Next Generation Space Defense

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U.S. SPACE FORCE SPACE SYSTEMS COMMAND'S NEXT TWO NORTHROP GRUMMAN-BUILT GSSAP SATELLITES LAUNCHED TO GEOSYNCHRONOUS ORBIT BY ULA

#AtlasV #USSF8

The *U.S. Space Force's Space Systems Command*, together with *United Launch Alliance* and its mission partners, have launched the fifth and sixth *Northrop Grumman*-built *Geosynchronous Space Situational Awareness Program* (GSSAP) satellites aboard an *Atlas V 551* launch vehicle from *Cape Canaveral Space Force Station*, Florida on January 21, 2022.

The mission — ***United States Space Force (USSF)-8*** — delivered two satellites, ***GSSAP-5*** and ***-6***, into orbit to further the ***Space Domain Awareness*** (**SDA**) mission.

Four ***GSSAP*** satellites are currently on-orbit and are contributing to the SSA architecture of sensors. The Northrop Grumman-built GSSAP satellites provide improved GEO-based ***space domain awareness*** (**SDA**) that will enhance the ability of the ***Combined Force Space Component Command*** commander to provide enhanced space safety of flight and better understand the ever evolving state of affairs in the GEO belt.

GSSAP-5 and ***-6*** will provide improved **SDA** data to the National Space Defense Center at *Schriever Space Force Base* and other national users to enhance the ability to navigate freely and safely within the GEO belt.

"*The first four GSSAP satellites have performed remarkably well*," said U.S. Space Force Lt. Gen. ***Stephen N. Whiting***, commander of *Space Operations Command* at *Peterson Space Force Base*, Colorado. "*These next two satellites will add to that capability and enable us to understand more completely things that occur in the geosynchronous orbit. It's a key piece in the puzzle for space domain awareness.*"

Operated by the U.S. Space Force, the GSSAP system provides precise GEO based SDA data seven days a week, 24-hours a day. The satellites join a GSSAP constellation that is supporting ***U.S. Space Command*** *space surveillance operations* (**SSA**) as a dedicated ***Space Surveillance Network*** sensor. GSSAP also supports the ***Combined Force Space Component Command*** by collecting space domain awareness data, allowing for more accurate tracking and characterization of man-made orbiting objects.

SSC and its mission partners conducted the mission launch that was aboard ***ULA***'s ***Atlas V*** launch vehicle in the "511" configuration (*Five-meter fairing, one solid rocket booster and one upper stage engine*), procured through the *National Security Space Launch* (**NSSL**) program.

The NSSL program provides assured access to space for ***Department of Defense*** and other government payloads; and supports the full range of government mission requirements, while delivering on schedule and providing significant cost savings over the heritage launch systems.

Space Systems Command is the U.S. Space Force field command responsible for rapidly identifying, prototyping and fielding resilient space capabilities for joint warfighters.

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IBCS CONNECTS THE JOINT FORCE ACROSS ALL DOMAINS

A Northrop Grumman produced Engagement Operations Center (EOC) and Interactive Collaborative Environment (ICE) emplaced at White Sands Missile Range, New Mexico. Photo is courtesy of the U.S. Army.

Northrop Grumman Corporation **(NYSE: NOC) was awarded a five-year contract valued at more than $1 billion from the U.S. Army for low-rate initial production and full-rate production of the Integrated Battle Command System (IBCS) on December 23.**

Under this contract, Northrop Grumman will produce and field IBCS and provide product engineering and logistics support for the U.S. and select allied forces through foreign military sales.

IBCS's resilient, open, modular and scalable architecture is foundational to integrating all available assets in the battlespace, regardless of source, service or domain. Its architecture enables the efficient and affordable integration of current and future systems.

Through numerous, successful flight tests, IBCS has validated the ability to connect and fuse multi-service sensor data to multi-service weapons demonstrating JADC2 capabilities.

Since Northrop Grumman delivered the first IBCS to the U.S. Army, the program has undergone extensive hardware-in-the-loop environmental, live fire, and developmental testing and has participated in numerous Joint Service and U.S. Army exercises.

The current award follows the program's recent flight test which integrated multi-domain systems across the services and the decision by the ***Department of Defense*** authorizing IBCS to proceed into low rate initial production as a result of the successful Limited User Test.

"*IBCS is a centerpiece of the U.S. Army's modernization strategy for air and missile defense to address the changing battlefield*," said ***Mary Petryszyn***, corporate vice president and president, Northrop Grumman Defense Systems. "*Working closely with the Army, we look forward to leveraging the IBCS architecture to create an all-domain command and control capability*."

DEMO JADC2 ENABLES CAPABILITIES IN THE U.S. ARMY'S PROJECT CONVERGENCE

Northrop Grumman Corporation **(NYSE: NOC) programs recently completed successful testing and demonstrations as part of U.S. Army's Project Convergence. The testing demonstrated Northrop Grumman's architectural capability to integrate networks, sensors, and effectors across domains for joint operations.**

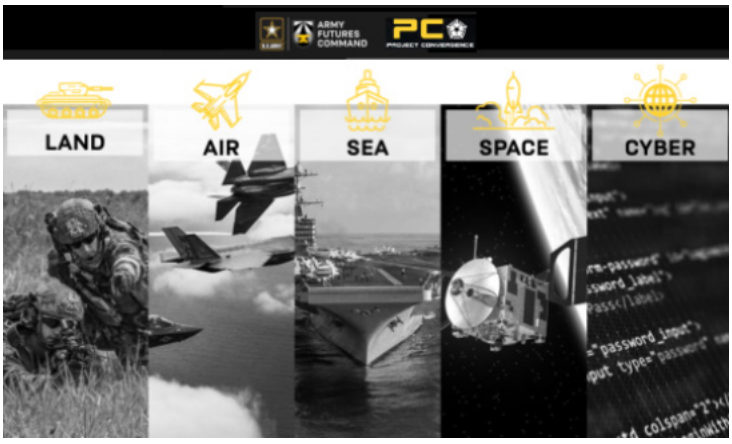
The Northrop Grumman systems involved included the U.S. Army's ***Integrated Air and Missile Defense Battle Command System*** (**IBCS**), ***Joint Tactical Ground Station*** (**JTAGS**), and the ***Marine Corps AN/TPS-80 Ground/Air Task-Oriented Radar*** (**G/ATOR**).

During live-fire exercises at White Sands Missile Range, New Mexico, numerous tactical ballistic missile surrogates were launched. A mix of ground, airborne, and space-based sensors sent tracking data via satellite communications to an Engagement Operations Center at ***Fort Bliss***, Texas. There, soldier operators remotely tracked the targets and initiated the launch of missiles to engage the targets.

Also during Project Convergence, the Army conducted a series of complex network and communication exercises in which IBCS supported the execution of precision strike missions, in addition to conducting an integrated air and missile defense mission. It fused data from an F-35 sensor to identify and track a ground target and provided the data to ***Army Field Artillery Tactical Data System*** (**AFATDS**) and AFATDS engaged the target.

Project Convergence is the U.S. Army's campaign of learning to aggressively pursue an Artificial Intelligence and machine learning-enabled battlefield management system and is the U.S. Army's contribution to the military-wide ***Joint All Domain Command and Control*** (**JADC2**). ***Project Convergence 21*** was an event that tested the Army's sensor-to-sensor capabilities as a Joint Force through a series of seven scenarios.

"*Project Convergence provided us another opportunity to demonstrate our architecture's ability to deliver joint connectivity across the services*," said ***Christine Harbison***, vice president and general manager, combat systems and mission readiness, Northrop Grumman. "*That open architecture allows utilization of satellite communications to conduct remote engagements of target missiles, demonstrating our ability to connect the battlespace for all-domain operations*."



MULTI-ORBIT SOLUTIONS TESTED BY U.S. ARMY + SES GS

SES GS supports the U.S. Army in recently 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 Mbs on a ***Wideband Global SATCOM*** (**WGS**) GEO network and up to 600×600 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, Vice President, Government Affairs, SES GS This post first appeared first on **GovSat** and is republished with permission of **SES GS.***

SES GOVERNMENT SOLUTIONS LAUNCHES TACTIXS ON-DEMAND X-BAND SERVICE PLATFORM

SES Government Solutions has launched tactiXs, a mission-specific managed service platform in partnership with Network Innovations and GovSat, a public-private joint venture between the Government of Luxembourg and SES.

The full end-to-end managed service provides practical, cost-effective solutions to mission parameters by allowing the customer to purchase a volume-based Mbps service, as opposed to MHz bandwidth agreements, whilst ensuring security and performance of the connectivity service.

Leveraging the ***GovSat-1*** satellite, operated by ***GovSat***, tactiXs delivers secure, non-preemptible X-band capacity to customers on an on-demand basis across any domain or austere environment in Europe, Africa and the Middle East. Utilizing high-powered, steerable spot beams that can be quickly repositioned to provide robust coverage makes this solution well suited for any U.S. military or government-based mission whether it be ***Comms-On-The-Move*** (**COTM**) or ***Comms-On-The-Pause*** (**COTP**).

tactiXs can support a myriad of use cases required by military users, including covert missions and various types of special ops. The GovSat-1 satellite connectivity is ideally paired with the capabilities of the tactiXs platform and has all the key attributes of MILSATCOM such as anti-jam, encrypted telemetry & control as well as secure beam steering & control, and can augment the Wideband Global SATCOM system (WGS) with secure X- and Mil Ka- band capabilities.

"*Our new service platform is a non-preemptible alternative to WGS that can handle the most tactical-edge customers' data and mission requirements, and with no lead time required can be set up within hours for the mission at hand,*"

said President and CEO of SES Government Solutions, Brigadier General ***Pete Hoene***, USAF (retired). "*We are proud to partner with both Network Innovations and GovSat as we understand the demand for reliable, uncontended bandwidth and we are excited to bring this innovative and secure solution to the market.*"

"*tactiXs is the only commercial satellite managed service available to the military that offers X-band satellite capacity on an as-needed, volume-based basis,*" said ***Patti Aston***, a Senior Director at SES Government Solutions. "*By making capacity on GovSat-1 available as a short-term managed service, tactiXs enables the military to access X-band capacity specifically tailored to the mission in which communications are needed.*"

For additional information about the tactiXs managed service platform, please ***access this direct infolink...***

MOOG ACTUATION PROVIDES PRECISION MOTION CONTROL FOR GREMLINS AIR RECOVERY MISSION

Moog Inc.'s (NYSE: MOG.A and MOG.B) hardware has played a critical role in a historic milestone in unmanned aviation by successfully launching and retrieving an X-61A Gremlins Air Vehicle (GAV) *(pictured above)* **during the program's fourth flight test event in October at the Dugway Proving Ground in Utah.**

The Gremlins demonstration system flew three GAVs to conduct four individual flight sorties for a combined 6.7 hours of flight, including the 1.4-hour airborne recovery mission. The overarching goal of the Gremlins Program, managed by ***DARPA's Tactical Technology Office***, is to demonstrate aerial launch and recovery of multiple, low-cost, reusable, ***unmanned aerial systems*** (**UASs**).

Moog's electromechanical actuation systems provide precision motion control for several elements of the Gremlins demonstration system, including GAV tail fin control, GAV wing deploy, and fin control for the attitude-controlled "***Bullet,***" which is a key element in the recovery system. These actuation systems have been developed in a highly collaborative environment with ***Dynetics*** to achieve the rapid integration and flight test schedule that is expected for DARPA programs.

The solutions leverage previously flight-qualified elements and ***Commercial-Off-The-Shelf*** (**COTS**) components striking a unique balance between reliability and cost that is essential to all successful programs. The electromechanical actuation system design allows for multiple sorties, enabling Dynetics to meet the critical goal of 24-hour refurbishment for return to flight.

"*Our development of application-specific systems over the last several decades has resulted in an extensive portfolio of flight-proven solutions,*" said ***Mike Brunner***, Moog Missile Systems Director. "*In order to support the rapidly evolving needs of our warfighter, whenever possible we are shifting from the longer timelines associated with the traditional development of unique solutions, and instead, as an embedded teammate, work to fully leverage our proven solutions to bring low risk capabilities to our customers at a much faster pace.*"

CACI WINS $514 MILLION TASK ORDER TO MODERNIZE U.S. ARMY NETWORKS

CACI International Inc (NYSE: CACI) has been awarded a new, five-year (one-year base and four one-year options), single-award task order, with a potential value of $514 million, to provide network modernization of *outside plant* (OSP) infrastructure and facilities across major U.S. Army locations within the continental United States.

CACI engineers, managers, and technicians will deliver enterprise technology to enhance capabilities and improve capacity needed for an underground

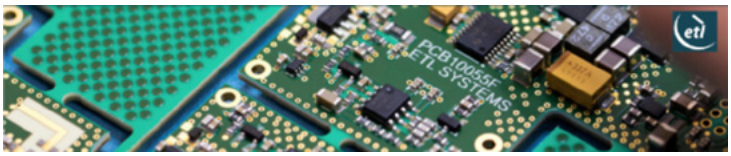
fiber optic cable infrastructure required to support robust, reliable, high-speed voice, video and data networks for critical command and control systems.

As part of the OSP task order, awarded under the ***GSA's Alliant 2 contract vehicle***, CACI will ***engineer, furnish, install, and test*** (**EFI&T**) a turnkey solution to upgrade the existing OSP infrastructure and facilities at a minimum of 40 different military installations using industry best practices.

John Mengucci, CACI President and Chief Executive Officer, said, "*CACI's understanding and unique OSP knowledge will ensure that this modernization maximizes the Army's current infrastructure, evolves to incorporate the latest network standards, and supports Army communications for software, data and analytics at scale as well as network security. Working with the Army, we will effectively deliver higher reliability and survivability supporting all missions with near-zero downtime*"

With more than 30 years of solid past performance and advanced network modernization capabilities, strengthened through CACI's acquisition of ***LGS Innovations***, this new task order further expands CACI's current global OSP efforts providing repeatable infrastructure solutions that support current and future communications, command and control, and other requirements.

MAJOR MILESTONE ACHIEVED AS ETL LAUNCHES HAVOC MATRIX



ETL Systems has launched the world's first single chassis, 256 x 256 RF router.

The new, ultra-compact, ***L-band Havoc Matrix*** is a major step forward for the industry, providing routing for as many as 256 input and output feeds in a 16U high chassis.

The HAV-80 is a distributive (full fan out) Matrix unit that can be expanded from 16x16 up to 256x256 in blocks of 16, enabling operators to cut down on modems and modulators, as well as significantly reducing capital expenditure.

Havoc L-band Matrix System (Downlink) 64 x 192

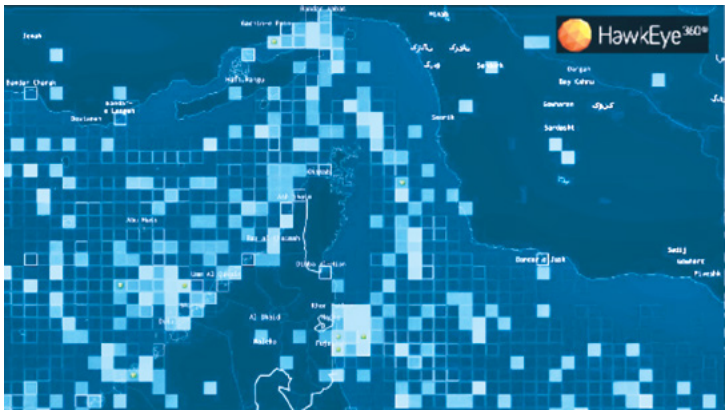
Havoc L-band Matrix System (Downlink) 96 x 160

256 x 256 L-band Havoc Matrix

The first orders have already been shipped to two major players in the Government and Defense markets, with the high-tech design attracting attention from across the industry.

Dr Esen Bayer, CEO at ETL Systems, said, "*We are really excited to be launching the HAV-80. This is not only a major achievement for our engineering team, but also a significant step forward for the industry. Offering unrivalled capacity for its size, the Havoc Matrix can carry an amazing amount of data and is the most advanced device of its kind. The innovative design combines many challenging production technologies, harmoniously integrating RF and electronics, software and firmware, secure and user-friendly interfaces and thermal and mechanical engineering. The HAV-80 has been built with precision engineering and I'm immensely proud of the team at ETL for their incredible contribution throughout the design and development process.*"

AFRL ASSIGNS MILLION$$ CONTRACT TO HAWKEYE 360 FOR SPACE-BASED ISR



HawkEye 360 Inc. has been awarded a three year, $15.5 million *Experimental Purpose Agreement* (EPA) contract with the Air Force Research Laboratory's (AFRL) Space Vehicles Directorate. Through the agreement, HawkEye 360 will provide radio frequency analytics research, development, and experiments to help the government demonstrate, test and evaluate its hybrid space ISR architecture.

HawkEye 360 has previously supported numerous AFRL exercises, but had never done so through a direct contract vehicle. As part of the new agreement, HawkEye 360 will support a variety of operational use cases by providing embedded personnel support, data collection, tools for data ingestion, analytics and more.

The agreement scope includes participating military exercises, such as the Rim of the Pacific exercises, to introduce new capabilities to the warfighter and identify ways to improve and integrate into operational workflows. The EPA contract vehicle is available for use by all Combatant Commands as they look to test and demonstrate innovative commercial RF data and analytics to include Direct Downlink to government ground stations.

"*This agreement is a tremendous opportunity for HawkEye 360 to showcase the whole spectrum of capability we offer the government as it develops its space architectures,*" said CEO, ***John Serafini***. "*We deliver value not only through the efficient tasking, collection and delivery of our RF data, which has never before been commercially available, but also through embedded operational support and enhanced analytics capabilities, deriving applicable insights for diverse end users. Ultimately, we hope to shape a pathway for further integration of valuable commercial capabilities into the government's space architecture.*"

"*We appreciate the opportunity to partner with one of the most prestigious military research organizations in the world,*" said ***Alex Fox***, Executive Vice President for Global Growth. "*Our team is excited to be part of an AFRL program focused on developing and transitioning space capabilities for more effective and affordable warfighter missions. We share AFRL's vision for a hybrid government and commercial ISR architecture to address growing global threats and to provide the warfighter with high-impact insights needed to support their mission.*"

AFRL Technical Program Manager, ***Charlene Jack***a. "*We are pleased to have the opportunity to explore at greater scale and depth, using real-world scenarios, how a leading radio frequency data and analytics provider such as HawkEye 360 can supplement and strengthen our hybrid satellite ISR architecture, and to develop new tactics, techniques and procedures to enable further utility assessments.*"

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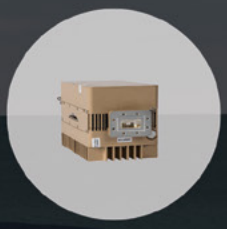

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SPELLING INNOVATION WITH THREE LETTERS: GSU

Geographically Separate Units (GSU) leverage partnerships to ensure Space Systems Command is at the forefront of emerging Technology

Author: United States Space Force (USSF) Space Systems Command (SSC)

The USSF's Space Systems Command (SSC) may have its headquarters at the Los Angeles Air Force Base, but it also depends on the work of thousands of Guardians at its Geographically Separate Units (GSUs) around the country. These units fall under the SSC organizational structure and perform space-related work in a variety of fields at multiple locations.

Space Launch Delta 30, located at ***Vandenberg Space Force Base***, and ***Space Launch Delta 45***, located at ***Patrick Space Force Base*** and ***Ascension Island***, are among SSC's more than 25 GSUs at 14 different locations.

One of SSC's largest GSUs is the ***Innovation and Prototyping Directorate*** (**SSC Det-1**) at ***Kirtland AFB***, which includes two more GSUs — the ***Tools, Applications and Processing Laboratory*** (**TAP Lab**) in Boulder, Colorado, and the ***Space Test Program*** (**STP**) ***Human Spaceflight Payloads*** branch located at ***NASA's Johnson Space Center*** (**JSC**) in Houston, Texas. The STP branch in Houston is an ***Operating Location***, the smallest type of GSU.

Steven Polliard

"*The TAP Lab in Boulder, Colo. represents one of SSC's GSUs at the forefront of U.S. Space Force's innovation strategy*," said ***Steven Polliard***, director of the TAP Lab, a government-operated, ***remote sensing, data exploitation research, development, test and evaluation*** (**RDT&E**) facility.

The location earned accolades while previously functioning as a backup facility for all ***Overhead Persistent Infrared*** (**OPIR**) satellite data. "*U.S. Air Force leaders chose Boulder in 2015 to establish the TAP Lab where it could leverage a unique series of existing investments in facility, infrastructure, physical and cybersecurity measures*," Polliard said.

The planned ramp-down of the ***Space Based Infrared Systems*** (**SBIRS**) activities — being replaced by the *Next-Gen OPIR system* — created the opportunity to stand up an all-new, RDT&E environment to exploit data and unlock more value from sensors in space.

The Boulder location provides proximity to ***TAP Lab***'s operations mission partners at ***Buckley Space Force Base*** and also places the lab squarely in Colorado's front range "*Aerospace Alley*" with hundreds of technology, defense and aerospace firms and research institutions, such as the ***University of Colorado, Boulder***.

The TAP Lab, located in Boulder, Colo., is one of Space Systems Command's Geographically Separated Units. The government-operated remote sensing data exploitation research, development, test and evaluation (RDT&E) facility takes data collected from DoD and other satellites and uses high-value data exploitation algorithms and software applications to improve and enhance data for the warfighter and other DoD and civil agencies. Photo is courtesy of TAP Lab.

"*When we were standing up the TAP Lab, the vision was: we are using this sensor data to enhance our primary missions – missile warning, missile defense and battle space awareness – but isn't there some other value that we can squeeze from the data to support other mission areas?*" Polliard said.

For example, the TAP Lab also provides a secondary source of weather data to ***U.S. Navy*** ships at sea, as a back-up to commercial weather sensors the Navy doesn't own or control, Polliard explained.

DATA MAPPING + CRUCIAL CAPABILITIES

"*Our primary mission is to rapidly develop and deploy high-value data exploitation algorithms and software applications using modern, innovative methods*," Polliard said. "*Software applications address emerging, time-critical and challenging threats. They do this by 'squeezing out' critical knowledge from data collected by DoD and other satellites, including environmental sensors, such as GOES, VIIRS, MARK-IVB and potential future Environmental Weather Sensor (EWS) programs. We're leveraging multiple sensor data to fill gaps in our data and to fuse to create new data, to improve and enhance our mission areas and those of other stakeholders.*"

Much of the lab's space data is archived and time-stamped and is used to help keep transactions consistent as they are mapped to each other. Major ***Evan M. Porter***, deputy chief for data exploitation for the ***Technology Evolution*** branch, compared it to two people, standing at opposite ends of a long hallway, looking at an object in the middle of the hallway, from different vantage points.

"*Even though they have different perspectives, it's the same piece of information that they're looking at*," Porter said. "*It's important when we're exploiting data from often different sensors, that the data is marked, archived and time-stamped so when different parties are trying to access that data, they're getting the correct data at the right time, even though they may be looking at it from different mediums. Not only does this provide the ability to properly warehouse the data but it allows the user to ensure accuracy of the data across all sensors.*"

TAP Lab's in-house software factory team is complemented by more than two dozen external vendors, ranging from small start-ups to major companies, academic partners and other government entities, all working in an open framework, collaborative environment.

The TAP Lab is directly staffed by military and government civilians, and organically staffed with ***Aerospace***, ***MITRE***, ***Software Engineering Institute***, ***SE&I***, and ***SETA*** personnel and provides access to top experts in their fields, creating the perfect environment for cooperation in ongoing research and development.

SPACE TEST PROGRAM, THE BACKBONE OF EXPERIMENTAL SCIENTIFIC PAYLOADS

Based at NASA's JSC in Houston, Texas, the Space Test Program's (STP) ***Human Spaceflight Payloads*** branch is focused on the acquisition, integration and environmental testing of payloads that host ***U.S. Department of Defense*** experiments for launch to the ***International Space Station*** (**ISS**).

The DoD's STP has been sending experimental scientific payloads into space since 1965. To date, STP has executed more than 289 missions and provided spaceflight for more than 636 DoD experiments.

Craig R. Lamb

"*The Space Test Program is the longest-running space program in the U.S. Department of Defense and is the second-longest program in the DoD, after the B-52 program*," said ***Craig R. Lamb***, Director, ***Human Spaceflight Payloads Office***, ***NASA's Johnson Space Center***. "*There isn't a single major operational system that Space Systems Command has developed that hasn't been influenced by STP. The R&D technology that STP flies proves these new, emerging technologies for future DoD space systems and that's important especially in today's era, where the threat is greatly increasing in space.*"

The ***Global Positioning System*** (**GPS**) that people take for granted today was developed from an STP experiment and is still provided via a DoD satellite constellation, managed by the ***United States Space Force*** (**USSF**), and provided to the public at no cost to the users, Lamb noted.

STP executes its mission from two locations. Headquarters are located at SSC's **Det-1** at **Kirtland AFB** and runs the overall Space Test Program and executes expendable launch vehicle missions such as the ***STP-3*** mission with the ***STPSat-6*** as its primary payload, as well as small launch vehicle missions such as the ***Rapid Agile Launch Initiative*** that fosters growth of the commercial small launch industry. STP's Kirtland office also conducts suborbital sounding rocket missions, missions requiring geosynchronous access, and develops small spacecraft to host DoD experiments.

> ***"We're leveraging multiple sensor data to fill gaps in our data and to fuse to create new data, to improve and enhance our mission areas and those of other stakeholders."***
> ***— Steven Polliard, Director of SSC's TAP Lab, RDT&E facility***

STPSat-6's nine payloads include the National Nuclear Security Administration (NNSA)'s Space and Atmospheric Burst Reporting System (SABRS), NASA's Laser Communications Relay Demonstration (LCRD) and seven Space Experiments Review Board (SERB) payloads that demonstrate cutting edge space technologies.
Artistic rendition is courtesy of Northrop Grumman.

STP's Operating Location, based at ***NASA's Johnson Space Center*** executes STP missions that fly to, and operate from, the ISS. The STP Operating Location in Houston has a variety of ways to test new technology, including flying experiments in microgravity on reduced-gravity aircraft and sending experiments to the ISS, to be run either inside the station, or outside, attached to external modules.

"We are partnering with NASA and the space station program to get DoD STP technology tested in a very quick and cost-effective way," Lamb said. *"We've developed a pallet that you can fly to the ISS, plug into the side of the space station and you can test new sensors, new techniques of remote sensing, new pieces of hardware and we don't have to build our own satellite to do that. We leverage NASA's investment in the space station and get launched on commercial launch vehicles like the Falcon 9."*

REDUCING TIME AND COST WITH REUSE… AND PARTNERS

"We're able to go from a paper concept to a payload in space in just a couple of years and get researchers the data they need," Lamb said. *"The program also uses reusable avionics to further cut costs and time. We're taking the same flight computer, the same software, the same power converters, the same basic designs and we're flying those time and time again, to save on that development effort," Lamb said. "We're reducing the time it takes us to build payloads that fly in space and we can get data faster and get research done faster so new technology can go into new operational systems faster."*

In some cases, the STP program saves money by identifying technology that doesn't work, Lamb said.

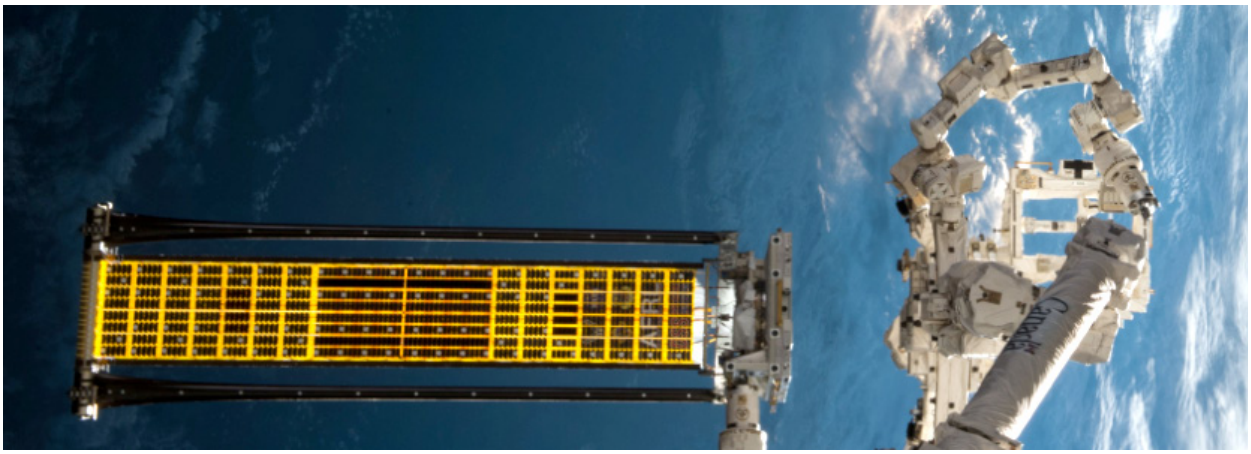
"Even if an experiment proves that this technology is not useful, it can save SSC or the DoD time and effort in not investing in technology that does not have a future," Lamb said. *"If you're in charge of a multi-billion dollar program, you don't want to take that risk of a new technology on that program. Programs need to have that technology demonstrated in space before they can build it into an operational system. You can't afford to have that operational system fail – but you can afford to have an R&D experiment fail."*

Similar to the TAP Lab, STP works with a multitude of partners. STP is a DoD program, which means it flies experiments from the **U.S. Army**, **U.S. Air Force, U.S. Space Force**, **U.S. Navy** and other DoD agencies such as ***DARPA*** (***Defense Advanced Research Projects Agency***).

The agencies meet once a year with the ***Space Experiments Review Board*** to discuss and review the research projects they want STP to test, and rank them in order of priority. STP then tests as many of them as possible.

"The DoD and NASA have different missions in space, but both agencies operate in the space environment," Lamb said. *"There's often cross-collaboration between agencies."*

One example of successful interagency cooperation is the ***Roll Out Solar Array***, or ***ROSA***, which started out with NASA and the ***Air Force Research Laboratory*** (**AFRL**) working together to find a way to make solar arrays more energy-efficient, lighter, and more dependable, Lamb said.



The ROSA technology was first tested in vacuum chambers on Earth, then sent into space on an STP mission in 2017, where the project was tested to see how it functioned in space and responded to vibrations and stress loads from ISS maneuvers.

It worked so well that, in June of 2021, two new solar **iROSA** panels were installed on the ISS, the first of a six-panel, 120-kilowatt upgrade. The new technology also will be used on NASA's ***Lunar Gateway*** project in the future, Lamb said.

"Everyone wants better solar arrays — whether it's on a DoD satellite or a NASA space station," Lamb said. *"Everyone wants more power for the mass: in the old days, you were lucky to get 12 percent of the energy that fell on a square foot of solar array, and now, with new technology - largely from space R&D – 33 to 34 percent of*

the sun's energy can be converted to electricity and the ROSA technology reduces the mass needed so that more mass can be allocated to other spacecraft systems."

He added, "*If you have a communications satellite, and you can put more energy into your signal, that means your antennas on the ground can be smaller and you can get more data from space to ground. It's not just about new solar cell technology, but what that technology enables the satellite to do.*"

STP's Houston branch's latest mission, ***STP-H7*** and ***STP-H-8***, which launched in December on NASA's ***SpaceX-24*** resupply mission, sent nine DoD experiments to the ISS: six one-year experiments, and three-year experiments.

The payloads were installed on the ***Japanese*** (**JAXA**) and the ***European Space Agency*** (**ESA**)'s ***Columbus*** experiment modules on board the ISS and will run experiments demonstrating new technologies in surface wind detection, radiation sensors and space domain awareness and more.

INNOVATION + PROTOTYPING

SSC's ***Innovation and Prototyping Directorate*** is headquartered at Kirtland Air Force Base, New Mexico, and executes diverse missions not only from Kirtland, but also from various locations, including ***Los Angeles Air Force Base***, California; ***Johnson Space Center***, Houston, Texas; and three locations in Colorado — ***Schriever Space Force Base***, ***Buckley Space Force Base***, and ***Boulder***, respectively.

The directorate's primary mission areas include rapid prototyping development, prototype space operations, worldwide deployable telemetry, tracking, and control, prototyping capability maturation, and executing the DoD Space Test Program.

> ***"It's not just about new solar cell technology, but what that technology enables the satellite to do." — Craig R. Lamb, Director, DoD Human Spaceflight.***

The directorate is leading the way on enabling and delivering next-generation space enterprise solutions through rapid, innovative and affordable technology that leverages international, commercial, and interagency partnerships.

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

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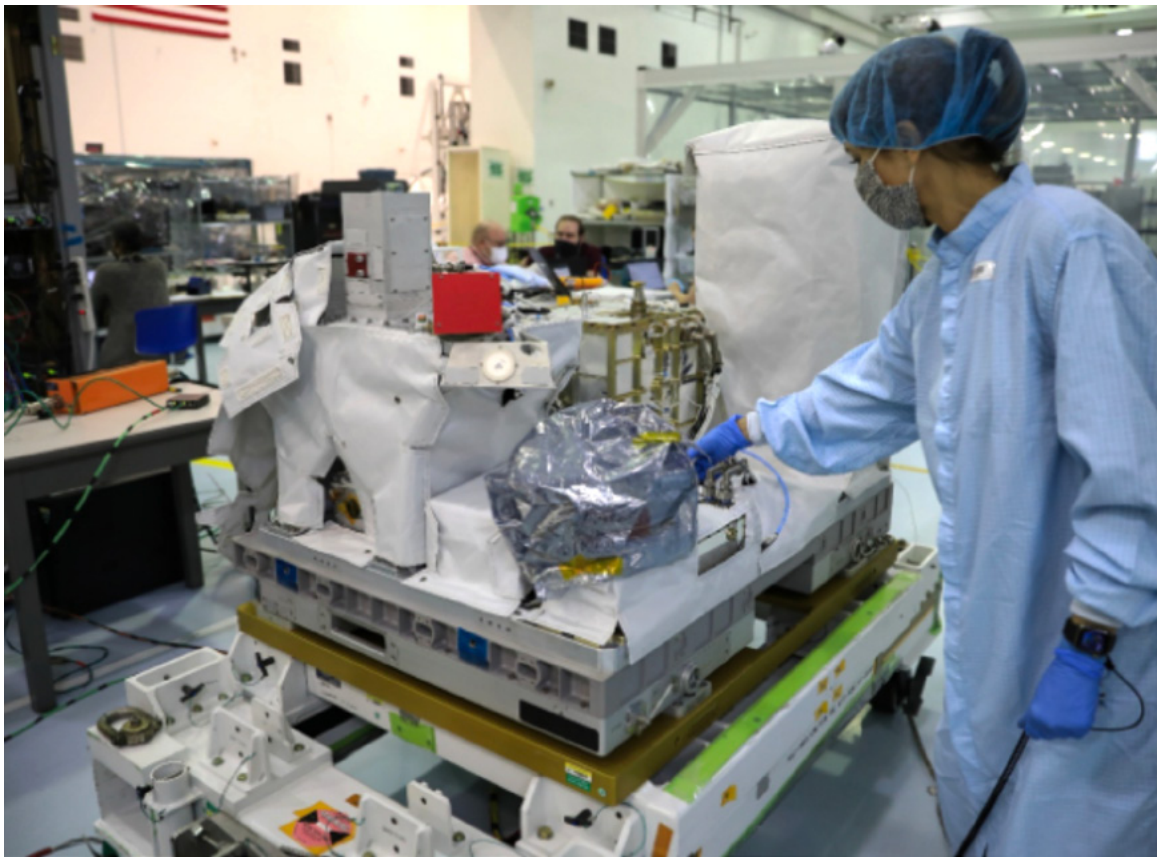
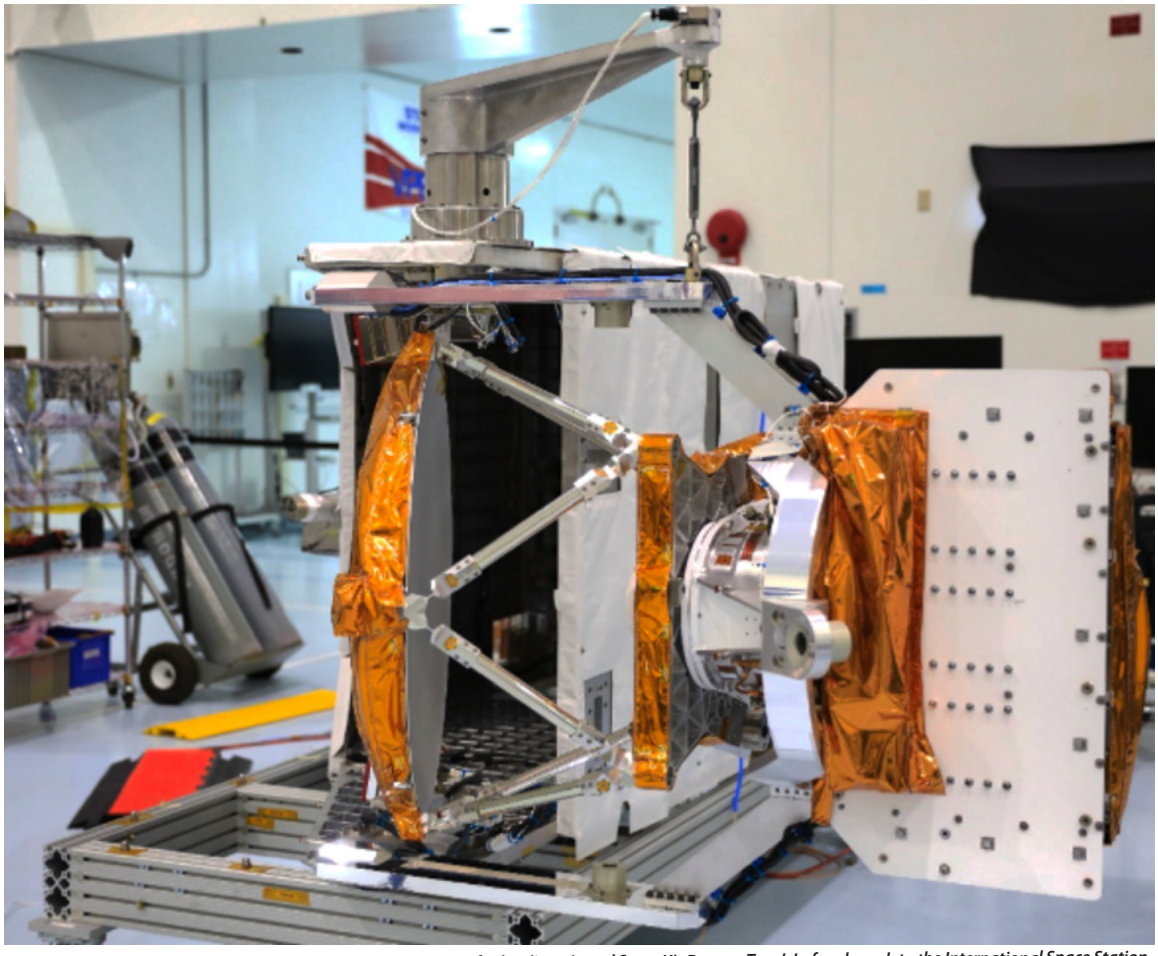


SSC's Space Test Program H7 platform is shown being prepared for loading aboard SpaceX's Dragon Trunk before the December 2021 launch to the International Space Station. Photo courtesy SSC Space Test Program.



SSC's Space Test Program H8 platform is shown being prepared for loading aboard SpaceX's Dragon Trunk before launch to the International Space Station. The launch, on December 21, 2021, was successful and both platforms were delivered to the ISS. Photo courtesy SSC Space Test Program.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Hydra — Delivering More Resilient Networks To A More Network-Enabled Military

Author: Ryan Schradin, Editor, GovSat

Over the past few years, we've seen the United States Department of Defense (DoD) invest heavily in a new joint strike fighter that has been casually referred to as a "sensor with wings."

We've seen the adoption of unmanned vehicles outside of the air domain, with ***unmanned surface vehicles*** (**USV**) and ***unmanned underwater vehicles*** (**UUV**) increasingly considered a large part of the Navy's future. And we've seen the warfighter start to rely on mobile devices in theater.

To say that the future of the U.S. military is more software-enabled, and more network-enabled than ever before would be a massive understatement. Everything that the military is developing and piloting for use in battle today needs connectivity.

Just look at the Army's ***IVAS*** program, which is working to deliver an ***advanced augmented reality*** (**AR**) solution to the warfighter on the battlefield — putting important information, situational awareness capabilities and other tools directly in their field of vision via a ***HoloLens*** headset.

According to ***Steve Kitay***, the Senior Director of ***Azure Space*** at Microsoft, the IVAS headset will be augmented by Azure cloud services, and function to, "*[keep] soldiers safer and [make] them more effective…[by] delivering enhanced situational awareness, enabling information sharing, and decision making for a variety of scenarios*."

While this is certainly an exciting and revolutionary new tool in the warfighter's kit, it's only possible with connectivity in theater. If everything that the warfighter relies on in theater is going to become network-enabled, then connectivity needs to be assured. Training a soldier to rely on a tool that only works when connected would be setting them up for failure if the network that supports the tool can be degraded or denied.

Resilient, assured networks are no longer "*nice to have*," **they're mission-critical**.

While that looks good on paper, a*ssured network*s are easier to discuss — or write about — than they are to implement in the real world. Complexity and a lack of transparency impact uptime

The terrestrial networks that provide the backbone of our high-bandwidth connectivity at home are incredibly stable and reliable, with SLAs and uptimes that ensure that connectivity is almost always available. Unfortunately, those terrestrial networks, themselves, are often unavailable where the military and government operates.

In foreign countries and isolated geographic locations, terrestrial networks may not exist at all. If that infrastructure does exist, it could be unreliable, or it could be untrusted. But that's not just a problem that the military faces abroad.

There are large swaths of the U.S. with no high-bandwidth terrestrial networks due to cost, geography or other reasons. In these places, satellite connectivity is essential and necessary to deliver the high-bandwidth, high-throughput, low-latency connectivity necessary for the government and military to operate their next-generation, network-enabled platforms, devices, and vehicles.

However, adding satellite communications to the network infrastructure for government agencies and the military effectively increases the complexity of the networks — giving them a network architecture that incorporates assets on Earth, and in space.

> *"…Hydra includes an inventory management system that integrates shared and dedicated devices, circuits, and the space segment into the same contextual environment…[allowing users] to schedule and monitor the entire end-to-end network in a single, integrated pane of glass, diagnose problems more rapidly, and fix problems before they take applications, services, and capabilities offline."*
> — ***Amit Katti***

Much like with a modern car that's more of a computer than an automobile, this increased complexity can also mean that there are more things that can fail or more things that can go wrong. Worse, the military is using a number of disparate terrestrial networks, disparate terrestrial hardware, and using space assets and networks that include their own military assets, as well as commercial assets.

For the government and military to ensure connectivity and have assured networks, they need the ability to see the entire network — both terrestrial assets and space assets — on a single pane of glass. If a single, unified view of the network and the individual devices connected to it were available, the government and military would be able to diagnose problems more rapidly, and fix problems before they take applications, services, and capabilities offline.

Luckily, such a solution now exists.

INCREASING TRANSPARENCY + UPTIME WITH HYDRA

Recently, commercial satellite operator, ***SES Government Solutions (SES GS)*** launched a new ***common operational picture*** (**COP**) platform called ***Hydra*** that the company claims, "*…provides end-to-end situational awareness in a single unified operational network platform.*"

Hydra was built in-house by SES GS specifically for their government and military customers. The solution integrates network data from multiple different sources — including operational data from the company's satellite networks — and users are able to display data on a single dashboard or pane of glass.

This could effectively enable the government and military the opportunity to view everything happening on and within their networks in one place — increasing transparency and allowing them to identify and remediate problems with the network more quickly.

"*In addition to providing basic M&C data, Hydra includes an inventory management system that integrates shared and dedicated devices, circuits, and the space segment into the same contextual environment*," explained ***Amit Katti***, a Principal Engineer at SES GS. "*This ability to incorporate and visualize the entire network allows the customer to schedule and monitor the entire end-to-end network in a single, integrated pane of glass, diagnose problems more rapidly, and fix problems before they take applications, services, and capabilities offline.*"

COP platforms, such as Hydra, could be revolutionary in enabling the military to better monitor their networks – both on Earth and in space — and identify problems before they bring down networks.

With network-enabled and software-enabled devices, as well as applications and platforms making their way into every government and military mission and operation, the timing couldn't be better.

Networks aren't "nice to have" at the tactical edge anymore. They're essential.

COP platforms, such as Hydra, are ensuring that these networks are always on and available to the warfighter. This way, the next-generation, high-tech tools that our government and military personnel rely on are there when and where they need them — even in the most remote and austere of environments.

Author Ryan Schradin is the Executive Editor of GovSat Report. A communications expert and journalist with more than a decade of experience, Ryan has edited and contributed to multiple, popular, online trade publications that are focused on government technology, satellite, unified communications and network infrastructure. His work includes editing and writing for the GovSat Report, The Modern Network, Public Sector View, and Cloud Sprawl. His work for the GovSat Report includes editing content, establishing editorial direction, contributing articles about satellite news and trends, and conducting both written and podcast interviews. Ryan also contributes to the publication's industry event and conference coverage, providing in-depth reporting from leading satellite shows.

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A CONSTELLATIONS CONVERSATION WITH…

Bill Joo, Special Projects Engineer, U.S. Navy

DoD pursue imperatives such as resilience and multi-domain joint operations across the armed forces. Bill Joo, with the U.S. Navy's Communication Program office talks about the challenges and progress of these new initiatives with Constellations host, John Gilroy.

Welcome to Constellations — we are going to discuss the SATCOM challenges the U.S. Navy faces, as well as issues across the armed forces such as the importance of interoperability. The guest is Bill Joo, special projects engineer at the U.S. Navy's Communication Program office. Bill, can you tell us a bit more about how you fit into the Navy's communication program office?

BILL JOO

Bill Joo

My role as a special projects engineer seems a bit nebulous, but it is to basically take care of any advanced technologies we are trying to deploy for the Navy. Many technologies have evolved quickly over the past several years, from proliferated LEO and various PNT systems to determine where we are on earth, to the SpaceX Starlink constellation that's disrupting space and how we potentially communicate. My job is to discover and try to exploit those technologies to deliver capabilities for our fleet.

What sort of capabilities does the Navy need for its future SATCOM network?

BILL JOO

Because of the Navy's unique mission, operating in the blue waters where there's no real infrastructure, SATCOM is really the only means of delivering high throughput data with protection to the warfighters at sea. Not the nominal variety, as if you were on a cruise ship and you're able to dial up a high-speed internet. For us, we need to be able to provide protected communications mindful we will likely be in harm's way where comms will be challenging.

We call that TSCS, or resilient communications with command and control. Obviously, command and control is not possible without resilient communications. One of the evolving technologies is this notion of a proliferated Low Earth Orbit constellation. SpaceX and Starlink started that process, and now there's also Amazon's Kuiper, OneWeb, Telesat, and others.

Those constellations hold great promise for delivering high throughput capability. And, oddly enough, there is some inherent protected nature with these communication systems, so we may be able to deliver both high throughput and some level of protection using commercial SATCOM. But of course, our go-to is military SATCOM, whether AEHF or the Wideband Global Satellite systems.

Thousands of satellites going up might mean resiliency, yes?

BILL JOO

Correct. SpaceX is aiming to launch 42,000 satellites. To put that into context, when SpaceX started, we had no more than 2,000 satellites of the communications variety.

If SpaceX is capable of delivering those 42,000 satellites, this is an order magnitude improvement in the number of apertures that will be available in space. They are already at 2,000 [*as of this interview*] and we're looking forward to other constellations supplementing this. The future is looking bright for communications.

With all these new technologies coming up, how do you evaluate new technologies for the roadmaps that you're seeing?

BILL JOO

The primary mechanism is through our science and technology forecasts. We try to learn from industry and what's moving forward in technology. And they've been very, very open with us in terms of what they expect to do, how they expect to deploy these capabilities, not just for their commercial interests, but for the military applications.

It's not necessarily always about wartime functionality. Sometimes it's just simple things like morale, welfare, and recreation. In this COVID-19 environment, we've had ships that were anchored offshore nearly a year.

Sailors have not been able to really take advantage of any kind of communications means that they'd normally have when they go ashore to stay in touch with their families and such.

We find that delivering even communications capabilities in the commercial sense to the warfighter will improve their morale and possibly their warfare readiness. There's an interesting dichotomy between military and commercial communications, but also a nice fusion between the two.

Trying to project out some of those forecasts or roadmaps, what do you think the biggest challenge is going to be? Will it be in interference, in the ground, in security? Where are the challenges going to be for your future SATCOM?

BILL JOO

We've had a pretty easy run the past dozen years or so, whereby we've been able to deliver a lot of throughput. In fact, the Navy's data throughput to ships have increased by almost two orders of magnitude in 12 years, which is pretty impressive. Now the real challenge comes in terms of cyber threats, and the actors are not the usual variety, and it's not always about the warfighting readiness, but cyber threats to our control systems, not necessarily the data systems.

In the past, we worried about anti jamming, but now we find the threats are against the actual satellite control and management. We will need some resiliency and hardening in that domain, if we're going to try to rely on these high throughput satellites, where the control and management systems can be compromised. The threats have become much more sophisticated, such that jamming is rather crude by today's standards.

How does the Navy work with the U.S. Space Force?

BILL JOO

Our relationship with the **U.S. Space Force (USSF)** really hasn't changed any of the dynamics. Establishment of the Space Force has now given space a bit more focus. I believe in the past, when we were working with the **U.S. Air Force**, there was a vague mission as to whether the Air Force is responsible for everything that's up in the air and space domain, which gets a bit cloudy as to the emerging space domain.

For the Navy, for instance, we ran the newest program, and we launched those satellites, as well. It became ambiguous as to who actually controls the space domain.

Having Space Force clearly delineates the domains and allows us to focus on space and the special challenges and opportunities that exist there. The Space Force establishment is a good move, although it was a bit ambiguous in the beginning.

Speaking of different forces and aspects of the DoD, how is the Navy participating in the DoD's Joint All-Domain Command and Control, JADC2? How will they participate in that vision?

BILL JOO

We are clearly part of the **JADC2** implementation, which is beyond a vision at this point. Admiral Smalls has been assigned to run a project called ***Overmatch***, which is a subcomponent of JADC2. Overmatch essentially is taking JADC2 and putting in the implementation hooks, basically aligning all of our programs to ensure that we are delivering a focus capability at the end of the day.

I think what you're hinting at is this concept of interoperability, so that Space Force, Air Force, Army, Navy, all will work together to enhance your effectiveness. Is that right?

BILL JOO

That's correct. We take that joint notion very seriously. Fortunately, in the space business, we all converge on a common set of apertures and platforms. Therefore, we work very closely with the Army and U.S. Air Force research laboratories. I believe we are well aligned in terms of the jointness of the fight. Of course, that common domain called space helps to glue this fabric together.

In the world of software and large enterprise systems, everyone's talking about open standards and so my question to you is, are there open standards that the armed forces could adopt to fast track this interoperability or maybe even expand capabilities?

BILL JOO

Yes, great question. Open standards and interoperability have been the windmill that we've been seeking. The problem is that there are too many. You may be implementing an open standard, but that does not guarantee interoperability or the ability to expand the intended capabilities.

We've been pursuing what's called **P3I**, which is ***Preplanned Product Improvement***. With P3I, we will define a limited set of standards that we plan against for the future, versus letting open standards dictate where we go in the future.

For instance, in the intermediate frequency domain, we've had lots of work in the digital intermediate frequency interoperability standards development. We ended up with about a dozen different standards.

Recently, we've joined the ***Digital IF Interoperability Consortium***, which takes a common standard called VITA 49 and we specify exactly how we intend to use this in a pre-planned manner. By dictating standards early and limiting them to just a few sets that the coalition can agree on, we could potentially extend capabilities and ensure interoperability in the future.

Once again, we need to focus on what we pursue as common standards.

It seems you're trying to influence some of these standards before they go down the pike and ensure that they meet some of your Navy requirements. Is that correct?

BILL JOO

Yes. Again, with the DIFI consortium, we didn't just simply stand by and watch an industry group define us. We joined as a member, and we've encouraged other organizations, such as PM West from the U.S. Army, to join so that we can collectively influence where that commercial standard goes. That is a critical part of making any open standard come alive.

Admirals and generals like to think big. One big idea is this concept of digital transformation. Everyone has a different idea of it. From your perspective, what is the Navy's approach to digital transformation?

Submarine in the Arctic.

BILL JOO

I can't speak for the big Navy as a whole. I will tell you that we have been pursuing digital twins. Rather than deploying systems and learning on the job, we have initiatives such as Chimera, which tries to create digital training twins and study the effects that will impact them early and often.

Digital transformation from a communications point of view, for me, is that we've been living off of a lot of analog systems and for good reason. They function extremely well.

The notion of legacy typically means that it works well, and why throw out something that doesn't fail? Going the digital path in the communication sense involves taking all of our systems, reviewing how we do signal processing and possibly going down the path of digitizing every element so we can have a force multiplying effect.

For instance, if we tie a digital radio system with a digital radar system, we blur the line as to what an electromagnetic system even looks like. By blurring that line, we may find that communication systems can use a radar system to actually communicate and vice versa. We want to get to a point of convergence, and that's what digital transformation means for us.

Again, we're coming more from the communication side, but digital twins gives us the ability to do a lot of analysis before we encounter our adversaries.

Convergence would seem to give you all kinds of resilience, which was one of the primary goals to start with, wasn't it?

BILL JOO

That's correct. Resilience for us, ultimately, is about the warfighter being able to perform his or her mission without necessarily counting on systems to do exactly what they're supposed to.

Resilience is the ability to reform what we have and develop new capabilities on the spot in a MacGyver type of way. I believe digital transformation will play a major role in yielding resilience for Naval shipboard communications and ENT systems.

Want to hear from more thought-leaders? Listen to **Constellations** podcasts as they become available.

See the full list of interviews and subscribe at:
www.kratosdefense.com/constellations-podcast

Want to hear a particular topic discussed? Let us know!
Email ***Podcast@KratosComms.com***

A Route-planning solution for the British Army

Maxar demonstrated one of the winning military solutions during the British Army's Hackathon 2021, delivered in collaboration with AI software provider Adarga, at the Army's new Battlelab facility in Dorset, U.K.

Maxar was tasked with creating a solution that delivers the safest and most appropriate routes for military convoys in real time via a digital platform.

"*This challenge presented a great opportunity to bring together unique data and tools from across Maxar to help military operators better understand environments ahead of deployment*," said ***Mike Small***, Maxar's Defense and Security Director for Europe, Middle East, Africa and Asia Pacific. "*With our solution, commanders have access to these digital environments anywhere on the globe, providing the means for British forces to plan and rehearse for multi-domain operations.*"

The hackathon, organized by the British Army and Adarga, asked participants to design digital solutions for the future that leverage ***artificial intelligence*** (**AI**) and software solutions to address real-world challenges the British Army faces. Nine teams composed of military subject matter experts, as well as software engineers and data scientists from across industry, came together to develop innovative concepts.

Maxar's solution was selected for further development and was deployed for testing during an exercise at the close of 2021.

Maxar's Sam Orlando (right) demonstrates the company's immersive solution to a British Army 1st Division Headquarters Staff Officer during the hackathon. Photo is courtesy of Maxar.

NEXT STEPS

This event formed part of the ***1st (UK) Division's Digital Readiness Experiment***, designed to accelerate the British Army's understanding and ability to adapt to digital force preparation timelines and processes. The British Army tested the winning solutions, including Maxar's, in a real-world environment.

British Army soldiers engaged in an AI exercise at Battlelab. Photo is courtesy of the British MoD.

3D model of an African village, courtesy of Maxar.

Maxar's Globe In 3D

The company's high-resolution, high-accuracy, 3D data provides true height measurements of terrain, structures and vegetation, enabling an immersive solution to display and interact with large volumes of data and acclimate with real-world environments for mission planning and rehearsal.

Human Landscape

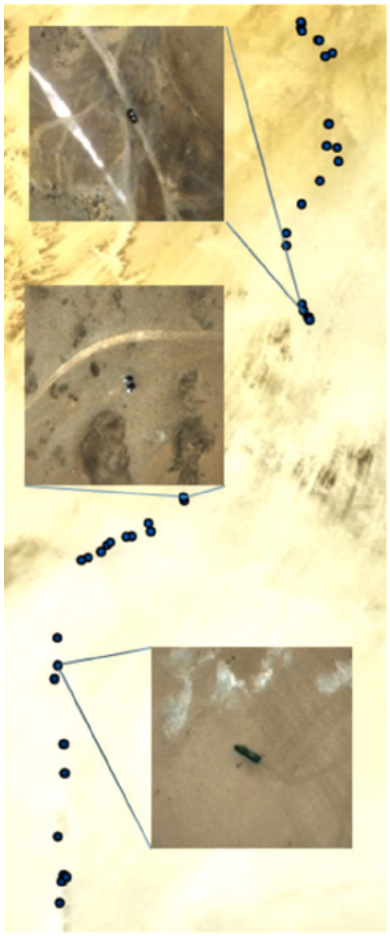
Maxar's country-scale human geography information bundle leverages crowdsourcing and AI to reveal important demographic insights for enhanced situational awareness.

Human Landscape data identified medical facilities and clinics in Monrovia, Liberia. This information streamlined the transportation of humanitarian aid resources to combat the 2014 Ebola outbreak. Image is courtesy of Maxar.

GeoHIVE

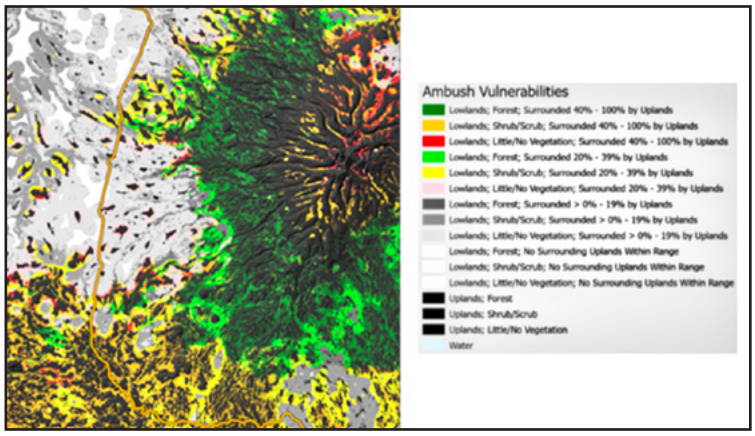
Maxar's ***Geospatial Human Imagery Verification Effort*** (GeoHIVE) is a crowdsourcing platform that allows users to rapidly discover and verify features of interest in Maxar's high-resolution satellite imagery.

The Maxar satellite image to the right shows GeoHIVE-produced tags identifying vehicles along a potential smuggling route.



VEHICLE MOBILITY + TERRAIN ANALYSIS DATA

Maxar developed modeling techniques for ambush vulnerability to identify areas that may be susceptible to surprise attacks from a covert location due to low elevation, presence of surrounding uplands and lack of vegetative cover.



This image of a location in Africa shows an ambush vulnerabilities report from the British Army's hackathon.

To learn more about the solutions mentioned in this article, ***please visit this direct link...***

www.maxar.com

A CONVERSATION WITH PETER KANT

CHIEF EXECUTIVE OFFICER, ACCION SYSTEMS

Peter Kant.

Peter Kant is the CEO of Accion Systems. He brings two decades of experience at the nexus of business, government, technology and policy, including leadership positions in state and federal government, large companies, start-ups, and non-profits. He also currently serves on multiple corporate boards and advisory boards of venture funds.

Peter was previously the CEO of Synapse Technology, which developed computer vision artificial intelligence technologies for the security industry. He took Synapse from pre-revenue to $6 million in ARR, resulting in a successful exit acquisition in just over 12 months.

He previously served as Vice President, Federal Partnerships, at SRI International. SRI is a large, non-profit research and development institute headquartered in Silicon Valley and provides R&D in multiple science and technology disciplines including artificial intelligence, bioscience, computer science, education policy, robotics and space. In his role he led SRI's overall strategy and relationships in support of all fits $400M+ federal government programs and activities. While at SRI, Peter led SRI's Center for Innovation Strategy and Policy as Executive Director. The Washington, D.C.-based Center focuses on the impacts of science and technology on public policy and strategy.

Peter started his career in government service working in political positions at the state and federal levels. He worked for Congressman Joseph P. Kennedy II; served as Policy Director for the Texas House of Representatives; and served as an appointee in President Clinton's administration at the U.S. Department of Agriculture and on Vice President Gore's Domestic Policy staff.

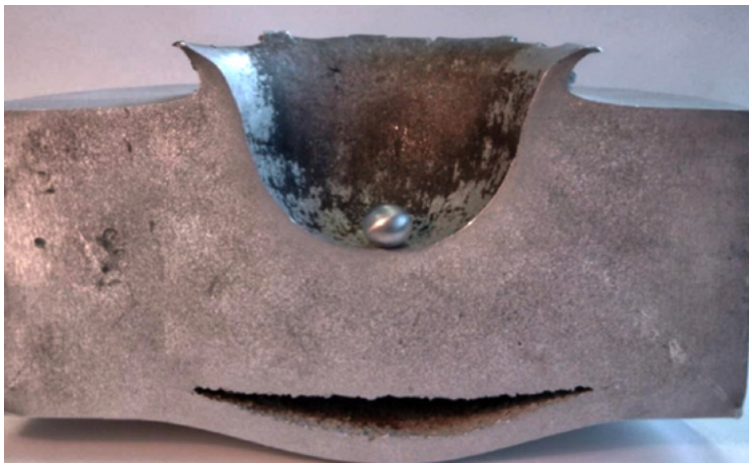
What are the risks posed by space debris for the International Space Station (ISS), satellites an other spacecraft?

PETER KANT

The space economy is booming with thousands of new satellites being launched over the next few years. However, we need to be sure to sustainably manage that growth or risk costly and even catastrophic collisions in this cluttered space environment.

The ***U.S. Space Command*** is tracking almost 38,000 objects in Low Earth Orbit (LEO), a 22% increase in the last two years. And, of course, this number only accounts for the objects that can be tracked.

There are estimated to be millions of objects the size of a marble or larger that could still do significant damage if they collided with a satellite, a rocket, or God forbid, a human-crewed mission such as the International Space Station. These objects may seem small, but when they are moving at 17,000 miles per hour, the damage can be catastrophic.



The image above shows the damage a tiny piece of debris can cause while moving at orbital speeds.

The risk of collisions will only get worse as thousands of new satellites and mega-constellations go into orbit in the next five to ten years. To make matters worse, we now also need to worry about anti-satellite (ASAT) weapons and weapon tests.

On November 15, 2021, a Russian ASAT test destroyed a satellite and created at least 1,500 trackable pieces of debris. The explosion and resulting debris cloud forced the astronauts aboard the ISS to take shelter multiple times and to also cancel a planned spacewalk as the station's orbit crossed paths with the debris. Already, satellite operators, such as SpaceX, have had to maneuver their satellites out of the path of debris created by the ASAT test.

As the U.S. Space Force (USSF) and other branches of the defense community continue to develop their in-space infrastructure and capabilities, they will need to take action to defend their assets from the risks posed by the growing space debris problem.

How is the U.S. Government responding to the threat posed by space debris?

PETER KANT

There are a number of concurrent efforts underway to address the threat.

An interagency group within the ***National Science and Technology Council*** (**NSTC**) is updating an orbital debris R&D plan to be released this year after soliciting public input through December 31 of 2021.

At the same time, the USSF has launched a new project called ***Orbital Prime*** aimed at actively removing existing debris from space and potentially recycling it for in-orbit manufacturing and satellite servicing.

Congress is also taking action. In their report on ***The National Defense Authorization Act for Fiscal Year 2022***, which passed in September of 2021,

the ***House Committee on Armed Services*** directed the Secretary of Defense to provide a report to the committee on the Department's efforts to reduce future space debris by June 1, 2022. This included the identification of specific defense research and development efforts to minimize future debris-creating events, including alternatives to traditional propellant propulsion systems.

Are there low-pressure alternatives for propulsion?

PETER KANT

Yes. There are propulsion systems available today that don't use pressurized gases as their propellants. ***Field-Emission Electric Propulsion*** (**FEEP**) is one technology that uses metals as its propellant. Typically, the metal is stored as a solid and must be heated up to melt it into a liquid before it can be used as a propellant. This is safer than a pressurized tank, and eliminates much of the bulky plumbing that comes with pressurized tanks, which makes for a small form factor ideal for smaller satellites.

However, the heat necessary to melt the metals increases the power draw of the propulsion system, which, depending on the satellite's power budget, may require the satellite's other powered systems, such as sensors and communication hardware, to turn off. It also calls for complex thermal management requirements that can complicate the design of the spacecraft.

In addition, melting the metal requires extended warm up and cool down periods, which can make it difficult to accurately position the satellite using the thrusters and can make it take longer to move out of the way of an imminent collision.

Finally, the metals that are emitted are also often reactive and can deposit on the sensors, solar panels and other critical equipment and render them less effective.

At Accion Systems, an ionic liquid propellant is used. The technology is called ***Tiled Ionic Liquid Electrospray,*** or **TILE** for short (*pictured to the right*). The system works by using an electric field to extract and accelerate ionic liquid particles out of thousands of ion emitter tips, which are arrayed on chips the size of a postage stamp. The movement of these ions out of the thruster chips generates thrust in the opposite direction.

accion-systems.com

TILE
Advantages

ACCION SYSTEMS

Unmatched Efficiency

The highest thrust to power ratio on the market, in less than 1U. Devote more space and power for your critical payloads.

Scalable Manufacturing

Using commercial MEMS manufacturing processes, TILE can be mass produced for constellations with short lead times and low costs.

Modular Flexibility

The modular design can be flexibly configured to meet your mission needs. Aggregate units to multiply thrust, or distribute components across the spacecraft.

Seamless Integration

Propulsion control integrates easily with your existing mission control software. Access health monitoring and diagnostics with a user-friendly interface.

Low Signature

Orbit in stealth. Unlike plasma-based solutions, TILE ionization doesn't produce easily detectable emissions of high-power RF, UV, IR, or visible light.

Multi-Mode Compatibility

Increase resiliency by combining the high thrust of chemical propulsion with the high efficiency of TILE, all with the same ionic liquid propellant.

Extreme Resiliency

Thruster chip arrays are fault tolerant and eliminate common points of failure. No external cathodes, no plasma and no reactive emissions.

Safe Propellant

Ionic liquid is an inert, inexpensive, non-toxic and non-explosive source of propulsion. It's stored in a low pressure container to further reduce risk.

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