technologies that will defend drone fleets and such technical tools need to be automated to assist in immediate implementation and that will be able to negate attacks on the crucial networks that are relied upon by today's warfighters.

Author Alvaro Sanchez is the Chief Executive Officer of INTEGRASYS.

www.integrasys-space.com

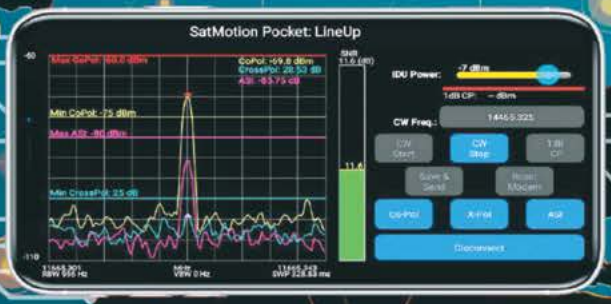
INTEGRASYS

Alvaro Sanchez

INTEGRASYS

"Building Success from Innovation"

LEADING THE SATELLITE NETWORK RESILIENCY



Buy/Sell, Design & Manage

Deploy & Monitor

Interference Geolocation

Interference Mitigation & Removal

integrasys-space.com | info.sales@integrasys-sa.com | @IntegrasysSA | Integrasys SA and LLC

MODULAR ANTENNA DESIGNS CHANGE...

...AT THE SPEED OF RELEVANCE

Author: Fred Vinezeano, Vice President of Products, Kratos Antenna Solutions

With the space industry on a shift from hardware to software in all possible ways, parabolic antenna manufacturers are relying on modularity to help ensure the mission even as it is changing. In the case of antenna systems, reflectors, positioners, or even feeds can be purchased ahead of time and swapped out or replaced at the time of need instead of replacing an entire antenna system.

TRANSFORMING FIXED INTO FLEXIBLE

The ***U.S. Space Force***, along with the rest of the ***Department of Defense*** (**DoD**), continuously seeks out ways to make the space segment more reliable and redundant like including commercial satellites as a resource in their network. In the ground segment, there is no readily available commercial antenna hardware that supports the exact specifications and security requirements of a particular mission to use as a resource without going through a new procurement process.

Trifold transportable antenna system. Photo provided by Kratos.

When antenna system parts can be easily removed, added, and upgraded, the inherently fixed nature of a parabolic antenna becomes more flexible in order for it to adapt to military conditions such as adversary attacks, accidental interference, on-orbit failures, or increased bandwidth requirements without causing a major service interruption. Although antennas will always maintain a certain degree of complex customization to fit individual mission needs, some manufacturers have managed to incorporate interchangeable parts in ways that were not considered possible before that do not compromise ***Army Strategic Command (ARTSRAT)*** performance.

These interchangeable parts are turning what were once complex modifications into more simplified plug-and-play tasks so that any person in the field can modify an antenna in response to critical mission changes in a timely manner. Most importantly, there is the effect that interchangeable parts have on total mission cost.

Leveraging modularity for existing antenna systems enables the ability to add entirely new mission capabilities with reset, sustainment, or upgrade funding for modular components, which is often easier to achieve than funding for a brand-new antenna system.

MAINTAIN CONSTANT ACCESS TO A SPACE SEGMENT

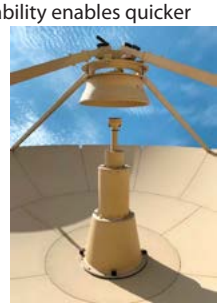
It used to be unthinkable to transplant a feed from one antenna and easily install it in another with reliable results. Today, it is possible to move feeds and parts of feeds can also be removed and used in multiple places to repurpose existing assets. The U.S. Air Force leveraged this capability when they successfully moved C-, Ku-, Ka-, X-, and X/Ka- multi-frequency feeds from 3.4 meter trifold antennas into 4 meter systems to support expanded mission requirements.

When the U.S. Army required a rapid, quick-deployable terminal, their onsite personnel were able to swap out a 3.9 meter trifold transportable antenna feed to a 4.0 meter antenna to meet that need. Whatever the catalyst, interchangeable feeds can save the military thousands to hundreds of thousands of dollars, depending on the feed type.

EASIER MANAGEMENT OF MULTI-SITE, MIXED ANTENNA REQUIREMENTS

Like feed-swapping, the ability to use the same exact hub specifications for a variety of antenna apertures allows for the same exact RF system design to be used to achieve various mission specific **EIRPs** (***Effective Isotropic Radiated Power commonly understood as "transmit capabilities"***) and **G/T** (**Antenna Gain /Total Noise Temperature commonly understood as "receive sensitivity"**). As a case in point, when 5.6, 8.1 and 9.4 meter Ka-Band antennas can all share the same hub, a multi-site project with mixed antenna requirements would use just one RF design and system configuration that can be mounted into any one of the three antennas. This capability enables quicker program deployment, reduced downtime and lower cost on design work, training, and installation.

The value of this modularity feature is underscored when major players begin selecting contractors with single RF system designs in mind. One large satellite operator that recently built a ground network of more than twenty 8.1 and 5.6 meter antennas selected their antenna manufacturer based on key modularity options, specifically, streamlined sparing of antenna parts enabled by a common RF system configuration. In this situation, all the active and nonactive system spares were sharable among the antennas.



4.0 meter carbon fiber feed. Photo provided by Kratos.

MORE CONTROL THAT REQUIRES LESS RACK SPACE

Traditionally in the antenna world, the antenna controller and the antenna itself come at a 1:1 ratio. One antenna is paired with its own controller for the duration of their service lives together.

This is no longer the case with controllers such as ***Kratos***' new ***NGC2*** (**Next Generation Controller**) which is designed to operate and manage up to ten antennas all on its own. The NGC2 is designed for commonality across multiple antenna systems enabling a single hardware platform to provide the best capabilities and interoperability across a line of very disparate applications.

For example, one NGC2 can be used to control transportable and tactical antennas with auto acquisition capabilities, a 3.5 XY LEO antenna with ***Conical Scanning***, and can also be configured to operate a six-axis, Ka-band, Earth Station at the same time. The NGC2 can even be used as a control system for ***High Frequency*** (**HF**) antenna rotators.

As the NGC2 works with more than one antenna, it can serve as a redundancy controller for the other RF elements in addition to handling the antenna tracking capability. This concept allows for familiarity and ease of use for personnel – once it is learned, it doesn't have to be relearned for a different antenna.

In the end, one controller for multiple antennas that can also control other systems such as LNAs, HPAs, and more means a whole lot of extra rack space and a lot less spares to maintain.

MODULAR DESIGNS DELIVER MISSION-ADAPTABLE COMMUNICATIONS

While the space industry continues to become more software-defined, and as we embrace virtual network functionality, ground system antennas will remain hardware for the foreseeable future. Antenna manufacturers continue to find new ways to optimize mission success by creating modular, standardized, transportable designs to make antennas more mission adaptable, flexible and interoperable.

SPACEBRIDGE

CONNECTING OUR MILITARY TO ITS MISSIONS

ASAT II™
Tactical, BLoS
HTS System

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.

We live on the cutting edge of what's possible, challenging ourselves to provide products and services that rise to the occasion. In a world of mounting unconventional threats, there is no room for failure or compromise.

We are dedicated to the exploration and implementation of new communication technologies that provide our armed forces with ultra high-performance satellite connectivity products that boast the best security, and highest availability.

Recognized by major players such DISA, SpaceBridge will continue to offer high-throughput solutions at exceptional value.

Contact us today to learn how we can connect you to your beyond line of sight missions.

SpaceBridge.com | info@SpaceBridge.com | +1.514.420.0045
USA | CANADA | LATAM | BRAZIL | EMEA | APAC

The augmentation and upgradeability of antenna systems components, such as reusable feeds, positioners, RF system design, and controller commonality, enables the ability to adapt to mission changes in a way that increases resiliency, decreases complexity, and saves time and costs.

While the concept of modular designs may have been born in the industrial revolution, it has finally managed to evolve the complex and largely fixed nature of antennas to deliver more cost efficient, and mission-adaptable satellite communication systems.

Fred Vinezeano

Author Fred Vinezeano has 35 years of experience in the Satellite Communication & RF industry serving the Earth Station, Field Service, and System Engineering segments. Currently, Fred serves as Vice President of Products for Kratos Antenna Solutions business which operates from Plano Texas, Whitby Canada, and Newcastle UK. He can be reached at ***Fred.Vinezeano@KratosDefense.com***

Kratos designs and manufactures antenna systems with modularity options that meet the high performance, accuracy and high reliability needs of demanding satellite tracking applications and mission-critical uplink and downlink applications, including full motion antennas to serve NGSO satellites. The broad product portfolio includes transportable and fixed earth station antennas ranging from 2.4m to 18m, radar antennas for air traffic control and weather applications, High-Frequency (HF) and specialty antennas for government, military, broadcasters and integrators worldwide. In addition to individual gateway installations, Kratos is one of the few organizations in the industry that can provide true end-to-end ground systems. Kratos can build the physical earth station site as well as provide all the necessary management systems serving applications such as Telemetry, Tracking and Command (TT&C), In Orbit Test (IOT), Monitoring and Control (M&C), Carrier System Monitoring (CSM), communications gateways, VSAT systems, and broadcast. Find out more about Kratos' products and services at: ***www.kratosdefense.com***.

Next Generation Controller (NGC2) touch screen user interface. Photo provided by Kratos

KRATOS
READY FOR WHAT'S NEXT

DISPATCHES

L3HARRIS BRINGS MAXAR INTO THEIR TRANCHE 1 TRACKING LAYER CONTRACT WITH THE SDA FOR THE DESIGN + PRODUCTION OF 14 SPACECRAFT

Maxar Technologies has been selected by ***L3Harris Technologies*** for the design and production of 14 spacecraft platforms and associated support for their Tranche 1 Tracking Layer contract with the ***Space Development Agency (SDA)***.

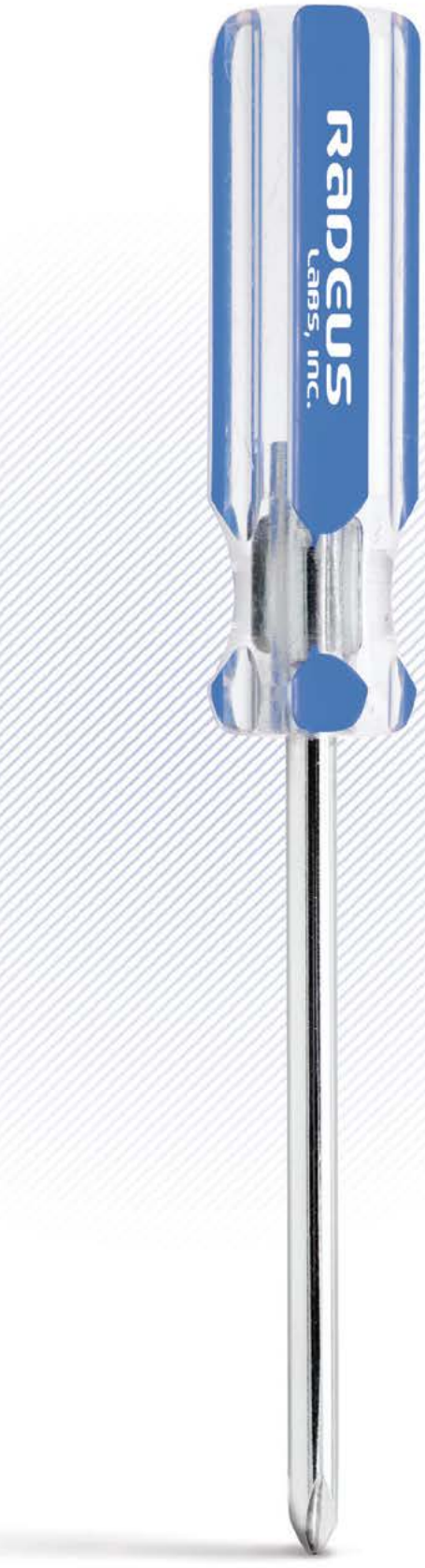
SDA selected L3Harris as a prime for its Tranche 1 Tracking Layer as part of the initial ***Missile Warning/Missile Tracking*** warfighting capability of the ***National Defense Space Architecture (NDSA)***.

Tranche 1 Tracking Layer will provide limited global indications, warning and tracking of conventional and advanced missile threats, including hypersonic missile systems.

Designed, engineered and built in-house, these modular satellite platforms illustrate Maxar's ability to adapt and extend its deep experience to provide agile, affordable solutions in proliferated LEO constellations.

With this contract, Maxar will provide a robust foundation for the integration of various mission payloads, including optical terminals for space mesh networking, Ka-band communications, and infrared sensors.

Additionally, it will provide related ground, operations and sustainment support. Maxar will manufacture the platforms at its factories in Palo Alto and San Jose, California, for delivery in 2024, and launches are scheduled to begin in April of 2025. ***Additional details...***



Radeus Labs
8200 Legacy ACU

The Only Tool You'll Need.

Installation is that simple.

The Radeus Labs 8200 Legacy ACU is the ideal drop-in replacement for ageing 7200 systems.

- **No hidden costs**
- **Easy Installation**
- **Quality without compromise**

Full systems are available for all makes of antennas. Visit us at Radeuslabs.com to find your state of the art antenna control solution today!

Contact Us

Contact us today for a site visit!

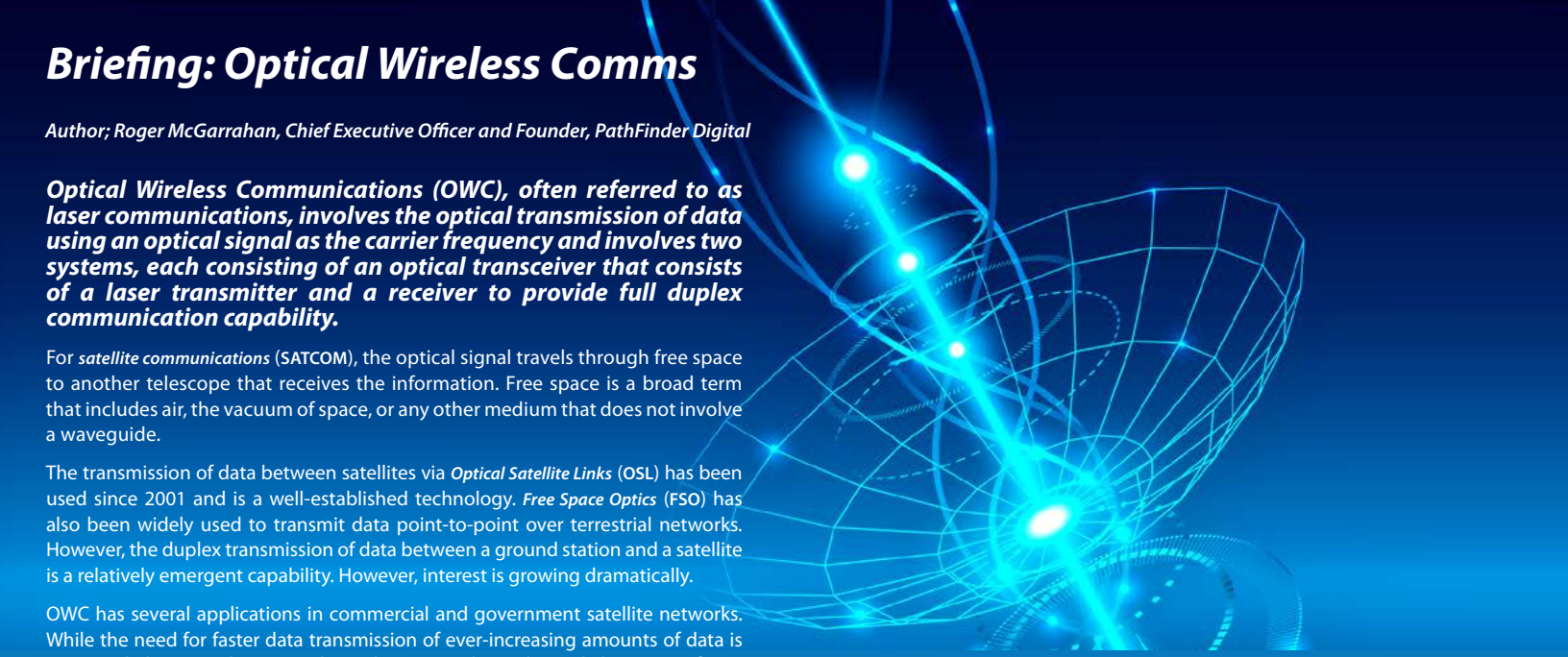
SALES (858) 602-1255 | Sales@RadeusLabs.com | Radeuslabs.com

(858) 391-1210 • 12720 Danielson Court • Poway, CA 92064 USA

RADEUS LABS, INC.

Briefing: Optical Wireless Comms

Author; Roger McGarrahan, Chief Executive Officer and Founder, PathFinder Digital



Optical Wireless Communications (OWC), often referred to as laser communications, involves the optical transmission of data using an optical signal as the carrier frequency and involves two systems, each consisting of an optical transceiver that consists of a laser transmitter and a receiver to provide full duplex communication capability.

For ***satellite communications*** (**SATCOM**), the optical signal travels through free space to another telescope that receives the information. Free space is a broad term that includes air, the vacuum of space, or any other medium that does not involve a waveguide.

The transmission of data between satellites via ***Optical Satellite Links*** (**OSL**) has been used since 2001 and is a well-established technology. ***Free Space Optics*** (**FSO**) has also been widely used to transmit data point-to-point over terrestrial networks. However, the duplex transmission of data between a ground station and a satellite is a relatively emergent capability. However, interest is growing dramatically.

OWC has several applications in commercial and government satellite networks. While the need for faster data transmission of ever-increasing amounts of data is perpetual, data speeds over traditional RF networks are limited absent significant increases in antenna sizes and power systems. OWC provides the potential of breaking the bottleneck of RF links by using an optical carrier with a frequency 10,000 times higher than in RF. Although FSO technology applications are not yet widely deployed, satellite based FSO applications are likely to become a disruptive technology in satellite communications.

OWC TRANSMISSION SYSTEMS + NETWORKS

Optical Satellite Networks (**OSNs**) use optical ***Space to Ground Links*** (**SGL**) to provide high-bandwidth connectivity between satellites and terrestrial (ground) terminals. The terrestrial terminals are referred to as ***Optical Ground Systems*** (**OGS**). OSNs can provide connectivity to any location on Earth as long as a ***Line-Of-Sight*** (***LOS***) from the ground terminal to the satellite exists.

In addition to SGL links, OSLs are used for routing data traffic hop-by-hop between satellites and then up/down between the satellite and the OGS. These OISLs function as a backbone operating at very high data rates, which makes them ideal for inter-continental communications.

Each subsystem of an OGS needs to be designed and built to be interoperable with its ***Optical Communications Payload*** (**OCP**) counterpart. An OSN can be partitioned into three, interacting subsystems, each with their separate critical design issues. The subsystems may be physically segregated, or they may share common physical platforms. These three basic subsystems are the *opto/mechanical/thermal subsystem*, *spatial acquisition and tracking subsystem* and *communication subsystem*.

For an OGS to be designed and built to be interoperable with a previously designed OCP, the OGS must be compatible with the specifications of that space segment optical module. However, given the variety of potential approaches, the effects each design decision has on other design criteria, and the variety of environmental conditions in which the OSN may operate, OGS specifications are not yet standardized. Although groups such as the ***Space Development Agency*** (**SDA**) and ***NASA*** are actively pursuing standards.

OWC has multiple potential applications in both commercial and government networks. The need for increasingly higher bandwidth and economically viable data transmission solutions are driving demand for an alternative to RF. Regardless of whether data is collected over a ***Geosynchronous Earth Orbit*** (**GEO**), ***Low Earth Orbit*** (**LEO**) or ***Medium Earth Orbit*** (**MEO**) satellite network, the data will need to be downlinked to a ground terminal for retrieval and dissemination. As traditional satellite RF transmission links are relatively slow when compared to FSO links, optical may become the primary backbone to uplink and downlink satellite networks.

ADVANTAGES OF FSO

The interest in developing laser-based communications architectures is due to the many advantageous that laser communications have over traditional RF.

Speed of Data Transmission
As with most all enterprises using data, the demand for the speed of the transmission of data through networks is always increasing. OGS are expected to support data links with user rates in the 10's to 100's of Gbps. In addition to the speed advantage FSO has over RF transmissions, FSO also has a speed advantage over optical fiber; 3.3 µs per kilometer of link distance versus 5 µs per kilometer length of fiber.

Data Security
One of the security risks of wireless transmissions is the interception of data. The broader the footprint of a signal when it reaches the Earth, the easier it is to intercept as the energy of the signal can be received over a larger geographic area. The signal footprint of a traditional RF satellite signal is quite large, often covering an entire continent. As depicted in *Figure 1*, even the footprint of "*spot beams*" of HTS RF satellites are relatively large compared to the footprint of FSO beams. (*See figure 1 on the next page...*)

Adjacent Satellite Interference
A significant problem with traditional satellite networks is adjacent satellite interference which occurs when a ground terminal transmits a signal to its intended target satellite, but the signal energy propagates off target and is received by an adjacent satellite. Such occurrences can disrupt or even forestall the proper operation of the adjacent satellite. As FSO creates a much narrower signal than RF transmission and it stays narrow for the entire journey, with an absence of side lobes, FSO signals are much less likely to reach adjacent satellites and they are therefore much less likely to cause adjacent satellite interference.

Spectrum Availability
As RF transmissions in the same geographic location can interfere with each other, and as a finite amount of RF spectrum exists, the use of RF spectrum is heavily regulated. Both the physical limitation of RF spectrum and the regulatory limitations on the use of RF spectrum result in significant limits on one's propagation of RF transmissions; and therefore, on the amount of data that can be transmitted. Optical frequencies are free from spectrum licensing and are not regulated. This lack of regulation provides much greater flexibility in designing, deploying and operating OSNs.

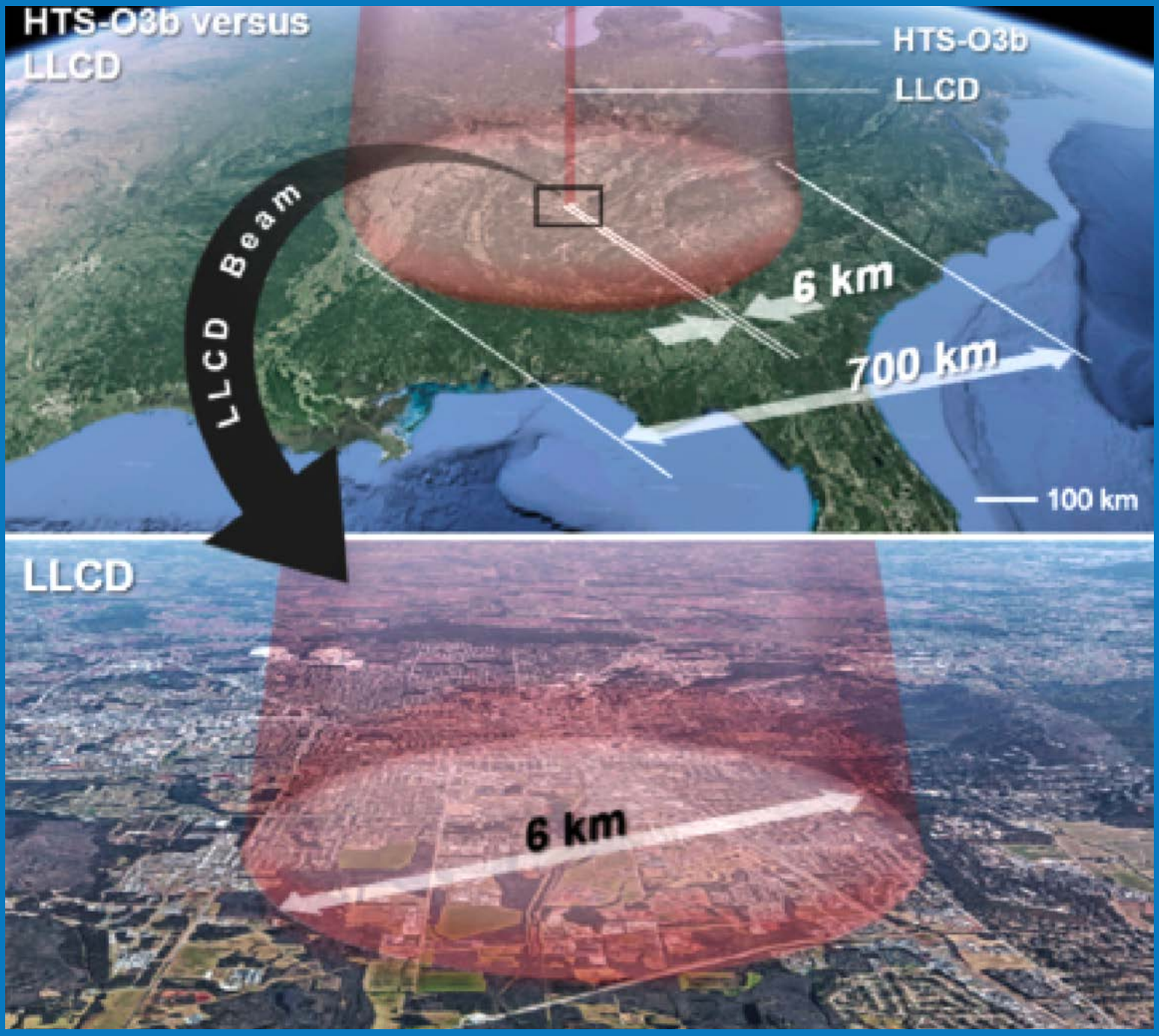


Figure1. Relative Footprint Sizes of O3b HTS RF Beam Coverage (~700 km diameter) and LLCD Beam Coverage (~6 km diameter). [8]

Electromagnetic interference
Optical beams are immune to electromagnetic interference (EMI) and therefore the integrity of optical beams is not affected by electrical noise in the environment.

OWC CHALLENGES

As with all technologies, there are challenges to implementing an OWC network. OGSs must be designed to mitigate the adverse effects of clouds, atmospheric turbulence and other environmental conditions.

When light is transmitted through the air as in optical wireless systems like FSO, it must contend with the atmosphere. The fundamental limitation of FSO communications arises from the environment through which it propagates. Although relatively unaffected by rain and snow, FSO communication systems can be severely affected by clouds, fog, atmospheric turbulence and other environmental influences.

There are multiple external parameters related to the environment in which optical terminals must operate that affect the operation and performance of FSO systems including visibility, atmospheric attenuation, scintillation, deployment distance, window loss, and pointing loss. Many of these parameters are not independent but rather cross affect each other in determining overall system performance.

However, a multitude of mitigation techniques and technologies exist to overcome these challenges and are being implemented by the architects of OWC systems. Laser communications is a subject that all of us in the satellite industry will be learning more about over the next few months.

For additional information on Optical Wireless Communications, Free Space Optics, Laser Communications, visit **PathFinder Digital's Wiki** at ***wiki.pathfinderdigital.com/***

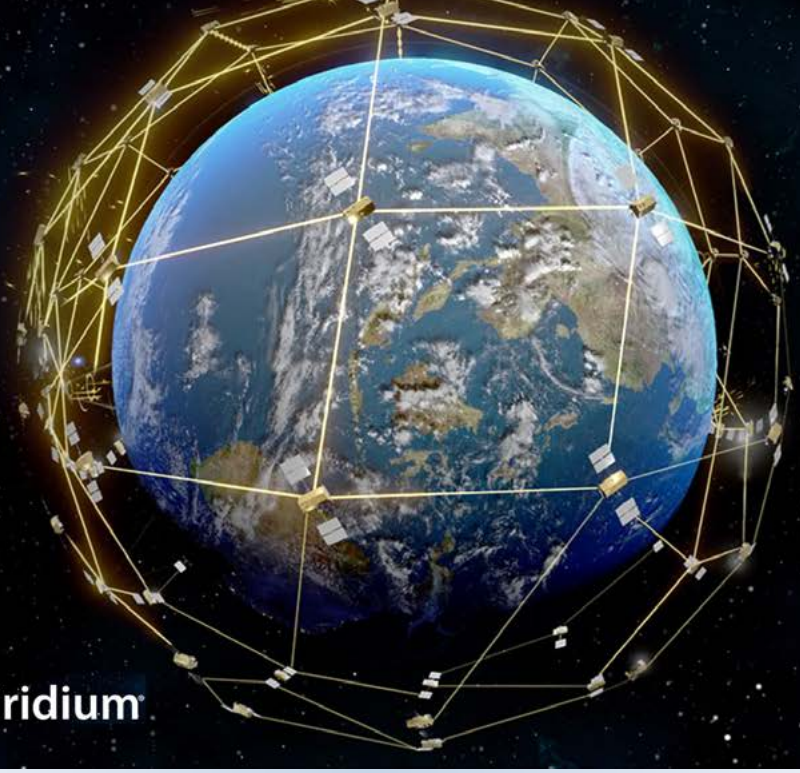
Author Roger McGarrahan is the CEO and founder of PathFinder Digital which specializes in the customization of COTS satellite ground terminal/antenna solutions that are engineered to meet the unique and particular needs of government programs. PathFinder's services include the design, engineering, integration, and sustainment of VSATs for military and government applications.

www.pathfinderdigital.com

Roger McGarrahan

THE CRITICAL ROLE OF SWAP SATELLITE SOLUTIONS...

...FOR THE MODERN MILITARY



Author: Jay Chapman,
Director of Government Solutions

iridium

As technology providers, one of the biggest challenges is keeping pace with constantly evolving market demands and trends. While many providers are focused on going bigger and faster, when it comes to enabling critical communications applications, the need for smaller, low cost and highly mobile solutions is on the rise.

A prime example of this is in the military landscape, where the stakes are incredibly high and the margin for error is zero. Similar to other industries, the critical communication needs for the military are trending toward autonomous applications and smaller, lower power solutions that enable the constant flow of important *sensor*, command and control, *mission command*, *logistics* and other information into the military data fabric from anywhere in the world.

These trends are apparent across top initiatives, such as the ***United States Department of Defense***'s (**DoD**) ***Joint All-Domain Command and Control*** (**JADC2**) ***Primary, Alternate, Contingency and Emergency*** (**PACE**) architecture which is shedding light on what the future military operating environment could look like, with the goal of creating a fully connected and interoperable landscape.

Additionally, as military operations expand to remote and harsh locations such as the Arctic, the needs of the Warfighter continue to evolve, requiring more portable, lightweight and low power devices that remain connected regardless of location and weather condition.

It is abundantly clear that one common thread across these trends is the need for scalable connectivity solutions that are reliable, global and resilient, and this can only be achieved through ***satellite communications*** (**SATCOM**). Though the use of satellite technology is not new for this industry, new, midband satellite solutions are at the forefront of meeting these current market demands.

While previous beliefs were that more data was always the answer, that is no longer the case. Midband satellite solutions, in the 88 kbps range, are ideal for autonomous systems and mobile applications for military field operations as they address the ***Size, Weight and Power*** (**SWaP**) needs specific to these use cases.

For example, a deployed field officer in a remote combat mission needs a highly portable communications solution that is discreet as well as reliable and highly capable to effectively transmit and receive critical ***command and control*** (**C2**) data, ensuring their information reaches decision makers and feeds a common operating picture. Likewise, a pilot remotely operating an ***unmanned aerial vehicle*** (**UAV**) ***Beyond Visual Line of Sight*** (**BVLOS**) or ***Over the Horizon*** (**OTH**) needs the peace of mind that their connection will remain intact no matter what lies ahead on the flight path.

Today, ***Iridium***'s midband L-band satellite service is providing militaries with the connectivity to successfully operate off-the-grid and is connecting new, autonomous vehicle programs for *asset monitoring*, *situational awareness* and *C2* purposes. Unlike anything else on the market, ***Iridium Certus® 100*** enables small, low-profile antennas and portable battery-powered devices that are equipped with IP-data speeds that can efficiently share position location information, send emails, pictures, attachments and other vital information from anywhere on the planet.

Since the availability of Iridium Certus® 100, multiple industry leaders have built products using the service including **NAL Research**, **BlueSky Network** and **McQ**. For instance, the ***NAL Research QUICKSILVER (QS-100***) uses Iridium Certus 100 to enable reliable C2 data links of unmanned systems and diagnostic monitoring applications from harsh and remote places.

BlueSky Network has integrated the service into their dual-mode, data management solution for autonomous vehicles called ***SkyLink***. Additionally, the ***McQ CONNECT*** is a small, SATCOM modem for government applications that allows users to send and receive information in real-time over IP networks, including compressed low-bandwidth video. Key information is shared through a secure Cloud network that enables command and control of remote assets globally.

While a completely connected military, capable of autonomous combat and seamless communication between agencies may seem far away, midband satellite solution providers are moving the needle and bringing the industry one step closer to this desired operating environment.

Iridium operates the world's only truly global satellite networks and has a strong, longstanding relationship with the United States Government, specifically through its Enhanced Mobile Satellite Services Airtime (EMSS) contract that provides unlimited voice, text and data services to the DoD and associated federal government partners through the dedicated government gateway. For more information about Iridium's government solutions, please visit ***www.iridium.com/markets/defense-intelligence-national-security/***

Author Jay Chapman is the Director of Government Solutions at Iridium.

Jay Chapman

SatNews

CONNECTIONS ON EARTH FOR CONNECTIONS IN SPACE

JOIN US ONLINE!

Free subscriptions and access
Timely news and editorials
Complete archives

satnews.com/reg

SatMagazine | MilsatMagazine | SatNews.com

CONTROL, SUPERIORITY, AND DETERRENCE IN THE SPACE DOMAIN

Author: Sergio Gallucci, Co-Founder and Chief Technology Officer, SCOUT Inc.

Most of our conversations about the space domain within a national security context return to three core topics: space operations' impacts on the terrestrial domain, hypothetical adversarial activities, and capabilities and how to maintain space superiority.

The U.S. Space Force's primary mission can be seen as a pursuit of space superiority via spacepower, predicated on core competencies in Space Security, Combat Power Projection, Space Mobility and Logistics, Information Mobility, and Space Domain Awareness. These pillars address fundamental operation areas, in order: ensuring space is safe, ensuring that others cannot make it less safe, achieving responsiveness toward mission success, communicating effectively across the domain, and having visibility into the domain.

Is spacepower the best means to achieve stability and safety in space? The answer is not so simple. The best way to fight a war is to ***not*** fight a war, and the second best way to fight a war is to ***win it immediately***. The latter is the domain of the aggressor, but the former is the domain of incumbents well-equipped with deterrence against aggressors and resiliency against first strikes. Deterrence is the biggest stabilizer in the modern era, and the United States must be equipped to deter aggression and retain peace.

ORBITAL WARFARE + DETERRENCE

The risk of escalation is a tremendous deterrent and the best way to ensure that deterrent stays in place is with infrastructural and counterspace resiliency. The United States' degrees of space control are asserted by a scant number of assets, notably the space-based surveillance system (SBSS) and geostationary space situational awareness program (GSSAP) satellites. SBSS and GSSAP provide coverage and fidelity of data on the space domain beyond the purview of terrestrial data sources and significantly augment the Space Surveillance Network (SSN).

Unfortunately, SSN assets are increasingly outnumbered by potential threats from competitors with demonstrated counterspace capabilities. The Defense Intelligence Agency's 2022 Challenges to Space Security Report estimated Chinese and Russian space fleets grew by ~70% between 2019 and 2021. The space environment is increasingly congested with competitors operating at an unprecedented scope.

The U.S. government has recognized the situation it is in and has started addressing them. Exercises such as SACT (Sprint Advanced Concept Training) and SPACE FLAG have become increasingly prevalent to wargame scenarios for adversarial actions in space, and showcase the resiliency of defense systems.

Key stakeholders across the Department of Defense have advocated for integrating commercial segment innovations into military operations. The U.S. Space Force is continually standing up new operational units tasked with myriad space domain challenges, with space security receiving more funding and manning.

Unfortunately, deterrent deployment and resiliency of space capabilities is weighed down by significant baggage. U.S. operational satellite-to-satellite capabilities are not poised to match competitors' scaling growth, thanks to a history of long development cycles, iterative improvements upon existing architectures and a propensity for traditional acquisitions processes to yield single-use, made-to-order systems.

STRATAGEMS FROM THE COLD WAR

We live in a world defined by the Cold War and the concept of orbital warfare is intrinsically connected with ***Mutually-Assured Destruction*** (**MAD**). Space operations have immense, strategic terrestrial implications and, therefore ,we commonly perceive space through a strategic lens as well.

The Russian Aerospace Forces' doctrine establishes its focus on strategic deterrence, active defense and highlights the need for response to massed aerospace assault, because it is understood that those who control air and space control what goes up and comes down, including information from space assets as well as information moving through space.

There is, naturally, a perceived equivalency between space control and space security given naval and aeronautical precedents in history.

AERIAL, NAVAL + SPACE SUPERIORITY

Aerial supremacy and naval supremacy define a zero-sum battlespace, with considerations for dominant airpower or seapower suffering from setbacks and limiting force application to retain it. Unfortunately, space security is not attainable with the biggest ship, the fastest plane, or the best radar system, and stability in space is predicated on a deceptively fragile underlying infrastructure. First-mover aggressor advantage in the space domain, under current conditions, might allow for unrecoverable damage to this infrastructure.

The Air Force Doctrine on Counterspace Operations (3-14) reasonably states that space is different, and that space superiority may be gauged by the potential for prohibitive interference to space operations, and supremacy by the potential for any effective interference. Ultimately, even with this understanding, the conversation returns to "*degrees of control,"* albeit defined more broadly in terms of deterrence and interference.

PRESENT OPERATIONAL CHALLENGES + MODES OF MITIGATION

The paradigm of U.S. space operations, doctrine, and acquisitions leads us to today: Chinese paired-satellite systems harrying and playing a "*cat-and-mouse game*" with U.S. satellites; anti-satellite tests producing tens of thousands of pieces of debris without a viable short-term recourse; low-surveillance regions where highly-mobile satellites can conduct maneuvers and conduct covert operations for weeks prior to positive identification. In the face of this, the U.S. leverages significant terrestrial infrastructure and a few tens of assets in orbit to assert space control, and continues to invest in similarly monolithic architectures to maintain it.

If a decapitation strike is feasible that can reasonably make underlying space infrastructure obsolete, then space is not under control; in fact, space is not secure at all.

The United States lacks the deterrent of high-fidelity, persistent, actionable intelligence on space that is delivered in a timely manner. This capability can ensure, if not space control, then certainly space security and responsiveness efforts which are ultimately under threat by the status quo.

The power in numbers is significant in any warfare domain; in an emerging segment such as space, it is absolutely crucial. Existing space domain awareness gaps are aggravated by the architectural complexities of monolithic space control and warfare-oriented missions, as opposed to architectures built around multi-use, proliferative capabilities.

Without more widespread deployment of space-based sensors to make space domain awareness infrastructure more resilient, the outlook is not good against space-based aggression.

scout.space

Author Sergio Gallucci is the co-founder and CTO of SCOUT, a company innovating space safety and traceability with dual-use distributed space-based sensing capabilities. Sergio brings diverse technical insights to SCOUT's mission, with a technical background in space systems, risks, and the space environment; and with space program leadership across academia, industry, and government, having led programs with NASA, USAF, and USSF. He is the principal investigator for various U.S. government contracts focused on improving space domain awareness and spaceflight autonomy In 2021, Sergio was recognized as one of the Forbes Next 1,000 Upstart Entrepreneurs who are "Redefining the American Dream". In 2022, he was appointed to the IAA committee on Space Traffic Management. Sergio holds a B.S. (Honors) in Aeronautical Engineering from Clarkson University, was an NSF GRFP Fellow at the Pennsylvania State University for his graduate work.

Sergio Gallucci

TRANSFORMING BATTLESPACE COMMS

Author: Brian Billman, Chief Marketing Officer, ALL.SPACE

The Russian invasion in Ukraine has highlighted the security stakes and has intensified the need for resilient communication networks with diverse and simultaneous streams over a single platform. Increased global threats have made it more important than ever before to keep connectivity flowing in the event of intentional jamming, cyberattacks, kinetic attacks, interference and outages.

ALL.SPACE, formerly ***Isotropic System***s, has completed a series of real-world communications tests over the world's only full-performance smart terminal proven to run multiple redundant or complementary communications links concurrently over GEO, MEO and LEO orbits.

NATO forces can deliver mission-critical HD video surveillance of targets over LEO-based satellite links, for example, while intelligence data is intelligently routed, based on real-time network assessments to warfighters on the frontlines. Using the same terminal, that information can be sent over high-speed links to other satellites in multiple orbits, or be processed locally in real-time via integrated edge computing.

If communications are cut to one satellite or network link for any reason, the smart terminal will instantly and automatically route traffic over one of the other established links.

Here's the simplest way to think about it. A single ALL.SPACE smart terminal performs the role of multiple physical terminals by creating concurrent full performance links to multiple satellites or networks. U.S. Government agencies and military forces currently use one antenna to point to one satellite and, unfortunately, require a second, third and fourth antenna to provide redundant links, or for NGSO handovers. This is cumbersome, complex, costly, and requires too much space aboard ships and vehicles where real estate is limited.

Instead, they can now use one smart terminal that meets **DoD JADC2** and the **U.S. Army's CS25** and **CS27** requirements, using new, deep tech called ***transformational optics*** that are capable of connecting with all networks via multiple full-performance links in a fully integrated platform for an entirely new level of secure comms.

THE START OF THE SMART TERMINAL ERA

The ALL.SPACE smart terminal marks the fifth generation of ground segment devices and delivers an entirely new level of connectivity when compared to the previous four generations of antennas — ***parabolic***, ***phased array***, ***mechanical hybrid***, ***and meta-material flat panels***.

The ALL.SPACE smart terminal can accomplish what no other antenna can do today — in recent tests, the platform enabled voice, video and data transmissions over simultaneous, two-way connections, to ***SES*** satellites in ***geosynchronous*** **(GEO)** and ***Medium Earth Orbit*** (**MEO**) orbits during military trials at the U.S. Army's proving grounds in *Aberdeen*, *Maryland*.

The terminal has also opened the door to all-orbit connectivity following successful tests that delivered bi-directional traffic over ***Telesat***'s ***phase 1 Low Earth Orbit*** (**LEO**) satellite, while concurrently transporting communications over a GEO satellite. The links coming from this single, smart terminal, use patented lens technology to simultaneously point to different satellites over different frequencies across commercial, government and military networks — all without compromising performance.

These trials played a key role in the lead up to the ALL.SPACE commercial rollout of the world's first smart terminal later this year. The ***S2000*** smart terminal is the first military-grade, multi-link mobility, Ka-band platform that will unlock highly anticipated communications capabilities for defense, and ultimately across a wide range of sectors that include maritime, enterprise, government and land mobility markets.

THE WORKINGS

Commercial and government engineers have tried to develop full-performance multi-link antennas for years. When ALL.SPACE initiated the development of this new platform, the company engaged in a unique approach by pioneering a new, deep tech sector called transformational optics.

The exact behavior wanted from RF energy, radio waves, is initially determined. That results in a series of equations that define what needs to happen within a specified shape to obtain that desired behavior. Once those equations are solved, however, what results is material that actually doesn't exist in nature. That's a problem if the final result is to make a real antenna from that material.

Some workarounds to this challenge include using metamaterials; however, they come with significant drawbacks such as being narrowband and susceptible to signal loss. ALL.SPACE found a way to solve those equations using broadband, low-loss, multi-directional materials. Ultimately, the company ended up with a unique optical beam former design that is at the core of all of the firm's multi-link, smart terminal products.

In essence, ALL.SPACE is enabling what the satellite industry forgot to accomplish a long time ago — mesh satellite networks together and offer convergence with cellular and edge computing to allow for empowering levels of interoperability. Imagine carrying five cell phones in a pocket for every time a move is made from one cell network to another — that's exactly how the satellite networks work today — in proprietary silos.

Interoperability across satellite systems and all networks is more important than ever, especially for government and defense systems. They need to access the plethora of new satellites and constellations coming online in GEO, MEO and LEO orbits to realize the flexibility and resiliency they must have in today's adversarial environment.

The ability to provide multiple full-performance links also means the military can multiply the throughput to the terminal and dramatically increase the bandwidth that every frontline warfighter has at their fingertips.

The ALL.SPACE smart terminal has the unique capability to converge advanced communications over multiple networks and operators, including satellite and terrestrial cellular, while intelligently sensing transmission environments.

The breakthrough ability to continuously monitor and assess network and operating environments in real time allows the terminal to automatically switch to other satellites, frequencies and networks to avoid potential blockage or interference issues, and even mitigate intentional interference for government and military users. Once this mission-critical, multi-link platform is running, there's an endless combination of possibilities for leveraging multiple links and services in support of NATO forces — especially with the growing number of sensors across the battlefield.

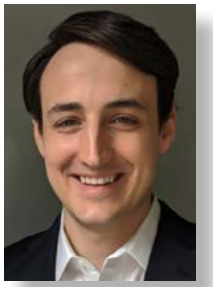
Resiliency and flexibility across a military comms network will offer a competitive edge and save lives. If a unit outfits all of its Humvees with a terminal that can only connect to a specific network, enemy forces can easily take down communications capabilities across that fleet.

A multi-layered, fully-integrated terminal makes an adversary's decision matrix inherently far more complex and extremely tough to knock out your comms-on-the-move and comms-on-the-pause.

As the government's modernization initiative takes shape, multi-link antennas capable of delivering a new age of multi-layered, multi-orbit connectivity will be at the core of the military's competitive edge in the very near future.

For more information about the ALL.SPACE smart terminal and the new smart terminal era, visit ***http://all.space***.

Author Brian Billman is the Chief Marketing Officer for ALL.SPACE — HE has a Masters Degree in electrical engineering and a strong design and electrical engineering background. Previously, he was the company's Vice President of Product Management and is now responsible for all marketing activities as the firm gets closer to the 2022 product launch. Brian will help to develop our product roadmap and implement stronger processes, as the company and the firm's product portfolio grow rapidly.

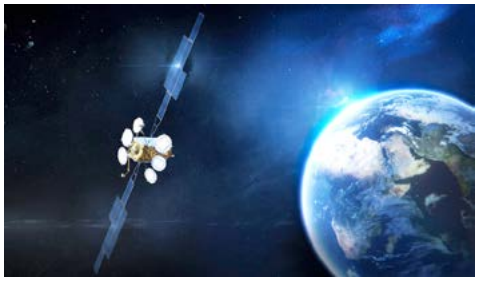


Brian Billman

AIRBUS MILSATCOM ENLISTED FOR THE CZECH ARMED FORCES + THE NETHERLANDS

Airbus has signed contracts with the ***Ministries of Defense of Czech Republic*** and the ***Netherlands*** to provide satellite communications for a 15-year period.

The Armed Forces of Czech Republic and the Netherlands will use 2 and 3 channels respectively of the Airbus **UHF** (***Ultra High Frequency***) military communications hosted payload on-board the ***EUTELSAT 36D*** telecommunications satellite scheduled for launch in 2024.



Artistic rendition of the EUTELSAT 36D satellite on-orbit.

With this new UHF payload, Airbus will be able to offer a new UHF communications service to the armed forces, particularly those of European countries and NATO allies.

As the UHF frequency band is a relatively scarce orbital resource, this offering will make up for the capacity shortage around the world. Airbus has already signed several firm orders for this capacity, well ahead of the satellite's scheduled launch. ***Additional details...***

SPACELINK SELECTED BY DARPA FOR THE AGENCY'S PROLIFERATED

SpaceLink has been selected by the ***Defense Advanced Research Projects Agency (DARPA) Strategic Technology Office (STO)*** for a contract award — the company will participate in the ***Space-Based Adaptive Communications Node*** (**Space-BACN**) program designed to connect the proliferated space domain.

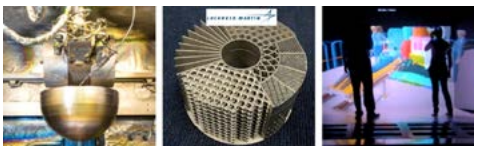
SpaceLink is building a constellation of relay satellites in MEO that use ***optical intersatellite links*** to speed communications between spacecraft on-orbit and users on the ground.

In addition to other contributors, SpaceLink will assist DARPA in studying and developing protocols for how commercial communications constellations will interact with ***Department of Defense (DoD)*** systems in a Space-to-Space interconnected future.

SpaceLink will contribute its technical insights in the development of the application program interface (API) and algorithms included in ***Space-BACN Technical Area 3*** (**TA3**). SpaceLink will also have the opportunity to support the simulation and testing that informs the deployment and use of Space-BACN reconfigurable optical communications terminals.

SpaceLink is partnering with ***Parsons Corporation*** (NYSE: PSN) on a technical approach to support the Space-BACN program by combining Parsons' existing enterprise scheduling and tasking software with the SpaceLink optical relay network. ***Additional details...***

LOCKHEED MARTIN TAKING SPACE-AUGMENTED JADO (JOINT ALL-DOMAIN OPERATIONS) FROM CONCEPT TO ORBIT IN 2023



To date, limited experiments on Earth show how space could potentially enhance Joint All-Domain Operations (JADO) — but that's about to change quite significantly.

In 2023, ***Lockheed Martin*** will launch their own constellation of smallsats to demonstrate how space can provide global battlefield awareness, sensing and connectivity in even the most austere, denied or contested areas.

Why is this Important? Maintaining an information and decision advantage is key to ***21st Century Security (21CS)*** for our nation and allies. The ***U.S. Department of Defense's (DoD)*** JADO vision is to connect assets across every domain – sea, land, air, space and cyber – to give our service members information superiority.

The ultimate high ground — space — will enable JADO by providing omni-present, connected information and data services over communications-challenged territories and regions to support Joint All-Domain Command & Control (JADC2) of theater-focused effects in a global context.

Space-Augmented JADO Environment (SAJE) Test Bed

As part of its SAJE project, in early 2023, Lockheed Martin plans to launch three self-funded small satellites – t***wo Pony Express 2 satellites and one Tactical Intelligence, Surveillance & Reconnaissance (ISR) and Communications satellite*** – to establish a first-ever, space-based JADO test bed. This test bed will provide a variety of sensors, processors and communications links in space to perform live on orbit demonstrations and experiments.

The timing for fielding this new space testbed in 2023 couldn't be better, as SAJE will be available to participate in the **U.S. Indo-Pacific Command's Northern Edge exercise**. SAJE would also be available for JADO demonstrations to advance the ***U.S. Air Force's Advanced Battle Management System (ABMS)***, the ***U.S. Navy's Project Overmatch*** and the ***U.S. Army's Project Convergence***. ***Additional details...***

SDRS FOR GROUND-STATION-AS-A-SERVICE (GSAAS)

Author: Brendon McHugh, Field Application Engineer + Technical Writer, Per Vices

Fifty-three years after the original moon landing, a new space race is starting to take shape. This time, with another setup: instead of superpower countries gauging their technological advances to ensure global domination, we have companies disputing market territories in a profitable endeavor.

The growing privatization process of space exploration, also called New Space, is driving important developments in several areas of science and technology. The RF industry, one of the pillars of New Space, is providing exciting solutions for several problems in space deployments.

One of the most urgent challenges in the New Space industry is the need for more flexible, distributed and affordable ground station infrastructure. Conventional ground station infrastructure is extremely expensive and requires a high-level of expertise to build and that can kill a satellite project before it even starts — especially for startups and small companies.

To solve this issue, ***Ground Station as a Service*** (**GSaaS**) was developed. This concept provides an abstraction layer over the ground station infrastructure in the lines of cloud computing by sharing the physical resources of a fully-managed ground station network between multiple applications. This provides a service for the satellite operator to control communication and process data without needing to worry about the physical infrastructure in the ground.

At the heart of this service is the ***software-defined radio*** (**SDR**), which performs all RF functionalities that are essential to GSaaS, from the up and down-linking of data to network control and cloud algorithms. The basic concept, the technology's advantages when compared to conventional approaches and the importance in the development of this service are key to understanding the significant roles of GSaaS. Additionally, the critical specifications for design and selection, including frequency requirements for up/down-linking, channelization and digitization to different modems over variable bandwidths as well as networking capabilities over Ethernet links to data storage and cloud-based servers, are all important inclusions in GSaaS applications.

WHAT IS GROUND STATION-AS-A SERVICE (GSAAS)?

Ground stations perform all communications between the Earth facilities and the satellite itself. Therefore, they are the main link between the satellite and the operator/Earth network, which is essential for satellite or spacecraft control and data exchange. Due to the onboard storage and processing limitations of satellites, reliable links with ground networks are important to improve the processing power of missions, by performing all the heavy computation on earth using large facilities. In conventional systems, each satellite is connected to dedicated ground station facilities, communicating using very high frequencies and specific protocols. Although this works fine for ***Geostationary Earth Orbit*** (**GEO**) satellites, as the satellite and ground station are always in the line of sight, such is not optimal for ***Low*** and ***Medium Earth Orbit*** (**LEO / MEO**). New Space ground station networks can help these satellites to retain their connections with Earth.

GSaaS are based on the concept of basic communication networks: instead of building a dedicated infrastructure for each satellite deployment, a common infrastructure can be shared by all satellite applications through a layer of abstraction, while the physical management is performed internally by the company that owns the infrastructure. There are two main paradigms in GSaaS, namely dedicated GSaaS, where the capacity of existing ground stations built for particular purposes is rented, and ground station capacity aggregators, where the spare time of installed antennas around the world is used by the ground station network.

Figure 1 in the next column describes the high-level architecture of a GSaaS implementation, showing the connection between satellite and ***ground station*** (**GS**), as well as the virtual uplink/downlink between the customer cloud and the GS. Data can be then processed in the user application and then used for analytics, ***machine-learning*** (**ML**), and basic storage.

The difference between GSaaS and conventional systems is the virtualization of satellite gateways, where all physical up-link and downlink is performed by the infrastructure of a third-party company, which communicates with the user application.

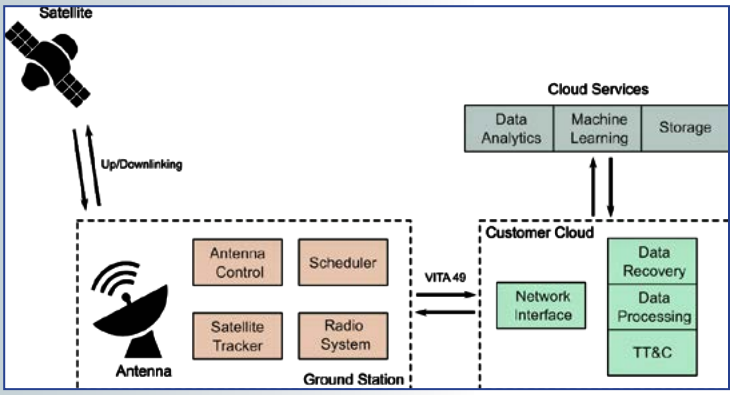


Figure 1: High Level Architecture of a GSaaS.

However, the virtual ground station provides the same functionalities as a real one, including transceiver configuration and frequency selection.

Using this virtualization mechanism, the user is able to manage satellite data ingestion, perform AI/ML-based algorithms, and distribute data in the cloud without having to worry about the physical connections with the satellite.

GSaaS is particularly attractive for small companies and startups that cannot afford expending time and resources in dedicated ground station infrastructure, so they are expected to be the main clients of these networks. Land and sea sensors that collect measurements on the earth surface can use this service to send data to satellites, de-centralizing data distribution.

This can be used by both academics and the industry to perform analytics in the big data collected by several sensors around the world and to perform imaging from space.

Alternatives to GPS/GNSS are also possible for users of GSaaS, profiting from its distributed infrastructure. However, this ground station paradigm is not meant for large companies that have the resources to build state-of-the-art infrastructures with dedicated features and computing power that cannot be obtained from shared ground stations.

There are several advantages of using GSaaS instead of dedicated ground stations. The most obvious one is the reduction in maintenance cost and launch time, by using an already existing ground station facility that is managed internally.

This allows the users to focus on satellite construction and the application, which not only reduces the design cost but also helps to push the technological envelope by concentrating the efforts in what matters.

In a commercial perspective, GSaaS operations do not require long-term commitment, as the company can pay per minute and stop using the service at any given time. This provides another layer of flexibility for making financial decisions. Finally, GSaaS are installed near to data centers, which greatly facilitate data storage and processing.

SDRS FOR GSAAS

One of the most recent revolutions in radio technology is the impact software has on the operation of the radio itself: the heart of this revolution lies the software-defined radio. SDRs are designed to perform most of signal processing functions in the software domain, minimizing the amount of analog hardware required. This improves not only the processing power of the device, but also increases the level of flexibility, precision, and reliability of radio applications.

The basic SDR can be divided into two main functional blocks: the radio front-end (RFE) and the digital backend. The RFE is the analog part of the SDR, containing the receive (Rx) and transmit (Tx) channels working on a wide variety of tuning range.

Bandwidth is important in radio applications, so the highest-performance SDRs are designed to provide up to 3 GHz of instantaneous bandwidth, over multiple channels. The RFE performs amplification, mixing, and filtering of the signal, interfacing with the digital backend through independent ADCs and DACs.

The digital backend consists of and high-performance FPGA with DSP capabilities, including modulation, demodulation, up/down-converting, and data digitization over Ethernet links. The parallel nature of the FPGA allows high throughput operation with very low latency.

The reprogrammable nature of the digital backend combined with the versatility of the RFE significantly improves the adaptability of the SDR, allowing the use of off-the-shelf devices for several different applications, without requiring any hardware modification.

Furthermore, several algorithms can be performed using the digital backend, from basic communication protocols to complex ***artificial intelligence/ machine learning*** (**AI/ML**) software. Channelization, an important function in GSaaS systems, can also be performed by the FPGA.

In a GSaaS architecture, the client's satellite is connected to the antenna network with several ground sub-systems. The user sees only the service performed by these sub-systems, which are managed by the cloud provider company.

It is in the ground station sub-systems that the SDR is applied, in the infrastructure that also includes the antennas, the antenna control, the schedulers, and the satellite tracking system.

The customer cloud is virtually connected to the ground station infrastructure, exchanging information via raw data, VITA-49 standard, or extended data protocols.

The connection itself is performed using software modems, that are hosted in the cloud infrastructure. By using a cloud-based infrastructure, the customer can profit from cloud services for data processing and storage, making it easy to perform analytics on big sets of data.

Figure 2 below shows the SDR integrated into the GSaaS architecture, being linked to the antenna through SMA connectors, and interfacing with the GS via Ethernet optical links. The SDR provides all RF functionalities necessary for signal reception in a variety of applications, including wide tuning range, up/ down conversion of frequency, and signal digitization using ADCs and DACs.

However, one feature that cannot be overlooked in GSaaS systems is channelization capability. As the GSaaS network has to deal with several different applications running at the same time, the SDR must be able to break the frequency spectrum into sections and perform parallel demodulation of the different carriers simultaneously, which is called channelization.

FPGA-based digital units are fundamental to allow robust channelization techniques that can be reconfigured and adapted on-the-fly. The SDR is also responsible for data packetization into VITA-49, sending packets over Ethernet links.

Data throughput is important to manage large sets of data, so the highest data-throughput SDRs in the market implement +qSFP links for reliable communication at high speeds.

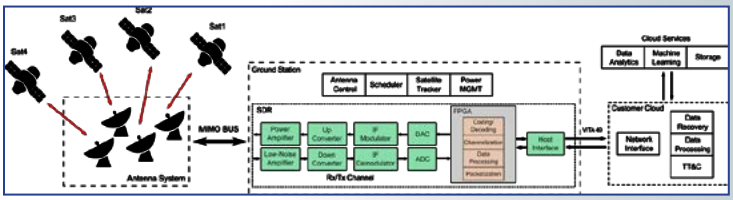


Figure 2. Block diagram of SDR integrated into GSaaS.

There are several advantages of using SDRs as the main radio modules in GSaaS systems. Firstly, they significantly increase the flexibility of the infrastructure, being able to work with several protocols, bandwidths, and waveforms (due to the ADCs and DACs) without needing any hardware modification. This allows the GSaaS system to work with any application, even the ones implementing customized modulation schemes and coding methods.

Additionally, FPGAs can be easily reprogrammed online — they can be upgraded and calibrated while in service, improving overall performance using error correction and IQ imbalance compensation techniques.

MIMO SDRs also offer several independent channels working in parallel, which is crucial for up/down-linking of several satellites, multipurpose operations, and beamsteering or beamforming techniques for high-performance communication. Modular SDRs can be reconfigured to satisfy several ***size, weight, and power*** (**SWaP**) requirements, allowing application in remote areas with limited resources.

Furthermore, SDRs provide the high-level of interoperability, which is necessary to work with legacy equipment and can also extend the service life of the infrastructure. SDRs can also be used for compatibility testing of ground stations, to check if the facility can be properly linked with the satellite in question.

Finally, SDRs can ensure the accuracy of real-time kinematic positioning (RTK) by providing precise and reliable measurements of the carrier phase.

PROBLEM SOLVING

A new paradigm in ground-station technology is needed in the face of New Space and the consequent modernization of the satellite industry.

Small companies and startups cannot afford the resources and time necessary for the design, construction, and management of large ground facilities to deploy their satellites applications.

GSaaS can solve this problem by providing a self-managed ground infrastructure that can be shared among customers as a network service, eliminating the need for dedicated ground stations in small deployments. This greatly reduces the cost and design time of satellite applications, as the customer can pay per use instead of building their own facilities.

The virtualization of the satellite gateways and modems also provides better integration with the cloud, allowing the easy implementation of data analytics and machine learning algorithms.

SDRs play a major role in the GSaaS architecture by receiving and transmitting signals to the antenna, performing all RF operations required for signal processing, and interfacing with the host/network via Ethernet connections.

Their software-based operation provides the flexibility and adaptability necessary to work with several protocols, frequencies, channelization techniques, and modulation schemes, as well as allowing the system to be upgraded and reconfigured while in service, without requiring any hardware modification.

Therefore, SDRs are fundamental building blocks in GSaaS systems, and the proper selection of the SDR model can highly influence the performance of the whole infrastructure.

Brendon McHugh is a field application engineer and technical writer at Per Vices. Per Vices has extensive experience in designing, developing, building and integrating SDRs for various applications in satellite, GPS/GNSS and ground station applications. Brendon is responsible for assisting current and prospective clients in configuring the right SDR solutions for their unique needs. He possesses a degree in theoretical and mathematical physics from the University of Toronto. Visit the company's website at ***www.pervices.com*** *or contact* ***solutions@pervices.com*** *today to see how we can help you with your SDR needs.*

Per Vices Corporation

GOVERNMENT SATELLITE REPORT #1

U.S. Air Force Secretary Calvelli Shares His Top Five Space Acquisition Priorities

Author: David Pesgraves, Government Satellite Report (GSR)

Frank Calvelli

The recently appointed Assistant Secretary of the Air Force for Space Acquisition and Integration (SAF/SQ), Frank Calvelli, joined the Mitchell Institute for a Schriever Spacepower Forum dedicated to "Delivering on Our Commitments in Space Acquisition."

Before joining the Air Force, Mr. Calvelli's three-decade career includes experience in national security, space acquisitions and operations, and leadership at the ***National Reconnaissance Office*** (**NRO**), where he served for eight years as the ***Principal Deputy Director***.

General Kevin P. Chilton (Ret.)

During the forum, Mr. Calvelli sat down with Gen. ***Kevin P. Chilton*** (Ret.) to discuss his top priorities for space acquisition and the role the commercial sector will play in the military's space operations moving forward.

CALVELLI'S FIVE PRIORITIES

To Mr. Calvelli, there is no higher priority than space. "*Space is just an amazing enabler for the country*," he said. "*It supports the nation's economy. It supports our military. It supports all the services in the department.*" *With great enthusiasm, he said that being appointed assistant secretary is "an amazing opportunity*," and that he looks forward to fulfilling his commitment to help set the direction for space acquisitions.

As his journey continues at the Air Force, expect Mr. Calvelli to draw upon his time at the NRO for inspiration in his new role. "*My hope is to bring my experience from the NRO to the department, and to really help them out where I can in terms of space acquisition*," he said.

One part of Mr. Calvelli's past experience that he will carry over to SAF/SQ includes five priorities that he developed during his time at NRO: **speed**, **resiliency**, **architecture integration with other domains**, **project management discipline**, and **space and ground systems integration**.

"*It's really important that space is always available to the nation, no matter what the environment is.*" -Assistant Secretary Frank Calvelli

First, Mr. Calvelli emphasized the importance of advancing speed in space acquisitions. "*And why is that important*?" he asked rhetorically. "*It's going to allow us to modernize our service and allow us to stay technologically ahead of our adversaries. And if necessary, it's going to allow us to deter, defend, or defeat any adversary.*" According to Mr. Calvelli, in order to maintain that technological advantage, there has to be a real sense of urgency to get new capabilities into the hands of warfighters faster.

He also highlighted that the U.S. needs to bolster its space architectures by making them more resilient, a similar sentiment shared by Gen. ***John Raymond***, Lt. Gen. ***B. Chance Saltzman***, and Rep. ***Jim Cooper*** (D-TN) at recent Spacepower Forums.

Mr. Calvelli explained that a resilient space architecture is critical, because the military depends on space in both times of peace and conflict. "*It's really important that space is always available to the nation, no matter what the environment is,*" he said.

Integrating space architectures into other warfighting domains is another priority that Mr. Calvelli plans to focus on in his new position.

He explained that since space is a critical enabler of other domain capabilities, it is vital that the military has the ability to integrate space with land, air and sea, which will give all warfighters an advantage over adversarial threats.

"*I also think that if commercial has a capability…you're not going to get any faster than taking advantage of what you could just buy off the shelf as opposed to develop,*" Calvelli said.

According to Mr. Calvelli, one piece of experience from the NRO that he plans on implementing at SAF/SQ is fostering a department culture that runs on project management discipline. "*I think there's no better way to actually get some speed than actually delivering on your commitments and actually execute your programs on cost and schedule*," he explained. "*My fourth priority is to really drive project management discipline across the service*."

Mr. Calvelli went on to say that the department seems "*to have a disconnect with space and ground systems*." For his fifth priority as assistant secretary, he wants to ensure that space and ground systems come together as an integrated system, "*so that when we launch the systems, we can take full advantage of them*."

EXECUTING PRIORITIES BY LEVERAGING INDUSTRY

When asked how Mr. Calvelli viewed the commercial sector's role in delivering space capabilities to the ***U.S. Department of Defense*** **(DoD)**, he responded by saying that industry can play a pivotal role in advancing the speed of acquisition.

"*I think it's an exciting time for the country, an exciting opportunity for anybody who's involved with space programs, whether you're in the Intelligence Community, the DoD, at NASA, or commercial*," said Mr. Calvelli. "*I also think that if commercial has a capability…you're not going to get any faster than taking advantage of what you could just buy off the shelf as opposed to develop*."

Indeed, the commercial space industry is currently booming with new technologies, capabilities and solutions that could execute the promise of Mr. Calvelli's SAF/SQ speed of acquisition priority, but it can also meet his other priorities, such as space architecture resiliency and ground/space system integration.

This is evident with SES' newest geostationary (GEO) Ka-band satellite, ***SES-17***, which recently became fully operational with readied capabilities to support multi-orbit resiliency for military space architectures. The technologies inherent in SES-17 can enable the military to seamlessly roll communications between MILSATCOM and COMSATCOM resources at GEO and ***Medium Earth orbit*** **(MEO)**. This groundbreaking capability will provide resilient and hardened SATCOM defense against adversaries that try to deny or degrade mission-critical comms. It also allows flexibility if mission requirements were to change.

According to SES GS' Vice President of Mobility and Integrated Solutions, ***Rashid Neighbors***, "*Ultimately, our intent is to provide the U.S. Government with highly resilient, multi-orbit hybrid satellite solutions. While the spacecraft technology in SES-17…is fundamentally different, the ground system will be integrated through…ARC. This allows our government customers to focus on their mission and applications and let SES GS worry about how the transport works*."

To learn more about SES-17, select this link...

Select the video splash screen below to watch the ***Spacepower Forum*** in its entirety.

This article — U.S. Air Force Assistant Secretary Calvelli shares his top 5 space acquisition priorities — first appeared on ***GovSat***.

GOVERNMENT SATELLITE REPORT #2

WILL THE U.S. MILITARY SHIFT AWAY FROM WGS IN FAVOR OF NGSO SOLUTIONS?

Author: David Pesgraves, Government Satellite Report (GSR)

Jon Bennett, **the Vice President for Government Affairs, Marketing, and Corporate Communications at SES Government Solutions (SES GS) examines whether or not the military will shift away from the military's own WGS satellites and commercially-operated GEO satellite services in favor of NGSO solutions, as well as give an update on the highly anticipated, official DoD report on the use of NGSO satellites.**

GSR: ***Congress appears to be pretty focused on NGSO satellite right now, but do you anticipate the military moving away from WGS and commercial GEO solutions in the immediate future? Is there a need for GEO satellite in a world with LEO and MEO satellites?***

Jon Bennett: **I think there is a need for GEO, and that goes back to the "Fighting SATCOM" effort. COMSATCOM integration – which is an appropriate mix of military satellite communications and commercial satellite communications capabilities — is something that the U.S. Space Force has talked about and worked hard to implement. Fully recognizing and achieving that goal will take time, but there is hope that the Department will get there eventually. That said, I believe there is still a need for GEO birds and I don't think we'll ever get away from WGS.**

For example, if a special operations team needs MILSAT to communicate at the tactical edge, they have direct access to WGS capabilities as those operations are heavily prioritized. Whereas with COMSATCOM, you'll need to have an identified demand signal, a contract vehicle in place, and the ability to onboard that capability with the necessary ground segment and networking infrastructure. Integrating commercial capabilities into the DoD enterprise architecture would give the warfighters the ability to leverage next generation and forward leaning innovative assets across the board.

If you just look at WGS, Father Time is clearly coming into the picture and limiting that constellation's shelf life. Bottom line, those satellites are getting old. So, ask yourself, "What's the cost associated with replacing a WGS satellite?" We, the commercial sector, already have assets that are paid for, flying, and delivering to U.S. government agencies right now. The capacity is available. So, if the military constellation of WGS satellites is starting to wane and its shelf life is diminishing, the DoD needs to hop over to commercial. That's going to be imperative when it pertains to military dollars associated with the government's demanding requirements.

Congress cares and wants to be good stewards of taxpayer dollars. And it is an extremely smart investment for them to leverage commercial capabilities, especially when you have commercial solutions that are close to providing the level of security features that you see in WGS satellites.

That, to me, is why it would behoove the military to leverage their WGS assets, but also integrate commercial capabilities into their enterprise architecture. The Hill remains well aware of the opportunities presented by integrated SATCOM capabilities at GEO, MEO, and LEO for delivering robust, flexible, and manageable enterprise solutions for the DoD.

***GSR**: We know that the NDAA instructed the DoD to author a report about its use of NGSO satellite. What is the current status of that? Has it been submitted?*

Jon Bennett: The DoD has been hard at work on that effort. Congress is continuing to hold the department's feet to the fire with that NDAA language

Congress' directive is really an assessment of the vulnerabilities and the overall resiliency of space access to national security missions across the board. If you look at not just last year's NDAA, but this year's also, there are additional requirements being levied by members of the Armed Services Committee

They are requiring knowing how the acquisition process has been impacted. They also want to know what the contracts with commercial providers look like. And the Hill wants to understand, at the current state of play, if the use of commercial capabilities can accommodate unforeseen demand signals.

For example, if the INDOPACOM were to pop, and there is a conflict between China and Taiwan, does the DoD have enough capability from a MILSATCOM or a COMSATCOM perspective to address that demand signal? To us, the answer is no. We are not seeing the Department scheme for potential surge requirements. So, how do you improve the plan for commercial satellite communications across the military departments? They must plan accordingly, right?

The Department needs to address and build out the requirement for NGSO satellite integration. Congress must be willing to support a long-term sustainable budget that enables the Department to leverage the necessary capabilities in defense of our national and economic security interests. The NDAA is getting after this issue but we are not where we need to be, yet.

The report that was put in the FY22 NDAA is really holding the department accountable on multiple fronts. Congress is hungry to understand how the department is going to leverage COMSATCOM capabilities. This year, next year, and certainly for the long-term future. The Hill is well aware of the increasing importance of delivering resilient global SATCOM for the joint warfighter. Congress wants to see a long-term investment strategy on integrating commercial NGSO satellite capabilities in support of a secure, resilient and disaggregated multi-band/multi-orbit enterprise architecture.

GSR: Based on what you heard at these demonstrations for lawmakers, and what we're hearing from the military, how far away are we from NGSO satellite seeing wide use across the DoD? What would need to happen for that to become a reality?

Jon Bennett: The reality is that the military has been using non-GEO satellites in their services since 2016. When SES launched their O3b MEO capabilities, LEO players hadn't even bent metal. And in 2016, the COCOMs saw the benefits of the original NGSO COMSATCOM capability in MEO. O3b offered very high-throughput, low latency capabilities that really enabled the Pentagon decision makers the ability to act on intelligence in real-time. We've been doing that since 2016, so it's been a reality for six years already.

Based on the demonstrations with lawmakers and what we heard from them several weeks back, they are extremely interested in the security features. The threat landscape is evolving for the worse. We're seeing more and more threats posed to our national security interests, without question. So, understandably, you have Members of Congress and their staff wanting to understand how these SATCOM assets are built to an inherently resilient, robust, and secure capability set that mitigates the threats posed.

We walked them through that and other areas of interest. We talked about the advanced battle management system (ABMS), and how it allows commanders and warfighters to share more and better information faster. Modernizing DoD's decision-making processes for combat operations is paramount, and the Hill understands that leveraging commercial and its next generation end-to-end SATCOM solutions will only enhance ABMS.

So, how is SATCOM an enabler to ABMS? The members of Congress were certainly interested in that question. As we provide Capitol Hill with further information as to the roles and responsibilities that SATCOM providers have on the Department's Enterprise Network Architecture, Congress is going to fully appreciate that SATCOM is the backbone to any theater operation in support of the warfighters.

***GSR:** Should funding be made available, and should the DoD decide to invest that funding in commercial NGSO satellite services, what would be needed from a hardware standpoint? How long would it take to get these services rolled out to the warfighter in a meaningful way?*

Jon Bennett: On the heels of this NDAA, the Hill continues to be supportive of integrating COMSATCOM capabilities into the national security space communications architecture. Congress wants to see the Department work towards identifying the necessary tools and acquisition models to integrate COMSATCOM systems more effectively and efficiently into architecture.

When it comes to the hardware, one of the things that we were able to demonstrate during our Congressional visit a few weeks back, was showcasing the Army's bread and butter terminal, the Phoenix E-Model terminal. The Army assessed the potential Phoenix E-Model MEO capability during the Project Convergence 21 network modernization exercise last fall. Since Project Convergence, the Army has been able to "MEO-ize" their Phoenix terminal. We call it MEO-ization. Think about upgrading and modernizing legacy equipment and what that means from a dollar standpoint.

When military services couldn't leverage their current terminals, they'd have to buy new terminals. And the costs associated with those terminals are astronomical. We were able to work with the Army and help them convert their terminals so they could talk to our MEO satellites. Think about that. We were able to reconfigure an older and heavily leveraged piece of equipment so that it could now talk to multiple assets in multiple orbits at multiple frequencies. The ability to leverage those capabilities at the tactical edge into the fight is incredible. Think about the dollars saved! That's awesome.

Commercial strongly encourages the Department to clearly articulate and prioritize these critical commercial satellite communication integration efforts in the next budget request." -Jon Bennett

When it comes to rolling these services out to the warfighters, there was a concern back in 2016 when CENTCOM didn't want to pay for the service. But that was okay because the commercial industry can lease these terminals to them. They don't have to buy them. It just becomes a fully end-to-end managed service, which enables capabilities to be rolled out to the warfighter in a meaningful way. We can do that easily at a high level of efficiency. It's something that we've done before. It's something that we continue to do.

As we work with the different military services, and their respective hardware requirements, it's only going to get better, especially when O3b mPOWER comes on board. We are launching later this year and will be operational next year. And the military services fully understand that O3b mPOWER is a game-changing capability. They want to get their hands on it.

I will end with this though…as the Department works to implement a new strategy for comprehensive satellite communications capabilities, to what extent will the Department leverage multi-orbit capabilities and commercial partnerships to achieve cost efficiency and enhance resiliency?

Commercial strongly encourages the Department to clearly articulate and prioritize these critical commercial satellite communication integration efforts in the next budget request. I believe, as does Congress, the Department's approach to resiliency, flexibility, and security, must include plans to secure multi-orbit and multi-band capabilities. But once again, the support to investment in commercial needs to be there.

*These two articles first appeared on **GovSat** and are republished with permission of **SES GS.***

Author David Presgraves is a Staff Writer for GovSat Report, in addition to several other online publications dedicated to defense, military, and federal government agency technologies.

NORTHROP GRUMMAN'S RQ-4 RANGEHAWKS EMBARK ON NEW MISSION

Northrop Grumman Corporation's (NYSE: NOC) ***RQ-4 RangeHawk*** is poised to support the **SkyRange** program's U.S. hypersonic missile flight tests from its Grand Sky facility near Grand Forks, North Dakota.

SkyRange is the ***Department of Defense Test Resource Management Center's (TRMC)*** unmanned high-altitude, long-endurance, responsive mobile flight test system,

In support of the SkyRange initiative, Block 20 and 30 RQ-4B Global Hawk aircraft are being transferred to TRMC to be reconfigured into RangeHawks. The conversion will integrate advanced payloads to equip the aircraft with the capability to support the testing of hypersonic vehicles and other long-range weapons.

RangeHawks provide over-the-horizon altitude, endurance and flexibility, which are critical for collecting telemetry and other data to monitor the vehicle during flight tests. Increasing the capacity of hypersonic vehicle testing furthers research and development necessary to remain competitive in the global landscape.

While previous testing relied on ship-based sensors, RangeHawks can perform such missions with fewer assets, reducing cost and complexity. RangeHawks are equipped with sensors to demonstrate an alternative data-collection support system to test hypersonic systems, and have participated in several hypersonic test events in the Pacific and elsewhere.

IN CASE OF AN EMERGENCY — SES + DIGICEL PARTNERSHIP TO PROVIDE TONGA WITH CONNECTIVITY

SES and international mobile network operator ***Digicel*** will extend their partnership to provide the ***Kingdom of Tonga*** with long-term, disaster resiliency to minimize bandwidth disruptions — under the agreement, Digicel will benefit from SES's expertise in offering disaster resiliency via SES's ***O3b*** satellite constellation to deliver low-latency and high-throughput connectivity and protect the Tonga population from future communication interruptions in the event of a natural disaster.

Launched in 2013, SES's O3b satellites are orbiting 8,000 km.. above the Earth's surface in MEO and delivers low-latency connectivity services to any area within 50° north or south of the equator. For the past decade, governments and businesses around the Pacific have been benefiting from the fiber-equivalent performance of the O3b satellite constellation.

The Kingdom of Tonga has suffered two major connectivity disruptions in the last four years, the latest being the result of the **Hunga Tonga-Hunga Ha'apai** volcano eruption and subsequent **tsunami** in January 2022 which severely damaged undersea communication links. In the immediate wake of the disaster, Digicel had leveraged SES's Geostationary Earth Orbit (GEO) satellite capacity to restore temporary connectivity on the islands, allowing Tongan residents to connect with their families and loved ones. As the damaged cable connecting the islands of Vava'u and Tongatapu in Tonga undergo repair, SES's MEO satellite service provides Vava'u residents of with connectivity. Once the cable is fully repaired, it will become a resiliency service to the main cable that connects the island to Tongatapu.

NORTHROP GRUMMAN UNVEILS FIRST AUSTRALIAN MQ-4C TRITON

Australia's first MQ-4C Triton on the runway in Palmdale, California. Photo is courtesy of Northrop Grumman.

Northrop Grumman Corporation (NYSE: NOC) today unveiled Australia's first ***MQ-4C Triton*** autonomous aircraft during a ceremony at its ***high-altitude, long-endurance*** (**HALE**) aircraft production site in California. The event, attended by Australian, U.S. government and defense officials, highlights the continued progress of the MQ-4C Triton program for both the Royal Australian Air Force and ***U.S. Navy***.

"*Today marks a significant milestone for Australia and the MQ-4C Triton program*," said ***Tom Jones***, corporate vice president and president, Northrop Grumman Aeronautics Systems. "*As we get ready for final system integration and flight test, we are one step closer to delivering this extraordinary maritime awareness capability to Australia*."

Australia is a cooperative program partner in the Triton program and was critical in helping shape the requirements for the system.

As partners, U.S. and Australian defense forces will be able to share data collected by their respective Tritons, a critical ability in one of the world's most strategically important regions.

"*Triton will provide the Royal Australian Air Force with an unprecedented capability to monitor and protect our maritime approaches*," said Air Marshal ***Robert Chipman,*** Chief of the Royal Australian Air Force. "*Triton will work alongside the P-8A Poseidon and this unmanned aircraft system will allow us to cover significant areas, at longer ranges and has the ability to stay airborne longer than a traditional aircraft*."

Northrop Grumman initiated the build of the first Australian Triton in October 2020 at its production facility in Moss Point, Miss., and met another major production milestone in December 2021 when the fuselage and one-piece wing were mated in Palmdale, Calif. The aircraft is scheduled for production completion in 2023 and delivery to Australia in 2024.

U.S. NAVY MILITARY SEALIFT COMMAND AWARDS INMARSAT GOVERNMENT A MILLION$$$ FOLLOW-ON CONTRACT

Inmarsat Government has been awarded a **NexGen Wideband (NGW) Follow-On (FO)** contract for the ***U.S. Navy Military Sealift Command (MSC)*** by the ***Defense Information Systems Agency (DISA)*** for worldwide, end-to-end, commercial satellite communications services.

An ***Indefinite-Delivery, Indefinite Quantity*** (***IDIQ***) contract, the ceiling value of the award is $578 million over a 10 year period of time. Under the contract, Inmarsat Government will maintain and operate commercial communications infrastructure, which includes satellite systems, teleport services and terrestrial services.

For the past decade, Inmarsat Government has demonstrated the firm's ability to deliver robust, reliable, global SATCOM solutions to MSC. Under this newly awarded FO contract, the company will also upgrade the primary afloat network from Ku- to the ***Global Xpress (GX)*** Ka-band system, paired with ***Inmarsat ELERA***'s enhanced, ***L-band, Airborne Intelligence, Surveillance and Reconnaissance*** (**LAISR**) service to provide a uniquely reliable, global back-up network.

This combination of networks ensures that MSC has secure global communications, delivering a high-throughput, low size and weight solution.

GILAT TO PROVIDE DIGITAL SERVICES OVER SATELLITE TO CENTRAL ASIAN GOVERNMENT

Gilat Satellite Networks Ltd. (Nasdaq: GILT, TASE: GILT) has signed an agreement to provide a SkyEdge II-c hub (*pictured below*) and hundreds of VSATs to a government in Central Asia.

The Gilat equipment will be used to connect rural villages to the government network, serve as a backup communication channel for disaster preparedness, and provide remote services to citizens.

Using the services enabled by Gilat's proven SATCOM technology, citizens all over the country, even in the farthest most remote regions, will be able to interact with all governmental bodies, including the police, the land registry, licensing authorities, notarization, and more.

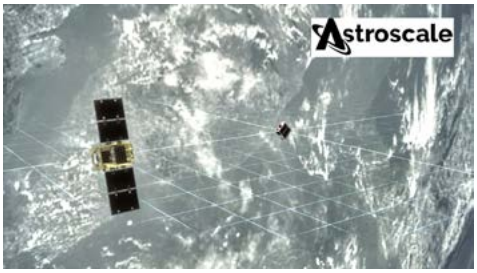
"*Gilat technology is being leveraged to connect people and provide for the efficient provisioning of services, regardless of geographic distances*," said ***Michal Aharonov***, Chief Commercial Officer at Gilat. "*Once again, Gilat's SkyEdge II-c platform is bridging the digital divide and helping to improve the lives of people throughout the world*."

UK GOVERNMENT TO OFFER FINANCIAL SUPPORT FOR DEBRIS REMOVAL MISSIONS + SPACE LEGISLATION REVIEW

The ***UK's Department for Business, Energy and Industrial Strategy*** will begin to develop a number of initiatives to help protect the planet's orbital environment.

This announcement pledged to develop a new standard for space sustainability which will be designed to encompass existing guidelines and principles in relation to space sustainability and fill the gaps in these standards and guidelines, seeking to develop best sustainability practice across the lifecycle of space activities.

Astroscale, as Co-Chair of the ***In-Orbit Servicing and Manufacturing Working Group*** at ***UKspace***, is proud to support the review and industry consultation in the coming months.



The UK government ***Plan for Space Sustainability*** includes a review of secondary legislation and associated regulations focused on orbital constellations with a view to the update reflecting the huge growth in satellite constellations and the rapidly changing space environment.
Additional details...

FAA CONTRACTS RAYTHEON I&S TO MODERNIZE WAAS

Raytheon Intelligence & Space, a ***Raytheon Technologies*** business (NYSE: RTX), has been awarded a competitive, ***indefinite delivery indefinite quantity*** (**IDIQ**) contract from the ***Federal Aviation Administration*** with a ceiling value of $375 million over the next 10 years.

Task orders, valued at $215 million, were executed at contract award to provide technical refresh and ***Dual Frequency Operation*** (**DFO**) upgrades to the FAA's ***Wide-Area Augmentation System***, or **WAAS**, a space-based, precision, navigation system, that will enhance safer air travel in support of the National Airspace System. (***View the FAA WAAS video at this direct link...***)

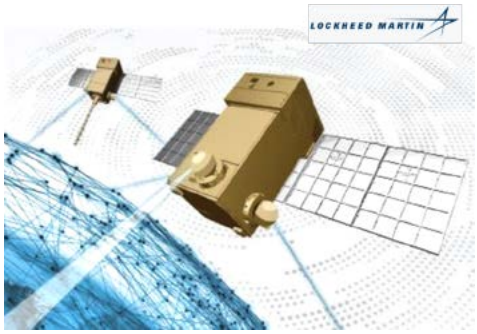
WAAS monitors and evaluates all GPS signals over North America to enable pilots to fly using augmented **GPS** data for safety of life missions like precision landing and en-route navigation. The system allows pilots to safely land in places that were previously inaccessible because of the airport location and/or weather. It also makes airports without ground-based navigation available to pilots.

WAAS is a ***Satellite-based Augmentation System*** (**SBAS**) that provides GPS corrections for critical navigation for the aviation community, first responders and other government agencies, ensuring pilots can land safely in austere environments, despite weather challenges. WAAS also provides corrections for SBAS-capable receivers in use across a diverse set of communities, including agriculture, maritime and surveyance, among others. ***Additional details...***

TESAT COMPLETES THE PDR OF THEIR OPTICAL COMMS TERMINAL FOR SDA'S TRANCHE 1 TRANSPORT LAYER

Tesat-Spacecom (TESAT) recently completed the ***Preliminary Design Review*** (PDR) of the company's ***Optical Communication Terminals*** (**OCTs**) for satellites as part of ***Space Development Agency***'s (SDA) ***Tranche 1 Transport Layer*** (T1TL).

Lockheed Martin, a prime contractor for the agency's **tranche 0 (TLT0) and TLT1 satellites**, and the SDA were on site at TESAT for the review. The PDR confirmed the TESAT OCT design and specifications are compliant to the **SDA's OCT Standard Version 3.0** requirements. OCTs use optical technologies to route data traffic between interconnected satellites and will support lower latencies in LEO constellations, a critical improvement for prosecuting time-sensitive targets in today's wartime environment.



As the primary vendor of OCTs to Lockheed Martin for the **SDA Transport Layer Space Vehicles (SV)**, TESAT was able to leverage qualified hardware to rapidly achieve **T1TL PDR**. Updates for the T1TL design include moving to the V3.0 OCT Standard as well as optimized volume and mass.

TESAT's OCT, the SCOT80.

Additional details.

UPCOMING MILITARY EXERCISES WILL HIGHLIGHT COMMERCIAL TECH FOR GNSS DISRUPTION DETECTION

Position, navigation, and timing (PNT) is a daily fixture for private citizens and military operators alike.

The Global Navigation Satellite Systems (GNSS) include space networks from the European Union, China, Russia, and the United States' ***Global Positioning Satellites*** (**GPS**), to provide PNT reference messages.

The signals that emanate from the GPS constellation to empower precision-guided munitions are the same ones that allow a smartphone to navigate the road with ease. Despite being a critical infrastructure to billions, GPS users remain vulnerable to deception and manipulation, which is why the degradation or denial of GPS-enabled capabilities is a significant concern to the U.S. military, civil agencies, and private citizens.

PNT disruptions come in many forms—spoofing and jamming to name a few—and can be unintentional or intentional tactics applied by adversarial nation-states, criminal networks, or privateers.

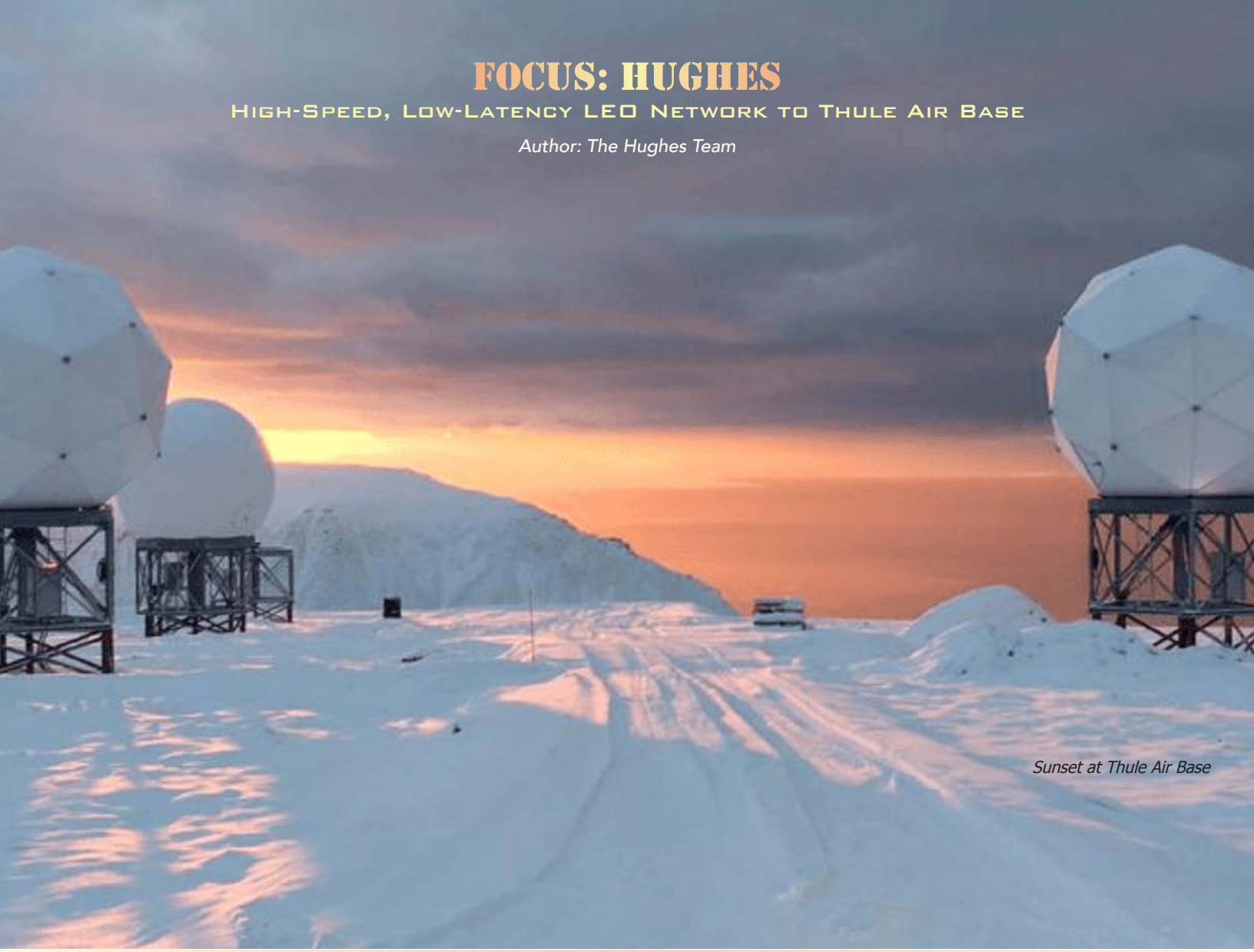
The shared interests between the government and private citizens alike for awareness of GPS disruptions make commercial solutions ideal; information and insight can be broadly shared not just within the Department of Defense (DoD), but across agencies, allied partners, and the public, as needed.

In the Fall of 2021, the ***Defense Innovation Unit (DIU)*** launched the ***Harmonious Rook*** prototype project to address the need for scalable, persistent awareness of PNT disruptions across the globe. ***Additional details...***

FOCUS: HUGHES

High-Speed, Low-Latency LEO Network to Thule Air Base

Author: The Hughes Team



Sunset at Thule Air Base

Just one year ago, Hughes announced the company's selection by the U.S. Air Force Research Lab (AFRL) to design and deploy a Low Earth Orbit (LEO) network at Thule Air Base, Greenland.

Thule is the northernmost U.S. military installation, situated a little less than 1,000 miles from the North Pole. Built in the 1950s, the strategic base is used today for force projection, space superiority, and scientific research.

The remote outpost at 76.32' North latitude is situated well outside the footprint of a typical geostationary satellite, which orbits the Earth above the Equator.

At the snowy outpost, two Intellian terminals dot the landscape connecting with the OneWeb satellites that orbit overhead.

Under the dome-shaped terminal covers, parabolic antennas rotate to maintain connection with the satellite beams...

Coupled with limited terrestrial connectivity, it was a veritable desert when it comes to connectivity — until recently.

With LEO connectivity, the ~600 men and women living at this far-flung base are enjoying high-speed, low latency broadband for the first time, conducting experiments, connecting securely through virtual private networks and staying in touch with family and friends.

This ***Air Force Research Lab*** (**AFRL**) long term test is proving that the Hughes installed ***OneWeb*** network can support growth planning requirements. With video conferencing, streaming video and even interactive games, 100 base personnel were online simultaneously one recent evening, consuming close to a terabyte of connectivity.

The nearby gateway for global communications.

"*The testing has demonstrated the ability of emerging LEO networks to dramatically improve communications to areas that have traditionally been extremely difficult to serve. The residents at Thule have been thrilled with both the performance and stability of the network as they've used it to connect with family, friends, and colleagues around the world*," said Dr. ***Brian Beal***, Program Manager at AFRL.

The Thule LEO network, designed, integrated and installed by Hughes engineers using capacity from the OneWeb constellation, spans four antennas, delivering almost 14 TB of data per month, 24 hours a day, seven days a week, while reliably seeing the specified downlink and significantly lower latency (compared to GEO satellites).

More than half of the OneWeb satellites are already on-orbit, delivering full coverage of the northern regions spanning the Arctic, Alaska, Greenland and the U.K. and supporting not only the Thule base personnel, but government and coalition partners, as well.

The frozen environment presented a unique challenge when it came to implementing the solution. However, a judicious mix of timely site surveys and collaboration with the base logistics teams under AFRL guidance helped Hughes make the LEO system operational within a short time.

From ***Morale Welfare and Recreation*** (**MWR**) applications, the Thule LEO implementation paves a path towards detailed performance assessments for mission-critical base applications. The low-latency connectivity is now fundamental to defending against emerging high velocity threats, and the Hughes team stands ready to support the evolving customer needs in Thule – and around the world.

Turning what was once just a frozen outpost into a hub of resilient satcom networking for tactical, multi-domain operations.

www.hughes.com

HUGHES

SPACE INDUSTRY GROWTH IS NOT GUARANTEED

WHERE WE BUILD WILL DETERMINE OUR FUTURE

Author: Jim Cantrell, Chief Executive Office and Co-Founder, Phantom Space

Space is a young industry growing up in an uncertain economic and political climate. In just the past two decades, we've watched the industry fall into near quiescence, only to emerge stronger — and much, much louder — than before, less than ten years after it quieted.

However, unlike previous decades in the industry's short life, the "next generation" of space solutions and companies are facing a global growth sustainability problem. Crumbling international supply chains combined with a lack of available skilled talent, and political, social, and cultural unrest are putting pressure on an industry that has long promised to be the future of... ***everything***.

The U.S. space industry can keep that promise, and even overdeliver on it, if we make smart decisions about commercial and defense applications, and more importantly, getting rid of unreliable supply chains. What we do today will impact more than just this quarters or this year's bottom line; it will impact the future of the industry. I, for one, say the future of the U.S. space industry is right here, in the United States.

EXPLOSIVE GROWTH CAME KNOCKING + THE INDUSTRY MUST ANSWER

At the time of writing, there were 8,837 "*currently in orbit*" entries in the ***Online Index of Objects Launched to Outer Space***, a global log managed by the ***United Nations' Office for Outer Space Affairs.*** Reaching all the way back to 1957 and the launch of ***Sputnik***, the index provides a snapshot of everything that's ever been out there, and what it's doing now. More importantly, it highlights the explosive growth of the space industry over the past decade.

From 1965 to 1999, a steady 100 to170 objects were launched to orbit each year; the cost to launch and maintain space programs kept the industry steady but without room for significant growth. The early 2000s saw a marked dip — in no small part due to the explosion of **Space Shuttle Columbia** in 2003, 9/11 and the war in Afghanistan plus Y2K fears — and it required more than a decade for the industry to fully recover.

But recover it did. From 221 launched objects at the end of 2016, the space industry more than doubled its launch output to 456 in 2017. Just four years later, 2021 saw the launch of 1,809 objects to orbit. If the trend continues, the industry could see a launch of more than 3,600 objects per year by 2023 or 2024.

It's worth noting that the initial supply chain impact of the COVID-19 pandemic didn't hit the industry hard (***see 2021's growth***). However, the continuation of pandemic-related supply chain disruptions caused a reduction in the production and export of microchips from places like China and Japan. And the war in Ukraine has dead-stopped the production and export of rocket engines through Ukrainian firms.

Overseas supply chains have always been a gamble, and these recent disruptions, or more pointedly, derailments, have proven it in a painful way. Some would say that this has forced the industry, in excruciating fashion, to re-evaluate its methods. Really, it has presented an opportunity to think creatively about supply chains, production, and the future of the industry.

THE DEEP IMPACT OF SUPPLY CHAIN ISSUES

As recently as June 2022 — more than two years after the onset of the pandemic and more than four months after the Russian invasion of Ukraine — multiple space industry leaders stood together at ***Space Tech Expo 2022*** in recognition of the sharp, uphill battles facing the industry.

Topics of discussion included *increased production timelines*, *difficulty in obtaining Tier 3 and Tier 4 production components* and the *unavailability of parts* for which production is outsourced to other countries. These concerns weren't being shared by companies the industry has not yet heard of; rather, they were coming from industry veterans including ***Ron Faith*** of ***RBC Signals***, ***Chris Winslett*** of ***Lockheed Martin*** and Jordan Noone of ***Embedded Ventures***. These leaders weren't quiet about the problems facing the industry, chief among them the overseas outsourcing of technology manufacturing and acquisition.

In the immediate term, challenges related to overseas outsourcing have caused stagnation and deflation for some in the industry. There have been significant roadblocks to the launch and conclusion of meaningful growth projects from both industry-reinvigorating startups and established industry leaders.

And still other challenges related to national security arising from some foreign suppliers to US space systems have caused wholesale rewriting of US space acquisition policy. These challenges may also mean bankruptcy for those space companies unable or unwilling to shift manufacturing and production to other, more accessible supply chains. More bluntly, most companies continuing to rely on these dead-stopped supply chains will go out of business, and soon.

However, this is only the immediate term. The space industry has experienced downturns and growing pains before and has come back stronger each time. This time will be no different in that the industry will emerge stronger and more profitable than before. But it will also uniquely transform the how and where of industry production and manufacturing.

SUPPLY CHAIN DISRUPTIONS CREATE OPPORTUNITIES + STRENGTHEN GROWTH SUSTAINABILITY

As a significant portion of the supply chain for most U.S.-based space industry businesses exists outside of the United States, these businesses have been vulnerable to global upheaval, inflation, and bottlenecks in the logistics. They're feeling the pain of that now. Despite the strain, current supply chain disruptions have highlighted a unique opportunity for a shift in the way the industry does business, and in the way that it innovates.

The opportunity lies in the shift to American, or western production. Besides the obvious benefits to logistics, pricing, and the availability of Tier 1 through Tier 4 components, increased support for American supply chains provides added security. When components are made on American soil, U.S.-based businesses, and in particular defense systems, have more control and oversight.

My own company, **Phantom Space**, intentionally requires every part on every rocket we build to be made in the U.S.A. It's not just a point of pride in making things at home, although we are proud of this decision and its outcomes. Building at home eliminates the risks and unreliability associated with overseas supply chains and creates opportunities for growth and sustainability.

The global space economy achieved a valuation of $424 billion in 2020, and analysts speculate that it could potentially reach $1 trillion by 2040. That is in no small due to the efforts of space startups that are scaling production and decreasing launch costs and timeframes. These startups, particularly those focusing on new applications and industries with the space economy, are expected to contribute more than $101 billion to this growth.

Launch costs and timeframes can also be reduced by bringing the supply chain home — when your rocket parts are made in Tucson, it takes a lot less time to acquire them and install them than it does if they're coming from overseas; it's also much easier and more cost-effective to drop in and check on the process.

Changing the way the industry thinks about production — not just the how, but the where — is exactly the injection the U.S. space industry needs to take back our power and to manage our own growth. And while the past two years have revealed weaknesses in the industry, those weaknesses have in turn revealed an incredible opportunity. It's time to give up the ghost on unstable, unreliable overseas supply chains, and focus on homegrown space technologies, built here in the U.S.A.

Jim Cantrell is an inventor, entrepreneur and the CEO and Co-Founder of Phantom Space – a space applications company. With more than 30 years of proven leadership experience and significant contributions to space technology, he is considered a luminary in the aerospace industry. Jim also served as a founding team member at SpaceX.

www.phantomspace.com

PHANTOM SPACE CORPORATION

Jim Cantrell

SOUTHERN LAUNCH RECEIVES FURTHER SUPPORT FROM THE AUSTRALIAN GOVERNMENT

Australian spaceport and space mission provider, ***Southern Launch***, has been awarded an ***Australian Space Agency*** Moon to Mars Grant for their mobile launch rail.

The almost $1 million grant will enable Southern Launch to design, construct, and commission a mobile launch rail that will be capable of launching sub-orbital vehicles ranging in mass from 20 to 3,500 kg. The mobility of the rocket launcher will allow Southern Launch to use the launch rail at both the ***Koonibba Test Range*** and the ***Whalers Way Orbital Launch Complex***.

The mobile launch rail project will deliver on the Federal Government's commitment to providing world-class, reliable, economical, and safe launch facilities in Australia, which will serve a wide range of Australian and international customers. The increased capability will also mean that more international launch customers will be able to consider Southern Launch as their launch site.

Southern Launch CEO ***Lloyd Damp*** highlighted the benefits of a mobile launch rail for Australian space companies. "*The mobile launch rail will allow the testing of new rocket and payload technologies, which in turn will grow jobs across the Australian space industry," said Mr Damp. "The mobile launch rail will also increase Southern Launch's capability in driving Launch as a service from Australian shores. We thank the Australian Space Agency for their continued support in driving the Australian spaceport industry.*"

ULA LAUNCHES THE USSF / SSC SBIRS GEO 6 SATELLITE

Photo of SBIRS GEO-6 satellite launch by United Launch Alliance from Cape Canaveral Air Force Station. Photo is courtesy of ULA

A ***United Launch Alliance (ULA)*** Atlas V rocket carrying the Space Based Infrared System Geosynchronous Earth Orbit-6 (SBIRS GEO 6) mission for the ***U.S. Space Force's Space Systems Command*** lifted off on August 4that 6:29 a.m. EDT from Space Launch Complex-41 at Cape Canaveral Space Force Station — to date, ULA has launched 152 times with 100 percent mission success.

"*Thank you to our U.S. Space Force and industry partners for their outstanding teamwork in successfully delivering the sixth and final SBIRS satellite to orbit,*" said ***Gary Wentz***, ULA vice president of Government and Commercial Programs. "*We are proud of our role in supporting the warfighter by launching the entire SBIRS satellite constellation, a critical constellation of missile warning satellites that expands the U.S. military's situational awareness on the battlefield and beyond. This launch marked ULA's 95th U.S. National Space Security launch. As the Air Force is gearing up to celebrate its 75th anniversary, we are honored to have been entrusted to deliver the vast majority of our nation's critical assets to orbit. Our customer's missions are vital to ensuring the safety of our women and men in harm's way serving our country.*"

The SBIRS program delivers timely, reliable, and accurate missile-warning and infrared surveillance information to the president, secretary of defense, combatant commanders, the intelligence community, and other key decision makers. The system enhances global missile launch detection capability, supports the nation's ballistic missile defense system, expands the country's technical intelligence gathering capacity, and bolsters domain awareness for warfighters on the battlefield.

"*SBIRS GEO-6's successful launch is a great achievement for the entire team and nation,*" said Col. ***Brian Denaro***, program executive officer for Space Sensing at SSC. "Our near-peer competitors continue to deve*lop missile technology that is faster-burning and dimmer, as well as harder to detect. The U.S. Space Force's SBIRS constellation provides the world's most advanced capability to detect missile launches earlier and track these threats more accurately.*"

"*Now, more than ever, we must focus our collective efforts to ensure each National Security Space Launch (NSSL) is successful,*" said Mr. ***John Steinmeyer***, SBIRS GEO-6 mission director and executive director, SSC's Assured Access to Space Directorate. "*It's the best way to stay ahead of our adversaries in the near term. I'm extremely proud of the accomplishments of this team, which marks not only the successful SBIRS GEO-6 launch, but completion of the SBIRS constellation.*" ***Additional details...***

In honor of the U.S. Air Force's 75th anniversary in September, ULA collaborated with the U.S. Space Force to form a human 75 next to the SBIRS GEO 6 launch vehicle.
Photo credit: United Launch Alliance

HOW GLOBAL INSTABILITY IS DRIVING CHANGES IN THE INTELLIGENCE COMMUNITY

Author: Bill Pryle, Government RF Consultant, ETL Systems

Whether it's the ongoing war in Ukraine or the growing tension surrounding Taiwan, the prospect of unrest between 'East and West' has not been this intense for decades. Russia's full-scale invasion of Ukraine in February marked a dramatic escalation of the eight-year-old conflict and a historic turning point for European security. In addition, China's decision to resume military drills off Taiwan, following Nancy Pelosi's visit in August, sparked concern regarding the status of the island and China's intentions.

Given this ongoing instability, governments around the world are looking to bolster their defenses in terms of military and intelligence capability, as well as investing in satellite technology that is designed to ensure secure data transmission across vast areas of the land and sea.

The world is changing — how is this impacting the intelligence community and their approach to data security?

Since the 1950s when the first government satellites were launched into space, with the U.S.'s **Vanguard *1*** providing the first-ever measurements of Earth's outer atmosphere, SATCOM technology has been relied upon for surveillance, military communications and intelligence gathering. Fast-forward 70 years and, while these three elements are still vitally important, the manner in which governments are using satellites has completely evolved — largely driven by the demand for ***data***, ***Internet of Things*** (**IoT**) and **5G**.

As seen across many industries, this shift in behaviour has created an opportunity for hackers and criminals to exploit any weak points in the network to their advantage. For example, criminals were able to hack into a Massachusetts-based HVAC provider's system last year, remotely accessing a number of its client's systems. These clients included the **Boston Children's Hospital**.

While Boston Children's Hospital issued a statement acknowledging that one of their vendors had encountered a security compromise to their network environment and played down the threat, this example highlights the security risks associated with all devices that rely on IoT to function.

Similarly, a series of high-profile cyber attacks during the 2016 and 2020 U.S. elections were experienced, with Russia, China and Iran accused of interference. **Microsoft** warned of an escalation in the efforts of foreign activity groups, specifically highlighting the activity of Russian hackers from the **Strontium** group, while **Google** also stated the company had detected cyberhack attempts by China and Iran.

Why do many governments choose to always access their network remotely? How does this impact risk?

While the RF devices in themselves aren't vulnerable to attacks of this nature - and wouldn't make particularly fruitful hacking targets — in the current climate anything that touches the network has to be secure.

Interestingly, we have found that between 70 to 80 per cent of **ETL** customers access their equipment remotely. There are two main drivers behind this strategic decision. The first is that a large number of government facilities employ foreign nationals. Should any of these individuals harbor negative intentions, they could, potentially, access any equipment stored locally. Secondly, as you have more people exposed to and able to access the network, the risk of someone being compromised naturally increases.

While our products would not be considered '*network management*' tools, if they were not secure they could still become a 'weak link' and used as a means for someone with bad intentions to access the overall network — as demonstrated in the Boston Children's Hospital example.

What drove the decision to establish a new security standard?

With this in mind, a number of new precautionary security measures have been introduced over recent years and we continue to ensure that our new products have these protocols inbuilt. The Intelligence Community introduced a new mandate that any device connected to their network had to use secure protocols, namely **SNMPv3** and **HTTPS**. The defense sector soon followed, requesting secure communications protocols for any networked device operating at a government facility.

SNMPv3 (***Simple Network Management Protocol Version 3***) is an interoperable, standards-based protocol used for access control and authorization. Products developed more recently provide additional safety features such as the option to disable unused protocols and password complexity enforcement, as well as enforcing a restriction on the number of login attempts. **HTTPS** (***Hypertext Transfer Protocol Secure***) is used for secure online communication and encrypts data in transit, safeguarding against eavesdropping and tampering.

The ground stations where RF signals are received, converted and redirected are also growing in complexity, with the majority now remotely operated and controlled via ***Ethernet*** — another key driver in the widespread adoption of secure protocols like SNMPv3 and HTTPS.

Take-up of products using the new secure protocols is already high and the expectation is that this will increase in the face of the aforementioned global instabilities. While North America remains the largest market, ETL products are shipping worldwide and commercial satellite operators are likely to follow suit and request the same enhanced network security. When this happens, the worldwide adoption of the technology will increase rapidly.

Why does the SATCOM infrastructure need to be future-proofed, given the issues outlined above?

It's not just a case of looking at the here and now — future-proofing the network is essential. With its higher frequencies, larger bandwidths and increased spectral efficiencies, Ka-band is now used by the military to ensure its data demands can be met. Similarly, given the rate at which societies generate and consume data, device capabilities must increase in parallel – not just to transmit that data, but also to process it into usable information in a timely and secure fashion.

LEO SATELLITES AND THE FUTURE OF RF CONNECTIVITY

There's another significant reason why the company's remote capabilities are set to increase and that's due to the advent of LEO satellites: these huge '*constellations*' will be at altitudes ranging from about 700 to 3,000 km. above the Earth's surface. As the satellites orbit relatively close to the Earth, with a limited field of view, larger numbers are needed to achieve global coverage. Accordingly, specialist tracking antennas are needed on the ground to ensure seamless connection, coordination and control of these satellite networks.

We've all read about the likes of ***Telesat***, ***Starlink*** and ***Project Kuiper***: next-generation tech businesses are clamoring to deliver low-latency, high-speed broadband worldwide. However, as well as helping the world get closer to 100% internet access, LEO constellations can also offer 100% worldwide surveillance and imaging coverage. The ***U.S. Department of Defence*** (**DoD**) has already contracted Elon Musk's ***SpaceX Corporation*** to develop a prototype rocket propulsion system and it's likely that, in the near future, the U.S. government will entertain using LEO constellations for surveillance purposes, probably by contracting to one of the major players but operating their own sites on the ground.

In a world where information and data are the new bullets and rockets, government agencies must ensure that all aspects of their network are highly secure. Whether that's the simplest of L-band splitters, or a more sophisticated matrix switch, those with ill intent should not be given any opportunity to access the network.

As remote operations continue to become the norm and the RF ecosystem grows in both complexity and size, the security of intelligence and military communications is paramount.

Author Bill Pryle is ETL Systems' Government RF Consultant. He supports clients from North America, particularly for government and defence applications.

www.etlsystems.com

Bill Pryle


Beyond Secure Satcoms
Are you ready to put your teleport service in the hands of a world-class team?
SANTANDER TELEPORT
Technology always, peoplefirst.
CERTIFIED
Santander Teleport
Spain
WTA
AENOR
QUALITY MANAGEMENT
ISO 9001
WTA
2019 Teleport of the Year
AENOR
INFORMATION SECURITY
ISO/IEC 27001
santanderteleport.com