

Next Generation Space Defense

MILSATMAGAZINE

November 2022



Cover image is courtesy of [Northrop Grumman Space](#)

Beyond Secure Satcoms

**SANTANDER
TELEPORT**



Publishing Operations

- Silvano Payne, Publisher + Executive Writer
- Simon Payne, Chief Technical Officer
- Hartley G. Lesser, Editorial Director
- Pattie Lesser, Executive Editor
- Donald McGee, Production Manager
- Teresa Sanderson, Operations Director
- Sean Payne, Business Development Manager
- Dan Makinster, Technical Advisor
- Chris Forrester, Senior Columnist

This issue's authors...

- Kevin Kelly
- Dominic Perez
- David Pesgraves
- Rob Spalding

Features

A Briefing with Augustine Ponturiero, TriSept 14

COMMO: Amazon Web Services + 16
The U.S. Military's HSA Project
 Authors: AWS Public Sector Blog Team

Secure Mesh Wireless Networks..... 18
Drive Command Post Mobility
 Author: Dominic Perez, Curtiss-Wright Defense Solutions

Space Is The Next Frontier... For Cyberattackers20
 Author: Kevin Kelly, Arcfield

A Briefing With Daniel Gizinski,22
 Comtech Satellite Network Technologies

Government Satellite Report:24
Current Space Acquisition Priorities Outlined
 By USAF Officials
 Author: David Pesgraves, GSR

Defining Resilient + Secure Architecture:26
Fusing terrestrial + satellite networks
 Author: Rob Spalding, SEMPRE

Dispatches

Comtech Telecommunications3

SAFRAN + MBDA + Syrlinks4

General Atomics4

DARPA, SpaceLogistics + NRL.....6

ULA, NOAA + NASA10

Rocket Lab + Inmarsat.....11

Space Foundation.....12

SpaceWERX + AFWERX13

Advertisers

Advantech Wireless Technologies9

AvL Technologies7

Comtech Telecommunications Corporation3

CPI SATCOM Products11

SatNews Digital Publications33

Santander Teleport.....1

SES Government Solutions5

MilsatMagazine is published 11 times per year by SatNews Publishers,
 800 Siesta Way, Sonoma, California - 94576 - USA
 Phone: (707) 939-9306 / Fax: (707) 939-9235
 © 2022 SatNews Publishers

We reserve the right to edit all submitted materials to meet publication content guidelines, as well as for grammar and spelling errors, or to move articles to an alternative issue to accommodate publication space requirements, or remove content due to space restrictions or unacceptable content. Submission of articles does not constitute acceptance of said material by SatNews Publishers. Edited materials may, or may not, be returned to authors and/or companies for review, prior to publication. The views expressed in SatNews Publishers' various publications do not necessarily reflect the views or opinions of SatNews Publishers. All rights reserved. All included imagery is courtesy of, and copyright to, the respective companies and/or named individuals. SatNews reserves the right to alter publication dates and print issue designations, based on industry event date changes and circumstances that are beyond the control of SatNews Publishers or the company's staff.

KNOW SATELLITES

FREE SatNews Subscription

www.satnews.com/reg



Satellite News • SatMagazine • MilsatMagazine

COMTECH AWARDED FOREIGN MILITARY SALES CONTRACT TO SUPPORT UKRAINE'S WAR EFFORTS

Comtech (NASDAQ: CMTL) has been awarded a Foreign Military Sales (FMS) contract for the Ukrainian Government.



"Comtech's Troposcatter Family of Systems (FOS) provides U.S. and International customers the benefit of transporting secure, resilient high-capacity IP data communications to the tactical edge," said **Doug Houston**, President of Comtech Systems, Inc.

"Global militaries have relied on our Comtech Systems division to consistently provide robust communications solutions globally for more than 40 years and our new state-of-the-art radio-modem technology is a game changer in the marketplace," said Comtech's Chairman, President, and CEO, **Ken Peterman**.



The FMS contract is for **Beyond-Line-Of-Sight (BLOS)** communications terminals and upgrades to the country's existing systems.

In March of 2022, Comtech donated identical systems to those now being purchased to the international effort to support the defense of Ukraine at the request of the Ukrainian government. These systems were requested by Ukrainian Special Forces to enhance their ability to rapidly deploy secure, resilient communication channels in contested environments.

Comtech has supported multiple communications upgrades and modernization initiatives for the **Ukrainian Ministry of Defense** since 2017. As a result, Comtech is well placed to provide systems that were previously certified for use by the Ukrainian military and can be fielded with training provided by Comtech and current operators.

Comtech's solutions, coupled with the firm's ability to speed deployment of these critical support capabilities, made the company the choice for a contract award.

The Company's terminals can easily be linked with other Comtech tactical, mobile and fixed systems to provide a robust, comprehensive BLOS communications solution that can be used to enhance the Ukrainian Military's existing communications capabilities.

Comtech's solutions are ideal for Tactical Military, Disaster Recovery, and Emergency Communications Restoration applications anywhere in the world.

COMTECH

DON'T GET LEFT BEHIND. JOIN THE VSAT REVOLUTION.

REV UP YOUR VSAT PERFORMANCE WITH MORE BANDWIDTH, MORE ACCESS, MORE COVERAGE, AND HIGHER QoS

Comtech ELEVATE is the Next-Gen solution that revs up your VSAT performance with MORE THROUGHPUT, MORE FLEXIBILITY, MORE COVERAGE, and HIGHER QoS.

Its ultra-intelligent VSAT platform fast-tracks your transformation, by using virtualization, cloud computing, and Software-Defined architecture.

Comtech ELEVATE

The Next-Generation of Intelligent Software-Defined VSAT Solution. Anytime. Anywhere.

It's time to elevate, innovate and activate with Comtech ELEVATE: the smartest and most agile VSAT solution.

Join the revolution
Visit us at Comtech.com/Elevate



SAFRAN + MBDA TAKE MAJORITY STAKE IN CILAS

Safran Electronics & Defense and MBDA have completed the acquisition of ArianeGroup's 63% majority stake in CILAS, a French company specialized in lasers for military applications.

and production of solutions designed to support France's sovereignty and strategic independence, while also facilitating the company's European positioning and export opportunities.

CILAS is a specialized equipment supplier offering cross-functional technologies. It will continue to apply a business model based on its

achieving operational superiority and strategic independence."

Martin Sion, CEO of Safran Electronics & Defense, added, "CILAS is a long-standing partner to our company. Our complementary optronics capabilities will enable us to develop and refine our solutions involving laser designation, while also



The acquisition was carried out through a joint company created for the purpose called **HMS Laser**, equally owned by Safran Electronics & Defense and MBDA.

Founded in 1966, CILAS designs, develops, produces and sells laser products and optical solutions for military and civil applications. Safran Electronics & Defense and MBDA will support the growth of CILAS, as well as the development

position as a supplier of products and technologies to all domestic and international customers.

"CILAS is the French laser technology champion," said **Eric Béranger**, CEO of MBDA. "Today's weapon systems increasingly call on latest-generation lasers, and this trend is likely to continue. By combining the complementary strengths of CILAS and MBDA, we will meet the upcoming challenges for France and Europe of

investigating the possibilities of optical communications for both terrestrial and space applications. We can now team up with CILAS and our partner MBDA to offer sovereignty solutions that integrate power lasers, by calling on our respective areas of expertise."

SAFRAN ACQUIRES SYRLINKS

Safran Electronics & Defense has also completed its acquisition of Syrlinks, a French mid-sized firm founded in 2011 that specializes in radio communications and radio navigation, primarily for the space sector, and positioning, navigation and timing (PNT).

Through this acquisition, Safran Electronics & Defense continues to consolidate the company's position as an OEM delivering sovereign space solutions. Building on its expertise in ground stations for space communications, Safran Electronics & Defense rounds out its portfolio with Syrlinks' onboard satellite communications systems to extend its coverage of the complete ground-space communications sector.

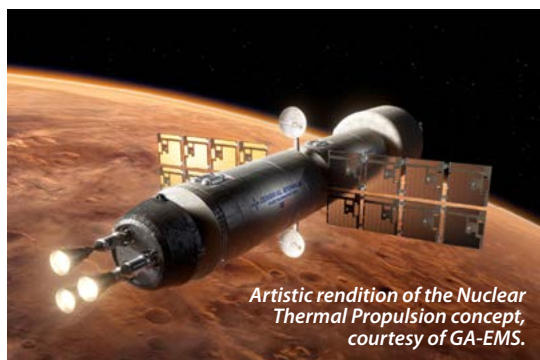
Syrlinks also offers proven expertise in resilient GNSS and miniature atomic clocks to complement that of Safran Electronics & Defense. This will further strengthen Safran Electronics & Defense's unique integrated positioning, navigation and timing (PNT) capabilities, which come into their own when satellite navigation systems are inadvertently or intentionally disrupted in civil or military environments.

Headquartered in Cesson-Sévigné, near Rennes, France, and with an office in Toulouse, Syrlinks employs 140 people. This base in Brittany will help boost Safran's presence in an academic and industrial community renowned for its expertise in telecommunications and electronics.

GENERAL ATOMICS COMPLETES NUCLEAR THERMAL PROPULSION SYSTEM DESIGN + TEST MILESTONE

General Atomics Electromagnetic Systems (GA-EMS) has completed major milestones for the Track A, Phase 1 Demonstration Rocket for Agile Cislunar Operations (DRACO) program.

Under contract from the **Defense Advanced Research Projects Agency (DARPA)**, GA-EMS delivered a baseline design of a DRACO Nuclear



Thermal Propulsion (NTP) reactor and engine and successfully tested key components of the nuclear reactor, including the vitally important high-

temperature fuel elements in prototypic conditions at the **NASA Nuclear Thermal Element Environmental Simulator (NTRES)**.

The NTP system is intended to allow a nuclear thermal rocket to operate in cislunar space, the region between the Earth and the Moon.

"We have leveraged our expertise in nuclear and space system technologies to design an NTP system and test the vital components of that system to confirm they will withstand the relevant design conditions," said **Scott Forney**, president of GA-EMS. "Unlike electric and chemical propulsion technologies in use today, NTP propulsive capabilities can achieve two to three times the propellant mass efficiency, which is critically important for cislunar missions."

Sensors: 100 Mbits/s (Fiber Optic) (365 days)
Firewalls and Data Line Infrastructure / Firewall 1

Daily Host Alerts Trend (Last 5 Days)

RESILIENT & SECURE END-TO-END COMMAND THE ADVANTAGE

When U.S. Defense and Federal agencies need resilient and secure end-to-end communications for maritime, airborne, and ground-mobility operations anywhere in the world, they put their trust in SES Government Solutions (GS). As an industry leader for over 40 years, SES GS supports the most demanding U.S. Government customer requirements with fully integrated Information & Communications Technology Solutions that leverage state-of-the-art multi-band, multi-orbit satellite services. Our unwavering commitment to ensuring resiliency and security in global communications makes SES GS the only choice when success is critical – **command the advantage.**

SES[▲]
GOVERNMENT
SOLUTIONS

www.ses-gs.com

DARPA'S ROBOTIC SERVICING OF GEO SATS DEMO MISSION AIMS FOR A 2024 LAUNCH + NAVAL RESEARCH LAB + SPACELOGISTICS PROJECT INVOLVEMENT

All component-level tests are complete on **DARPA's** Robotic Servicing of Geosynchronous Satellites (RSGS) program and the on-orbit demonstration mission is on schedule for launch in 2024 — the RSGS goal is to enable inspection and servicing of satellites in GEO, where hundreds of satellites provide communications, meteorological, national security, and other vital functions. Currently, no options exist for visual diagnosis, upgrades or repairs of a malfunctioning satellite's components.

Integration of the robotic payload with the spacecraft bus will begin in 2023, followed by testing and verification of the combined system. After launch in 2024, the host vehicle will use highly efficient electric propulsion to climb to GEO. Following a period of checkout and calibration activities, the program anticipates on-orbit satellite servicing activities will begin in 2025.

In 2020, DARPA partnered with **SpaceLogistics**, a **Northrop Grumman** company, to provide the spacecraft bus, launch, and operations of the integrated spacecraft in exchange for the ability to use the robotic payload to provide commercial servicing once on-orbit. DARPA is funding the **U.S. Naval Research Laboratory (NRL)** to lead development of the RSGS robotic servicing capabilities.

The on-orbit system DARPA is providing will include two robotic arms, multiple robotic tools, on-orbit checkout and calibration equipment, equipment stowage ports, cameras and lighting, and associated avionics boxes running advanced robotics control flight software. Each arm consists of seven, high-strength, high-performance joints as well as a tool drive. Avionics boxes provide power, data and control services to the arms.

The RSGS arms are robust enough to be fully testable in Earth gravity. Few, if any, other spaceflight robotic arms, either past or in development, meet this design criterion. This unique



Flight manipulator arm, part of the RSGS robotic payload, in electromagnetic test. Image courtesy NRL.

characteristic is what makes this combined servicing system singularly capable on-orbit, as well as fully ground testable.

To ensure survival of RSGS during launch stresses and years of operations in the harsh environment of space, both the RSGS robotics payload and the partner-provided bus will undergo extensive testing prior to launch. Major tests include those for basic functionality, vibration stresses simulating those during launch, electromagnetic tests to ensure components work together without interference, and thermal-vacuum exposures that simulate the extreme temperature and vacuum conditions of the space environment.

As with most space systems, RSGS is tested in each of these modes at a

component level (by joint or box), then after arm assembly, and again at the vehicle level. The first assembled arm has successfully completed functional, vibration, and electromagnetic testing, and is preparing to begin thermal vacuum testing. The second arm is completing integration and will begin environmental testing this fall at NRL.

RSGS is intended to remain on-orbit over the long term, solving problems on existing spacecraft as they arise. DARPA designed RSGS with the ability to resupply it during flight with additional tools and hardware, enabling it to solve unanticipated or emerging challenges in GEO. With the advent of this in-space robotic capability, a variety of new services will become possible – from rescuing a new spacecraft that encounters a deployment anomaly, to upgrading

older satellites that still have useful life. With RSGS, DARPA is establishing the trajectory for an on-orbit servicing industry that benefits both government and commercial clients.

"We are seeking to create a persistent operational dexterous robotic capability in geosynchronous Earth orbit," said **Ana Saplán**, RSGS Program Manager in DARPA's Tactical Technology Office. "This will enable on-orbit satellite repair and upgrade, extending satellite life spans, expanding the capabilities of existing satellites, enhancing spacecraft resilience, and improving the reliability of the current U.S. space infrastructure. Through public-private partnership, DARPA will help propel this technology from demonstration to operational capability. Soon, instead of relegating satellites to space junk because of a



AvL
TECHNOLOGIES
avltech.com

AvL

HARSH WEATHER?

Communicate through extremes



1.6m Manual Point Tri-Band Terminal
Operational winds to 60 mph
MIL-STD-810G tested
MIL-STD-188-164C & Skynet compliant

DISPATCHES

broken part or lack of propellant, our robot mechanic will be making repair 'service calls' in space."

"This partnership will enable revolutionary servicing capabilities to commercial and government users for visual diagnostics, upgrades, orbit adjustment, and satellite repairs," **Bernie Kelm**, Superintendent of the Spacecraft Engineering Division, **U.S. Naval Research Laboratory's (NRL) Naval Center for Space Technology (NCST)**, said. "As the robotic payload developer, we designed this innovative set of spacecraft hardware and software that will advance national capabilities in satellite servicing."

software which also provides all of the command-and-control functionality for the payload and provides control interfaces to the spacecraft bus."

Robotic motions require special planning to ensure safe spacecraft operations. NRL has developed the **Integrated Robotic Workstation (IRW)** to accomplish just that. The IRW supports mission planning for the development of new mission activities.

Once a mission is planned, the IRW supports screening activities to pre-screen all robotic motion commands in a payload simulator to verify command loads before they are sent.

payload will enable the wide range of missions envisioned and future missions not yet imagined."

The RSGS team completed environmental testing of the first of two flight robotic arm systems. This included simulating the launch environment in NRL's vibration lab, simulating both the vacuum and extreme temperature ranges of space in NRL's **thermal vacuum (TVAC)** chamber, and ensuring **electromagnetic interference (EMI)** functionality in EMI chamber testing.

During TVAC testing, the robotic arm system demonstrated performance

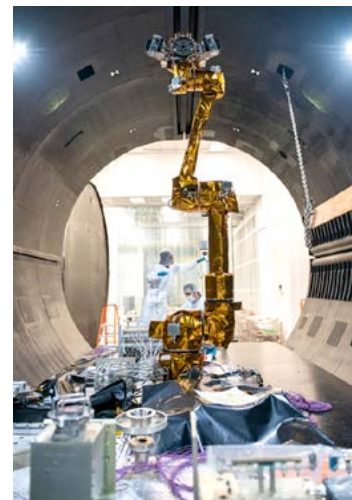


Photo is courtesy of NRL.

the **Robotics Testbed (RTB)** at NRL's **Space Robotics Laboratory**.

The RTB consists of a non-spaceflight version of the flight robotic arm system and avionics hardware running flight software. This high-fidelity robotics testbed allows ground verification of many system-level robotic performance characteristics for the RSGS payload.

Compliance Control algorithm characterization and Marman Ring Detector algorithm performance characterization have been completed. Contact dynamics testing uses a sled floating on a thin layer of air to simulate the arm contacting client space vehicles ranging in mass from 75 – 3,000kg (165 – 6,613lbs.). Grapple, articulation, and release testing is scheduled later this summer.

"The systems engineering and verification efforts required by RSGS are extensive," **Amy Hurley**, NRL's Lead Systems Engineer, said. "It is amazing to see years of systems engineering and a strong verification and validation plan come together successfully."



NRL developed the robotic tool to grapple customer satellites via their standard launch vehicle interface and procured another tool to capture resupply elements that are compatible with DARPA's Payload Orbital Delivery (POD) design standard.

"Our diverse team of NCST engineers has focused their efforts on the robotic payload for the RSGS Program for the last seven years," **William Vincent**, NRL's RSGS program manager, said. "The Robotic Payload is one of NRL's most complicated payload developments ever."

NRL engineers developed multiple power and control avionics running on a distributed **SpaceWire** network to support an extended duration mission to control all the sensors and actuators in a robust and redundant manner. NRL procured panchromatic and color cameras, alongside designing LED lighting units to provide situational awareness during robotic activities. Photo is courtesy of NRL.

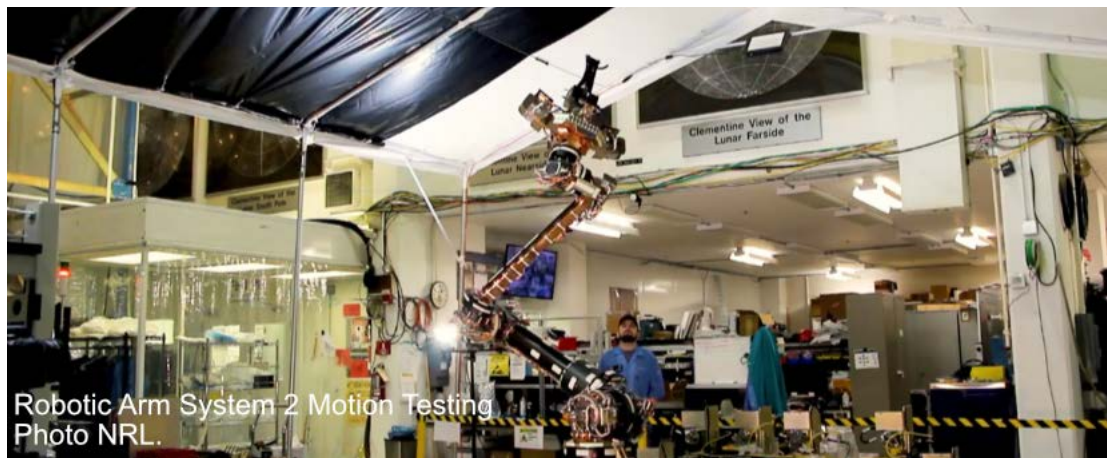
"Our algorithms team developed machine vision, position control, collision avoidance, and compliance control algorithms that support robotics control and enable autonomous grapple capabilities," Vincent said. "The algorithms are implemented in flight

Finally, using NRL's **Neptune®** ground control software, the IRW commands all robotic payload activities and displays and trends payload telemetry during operations. To execute this effort, a skilled systems engineering team spent years performing system analyses, documenting requirements and interfaces, and generating a robust verification and validation plan.

"The engineers worked closely with the integration and test teams to ensure the system meets all requirements as it comes together for component, subsystem, and payload level testing," Vincent said. "Once complete, the robotic

over temperatures representing actual on-orbit conditions. Under the harsh temperature and vacuum conditions of space, the robot arm performed a variety of operations including running pre-planned robotic calibration movements, tool actuation, and camera and light functions.

The second robotic arm system is integrated with a separate testbed that has the entire flight avionics suite. The second arm system has completed environmental testing. Robotic performance testing to demonstrate and verify robotic algorithms' function is underway in

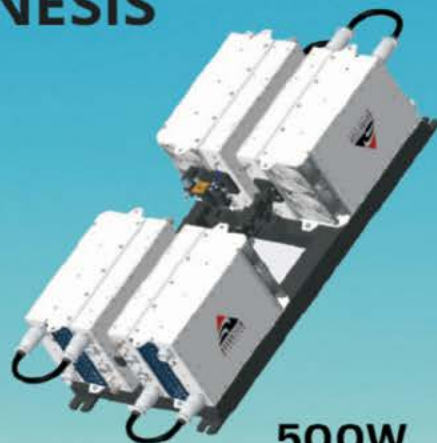


Robotic Arm System 2 Motion Testing
Photo NRL.



Introducing **SUMMIT III** 'Powered by GENESIS'

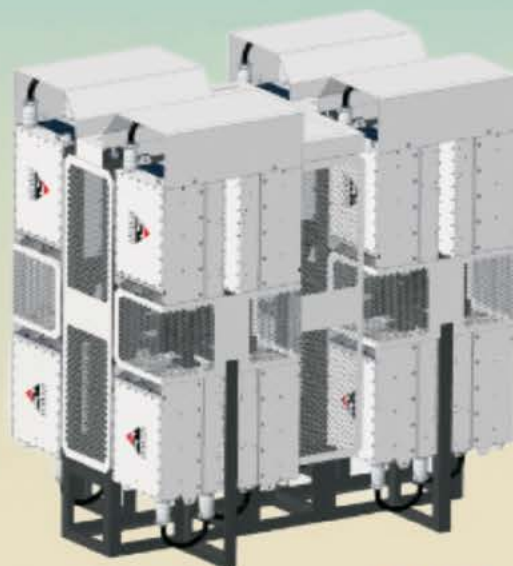
- *Soft-Fail Redundant SSPA System*
- *Delivers 500W to 2kW of linear, Ku-band power*
- *Ethernet SNMPv3 & Embedded Web server*
- *Removable Power Supplies*
- *Compact package, factory assembled and tested*
- *No waveguide switching or external logic controller*
- *High availability and low MTTR*



**500W
Linear
Power**



**1kW
Linear
Power**



**2kW
Linear
Power**

ULA'S ATLAS V LAUNCH VEHICLE LOFTS NOAA'S / NASA'S JPSS-2 SATELLITE TO ORBIT

A **United Launch Alliance (ULA)** Atlas V rocket carrying the **Joint Polar Satellite System (JPSS)-2** mission for the **National Oceanic and Atmospheric Administration (NOAA)** and **National Aeronautics and Space Administration (NASA)** and **NASA's Low-Earth Orbit Flight Test of an Inflatable Decelerator (LOFTID)** lifted off on November 10 at 1:49 a.m., PST, from Space Launch Complex-3 at **Vandenberg Space Force Base**.

To date, ULA has launched 155 times with 100 percent mission success.

The Atlas V rocket delivered the JPSS-2 spacecraft to sun-synchronous LEO. After delivering the JPSS-2 spacecraft, subsequent burns by the **Centaur** upper stage lowered the altitude to a re-entry trajectory to deploy the LOFTID experiment.

Once separated, LOFTID reentered Earth's atmosphere, deployed its parachute and landed off the coast of Hawaii. This experiment demonstrates how an inflatable aeroshell, or heat shield, could deliver heavy payloads safely through the atmosphere to the surface of Earth and potentially other planets.



ULA's launch of the JPSS-2 satellite for NOAA and NASA. Photo is courtesy of ULA.

"We depend on accuracy and timeliness of weather prediction models for enhanced weather forecasting and climate observations. Our ULA team is proud to launch the JPSS-2 mission that supports advanced forecasting of extreme weather and global climate monitoring," said **Gary Wentz**, ULA vice president of Government and Commercial Programs. "Additionally, we look forward to reviewing the data collected from LOFTID as we explore

Hypersonic Inflatable Aerodynamic Decelerator (HIAD) technology for engine reusability on our future Vulcan rocket. Successfully deploying these two payloads is a monumental achievement; thank you to our mission partners for their outstanding teamwork."

"The NASA and ULA public-private LOFTID partnership was the ideal pairing opportunity for demonstrating our Vulcan reuse plans," said **Mark Peller**, ULA

vice president of Major Development. "This demonstration allows ULA to focus on launch integration applications for engine recovery including parachute development, transportation and recovery, flight environments, precision navigation for landing and recovery and more."

Leveraging a legacy of 100 percent mission success launching more than 150 missions to explore, protect and enhance our world, ULA is the nation's most experienced and reliable launch service provider with world-leading reliability, schedule confidence, and mission optimization. We deliver value unmatched by any launch services company in the industry, a tireless drive to improve, and commitment to the extraordinary.

www.ulalaunch.com



ULA's launch of the JPSS-2 satellite for NOAA and NASA. Photo is courtesy of ULA.



Artistic rendition of the JPSS-2 satellite on-orbit.



ROCKET LAB AND INMARSAT GOVERNMENT TO DEVELOP L-BAND RADIO FOR NASA'S COMMUNICATIONS SERVICES PROJECT



"Rocket Lab and Inmarsat Government both share a culture of innovation, pioneering technology and delivering reliable mission success, so we're honored to be working together to support NASA in this vital project to enable major missions of the future," said

Rocket Lab founder and CEO, **Peter Beck**. "We look forward to building on the strong heritage of our Frontier radios by supporting Inmarsat's world-renowned satellite network and leading capabilities providing satcom as a service."

Rocket Lab USA, Inc. has been selected by **Inmarsat Government** as their partner to develop and manufacture an L-band radio in support of **NASA's Communications Services Project (CSP)**.

CSP seeks to accelerate the development of commercial near-Earth communications services by partnering with satellite communications (SATCOM) providers.

Rocket Lab will help enable Inmarsat's **InCommand**, a real-time, near-Earth telemetry, command, and control (TT&C) service for satellites in **Low Earth Orbit (LEO) for the CSP** with the Company's new **Frontier-L** radio connecting to Inmarsat's **ELERA** global L-band network in **Geosynchronous Orbit (GEO)**.

As NASA prepares to decommission the agency's owned and operated **Tracking and Data Relay Satellite System (TDRSS)** system, which has provided communication for the Hubble Space Telescope, the International Space Station, and numerous NASA's **Earth Observation (EO)** satellites, the CSP aims to tap into commercial satellite communications services to ensure future NASA missions have similar reliable, secure, and high-performance space relay capabilities.

Rocket Lab's Frontier-L radio is a transmitter that will support Inmarsat Government's demonstrations of a variety of TT&C applications, enabled by Inmarsat's ELERA worldwide L-band network, including **Launch and Early Operations Phase (LEOP)**, ubiquitous command and control, real-time tasking, and contingency operations for satellites in LEO orbits.

Frontier-L join's Rocket Lab's existing line of radios including the software-defined telemetry, tracking, and command (TT&C) S-band Frontier-S and X-band Frontier-X radios which can support near Earth and deep space missions.

Based on the **Johns Hopkins University (JHU) Applied Physics Lab (APL)** Frontier Radio, Frontier-L packs **Deep Space Network (DSN)** and other typical waveforms (SN, KSAT, SSC) into a compact package with up-screened commercial components for high reliability applications. The family of Frontier by Rocket Lab radios includes extended functionality not typically available in a low-cost radio including a coherent transponder to enable radiometric navigation methods, precision timekeeping functions, **forward error correction (FEC)** encoding and decoding, and a hardware based **critical command decoder (CCD)**.

Steve Gizinski, President, Inmarsat Government, said, "Inmarsat Government has joined with major space-based industry suppliers to demonstrate the capabilities of Inmarsat's **ELERA** global, reliable satellite network, including for NASA's Communications Services Project and Rocket Lab is a key partner for us. Rocket Lab's Frontier-L radio will leverage InCommand on the ELERA network as an important new capability for ubiquitous command and control to enhance the operation of low Earth orbit spacecraft. This will enable new communications services for industry and government alike."



Download the CPI mobile app!

HPA RF calculator
Quickly access HPA data sheets
TWTA/SSPA product finder
Convenient contact info

Search: **CPI Satcom**



SPACE FOUNDATION PUBLISHES THE SPACE REPORT 2022 Q3

*Space Foundation has released **The Space Report 2022 Q3**, which examines key global space workforce data, a recruiting bonanza for the U.S. Space Force (USSF), a technological leap to treat astronaut injuries, and a new generation of spacesuits designed to fit 99% of the world's adults.*

In a four-part analysis, the Q3 edition offers a deep look at workforce issues from 2021 employment trends in the U.S. and Europe, recent headwinds that could temporarily tighten space hiring, a look at new and unexpected faces joining the space workforce, and an examination of the USSF's recruiting success.

The newest U.S. military branch is seeing just three of every 100 applicants donning the uniform. The 2021 data is the latest year for which annual analysis is available.

The Q3 edition continues more than a decade of reporting by The Space Report on the space workforce, focusing in this edition on 2021 workforce data from across the globe.

Ongoing growth in Europe and the United States led hiring, while Asian space firms held the line or saw slight employment declines.

The variety of talent required across the space ecosystem is highlighted with a look at workers who tell of their journeys to find jobs tied to space, including some who took unlikely paths.

Included in the Q3 edition is a discussion with Maj. Gen. **Ed Thomas**, who is finding few challenges in his role as the U.S. Space Force's top recruiter.

Thomas said the service is the most difficult for new recruits to enter, with more than 18,000 applicants for about 500 posts. The Guardians who did gain entry include the largest percentage of women to enter any armed service in U.S. history.

The Space Report also examines technologies that could improve the lives of astronauts as the agency races to reach the Moon and beyond.



Advancements in biotechnologies combined with 3D printing could be a boon for injured astronauts with biobandages, a polymer containing astronauts' own cells that promises quicker healing.

Those astronauts will also be more comfortable on spacewalks and the Moon's surface thanks to a deal between NASA and Axiom Space.

Newly developed Axiom-owned spacesuits promise a better fit than older models along with advancements in mobility and life support. Once approved for spaceflight, the spacesuits will be available for lease to NASA and commercial companies under the agreement.

*"The ongoing demands of the growing space industry show the continued need for a steady supply of talent to fill an ever-growing variety of roles," said Space Foundation CEO, **Tom Zelibor**. "The good news from Space Force recruiting shows these space jobs have a growing allure for young people, pointing to a bright future across the space industry as its accomplishments inspire a new generation."*

The Space Report is the authoritative report on the global space ecosystem, covering space exploration and space-inspired industries on Earth.

Published by Space Foundation since 2006 and operating under Symposium 365 division, The Space Report is available on a subscription basis, providing policy analysts, congressional staff, investors, media, and space industry newcomers with

research and insight on trends and opportunities with informative articles and quarterly reports. Highlighting each report is an overview of the latest data available on the space economy, space infrastructure, and other key industry indicators as well as analysis of commercial, government and educational events impacting business, workforce and our daily lives.

Symposium 365, a division of Space Foundation, is the premier source for media and events in the global space ecosystem, offering authoritative news and information and venues for networking and conducting business via the world-renowned **Space Symposium**,



Symposium 365 Digital Platform and The Space Report. Serving commercial, government and education sectors, Symposium 365 produces signature programming —live and online — for professionals, entrepreneurs, educators and students to learn, connect and conduct business 365 days a year.

www.spacefoundation.org

Space Foundation is a nonprofit advocate organization founded in 1983, offering a gateway to information, education and collaboration for space exploration and space-inspired industries that define the global space ecosystem

Driven by a partnership model, Space Foundation operates three divisions that unite the entire spectrum of stakeholders — business, government, education and local communities — through corporate membership, sponsorship, fundraising and grants.

Symposium 365 is the premier source for media and events, including the world-renowned Space Symposium and The Space Report. Center for Innovation and Education is a lifelong learning platform. Global Alliance facilitates collaboration around the world.

SPACEWERX AWARDS 124 ORBITAL PRIME CONTRACTS

The SpaceWERX Orbital Prime program awarded 124 Phase 1 contracts from June 15 to September 22, 2022, each with a five-month term valued at \$250,000. Orbital Prime, which is the first space effort under the SpaceWERX Prime line of business, intends to invigorate the In-space Servicing, Assembly, and Manufacturing, or ISAM, market using Active Debris Remediation as a use case for the foundational technologies.

The awards, made under the **Department of the Air Force's Small Business Technology Transfer**, or **STTR**, program, administered by **AFWERX**, represent the first phase of the Orbital Prime program.

"As the U.S. Space Force component of AFWERX, the SpaceWERX team chose STTR awards over its more well-known and revamped Small Business Innovative Research (SBIR) contracts to drive academic engagement alongside small business," said **Gabe Mounce**, SpaceWERX deputy director.

The STTR program requires that companies partner with a research institution such as an academic institution, non-profit or Federally Funded Research and Development Center to perform concept exploration, development and maturation.

Through these awards, SpaceWERX has partnered with 92 companies and 66 research institutions across the country to explore ISAM capabilities and technologies relating to identifying, approaching and servicing an object in space. The Orbital Prime program will culminate with an on-orbit mission to demonstrate active space debris remediation, a public purpose use case intended to stimulate the market for space logistics.

From this initial phase, the STTR Phase 1 awardees will be invited to propose to a STTR Phase 2 opportunity in the early part of next year. Phase 2 will last 15 months at a maximum of \$1.5 million per award. SpaceWERX also recently opened a **Direct-to-Phase 2 SBIR** offering under topic **AFX234-DCSO1** to enable small businesses to enter the Orbital Prime program in a parallel path to the **STTR Phase 2**. Both paths, considered to be Phase II



of the Orbital Prime program, will lead to Strategic Financing opportunities in Phase 3 of the program.

The companies receiving Phase 1 awards include:

- **Acellent Technologies, Inc.**
- **Altius Space Machines, Inc.**
- **Assured Space Access Technologies, Inc.**
- **ASTER Labs, Inc.**
- **Astrobotic Technology Inc.**
- **Atomos Nuclear and Space Corporation**
- **Auxon Corporation**
- **BlackSky Geospatial Solutions, Inc.**
- **BotFactory, Inc.**
- **Busek Co Inc.**
- **Cambrian Works, Inc.**
- **Circle Optics, Inc.**
- **Continuum Space Systems, Inc.**
- **ControlX, Inc.**
- **Elevan LLC dba Elevate Systems**
- **Enduralock, LLC**
- **EPSILON3, Inc.**
- **First Light Observatory Systems, LLC**
- **Free Space Inc.**
- **Galactiv, Inc.**
- **Galois, Inc.**
- **GEOJUMP, Inc.**
- **GhostWave Inc.**
- **GreenSight**
- **GRID RASTER Inc.**
- **Howe Industries LLC**
- **Hypergiant Galactic Systems, Inc..**
- **iMetalx Group, LLC**
- **Integral & Open Systems, Inc..**
- **Inversion Space Company**
- **Kall Morris Inc.**
- **Karax LLC**
- **Kayhan Space Corp**
- **krtkl Inc.**
- **Launcher Inc.**
- **Lexsetai Inc.**
- **LGarde, Inc.**
- **Lunar Outpost Inc.**
- **Lunar Resources, Inc.**
- **MARS Aerospace Company**
- **Martian Sky Industries, LLC**
- **Metis Design Corporation**
- **Microsurgeonbot Inc.**
- **Motiv Space Systems**
- **Mountain Aerospace Research Solutions**
- **Nanoracks, LLC**
- **NearSpace Launch Inc.**
- **Neutron Star Systems USA LLC**
- **nou Systems, Inc.**
- **O Analytics Incorporated**
- **Octagon II, Inc.**
- **Off-World, Inc.**
- **Ombra LLC**

- **Orbital Bridge LLC**
- **Orbital Composites, Inc.**
- **Physical Sciences Inc.**
- **PickNik Inc.**
- **Plasma Controls, LLC**
- **Polaron Analytics**
- **Quidient, LLC**
- **Radsul Inc.**
- **RapidFort, Inc.**
- **Rhea Space Activity**
- **Rockdrill Research LLC**
- **Rogue Space Systems Corp.**
- **Sci Zone**
- **Scientific Systems Company, Inc.**
- **SCOUT Inc.**
- **Sedar Corporation**
- **Senseics Ltd**
- **SIMBA Chain Inc.**
- **Slingshot Aerospace, Inc.**
- **Space Micro Inc.**
- **SpaceWorks Enterprises, Inc.**
- **Spectral Energies, LLC**
- **Starfish Space**
- **Tangram Flex, Inc.**
- **Target Arm Inc.**
- **Ten One Aerospace LLC**
- **ThinkOrbital Inc.**
- **Toyon Research Corp**
- **Traclabs, Inc.**
- **Traction Jedi Technologies, LLC**
- **TrustPoint, Inc.**
- **Turion Space Corp**
- **Vision Systems Inc.**
- **VisSidus Technologies, Inc.**
- **Vy Corporation**
- **Wallaroo Labs, Inc.**
- **Weintraus, Inc.**
- **DBA Modularity Space**
- **Xtensor Systems Inc.**
- **Ziuli Holdings LLC**

The Phase 1 research institution partners include:

- **Air Force Institute of Technology (AFIT)**
- **Arizona State University**
- **Boston University**
- **Brigham Young University**
- **Brookhaven National Laboratory**
- **California State University Northridge**
- **Carthage College**
- **Catalyst Campus for Technology and Innovation**
- **Clarkson University**
- **Colorado State University**
- **Cornell University**
- **Draper Laboratories**
- **Eastern Michigan University**
- **Embry-Riddle Aeronautical University**
- **Expanding Frontiers**

- **Florida Institute of Technology**
- **Georgia Institute of Technology**
- **Illinois Institute of Technology**
- **Johns Hopkins University**
- **Johns Hopkins University Applied Physics Laboratory**
- **Louisiana Tech University**
- **Massachusetts Institute of Technology Lincoln Laboratory**
- **Michigan Technological University & Michigan State University**
- **MIT Innovation Initiative**
- **MIT Lincoln Laboratory**
- **Morehead State University**
- **New Mexico Institute of Mining and Technology**
- **New Space New Mexico**
- **Oakland University**
- **Oklahoma State University**
- **Purdue University**
- **San Diego State University Research Foundation**
- **Sandia National Laboratories**
- **Southeast Innovation Institute**
- **Southwest Research Institute**
- **SRI International Computer Science Laboratory**
- **Stanford University**
- **Stevens Institute of Technology**
- **Taylor University**
- **Texas A&M Engineering Experiment Station**
- **The Ohio State University**
- **The Pennsylvania State University, Applied Research Laboratory**
- **The University of Alabama**
- **The University of Texas at Austin**
- **The University of Texas at Austin Office of Sponsored Projects**
- **Trustees of the University of Pennsylvania**
- **United States Naval Research Laboratory**
- **University of Alabama in Huntsville**
- **University of Central Florida**
- **University of Cincinnati**
- **University of Colorado Boulder-Office of Contracts and Grants**
- **University of Dayton CME Department**
- **University of Florida**
- **University of Illinois at Urbana Champaign**
- **University of Maryland**
- **University of Massachusetts Amherst**
- **University of New Mexico**
- **University of Notre Dame**
- **University of Southern California Information Sciences Institute**
- **University of Tennessee Space Institute**
- **University of Texas at Arlington**
- **University of Texas at Austin**
- **University of Texas at San Antonio**
- **University of Utah**
- **University of Washington**
- **Virginia Polytechnic Institute and State University**
- **Yeshiva University**

A BRIEFING WITH AUGUSTINE PONTURIERO

Chief Strategy and Growth Officer, TriSept



TriSept has played a pivotal role in the innovations that have opened the door to broader access to space. The company helped conceptualize and shape, for example, the very rideshare and small sat missions it supports today for commercial, government and defense initiatives around the world.



Augustine Ponturiero

Based in Chantilly, Virginia, USA, the firm has a strong heritage across the space industry, enabling the launch of more than 230+ satellites on 21 different launch vehicles from 14 launch sites across the globe. TriSept has provided mission support expertise to DoD, NASA, leading launch providers, and technology innovators as they lift milestone missions into orbit that are empowering new capabilities for defense and the emerging, commercial space economies.

Augustine (Augie) Ponturiero, TriSept's Chief Strategy and Growth Officer, engaged in a discussion

of the company's latest business drivers as the firm closes in on 30 years of innovation in the space industry.

The U.S. Government and military are in the midst of a major modernization push. How is the TriSept team contributing to this all-important mission?

AUGUSTINE PONTURIERO

TriSept is a reliable, and effective, small business partner to the U.S. Government and Department of Defense. For the past 10 years, we've provided technical expertise and a deep understanding of the challenges the government and military are facing with *satellite communications (SATCOM)* in an increasingly adversarial world.

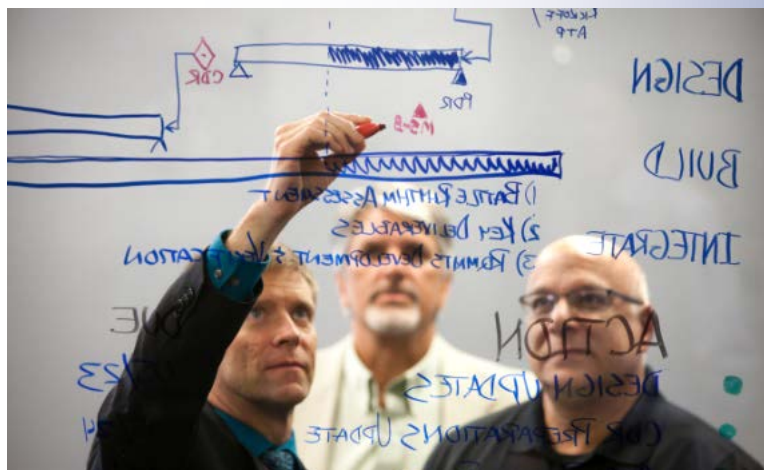
Today, we have an experienced team working to support our Government customers in accelerating the delivery of *Commercial SATCOM (COMSATCOM)* technologies and services to the DoD so that deployed units and personnel have the communications capabilities they need to stay safe and accomplish their assigned missions.

To provide some context, our subject matter experts, systems engineering and acquisition support teams are currently working with our government leads in supporting approximately 90 active COMSATCOM acquisitions — providing everything from small unit, mobile satellite COTM (*Communications-*

On-The-Move) capabilities, to larger, fixed-site, high data rate communications in support of Department of Defense-related teams, warfighters, and programs deployed around the world.

We are there to make certain everyone from office managers to warfighters in the battlespace are able to quickly and easily configure and reconfigure their SATCOM systems and capabilities. TriSept provides support ranging from reviewing innovative technical solutions, working with customers to understand the impacts of new high-powered, high-capacity ground infrastructure on their communications, or aligning more effective operational processes to streamline acquisitions and service processing.

Our teams and people are involved in analyzing and evaluating some of the newest SATCOM technologies and services available in the commercial market today. We are dedicated in our support of warfighters and helping Government customers evolve their use of COMSATCOM services so they can achieve mission success.



However, our expertise doesn't end there: We provide a high level of commercial and government mission expertise to DoD, NASA, and other Government organizations for a wide array of space-based engineering and operational capabilities — offering everything from informed recommendations around new transformational technologies to finding more efficient ways to run legacy operations as well as improving the cadence and responsiveness of satellite launch missions.

How has TriSept grown its business in such sensitive and important areas of the U.S. Government and Department of Defense?

AUGUSTINE PONTURIERO

It all boils down to experience and an understanding that we cannot be successful without maintaining a laser focus on customers' missions and goals. TriSept brings a wealth of experience across all facets of the government SATCOM sector and we know how to deliver on specific and specialized DoD communications requirements with tailored, robust communications solution analyses and recommendations.

All of our team members have either served in the U.S. military, worked in the commercial SATCOM services market, or they've been involved in both at different points in their career. We have deep expertise in government and commercial SATCOM services — we've got the know-how to solve the toughest communications challenges in some of the roughest environments in the world.

It's been our experience that when a Government customer needs a communications challenge solved, there is often little time to consult other organizations to deliver recommendations and solutions for consideration — often you work with who and what you have as quickly as possible. Fortunately, we have high-performing engineering and operations experts on our team that have consistently demonstrated the ability to bring innovative, out-of-the-box thinking and technologies to the table. As a result, TriSept has consistently helped our government customers meet time-sensitive and geographically- and technologically-demanding communications challenges.

We can't share too many project details, but at a high level, we have many success stories — across a wide array of projects, programs and mission scenarios — where TriSept has provided key engineering and operational expertise in order to solve a customer's immediate communication needs.

For example: when presented with a government COMSATCOM user's urgent supplemental communications requirement, TriSept developed and analyzed several courses of action within hours and provided technical and operational analyses for this Government customer and the COMSATCOM user so they could select the best course of action to meet their mission requirements.

Our teammates leveraged their experience in commercial and military communications systems, peripheral systems and operational tactics to develop and present several options that incorporated ground, airborne and satellite-based communications capabilities for consideration. We then supported the acquisition of these communications services and confirmed that the end user was able to use the services. In the end, TriSept's team played a key support role in solving a challenging communications problem that allowed deployed DoD forces to successfully complete their assigned missions.

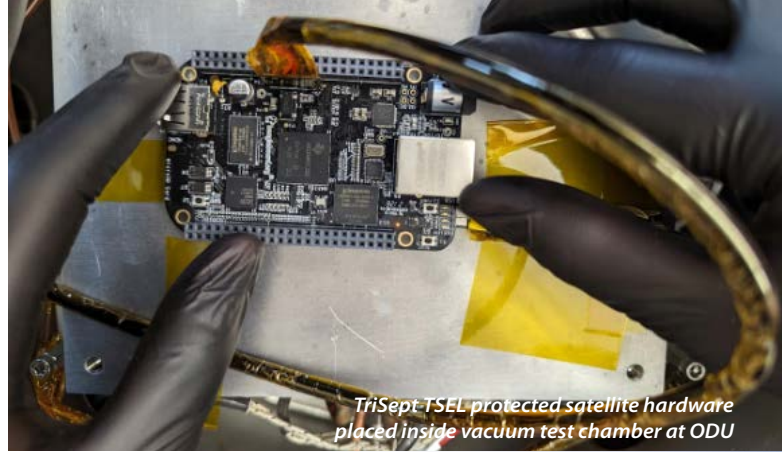
What are some of the biggest space-based challenges that TriSept is most passionate about helping both commercial and government markets solve?

AUGUSTINE PONTURIERO

Cybersecurity is a major challenge facing both government and commercial sectors today, as security and adversarial threats have never been higher. Our cybersecurity team is heavily involved in advising government and military initiatives around the world. We also rolled out our new **TSEL (TriSept Security Enhanced Layer)** satellite security software solution to the satellite industry earlier this year. TSEL is commercially available today following an extensive series of rigorous vacuum chamber and lab tests — the demand for this new, satellite security offering has been strong.

TSEL is a Linux-based security OS that easily integrates on platforms to run and secure cubesat mission spacecraft. The rising number of attacks on critical infrastructure across the U.S. and world have shown just how vulnerable spacecraft can be, especially as the vast majority of smallsats launched into orbit are ill-prepared to protect themselves in the event of adversarial threats.

We are passionate about contributing to mission solutions aimed at keeping space sustainable and safe — reducing space debris and accelerating the de-orbit process are among some of the more recent programs we've supported.



TriSept TSEL protected satellite hardware placed inside vacuum test chamber at ODU

What does the TriSept roadmap look like as the company prepares to meet rising demands and challenges on the horizon?

AUGUSTINE PONTURIERO

TriSept leadership has consistently inspired the firm's teams to maintain and expand on our systems and services knowledge and expertise. As a result, the company is well positioned to apply our skills in new and innovative ways to develop and drive breakthrough solutions on the ground and in space.

Our systems engineers and government mission teams are constantly adapting our business and organization to leverage our strong skillsets to deliver viable solutions to support applications for near-earth, cislunar, and lunar missions, even upcoming programs that go far beyond the moon.

We are absolutely committed to making space more accessible for everyone, including academic, experimental smallsat missions such as the ones that are testing our TSEL satellite security operating system.

We are working on missions that are aimed at reducing orbital space debris, finding valuable resources below the Earth's surface, and keeping spacecraft safe in the busiest orbits — all from space and all in collaboration with some of the most exciting companies and innovators on Earth.

Our **SCIF (Sensitive Compartmented Information Facility)** development and management business is soaring, as well, as more companies, contractors, government agencies and mission operators need extremely secure work environments where they can plan, work on and deliver sensitive and confidential programs. We're seeing rising demand for our SCIF design and construction expertise, especially in the Washington, DC corridor as well as across the country.

What about company growth, as you eye expansion to meet new government and commercial opportunities?

AUGUSTINE PONTURIERO

While TriSept has an extremely deep bench to support important and innovative government and defense initiatives in the works, we are constantly recruiting some of the best talent in the world to add to the expertise that has long been our differentiator in government and commercial markets.

We are able to attract young engineers, operations professionals, analysts and scientists with an incredible lineup of exciting missions that truly make a difference in critical government and military operations and innovative commercial applications.

They're able to work on dream assignments and hone their skills by learning from some of the most experienced teams in the industry. We've seen an exciting uptick in our government and commercial businesses, and we continue to grow our team to deliver the capabilities and solutions our customers have come to rely on us for nearly three decades now.

I only see that trend accelerating as government, defense and commercial operations are all looking to space for new possibilities and opportunities in the years to come and, in many cases, are converging. I'm excited to say TriSept will be there every step of the way, solving new challenges and developing new solutions for all of our customers.

<https://trisept.com>

COMMO: AMAZON WEB SERVICES (AWS) + THE U.S. MILITARY'S HSA PROJECT

Authors: AWS Public Sector Blog Team



*Whether on land, in air, or at sea, having connectivity and access to information in the field is critical for the **U.S. Department of Defense (DoD)** as satellite communications systems provide the DoD with critical capabilities — from delivering satellite imagery to enabling communications—that support military users operating around the globe.*

connectivity and information sharing, it's increasingly exploring ways to bolster government capabilities to improve latency, scalability, and communications resiliency.

Now, as part of a new DoD research and development effort, **Amazon Web Services (AWS)** and **Amazon's Project Kuiper** will help shape the future of global, ubiquitous, and secure internet connectivity throughout the space domain for the United States and its allies.



The **Hybrid Space Architecture (HSA)** project is led

by the **Defense Innovation Unit (DIU)**, a defense organization focused on accelerating the DoD's adoption of commercial technology to help solve operational challenges.

The project aims to demonstrate a network architecture that uses both commercial capabilities and **U.S. Government (USG)** space assets in all orbits to provide secure, assured, and low-latency data comms.





SECURE MESH WIRELESS NETWORKS DRIVE COMMAND POST MOBILITY

Author: Dominic Perez, Curtiss-Wright Defense Solutions

For years, the goal of our armed forces has been mobility at the command post, with Army leaders setting the standard to be able to move hourly, with the command post's network ready, powered up and receiving in five minutes.

That goal is understandable and achievable, but is difficult to achieve with today's approach to edge networking. Imagine a typical scenario: while tents are being set up at the new command post location, soldiers must also run 100 CAT5/6 Ethernet cables to connect everything, all within minutes.

It's simply not possible to meet the setup time goal using traditional copper or fiber optic Ethernet cables. Beyond set up, there are logistical issues: the use of traditional Ethernet in the battlefield brings with it the requirement to manage spools of CAT5/6, as well as the challenge of re-terminating the cables in the field.

There is a solution, though, that can optimize mobility in the field. A secure wireless command post system can be setup and servicing tens to hundreds of users in just a matter of minutes.

While many military users still have trepidation about the security of wireless networks in the military, those concerns have been met and mitigated through the proven use of NSA approved Commercial Solutions for Classified (CSfC) encryption, using two layers of approved software and/or hardware encryption approaches. In fact, a mobile, rapidly deployable and extendable network is possible today and qualified to TRL9.

It is true that when compared to traditional direct Ethernet cabling, there's a trade-off when using wireless networking where you gain connectivity speed at the cost of connection throughput. However, that trade-off becomes compelling when one considers that the nature of threats keeps changing and the demands of warfighters keep expanding.

There is a growing awareness of the challenge of command post survivability. Two years ago, in 2020, Maj. **Jeremy Horton** and Col. **Ted Thomas** issued a thought piece on this topic, and the events of 2022 only further highlight the threat and challenge.

"Recent events in Eastern Europe demonstrate that command posts (CPs) are not only susceptible to detection but that they can be destroyed within minutes if they do not adapt. To address this, the Army must understand how a peer adversary will exploit CP vulnerabilities; and then develop improved survivability approaches to mitigate detection and attack, while maintaining effective command and control (C2) that ensure the success of the operations they are designed to orchestrate."

Our adversaries are increasingly sophisticated and Command Posts can be detected and destroyed within minutes. The warfighter needs to understand these vulnerabilities and mitigate the effects of an attack and next generation of Command Posts will contain the necessary communication infrastructure on vehicle platforms

While few would argue that a wireless network can compete with cable for connection speed, while everyone knows that the advertised max speeds on Wi-Fi can only be met under laboratory conditions, with Wi-Fi 6 multi-hundreds of megabits of throughput can realistically be deployed in the field.

Another advantage of wireless networking is its support for mesh topologies, which can be used to eliminate the threat of a single point of failure in the network. That means that the loss of a single node or vehicle does not bring down the entire network, delivering true network resiliency.



Dominic Perez

A mesh network can exist in many different topologies, and a key attribute of meshing is the ability to route across the network with direct hop, single hop, or multiple hop, data distribution to connect any two nodes on the network. Meshing can come in a variety of formats, with the most common example in the field provided by MANET (**Mobile Adhoc Network**) radios. Usually, each user would have to have their own MANET compatible radio, which while fine for handheld communications, is less than ideal for data based comms, which if needed would require the user, for example, to plug-in into a laptop or tablet.





Curtiss-Wright SWCP Wi-Fi

Commercially sourced Wi-Fi solutions typically have built in support for mesh network topologies. Unfortunately, that class of network solution is not always compatible with NSA requirements for CSfC. Commercial Wi-Fi can be a short cut to setting up a CUI network, but it's not going to get you to a secret or higher network.

The use of *secure wireless mesh networks (SecMesh)* delivers a leap forward, if not revolutionary at least evolutionary, in the distribution of data connections to our warfighters. With SecMesh the warfighter can setup a wireless network that provides connectivity between vehicles as well as creating a bubble that's broadcasting to end-users. The SecMesh approach enables vehicle-to-vehicle mesh communications, along with the ability to do tunnel-in-tunnel CSfC encryption.

For several years, **Curtiss-Wright** has been deploying **Secure Wireless Command Posts** with the Army and with other groups. In a typical deployment, best practice has been to install a secure wireless command post system on each vehicle, where each vehicle would then have an actual network connection outbound, and not connect to other vehicles that are in the same area.

While this style of deployment means that each vehicle can operate independently, it results in duplication of equipment and sub-optimal SWaP-C (Size, Weight, Power and Cost). Further, with each system operating independently users and devices cannot roam between systems without being pre-registered with each system they may encounter.

The next generation evolutionary step in SecMesh technology will be to mesh vehicles together such that multiple true-north bound network connections can be available in that case that one of the vehicles is lost. That approach will enable the users that are registered with one wireless system to roam between all of the wireless systems on the secure network.

Beyond that, where system designers are headed is for true vehicle secure network connectivity vehicle-to-vehicle while on the move. This capability has been shown today in the field and development continues, ensuring that this capability will only get more robust going forward.

The vehicle-to-vehicle links, don't need to be commercial Wi-Fi; they can be any IP based communications transport such as Wi-Fi, 4G, 5G, mmWave, MANET, LOS, or wired connections. Yes, even wired. When vehicles are going to be parked some place for a long time and higher speed comms is required between the vehicles, they can be hard-wired and connected to each other using traditional Ethernet or fiber optic cabling.

One example of how you can up a SecMesh network in the battlefield today is to use a Curtiss-Wright **PacStar Secure Wireless Command Post (SWCP)** as a network hub. A secure wireless **PacStar**

Command Post-X, serving as a first gen, non-meshing network, is then combined with a **PacStar Secure Meshing Command Post (SMCP)** system, which provides the full hardware and software suite needed to setup any number of vehicles into a mesh topology.

Typically, setting up a mesh network topology can be complicated because many legacy applications have built-in assumptions about the network on which they will operate. For example, the application will expect that network to be set up as a Layer 2 LAN instead of Layer 3 routed network.

That puts the burden on the network designer and network maintainer to hide the true nature of the underlying network to ensure it just works, both for the users and for the applications they are running on the network.

It's at this stage that **PacStar IQ-Core Software** can greatly simplify the setup, monitor and manage process, reducing the task to mere minutes by eliminating the need for the system manager to manually set each individual node on the network. Manual setup might take hours, which again, undermines the Army's goal to optimize mobility and reduce network setup to five minutes in the field.

Even better, the SecMesh approach can be deployed in extremely harsh environments.

Users can select the hardware form factor that is appropriate for the node, whether this is a communications vehicle with an enclosure for things such as the PacStar 400-Series, or a more combat focused vehicle, whether land or amphibious, that requires fully sealed electronics made possible by a SOSA-aligned design based on VPX hardware. As threats continue to evolve, we must, as industry partners to government, continue to expand our capabilities and rise to these challenges.

www.curtisswrightds.com

CURTISS-WRIGHT



Core Network Comms Manager dashboard

SPACE IS THE NEXT FRONTIER... FOR **CYBERATTACKERS**

Author: Kevin Kelly, Chairman and Chief Executive Officer, Arcfield



In February of 2022, Russian government hackers launched a cyberattack on U.S. satellite company Viasat, disabling communications in Ukraine just prior to its invasion of the country.

The **European Union** referred to this attack as one of the most significant hacks of space equipment to date and it illustrates the vulnerability of essential technology in the new warfare domain of the 21st century.

With satellites facilitating everything from **command and control (C&C)** to **positioning, navigation and timing (PNT)** in defense arenas, as well as communications, information distribution and other critical civilian operations, satellite constellations represent one of the first targets in a multi-domain conflict fought with conventional forces, online and increasingly, in space.

This comes as increasing cyberattacks are targeting critical infrastructure operations and threatening broad economic impacts.

With the space industry projected to reach \$1 trillion in annual revenue by 2040, effective cybersecurity practices must be put in place to ensure the safety of space operations.

Thanks to modernized systems engineering and advanced design techniques, satellite companies are taking a page from the nuanced **DevSecOps** approach of software design and applying it to the space domain, baking in the resiliency needed to withstand sustained cyber assaults orchestrated by an adversarial nation-state.

However, as we saw at this year's **Black Hat** security conference, **Starlink** terminals were vulnerable to a cyberattack with \$25 worth of **Commercial Off-The-Shelf (COTS)** parts, the barrier to entry for potential attackers remains startlingly low when compared with the potential damage they can inflict.

This is nothing to say of the legacy satellite infrastructure that is still on-orbit and was developed at a time when U.S. supremacy in space was inherent and potential cyber intrusions were not a concern.

Protecting our satellite constellations will take a combination of technical resilience, collaboration between public and private sectors, legislative and regulatory updates and another realm of cyber awareness.

HOW A CYBERATTACK CAN OCCUR IN SPACE

Satellite operations — similar to laptops, smartphones or any other widely used technology — are built on memory, compute and communications infrastructures that rely on microelectronics and circuitry, and are increasingly connected to the internet. Like those other devices, satellites and their ground operations have the potential for network vulnerabilities for bad actors to exploit.

If an attacker were able to deploy a **phishing** or **ransomware** attack to gain access to the network of terrestrial-based stations communicating commands to a satellite constellation, it could take over access and issue commands to alter a satellite's

telemetry, control, memory and content. The result would be catastrophic.

As we've seen with recent ransomware attacks on critical infrastructure institutions such as health systems, water treatment facilities or even the Colonial Pipeline attack in 2021, there are numerous ways attackers can gain access to a targeted network, from phishing attempts or supply chain vulnerabilities.

Further, the problem can be exacerbated by legacy satellites that were developed or deployed more than 20 years ago when onboard cyber defenses weren't included in their design. Many of these satellites remain on-orbit and could be prime targets for a cyberattack.

A ransomware attack on a satellite constellation could have even more devastating consequences and prove incredibly lucrative for attackers, given the explosion of commercial satellite development and its growing work with the **Department of Defense**.

Considering that most ransomware attacks begin with the attackers covertly gaining access to a network and observing what data they are able to obtain before encrypting it, a satellite-based ransomware attack could start with a network intrusion that allows hackers to observe a satellite's command and control signals from a ground station.

From there, the attackers could use their own wireless uplink to mimic those command and control signals to targeted satellites.



When a system is compromised, the first step is to take it offline. There should be a fallback to a safe mode that only allows a satellite to communicate with one ground station and one wave form that is not used in the ordinary operations of the spacecraft and is only meant to conduct recovery and survivability functions.

That station must be considered a “crown jewel,” one that is unknown and never used in operation. This gives the ability to do a failsafe back to a protected mode and restore software, which requires the architecture of a satellite to be resilient enough that it can fly with limited command control and access to the ground.

MAINTAINING THE SPACE DOMAIN

Securing our space infrastructure and maintaining superiority in the domain will require, among other elements, making the appropriate investments.

That is something the DoD and NASA have done well — the Air Force, Army and intelligence community have also made space a priority and are investing appropriately.

One driver in the investment of space has been the creation of entities such as the **U.S. Space Force** and the development of commercial space operations.

Space is one of the fastest growing business sectors, certainly in federal markets and increasingly so in commercial. The commercial investment and federal demand are significant to maintaining superiority

in the domain when in competition with near-peer nation states like Russia and China.

While there are well known contractors in the space arena who’ve historically driven the market, the industry has evolved and now has multiple companies that specialize in different components of space architecture.

The growing ecosystem of technology providers are now active in manufacturing components that go onboard satellites as opposed to one builder manufacturing everything. Smallsat providers are also becoming increasingly attractive to the government as they provide a lower cost alternative.

The federal government has the largest role to play in helping shape the future of the space economy. To remain the major player in the domain, the U.S. must encourage leading edge innovation by creating a commerce system that supports investment and encourages the growth of a healthy ecosystem of innovative companies.

We also need to strike shared nation agreements on how satellites operate in the domain to help ensure the proper governance for how countries deploy satellites to certain orbits with consideration to equitable operations.

Due to the expansion of the space business, collaboration between the government and commercial sectors is imperative to advance the industry and to safeguard space infrastructure from our adversaries.

Understanding how we can best shepherd this industry and defend from near-peer adversaries, cybercriminals and others is paramount to our national security strategy moving forward.

www.arcfield.com/

ARCFIELD

Author Kevin Kelly is the chairman and chief executive officer (CEO) of Arcfield and oversees the development and implementation of the company's strategy, while ensuring the company delivers technology-differentiated solutions to missions that are critical in protecting the United States and its allies. As CEO, Kevin is responsible for establishing a corporate culture, building and managing an expert leadership team, launching an innovation incubator that will ensure the company is developing solutions ahead of mission needs, and the overall growth of the company.



Kevin has been an active leader in the defense and intelligence industry for more than 30 years with proven success leading and managing companies through growth activities. He is passionate about innovation and ensuring that a company leverages its people, processes and technologies to its maximum potential to deliver for its customers. Prior to Arcfield, Kevin was the CEO of LGS Innovations, a privately held independent technology company that was eventually acquired by CACI International in March of 2019. After its acquisition, Kevin oversaw the company's integration into CACI through the company's creation of a new high-tech sector (National Security and Innovation Solutions Sector), where Kevin would ultimately serve as president.



A BRIEFING WITH DANIEL GIZINSKI

President, Comtech Satellite Network Technologies



Daniel Gizinski

Daniel Gizinski is the President of Comtech Satellite Network Technologies, Inc. (a U.S. Corporation) He was named to this leadership position on January 3, 2022. Previously, he

held various senior management positions at Comtech, including Vice President of Product and Strategy for Comtech Systems Inc. Prior to joining Comtech in 2019, Daniel held program management and leadership roles at General Electric, Sierra Nevada Corporation, and L3Harris Technologies. Daniel holds a Bachelor's degree in Electrical Engineering from the University of Virginia and a Master's degree from Duke University.

As near-peer threats reach their highest level since the Cold War, battle-ground-infrastructure innovations are increasingly mission critical. Comtech has developed key software-defined components that are enabling US and allied forces to instantly bring JADC2-level capabilities to fielded gear.

That has proven to be a game changer for warfighters who are tasked with many responsibilities – from tactical logistics to comms. Daniel Gizinski offers his thoughts regarding the latest on such groundbreaking defense solutions and the impact they've already had, as adversarial threats continue to rise around the globe.

Comtech has made some big contributions to the defense and government market. What are some of the most significant differences you've made for warfighters lately?

Daniel Gizinski

Adversarial threats have certainly reached Cold War levels and, as a result, global communications requirements have shifted toward addressing an

advanced threat profile where Comtech truly excels. The U.S. Government and many of our allies have migrated to a strategy that has explicitly re-focused on addressing near-peer threats.

Comtech has been delivering software-defined modems into the defense market for more than a decade, offering software-only upgrades to fielded, in-use hardware, to bring them up to the current fight, which has been a game-changer for our in-theater forces.

We've been highly effective at providing capabilities to bridge the gap between old standards and new capabilities, addressing a core challenge of fielding *Joint All Domain Command and Control (JADC2)* in connecting more sensors to more shooters and shortening the time to close the kill chain.

What are the game-changing defense solutions Comtech has recently brought to market that have already had an impact across the battlespace?

Comtech has received *WGS / ARSTRAT* certification of our newest **SLM650C2 modem**, enabling our most widely fielded government satellite modem family to work on the *WGS* constellation as well as *COTS / commercial* satellite constellations.

With the ever-growing demand in data and imagery, our defense and government customers are demanding higher capacity communications links.

The newly released *CDM-780* ultra-high-speed modular modem will give our intelligence and warfighter communities the fastest communications speeds available over satellite, supporting up to 7.2Gbps of user traffic. Our users also require a wide variety of communications capabilities, which have historically been used independently in a sort of communications "vacuum". We have demonstrated technologies that enable our users to communicate over terrestrial, satellite, tropo and microwave in an auto switching, auto healing environment so that any communications channel available can be used to aggregate comms or self-heal in a contested environment. This capability enables an always on, always available link to valuable support and data services.

Comtech is close to opening a newly expanded defense solutions manufacturing facility in Arizona. How important is that expanded production capability to your overall mission?

Building products in the U.S. has become more important as the impacts of the COVID-19 pandemic have revealed supply chain vulnerabilities. Comtech



Comtech SLM650C modem

has been and remains a U.S. manufacturer for more than 40 years. While others outsourced production overseas, we have learned how to better compete with American manufacturing, which has allowed us to build our brand known for high quality. Comtech is expanding our manufacturing and technology facility in Arizona.

We recently invested in a new 150,000 square foot manufacturing and engineering center of excellence in Chandler, Arizona. The operation is strategically located down the street from a large Intel Corporation facility, as well as TSMC's new 1,000+ acre fab. Investments in production facilities take time and energy, and leaning forward into the U.S. Government's (USG) desire to on-shore production has been key in our ability to deliver on these capabilities.

How has the Russian invasion and the subsequent war in the Ukraine impacted your dedication to the U.S. and allied governments?

Daniel Gizinski

Early during Russia's invasion of Ukraine, we donated several, small form factor, **troposcatter systems** and upgrade kits for fielded equipment

The ability to communicate in a denied and degraded electromagnetic environment is critical. We understand the need to move fast and we were able to deliver these systems prior to any contracting efforts. We have now seen demand for dozens of follow-on systems via **Foreign Military Sales (FMS)** channels and we are fulfilling these orders to continue the support of the Ukraine and allied countries.

It proved to be an extension of our commitment to delivering solutions based on our customer's problem sets, rather than a defined path to addressing requirements. We've been able to deliver advanced satellite communications capabilities, resilient troposcatter networks, and supporting equipment based on customers' real challenges and issues that they experience with their equipment in the field.

Our defense customers have stated to us privately and publicly that our products have proven to provide reliable communications in contested theater where others could not. When you hear from users in mission-critical situations who say



they rely and trust in the Comtech products where other communications solutions failed, it really underlines our team's dedication to doing our part in defending our U.S. and Allied interests.

You have personally participated in defense and government technical trials in the field and heard firsthand about the pain points and challenges being faced by warfighters around the world. What are some of the biggest technical and comms challenges across the battlespace and how has Comtech helped to solve them?

Daniel Gizinski

One of the most exciting things about our organization is that we haven't lost sight of our end user's requirements. I have personally attended dozens of customer demonstration events and training exercises throughout the year. It's a hands-on experience that allows us to rapidly align our development focus with real customer needs, sometimes before they even realize there is a capability gap.

One of the biggest challenges is that most communications operators don't just have one job. They are responsible for setting up and troubleshooting communications equipment, as well as a dozen other tasks. Any time spent troubleshooting a satellite link is time that could be better spent elsewhere.

One of our responsibilities is to ensure our end users can easily configure and establish communications with minimal time and training. Witnessing these on-site demonstrations and speaking directly with the military and government users is one of the reasons why we developed our **SCC (Stored Configuration Controller)**, a field installable push-button configurator that is pre-loaded for multiple communications missions. This SCC allows the warfighter to change the communications mode, frequency, data rate, waveform and more without the need to carry a laptop or cables. It ensures that our warfighters can set-up reliable communications in seconds with nothing more than a finger.

Comtech is a big company but we haven't lost the personal touch with our customers. We offer ease of use across our solution sets and we consistently stay focused and on the operator and have a personal touch with our customers. Anywhere in the world our customers will call us on the phone and can talk with an engineer in minutes. We actually answer the call.

The complexity of the various constellations has made setting up satcom networks very difficult for the average soldier, sailor and airman. Comtech equipment plays well across all providers, and our technicians have broad experience to help in any region of the world, any network.

We have made modifications to products that are 7+ years old to work over GEO, MEO, LEO and HEO constellations. Our next generation products will support single box hitless antenna handovers and multi-constellation, multi-waveform solutions while minimizing cabling and configuration.

Comtech is a longstanding leader and innovator in defense solutions — how does the company continue to further its mission of enabling government and defense communications capabilities?

Daniel Gizinski

Comtech has always been an innovator in defense solutions, and we continue to provide our customers new capabilities and services to ensure communications dominance over our adversaries. We recently introduced the modem breakthroughs we discussed earlier and have also enabled 3rd party manufacturers and service providers to implement and integrate some of Comtech's intellectual property and communications waveforms into non-Comtech hardware solutions.

We have ported our waveforms onto 3rd party modems to ensure that more branches of the DoD can access global gateways and trunking nodes, and we are working with companies that are porting our waveforms into virtualized environments. We have also initiated the development of our own virtual environment, as well as digital IF between modems and edge devices to support the flexibility and expandability needed by our government and defense community.

The past few years have marked a major shift in the Government spending away from a focus on the Global War on Terror towards a primary focus on addressing near-peer capabilities. There's been a shift from operations in a permissive environment to operations in an **Anti-Access / Area Denial (A2AD)** environment. Our communications will be up against much more sophisticated threats, and we've been working to develop capabilities that are up to the challenge.

What are a few key differentiators when it comes to Comtech's innovative approach to defense solutions?

Daniel Gizinski

When Comtech shows its offerings to potential military customers, unlike our competitors, we show up with real operating equipment, not a PowerPoint presentation. We are a commercial manufacturer that has high manufacturing output and high-quality product capacity. We don't have to wait a few years to determine how we will build a new product, because manufacturing is built into our design with co-located U.S. based manufacturing and engineering in Arizona.

Our design, release, and testing is second to none. This is why Comtech has come to be known as the most reliable modem manufacturer in the world. We are like the Toyota of the modem industry—many of our modems have lasted decades beyond expectations, and we regularly get customers calling asking about modems that we thought were long retired.

That is a testament to our quality and ability to offer software and firmware upgrades that enable our users to maximize the value of the product and extend the life of their investment.



GOVERNMENT SATELLITE REPORT (GSR)

CURRENT SPACE ACQUISITION PRIORITIES OUTLINED BY USAF OFFICIALS

Author: David Pesgraves, Government Satellite Report (GSR)



According to Brigadier General Steven P. Whitney, the U.S. Air Force (USAF) is the only department within the entire federal government that has more than one acquisition executive.

This fact is attributed to **FY2021's National Defense Authorization Act (NDAA)** that created the second acquisition position for the USAF.

Gen. Whitney, who serves as *Military Deputy* in the **Office of the Assistant Secretary of the Air Force for Space Acquisition and Integration**, believes that this additional second appointment highlights the importance the federal government is placing on "the space problem," with acquisition being the clear pathway to the U.S. gaining a strategic edge over near-peer, space race competitors.

During a session on "Accelerating Space Acquisition" during the recent **Air Force Association's (AFA)**

Air, Space, and Cyber Conference, Frank Calvelli, Assistant Secretary of the Air Force for Space Acquisition and Integration (ASAF/SQ), Dr. Kelly Hammett, Director of the **Space Rapid Capabilities Office**, and Brig. Gen. **Stephen J. Purdy**, Program Executive Officer (PEO) of Assured Access to Space, joined Gen. Whitney to examine the current status

of space acquisition within the **U.S. Department of Defense (DoD)**, to outline their space acquisition priorities as such pertains to each of their stations, as well as to discuss how commercial industry can assist in propelling the U.S. ahead of its adversaries in the space domain.

IS SPEED KING?

There is no doubt that Calvelli has a solid and clear vision for space acquisition within the USAF — his three main priorities for the department's space acquisition initiatives are *speed, resiliency, and integration*.

During the AFA session, Calvelli explained, "Speed in our acquisitions enables us to deliver new capabilities to our warfighters faster. Resiliency in our space architecture makes sure that space can be counted on during times of crisis and conflict. And integrating space with other warfighting domains supports our operational imperatives in the Department to give our warfighters a strategic edge."

To achieve speed, Calvelli explained that the Department should start by focusing on building smaller spacecrafts, rather than giant assets that can take many years to produce.



Frank Calvelli

"Building smaller spacecraft can be done faster. It's just a matter of physics. Going smaller and more manageable... are key enablers to speed," he said.

He also suggested looking into cutting down on one-time, engineering costs by using existing technology and designs.

"If we build smaller, reduce non-recurring engineering, and execute our plans [on schedule], there's nothing that can stop us," Calvelli said.

For Dr. Hammett, his acquisition priorities are on focus and alignment. Building off Calvelli's comments on speed, he took it a step further by saying, "Speed is not King... Velocity is King, because velocity is speed with direction."

According to Dr. Hammett, having a competent workforce that is focused on the same purpose and mission will also accelerate space acquisition.

"If we're all pulling in the same direction with the same unity of effort and purpose, we can go fast," he said.

For Gen. Whitney, his priority is delivering on capabilities, while simultaneously building relationships with other organizations.



Dr. Kelly Hammett





"You've heard a lot of talk... about how we play together with different entities, how the space side plays with the air side, and how we work together in different programs," said Gen. Whitney. "We've got to get those right, and we've got to be able to work together."

COMMERCIAL SPACE + THE ADVERSARY

A common theme that was echoed throughout the AFA conference is the growing threat China poses in the space domain.

For Calvelli, the commercial space industry is a resource that the DoD must leverage to counteract our adversaries' advancements, but delivery schedules need to be drastically reduced from the traditionally drawn out, multi-year contracts.

"We really, truly have a threat from China," explained Calvelli. "If we really want to go fast, we have got to stop the traditional way of doing satellites with these large, seven-year plus contracts and go to smaller, more proliferated systems, whether they be at MEO, LEO, or even at GEO."

He added, *"So my message to industry is please bid on programs with realistic cost and realistic schedules. And please bid on programs that you can be successful with. And then when you win that contract, execute, and deliver those programs on-cost and on-schedule. That is going to be key to all of our success as a nation and to counter the threat against China."*

For Gen. Purdy, before the commercial space industry can assist the fight against U.S. adversaries, it must first fully understand the DoD's needs and work towards developing capabilities and solutions that are mission-specific.

"What I really need is for industry to understand where our systems are, what our needs are, and how you can plug into those needs in a non-proprietary way so that we can continue to move along [without] having to go buy licenses from here to eternity," he said.

Gen. Whitney echoed Gen. Purdy by addressing the commercial space industry directly. He said, *"Industry, we need you to deliver on your commitments. Nothing will set us up for success more than you delivering on your commitments."*

LOOKING TO 2023

Before addressing what is coming down the space acquisition pipeline in 2023, Calvelli wanted to first acknowledge and express that he is happily surprised by the pivot and the architecture changes that the **U.S. Space Force** has already started.



"They have done an absolute magnificent job of getting to more of a hybrid architecture that includes more proliferated systems, more smaller systems, some larger systems, and a much more resilient architecture," said Calvelli.

"For me, the focus of next year is executing and actually making sure that we deliver on the great set of work that's been done in the past couple of years by the Department and by the Space Force... Execution is really a key thing for us this next year," he noted.

To learn more about Frank Calvelli's space acquisition priorities and the role the commercial space industry will play in delivering upon his priorities, **[select this direct link...](#)**

*This article first appeared first on **GovSat** and is republished with permission of GSR and SES-GS.*

ses-gs.com/govsat



Author David Pesgraves is a Staff Writer for GovSat Report, in addition to several other online publications dedicated to

David Pesgraves

DEFINING RESILIENT + SECURE ARCHITECTURE

Fusing terrestrial and satellite networks

Author: Rob Spalding, Founder and Chief Executive Officer, SEMPRE

When SEMPRE was founded in 2019, it was premised on the belief that 5G was moving cellular infrastructure increasingly to software, away from bespoke hardware. It was a seized opportunity to rethink architecture for telecommunications.

The idea was to take non-resilient and unsecure infrastructure and make it hardened and secure. It's been a long four years, but SEMPRE has shown it's possible.

This article is about the principles that went into developing that architecture. When the iPhone came out in 2007, there were technologies in the phone that had yet to evolve.

Today, one sees the full evolution of Steve Job's vision, but unfortunately, infrastructure has not kept pace with software.

For example, in a sense, a smartphone can be turned into an infrastructure device by making it a Wi-Fi hotspot.

Why not apply the concept to infrastructure by consolidating all the software into an autonomous, self-enclosed infrastructure node?

Like the iPhone, SEMPRE thinks of its network nodes as devices, or rather, as decentralized infrastructure architecture that can be made resilient and secure, using an *Open Radio Access Network (ORAN)* and other technology initiatives.

It is important to note that it is the evolution of cellular into software that makes this possible. The evolution could not have happened until 3GPP specifications introduced the widespread use of *network function virtualization, software-defined networking* and *software-defined radios (SDRs)*.

5G is taking all the pieces of the hardware and bringing them into software. Yet, the architecture the telecom industry is using, even in the newest 5G stand-alone networks, is the same architecture used to build 4G LTE networks.

For instance, the *Core Network/Centralized Unit (CU)*, *Distributed Unit (DU)* and the *Radio Unit (RU)* are all geographically separated. Anywhere along the way, if access to any of these is severed, a cell tower won't work.

Fragility has been built into the current system despite the fact that almost the entire network is software running on *Commercial-Off-The-Shelf (COTS)* servers.

SOFTWARE CONSOLIDATION

The first principle for creating security and resiliency is **software consolidation into a single node**. The second is **hardening**; as zero trust is important in security and resiliency, it is not sufficient to only consolidate.

All of the technology that goes into powering smartphones today can be run by software in self-enclosed autonomous infrastructure nodes that

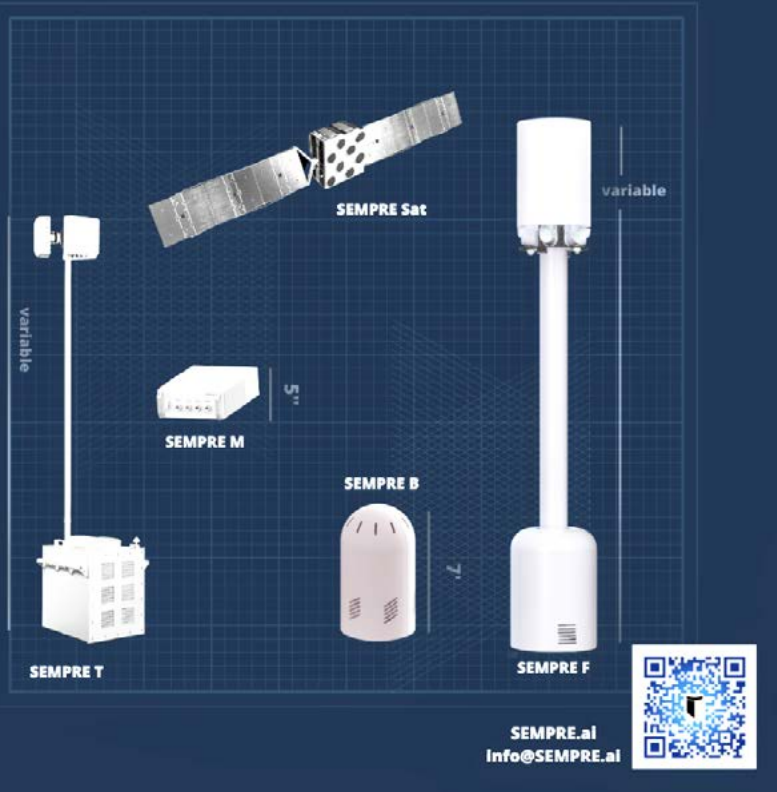
allow all the security and resiliency to be built into the node.

Pairing that infrastructure node with satellite backhaul puts the internet anywhere on Earth.

Latency and bandwidth issues are less of an issue because the datacenter is in the node for *Edge processing* running applications and caching data.

This creates a fiber experience at the edge of the network with satellite constellations. In other words, cellular for the first time allows the fusion of space and terrestrial networks in a more secure, resilient, efficient, and cost-effective way.

Today, network operators cannot get the most out of the network infrastructure because the industry looks at satellite networks and terrestrial networks separately. This is because the telecom industry has been highly centralized and satellite networks were thought to enable distinct use cases and customers.



SEMPRE fuses terrestrial and space networks to create global architecture: end-to-end secure, resilient communications and compute in multiple form factors.

Consolidating all of the capabilities of today's networks into software can enable interesting elements, such as having multiple satellite modems in software, thereby giving enormous flexibility and resiliency.

SECURE CONTROL PLANE

Satellite networks can be used for more than a transport layer where communications are concerned. In SEMPRES's architecture, the control plane is run through a secure satellite constellation for globally assured secure command and control of SEMPRES's infrastructure nodes.



SEMPRE offers distributed micro edge datacenters that ensure access to data with highly secure connectivity and high-performance compute in a fixed location or on-the-move—all in a tamper-resistant, EMP-hardened enclosure. Pictured: SEMPRES T "transportable" micro edge datacenter.

SEMPRES's encrypted data plane, on the other hand, liberally uses existing constellations to ensure the most cost-effective paths for backhaul. This creates a hybrid network that is open and closed providing secure, yet interoperable, services to the customer.

HARDENING

Consolidating software into a single, self-enclosed autonomous network node gives the ability to harden it against threats in a way that wasn't possible before — threats such as **EMP/HEMP** events. Hardening is not an additional expense because 5G allows one to share the **Radio Access Network (RAN)**

at the edge. That means savings of up to 40% on **Capital Expenditures (CAPEX)**.

Tamper resistance is another important, zero-trust feature as infrastructure nodes are physically available, without restrictions on a person simply walking up and touching one. Today we have tamper-evident seals that may give an indication that something's been tampered with, but how often are the actual sites visited to check the seals?

Building tamper resistance into infrastructure, making it EMP-hardened and pairing it with multiple satellite backhaul networks enables resiliency.

Today, resiliency is not built into infrastructure, and that makes our nation and our communities vulnerable. This was evident two Christmases ago when a domestic terrorist blew up his Winnebago near the AT&T switching center in Nashville, Tennessee. Tennessee and the surrounding states lost mobile service and e911 for up to two weeks. Fully functioning cell towers didn't work because they had lost connection to the core Network.

ENCRYPTION

Encryption is a necessity when it comes to survivable and secure infrastructure. Post-quantum encryption is important for ensuring it isn't broken by a quantum computer. NIST and the NSA are putting forward potential candidates for post-quantum encryption.

DATA MODEL

Another principle to consider is the data model itself. Today, the industry looks at security using a "rings around things" model. They put ever higher walls around data, but ultimately when one gets to that data, it's open and often unencrypted.

Ensuring data is encrypted — no matter whether it is being moved, stationary or being acted upon — is an important part of resilient and survival infrastructure. Ultimately, the infrastructure is only as good as the ability to secure the data and make it available and accessible.

A NEW COLD WAR

Finally, when considering what the future holds, whether it be Russia's invasion of Ukraine or Chinese threats to invade Taiwan, the world is witnessing a lot of nuclear saber-rattling. This is going to accelerate as the world moves deeper into the second Cold War.

Currently the world is split into two halves — the free and the unfree. There are two elements to consider. Nuclear weapons are still out there and they are enormously dangerous. This will affect the satellite industry in technology, business models, and risk.

It is important the industry starts to consider these challenges and takes advantage of the consolidation of infrastructure in software and starts the effort to fuse terrestrial and satellite networks in ways that make them more secure, resilient, cost-effective, and efficient.

sempre.ai

US Air Force Brigadier General (ret) Rob Spalding is the former White House National Security Council senior director for strategic planning and served in senior positions of strategy and diplomacy within the Defense and State Departments for more than 26 years. Rob is the founder and CEO of SEMPRES, the only true technology company created to protect and secure our most critical resource: data. Rob has served in senior positions of strategy and diplomacy within the Defense and State Departments for more than 26 years, retiring as brigadier general. He was the chief architect for the widely praised 2017 National Security Strategy and the Senior Director for Strategy to the President at the National Security Council. Rob's innovation while serving in the White House has led to a reset in national security and public policy regarding telecommunications in the US as well as globally. Rob has written extensively on national security matters. His academic papers and editorial work are frequently published and cited, both nationally and internationally. Rob is the author of "STEALTH WAR: How China took over while America's elites slept" and "War without Rules."

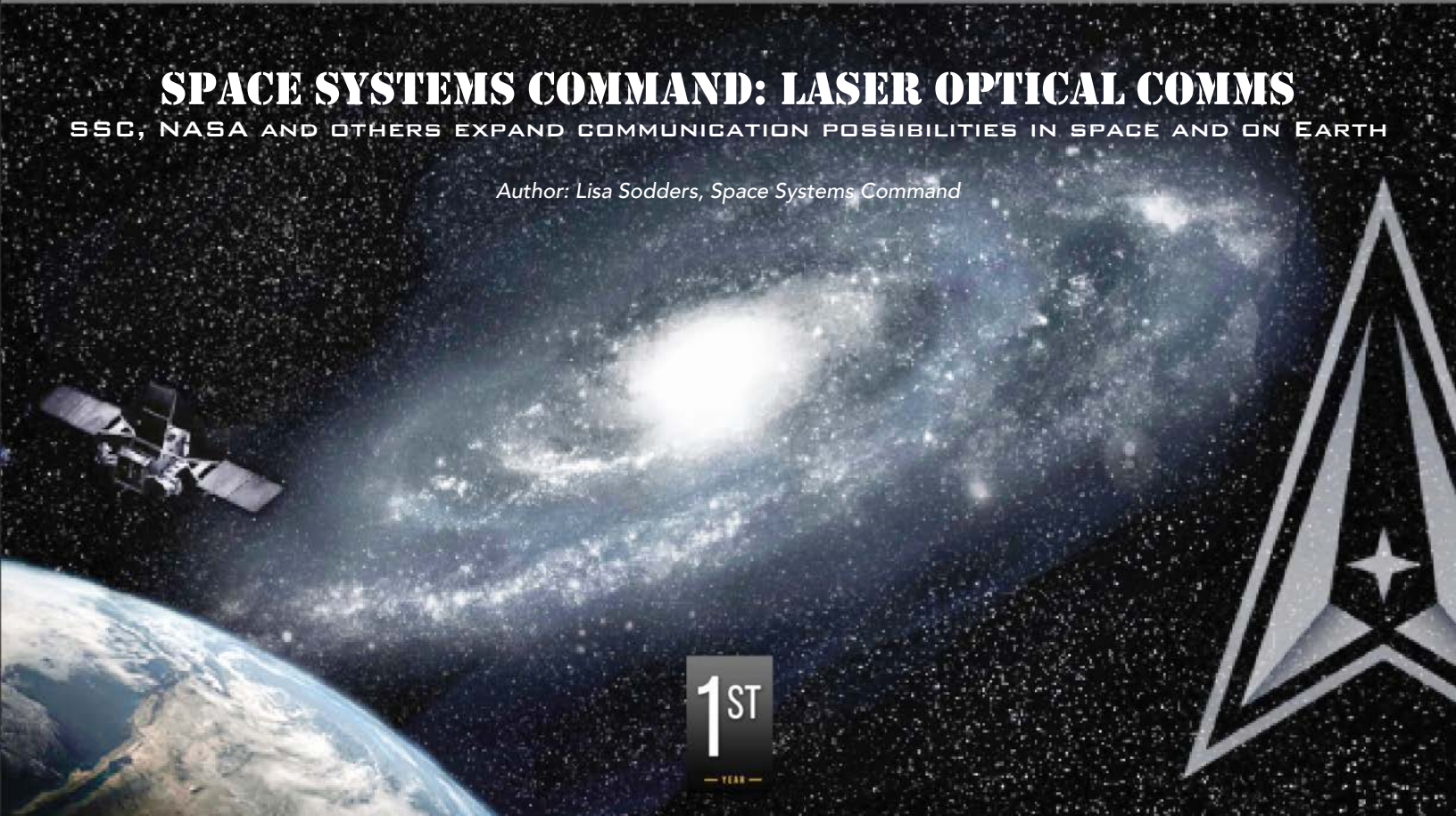


Rob Spalding

SPACE SYSTEMS COMMAND: LASER OPTICAL COMMS

SSC, NASA AND OTHERS EXPAND COMMUNICATION POSSIBILITIES IN SPACE AND ON EARTH

Author: Lisa Sodders, Space Systems Command



1ST
— YEAR —

Space Systems Command recently partnered with the **NASA** to launch a laser optical communications demonstration project that will help chart the future of space-based laser optical communications.

One of the payloads on the **U.S. Department of Defense's (DoD) Space Test Program Satellite 6 (STP Sat-6)** that was built by **Northrop Grumman** that was launched on December 7, 2021, was a test project: NASA's **Laser Communications Relay**

Demonstration (LCRD), designed to communicate between **geosynchronous orbit (GEO)** and the surface of the Earth.

Lt. Col. **Jonathan Shea**, director of the DoD Space Test Program, noted that the LCRD mission was a special collaboration with NASA, not an experimental project from the DoD Space Experiment Review Board, which evaluates



Lt. Col. Jonathan Shea

and recommends projects to be launched using STP's organic resources.

"NASA saw an opportunity, we were going to the right orbit, and they basically offered a collaboration with us," Shea said. "It was a successful launch and we successfully executed the test and check-out campaign. We are committed to assisting partners like NASA to do these kinds of missions, and we're watching with bated breath to see how their experiment goes, because there are lots of military applications for it."

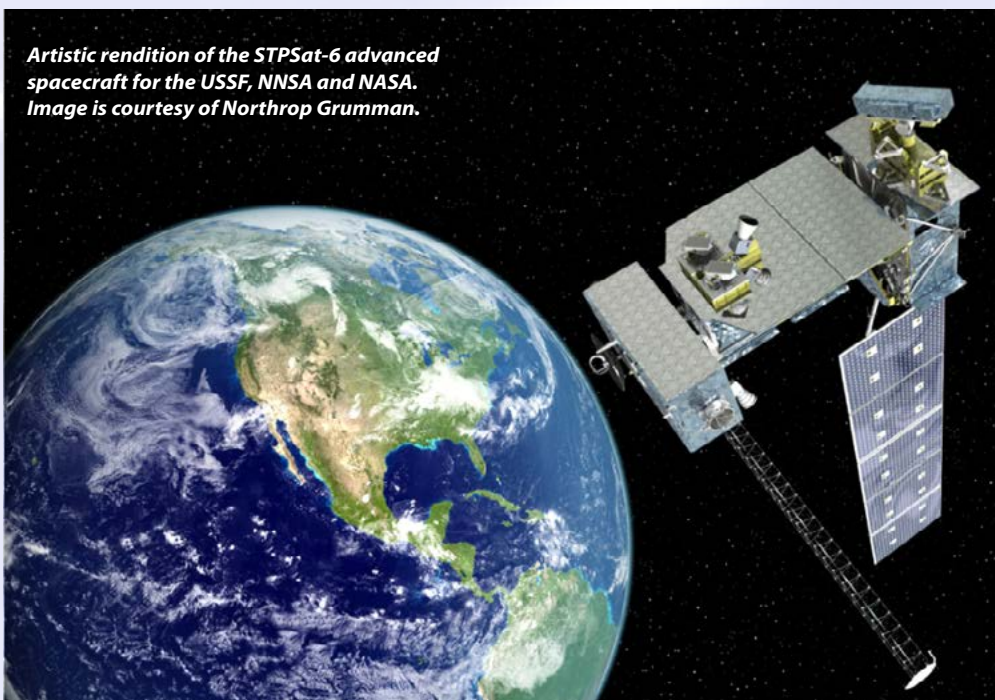
Shea continued, "Laser communication is something the DoD is extremely interested in, so it's about being able to help our partners, but at the same time, help the whole of the U.S. government better understand and test out laser communication systems – especially in space – which will help the entire space security infrastructure that we're trying to build."

"This isn't STP's only collaboration with NASA," Shea noted. "This is one of multiple collaborations that the DoD STP has with NASA, including the team at the Johnson Space Center in Houston that is embedded in the International Space Station (ISS) program office, and produces special platforms that usually contain anywhere from six to 10 payloads that we can integrate directly into the ISS."

"Optical communications use light as a means of transmitting data via lasers and allow for larger data transmissions and are more secure, making them attractive to commercial users as well as military applications," said Dr. **Shantanu Gupta**, chief engineer for optical communications with **The Aerospace Corporation**,



Dr. Shantanu Gupta



Artistic rendition of the STPSat-6 advanced spacecraft for the USSF, NNSA and NASA. Image is courtesy of Northrop Grumman.



Artistic rendition of the LCRD, courtesy of NASA.

an independent, nonprofit corporation operating the only Federally Funded Research and Development Center (FFRDC) for the space enterprise.

"You have a lot more bandwidth available to carry large amounts of data than traditional radio frequency (RF) communication channels," – 10 to 100 times more", Gupta said. "Current commercial state-of-the art RF links from Low Earth Orbit provide a couple of gigabits per second data rates, whereas optical communication data rates start here, with 100 gigabit per second optical links being deployed in commercial constellations — it's a fatter data pipe."

"The underlying physics of it is, when you have the smaller wave lengths and higher frequencies that are in the optical part of the electromagnetic spectrum, it gives you the ability to carry more bandwidth to get the data advantage," said David J. Israel, division architect for the Exploration and Space Communications Project Division at the Goddard Space Flight Center and principal investigator for the LCRD mission at NASA.



David J. Israel

For commercial companies, laser optical communications are attractive because that 'fatter data pipe' provides the ability to handle more users and more data, Gupta said. Optical communications equipment also tends to be smaller and lighter, making it easier and less expensive to put on the spacecraft and launch into orbit. That can lead to systems with more resiliency, as it becomes more economical to launch networks of satellites.

The traditional RF spectrum is fairly narrow and therefore congested, and is coordinated and licensed but the laser communication spectrum not only has much more bandwidth available but isn't regulated, Gupta said.

For military applications, "Optical is a more secure way of transmitting large amounts of data," said Maj.

Eric Stroka, STP program manager for the STP Sat-6 mission. "As technology has improved, people want to get more and more data from all the experiments and payloads in space, and [bandwidth] has increased dramatically on the ground - everybody's used to gigabyte networks. In space, generally, RF is very, very slow. So it's really hard to get down a large amount of data, and optical will improve that dramatically."



Eric Stroka

"We're trying to investigate more secure ways of sending data for disaggregated space architecture in the future," Shea added.

"Laser communication in space is much, much narrower (than RF)" Gupta said. "Think of it like a laser pointer. You can't actually see an RF beam, but it's much wider and fatter and the farther out you go, it's a very large footprint – so easier to detect it. You cannot do that with optical communication – or it is very, very hard. It's about 1,000 to 10,000 times narrower than a traditional RF communication beam. It's what is called in the military and defense circles as 'low probability of intercept. In fact, you can most likely see the adversary

is trying to sniff you because they will be close enough, like a couple of kilometers away. You cannot intercept it covertly – if you try to do that, there's a high chance you'll expose yourself. That's not true with RF."

Early attempts to develop laser optical communications go as far back as the late 1960s, but technological advancements in highly reliable telecom technology in the 1990s, including the development of fiber optics and fiber lasers, drove increased development and have made them more practical, Gupta said.

In addition to several military and government demonstration projects, optical communications are currently in use in some commercial applications, particularly in Europe, and now in commercial constellations being deployed in the U.S., Gupta added.

As mankind expands space exploration past geosynchronous orbit, laser optical communication will have a clear advantage over RF, Gupta said, due to the size, weight, power and data rate advantages.

However, in spite of the advantages of laser optical communication, RF also continues to evolve, and won't be completely replaced by optical communications. Optical signals can't penetrate cloud coverage, for example.

"Lasers are great when you don't have any atmosphere or clouds," Gupta said. "But most of us still live on Earth, not in space. Ultimately, the data has to come to the ground, and getting it through the atmosphere, especially through clouds, is still a challenge."

One way around that is to have ground stations in more than one location, called ground site diversity, Gupta said.

The LCRD will transmit data received from missions to two ground stations, located in **Table Mountain, California**, and **Haleakalā, Hawaii**, which were selected for their minimal cloud coverage, according to NASA. LCRD will test different cloud coverage scenarios, gathering valuable information about the flexibility of optical communications.

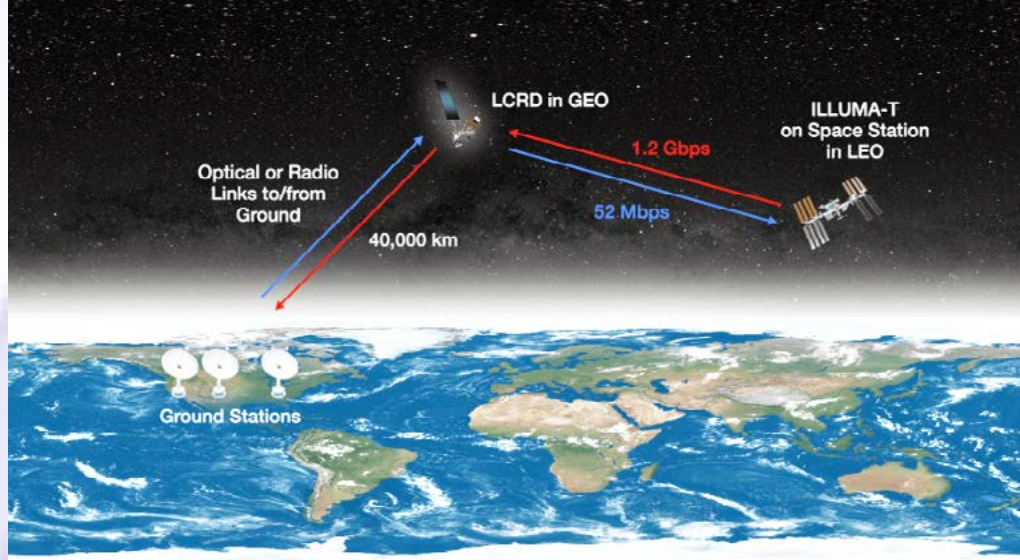
Following the successful launch last year, engineers at LCRD's mission operation center in **Las Cruces, New Mexico**, activated the payload and prepared it to start sending test data over infrared lasers.

At the beginning of June, the LCRD started running experiments that will run for two years, Israel said: collecting data at different times of the day and night and over different seasons, analyzing the effects of the atmosphere on basic link performance.

Another set of experiments will focus on **Delay and Disruption Tolerant Networking (DTN)**, to allow communication in ways a traditional **Internet (IP) and Transmission Control Protocol (TCP)** computer network protocols won't support, Israel said.

Radiometrics uses radiowaves and the characteristics of radio frequency wave to get measurements to help with determining positioning, navigation and timing, Israel said. For example, one can measure the **Doppler** effect to help determine the relative velocity of an object. NASA also will be carrying out experiments in optometrics to do similar things using the LCRD.

"The entire idea is, over the course of the two year period, we'll continue do basic characterization of link performance over atmosphere and determining ways to optimize operations," Israel said. *"How well can you predict when the weather's going to be too bad to continue operating at a particular ground station? How quickly can you do a handover from one ground station to another?"*



ILLUMA-T communicating to LCRD over optical signals. Credit: NASA

He continued, *"Then we'll start to layer more complexity into the demonstrations and experiments to combine these things, so as time goes on, it will be acting more and more like a full-on operational relay with multiple users, doing all the networking things and functionality."*

NASA also has a guest **Experimenters Program** where universities, researchers or companies can propose experiments for the LCRD, Israel said.

One of LCRD's first operational users will be the **Integrated LCRD Low-Earth Orbit User Modem and Amplifier Terminal (ILLUMA-T)**, a payload launching early next year that will be hosted on the International Space Station. The terminal will receive high-resolution science data from experiments and instruments onboard the space station and then transfer this data to LCRD, which will then transmit it to a ground station. After the data arrives on Earth, it will be delivered to mission operation centers and mission scientists, according to NASA.

Laser optical communications may be the next wave, but they will coexist with radio frequency, Gupta said.

"We need to think of it as a space communication enterprise where individual technologies and platforms have their strengths and weaknesses and are deployed or used accordingly," Gupta said. *"Even in the ground transport network – not everybody or every business has fiber optic service to their home, it could still be cable or even DSL lines or T1 lines, but then ultimately they connect to some fiber optic hub that connects to the network."*

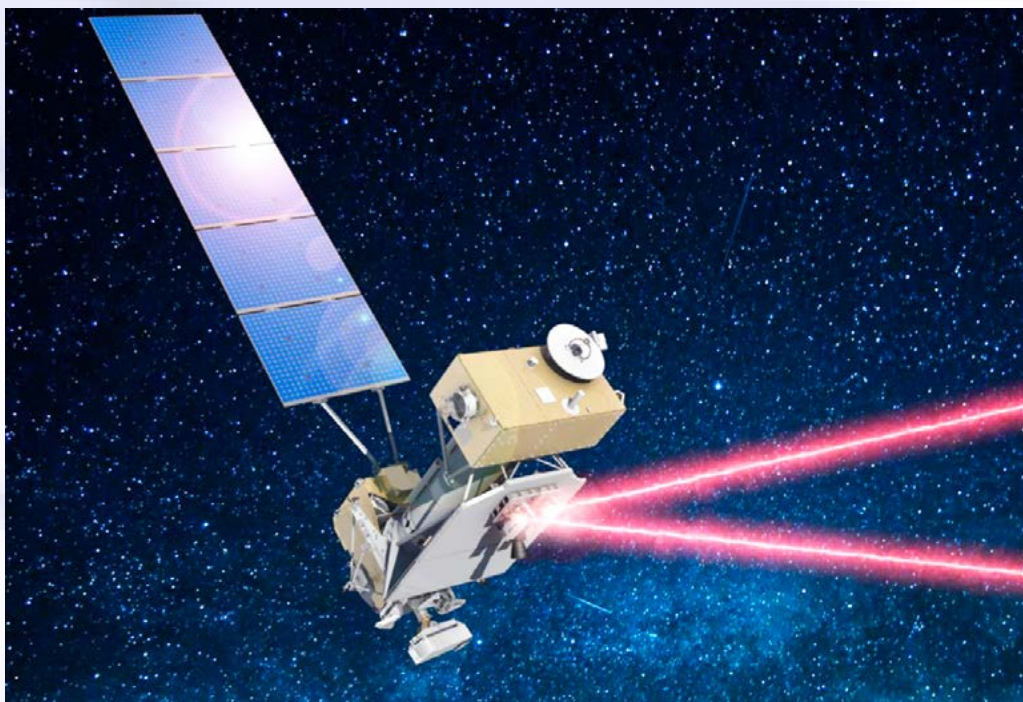
"There are constant debates and studies about at what point the NASA missions switch to optical instead of RF," Israel said. *"One point everybody agrees with, is that when we start to do more exploration at Mars, then using optical communication is the only way that we're going to get high data rates back to Earth from Mars. There's the huge distance, but because of the shorter wavelengths, optical allows the hardware you need on the spacecraft to be smaller and use less power, and that really gives you an advantage when you have to communicate from something you have to launch a long distance."*

NASA has been leveraging communications relay satellites since 1983 when the first **Tracking and Data Relay Satellite** launched. With relays, missions are not required to have direct line-of-sight to antennas on Earth, increasing communications coverage. LCRD creates a continuous path for data flowing from missions in space to ground stations on Earth, making a complete end-to-end system.

Additionally, LCRD's ability to both send and receive data from missions and the ground stations makes the system two-way. Together, these capabilities make LCRD NASA's first two-way, end-to-end optical relay, according to NASA.

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

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



SPACE SYSTEMS COMMAND: PNT — GOING BEYOND GPS

Authors: SSC team



Artistic rendition of a GPS III / IIF satellite, courtesy of Lockheed Martin.

One of the first things many people think of when they think about the U.S. Space Force (USSF) is the Global Positioning System (GPS).

The USSF's **Space Systems Command** is the executive agent for the **U.S. Department of Defense** for acquiring GPS satellites and user equipment, and also sustaining the satellites and ground control segment systems which are operated and controlled by **Space Delta 8 at Schriever Air Force Base** in Colorado.

"GPS has become a world utility — we provide free access to the world," said **Barbara J. Baker**, deputy program executive officer of **Military Communications and Positioning, Navigation and Timing (PNT)** at SSC.



Barbara J. Baker

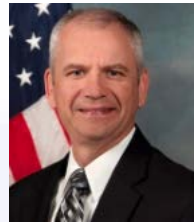
"Businesses have been built on the use of position, navigation and timing," Baker said. "The world's economy relies on GPS: whether it's the navigation piece that we know from our cars, the timing that the banking industry relies on for currency conversion rates, to positioning and navigation for trucking and shipping."

She continued, "It has been so ingrained in our economy — if you woke up, turned on your lights, went into your refrigerator and grabbed some fresh produce, and then got some money from the ATM, all of that relies on GPS. So many people do not realize how much of our world relies on some element of that signal in space that we're publishing out."

Although it's hard to imagine a world without GPS today, the GPS project was started by the U.S. Department of Defense in 1973, with the first prototype launched in 1978 and a full constellation of 24 satellites operational by 1993. Col. **Brad**

Parkinson, lead architect of the U.S. Air Force NAVSTAR program, the forerunner of GPS, is widely credited as the godfather of GPS, along with **Ivan Getting**, founding president of **The Aerospace Corporation**, and **Roger Easton**, American physicist and state representative.

"It started as a design concept for navigation in space, using space-based assets," said **Bruno A. Mediate Jr.**, director, GPS Product Support Delta for SSC's MilComm & PNT Directorate. "It was really approved because it also offered opportunities for nuclear detonation detection during the height of the Cold War — so what we know today as Positioning, Navigation and Timing has a dual purpose with a payload that could also be used for nuclear detonation detection and location."



Bruno A. Mediate Jr.

"It was a hard sell," Baker said. "GPS really existed because the nuclear detonation detection payload was going to be on a GPS vehicle."

The DoD soon found numerous uses for the new technology in military operations, including: aerial rendezvous and refueling, all-weather air drops, instrument landings, mine laying and mine sweeping, anti-submarine warfare, bombing and shelling, photo mapping, range instrumentation, rescue missions and satellite navigation.

GPS proved particularly useful during the U.S. involvement in **Operations Desert Shield and Desert Storm**. Allied troops relied heavily on GPS to navigate the Arabian Desert. During **Operations Enduring Freedom, Noble Eagle and Iraqi Freedom**, GPS again provided important intelligence to U.S. troops.

During Operation Iraqi Freedom, GPS satellites allowed the delivery of 5,500 GPS-guided **Joint**

Direct Attack Munitions with pinpoint precision that reduced collateral damage — nearly one quarter of the total number of bombs and missiles that coalition forces released against Iraqi targets.

Non-military use was approved in 1983 by then President **Ronald Reagan**, following an incident where a Korean airliner accidentally entered Soviet air space due to a navigational mistake and was shot down.

The current USSF GPS constellation consists of 31 operational satellites orbiting the Earth in **Medium Earth Orbit (MEO)**, or about 12,550 miles above the Earth. There also are "residual" satellites that can be swapped in for testing or supplementing the operational constellation, Mediate said. The MEO orbit passes through the **Van Allen radiation belts**, which means the satellites must be designed to survive a particularly harsh space environment, Baker said.

These satellites orbit the earth every 12 hours, emitting continuous navigation signals. With the proper equipment, users can receive at least four satellite signals from space to calculate time, location and velocity. The signals are so accurate, time can be configured to within a millionth of a second, velocity within a fraction of a mile per hour and location to within 43 centimeters, Baker said.

"While GPS provides the position, navigation and timing — it's all about the accuracy of keeping time — that's what everything gets calculated off of," Mediate said. "Our frequency standards, which are the atomic clocks on the satellites, provide the accuracy to keep time. And that accuracy of timing allows for mathematic calculation to then track position, navigation, and velocity from the signals that come from the satellite."

"GPS is not just a signal in space," Baker said. "You need three segments: the space segment, which is built up of a constellation of Boeing and Lockheed Martin



becoming the 24th **Military Code (M-code)** capable satellite on orbit, Mediate said. The M-code signal has greater resistance to jamming, and a new, fourth civil signal, **L1C**, on the GPS III satellites will be compatible with signals from the **European Space Agency's Galileo** navigation satellite system.

"With the Block III satellites, we have power management that enables more power to be flexed between the different signals," Mediate said. "Increased power means we can persist through any jamming and provides for greater anti-spoofing capability."

The next-generation, operational control segment — known as **OCX** — will be replacing the current GPS ground system OCS, Baker said. During the COVID pandemic, SSC's PNT team installed 17 world-wide monitoring stations, deployed the operational equipment into the field, and added an OCX element to the four Legacy Ground Antenna. OCX is in the final integration stages and software qualification testing.

GPS III satellites have a design life of 15 years, compared to 12 for the GPS IIF block satellites, and offer three times the greater navigational accuracy and signal power. However, many of the older satellites have far exceeded their expected lifespan: the longest-serving GPS satellite is an IIR-2 satellite that was launched in July 1997.

satellites on orbit; the control segment, the ground-based hardware and software that tracks, monitors and updates the satellites; and then you have the user segment that receives and processes the signals."

GPS satellites have been released in blocks — or series of satellites — with new improvements for each iteration: **Block I (1978-1985)**; **Block II (1989-1990)**; **Block IIA (1990-1997)**; **Block IIR (1997-2004)**;

Block IIR-M (2005-2009); **Block IIF (2010-2016)**; and the latest, **Block III**. Block III consists of 10 satellites, each weighing about 5,003 pounds, compared to 4,480 pounds for Block IIR-M satellites.

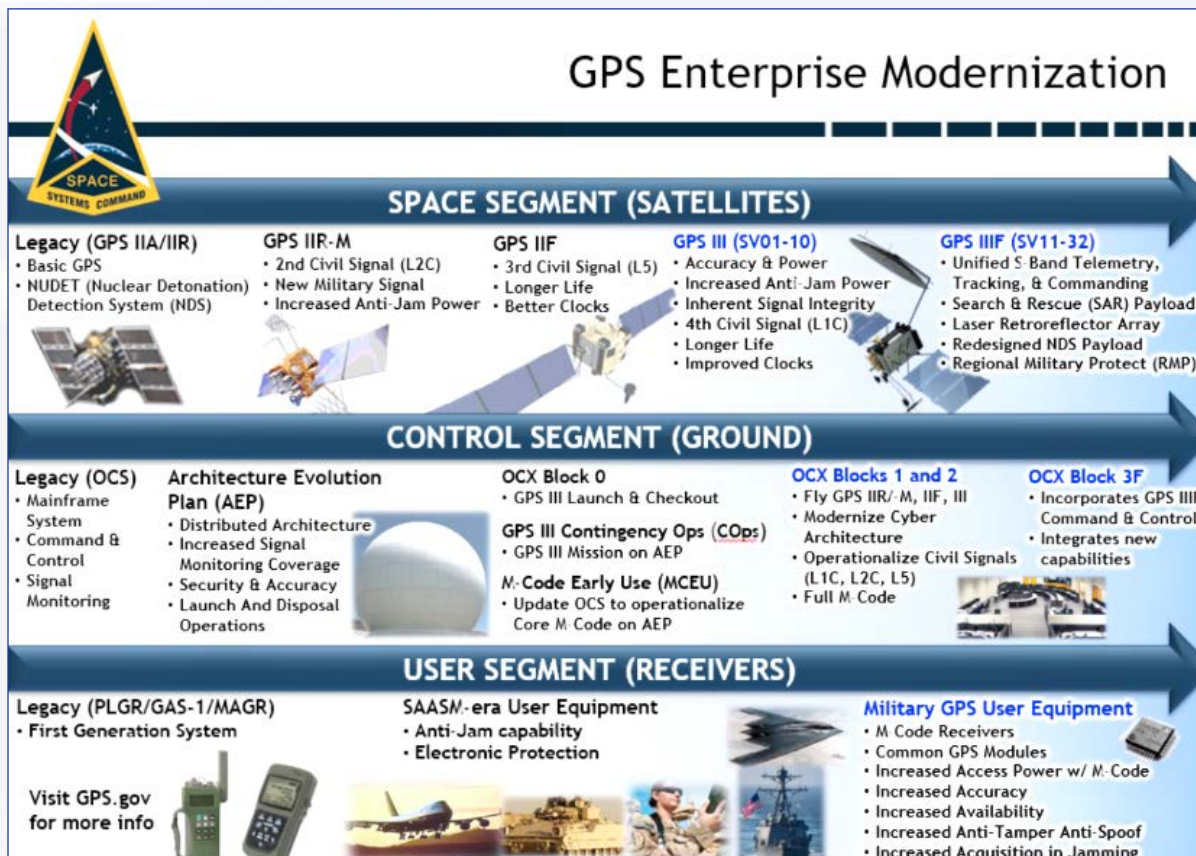
The sixth GPS III satellite is scheduled to be launched in January of 2023, but the launching of **GPS III SV5** — nicknamed "*Armstrong*" on June 17, 2021 — marked a significant milestone by

"Some of our satellites are now of drinking age," Baker said. "GPS is a world utility and the U.S. is most robust and the gold standard because we've been doing it for so long and because of the number and capability of satellites we have in space. But within the GPS navigation community, there are other countries that are developing a GPS-like navigation constellation."

Russia has the **Russian Global Navigation System, GLONASS**; China has the **BeiDou Navigation Satellite System**; the European Union has the Galileo navigation system; India's **NavIC**; and Japan has the **Quasi-Zenith Satellite System (QZSS)**.

Because the world relies so heavily on GPS, SSC *"is working collaboratively with our space operational partners in Space Delta 8 and the 2nd Space Operations squadron to identify what we can do with tactics, techniques and procedures to protect our space assets,"* Mediate said. *"What makes GPS unique is that the U.S. has made a commitment to the international community for the availability and integrity of the GPS signal. Other countries have not made that level of commitment internationally, which is what makes U.S. GPS at the present time the gold standard for international use and why we call it a global navigation satellite system."*

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



SatNews

CONNECTIONS ON EARTH FOR CONNECTIONS IN SPACE

**JOIN US
ONLINE!**
Free subscriptions and access
Timely news and editorials
Complete archives

satnews.com/reg



SatMagazine | MilsatMagazine | SatNews.com