

Next Generation Space Defense

Milsat Magazine

December 2021

United Launch Alliance Atlas V
launch of USSF's STP-6 mission

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THE USSF'S STP-3 MISSION LAUNCH BY ULA IS SUCCESSFUL — THE STPSAT-6 SATELLITE IS RELEASED FROM EARTH'S GRAVITY VIA AN ATLAS V ROCKET + NAVIGATES TO ORBIT

Reporting System-3 (SABRS-3) package and NASA's Laser Communications Relay Demonstration (LCRD) experiment. The launch also includes a propulsive secondary payload adapter carrying additional small science and technology missions.



The Atlas V launch of STP-3 for the USSF by ULA... photo is courtesy of the company.

A United Launch Alliance (ULA) Atlas V rocket carrying the Space Test Program (STP)-3 mission for U.S. Space Force lifts off from Space Launch Complex-41 at 5:19 a.m., EDT, on December 7, 2021.

The STP-3 mission consists of the *STPSat-6* satellite that hosts the National Nuclear Security Administration's Space and Atmospheric Burst

The mission launched on an **Atlas V 551** configuration rocket that included a 5.4 meter payload fairing and stands 196 ft. (59.7 m) tall. The Atlas booster for this mission is powered by the **RD AMROSS RD-180** engine. Aerojet Rocketdyne provided the **RL10C-1** engine for the **Centaur** upper stage and Northrop Grumman provided the five Graphite Epoxy Motors (GEM) 63 solid rocket boosters.





This was the 90th launch of the Atlas V rocket. To date, United Launch Alliance has launched 146 times with 100 percent mission success.

- *STP-3 is a co-manifested mission that matures technology and reduces future space program risk for the Department of the Air Force and the U.S. Space Force by advancing warfighting capabilities in the areas of nuclear detonation detection, space domain awareness (SDA), weather, and communication. Both spacecraft will be delivered to geosynchronous orbit. Liftoff will occur from Space Launch Complex-41 at Cape Canaveral Space Force Station, Florida.*
- *The OoA payload fairing was developed with a new manufacturing method, an alternative process to cure carbon fiber composites, which allows for a more efficient production process, lower cost and lower system mass while maintaining the same level of reliability and quality.*

- *The Atlas V is also equipped with a new In-Flight Power System (IFPS). This system supplies power to the satellites' batteries during the rocket's long duration ascent, a mission more than seven hours. The IFPS will ensure the spacecraft have fully charged batteries when deployed into geosynchronous orbit (GEO).*
- *GPS Enhanced Navigation is an additional first flight item that utilizes existing flight computer hardware to provide GPS signals that improve the Centaur's navigation system performance, allowing the Centaur to achieve even more accurate orbits.*

*"STP-3 is a unique mission as the Atlas V will deliver STP-3 directly into Geosynchronous Equatorial Orbit (GEO). This is a highly complex orbital insertion that requires three Centaur burns and precise navigation, a capability unique to the Atlas V. This is our longest mission to date at seven hours and 10 minutes until final spacecraft separation," said **Gary Wentz**, ULA vice president of Government and Commercial Programs. "We are proud to work alongside our mission partners to prepare to launch this challenging mission and thank them for their outstanding teamwork."*

COP HYDRA DEBUTS FROM SES GS TO MANAGE USG + MILITARY SITUATIONAL AWARENESS



***SES Government Solutions (SES GS)*, a wholly-owned subsidiary of SES, has announced their new Common Operational Picture (COP) platform, Hydra, built exclusively to serve the U.S. Government and military.**

Managed and operated in-house, Hydra is a modular, web-based, monitoring and control system that provides end-to-end situational awareness in a single unified operational network platform.

Hydra collects, normalizes, and organizes data from different sources based on the mission or customer and distributes the information to the appropriate dashboard providing an interactive user interface of consumable data in a single pane.

Built on a cloud-native and micro-services architecture, Hydra is secure by design and incorporates the latest security and data processing technologies, ensuring mission assurance for government and military users.

The ***SES Government Terrestrial Network (GTN)*** is the foundation of this platform built to synchronize operations across major global teleports, points of presence, and U.S. Government data centers.

The network integrates with Hydra providing complete visibility and management capabilities to the customer and SES GS' ***Network Operations Center (NOC)*** to optimize end-to-end system performance.

"Hydra is the convergence of tactical, operational, and strategic enterprise data in a single pane view," said President and CEO of SES Government Solutions, Brigadier General ***Pete Hoene***, USAF (retired). *"Having information in real-time can be the difference between mission success and mission failure. SES GS has identified the need for a tool that compiles and transforms open-source data in a customizable dashboard to help manage situations rapidly and allow in-real time informed decision making."*

GILAT'S WAVESTREAM RECEIVES MILLION\$ FOLLOW-ON ORDER FOR SSPAS FROM MILITARY TERMINAL PROVIDER



Gilat Satellite Networks Ltd. (Nasdaq: GILT, TASE: GILT) has received a follow-on order for subsidiary company ***Wavestream*** of more than \$5 million from a Tier-1, US global military terminal provider for Solid State Power Amplifiers (SSPAs) for satellite communication (SATCOM) terminals sold to militaries throughout the world.



Additional contract expansion for Wavestream MicroStream SSPAs is expected in the near future.

Gilat's fully-owned subsidiary, Wavestream, will provide tightly integrated MicroStream frequency conversion/amplifier units.

Wavestream's MicroStream Ka-band SSPAs were selected as they efficiently meet the exacting SWaP requirements most essential for tactical and expeditionary military users.

"We are proud of the partnership we are building with this customer, and this order is indicative of their continued trust in Wavestream technology, production capacity, and reliability," said ***Bob Huffman***, Wavestream's General Manager.

Wavestream, a Gilat subsidiary is an industry leader in the design and manufacture of next generation satellite communications high power transceivers for In Flight Connectivity, Ground Mobility and Gateway markets. Since 2001, the company provides system integrators with field-proven, high performance Ka, Ku and X band Solid State Power Amplifiers (SSPAs), Block Upconverters (BUCs), Block Down Converters and Transceivers.

NSR PUBLISHES GOVERNMENT + MILITARY SATCOM DEMAND ANALYSIS + REPORT

NSR's Government and Military Satellite Communications, 18th Edition, report finds that, despite COVID-19, troop drawdowns in the Middle East and ongoing pricing compression, demand for connectivity will continue to grow in the long term. At more than \$6.6 billion in revenue in 2020 — the market was at the tail end of its growth phase and is now entering a short-medium term shaped by many factors.

The need for connectivity is clear — however, macro-level factors like fewer boots on the ground vs. eyes in the sky vs. surging satellite capacity supply continue to alter the competitive landscape. Emerging paradigms such as “Joint,” “Enterprise” and “Unified” are the new catchphrases for commercial industry to get their heads around. Meanwhile, budgets continue to be squeezed, and existing contracts are no longer an automatic renewal. Rounding it out, **MILSATCOM vs. COMSATCOM** and Bulk Leased vs. Managed Services are still very much factors ‘in-play.’

The next three to four years will be challenging for Government and Military spending — budgets are

already stretched, but requirements for security and resiliency are increasing. This push and pull effect will only exacerbate the challenges facing mil/gov users as more satellite capacity is on the way but spending remains in a state of turbulence. From 2024 onward, NSR does expect revenue curves to return to growth as the cyclical nature of geopolitics comes back into focus and the market attempts to move more towards a tenuous supply-demand equilibrium.

All told, Gov & Mil end-users will demand more than 1 Tbps of throughput by 2030, up from 52 Gbps in 2020. Non-GEO HTS in MEO and LEO will drive the next-phase of satellite connectivity growth for Gov & Mil customers, combined with improved use-cases for narrowband IoT, and emerging requirements for GEO-based services. Combined, changing security and connectivity drivers will propel the market to over \$86 Billion in cumulative Retail Revenues from 2020 to 2030.

NSR's Government and Military Satellite Communications, 18th Edition (GMSC18) explores the market opportunities available to the satellite industry. With nearly two decades of insights and analysis, NSR's longest-running report on the Government & Military satellite communications market provides an in-depth view of the drivers, regional trends, and capacity demand through 2030.

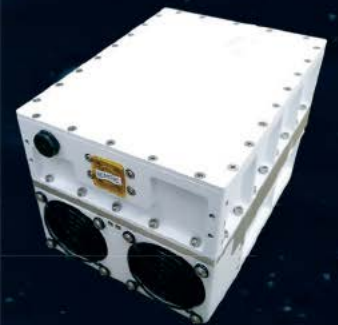
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MILITARY GNSS ANTI-JAMMING TECHNOLOGIES TO CHANGE THE COURSE OF EW SUPREMACY

ASD Reports

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The shift from PNT data supremacy to a decisive factor for electronic warfare makes Military GNSS Anti-jamming systems acquire many new tools and technologies.

Military GNSS Anti-jamming technology has taken conventional military operations to the next level and has uplifted the face of modern electronic warfare.

Withdrawal of the US and NATO forces from Afghanistan and establishing the rule of the Taliban has opened new avenues for China, Pakistan and Russia.

China is extending a friendly hand with the Taliban and the Taliban has eventually agreed to support China in its ambitious 'One Belt, One Road' project.

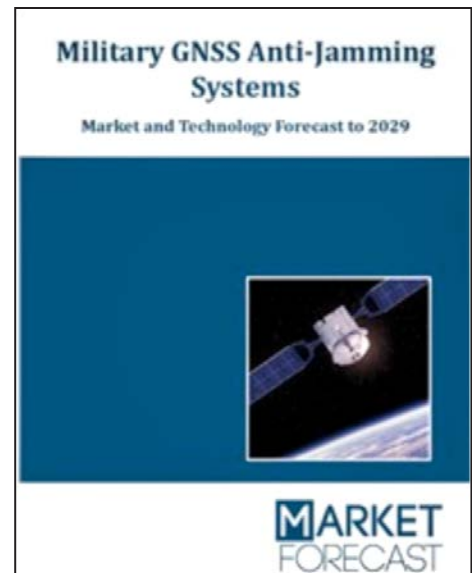
And Talibanists might support the free Kashmir agenda of Pakistan. There is going to be a massive change in electronic warfare (EW) investments in the Asian markets.

Japan, South Korea, East Asian countries, and the US and NATO forces are increasing investments in electronic warfare because of Russian activities in the Arctic Ocean, China's intervention in the South China Sea and North Korea's unpredictable behavior.

On the other hand, after the withdrawal of forces from Afghanistan, the US will divert its budgets on EW, especially investments in space programs and space-enabled electronic warfare. It might divert the funds from Afghanistan to the South China Sea for investing in maritime PNT data accuracy and precision.

On this background demand for assured and precise PNT data grows many folds. The support from strong Military GNSS Anti-jamming technologies becomes inevitable.

The latest study from Market Forecast a leading analysis firm on defense technologies and market trends provides ongoing developments in the U.S. and other parts of the world regarding developing Military GNSS Anti-jamming solutions to handle the growing nuisance of jamming devices.



The study "**Military GNSS Anti-jamming – Market and Technology Forecast to 2029**" from ASD Reports identifies that there will be massive demand for integration for new CRPAs (Controlled Reception Pattern Antennas), M-code enabled receivers and Assured PNT devices in various military platforms.

The report discusses technology adoption patterns for new anti-jamming technologies in various military organizations across the world. The report throws light on how various countries are preparing themselves for the new norms in electronic warfare and issues of jamming electronic munitions, aircraft, and battleships.

The study finds that global GNSS anti-jamming markets will reach \$7.55 billion through 2029 from \$2 billion in 2021.

The major growth of the market is anticipated from 2026, when the majority of deployments of new GNSS anti-jamming technology developments will take place in GPS Operational Control System (OCX), Assured PNT and M-code enabled antenna and receivers. You can learn more about these developments **inside the report.**

BAE SYSTEMS UNVEILS THEIR NEW, ULTRA-SMALL, GPS RECEIVER WITH M-CODE MILITARY GPS SIGNALS



BAE Systems, Inc. has unveiled their ultra-small **MicroGRAM™-M** global positioning system (GPS) receiver that is compatible with next-generation, M-Code military GPS signals that are resistant to jamming and spoofing.

About the size of a postage stamp, MicroGRAM-M is, according to the company, the world's smallest, lightest, and most power-efficient M-Code embedded GPS receiver – delivering assured positioning, navigation, and timing (PNT) for size-constrained and other micro-applications.

MicroGRAM-M features rapid secure GPS signal acquisition, enhanced security and resiliency, anti-jamming and anti-spoofing capabilities, and the industry's lowest power consumption for an M-Code device. The 1.0" x 1.25" x 0.275" MicroGRAM-M has the same physical dimensions as its predecessor, enabling quick upgradability to M-Code and reduced system integration costs. At its core is a proven, tamper-proof M-Code Common GPS Module that encapsulates classified data and signal processing.

"We're delivering reliable PNT where our customers need it – from soldiers' handheld devices to small unmanned aerial vehicles," said **Greg Wild**, director of Navigation and Sensor Systems at BAE Systems. *"MicroGRAM-M provides our armed forces and allies with a low-SWAP M-Code GPS solution that's resistant to adversaries' disruption efforts in highly contested environments."*

"MicroGRAM-M is the latest BAE Systems M-Code military GPS product, joining MPETM-M and NavStrikeTM-M, which deliver enhanced awareness in highly contested environments and precision munitions guidance," said **John Watkins**, vice president and general manager of Precision Strike & Sensing Solutions at BAE Systems. *"Qualification of MicroGRAM-M is underway, with full-rate production expected in 2022."*



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DEFENSE LOGISTICS AGENCY AWARDS BAE SYSTEMS WITH A MILLION\$\$\$ CONTRACT OPTION



The **Defense Logistics Agency (DLA)** has executed a **\$316 million contract option for BAE Systems' advanced M-Code Global Positioning System (GPS) modules, raising the contract funding to \$641 million.**



DEFENSE LOGISTICS AGENCY
THE NATION'S COMBAT LOGISTICS SUPPORT AGENCY

The modules provide dependable positioning, navigation, and timing for ground troops, vehicles, aircraft, and precision munitions. The contract will ensure the availability of **Common GPS Modules (CGM)** for advanced military GPS receivers with anti-jamming and anti-spoofing capabilities that enable operation in contested environments.

Under the contract option executed in November, BAE Systems will manufacture CGMs for future ground, airborne, and weapon GPS receivers for the U.S. Department of Defense (DoD) and its allies. The award builds on a May, 2021, \$325 million contract and enables BAE Systems to continue to meet domestic and international demand for **Military GPS User Equipment (MGUE) Increment 1 M-Code** modules in GPS receivers through the end of the decade.

BAE Systems is currently delivering two advanced M-Code GPS receivers — the **Miniature Precision Lightweight GPS Receiver Engine — M-Code (MPE™-M)** and **NavStrike™-M** GPS receiver. Deliveries of the ultra-small **MicroGRAM™-M** are expected in 2022 and deliveries of the **Strategic Anti-jam Beamforming Receiver – M-Code (SABR-M)** are expected in 2024.



M-code enabled global positioning system receiver.

Photo is courtesy of BAE Systems.

*"Military operations require assured positioning, navigation, and timing and our customers are shifting to M-Code to harden their GPS systems against jamming and spoofing," said **Frank Zane**, Navigation and Sensor Systems business development director at BAE Systems. "We're ready to meet this need today with secure, reliable M-Code GPS solutions, and we're developing the next-generation of solutions to stay ahead of the threat."*

BAE Systems' Precision Strike business has 45 years of military GPS experience, with over 1.5 million GPS devices on more than 280 platforms globally, and is developing next-generation military GPS technology. A state-of-the-art facility under construction in Cedar Rapids will provide the company's local workforce with a modern workspace – improving collaboration and optimizing production.



Artistic rendition of the BAE Systems state-of-the-art facility in Cedar Rapids, Iowa, now under construction. Image is courtesy of the company.

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DARPA + NGA DEVELOP NOVEL OPTICS TO FIELD MILITARY + GOVERNMENT IMAGING SYSTEMS PROTOTYPES TO SUPPORT WARFIGHTERS



EXTREME, a basic research program in DARPA's Defense Sciences Office, has successfully developed new optical components, devices, systems, architectures, and design tools using engineered optical materials, or metamaterials.



DARPA's EXTREME program developed optical materials technologies that the Air Force Research Laboratory is implementing on the **U.S. Air Force's XQ-58 Valkyrie** program (above image, left) and the **Air Launched Off-Board Operations (ALOBO)** program, a tube-launched unmanned aerial system (above image, middle) and a close-up (above image, right) shows a small gimbal housing new EXTREME technologies.

Metamaterials are composed of unit cells that are much smaller than the operating wavelength, allowing for greater manipulation of light.

Early examples of metamaterials were used to design and build multifunctional elements that seemingly defied standard "laws" of reflection and refraction. These were limited in efficiencies and in sizes less than a millimeter, prohibiting their integration into optical systems.

EXTREME addressed these challenges by improving efficiencies of lenses based on metamaterials, expanded their apertures to centimeter-scale, developed methods to reduce the effect of optical aberrations, and explored new optical design space and associated tradeoffs in size, weight, and power (SWaP) afforded by such metalenses.

The program kicked off in 2016 with multiple performers developing centimeter-scale metamaterials-based optics (metaoptics) and tools to design them.

The program was soon able to enable revolutionary improvement in SWaP characteristics of traditional optical systems as well as allow for multiple imaging applications from a single lens.

In 2018, DARPA partnered with the National Geospatial Intelligence Agency's (NGIA) Research Directorate to transition meta-optics concepts to unmanned aerial systems' (UAS) optical systems.



This NGA Metalenses program funded the Air Force Research Laboratory (AFRL) for multi-centimeter, meta-



optics development and characterization, the Naval Research Laboratory for volumetric 3D

metamaterial imaging capabilities, and Sandia National Laboratories for large-scale metalens modeling and optimization.



The above-mentioned EXTREME technologies are now transitioning from NGA to AFRL under its Seedlings for Disruptive Capabilities Program (SDCP).

Through SDCP, AFRL directorates partner with industry to answer critical needs of the Air Force Futures Strategy. EXTREME technologies are being employed in several SDCP projects: Integrated Compact Electro-Optic (EO) / Infrared (IR) Systems (ICES); the XQ-58 Valkyrie experimental stealthy unmanned combat aerial vehicle; and the Air Launched Off-Board Operations (ALOBO) program, a tube-launched UAS.



ICES is exploiting discoveries made under EXTREME to enable mounting multifunction sensors on low-cost platforms, such as UAS, to be deployed in contested environments. These smaller platforms have more stringent volume constraints and weight restrictions than legacy platforms, so adding a new sensor usually requires removing an existing one.

The introduction of compact metalenses and planar optics for EO/IR capabilities disrupts the trade space, potentially enabling multiple sensors on a single platform, thus increasing capability.

AFRL is relying on EXTREME technology to modify the EO/IR systems on two developmental platforms: the XQ-58 and ALOBO. For the XQ-58, AFRL is looking to reduce the volume of existing sensors to make room for additional sensors.

For ALOBO, AFRL is modifying the tube-launch compatible gimbal system. Advances in optics by DARPA and NGA allow AFRL to realize new trade space for the gimbal with either 10x reduction in SWaP while maintaining current performance or 4x improvement in resolution at current SWaP requirements.

"Through the NGA effort, AFRL developed unique capabilities using EXTREME technologies to characterize the optical performance of novel meta-optics and developed new insights into how they could be integrated into a full imaging system," said **Rohith Chandrasekar**, program manager in DARPA's Defense Sciences Office.

He continued, *"This work was also supported by Sandia's MIRAGE tool, which is a first-of-its-kind capability developed under DARPA EXTREME and NGA Metalenses programs, that exploits symmetries to enable large-scale metalens design and optimization to meet performance metrics."*

"Our close partnership with DARPA and the performers on the EXTREME program has enabled us to rapidly mature and demonstrate new technology for optical systems, which increases imaging system performance to address future system needs where conventional optics cannot meet performance or cost requirements," said **Paul Fleitz**, ALOBO team lead in AFRL's Aerospace Systems Directorate. *"Transitioning this technology and design tools developed under the EXTREME program to AFRL SDCP programs has dramatically accelerated the development and demonstration of this technology and increased the impact of the development program."*

EXTREME is a critical example of a successful partnership between DARPA, NGA, and AFRL to provide rapid transition from basic research to fieldable next-generation technology to support the warfighter.

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IDIRECT GOVERNMENT EVOLVES EVOLUTION TO V.4.4 WITH ENHANCED MILSATCOM PROTECTION

iDirect Government (iDirectGov) has announced their newest software release, Evolution® Defense 4.4, for enhanced military satellite communications (MILSATCOM) protection.

Evolution Defense 4.4 technology advancements are targeted at the *Defense Receive Line (DLC-R)* cards, enabling *Communication Signal Interference Removal (CSIR™)* on the DLC-R line cards, and other security improvements. CSIR represents a real-time streaming technology to mitigate interference, and the introduction of Evolution Defense 4.4 now applies to both iDirectGov's remote and line cards. This release complements the previous Evolution Defense 4.2.2.0 software release, which provided CSIR protection on the *9-Series*, establishing a complete end-to-end interference mitigation solution.

The DLC-R and 9-Series remote interference reporting work in the company's *iMonitor* network management software, which provides in-depth views into both real-time and historical network performance. This includes the health status of remotes, graphical displays, network probes and detailed bandwidth usage. The DLC-R-measured interference alerts and warnings thresholds are user configurable, as are the satellite remote alerts and warnings.

With security a highest priority for iDirectGov, the Evolution Defense platform is continuously tested and evaluated to ensure mission critical data is protected. To reinforce this security posture, the deployment of the Evolution Defense 4.4 software will have the protection of the *Federal Information Processing Standards (FIPS) 140-2 Level 1* enabled, along with the backing of the security enhancements in *Red Hat Enterprise Linux 8 (RHEL8)*. This implementation is applicable to all the servers associated with the platform beginning with Evolution Defense 4.4.

These security enhancements help to combat adversaries who are increasing their implementations of signal intelligence (SIGINT) to attack military and government spectrum use, as enemies seek to jam transmissions intended for radio communications, radar and various operations.

"Enhanced security solutions in Evolution Defense 4.4 create a multi-layered approach to MILSATCOM protection," said **John Ratigan**, president of iDirect Government. *"Evolution Defense 4.4 meets military communications requirements worldwide. Our security solution offers a Defense-in-Depth approach for reliable and secure communications."*

ROYAL AUSTRALIAN NAVY AWARDS SCANEAGLE CONTRACT EXTENSION TO INSITU PACIFIC

Insitu Pacific has been awarded a three-year contract extension by the Royal Australian Navy (RAN) for the sustainment of its ScanEagle Remotely Piloted Aircraft System (RPAS).



The extension allows the RAN to continue to experiment and develop knowledge using the ScanEagle Maritime Unmanned Aircraft System (MUAS), leveraging the foundation capability developed during embarked operations on **HMAS Newcastle** in the Gulf of Oman in 2017. ScanEagle has been in service with the RAN for experimentation and testing since 2014.

The RAN operates several ScanEagle systems at 822X Squadron in Nowra, and the contract extension enables continuation of MUAS training, tactics development and payload evaluation activities.

Insitu Pacific has supported and developed local capability for the RAN over the last seven years, including multiple training programs and the provision of deeper maintenance and support out of its Brisbane headquarters.

The comprehensive pilot and maintenance training courses delivered for defence personnel continue to be key success factors in delivering effective RPAS support. The most recent of these courses trialed virtual training, with RAN operators at Nowra being instructed by Insitu Pacific Instructors in Brisbane.

ScanEagle, along with the family of system platforms including Integrator, hold an impressive track record in supporting naval customers, with more than 66,000 embarked flight hours on over 24 classes of ship globally in the last 16 years.

ETL SYSTEMS' MILLIONS\$ CONTRACT FROM U.S. GOVERNMENT AND DEFENSE CONTRACTOR



***ETL Systems*, a UK specialist in designing and manufacturing RF equipment, recently received an order valued at \$1.33 million from a large U.S. Government and Defense contractor.**

Having worked with ETL previously, the customer knew it was able to consult with ETL's engineering team to deliver a custom 3U Test Matrix design; the product needed to simultaneously fulfill their RF performance requirements and eliminate their problem of limited rack space.

The total order included 20 Test Matrices which can cover frequencies from 0 to 6 GHz.

ETL delivered the order to a high standard, successfully meeting the customer's strict technical compliances and their short delivery time frame.

The entire process, including the design, manufacture, and delivery, was completed within five months.

Bill Pryle, Government RF Consultant at ETL Systems, said, "We worked closely with the RF engineering team to design a custom 3U Test Matrix. I am delighted they chose to work with ETL Systems and look forward to further projects with them in the future."

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Government

NEW AVIATION SOLUTIONS FOR THE U.S. GOVERNMENT DEBUT FROM INMARSAT GOVERNMENT

Inmarsat Government has unveiled their **G-MODMAN II modem manager and G-MODMAN Open Platform (OP) solutions.**



These are expanded, smart ecosystem solutions, built on the proven G-MODMAN modem manager technology that will support the implementation of **Global Xpress (GX)** terminals on government aviation platforms, starting in 2022.



Inmarsat's G-MODMAN II (l) + G-MODMAN OP (r)

Inmarsat GX is the first and only end-to-end high-throughput Ka-band network from a single operator that provides worldwide service.

In U.S. government operation since July 2014, GX complements military satellite communications (MILSATCOM) and delivers seamless, consistent wideband access that meets mobile, interoperable communications needs at an affordable price.

G-MODMAN II is a flexible, easy-to-use solution that seamlessly integrates with existing antenna systems and provides the enabling technology to support the implementation of the current and future generation of GX services and aero terminals across multiple aviation platforms.

This solution builds on Inmarsat's monitoring system and includes high-fidelity monitoring and logging features, allowing easy access to mission-critical data, and enabling highly detailed performance and trend analysis that leverages advanced ML (Machine Learning) and AI (Artificial Intelligence) techniques.

An option to G-MODMAN II is the G-MODMAN OP, which further expands upon the interoperable functionality by allowing for the seamless switching between GX, Inmarsat's steerable beams and the government's Wideband Global SATCOM system (WGS) to provide Inmarsat Government's customers with always-on availability, capacity, coverage and capability for mission operations.

This is a turn-key solution that integrates multiple modems/services with a single antenna by using loadable coverage map files and an easy-to-use **Graphical User Interface (GUI)** to manage the various services.

Both configurations leverage open standards, such as OpenAMIP and OpenBMIP, enabling interoperability with a multitude of terminals from various manufacturers.

The G-MODMAN II solution will be available in 1 Rack Unit (RU) and ARINC 404A ½ Air Transport Rack (ATR) form factors, G-MODMAN OP will be available in 19" 1 RU rack mount and ARINC-404A form factors, supporting a wide range of modems and services for government aviation missions — both crewed and uncrewed. Users will have also access to an Inmarsat's support structure that enables fast integration, easy configuration and detailed monitoring and control.

Matt Wissler, Chief Technology Officer at Inmarsat Government, said, *"Many of our customers' mission requirements drive the need for diverse SATCOM services spanning both commercial and military or government networks. Inmarsat Government recognizes the critical role of satellite communications in U.S. government aviation missions and takes pride in rapidly building solutions tailored to users' unique requirements. The G-MODMAN II and G-MODMAN OP solutions are testament to the company's dedication to solving customers' problems, maximizing and extending the capabilities that our customers have come to expect and trust from Inmarsat Government."*



CONNECTING OUR MILITARY TO ITS MISSIONS

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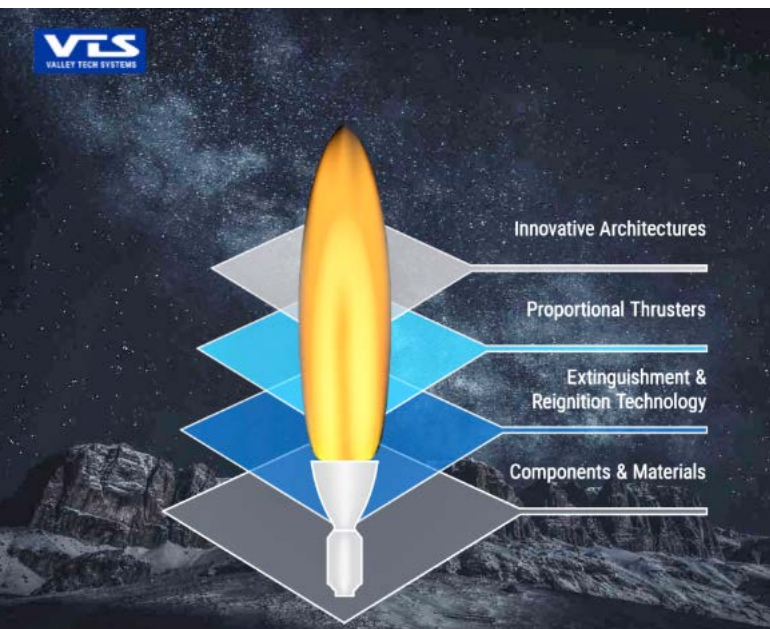
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VALLEY TECH SYSTEMS AWARDED MILLION\$\$ CONTRACT BY LOCKHEED MARTIN FOR MDA'S NEXT GENERATION INTERCEPTOR

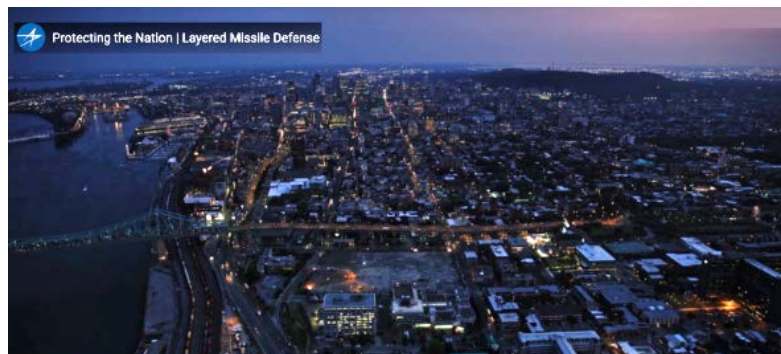


Valley Tech Systems, Inc., a Voyager Space company, has been awarded a subcontract worth up to \$94 million for base and future option scope by Lockheed Martin (NYSE: LMT) for an advanced solid-propulsion subsystem for its Next Generation Interceptor (NGI) contract with the U.S. Missile Defense Agency (MDA).



The NGI is a missile defense interceptor program designed to protect and defend the U.S. from intercontinental ballistic missiles.

This program will serve as a first line of a layered missile defense architecture against evolving threats from rogue nations.



Valley Tech Systems will provide a solid-propulsion roll control subsystem to assist in stabilizing the NGI's flight trajectory.

Under the subcontract for the technology development and risk reduction phase, Valley Tech Systems will deliver a flight-qualified, production-ready subsystem to Lockheed Martin in support of the 2027 fielding date.

Valley Tech Systems' controllable solid-propulsion technology regulates the use of solid propellant to achieve required levels of precision and long-duration operation, while offering superior reliability, safety and affordability.

The company developed the technology under a series of **Small Business Innovation Research (SBIR)** contracts from the MDA and the U.S. Air Force with Lockheed Martin as its commercialization and technology transition partner.

Derivations of the technology also are under development for future application to U.S. Air Force, U.S. Army and U.S. Navy missiles through additional SBIR contracts.

*"By including our cutting-edge technology in the NGI program, Lockheed Martin is tapping into American ingenuity, while expanding the defense industrial base and Lockheed Martin's supply chain," said **Russell Carlson**, vice president, Aerospace Division, Valley Tech Systems. "In transitioning from R&D to weapon system integration, we have upgraded our business systems and engineering processes to successfully achieve the stringent technical and quality program requirements of Lockheed Martin and the MDA."*

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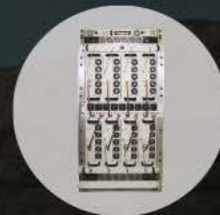
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GREEN HILLS SOFTWARE'S INTEGRITY-178 TUMP RTOS SELECTED FOR MILITARY GPS EQUIPMENT



INTEGRITY-178 tuMP RTOS
Safety-Critical & Security-Critical RTOS



Green Hills Software has announced the selection of their **INTEGRITY®-178 tuMP™** real-time operating system (RTOS) by **Raytheon Intelligence & Space (RI&S)** for their offering of the **Military Global Positioning System User Equipment (MGUE) Increment (Inc) 2 Miniature Serial Interface (MSI) with Next-Generation Application Specific Integrated Circuit (ASIC)**.



RI&S is developing one MSI card for aviation and maritime systems and another MSI card for ground-based systems. INTEGRITY-178 tuMP will be used in both solutions running on the Arm® processor-based ASIC.

RI&S selected the INTEGRITY-178 tuMP RTOS based on its use in previous programs and for its ability to simultaneously meet both safety and security requirements.

Those requirements included the highest **DO-178C** design assurance level (DAL A) and the NSA-defined separation kernel protection profile (SKPP) for "high robustness" security.

The Military GPS User Equipment is the GPS receiver for the modernized GPS Enterprise and it is capable of

receiving military code (M-Code) from newer satellites, including GPS-III. M-Code is a more robust, jam-resistant form of GPS that also uses more modern and flexible encryption methods to make it resistant to spoofing.

The MGUE Inc 2 MSI program is developing a smaller M-Code ASIC and receiver card that consumes less power, while increasing functionality, security and performance.

The smaller card will enable use in handheld and dismounted applications as well as mounted, maritime and aviation platforms.

The Government Accountability Office estimates that approximately 700 different types of weapon systems will ultimately require M-Code cards and M-Code-capable receivers, including ships, aircraft, ground vehicles, munitions, and handheld devices.

RI&S was one of three companies awarded by the U.S. Space Force's Space Systems Command for the MGUE Inc 2 MSI with Next-Generation ASIC program.

INTEGRITY-178 is the only commercial operating system ever certified to the SKPP and that certification was done by the National Information Assurance Partnership to Common Criteria EAL 6+ and "High Robustness."

Beyond the separation kernel, INTEGRITY-178 tuMP provides a complete set of APIs for use by multi-level security applications within a secure partition, e.g., an MLS guard, which is a fundamental requirement in a cross-domain system.

INTEGRITY-178 tuMP is also the first and only RTOS to be part of a cross-domain solution certification to NSA's new "Raise the Bar" initiative.

INTEGRITY-178 was the first commercial RTOS approved as complying with DO-178B Level A objectives, and INTEGRITY-178 tuMP is the only RTOS to be part of a multi-core certification to DO-178C and CAST-32A multi-core objectives.

INTEGRITY-178 tuMP directly supports a Modular Open Systems Approach, and it was the first RTOS to be certified conformant to the FACE™ Technical Standard, edition 3.0.

"Green Hills Software has a long history of working with RI&S on GPS & navigation systems, and we are pleased to be part of their MSI with Next Generation ASIC solution," said **Dan O'Dowd**, founder and CEO of Green Hills Software. *"Airborne GPS solutions require both safety and security, and the INTEGRITY-178 RTOS has an unrivaled pedigree in the combination of certified high-robustness security with certified DO-178C safety assurance."*

COMTECH TELECOMMUNICATIONS IS THE RECIPIENT OF MILLION\$\$\$ FROM THE FEDERAL GOVERNMENT FOR JCAC TRAINING SOLUTIONS

During the company's Q1 of fiscal 2022, Comtech Telecommunications Corp. (NASDAQ: CMTL) was awarded a five-year single award Indefinite Delivery Indefinite Quantity ("IDIQ") contract renewal with Firm Fixed Price ("FFP") and Time

and Materials ("T&M") delivery orders valued at approximately \$125 million from the Federal Government for the Joint Cyber Analysis Course ("JCAC") Training solutions.

The first delivery order on the IDIQ contract has been received and funded \$1.4 million to date.

"The Federal Government's cyber workforce development efforts are one of our nation's top priorities. This contract renewal acknowledges our proven track record of excellence in developing and delivering complex cybersecurity

*operations training at the scale and demanding operational tempo required by our Federal Government customers," said **Fred Kornberg**, Chairman of the Board and Chief Executive Officer of Comtech Telecommunications Corp.*



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STRENGTHENING THE “UNBLINKING EYE”

NEXT GENERATION OPIR SYSTEM TO HARDEN AND ENHANCE USSF'S MISSILE WARNING SYSTEM

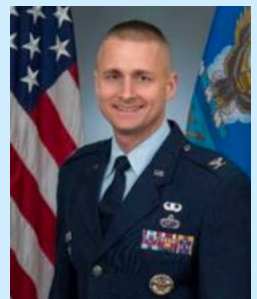
Author: USSF Space Systems Command (SSC)



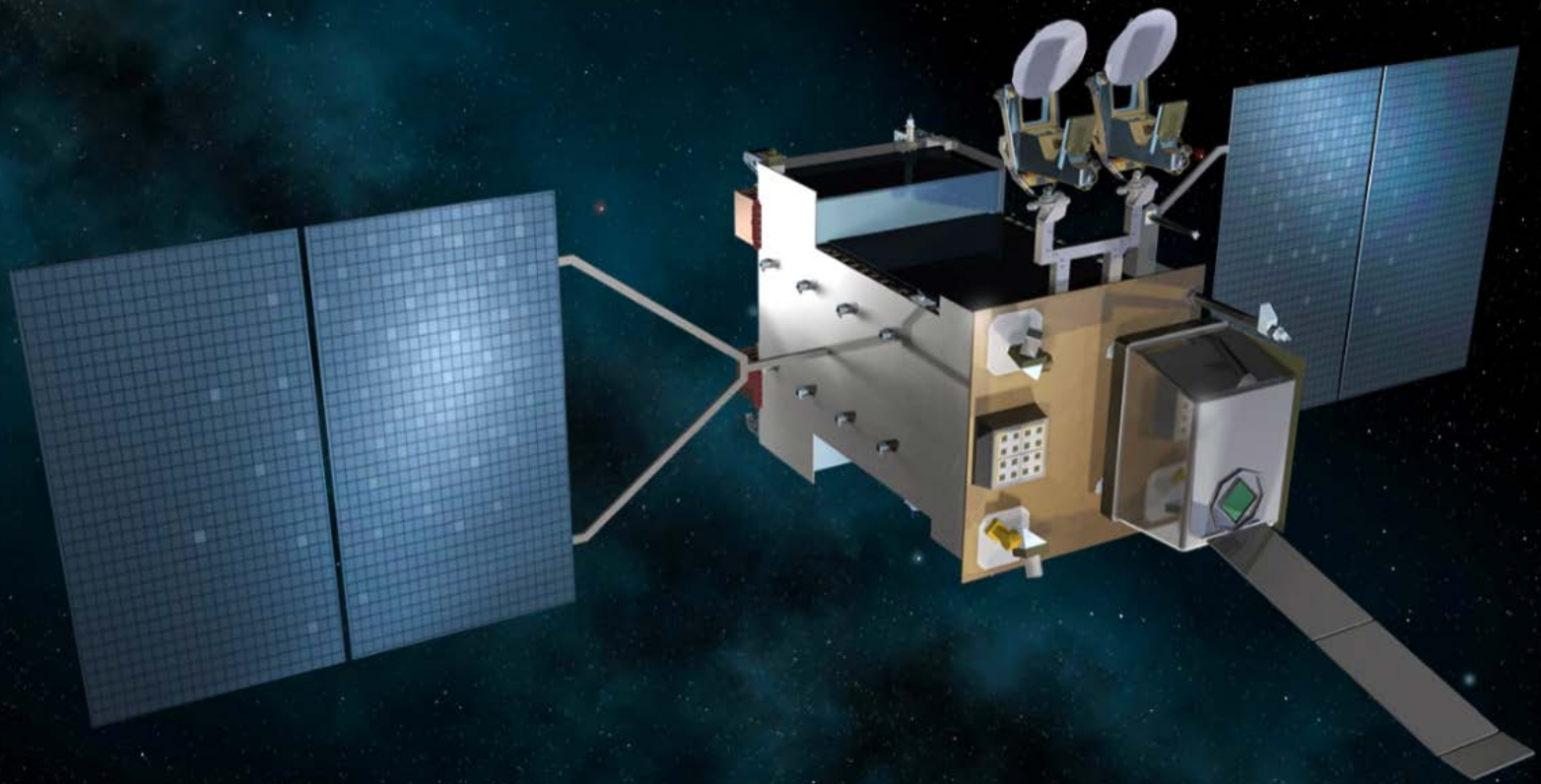
The United States' space-based missile warning system is about to become exponentially more resilient and complex to meet the evolving threats from its adversaries, Space Systems Command officials said.

"Missile warning is a foundational capability of the United States Space Force, and has been a foundational capability of what

*was previously the Air Force and Air Force Space Command for decades," said Col. **Brian Denaro**, SSC's Development Corps program executive officer. "It is the unblinking eye that is staring at the entire Earth, all the time. It has one very important mission: to look for missile threats — and it does it very, very well."*



Colonel Brian Denaro



Artistic rendition of Northrop Grumman's Next-Gen OPIR Polar satellite, courtesy of the company.

But that threat is evolving, and the United States Space Force (USSF) needs to evolve to counter that threat, which is why it plans to spend \$14.4 billion between now and 2025 on the **Next Generation Overhead Persistent Infrared (Next Gen OPIR)** system, which will enhance and eventually replace the **Space-Based Infrared System (SBIRS)**.

"Next Gen OPIR is the backbone of our nation's deterrence with war-winning performance and resilience against any adversary," Denaro explained. *"It is the first indicator when any missile is launched, whether that is a friendly or adversarial missile. And that kicks off an entire kill chain to make sure that the United States and its allies can mitigate that threat."*

Next-Gen OPIR consists of five satellites, the first of which is scheduled to be placed in geosynchronous orbit in 2025.

The first three GEO satellites are being built by **Lockheed Martin**; two additional satellites are being built for polar orbits by **Northrop Grumman**. Payloads for the satellites will be built by **Raytheon** and **Ball Aerospace**, among others.



Joseph Rickers

Block 0.

"Ballistic missile technology continues to advance and spread rapidly around the world," said **Joseph Rickers**, Lockheed Martin's Vice President and Program Manager for Next Gen OPIR Geo (NGG)

"Adversaries to our way of life — who once could never touch us — now proudly boast they have obtained the capability to do so," Rickers said. *"In 2020, SBIRS detected over a thousand missile launches globally, which is a continued escalation from prior years."*

He continued, *"Over the last two years, China and Russia have continued to build an entire spectrum of threats, including reversible jammers and ground-based laser systems capable of blinding or damaging satellites. These threats also include terrestrial threats such as hypersonic missile technology - with a shorter burn, different infrared radiation signature and non-standard flight patterns - as well as on-orbit threats such as the Russian "nesting doll" satellite and the Chinese satellite with a robotic arm that is on orbit today."*

Enter the Next-Gen OPIR system — GEO and Polar. Both have been designed with more sophisticated sensors for better data and also have been made more resilient to stand up to any attacks.

"The three Next Gen OPIR GEO Block 0 satellites are being designed to provide improved missile warning capabilities that are even more survivable against emerging threats," Rickers said. *"They will have new advanced sensors with the ability of detecting targets which are dimmer and faster."*

"In addition, Next Gen GEO (NGG) is being built on Lockheed Martin's LM 2100 Combat Bus," Rickers said. "This modernized space vehicle was intentionally designed to provide greater resiliency and cyber-hardening; enhanced spacecraft power, propulsion and electronics; common components and procedures to streamline manufacturing; and a flexible design that reduces the cost to incorporate future, modernized sensor suites or other mission augmentation capabilities."



Sarah Willoughby

"Next-Gen Polar (NGP) is on the leading edge of a broad U.S. effort to make our essential defense satellites more resilient in wartime," said **Sarah Willoughby**, Vice President of OPIR and the geospatial systems business unit for Northrop Grumman and Program Manager for Next-Gen OPIR Polar.

"With global technology proliferation, we don't expect space to be a sanctuary in the future," Willoughby said. "NGP is being designed for combat, with that in mind."

"If you pick up a globe and look down on the North Pole, you'll suddenly realize that the shortest path to the U.S. from places like Russia and China is directly over the Arctic," Willoughby said. "Missiles launched on those paths will give us the least warning before they hit targets in our homeland. Missile submarines hiding under the Arctic ice are even closer to the U.S. Warning times are frighteningly short."

She continued, "The Arctic is also warming up. As the ice melts, we're seeing more headlines every day about our strategic rivals competing to control untapped Arctic resources and new shipping lanes. Conflict in the Arctic may be a fact of life in the 21st century — and in a vast area twice the size of the continental U.S., missiles are an obvious weapon of choice. NGP needs to be on station, so we're not caught off guard if that happens. NGP will fly two independent satellites dedicated to the OPIR mission, as opposed to mounting sensors on a host platform like SBIRS-HEO. This will give Space Force operators full control, assuring that missile warning will always have top priority."



Colonel Daniel T. Walter

However, data can only be effective if it can be processed quickly and in such a way that human operators can make sense of it and swiftly act.

"A key component of the Next-Gen OPIR system is the Future Operationally Resilient Ground Evolution (FORGE) system, a modular, open-architecture mission-data processing framework that will not only support the current operational constellations, but also Next-Gen and

beyond," said Colonel **Daniel T. Walter**, SSC Next-Gen OPIR Program Manager. "The interim ground system, which will support SBIRS and all of the launch run-up activities in 2025 is on track to be ready by 2023."

"By having SBIRS and Next-Gen OPIR both run on FORGE, there won't be duplicate ground systems, which would be expensive from a sustainment perspective," said Colonel **Brian J. Gamble**, senior materiel leader in multi-domain awareness at SSC. FORGE also can be extended "so we can add items — space vehicles, sensor packages — to that ground system, and leverage mission-unique software for those various systems and integrate the outputs of those systems on the ground for a more comprehensive battlespace awareness picture. We can basically add containerized software to integrate things from multiple companies, multiple agencies in the future. It's extendable beyond just missile warning."



Colonel Brian J. Gamble

Some critics have been skeptical of the program, noting that SBIRS had serious cost overruns and schedule delays. SSC officials say Next-Gen OPIR was designed from the beginning to avoid the problems that plagued SBIRS — and has already successfully hit several early milestones.

"The Next Gen OPIR program continues to deliver within cost, schedule and performance targets established at the outset of the program," Denaro said. "To date, the Next-Gen OPIR program has hit every major milestone in support of an ambitious but achievable launch date. The program completed a System Requirements Review, a Preliminary Design Review, two parallel-path Mission Payload Critical Design Reviews (CDRs), as well as the Space Vehicle CDR, all on schedule."

"When we build a system — and Space Systems Command has decades and decades of program management experience — we know how to do this and how to do it well," Denaro said. "One of the key aspects is a very robust and detailed, integrated master schedule that pulls together the entire system on a timeline that delivers. Colonel Walter and his team have reliably and consistently hit those milestones as we march along to a very aggressive and achievable schedule. Achieving those milestones builds confidence for the program that we are on schedule to deliver in time for the warfighter's needs."

"Working closely with the Space Force, we are on track for delivering the first Next Gen OPIR space vehicle for launch in 2025," Rickers said. "In fact, we recently completed Critical Design Reviews for both our competitive payload provider teams and our Space Vehicle, and our System Level review was completed in October."

SPACE C2'S SOFTWARE HELPS USSF GUARDIANS WORK FASTER AND MORE EFFICIENTLY

"A space program of this size — which includes developing two entirely new missile warning payloads — has never moved this fast," Rickers noted. "That said, we've hit all of our contractual milestones to date since contract award in 2018. Our Go Fast Program Plan heavily leverages key decision points and early risk mitigation including Engineering Development Units for early design verification and interface integration and production process proofing to ensure schedule success."

"The U.S. has never put a global OPIR sensor with this much sensitivity, with a modern high-capacity downlink feeding advanced ground computers, onto a resilient combat bus with a view to the entire Northern Hemisphere," Willoughby said of NGP. "All of these technologies are mature today — if we just put them together, it will yield massive synergies for the mission."

The bottom line, according to *Denaro*, is that the Next-Gen OPIR system will have a high-fidelity sensor package, mated to a resilient spacecraft bus, in order to remain competitive in the ever-evolving space domain.

"USSF leadership deemed the development important enough to give us the freedom to employ a creative acquisition strategy that allows us to fully leverage private-sector innovation and field those capabilities in record time," *Denaro* said. "We do not have to look beyond this week's headlines to understand why leaders at every level of our force are raising awareness around our adversary's increasingly concerning activities in both the terrestrial and orbital domains."

Space Systems Command is the U.S. Space Force field command responsible for rapidly identifying, prototyping and fielding resilient space capabilities for joint warfighters. SSC delivers sustainable joint space warfighting capabilities to defend the nation and its allies while disrupting adversaries in the contested space domain. SSC mission areas include launch acquisition and operations; space domain awareness; positioning, navigation and timing; missile warning; satellite communication; and cross-mission ground, command and control and data.

Contact Space Systems Command at SSC@spaceforce.mil and follow on [LinkedIn](#).

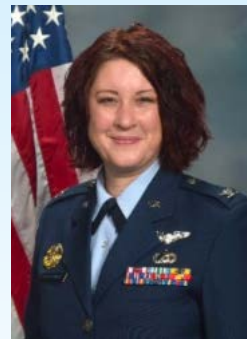


SPACE SYSTEMS COMMAND

The space domain has always required the most sophisticated technology humankind could develop to master it.

Today, the U.S. Space Force relies on Space C2 to quickly create the software that will help warfighters across all branches of the military do their jobs faster, better and with ever more accuracy — because lives depend on it.

Space C2 is Space Systems Command's West Coast coding factory for the U.S. Space Force, providing space domain awareness and battle management command-and-control software tools for the USSF, said Colonel **Jennifer M. Krolikowski**, SSC senior materiel leader for Space C2. Located in El Segundo, at Vandenberg Space Force Base and in Colorado Springs, Space C2 is made up of 35 teams composed of USSF Guardians and software industry professionals.



Colonel Jennifer M. Krolikowski



People also may know Space C2 by its nickname, "Kobayashi Maru," in a nod to the Star Trek Starfleet Academy training simulation designed to test cadets by putting them in a no-win command scenario. (In "Star Trek II: The Wrath of Khan," Captain Kirk says he beat the program by secretly reprogramming it so he could win.)

"It's one of the tenets we have in Kobayashi Maru: how do you look at the problem differently, how do you find new solutions, how do you actually change the conditions in order to win?"

Krolikowski said. "We're looking for people who want to be innovative, want to solve problems and ultimately get capability out for our users. This is what helps attract the workforce and the type of people we want. When they see that you are truly embracing this type of culture, then it draws people to want to work here."

Captain **Daniel Eichman**, USSF, said he had no idea he'd be able to do software development when he joined the military. Even with an undergraduate degree and a master's degree in computer engineering, he spent his first years working with satellites.



*Captain Daniel Eichman USSF, working on an application at Space C2.
U.S. Space Force photo by Staff Sgt. Andrew Moore.*

"I was really looking forward to doing some sort of software development, but it's kind of rare that people in uniform get an opportunity to write code," Eichman said. "Here, we are the U.S. Space Force's software factory, and we have a multitude of ways to develop software. We have organic teams — contractors in house and civilian and Air Force people working in teams as project managers and designers and developers — which allows us to provide value in a unique way."

"Technology is eating the world, and if it's eating the world, then it's definitely eating the war," said 1st Lieutenant **Oscar Chacon**, USSF, Space Tasking Cycle Portfolio lead. "We have a lot of capabilities at these operations centers that are being run on Microsoft products that weren't built to handle space workflows, space processes. We need to change that, which is why the applications we're building help improve those processes so things aren't as manual — you can start to see the data in a certain way that it wasn't capable of being seen before," Chacon said.

He continued, "(Our software) allows the operators to spend less time manually inputting certain data, and more time making strategic decisions in their day-to-day process."



*1st. Lieutenant Oscar Chacon USSF, space tasking cycle portfolio lead at Space C2.
U.S. Space Force photo by Staff Sgt. Andrew Moore*

One Space C2 application took a process that would have ordinarily taken four hours to complete — manually, by one person — and turned it into an automated process that uses fresh data, can be accessed by anyone on the team and completed in 15 minutes, Krolikowski said.

"We're challenging the traditional acquisition process in delivering software," Chacon said. "By questioning it, we're making sure that our operators who are receiving these applications are at the forefront of the development process. We're emphasizing User Centered Design (UCD) which means we interview the operators as we're developing, showing them prototypes, allowing them to see and provide feedback on the application that they'll be receiving, which is the first time we're doing that as a software acquisition community."

About three years ago, Space C2 moved from a traditional "waterfall" software development methodology — software is designed in a linear series of phases — to an **Agile** one, which breaks up software design into iterations and "sprints," allowing changes to be made at multiple points in a project.

"In many cases, people would design software for two or three years, thinking they understood what was needed — they'd have a capabilities document that they'd get from the requirements community, and that was thrown over the fence to the acquisition community, and then the acquisition community would have to try and interpret it, and see if they could translate it back to a contractor," Krolikowski said. "Then the contractor would work on it, and then you throw it over the fence to the users and hope that everyone was happy with the whole process."

Using an Agile process allows feedback from the end users throughout the project, and results in software deployed in the field in a much faster timeframe and in an end version that truly meets the needs of the warfighters, she said.

"We've had 11 different applications delivered to the field in under three years — versus something like JMS (Joint Mission System), our predecessor, that had one application delivered after eight years," Krolikowski said.

"A lot of the people who work here get super-excited because they actually see the effects of their work," Krolikowski said. "The initial minimum viable capability can be done in 180 days — six months from when the team scales up and gets their first outcome definition, and they do the discovery and framing with the users to when there's software in their hands that's been operationally accepted. And that drives a lot of the passion and satisfaction in my workforce.

"The way we end up doing it now, it's more about outcomes and what is it that the user is really trying to do in their daily lives? What are their workflows? How can we help optimize them? When we focus on that, and take small chunks and say, 'Here, I automated this for you,' then they can say, 'Yes, that's great,' or 'No, that doesn't fit my needs; can you tweak it?'"

"Our mission here at Kobayashi Maru is to deliver software that operators love," Chacon said. "That 'love' piece sounds atypical of the military, to hear a mission statement say 'love' — but we truly do mean it because we keep the operator at the front of our minds when we're doing everything, and I think that's a big part of why people really enjoy being here."

But using an Agile methodology doesn't mean Space C2 doesn't have an over-arching vision or end state, Krolikowski said.

"We still have to provide space domain awareness and battle management command-and-control," the colonel said. "We still know the specific elements of an architecture that help enable that, and we're very deliberate on those processes to make sure things are tested and cyber-secure. But we allow flexibility to be there at the lower level to evolve how the mission is conducted, optimized or automated in order to go after what the users truly need."

All of this reflects the fact that the space domain has changed dramatically from a largely peaceful and benign one to a much more congested and contested realm, with companies

launching large constellations of satellites such as SpaceX's Starlink and threats from adversaries such as China and Russia, Krolikowski said.

There also are services and pieces of Space C2's architecture that can extend to other mission threats, including cyber operations, Krolikowski said. Space C2 also has worked with other partners, including **NORTHCOM** and the **Department of the Air Force**.



"The threat against the space capabilities our nation depends upon are real and growing," said Colonel **Wallace "Rhett" Turnbull III**, Director, Cross Mission Ground and Communications Enterprise at SSC. "The Agile approach we've taken with the Space C2 program postures the USSF to compete, deter, and win against a growing threat.



"We're rapidly delivering applications to solve our Guardians' near term pain points while also building more complex command and control capabilities all while remaining nimble enough to pivot quickly to changes in the threat environment," Turnbull said. "This combination of Guardian and Airmen coders and industry partnership is allowing us to deliver more quickly than ever before!"



SPACE SYSTEMS COMMAND: FOCUS ON THE THREAT

Author: USSF Space Systems Command (SSC)

In October, Russia tested an anti-satellite (ASAT) weapon in Low Earth Orbit (LEO) that created a debris field of more than 1,500 trackable objects, and sent seven astronauts on the International Space Station scrambling for shelter as the orbital laboratory passed through the debris cloud.

China may have tested a hypersonic missile in August; one that travels at five times the speed of sound while maneuvering in the lower atmosphere, making them difficult to detect and track.

These are just two examples of the kinds of the issues that keep everyone at Space Systems Command — the Guardians, Airmen, government civilians and contractors who work there — awake at night: analyzing, planning and preparing to counter the threats — so you don't have to.

Lt. Gen. Michael A. Guetlein, SSC Commander

"I wake up every morning with an increasing sense of urgency that we have to do more to deliver capabilities faster to the nation in order to counter the increasing threat to our space systems. The freedoms we take for granted every day, and our way of life, is threatened on a daily basis. I have four daughters and I want them and their children's children to be afforded the same liberties afforded us by our founding fathers. Today, the adversary has not only demonstrated the capability to prevent our use of space for peace and for defense, but they have also demonstrated the will to do so. We must out-pace, out-think, and out-maneuver the adversary, or we risk losing it all."

Brig. Gen. Stephen G. Purdy Jr., Commander, Space Launch Delta 45 and Director, Eastern Range, Patrick Space Force Base, Florida

"I sleep soundly at night knowing that Space Launch Delta 45 is aggressively expanding our capability and throughput. We integrated a brand new launch provider to the Eastern Range in only 6 months, stood-up cyber defense from scratch, pioneered an agreement with the FAA and U.S. Navy which saves us roughly 1,100 hours annually in range coordination, and trail-blazed lightning range ring reductions decreasing work-stoppage time by 20%. We are planning integration of multiple new space launch providers, potentially launching hundreds of rockets every year in the near future. At Patrick SFB, Cape Canaveral SFS and Ascension Island the future is bright, is here now, and we are excited."

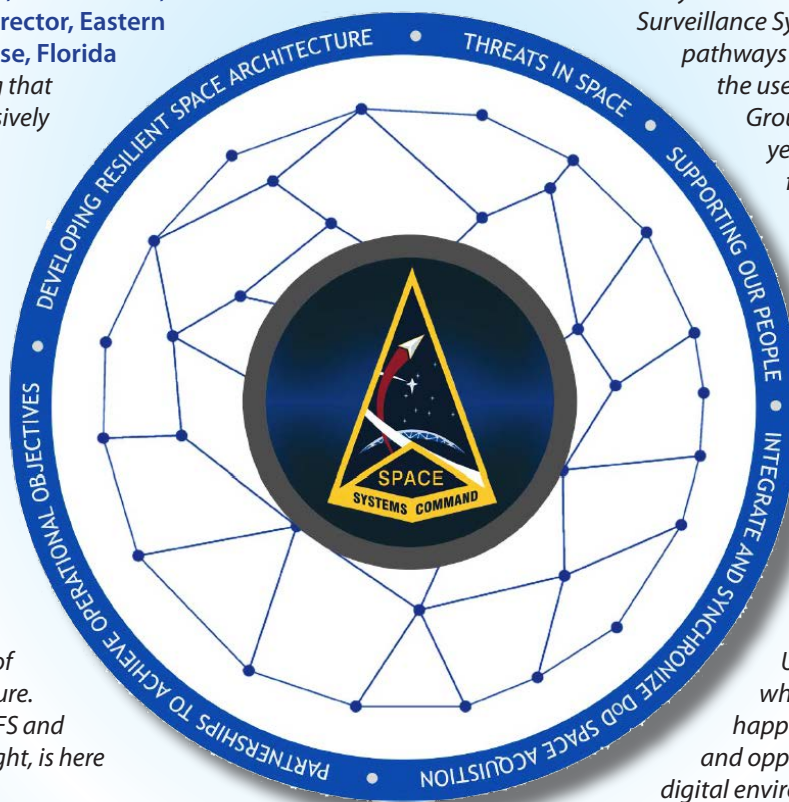
Col. Chris Ward, SSC division chief, Missile Defense and Missile Warning Systems

"Ensuring USSF focuses on the whole battlefield versus just responding to the immediate threat and thinking one-dimensional. Entering a space arms race with China gives me Cold War flashbacks, except then we were willing to take more

risks to stay ahead. SSC's Strategic Warning and Surveillance Systems Directorate is developing pathways to provide relevant capability to the users that has been dormant in the Ground Based Radars. In the next year, we will improve message formats, object classification, and transmission pathways to enable these radars to provide more data at quicker speeds to decision makers in the missile defense, missile warning, and space domain awareness missions."

Deidra A. W. Eberhardt, SSC acting director, Space Systems Architect

"I'm excited about the work SSC is doing towards moving the Command and ultimately USSF to a digital ecosystem— what keeps me up is it cannot happen soon enough! The benefits and opportunities of a multi-level secure, digital environment will positively affect each of us ... from more efficient and faster data movement/sharing for decision-makers, to enabling stronger partnerships with and among international partners, DoD, federal agencies, industry, and others, to optimizing workflows for the work SSC accomplishes daily. Transforming to a digital ecosystem is key for continuing to outpace any threat to the space enterprise."



Lt. Col. Paul La Tour, SSC materiel leader for Evolved Strategic SATCOM

"The current operational design of U.S. space assets has delivered exquisite, high-capability systems and immense value to warfighters across the globe. The day may come when U.S. orbital assets will be lost or held hostage as a mechanism of coercion. The designs of the past have been optimized for cost with the assumption that the earth-orbit was a sanctuary. The systems we must now field are ones that we know will be at risk before development begins and until the day they exit service. The systems of the future must: possess sufficient resilience, degrade gracefully, and be reconstituted efficiently. We must arm the U.S. with capabilities that will allow leadership to make strategic trades and not force U.S. policy to be dictated by threats to our assets; our leadership must have the confidence that our space assets are instruments of national power."

Col. Matthew Spencer, SSC senior materiel leader and GEO/Polar division chief.

"What keeps me awake at night is the balance we must strike between focusing our satellites entirely on increased capability, and the growing requirement to protect and defend the satellites in orbit. The environment is no longer a peaceful domain and it is a painful process to carve out mission capability to provide for defensive measures. I sleep better knowing launch costs continue to drop and facilitate the replenishment of on-orbit capabilities with the power to fight our enemies without a loss of mission to the warfighters."

Lt. Col. Omar Villarreal, SSC director, Public Affairs & Strategic Communication

"The fact that life as we know it...the creature comforts, the ease of transportation, our financial freedom and so much more ... could all be compromised without assured access and responsible use of space. Threats in space — that I had no idea about before joining Space Systems Command four months ago — exists and could change our tomorrow unless we act now."

Capt. Connor Hagan, SSC chief of Space Vehicle Integration and Development

"Recent adversary advancements in space technology demonstrate a keen ability to leverage all instruments of their National Power to achieve strategic goals and milestones on orbit; holding to timelines that were previously thought to be out of their reach. Maintaining our space dominance into the future will require novel solutions and relationships across the United States' commercial, civil, and defense communities - with the USSF and SSC acting as key capability integrators and policy drivers. SSC is uniquely postured as the conduit to industry in order to put tomorrow's ideas on today's contracts. Space Force initiatives, such as the University Partnership Program and SpaceWERX, ensure that we are thoughtfully cultivating upstream engagement in order to optimize our acquisition strategies and capitalize on private-sector innovation and development velocity."

Bryan Blue, SSC and Los Angeles Air Force Base Community support coordinator

"Ensuring the resiliency of our personnel and identifying their sometimes heavily-masked quality of life issues impacting Total Force readiness. Knowing that someone who needs emotional help, hasn't yet taken advantage of the resources available to them. Knowing there are Guardians and Airmen who come to work struggling."

Samantha Cox, SSC director, Manpower and Personnel

"Always planning... for my future and for the future of SSC's personnel; keeping the horizon open to allow for the unexpected. I have the eternal optimism to believe I have the power to drive the change that is needed. I believe in the power of one person to make a significant impact. So long as I hold that truth, worry of the unknown and the plague of what-ifs is staved."

Dan Crouch, SSC senior materiel leader, Prototype Operations division

"This is an unprecedented time for the USSF to rapidly deliver space capabilities to the warfighter. As we've seen over the last 10+ years, threat nations such as China, Russia, and North Korea are swarming space with new and advanced capabilities at a rapid pace. A primary objective of SSC's Innovation and Prototype (I&P) directorate is to address the threats, build capability, demonstrate and assess advanced prototype capabilities to inform the next generation production systems. Our Rendezvous and Proximity (REPR) Operations Center serves as an advanced operations environment providing rapid on-orbit operations and testing of multiple satellites, at multiple classification levels using a common Multi-Mission ground command and control system quadrupling the capacity to fly missions. Our ability to quickly address threats, learn, and deliver capability at an unprecedented pace will keep us on the leading edge of technology."

Capt. Forrest Babbitt, SSC FORGE C2X program manager

"Awarding contracts can be a complex and drawn-out process which can have detrimental effects to the warfighter if awarded late. Through SSC's Space Enterprise Consortium (SpEC), the Space Force has worked with close to 800 traditional and non-traditional organizations to decrease award timelines. Creating faster award times can increase timely deliveries to the warfighter and ensure that the Space Force stays ahead of the competition."

John Karns, SSC chief, Portfolio Integration Division

"In the past two years we have seen the birth of a new service, the stand up of a new command and multiple space launches that have not only improved warfighter capabilities but have also aided many of us with our navigational challenges and banking needs. It brings me great pride to stand amongst the men and women of SSC and the Space Force who are working tirelessly to bring future technologies from intellectual concepts to operational systems in an effort to keep the United States and our international partners at the forefront of space."

www.ssc.spaceforce.mil



2021 has been a very good year for AvL Technologies. The return to live shows, shaking hands and seeing smiling faces was a vast improvement over 2020. We experienced a brush with greatness with Jim Oliver's induction into the 2021 Space & Satellite Hall of Fame, rolled out many new products and product improvements, and added several brainiacs to our team. 2021 has been awesome!



Jim Oliver and his wife, Kendall, displaying his Satellite Hall of Fame award.

When I was copied on THE email from Robert Bell of SSPI on Feb. 23rd – notifying Jim Oliver that he had been selected for the Space & Satellite Hall of Fame class of 2021 — I screamed with excitement. I called **Tony Wilkey**, AvL SVP, and couldn't stop



A proud day for Jim Oliver and his wife, Kendall, celebrating his Satellite Hall of Fame award.

screaming. But Tony knew, immediately, what would make me so excited to render me speechless. I had nominated Mr. Oliver for the Hall of Fame several years prior, unbeknown to him, and Tony helped with every step, including asking industry greats for letters of recommendation.

Tony soon was screaming with me. He called Jim's wife, Kendall, as I called Jim. Jim and Kendall happened to be in their car, driving, when both calls came in together and they were worried something bad had happened at AvL. On the contrary, I had the honor of telling Mr. Oliver that he had a very important email

YEAR IN REVIEW: AVL TECHNOLOGIES

in his inbox from **Robert Bell** stating that he will be inducted into the Hall of Fame. I then confessed to my shenanigans of nominating him without his knowledge and with the help of Tony as well as Jim's lovely wife and daughters.

The induction ceremony was conducted, virtually, on March 23rd, and Mr. Oliver was inducted with a group of industry pioneers who changed, improved and enabled satellite communications as no other group could: **Peter B. deSelding**, Co-Founder and Chief Editor of *SpaceIntelReport*, **Kathryn L. Lueders**, Associate Administrator for Human Exploration and Operations Mission Directorate at NASA, and **Gladys B. West**, Mathematician (retired), for the *Naval Proving Ground* in Dahlgren, Virginia.

WOW! From reporting on SATCOM controversies and holding business leaders accountable, to integrating commercial launch into NASA's human space exploration, to modeling a critical building block for GPS, to designing and producing the most reliable ground terminals in the industry — this group is nothing short of amazing!

At AvL we celebrated... a lot! We asked our sister company, **StreamVu**, to help stream the induction ceremony into all parts of the AvL campus so all of the employees could watch — and cheer! Mr. Oliver then moved outside to speak to the entire AvL team, received congratulations and everyone saw his award. As an AvL employee and the ringleader for Mr. Oliver's nomination, this was the **best... day... ever**.



Todd Brown

The D.C. trade show was pushed back a bit to July, but it was wonderful to fill our booth with new products and see our industry peeps again. AvL's **Dave Provencher** spoke on *Designing Ground Systems for the Modern Militaries on the Move* panel, we showcased a new **75cm / 98cm Terminal** with a quick-change reflector and feed kit, showcased the new **2.4m** manually operated ultra-light antenna, and introduced **Todd Brown**, **Jongsoo Kim** and **Dan Nichols** to the AvL team.



Jongsoo Kim

The new **75cm / 98cm Terminal** is an enhancement to the 75cm Terminal, which enables an upgrade to a 98cm, ultra-lightweight, manual point flyaway with a quick-change reflector and feed kit. The antenna reflector does not need to be disassembled and the RF kit does not need to be removed — the



Dan Nichols

reflector and RF kit are removable together and can be replaced with a snap-into-place 98cm reflector and RF kit.

The terminal includes a rugged and sturdy folding tripod and positioner with course and fine adjustments and easy-to-read scales for **Az/EI/PoI** adjustments. The six-piece 75cm reflector is optimized for a tri-band terminal with X-, Ku- and Ka-band RF kits that snap into place with no tools or adjustments required. Band changes can be accomplished in less than one minute. The terminal packs into one or two IATA-compliant cases including ancillary equipment.

AvL's new **2.4 meter axi-symmetric, manually operated antenna** is ultra-lightweight and has a small two-case pack-up. The 9-piece carbon fiber reflector is designed to operate in X, Ku and Ka-band with new bayonet-style feeds and quick-change RF kits. The antenna is modular with numerous BUC and LNB options, and it supports RF or modem peaking.



Photo of AvL Technologies' 2.4m axi-symmetric, manually operated antenna, courtesy of the company.

YEAR IN REVIEW: AVL TECHNOLOGIES

This manual operation antenna functions on an aluminum space frame, which enables set-up or pack-up by one person in minutes. Once the antenna is set-up and anchored, the antenna is easily repositioned using simple, ergonomic pointing assist features — no anchor adjustments needed — for fine tuning to one satellite or pointing to a different satellite.

AvL's new team members were introduced during the D.C. show: **Todd Brown**, Director of Business Development, **Jongsoo Kim**, Senior SATCOM Systems Engineer, and **Dan Nichols**, Director of Corporate Accounts. Mr. Brown joined AvL after a successful career in with the **U.S. Department of Defense** as a proven leader in AvL's key markets and the communications industry as a whole. His sustained performance was recently awarded the **Special Operations Command Civilian Communicator of the Year for 2020**.

Mr. Kim has more than 25 years of cross-functional systems engineering experience that includes antennas, SATCOM system hardware and software architectural design, experience with ground terminals and the space segment, active RF component design and traffic engineering, and expertise with regulatory compliance. He is leading AvL's efforts with the development of electronically steered terminals among developing other advanced antenna and terminal products.

Mr. Nichols has more than 20 years of experience in satellite communications, most recently as the Director of

Engineering for **Envistacom**. He also founded and operated his own consulting company, **Apogee Technical Solutions**, and provided engineering consulting, technical writing, training curriculum development and delivery for large government prime contractors and the **U.S. Department of Defense (DoD)**.

We closed out our trade show efforts with the **Satellite Innovation Symposium** in northern California in October. This symposium continues to be lively and insanely informational, and we appreciated many speakers' eagerness to address controversial topics, such as space debris.

AvL's **Tony Wilkey** spoke on the **Terrestrial Infrastructure Enablers for Advanced Space Systems Panel**, and AvL's **Bryan Kerns** spoke on **Comparing Terrestrial Hardware Requirements for LEO vs. MEO Traditional HTS Transmissions** panel.

In our booth, we showed many, many symposium participants our new **75cm / 98cm Terminal**, and we closed the show feeling energized and excited about the forthcoming shows in 2022.

Throughout 2021, AvL continued to take new products to customer with live demos. Our "road show" team took the company's truck and trailer (*packed full of terminals*) out to meet customers and sometimes flew to meet, greet and demo when such transportation modes made more sense.

We collaborated with RF makers, integrators, network operators and MIL end-users at numerous demos. Feedback from participants was priceless and we continued to hone a few product details, that has resulted in additional, new product capabilities.

What's in store for AvL in 2022? **A LOT!** We're launching some extremely exciting new products in Q1 and the company can't wait to engage in road show demos and trade show expos to reveal all of the technical goodness to interested parties.

Author Krystal Dredge is the Marketing Director at AvL Technologies

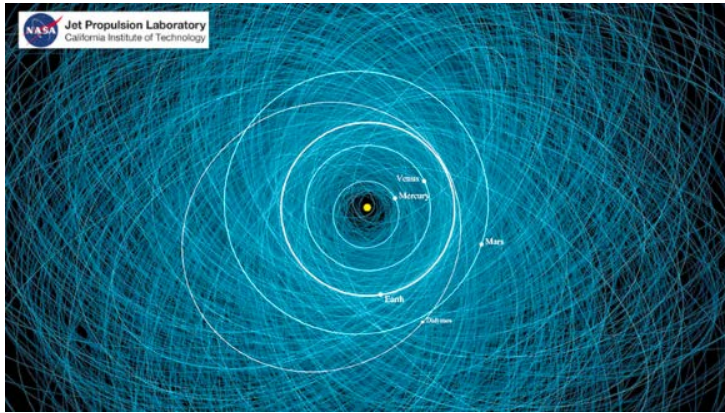


AvL Technologies new 75cm / 98cm terminal, photo is courtesy of the company.



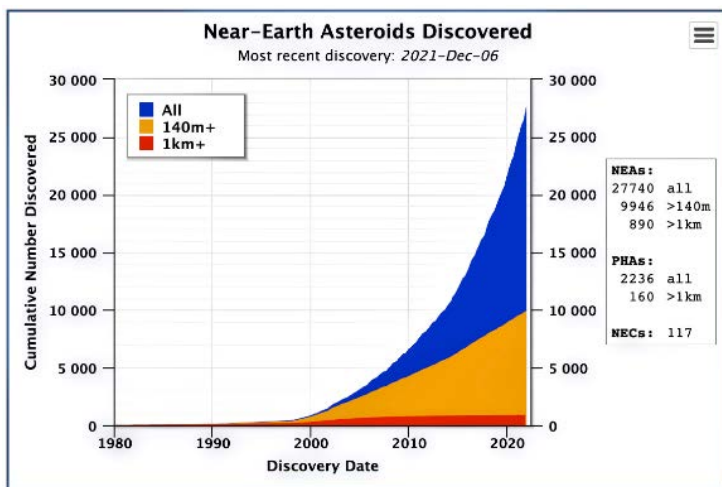
NASA'S NEXT-GENERATION ASTEROID IMPACT MONITORING SYSTEM GOES ONLINE

The new system improves the capabilities of NASA JPL's Center for Near Earth Object Studies to assess the impact risk of asteroids that can come close to our planet.



This diagram shows the orbits of 2,200 potentially hazardous objects as calculated by JPL's Center for Near Earth Object Studies (CNEOS). Highlighted is the orbit of the double asteroid Didymos, the target of NASA's Double Asteroid Redirect Test (DART) mission. Credits: NASA/JPL-Caltech

To date, nearly 28,000 near-Earth asteroids (NEAs) have been found by survey telescopes that continually scan the night sky, adding new discoveries at a rate of about 3,000 per year. However, as larger and more advanced survey telescopes turbocharge the search over the next few years, a rapid uptick in discoveries is expected. In anticipation of this increase, NASA astronomers have developed a next-generation impact monitoring algorithm called Sentry-II to better evaluate NEA impact probabilities.



Popular culture often depicts asteroids as chaotic objects that zoom haphazardly around our solar system, changing course unpredictably and threatening our planet without a moment's notice.

This is not the reality. Asteroids are extremely predictable celestial bodies that obey the laws of physics and follow knowable orbital paths around the Sun.

But sometimes, those paths can come very close to Earth's future position and, because of small uncertainties in the asteroids' positions, a future Earth impact cannot be completely ruled out. So, astronomers use sophisticated impact monitoring software to automatically calculate the impact risk.



Managed by NASA's Jet Propulsion Laboratory, the Center for Near Earth Object Studies (CNEOS) calculates every known NEA orbit to improve impact hazard assessments in support of NASA's Planetary Defense Coordination Office (PDCO). CNEOS has monitored the impact risk posed by NEAs with software called Sentry, developed by JPL in 2002.

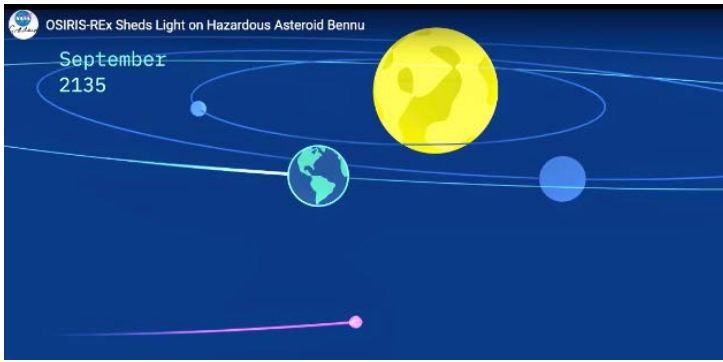


"The first version of Sentry was a very capable system that was in operation for almost 20 years," said Javier Roa Vicens, who led the development of Sentry-II while working at JPL as a navigation engineer and recently moved to SpaceX. "It was based on some very smart mathematics: In under an hour, you could reliably get the impact probability for a newly discovered asteroid over the next 100 years – an incredible feat."

But with Sentry-II, NASA has a tool that can rapidly calculate impact probabilities for all known NEAs, including some special cases not captured by the original Sentry. Sentry-II reports the objects of most risk in the CNEOS Sentry Table.

By systematically calculating impact probabilities in this new way, the researchers have made the impact monitoring system more robust, enabling NASA to confidently assess all potential impacts with odds as low as a few chances in 10 million.

As an asteroid travels through the solar system, the Sun's gravitational pull dictates the path of its orbit, and the gravity of the planets will also tug at its trajectory in predictable ways. Sentry modeled to a high precision how these gravitational forces shaped an asteroid's orbit, helping to predict where it will be far into the future. But it couldn't account for non-gravitational forces, the most significant being the thermal forces caused by the Sun's heat.



A video explains how asteroid Benu's orbit around the Sun was determined by considering gravitational and non-gravitational forces, helping scientists to understand how the asteroid's trajectory will change over time.

As an asteroid spins, sunlight heats the object's dayside. The heated surface will then rotate to the asteroid's shaded nightside and cool down. Infrared energy is released as it cools, generating a tiny yet continual thrust on the asteroid. This phenomenon is known as the Yarkovsky effect, which has little influence on the asteroid's motion over short periods but can significantly change its path over decades and centuries.

This video explains how asteroid Benu's orbit around the Sun was determined by considering gravitational and non-gravitational forces, helping scientists understand how the asteroid's trajectory will change over time. Credits: NASA's Goddard Space Flight Center

*"The fact that Sentry couldn't automatically handle the Yarkovsky effect was a limitation," said **Davide Farnocchia**, a navigation engineer at JPL who also helped develop Sentry-II. "Every time we came across a special case — like asteroids Apophis, Benu or 1950 DA — we had to do complex and time-consuming manual analysis. With Sentry-II, we don't have to do that anymore."*

Another issue with the original Sentry algorithm was that it sometimes couldn't accurately predict the impact probability of asteroids that undergo extremely close encounters with Earth. The motion of these NEAs gets significantly deflected by our planet's gravity, and the post-encounter orbital uncertainties can grow dramatically. In those cases, the old Sentry's calculations could fail, requiring manual intervention. Sentry-II doesn't have that limitation.

*"In terms of numbers, the special cases we'd find were a very tiny fraction of all the NEAs that we'd calculate impact probabilities for," said **Roa Vicens**. "But we are going to discover many more of these special cases when NASA's planned NEO Surveyor mission and the Vera C. Rubin Observatory in Chile go online, so we need to be prepared."*

This is how impact probabilities are calculated: When telescopes track a new NEA, astronomers measure the asteroid's observed positions in the sky and report them to the **Minor Planet Center**. CNEOS then uses that data

to determine the asteroid's most likely orbit around the Sun. But because there are slight uncertainties in the asteroid's observed position, its "most likely orbit" might not represent its true orbit. The true orbit is somewhere inside an uncertainty region, like a cloud of possibilities surrounding the most likely orbit.

To assess whether an impact is possible and narrow down where the true orbit may be, the original Sentry would make some assumptions as to how the uncertainty region may evolve. It would then select a set of evenly spaced points along a line spanning the uncertainty region. Each point represented a slightly different possible current location of the asteroid.

Sentry would then wind the clock forward, watch those "virtual asteroids" orbit the Sun, and see if any came near Earth in the future. If so, further calculations would be required to "zoom in" to see whether any intermediate points might impact Earth, and if they did, estimate the impact probability.

This animation shows an example of how the uncertainties in a near-Earth asteroid's orbit can evolve with time. After such an asteroid's close encounter with Earth, the uncertainty region becomes larger, making the possibility of future impacts more challenging to assess.

Sentry-II has a different philosophy. The new algorithm models thousands of random points not limited by any assumptions about how the uncertainty region may evolve; instead, it selects random points throughout the entire uncertainty region. Sentry-II's algorithm then asks: What are the possible orbits within the entire region of uncertainty that could hit Earth?

This way, the orbital determination calculations aren't shaped by predetermined assumptions about which portions of the uncertainty region might lead to a possible impact. This allows Sentry-II to zero in on more very low probability impact scenarios, some of which Sentry may have missed.

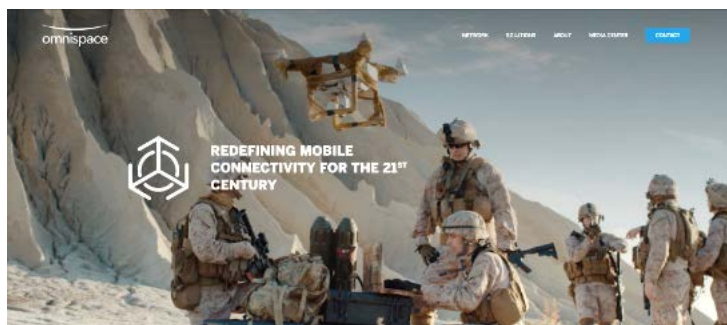
Farnocchia likens the process to searching for needles in a haystack: The needles are possible impact scenarios, and the haystack is the uncertainty region. The more the uncertainty in an asteroid's position, the bigger the haystack. Sentry would randomly poke at the haystack thousands of times looking for needles located near a single line stretching through the haystack. The assumption was that following this line was the best way of searching for needles. But Sentry-II assumes no line and instead throws thousands of tiny magnets randomly all over that haystack, which quickly get attracted to, and then find, the nearby needles.

*A study describing Sentry-II was published in the *Astronomical Journal* on December 1, 2021*

OMNISPACE AND VULCAN WIRELESS' DEMONSTRATION OF PORTABLE MILITARY RADIOS COMMUNICATING VIA COMMERCIAL SATELLITE



Omnispace, which is seamlessly uniting mobile and satellite to create the world's only truly global 5G mobile network, and **Vulcan Wireless Inc.** announced successful voice and data communication between its NGSO on-orbit satellite and a widely fielded model of mobile tactical military communications radios (PRC-117G).



As part of Omnispace's Phase II Small Business Innovation and Research (SBIR) contract, the demonstration was in cooperation with U.S. Space Force's Space Systems Command.

The contract was awarded as part of the U.S. Airforce's "Space Pitch Day," enabling Omnispace to bring next-generation narrowband capabilities to the warfighter.

The Omnispace next-generation global 5G network is being architected to support "dual-use," mission-critical enterprise and secure government applications.

Unlike legacy commercial and government networks, Omnispace's global system is being designed in line with 3GPP 5G NTN standards, which will enable interoperability for any compatible 5G commercial or government device.

Omnispace's 5G NTN platform will be helpful to government customers' reliability, and real-time decision-making by enabling advanced tactical handheld communications, **Military Internet-Of-Things (MIoT)**, and battlefield edge processing.

Together with Vulcan, the test successfully demonstrates the ability to connect the global Omnispace satellite network directly to existing mobile devices — addressing warfighter needs "at the edge" within the joint all-domain command and control (JADC2) architecture.

"One of the biggest challenges for the evolution of military enterprise communications is the cost and adaptation of legacy end-user equipment," said **Campbell Marshall**, Omnispace's Vice President for Government and International Markets. *"This demo proves that software-defined mobile, tactical user equipment can leverage our dual-use commercial infrastructure. Imagine the possibilities that 5G technology will enable for government — from COTM handheld devices to IoT platforms."*

The demonstrations with Vulcan Wireless were focused on connecting existing military hardware to satellites in commercial frequency bands and orbits, not traditionally used by government, to increase the resiliency of battlefield communications.

"The Vulcan Wireless and Omnispace teams worked closely to successfully conduct a live demonstration, integrating existing tactical communication systems with the Omnispace satellite network," said **Kevin Lynaugh**, CEO, Vulcan Wireless Inc. *"We're pleased with the results, which demonstrate how global, borderless beyond line of site (BLOS) connectivity is possible for real world military applications."*

These communications capabilities are the cornerstone for next-generation warfighting concepts such as multi-domain operations (MDO) and expeditionary advanced based operations (EABO) which are focused on minimizing physical and RF signatures.

SECRETARY OF DEFENSE EXPLAINS HOW THE U.S. WILL TAKE ON THE CHALLENGE OF CHINA

Author: Jim Garamone, Department of Defense

"China is not 10-feet tall," Secretary of Defense Lloyd J. Austin III said at the Reagan Library in California recently, and the United States is not a "country that fears competition."



China is a challenge to the United States and all democracies, but America and its allies will rise to the challenge. *"And we're going to meet this one with confidence and resolve — not panic and pessimism,"* Austin said.

Austin noted that President Joe Biden has said the United States is in *"stiff competition"* with China, and he has said that China is the U.S. military's *"pacing challenge."*

China is using all elements of national power to overturn the international rules-based architecture that has served the world so well since the end of World War II.



In his speech to the ***Reagan National Defense Forum***, Austin delved into the competition

with China, and what the ***Defense Department*** is doing to preserve the rules-based construct.

He noted that the world has seen two decades of *"breakneck modernization"* by the ***People's Liberation Army***. *"China's military is on pace to become a peer competitor to the United States in Asia — and, eventually, around the world,"* he said. *"China's leaders are expanding their ability to project force and to establish a global network of military bases. Meanwhile, the PLA is rapidly improving many of its capabilities, including strike, air, missile-defense and anti-submarine measures. And it's increasingly focused on integrating its information, cyber and space operations."*



The last is a combat domain with few rules and that increases the risk of escalation and miscalculation, he said. China is financing key technology sectors that have both civilian and military applications. China's nuclear posture is advancing as well, and the secretary said that China will possess at least a thousand nuclear warheads by 2030 and they are building a nuclear triad to deliver them.

"Now, we always assess not just capabilities but also intentions and actions," he said. *"The leaders of the Chinese Communist Party have been increasingly vocal about their dissatisfaction with the prevailing order — and about their aim of displacing America from its global leadership role. China's President, Xi Jinping, regularly talks about 'great changes unseen in the world in a century.' And he recently assured his fellow Party members that 'time and momentum are on China's side.'"*

China has a dismal human rights record and is bullying countries in Asia and Africa. *"Beijing is misusing technology to advance its repressive agenda at home and exporting the tools of autocracy abroad,"* Austin said.

Given all this, Austin does not see conflict as inevitable. The United States does not want a new Cold War.

"We're determined to deter aggression, and to prevent conflict, and to establish common sense guardrails," he said. *"And our new initiatives are part of a government-wide approach that draws on all tools of national power to meet the China challenge."*

The concept undergirding next year's ***National Defense Strategy*** is *"integrated deterrence,"* Austin said. *"It means integrating our efforts across domains and across the spectrum of conflict to ensure that the U.S. military — in close cooperation with the rest of the U.S. government and our allies and partners — makes the folly and costs of aggression very clear,"* he said.

He discussed two elements of integrated defense: partnership and innovation.

"First, we're building on a lesson that I learned over four decades in uniform: In war and in peace, we're always stronger when we work together with our friends. That defines our approach to the China challenge," Austin said.

This does not mean the United States will build an Asian NATO or an anti-China coalition like the one that defeated ISIS. *"And we're not asking countries to choose between the United States and China,"* he said. *"Instead, we're working to advance an international system that is free, stable and open."*

This means working closely with long-time allies and new partners around the globe, he said. The secretary noted that he has made three trips in 10 months to the Indo-Pacific. *"In every conversation with our partners, I hear the same thing again and again: a call for the United States to continue playing our stabilizing role in the Indo-Pacific,"* he said. *"And make no mistake: we will."*

This means more exercises with allies and partners, helping partners build security capabilities, and encouraging European allies to contribute to security in the Indo-Pacific, he said.

All this is in support of the status quo. *"We remain steadfast to our one-China policy, and our commitments under the Taiwan Relations Act to support Taiwan's ability to defend itself while also maintaining our capacity to resist any resort to force that would jeopardize the security of the people of Taiwan,"* he said.

There are real differences — in interests and values — between China and the United States. *"But the way that you manage them counts,"* Austin said. *"We're going to be open and candid with China's leaders. As President Biden put it, we need to talk 'honestly and directly to one another about our priorities and our intentions.' And big powers should be models of transparency and communication."*

The United States seeks to open lines of communication with China's defense leaders — especially in a crisis. This should help reduce risk and prevent miscalculations, he said.

America's unparalleled network of allies and partners is an asymmetric advantage over China. Innovation is another.

"Integrated deterrence requires us to weave together cutting-edge technology, operational concepts and state-of-the-art capabilities to seamlessly dissuade aggression in any form, domain or theater," Austin said. *"That means that innovation lies at the heart of American security."*

There have been incredible advances in artificial intelligence, edge computing and nanotechnology in the United States. *"Nobody innovates better than the United States, but we can't take that for granted,"* he said.

DoD must change the way it does business or risk losing that asymmetric advantage. *"Let's face it, for far too long, it's been far too hard for innovators and entrepreneurs to work with the department,"* he said. *"And the barriers to entry for working in national security are often just too steep."*

It takes too long to get innovation to American service members. Good ideas and capabilities are demonstrated, but often fall into what many call the "valley of death" before capabilities get fielded. *"It's bad enough that some companies get stuck in the valley of death, but some brilliant entrepreneurs and hungry innovators don't even want to try to cross it and work with us,"* he said.

Austin said the ***Defense Advanced Research Projects Agency (DARPA)*** — a hothouse for ideas — is now *"connecting its top research teams with corporate leaders and U.S. investors so that those teams can build successful businesses with the cutting-edge technologies they develop,"* he said.



"We're doubling down on our Small Business Innovation Research program. This program helps fuel American firms to pursue R&D tailored to the department's unique tech requirements. And so far this year, we've awarded funds to more than 2,500 small businesses working on groundbreaking tech."

The department has opened new technology hubs in Seattle and Chicago to add to the ones already working in Austin, Texas and Boston. *"The goal here is simple: to connect with new talent who will help us compete and win on challenges from countering UAVs to responsibly leading the AI revolution,"* he said.

These efforts and more are working, because *"when we maintain our technological edge, we maintain our military edge,"* the secretary said. *"Let me be clear: The United States has an advantage that no autocracy can match: our combination of free enterprise, free minds and free people. Even in times of challenge, our democracy is a powerful engine for its own renewal. So I will put the American system up against any other. And I'll do so with great pride and total confidence."*



YEAR IN REVIEW: ETL SYSTEMS

THE PACE OF INNOVATION CONTINUES

The disruption of Covid-19 during the first part of 2021 did nothing to dampen the pace of innovation at ETL Systems. Work began on our fourth manufacturing building at our main Hereford site in the UK, which is due to open next year, and we moved into a new R&D center in London. At the same time, we launched a new family of frequency converters, called Falcon, and won some impressive first contracts with them. All of this contributed to our double-digit growth in 2021.



STRONG START

Receiving the first orders for our new **Havoc RF matrix** was an important milestone in November and, as we produce this review, the products are heading to their new homes.

Havoc is the biggest RF matrix we've ever designed and manufactured and is the equivalent of two or three racks of smaller matrices — for example, it would require four Harrier 128x128 matrices to reach the same number of crosspoints.

Technically complex, the Havoc is a 256 input x 256 output RF matrix system and uses the latest technology for routing L-band signals dependably.

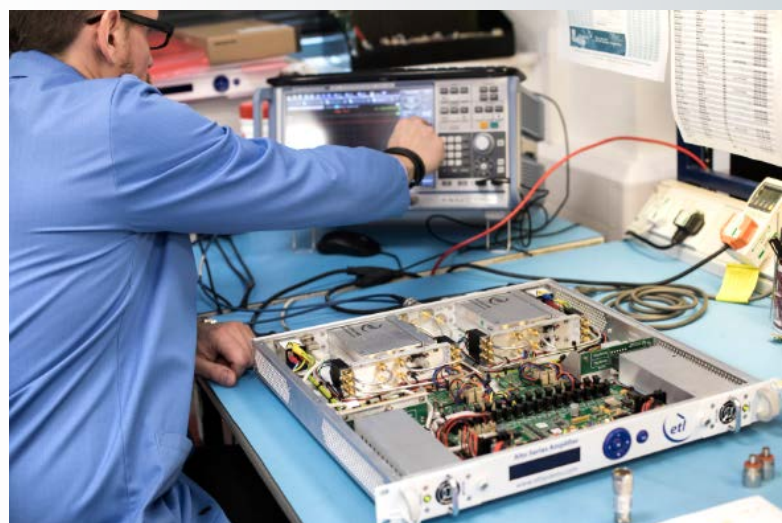
The fact that it can route such a high number of uplink and downlink SATCOM signals in a single chassis is a major step forward and also demonstrated that the company's RF engineers are at the cutting edge of the technology installed in the largest ground stations.

Both orders have gone to government customers that are based in the U.S. and Asia. This was a brilliant opportunity for our engineers to complete the design during the pandemic.

As a market indicator, this has shown that many strategic government projects within the SATCOM industry have not haven't slowed down at all. Indeed, this type of teleport project has really kept ETL Systems going.



ETL Systems' Havoc Matrix



GROWING DEMAND

We work with some of the biggest and best systems integrators in the world and, despite Covid-19, organizations have continued launching, upgrading and replacing satellites. For example, the Indian government has, once again, selected multiple **Enigma RF matrices** for a recent project.

What's driving demand for these higher-capacity matrices is a combination of reliability, heritage, trust in the ETL brand, cost-effectiveness and the fact that we are now offering the latest level of remote control security.



ETL Systems Enigma
IF Matrix (Uplink) 32x32

FURTHER DEVELOPMENTS

As mentioned, this year witnessed the launch of a ground-up design of frequency converter, which we have named **Falcon**.

This now sits within our new, scalable **Genus** chassis, which allows multiple and mixed field-replaceable modules in one unit.

Our customers in Indonesia and in the Middle East who have acquired the Falcon Frequency Converter now have a rack space saving solution that offers up and down conversion and single or redundant modules... all in one box.

The benefit of these up and down converters is that they can be engineered to meet the specific requirements of the business. Now we're designing Falcon to operate within C- and Ka-bands. In addition to the Falcon offerings, the company continues to supply and support equipment for the **SES O3b MPOWER** project as well as RF equipment for the **Eutelsat Konnect** project.

An important focus for our R&D team has been designing smaller Hawk matrices, which are specifically for the new LEO ground stations, and we're working with two of the major constellations to provide equipment for their ground stations, as well.

YEAR IN REVIEW: ETL SYSTEMS



ON THE ROAD AGAIN

The return of CABSAT at the *Dubai World Trade Centre* in October attracted visitors from around the world and there was clearly energy building in the market, although there's still work to be done if broadcasters want to catch up and keep up.

Our presence at the D.C. satellite industry trade event was a sign that ETL Systems is definitely open for business and doing what we're best at — being a trusted supplier that also provides a face-to-face presence across the globe.

THE WORLD WAKES UP

Broadcast has always been our bread and butter, but the sector has quietened down over the past year, particularly in the U.S., which is where much of our business is normally derived. However, the requirement for investment in next generation satellite infrastructure will eventually force the upgrade of the broadcasters' ground stations, and with those occurrences, we're anticipating a spike in demand as people and budgets return to normal operation.

During Covid-19, cruise liners around the world were docked. However, now the industry is preparing to welcome passengers in 2022 and we recently received a significant order to upgrade one of the world's largest fleets of cruise liners with the latest SATCOM routing technology.

EXPERT CONTRIBUTION

Our contribution to the virtualization movement has also involved looking at digitizing the RF signal. The goal is to digitize the signal as soon as leaves the satellite dish and a significant investment partnership from the ***European Space Agency*** means we'll have a product to launch in 2022.

We're also collaborating with a working group of experts who are creating a Digital IF standard across the board.

It's really good to see manufacturers and government working together to deliver a product that makes Digital IF commercially available — initially to the government and military market, but of course, also to be made available to the commercial SATCOM community.



With the new LEO constellations, data is one of the key drivers and is now growing at a phenomenal rate. A combination of satellites and 5G / 6G technologies can harmonize the use of data and more of it can be carried than ever before experienced.

ATLANTIC MICROWAVE

Atlantic Microwave, which ETL Systems acquired in 2019, has grown their market share in the ***Test and Measurement*** sector over the past year.

The company, both a manufacturer and distributor of RF and microwave equipment, has evolved their product range during the last 12 months to allow SATCOM testing on the new Q- and V-bands, driven by the pressure on bandwidth via the current spectrum. Atlantic Microwave also been upgrading its test and measurement capabilities for the new bands.

Over the last 12 months, Atlantic Microwave has cemented its position in the commercial market and seen demand from a number of key areas, including test and measurement, radar SAR (*search and rescue*) and advanced industrial (*cryogenics*), as well as standard SATCOM testing and the calibration of antennas.

ETL Systems is well-positioned to stay at the forefront of market evolution and is looking forward to 2022. We are seeing a vibrant future for the SATCOM and test market, driven by the new 5G / 6G technologies as well as the new satellite constellations and the emergence of the Internet of Things (IoT) driving data usage.

www.etlsystems.com



Author Andrew Bond, is the Sales and Marketing Director for ETL Systems



YEAR IN REVIEW: GILAT SATELLITE NETWORKS

AFFORDABLE MILSATCOM CONNECTIVITY



The quest for technological superiority and innovation makes sense when armed forces are trying to preserve and reinforce their strategic advantage. The Digital Transformation of the military continues to shape the future of global security. Seamless collaboration and communication are crucial for helping defense agencies realize a more modern way of working and managing themselves more effectively; sharing vast amounts of critical information (including voice, data and video) in real time makes military maneuvers more efficient and effective.

Combat troops need fast, reliable and secure communications in areas beyond the bounds of traditional fixed and wireless networks. *SATCOM-on-the-Move (SOTM)* communications is a game-changer for today's Net-Centric battlefield, enabling soldiers and homeland security personnel to gain instant access to critical information while staying in touch with command headquarters.



2021 was a great year for Gilat's achievements in the Defense segment worldwide.

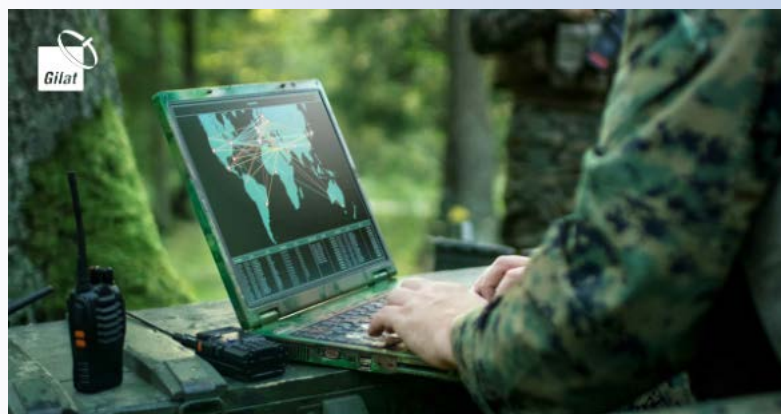
STRATEGIC FOCUS: THE DEFENSE MARKET

Gilat offers government and defense organizations a set of advanced *SOTM / SATCOM-on-the-Pause (SOTP)* solutions for all types of platforms to ensure assets in the field are connected at all times to central operations. Our high-performance and quick-to-deploy systems provide fast and reliable broadband connectivity for any mission,



as well as supporting a diverse range of civilian services. More specifically, Gilat's End-to-End SATCOM solutions have been designed specifically to meet the needs of today's Net-Centric battlefield, including: flexible, secure platforms for huge amounts of data and high-bandwidth applications to connect soldiers, platforms and terminals across land, sea and air; continuous and resilient connectivity to ensure that information is available when, where and how it is needed; with all necessary technology, equipment, applications, products and solutions under one roof.

Gilat's full scale, state of the art SATCOM solutions are fully equipped to provide the constant flow of two-way secured broadband that include intelligence, live video, voice, command and control information and enemy/friendly forces locations and operational commands. Offering antennas, modems, BUCS, manpacks and unmanned platforms, Gilat supports any SOTM/SOTP use case and any platform.



To further Gilat's strong position in the Defense Market, BG (Res.) **Eyal Zelinger** was hired at the end of 2020 to lead the company's Defense Division as Global Defense Vice President. Retired from the *Israel Defense Forces (IDF)*, Eyal was brought onboard to maximize global opportunities for Gilat's Defense business.

Prior to his retirement at the rank of Brigadier General, he served as the Chief Signal Officer and C4i/J6 Chief of Staff.



Eyal Zelinger

YEAR IN REVIEW: GILAT SATELLITE NETWORKS

Gilat's military SATCOM expertise and operational experience positions Gilat as an excellent choice for today's modern militaries as shown in the following awards during 2021.

MULTIPLE DEFENSE GLOBAL AWARDS

Gilat's global footprint in the Defense Market expanded, thanks to a number of large-scale deals.

In the Far East, Gilat received a contract to provide satellite communication equipment to defense forces in Asia via a large system integrator. Gilat's renowned, multi-application platform, **SkyEdge II-c**, **Capricorn VSATs** and **TotalNMS**



Gilat's SkyEdge II-c



Gilat's TotalNMS

will serve the needs of the defense forces to provide tactical SATCOM solutions for fixed and mobile platforms as well as enable efficient communication channels during emergency and disaster response in addition to the critical C4I (**Command, Control, Communications, Computers, & Intelligence**) needs. Multiple hubs and hundreds of VSATs will be deployed in redundant configurations to meet the critical security needs, as well as the high quality and key regulatory requirements.

This significant contract was awarded to Gilat due to the company's superior technology, highly secure solution, proven global track record and commitment to the local market. Gilat also demonstrated that its SkyEdge II-c platform answers the most stringent military requirements and thus provides the technological capability to enable today's demand of digital warfare, wherever and whenever digital information is required

On the other side of the world, in Latin America, Gilat was awarded multiple projects for the armed forces. Gilat works closely with its partner, **Newsat**, the defense integrator in **Latin America (LATAM)**, to provide end-to-end projects, including installations and remote maintenance to the armed forces for fixed, airborne, maritime and mobile military applications.

Gilat's one-stop-shop for defense satellite communication technology includes Gilat's SkyEdge II-c platform, modems, antenna terminals and BUCs. Gilat provides multiple fixed and mobile communications solutions in Latin America to support the General Command, Army, Navy and Air Force security, diversity and contingency needs, thus providing the confidence required for special and critical operations.

Gilat was selected in LATAM based on the firm's ability to provide the required increased high network availability and backup capabilities for multiple applications and critical operations that are required to support joint or individual operations. Newsat brings strong knowledge and expertise in managing and integrating the complex and battle proven military projects, leveraging Gilat's equipment for satellite communication which is specifically tailored to meet a wide variety of global defense needs.

In another region of the world, Gilat was awarded a contract to be the sole SATCOM equipment provider to address the most advanced present and future defense connectivity requirements. qGilat was tabbed for its unique ability to meet the demands of today's modern battlefield. As digital transformation has increased the importance of satellite-based communication solutions on the battlefield. Gilat's advanced technology exhibits superior performance and efficiency, thereby meeting the long-term requirements of the defense market.



U.S. DEFENSE PROJECTS

Throughout 2021, Gilat received numerous awards to provide amplifiers to defense organizations around the world. The next generation, high-power, solid-state amplifiers are designed and manufactured by **Wavestream**, a wholly owned subsidiary of Gilat, for integration into mission-critical Ground, Sea and Airborne SATCOM systems.



YEAR IN REVIEW: GILAT SATELLITE NETWORKS

Gilat received a large order from the United States Army for a military communication program contract. With this award, an industry record shipment milestone was achieved by surpassing 5,000 units of Wavestream, high-power, **50W Ka-band military Block Upconverters (BUCs)** delivered to this military program over a 14-year period.

Furthermore, a Tier-1 US terminal provider awarded Gilat a contract to provide several hundred **Solid State Power Amplifiers (SSPAs)** for SATCOM terminals for militaries worldwide. The Wavestream **MicroStream Ka-band SSPAs** were selected due to their ability to provide the required power and linearity in the low **SWaP (Size, Weight and Power)** solution essential for tactical and expeditionary military users. The terminals will serve tactical defense users throughout the world.

Gilat received another order from the U.S. Army to supply high-performance BUCs for tactical communications. Additional **50W Ka-band Wavestream BUCs** are supplied for program sustainment that is well into its second decade.



The **Wavestream Matchbox 50Ka MIL** was originally fielded by the U.S. Army in **WIN-T Increment 1** as early as 2007 and is still active in service today. With more than 5,000 amplifiers shipped to date, this is easily the largest deployment of high-performance, Ka-band BUCs supporting **Comms-on-the-Quick-Halt (COTQH)** tactical communications around the world.

Gilat also received a significant order from a customer in support of a military communications program run by the **U.S. Department of Defense (DoD)**. The new generation of **Wavestream Block Upconverters (BUCs)** were selected based on their ability to successfully meet the DoD program's requirement for interoperability on multiple satellite constellations at multiple frequencies.

The **Wavestream Matchbox 20W Ka-band BUC** is the most compact, outdoor-rated, Ka-band BUC ever developed by Wavestream. This unit rounds out the Wavestream Ka-band Matchbox product portfolio as a small, but powerful, BUC that is capable of connecting to multiple **Low Earth Orbit (LEO)** and **Geostationary Orbit (GEO)** satellite constellations

in multiple Ka-band frequency lineups. Additionally, the brand new **MicroStream 20W Ku BUC** is designed to be tightly integrated within the electronics enclosure of the terminal and has been specifically developed with **SWaP** in mind. It is indicative of the incredibly flexible capability set that Wavestream offers its customers when it comes to deeply integrated RF solutions.

MEETING DEFENSE ORGANIZATIONS NEEDS

Wartime and tactical missions often take forces into unfamiliar territory crawling with unpredictable and unknown threats. Access to real-time intelligence on the ground — where and when troops need it — can make all the difference between a successful and an aborted mission.

Gilat is proud to provide defense organizations around the world with quick-to-deploy, ruggedized, SOTM solutions that can be carried in a backpack or mounted on fighting vehicles. More specifically, Gilat provides fully integrated VSAT systems that ensure seamless connectivity for both COTM and COTP missions and support voice and data communications, military C4I and border patrol activities with full interoperability among land, sea and airborne forces.

Gilat continues to dedicate strategic resources to providing defense organizations with the technology, expertise, local presence and support they need in order to meet their current and future military needs.

www.gilat.com



Author Doreet Oren is the Senior Director, Product Marketing and Corporate Communications, for Gilat Satellite Networks.

Gilat Satellite Networks is a leading global provider of satellite-based broadband communications. The company

is committed to providing affordable broadband connectivity to millions of users in all parts of the world as well as providing technology-based defense solutions in order to help countries solve complex security challenges.

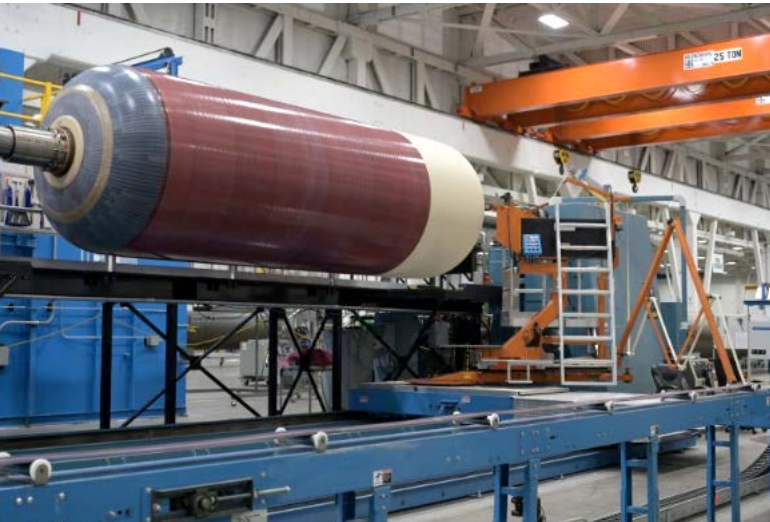


Doreet Oren



NORTHROP GRUMMAN'S GBSD FIRST-STAGE ENGINE MEETS MILESTONE

Northrop Grumman Corporation (NYSE: NOC) has successfully met a key manufacturing milestone, successfully performing the first insulation and case wind of the Ground Based Strategic Deterrent (GBSD) first-stage solid rocket motor.



Northrop Grumman begins the insulation wind process for the first-stage solid rocket motor, applying insulation from right to left.

Northrop Grumman performed the insulation wind around a plaster tooling mandrel. The insulation protects the outer casing of the motor from extreme temperatures caused by burning propellant inside the motor. Following insulation is the case wind process, which applies composite material around the insulation to form the outer structure, or shell, of the motor. Northrop Grumman has begun a similar insulation and case wind process for the second-stage motor, as the program team continues on track to the U.S. Air Force GBSD schedule.

This first-stage motor will now undergo testing to validate tooling and manufacturing processes as well as pressure-testing to ensure structural design integrity. The new GBSD missile will be a three stage solid rocket motor. Northrop Grumman is building the first and second stage.

Northrop Grumman was awarded the GBSD engineering and manufacturing development contract in September 2020 to begin modernizing the nation's aging intercontinental ballistic missile system. Northrop Grumman is leading a nationwide team that includes **Aerojet Rocketdyne, Bechtel, CAE, Clark, Collins Aerospace, General Dynamics, HDT, Honeywell, Kratos Defense and Security Solutions, Lockheed Martin, and Textron Systems**, as well as hundreds of small and medium-sized companies from across the defense, engineering and construction industries. Overall, the GBSD program will involve over 10,000 people across the U.S. directly working on this vital national security program.

SSC AWARDS PALANTIR TECHNOLOGIES MILLION\$ CONTRACT

Space Systems Command's (SSC) Cross-Mission Ground & Communications Enterprise (ECX) awarded a \$43 million contract to Palantir Technologies to continue their delivery of a data and decision platform to support national security objectives. This \$43 million contract is an additional extension, expanding upon previous awards from April and August this year. The total cumulative face value of the contract is \$91.5 million.

This award provides continued capabilities for **Project Brown Heron** which enables all-domain situational awareness and decision-making at **NORAD/USNORTHCOM** (N-NC), and the **Space C2** division under the **Cross Mission Ground & Communications Enterprise** (ECX).

The Palantir platform, known as **Warp Core**, is being used to make decisions from large volumes of data in support of these missions.

Warp Core leverages Palantir as a configurable enterprise data management and operations software solution that enables the integration and management of data from various data sources and supports application delivery, in-depth analysis, and data-driven decision-making across echelons and functional communities, including for users who operate on multiple security levels across multiple networks. As the application and data landscape continue to rapidly

expand in both scale and complexity, Warp Core simplifies and streamlines data management and integration, to aid in everything from readiness to improved decision-making.

Warp Core's work also extends beyond Space Domain Awareness missions and was recently used by SSC and its partners to assist the evacuation of U.S. allies from Afghanistan.

"The threats to our nation in and through the space domain are very real as we've seen in recent weeks, we must continue to advance our Nation's Space Domain Awareness capabilities," said **Doug Philippone**, Global Defense Lead at Palantir Technologies. *"We're very proud to have consistently earned the confidence of this innovative organization and to continue our partnership."*

GOVERNMENT SATELLITE REPORT (GSR) — #1

LEVERAGING MEO CAPABILITIES AMID SES'S UPCOMING O3B mPOWER LAUNCH

Author: Jon Bennett, Vice President of Government Affairs, SES Government Services (SES GS)



Artistic rendition of SES O3b mPower on-orbit.

SES GS supports the U.S. Army in conducting a series of cutting-edge trials and testing of commercial satellite constellations in multiple orbits, as well as services and ground terminals, in the U.S. Government's effort to establish Multi-Domain Operations (MDO) by 2028.

Most recently, the U.S. Army announced its integrated ground terminal, **Phoenix E-Model**, would serve **Expeditionary Signal Battalion – Enhanced (ESB-E)** formations with the likelihood of expanding operations from traditional **Geostationary Earth Orbit (GEO)** satellites to leveraging commercial **Medium Earth Orbit (MEO)** constellations. In this framework, SES GS, in close cooperation with **Lite Coms**, carried out extensive work to update the legacy U.S. Army Phoenix Terminal to be MEO capable (**AN/TSC-156(E)**) for the U.S. Army. The resultant **Lite Sat 2.2A** terminal delivers 50 Mbps on a **Wideband Global SATCOM (WGS)** GEO network and up to 600x600 Mbps on SES's

O3b MEO system.

Leveraging MEO satellite technologies provides the modern warfighter the resiliency, high-bandwidth, and low-latency required for mission assurance in contested environments against advanced adversaries.

"MEO satellites are unique in their capabilities and SES operates the world's only commercial MEO satellite constellation," said President and CEO of SES Government Solutions, Brigadier General **Pete Hoene**, USAF (retired). *"Early next year, SES will launch its second-generation MEO system, O3b mPOWER, which promises to meet and exceed the connectivity requirements of today's warfighting technologies — delivering flexible and secure fiber-like connectivity anywhere the mission requires."*

In alignment with the Army's stance on MDO, multi-orbit SATCOM solutions that leverage MEO significantly extend the Army's ability to securely transport data between the command post, soldiers-on-the-move, as well as multiple sensors in support of Joint All Domain Command and Control (**JADC2**). As the Army increasingly relies on data and network-enabled platforms for deployed warfighters, having interoperable communication systems that are flexible and assured is essential to capturing a common operating picture (COP) for multi-domain operations.

Author Jon Bennett is Vice President of Government Affairs, Marketing & Corporate Communications with SES Government Solutions.

GOVERNMENT SATELLITE REPORT (GSR) — #2

NEAR-PEER NO MORE? IS COMPLACENCY COSTING THE COUNTRY ITS INNOVATIVE EDGE?

Author: David Pesgraves, Author, SES Government Services (SES GS)

Immense pride comes from the idea that the United States is a dominant force on the global stage, competing with and edging out near-peer adversaries in the race to space, and other arenas of competitive advantage, such as technology, education, economic, and warfighting capabilities.

However, when it comes to the United States' place in near-peer competitions, where exactly does the global superpower fall on the spectrum?

At the recent **Space Innovation Summit 2021**, **David Hamilton**, the Founder and CEO of **America's Future Series**, and **Nicolas Chaillan**, the former — but first-ever — **Chief Software Officer (CSO) of the U.S. Air Force and Space Force**, held a fireside chat focused on the topic of near-peer competition. The session and discussion primarily revolved around Chaillan, who recently stepped down from his position last September,

and his experiences as CSO. During the session, Chaillan shared his thoughts on the United States' role as a global competitor and the changes he believes the U.S. government (USG) needs to make in order to remain a dominant force on the world stage.

Chaillan had many wins at the Department of Defense (DoD), which included nudging the Department towards modern IT and cybersecurity infrastructures and demonstrating that the DoD could put an advanced cyber stack with zero trust architecture and baked-in security on legacy hardware.

But, as great as Chaillan's wins were for the Department, he couldn't shake the startling realizations he was having as CSO. *"We proved again and again that all this is possible,"* said Chaillan. *"It is possible to move at a pace of relevance in the U.S. government. Unfortunately, what we were not seeing is a sense of urgency, particularly when it comes to China."*

According to Chaillan, the term "near-peer adversary" should not be applied in any discussion pertaining to

China. "We like to call them the near-peer adversary, but I completely disagree with that," explained Chaillan. "I would argue that they're leading actually in cybersecurity, and also in artificial intelligence (AI) and machine learning (ML) adoption."

Chaillan pointed to strict mandates placed on enterprise and industry technologies by the Chinese government as the primary catalyst of China surpassing the U.S. in these areas. But, in the end, Chaillan ultimately places most of the blame on the U.S. government for China's lead.

"We see the U.S. government becoming complacent and getting used to China catching up," said Chaillan. "We should be leading so far with the amount of money we're spending... We probably get a 10 cent ROI on the dollar."

Chaillan also directed sharp criticism towards the DoD's current reliance on waterfall IT approaches, its slow-drip pace on agile adoption, the Department's "nightmare of an acquisition process," as well as "siloes and egos," all of which he believes is crippling the U.S. from becoming a credible competitor on the world stage. According to Chaillan, all of the U.S. government's pitfalls equate to a "very poor return on investment ratio, which leads to China catching up."

To illustrate his vision of how he'd like the U.S. government to position itself in terms of being a global competitor, he used Tesla as an example. "Tesla is completely fine open-sourcing their patents, because they're moving so fast that they know by the time their competitors even remotely catch up, they're going to be five miles ahead." He explained that the U.S. should "be exactly in that role."

Chaillan believes that the U.S. is in a bit of denial when it pertains to its attitude of where the country falls on the competitive spectrum. "We need to stop telling ourselves that we're way ahead and someday they'll catch us."

Chaillan also explained that China is targeting to be the world leader in AI by 2030, and that the country is already far ahead of where our current capabilities stand. And even though the 2030 date may make it seem like the U.S. has time to catch up, Chaillan revealed a startling fact about China's dominance in the AI arena. A fact that he believes should be a wake-up call for the U.S. government.

Due to the nature of AI technology and how it advances and evolves, "You get to a point where you won't be able to catch up," explained Chaillan. "So, we estimate December of 2022 to be the deadline by which if the U.S. government does not wake up, we will not have an ability to catch up. And that means a real existential threat for our kids and the nation."

Despite Chaillan's bleak outlook, he does believe there are solutions that can help change the U.S. government's course for the better. He believes that the concept of agility is key.

"The whole concept of agile is the continuous, small, and incremental delivery of value in production in a tangible way used by the actual end-user warfighter," said Chaillan. He explained that the U.S. government needs to improve on training leaders and warfighters on agile. He also believes that training to needs to happen much earlier during the on-boarding process.

Chaillan also believes that mandating DevSecOps approaches to new programs would be a huge step forward for the DoD. He also pointed to further empowerment of current and future workforces, by investing in continuous learning and being on top of breaking IT and cybersecurity trends.

China taking the lead in AI and ML innovation should be a wake-up call to our country — an example of how complacency can result in us losing our leadership position in other areas. The space domain would be one area where America has always led in innovation and capability, but could soon find their leadership in question.

The U.S. military has always relied on space capabilities to enable warfighters in the field. Our near-peer adversaries have seen the success and strategic edge that space and satellites technologies have given the U.S. in the past, and they want to emulate it.

Though the U.S. has remained extremely competitive in space, it is anticipated that that edge could quickly evaporate. One way that the U.S. can maintain its lead ahead of near-peer competitors is to turn to the innovations and solutions the commercial satellite industry can provide.

Today's commercial satellite industry is the clear innovator in the space domain, and the military should be looking to leverage their solutions whenever possible, instead of building their own. Building and launching the satellites that the commercial satellite industry is launching today could take the U.S. military half a decade or more, depending on how smoothly the appropriation and acquisition processes run.

Instead of the U.S. government building and launching its own purpose-built satellites and having them operational in five year's time, it could partner with the commercial satellite companies whose technologies and services are immediately available, can be tailored to specific mission needs, and are priced at a fraction of the cost of building an entire satellite. The concern about the U.S. losing its competitive and innovative edge extends well beyond AI, cybersecurity, and machine learning. In fact, it's a problem that extends all the way into space.

Partnering closely with industry, the true innovators in space, instead of trying to emulate what industry partners are doing today could save years of time and money for the U.S. government, and help the country maintain its competitive edge in space.

These **Government Satellite Report** features first appeared on the GSR website and are republished with permission.

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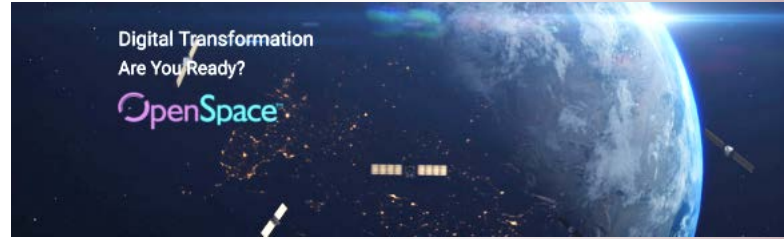
Author David Presgraves is a Staff Writer for GovSat Report, in addition to several other online publications dedicated to defense, military, and federal government agency technologies.



YEAR IN REVIEW: KRATOS

DIGITAL TRANSFORMATION IS CENTRAL TO THE MULTI-DOMAIN JOINT FIGHTING CONCEPT

Author: Chris Badgett, Vice President of Technology, Kratos Space



SUPPORTING DIGITAL TRANSFORMATION

Digital transformation is no longer a buzzword or a one-off IT project. For the U.S. military, digital transformation is central to the multi-domain joint-fighting concept of maintaining a decisive advantage, with the ability to decide and act faster than adversaries in any corner of the globe. This transformation requires more agile and dynamic satellite and ground capabilities to support data needs at the speed of operations across the enterprise to the tactical edge.

Kratos is at the forefront of commercial innovation to support this transformation with flexible, digital ground solutions based on technology that is well known and extensively used by the telecommunications and IT industry. Last year, Kratos released the **OpenSpace™** family of products, including a virtualized software-defined ground platform that is standards-based and cloud-enabled. The OpenSpace family of products support the military need for interoperable, resilient and automated satellite operations.

DIGITAL TRANSFORMATION KEYS

The first step to digital transformation requires converting RF Spectrum into a standardized digital format that can be sent and received across IP networks to service Remote Sensing, TT&C, Space Domain Awareness and SATCOM missions.

The industry has started moving in this direction and a good proof point is the development of the **Digital Intermediate Frequency Interoperability (DIFI) Consortium** (IEEE-ISTO Std 4900-2021).

DIFI was created this year to establish a simple, interoperable standard for digital IF/RF. The consortium, which includes the **U.S. Space Force (USSF)**, the **U.S. Navy**, the **Department of Defense Chief Information Office (CIO)** for SATCOM and other commercial and government organizations have united on a **VITA-49** standard for transmit/receive compatibility across vendors and equipment from the ground to the cloud.

Using the DIFI standard will ensure interoperability between military satellites and systems and the military's increasing reliance on commercial innovation. Kratos understood the need for the standard and immediately became a member of DIFI.

Secondly, Kratos is continually leveraging the power of virtualization. A few years ago, Kratos took a stance to virtualize everything in ground stations, teleports, gateways, and ground infrastructure. This started with OpenSpace quantum products, but now includes extensive capabilities within the OpenSpace Platform. By replacing purpose-built hardware, such as modems and front-end processors with containerized software, these *'virtual network functions'* can be delivered to generic compute on-premise, or in the cloud, making satellite ground operations highly flexible and scalable.

Third, satellite processing functions that are virtualized and software-defined can now be orchestrated and automated. A virtualized, software-defined ground network such as the OpenSpace platform is designed to automatically choose the right services, balance workloads, and get all the capabilities of a modern terminal. It can offer entirely new dynamic operations supporting real-time complex, multi-mission, multi-orbit satellite regimes. This enables simpler, faster, and more manageable operations that are key to military operations.

KRATOS DIGITAL TRANSFORMATION INITIATIVES

Satellite Roaming and Enterprise Management & Control Roaming has long enabled seamless connectivity for users in the world of mobile telecom, yet it has been elusive in the satellite world where it would offer tremendous value to warfighters. In April of 2021, Kratos and its partners demonstrated roaming among different networks to optimize wideband satellite communications using **Enterprise Management and Control (EM&C)**. EM&C is an effort by the DoD to provide warfighters with resilient satellite service across hybrid satellite constellations and networks operated by various service providers.

For warfighters using legacy and next-generation terminals in contested and congested environments, EM&C is an important strategic goal of the military to effectively operate an integrated SATCOM enterprise that provides automated near real-time switchover for assured SATCOM access in seconds to minutes, rather than taking days, weeks, or months.

The April event highlighted the ability to restore satellite service in response to interference and the capability to gather and fuse information from sensors and satellites through the **Unified Data Library (UDL)** and is another example of the ongoing digital transformation movement.

Supporting Space Domain Awareness With UDL

Today, DoD satellite operators use disparate tools, networks and data sources at varying classification

levels to attempt to build a picture of the Radio Frequency (RF) environment. The UDL is a joint initiative of the **U.S. Air Force Research Laboratory (AFRL)** and the USSF's **Space Systems Command (SSC)** that hosts **space situational awareness (SSA)** data from dozens of commercial, academic, and government organizations in a cloud-based platform, providing a digital "storefront" for users of the data.

In July of 2021, Kratos was awarded funding to develop a prototype that automatically delivers SSA data to the UDL. This initiative will use the **Kratos Global Sensor Network (KGSN)** for spectral monitoring, **Electromagnetic Interference (EMI)** detection, and geolocation.

Kratos' global sensor network continuously monitors communications and **Tracking, Telemetry and Command (TT&C)** signals on commercial satellites and other transmitting resident space objects to help improve real time SA. It will support the military's ability to make relevant assessments, assign attribution during hostile events, characterize hostile events, cue additional data gathering, identify assets at risk, and support the development of appropriate courses of action.



Virtualized Electronic Warfighter Training

In early December of 2021, Kratos demonstrated cloud-enabled **Electronic Warfare (EW)** training products at **I/ITSEC**, the world's largest simulation and training warfare conference. These electronic warfare products allow warfighters to *'train like they will fight'* for the unique demands of high-tech combat against near-peer adversaries, educating them on the capabilities and limitations of their battle networks.

The training systems, which leverage virtualization and cloud processing, no longer require large, customized equipment. The military can address new and emerging threats with software, avoiding custom and costly hardware upgrades.

Digital Transformation Pivotal Technologies

The space world is moving into a multi-orbit, multi-mission, software-defined realm and the ground system must transform accordingly. Kratos is advancing the ground segment's ability to digitally transform by supporting common standards, developing virtualization capabilities that avoid proprietary hardware and delivering orchestration methods that automatically deploy services at the speed of relevance.

Kratos continues to support our military in any way we can to stay flexible, resilient and ahead of adversary intent.

www.kratosdefense.com



Author Chris Badgett is Vice President of Technology for Kratos Space. In this role he sets vision, technology strategy, and direction for a portfolio of Kratos Space products. This includes secure and protected virtual satellite ground solutions for military and commercial applications. Prior to Kratos, Mr. Badgett served in the Air Force as a weapons engineer in the Air Force Research Lab. He has also worked in the Space Development and Test Wing as a program manager for a satellite system developed by Ball Aerospace. Mr. Badgett holds a BS in Electrical Engineering from University of Tennessee and an MS in Space Systems from the Air Force Institute of Technology.



Chris Badgett

YEAR IN REVIEW: LEONARDO DRS

Author: Gus Anderson, Global Enterprise Solutions Business Development, Leonardo DRS

As a leader in satellite-based Information and Communication Technology (ICT) solutions for defense, intelligence, and federal/civil markets, Leonardo DRS provides tailored end-to-end global satellite communications, terrestrial backhaul, managed network services, cybersecurity, network operations, and enterprise information technology for mission-critical, no-fail solutions.

Leonardo DRS has continued as the industry leader in 2021 by focusing on customer success. This includes its vendor agnostic and holistic approach to ICT system integration, its unwavering dedication to fulfilling mission requirements, its pursuit of innovation, and its commitment to providing best value solutions.

2021: A YEAR OF GROWTH

Throughout 2021, Leonardo DRS continued its culture of excellence, while taking advantage of opportunities and setting customers up for success in the coming decade. Its long-standing industry relationships, extensive product and service knowledge, team of experts, and commitment to innovation, quality, and excellence are the driving forces that keep Leonardo DRS delivering transformational solutions to its customers' year after year.

With its foundation of customer-centric quality in operations and service delivery, Leonardo DRS' significant achievements in 2021 include:

Expansion of Leonardo DRS' Information and Communications Technology (ICT) Ecosystem

Because SATCOM customers need their devices, terminals, and systems to work anywhere at any time, they require a no-fail solutions approach. Maintaining reliable systems (regardless of the environment) requires an ICT integrator such as Leonardo DRS that can provide a fully integrated global network infrastructure comprised of a space segment, global terrestrial network, network operations, and enterprise services, all secured to the highest levels of system confidentiality, integrity, and availability.

Over the past year the company has expanded its ICT Ecosystem network by:

- » *Conducting end-to-end field trials with LEO terminals that measured throughput rates, latency, jitter, packet error rates, and application effectiveness (Internet browsing, VoIP, video streams, etc.)*
- » *Provisioning select LEO terminals for end-to-end tests that measured throughput rates, Committed Information Rates, Maximum Information Rates, Quality of Service, latency, jitter, packet error rates, and application effectiveness (Internet browsing, VoIP, video streams, etc.)*

- » *Performing total life cycle replacement of Southern California's microwave backbone into a fully Multiprotocol Label Switching (MPLS) enabled network*
- » *Completing a Global Communications Network (GCN) and ICT Ecosystem migration to the Amazon Web Services (AWS) GovCloud, thereby providing customers with private/public cloud access*
- » *Refining our offering of mobile and portable global communication solutions to support the Department of Defense with high-throughput satellite connectivity and improved Committed Information Rates*
- » *Inserting COTM capabilities using small form factor antennas and associated hub-side architecture into our Global Communications Network (GCN)*

DRS offers a shared services platform that provides secure end-to-end solutions through its ICT Ecosystem, all of which are customized and customer accessible through its ICT Portal.

The Leonardo DRS ICT Portal Continues to Evolve

The DRS **ICT Portal** offers a consolidated view of management and operations, so customers may see in near-real time how their network is performing. Each Portal is designed around a customer's needs and provides visibility that includes system level, component level, and various performance parameters, including availability, latency, fault (with a trouble ticket system), configuration, accounting (with billing), and security management.

The DRS ICT Portal complies with industry best practice standards and uses the same holistic and vendor-agnostic approach that is engineered into the DRS **ICT Ecosystem**, providing a comprehensive and flexible monitoring and reporting solution. The ICT Portal provides DRS' customers with the advantage of not only having a single source of information for managing, operating, and troubleshooting their network from end-to-end, but also a single pane of glass through which they can monitor all facets of the network for themselves in near real-time. This capability gives them a tremendous advantage by providing key information to improve decision-making in the fast-paced environments where they operate, serving as an invaluable augmentation for supporting mission assurance.

During 2021, Leonardo DRS improved the Portal's capabilities by:

- » *Integrating FedRamp approved services and infrastructure that enhance the Portal's front and back-end services*
- » *Enhancing the Portal's interfaces and capabilities with respect to mission overview, satellite capacity management, network performance monitoring, ticketing and asset management, resource library management, and report generation detailing system configuration, performance, ticketing, administration, and Quality of Service (QoS)*

YEAR IN REVIEW: LEONARDO DRS

Leonardo DRS has successfully maintained continuity of operations during COVID-19 restrictions

In spite of the dynamic, worldwide travel restrictions resulting from the COVID-19 pandemic and its Delta variant, Leonardo DRS exceeded the contractual scope of its *United States Army's Wideband Communications Network* program to support the *Product Lead — Unified Network Capabilities and Integration (PdL-UNCI)* office by working with commercial teleports to decommission government furnished equipment and return it to the UNCI's logistical support staff at the *Integrated Network Operations Center*.

2022: COMPANY POSITIONING

During this decade, the communications industry will experience significant changes, both in terms of major technological advancements, as well as their accompanying risks. Leonardo DRS is positioning itself as a primary communications facilitator for its customers by incorporating innovative technologies into their network infrastructure, while simultaneously minimizing technical and transition risks. The following initiatives demonstrate Leonardo DRS' commitment to providing its customers with leading edge communication solutions in 2022.

Leonardo DRS GCN Development

Leonardo DRS provides terrestrial transport using either stand-alone or integrated backhaul circuits via its **GCN**, a privately owned and operated global network infrastructure that delivers gigabit speeds through 10 teleports on six continents and is accredited to DoD cybersecurity standards. The GCN is DRS' core capability and is used to deliver secure and reliable voice, video, and data services on demand, anywhere at any time.

Leonardo DRS is expanding the GCN's infrastructure throughout Europe to add X-and Ka-band capabilities for supporting military traffic. Leonardo DRS is also developing a managed software-defined *Wide Area Network (SD-WAN)*. This virtual WAN will allow its customers to leverage their current transport services (e.g., MPLS and *Long-Term Evolution (LTE)*) to securely connect with their applications. DRS will begin testing and offering this service in 2022.

Leonardo DRS' GCN Achieves Continuous DoD Risk Management Framework (RMF) Authorization To Operate (ATO) and Authorization to Connect (ATC)

Leonardo DRS's GCN was re-certified in 2021 with a *Risk Management Framework (RMF)* Government-issued *ATO* and *ATC* at the *Moderate-Moderate-High (M-M-H)* confidence level. The *ATO* and *ATC* authorization by the DoD allows Leonardo DRS to continue operating its GCN in support of missions for the U.S. military and government agencies around the world.

The GCN is a private ground-network of redundant MPLS, self-healing circuits that connects geographically diverse core nodes and teleports to provide visibility through 100% dual coverage of the world's satellite arc, along with highly available and secure global communications. To ensure the required levels of confidentiality, integrity, and availability are met, Leonardo DRS also provides a full range of engineering services, along with 24x7x365 network management, control, and support through its *Global Network Operations and Security Center (GNOSC)* and *Continuity of Operations NOSC*. The Leonardo DRS GCN is part of the company's key offering, the *Leonardo DRS ICT Ecosystem*, that provides fully integrated, turn-key information technology and global communication solutions tailored to its customers' current and future requirements.

CONCLUSION

Leonardo DRS is dedicated to supporting the military by delivering a "no-fail" ICT Ecosystem that guarantees all operations are reliable, resilient, and secure. Achievement of this objective is based on the company's commitment to incorporating multiple redundancies, ensuring that automatic alternate routes are always available, and data reaches its endpoint securely and uncorrupted.

The company's GCN's massive terrestrial infrastructure assures customers that Leonardo DRS' network is scalable and meets the most demanding network service requirements, now and in the future, which is a direct result of its singular pursuit for operations excellence.

www.leonardodrs.com



Author Gus Anderson served in the U.S. Army for 29 years as a Telecommunications Corps officer. During that period, he commanded numerous tactical and strategic communications organizations, to include the 509th Signal Battalion, Vicenza, Italy, and the Regional Signal Group SHAPE, NATO HQ (Belgium). He retired as a Colonel in 2008. Currently, he leads the Leonardo DRS Global Enterprise Solutions business development organization, helping grow customer and market understanding of the Leonardo DRS Information and Communications Technology (ICT) Ecosystem.



Gus Anderson

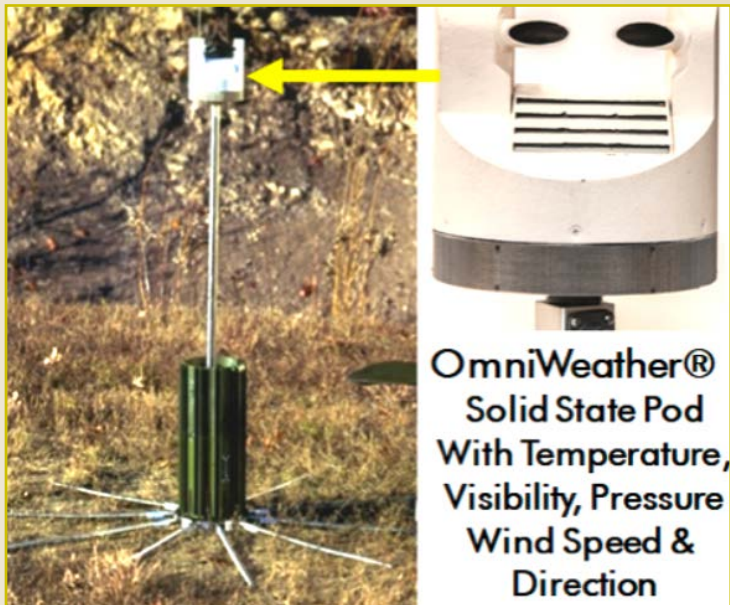
Leonardo DRS provides tailored, end-to-end, global satellite communications, fiber and wireless terrestrial back-haul, managed network services, cybersecurity, network operations, and enterprise IT for mission-critical, no-fail solutions.

YEAR IN REVIEW: MCQ

McQ Inc., located in Fredericksburg, Virginia, is a company with a long history of designing and deploying satellite networked systems integrated with their products deployed worldwide.

McQ is an R&D, Engineering and Product Manufacturing company that designs, develops, manufactures, delivers, and supports sophisticated sensor, surveillance and communications equipment for a wide variety of environments and customer missions. An ***Iridium Value Added Manufacturer (VAM) Partner*** company, McQ has been delivering Iridium enabled solutions to U.S. Government and commercial customers for more than 35 years. Having developed and produced a wide range of advanced systems for many applications, McQ is leader in using satellite communications (SATCOM) for remote area sensor applications, particularly with the U.S. military. Today, McQ continues with the latest technology in small, battery powered, satellite modem products that are used for commercial and military applications.

McQ's satellite product story began in the mid 1990s when the company developed an air dropped weather station, ***WeatherScene***[®], for the U.S. Air Force. This unit had a solid state, small weather pod with no moving parts to measure temperature, humidity, barometric pressure, visibility, wind speed and direction very accurately with advanced electronic chip technology. Critical to the weather pod and the satellite communications



was the requirement to survive more than 10,000 "g" forces when the weather station landed and automatically righted. The weather sensor pod then was deployed on a telescoping mast to a meter above the ground needed for accurate measurements. WeatherScene used ***Low Earth Orbit (LEO) ORBCOMM*** modems to connect the weather station data to military Command Centers. These weather stations were deployed at the start of the ***Desert Storm*** attack on Baghdad to provide weather data for paratrooper insertion and for advanced land attack during these military action missions.

WeatherScene was quickly followed in the late 1990s with an unattended, ground sensor system that used acoustic, magnetic, seismic, and passive IR sensors to detect military operations on the Kuwait-Iraq border. This McQ, unattended sensor used an Inmarsat transceiver integrated with McQ activity detection sensors to provide situational awareness information to military Command Centers.

When Iridium launched their first constellation in 1998, McQ quickly switched the satellite service to Iridium, with a new, unattended, sensor product called ***OmniSense***[®]. OmniSense provided magnetic, seismic, acoustic, and passive IR detection of activity in remote areas and, importantly, added pictures of the targets. The original McQ Iridium satellite transceiver was an Iridium phone from which McQ removed the case and keyboard to



integrate the radio with the McQ sensor data. Iridium added their ***Small Burst Data modem product*** that McQ used in their products. Thousands of OmniSense sensor units were deployed around the world in every military combatant command and in South American drug trafficking areas. The OmniSense used IP networking to distributed users at military Command Centers.

The network included messaging drone flight crews who could deliver an immediate strike using the OmniSense sensor location and the target picture. Millions of messages with target information and pictures were sent over the Iridium constellation.

Today, additional sensor technology advances have been married with the new Iridium satellite constellation to provide a wide variety of applications for connecting information to global users. McQ now has satellite connectivity built into very small ***McQ RANGER***[®] (*images on following page*) unattended ground sensors that can be airdropped into forward areas and immediately provide situational awareness information for military and border monitoring applications.

These Iridium linked sensors are being supplied to the U.S. Army, U.S. Air Force, U.S. Marine Corps, and to other U.S. and foreign customers. McQ RANGER sensors detect, locate, track, and classify targets in remote areas and also trigger McQ remote video imagers to send target videos to the users.

McQ RANGER®

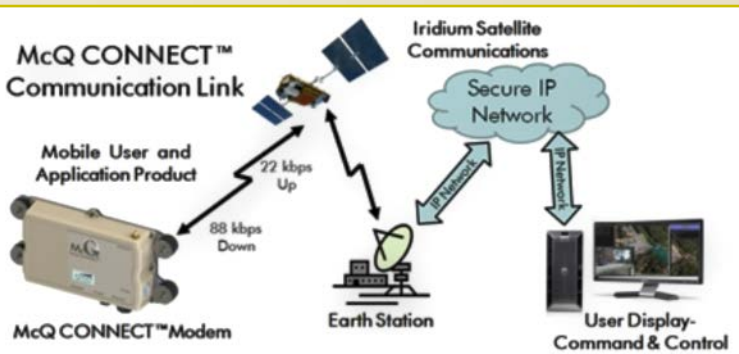
SURVEILLANCE SENSOR



The company has now launched a new, truly global information networking product, **McQ CONNECT™**, which operates using the secure **Iridium Certus® 100** service. McQ was selected by Iridium as one of the first VAM partners to create a new solution based on the Iridium Certus 100 modem. McQ CONNECT is a small SATCOM modem that can send and receive information in real-time over **Internet Protocol (IP)** networks. The new device was



developed using the latest in a line of Iridium core technology transceivers, the **Iridium Certus 9770**. McQCONNECT is a very small, battery operated unit, is ruggedized to IP67 (the rating of a protection level against intrusion of solids and liquids into mechanical and electrical enclosures) standards



and comes with a small, omni-directional antenna that enables easy operation for static or mobile applications. This allows the user to instantly feed information from a remote application via a secure cloud network and send command and control data to an application anywhere in the world.

CONNECT can provide handheld android user interface devices with real time data and video information to any operator in the field. The small modem can be carried in a backpack or use its mounting provisions for shock and vibration environments on mobile platforms.

Using Iridium's secure, low altitude, global communications network, this modem can send files of any size using many messaging protocols, including application data, pictures, safety alerts, security alerts, email messages, system monitoring data, and application command and control. The device also supports voice services and connects to computers, servers, tablets and smartphones, thereby enabling the use of additional applications.

For applications that require sending data and video on the move, **McQ vWatch®** video compression technology can be integrated into the solution. vWatch is a video compression, management solution that supports an IP link for sending high quality video from a fixed location or on the move.



McQ vWatch

McQ continues to develop new satellite linked products using the Iridium global network while developing new sensor capabilities that provide Government and commercial customers with the benefits of connecting their applications to worldwide users without the need for terrestrial infrastructure.

www.mcqinc.com



Author John McQuiddy is the President of McQ.



COMMAND CENTER: CRAIG BROWER

VICE PRESIDENT & GENERAL MANAGER, PUBLIC SECTOR, ORBITAL INSIGHT

Craig Brower is the Vice President and General Manager, Public Sector, at Orbital Insight. He is an accomplished business development strategist with extensive experience in identifying and developing business opportunities, nurturing critical partnerships as well as launching new products and services. Craig's core competencies include: Strategic Business Planning, Financial and Contract Negotiation, Account Management, Partnership Development, Competitive Analysis, Congressional Relations, New Market Development

Good day, Mr. Brower. Would you please give our readers an idea as to your background and how you became involved with Orbital Insight?

CRAIG BROWER

I began my career with the Federal Government as a photographer for the CIA. Over the course of my 11 years with the agency, I worked as a research analyst as well as a program manager for new and emerging technologies. It was during this time that I found my passion for applying technology to answer critical questions about the world we live in.

After leaving government service, I helped to build what is today the Global Analysis business unit at BAE Systems and then spent several years selling commercial satellite imagery in the IC and DoD markets.

More recently, I was the third U.S. employee for startup Vricon, a joint venture between SAAB AB and DigitalGlobe (now Maxar). At Vricon we created and sold a new 3D technology at global scale to the U.S. government. Vricon was acquired in 2020 and, in January of 2021, I joined the

Orbital Insight team as vice president and general manager of the firm's public sector business. My goal in this role is to accelerate the adoption of AI and ML technologies in the public sector market.

What does Orbital Insight offer? How can the company's technology improve the way analysis is currently done in the defense & intelligence community?

CRAIG BROWER

Orbital Insight's **GO** platform is an AI-powered, geospatial analytics platform designed to simplify the use of location data and allow users to query the world with three basic parameters: the what, where, and when.

Orbital Insight's GO platform uses AI to process multiple sources of geospatial data — satellite images, mobile location, connected cars and other IoT data — into objective answers to critical security questions about what's happening on the ground.

The defense and intelligence community uses Orbital Insight's technology to monitor global activity and proactively address critical situations. The technology supports critical activity-based intelligence by helping spot trends buried within billions of data points—for example, military asset movement, near peer geopolitical activity, economic patterns associated with global ports, airports and energy a human analyst hours or even days to decipher, takes only seconds due to the automated analytical technology. Orbital Insight helps the defense and intelligence community monitor the world to detect anomalies, prevent surprises, and respond with the right security policies, communications and aid.



You note your company's GO platform is a geospatial analytics platform. When you use the term 'geospatial' as such applies to the military /agency/ government market segments, what exactly does that encompass?

CRAIG BROWER

In our view, the goal of geospatial analytics is to understand what's happening on and to the Earth. To do that, geospatial data usually covers location information, attribute information and temporal information.

The term "geospatial" applies to the military and government markets in the same way as the term applies to commercial or personal use. The difference is the absolute importance for the data to be as accurate and complete as possible when applied within a government segment.

The military uses the terms *reliability* and *explainability*; it is all about ensuring that the best and cleanest information possible is accessible by our military and intelligence leaders. That information can include maps, directions, visualizations and especially patterns of life — all of which can tip-and-cue decision-makers to anomalies. If something is not normal or if situations change, our customers need to know it and they need to know it as soon as possible.

What makes Orbital Insight's capability unique? How does Orbital Insight's capability differentiate from the competition?

CRAIG BROWER

Orbital Insight develops geospatial data analytics to help our clients unlock trends at a global scale. While other companies use AI, process big data from multiple sources, and analyze imagery, only Orbital Insight combines them all into a single self-service platform, called GO. Our GO technology ingests satellite imagery, geospatial data, IoT, demographic, advertising data, and other open source data and translates results into explainable, reliable, unclassified and non-proprietary insights. Customers tell us that GO is the most comprehensive yet distillable solution out there.

"Big Data from multiple sources" — would you give us some examples of the sources used by Orbital Insight to formulate their data?

CRAIG BROWER

We use various types of imagery data coming from commercial satellites, drones, and high-altitude balloons. Our platform also ingests mobile phone or AdTech data for geolocation information as well as AIS and ADB data for tracking ships and aircraft. In addition, we partner with other companies to provide our customers with access to RF and SAR data.

How can AI be used to support the analyst? Does AI replace the need for humans?

CRAIG BROWER

AI is an incredibly helpful tool in analytics, but it will never replace the need for humans. Our goal is to augment the performance of the analyst and the vision is to leverage the human-in-the-loop paradigm. GO does not remove the analyst from the equation — it simply saves them time that can be used to probe intelligence challenges more deeply. By processing large amounts of data, GO's automation can tip-and-cue the analyst to what matters most.

For example, GO users can set alerts and automatically cue follow-up observations upon detection of indications and warnings. GO also enables geospatial and data analysts to automatically monitor thousands of areas of interest, from hyperlocal to global. Analysts benefit from high revisit collection platforms and high-performance analytics — reducing the time from event to analysis.

What's the most interesting finding you've recently uncovered?

CRAIG BROWER

There are so many interesting findings, it's difficult to pick just one. For instance, with our new *Supply Chain Intelligence* feature, we have been able to locate groups moving between *China* and *North Korea* and then on to other locations in the region. We've also been able to make sense of *Russian* military activity in southeastern *Ukraine* and detected evidence of a major Russian offensive military training event in the *Crimea* region.

More recently, we've uncovered China's port development in *Djibouti*, as well as China's depredation of the local fish populations off the coast of *Ecuador* and *Peru* that has the deep interest of our maritime partners. Open source intelligence analysts from **Stanford's Center for International Security and Cooperation** have also been using GO to monitor nuclear proliferation in *North Korea* and *Iran*.

Mr. Brower, would you please discuss the ways wherein this crucial intelligence could inform strategic decisions on the battlefield.

CRAIG BROWER

The intelligence that our technology gathers via AI can help decision-makers better understand normal patterns of life and then set alerts when those norms change. It also helps them identify threat indications and warnings, enabling more strategic operational planning and target development.

Is AI already widely adopted within the defense space? How do you see this changing in the next couple of years?

CRAIG BROWER

The defense industry has widely accepted the need for AI but has yet to fully adopt and implement it. The DoD is taking steps to enable adoption of new and advanced data technologies, and between the **Joint Artificial Intelligence Center** and the services, there is a serious effort underway

to test AI technologies, prepare data for AI integration, and build tool sets to solve unique military problems.

A clear case has been made for the utility of AI in the defense and intelligence space, and it's also clear that accuracy and reliability of its use is paramount. I'm encouraged by the pace, progress and thoroughness of the effort to implement AI more widely in the defense sector.

An area of deep concern within the intelligence community is that of security, the protection of data from outside 'influences.'

How does Orbital Insight handle this area?

CRAIG BROWER

Orbital Insight sources our data from multiple industry-leading vendors, and we authenticate all data to ensure we are sourcing from the actual vendors. Much of the data we source is overlapping for the most comprehensive coverage, and we run correlation and correction processes to remove invalid data. We also follow industry best practices regarding cybersecurity.

The data is encrypted within our environment to prevent modification or tampering. Lastly, we follow a strict ethics policy, which goes above and beyond what the law requires to ensure that we never identify individuals with our products.

What are the biggest challenges for adoption of AI in the defense and intel community today?

CRAIG BROWER

Reliability is the biggest challenge. First, AI must be explainable, transparent, and properly trained. There has to be a clear answer to why an algorithm decides one outcome versus another when presented with various data sets.

Second, AI has to be accurate. This is especially important in target development and execution. The data behind it must be protected and free of malign or corrupt influence.

Tremendous progress has been made on all of these fronts, and with any technological innovation there are obstacles to overcome. Overall I'm impressed with the continued developments.

What measures are you taking to ensure that your AI is used ethically?

CRAIG BROWER

All of our data is anonymized to protect the sources or content of the data. Privacy is an extremely important value to us and one we take seriously. We have established an ethics board to review and assess potential ethical questions and operate within our ethics framework which shapes all of our work and decision making.

What may we expect from Orbital Insight over the coming months?

CRAIG BROWER

You can expect a growing, impactful contribution to the U.S. government, building upon a firm foundation of existing defense work. We've demonstrated success in commercial markets, and as we scale our public sector side of the business, you'll see more features designed to support the DoD, specifically in global airfield and ship port monitoring.

We are in the process of deploying a new open architecture software service that will allow us to integrate many different types of data sets under one roof and on one screen that will provide the analyst with insights derived from Electro-Optical imagery, IoT/Cloud data, AIS, ADB, SAR, RF, and even HSI data. We want to become the single integrator for unique commercial data to support military analysts.

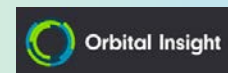
Lastly, Mr. Brower, when you look back upon your career, what missions or projects truly bring a sense of satisfaction to you and a smile to your face?

CRAIG BROWER

Mission success is the most rewarding aspect of my career, and that has been delivered in many different ways. At BAE Systems, I was honored to be able to hire some of the best analysts on the planet and their mission success with our customers was extremely rewarding. When I sold data and software solutions, it was most rewarding to learn of successful missions from our intel and warfighter customers because of our products. Most of those successes cannot be shared publicly, but you might catch a smile from me when that success is reported in the media.



orbitalinsight.com



BLUE HALO ACQUISITION

**BlueHalo as acquired Citadel Defense Company.**

Citadel develops advanced, **counter-unmanned aerial systems (cUAS)** technology used by customers within the Department of Defense and Intelligence Community, as well as civilian, commercial, and international markets.

Founded in 2016, Citadel's team of engineers and data scientists has developed best-of-breed cUAS products that leverage proprietary AI/ML algorithms to enable operators to locate drone threats, track flight paths, and autonomously neutralize threats.

Citadel's solutions create a distinct operational advantage for servicemen and servicewomen on the front lines. When defending against drone swarms and difficult-to-detect threats, Citadel's AI/ML-powered systems allow operators to identify and terminate enemy UAS threats with unmatched speed, accuracy, and reliability.

BlueHalo is a rapidly expanding, national security platform with market-leading capabilities spanning directed energy, cUAS, space superiority, space technology, advanced radio frequency, autonomy, and cyber and **signals intelligence (SIGINT)**.

The acquisition of Citadel complements BlueHalo's directed energy and layered perimeter defense capabilities where the company delivers a full suite of products, including the **Locust Laser Weapon System** and **Argus Perimeter Security Solution**.

Citadel's cUAS capabilities coupled with BlueHalo's existing portfolio of proprietary technology will uniquely enable the company to deliver multi-modal, unified cUAS solutions that support the warfighter and protect critical infrastructure.



"Citadel has established itself as a leader in the cUAS market and continues to innovate at a pace necessary to stay ahead of the rapidly evolving threat environment. We are incredibly excited to partner with the Citadel team as we continue to expand our cUAS capabilities and deliver transformative, market leading solutions to our customers," said **Jonathan MoneyMaker**, Chief Executive Officer (CEO) of BlueHalo. "The combination of Citadel and BlueHalo's unique technologies, deep mission intimacy, and systematic approach to innovation will accelerate our technology roadmap and allow us to rapidly field technologies critical to the warfighter."

David Wodlinger, a Partner at Arlington Capital Partners, said, "The increasing sophistication and widespread availability of UAS represents a critical and growing threat vector that will increasingly become a top priority for more and more organizations. Citadel has developed an innovative cUAS solution that we believe counters this threat in a differentiated way, positioning the Company to capture an outsized share of this large and growing market."

Chris Williams, CEO of Citadel, said, "Under the BlueHalo platform, our new and existing customers will benefit from an expanded set of capabilities, talent, and resources to achieve greater mission impact. We are excited to join an innovative company that we know will continue to push the boundaries of what is possible."

Henry Albers, a Vice President at Arlington Capital Partners, said, "The Citadel team is passionate about developing cutting-edge technology to address novel security threats, making this acquisition an excellent fit from a cultural perspective. We are excited to welcome these talented engineers to the organization as well as incorporate Citadel's technology into BlueHalo's rapidly expanding portfolio of proprietary solutions."

YEAR IN REVIEW: PER VICES

A YEAR OF NOTABLE SUCCESSES

Author: Brandon Malatest, Chief Operating Office & Co-Founder, Per Vices Corporation

Per Vices is a leading RF and digital systems innovator and integrator, supplying multiple industries with software-defined radios (SDR) for wireless communications solutions. Headquartered in Toronto, Canada, the company provides some of the world's top companies, governments, and organizations with SDR solutions for radar systems, GPS/GNSS, test & measurement (T&M), spectrum monitoring & recording, wireless communications, and interoperability, to name a few.

In the past year Per Vices has had several notable successes, with various new product launches and features that have expanded their capabilities to serve various clients and markets. Per Vices successes for 2021 included:

- » **Launching Chestnut; our latest mid-range SDR with extremely competitive pricing**
- » **Offering a spectrum monitoring, recording & playback solution as a package**
- » **Creating an extended channel option for our Cyan SDR platform**
- » **Developing a high instantaneous bandwidth option**
- » **Successfully navigating the supply chain issues that arose worldwide**

Per Vices now offers three top-of-the-line products that meet various budget and configuration needs. **Crimson TNG**, **Cyan**, and now **Chestnut**, are all **Commercial-Off-The-Shelf (COTS)** products that can fit clients' needs or be modified for specific use cases and technical requirements.

Chestnut has four **receive (Rx)** and four **transmit (Tx)** channels, 500 MHz of instantaneous bandwidth, and an operating frequency of near DC to 9 GHz to meet the needs of the evolving wireless communications market. Offering more power and performance than Crimson TNG, and a competitive mid-range price point, this product aims to fill the need in the market for an easy-to-integrate product for use cases such as wireless communications testing, signals intelligence and spectrum monitoring.

One of Per Vices signature products — Cyan — has launched three additional options: a host, storage and playback solution, high bandwidth (through extended digital backhaul capabilities), and an extended channel count option.

The fully configured solution for spectrum monitoring & recording, and playback, combines the Cyan SDR and a fully configured storage and playback solution that offers lossless data capture and storage at a rate of 160 Gbps. The high bandwidth option extends the RF bandwidth to 3 GHz per radio chain and the digital backhaul capabilities of the Cyan platform by upgrading to support up to 4 x 100 Gbps, making it the highest digital backhaul available in any COTS SDR solution.

The extended channel option, enabling multiple **digital down-converters (DDCs)** per physical radio port on Cyan, has been a huge success in addressing the complex needs of users that demand both high bandwidth and the option to only select channels within the given bandwidth needing to be streamed for processing on a host system.

These successes come amidst the challenge of managing the supply chain effectively to ensure that Per Vices can offer shorter lead times than others in the industry. The semiconductor chip shortage and the ripple effect of logistics and shipping problems due to the pandemic caused a compounding effect impacting manufacturing, design, production, and delivery.

To mitigate this challenge, Per Vices spoke with all of the firm's suppliers to obtain accurate and up-to-date figures on lead times, sourcing components and informing clients of timelines for deliverables. Potential delays were worked into forecasts and production cycles, and work sprints were rearranged to ensure that there wasn't a loss of productivity or delay in output

LOOKING TOWARD 2022

Per Vices hopes to achieve a continued release of new upgrades, features, and options for their existing platforms while continuing to navigate the supply chain challenges faced worldwide.

On the software front, the company will engage in a further expansion of the IP portfolio to move more of clients' application processing onto the onboard FPGAs. With the SDR market projected to grow to \$14.5 billion by 2025 due to its impact in shaping radio communications, there will be an increase in SDR integration into various projects in GPS/GNSS, radar, low-latency networking, spectrum monitoring & recording, medical, interoperability, T&M, and defense applications.



Per Vices Corporation





Per Vices Corporation

SOFTWARE DEFINED RADIOS



FLEXIBLE SDR
PLATFORMS FOR
YOUR MOST
DEMANDING
SYSTEM
REQUIREMENTS

As SDR is becoming more technologically advanced and versatile, more product families are emerging to meet customer needs that replace legacy equipment, improve compatibility and interoperability of equipment and devices, and reduce the costs of end products and services.

With the benefits of SDR being discovered for even more applications, Per Vices will continue to carve out its niche in

working closely with clients to develop, build and integrate high-performance SDRs.

www.pervices.com

Email: solutions@pervices.com for more information

Author Brandon Malatest is the Chief Operations Officer and Co-Founder of Per Vices Corporation

SDRs have become even more relevant in many diverse industries; it seems like many people are seeing firsthand the benefits that SDRs have to offer and we will continue to position ourselves as a leader in SDR to meet the needs demanded by customers across multiple industries including radar, radio links/communications, test and measurement, and spectrum monitoring, recording, and playback.

Many companies within this space have suffered from delays associated with component and material availability which has led to longer than anticipated lead times. One concern is that this will continue into the first half of 2022 and may disrupt other critical aspects associated with our customer's projects, especially in the government, agencies, and military fields. With shutdowns and lockdowns happening in various international regions, employees working from home, and manufacturers reducing the number of employees working in manufacturing facilities, the entire tech industry has suffered from supply chain shortages. From raw materials to components, to final assembly and distribution, there are numerous opportunities for delays due to the global nature of worldwide operations, trade tensions, and other factors.

The international supply chain is a complex system that balances precociously and needs precision and predictability to function. Once paused and restarted, cracks in the system began to emerge, such as backlogs in shipping ports, lack of containers, and business shut down due to Covid outbreaks. Each component is critical to the smooth continuation of operations but has its unique problems and solutions that need to be addressed and implemented – there is no blanket approach for all. Fixing the supply bottlenecks will take time, but as more and more supply chain operations start functioning, and materials and components start trickling through, the normal flow of goods will resume.

By creating sophisticated forecasting models and taking immediate and proactive action, Per Vices has ensured that impacts from supply chain delays are minimized. Per Vices will continue to work closely with suppliers to ensure productivity does not decline into 2022 and beyond.

www.pervices.com

YEAR IN REVIEW: QUILTY ANALYTICS

LOOKING AHEAD TO 2022'S CONTINUED DOWNLOAD OF SPACE 3.0

The evolution of the Satellite & Space industry can be likened to watching a decades-long, slow-motion movie — until the early 2010s, when SpaceX hit the fast-forward button on what would become a Space Age blockbuster.

Chris Quilty, a leading Wall Street analyst and founder of research and strategic advisory firm **Quilty Analytics**, refers to this crawl-to-sprint progression in figurative downloads that started in the 70s, when an entirely government-funded industry defined his categorization of “Space 1.0.” In the 90s, major corporations gave rise to “Space 2.0.” However, it wasn’t until 2010, with the first successful launch of the *Falcon 9*, that the space industry transitioned to the commercially driven, multi-billion-dollar economy with the many players that we know today. “We are ushering in a new era I like to call ‘Space 3.0’ where launch

affordability, smaller satellites, government and commercial partnerships, and an unprecedented infusion of private equity and venture capital funds are paving the way to a lucrative, thrilling future in space,” **Quilty** said before joking that his thoughts are gleaned from more than 20 years of analyzing the industry “long before SpaceX made it cool.”

GOVERNMENT INNOVATIONS CATALYZE COMMERCIAL GROWTH

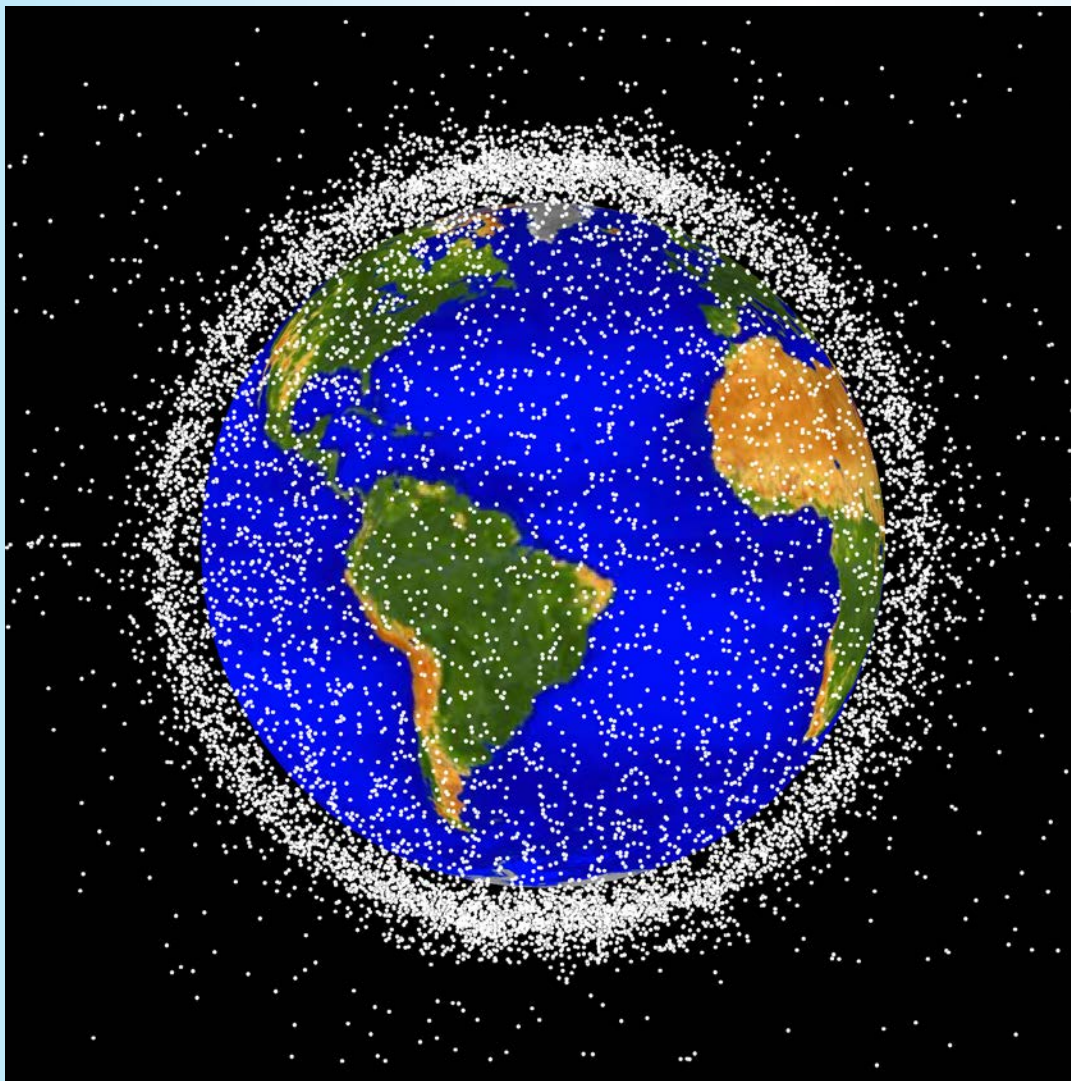
In the most recent **Satcom Quarterly** sector report, the Quilty Analytics team highlights several key developments contributing to Space 3.0, including the U.S. Military’s pivot to **Low Earth Orbit (LEO)** with a new, **military satcom (MILSATCOM)** constellation developed by the **U.S. Space Development Agency (SDA)**.

The SDA’s **National Defense Space Architecture (NDSA)**

initiative is a mesh network of hundreds of proliferated, optically connected satellites in LEO (or PLEO—**proliferated LEO**) that will start launching in 2022. To maintain U.S. superiority in the domain of space, the constellation provides complete global coverage to deliver advanced capabilities, including missile tracking, secure communications, GPS augmentation services (**position, navigation and timing – PNT**), and support for other military missions. While not a commercial constellation, SDA employs a novel spiral development strategy that relies entirely on an open, multi-vendor commercial acquisition approach.

Quilty views this development as a positive for LEO operators, satellite manufacturers, terminal makers, and the retail satellite industry at large, including ground station support, optical relay services, and connectivity services.

“The NDSA should strengthen a vibrant ecosystem of companies, both established and newspace, working to develop new technologies that enable DoD’s space assets to maintain the military’s strategic and tactical advantages,” he said. “Eventually, these technological advances will expand into the commercial sector and benefit satcom operators and the markets they serve, especially as hybrid architectures become the norm.”



In its *Satcom Quarterly* sector report, the Quilty Analytics team addresses the crescendo of concern mounting over space debris. Image is courtesy of NASA’s Orbital Debris Program Office

In addition to deploying its constellation, the DoD will soon issue RFPs for IDIQ contracts, with awards in August of 2022 for as much as \$875 million in commercial LEO broadband capacity. Quilty expects commercial LEO systems to be integrated with the NDSA later this decade, resulting in significant and ongoing LEO service awards to *OneWeb*, *Starlink*, *Telesat*, and others.

ACCELERATED SPACE SECTOR ACTIVITY HEATS UP SPACE SUSTAINABILITY DEBATE

In the company's third-quarter report, Quilty Analytics highlighted increased transactional activity in the space economy as mergers and acquisitions set the pace for vibrant activity with a disclosed deal value of \$5.1 billion.

Public offerings totaling \$2.9 billion in gross proceeds and venture equity financings raising \$1.7 billion also helped contribute to the upward trend. With steady industry growth, sustained LEO and SATCOM sector investment, and greater capital availability for early-stage investments as entrepreneurs capitalize on new ideas, disruption, and increased financing available for space companies, Quilty and other industry leaders are focusing their attention more on space debris mitigation and space sustainability.

"It is unclear whether we have reached a tipping point yet on space sustainability that will lead to definitive action, but industry leaders and government officials are sounding the alarm, especially after Russia's ASAT test," Quilty said. "We expect 2022 to bring heightened regulatory efforts and increasingly complex technology demonstrations."

STAKING OUT A PLACE IN SPACE

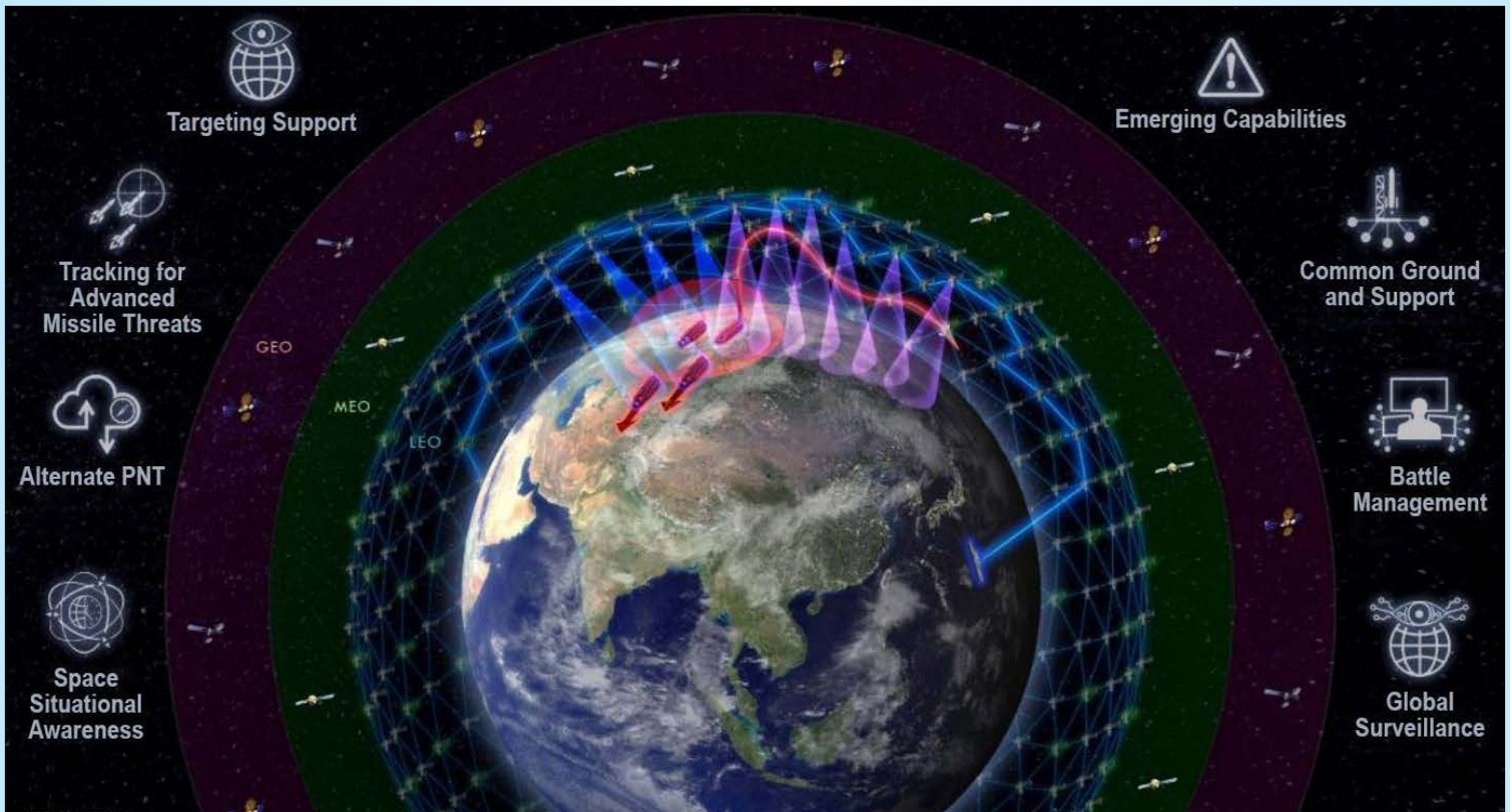
The FCC's spectrum processing round yielded plans from nine companies in November of 2021 for a total of 37,972 potential satellites. Quilty pointed out that FCC filing grounds do not guarantee any of the proposed constellations will be built. Instead, they are an essential preliminary step since "very little can happen, including fundraising, without having access to spectrum."

Quilty refers to the filings as a "land grab." He continued, "Broadband companies like Amazon are looking at space like Walt Disney must have looked at Orlando in the 1960s," Quilty said. "Acquiring the spectrum is the speed bump on the road toward building a LEO broadband network. Their ambitions are exciting, and I'm along for the ride. But staking a claim to space doesn't guarantee Magic Kingdom."



Quilty Analytics Founder Chris Quilty is a widely recognized Wall Street analyst with nearly three decades of experience in the Satellite & Space sector.

Quilty Analytics is an integrated boutique offering research, strategy, and investment banking advisory services for the Satellite & Space industry. Quilty Analytics offers an unmatched combination of financial, technical, and strategic insights that help drive better investment and policy decisions.



Vision for SDA's National Defense Space Architecture (NDSA) — a mesh network of hundreds of proliferated, optically connected satellites in LEO. Quilty Analytics Founder Chris Quilty thinks this initiative will benefit the commercial SATCOM industry.

THE URGENT NEED FOR AN INCREASED...

...U.S. TECHNOLOGICAL LUNAR PRESENCE

Authors: Cameo Lance, Rhea Space Activity, and Bruce MacDonald, Johns Hopkins University

Awareness of activity on the Lunar surface, and in the area of space between the Earth and the Moon, is critically important to maintaining U.S. space pre-eminence

China and Russia **signed an agreement** in March of this year to cooperate on their planned co-construction of an international lunar research station and possibly on the deployment of a companion space station in lunar orbit. This was followed up in June by a five-year extension of the 2001 Sino-Russian Treaty of Friendship, which was due to expire next February. That Treaty of Friendship enshrines the two powers' support for each other's defense of national unity and their own territorial integrity.

Of the treaty renewal, Russian President **Vladimir Putin** commented, "Such agreements are of serious importance. In the context of increasing geopolitical turbulence... Russian-Chinese coordination plays a stabilizing role in world affairs." (Reuters, June 28, 2021).

As aspirational and challenging as both nations' aims may seem at first glance, these developments, as well as China's rapidly expanding military and civilian space activities, highlight several important and immediate strategic issues facing the United States and its allies.

First and foremost, the U.S. Government is just beginning to ask itself: 'Does the United States need the ability to monitor Chinese and Russian activity on and around the Moon, as it does their activities in orbit around the Earth?'

In our view, the answer must be a resounding "yes."

Space is a domain rich with economic promise, as evidenced by a prolific and growing commercial presence out to *geostationary orbit* (GEO). Economic opportunities are arising in the area between the Earth and the Moon, the area referred to as "cislunar" space, as well as on the Moon itself. The United States and its allies and partners cannot responsibly operate in cislunar space without knowledge of the actions of other countries and

organizations in that very same domain. Ignorance of Chinese and Russian activities in these regions would be contrary to our commercial and national security interests.

Transparency on the part of China and Russia, the chief economic and strategic rivals of the U.S., has not exactly been a primary aim for either nation through many decades of fraught international relations. While the United States should discuss cooperative arrangements with all spacefaring nations, it would be unwise to think that China and Russia will be as forthcoming with information as we would like, or need.

Leave aside, for just a moment, the ready need for confirmable, accurate information about the activity of rivals in a strategically important operating environment. There will also be a vital need for a wide variety of shareable information, such as comprehensive "space weather" data, updated lunar geophysical (or "lunaphysical") conditions, and other cislunar and lunar situational analytics key to the success of U.S. and allied activities and, indeed, even personnel safety and survival. Leaders, as a demonstration of their pre-eminence, readily share such information.

The United States, while itself sharing useful information, is, without question, being technologically challenged by China.

NASA **recently awarded** the commercial rocket provider **SpaceX** a nearly \$3 billion contract for the development of a Moon lander, in step with U.S. plans to return to the Moon under the **Artemis** program — an ambitious effort, with the goal of "boots on the Moon" by 2024, set by the previous administration. It remains to be seen if that schedule will hold, however. The current U.S. administration, which is on record as supporting the Artemis program, has not yet made a decision on the mission's timeline, though it seems unlikely that the 2024 target date will be sustained.

The 2024 target date could be pushed back, for example, because **Blue Origin** and **Dynetics**, which lost the *Human Landing System* contract award to **SpaceX**, protested the award, further contributing to prospects for a project slowdown. Should the GAO rule in favor of the Blue Origin/Dynetics protest, we might all expect extended delays to the fruition of the Artemis program. Meanwhile, China moves forward apace, unhindered by commercial and bureaucratic challenges such as ours.

China's military space activities are cause for increasing U.S. and allied concern — so much so, in fact, that NATO Secretary-General **Jens Stoltenberg** warned that an attack on a NATO-member-deployed space satellite could trigger *Article V* NATO-wide assistance rendered to that NATO nation, with China clearly in mind.



Artistic rendition depicting cislunar space., courtesy of **Rhea Space Activity** and **Sabre Astronautics**.

It is important to remember that China's military and civilian space activities are much more closely linked than the well-known distinction between *NASA* and the *Department of Defense (DoD)* agencies. The technological prowess China recently demonstrated in landing and operating a rover on the Martian surface serves as a timely warning that we need to monitor its space activities closely.

Space Situational Awareness (SSA) — or, simply, knowing what is going on in space — has long been recognized as an important mission in the near-Earth environment (*low-, medium- and geosynchronous orbits*). Similarly, *SSA* is of emerging interest for monitoring spacecraft transiting between Earth, the Moon and Earth-Moon "*Lagrange points*," which are rare and valuable locations in space in which objects remain stationary.

The cislunar environment is much more gravitationally complex than areas closer to the Earth and is certainly not as well understood. Mechanisms to understand the behaviors of spacecraft in the cislunar domain exist, and all activity, regardless of origin, in the cislunar environment should be tracked and monitored to provide actionable, real-time information. This capability could be outsourced to the commercial market with solutions including inexpensive, small satellites potentially capable of monitoring spacecraft transit between the Earth and the Moon, as well as activity around the Moon and on the lunar surface.

A blossoming domestic commercial market for New Space technologies is already capable of designing, developing, and producing these mini-satellites (measured in the tens, as opposed to thousands, of kilograms in size), and several next-generation commercial companies have taken on the role of providing such services to U.S. government customers. For example, the *National Reconnaissance Office (NRO)* has already leveraged commercial companies, including through the award of a commercial imagery contract to the *Earth Observation (EO)* company, *Planet Labs*, which has 150, on-orbit satellites that are all about the size of a breadbox. Smaller satellites such as these are much less expensive to manufacture en masse, making their applications more economically appealing.

Therefore, if the technology exists and is available, what is missing from this equation? In our view, the United States should prioritize plans to identify needed sensing capabilities and then design a program to turn these priorities into an operational reality.

The United States has both the need and the capability to accomplish this important challenge. The time is now to build such a space infrastructure to meet the space information needs of the next several decades.

Such an infrastructure would not rule out cooperation with China and Russia when deemed appropriate. Healthy cooperation

and competition among the major space powers can lead to benefits for the entire world as progress is made on the Moon. *NASA*, the national academies, and other research organizations should be tasked to develop research agendas that can benefit all spacefaring nations. However, consideration should still be given to the realities and complexities of the mechanics of international rivalry in the space domain.

At a time when the Senate decisively approved \$250 billion for a major augmentation of federal science, technology, and research spending (*in which space plays an important role*), we should want to ensure that America does not simply return to the Moon but fully understands what is going on in and around the Moon as allies and adversaries alike begin to proliferate their own space assets. In so doing, we will expand our knowledge of this new 21st century frontier, demonstrate U.S. leadership, and maintain U.S. pre-eminence in space in and around the Moon for decades to come.

www.rheospaceactivity.com



Cameo Lance is the Director of Physics Programs for the Washington, D.C.-based New Space company Rhea Space Activity (www.rheospaceactivity.com).

Bruce MacDonald, a former Assistant Director for National Security with the White House Science Advisor's Office (1995 – 1999) has been a Senior Advisor to Rhea Space Activity, and is an adjunct professor at Johns Hopkins University (www.jhu.edu).

Rhea Space Activity (RSA) is an astrophysics start-up company that ideates and creates high-risk / high-reward research and development concepts to support U.S. national security objectives. RSA has developed technologies in fields as diverse as infrared satellites, directed energy, artificial intelligence, Light Detection and Ranging (LIDAR), astro-particle physics, small satellites, cislunar operations, intelligence collection, autonomous underwater vehicles, and for the F35 Lightning II.



Artistic rendition of the lunar landscape, courtesy of NASA.

YEAR IN REVIEW: WAVESTREAM

Wavestream has shipped more than 40,000 systems to airborne, ground/mobile and gateway customers in support of commercial and military applications around the globe. Our company has earned a reputation across the SATCOM industry for innovative design, high quality, reliability, and performance of our Solid-State Power Amplifiers (SSPAs), Block Upconverters (BUCs), Block Downconverters (BDCs), and Transceivers.

2021 IN RETROSPECT

As challenging as 2020 was for Wavestream, and indeed the entire satellite communications community, 2021 was a year of explosive growth for Wavestream. We saw a huge surge in orders from a surprisingly strong resurgence in business operations, investments in large projects, and an insatiable demand for more bandwidth in mobile and remote environments.

Wavestream received several major contract awards in 2021. Most notably, we received purchase orders totaling more than \$50 million for support of gateways for large **Low Earth Orbit (LEO)** constellation. These 160W Ka-Band SSPAs are designed specifically for networks using wide bandwidth uplinks and high-order modulation schemes. The customer asked us to accelerate our production and we are producing these units at about twice the initial anticipated production rate.

Additionally, Wavestream announced \$10 million in awards from a Tier-1 U.S. terminal provider for a highly integrated RF frequency conversion and power amplification subsystem. We refer to these deeply embedded products as **MicroStream**. More than 1,200 MicroStream units were ordered in 2021 by multiple Wavestream customers.

Wavestream also saw our **In-Flight Connectivity (IFC)** business rebound in 2021. While still not back to the levels we saw in 2019, our orders for airborne equipment easily tripled the orders received in 2020 during the height of the pandemic and the near complete shutdown of airborne travel around the globe. As part of these IFC awards, Wavestream announced that we had received **DO-160G Certification** for the **AeroStream 50Ku High Power Transceiver**.



Wavestream's AeroStream Transceiver

INNOVATION+ R&D

In 2021, Wavestream continued a trend of significant investment in new products and technologies that we started in 2020. At the height of the pandemic, Wavestream looked at the changing marketplace and our product line and saw a misalignment with the new post-COVID world. We poured ourselves into a new modular product architecture that will allow us to mix and match components for faster product development and better supply chain resilience. This trend will continue through 2022 and beyond, and indeed will be the core of our RF architecture for a decade or longer.

In 2021, Wavestream announced several new products — two **PowerStream** units, one MicroStream unit and one AeroStream unit. Two new PowerStream 160Ka units are now available, one for **MILSATCOM** applications (30.0 – 31.0 GHz) and one for commercial wideband applications (27.5 – 30.0 GHz).



Wavestream's PowerStream 160Ka

The military version is part of **DataPath's Gen-3 DKET** terminal that recently received ARSTRAT certification for operations on the **Wideband Global Satcom (WGS)** constellation. Our unit was selected to replace a competitor's unit due to better overall performance.

Our MicroStream 20Ka Wideband unit already has more than 1,000 orders and is indicative of how Wavestream can work with terminal providers to build complex RF subsystems to fit inside and around a tightly integrated terminal. For tactical terminal providers, we are seeing an increase in interest for deeply integrated RF subsystems, with less interest in typical box BUCs (which we refer to as our **Matchbox** product line).

As mentioned earlier, our **AeroStream 50Ku High-Power Transceiver (HPT)**, which has received DO-160G certification, was announced earlier in 2021. This unit is our next-generation, aviation-grade transceiver designed to be used in commercial and private jet applications for customers with high bandwidth requirements.

YEAR IN REVIEW: WAVESTREAM

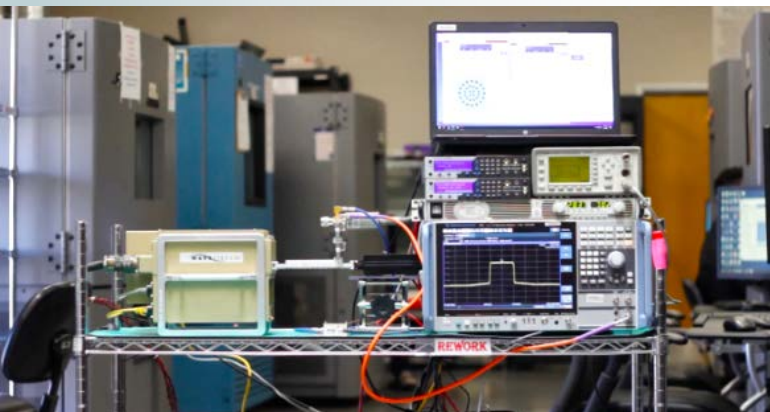
DIGITAL INTERFACE STANDARD (DIS)

Also in 2021, Wavestream spearheaded an effort to create an open standard for a digital interface between the satellite modem and the block upconverter. This interface has traditionally been an analog one, with the Modem modulating a signal onto an RF carrier centered originally at 70 MHz, or more recently at L-Band, usually centered around 1500 MHz.

This L-Band interface worked quite well for 20 years since it was introduced around 2000, but with the advent of **High-Throughput Satellites (HTS)** with 2.5GHz wide transponders, it has become difficult to use L-band as the intermediate frequency between modem and BUC. The carriers are just too wide to be centered at 1500 MHz.

Some operators handle this by changing the IF frequency to something higher than L-band, usually in the S-band (around 3 GHz). However, there are now so many fragmented IF bands that it's nearly impossible to build a standard block upconverter to work with all of them. One of our products can operate in 8 discrete IF frequencies, which is fantastic technologically, but imprudent from a business perspective.

With the support of several other companies including our parent company **Gilat Satellite Networks**, Wavestream created the **Digital Interface Standard (DIS) Working Group** and jointly built an open standard for a digital interface. This digital interface is explained further on our website and in this video found [at this direct link](#). Wavestream has built a demonstration of this digital interface and will be demonstrating it to customers throughout 2022.



Wavestream's DIS demo.

LOOKING AHEAD TO 2022

Next year will be a big year for Wavestream. We will be doubling our production capacity as we expand beyond our current building into a second facility next door. We are also working diligently to modernize our internal processes and workflows to better streamline our customer care.

We will have several new products to announce for gateway, airborne and defense markets and we will be spending a lot of energy on **Electronic Warfare (EW)** and **Protected SATCOM** applications, as well as space-based RF technologies.



Wavestream manufacturing

We expect to see continued pressure in the global supply chain which is driving our efforts to streamline and add resiliency to our product portfolio to try to reduce lead times of critical components for our products. We also expect to witness further adoption of **non-GEO** satellite communications technologies as well as the adoption of a digital IF interface between modems and BUCs.

From all of us at Wavestream, we wish you the very best for a prosperous and safe new year and look forward to working with you for years to come.



The Wavestream team.

www.wavestream.com



Author Tom Cox has been in and around the SATCOM industry for 25 years, starting as a Satellite Controller in the U.S. Army. He has held roles in Engineering, Product Management, Innovation, and Business Development at multiple systems integrators, and was the founder and CEO of two venture-backed technology startups. Tom has an MBA from Georgia State University.

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