Next Generation Space Defense

MilsatMagazine

November 2021

General Atomics ASI 's MQ-9B Remotely Piloted Aircraft (RPA)

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Cover image: *General Atomics-ASI has developed a variant of the Predator® B Remotely Piloted Aircraft (RPA) series that meets NATO standards (STANAG-4671), and in cooperation with the FAA, will subsequently meet airworthiness certification standards domestically and around the world. This RPA leverages both the Predator B RPA and Certifiable Ground Control Station (CGCS) as points-of-departure systems and identifies and incorporates the changes needed to achieve a "Type-Certifiable" system. The Royal Air Force was the first to acquire the SkyGuardian, referred to as PROTECTOR by the British acquisition program, as a replacement for their Reaper UAV fleet.*

MilsatMagazine is published 11 times per year by SatNews Publishers, 800 Siesta Way, Sonoma, California - 94576 - USA
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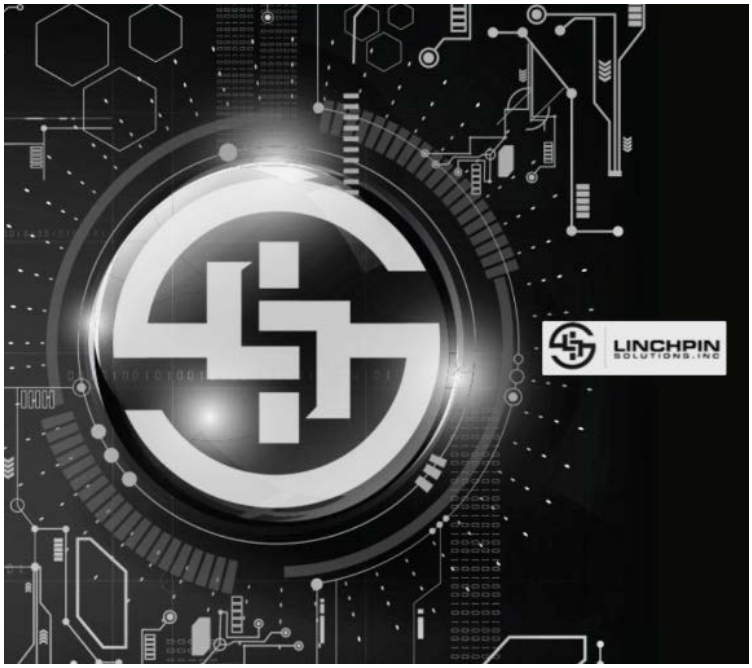

***Intelsat*, *OneWeb (OWT)* and *Linchpin Solutions* have successfully demonstrated a multi-orbit satellite communications solution for representatives of the U.S. Army and Department of Defense (DoD).**

This is a strategic demonstration to the U.S. DoD that shows transport diversification between GEO and LEO constellations, with seamless switching between them.

Referred to as ***Automated Primary, Alternate, Contingency, and Emergency (APACE)*** communications, the solution enables soldiers to survive and excel in contested electronic warfare environments. The reliability of communications is significantly improved by simultaneously sending data over multiple paths and adjusting the traffic flow in real-time between GEO and LEO satellite constellations.

Intelsat and OWT used both GEO and LEO services simultaneously, switching the data flow between orbits instantly at the packet level, using software to determine which connection will provide the best experience based on the technical requirements of the end service. The software solution can be hosted on existing fielded ruggedized virtual machine platforms allowing the system to run in the harshest environments.

Two satellite links were established during the demo – one on the ***Intelsat 37*** (***IS-37***) satellite and one on a OneWeb satellite. The links communicated through various end-user terminals, including a ***SatCube*** terminal, a ***Kymeta*** U7/8 terminal, a ***Litecom*** GEO terminal, and a OneWeb ***Intellian*** terminal, demonstrating applications such as two-way voice and data downloads and MP4 video.

Intelsat's ***FlexMove*** service, combined with partner terminals, can be deployed within an hour. For military customers, this quick set-up, reliable and secure offering provides Beyond-Line-Of-Sight (BLOS) seamless communications at times when connectivity is most critical.

"*This demonstration shows how through the power of partnership, we can provide a reliable, secure, multi-orbit, multi-band capability for the military that connects our warfighters to meet their evolving mission requirements*," said President of Intelsat General, ***Dave Micha***. "*This enables the delivery of required connectivity, throughput and services to customers when and where that reliable access is needed, even in the harshest elements*."

"*This demonstration of low latency, high-capacity throughput via a multi-orbit solution that increases the resiliency of commercial SATCOM to DoD and allied partners globally is an important steppingstone as OneWeb rises to the challenges and needs of our customers through partnerships*," said ***Bob Roe***, CEO of OneWeb Technologies, the U.S. Proxy subsidiary of OneWeb.

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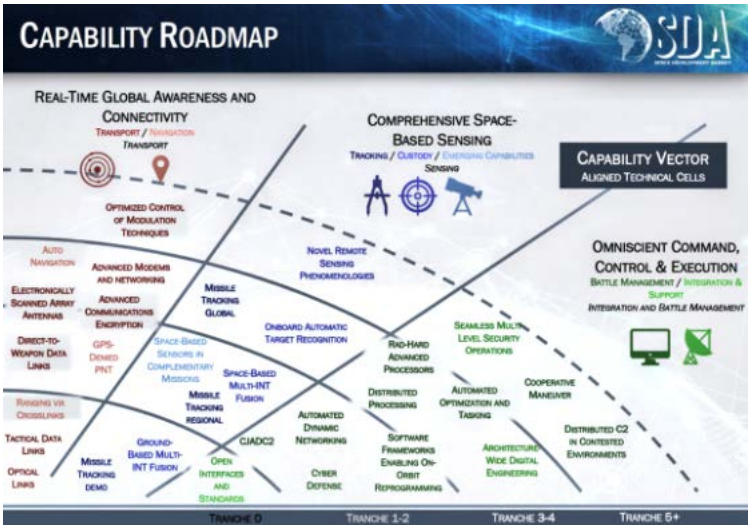
DEMO'ING SAR OISL CAPABILITY WITH THE SDA'S NATIONAL DEFENSE SPACE ARCHITECTURE IS CAPELLA SPACE

Capella Space **has announced that the company will become the first** ***commercial synthetic aperture radar (SAR)*** **supplier to demonstrate** ***Optical Inter-Satellite Link (OISL)*** **compatibility with the** ***U.S. Space Development Agency*** **(SDA)'s new** ***National Defense Space Architecture (NDSA).***



SAR data is a highly valuable asset for the SDA and the U.S. Department of Defense. The next generation of Capella's persistent SAR monitoring capabilities will leverage new technology that enables high delivery speeds and direct access to its 24/7 all-weather data for U.S. Government customers.

Capella Space will install ***optical communications terminals (OCTs)*** on its commercial SAR satellites, starting in late 2022. This will enable the company to use highly efficient laser communications technology to send and receive data to and from its satellites in LEO, relaying data to compatibly equipped government satellites and military operations on the ground. The integration of OCTs onto Capella's SAR constellation will drastically reduce latency from image collect to download and ensure spaceborne data is quickly available to inform critical decision-making for terrestrial missions.

Capella Space selected ***Mynaric***'s CONDOR Mk3 Optical Communications Terminal. The company selected Mynaric's technology following a thorough vetting process. Mynaric has previously demonstrated compatibility with the SDA systems and standards.

Capella Space has partnered with a number of **U.S. Department of Defense** agencies, including the **National Reconnaissance Office (NRO)** , **U.S. Air Force**, **U.S. Army** and the **U.S. Space Force**.

This announcement follows a new ***Collaborative Research Agreement*** with the ***U.S. Army Space and Missile Technical Defense Center*** as well as the hiring of Amy Hopkins as Capella's new vice president and general manager of U.S. Government. Since officially launching commercial operations in January 2021,

Capella's new innovations and the growth of its federal team positions it to serve U.S. Government customers with fast, direct access to reliable SAR data in order to solve challenges from tactical users to global policy making.

In 2016, Capella Space was founded to enable a richer understanding of our planet in entirely new and powerful ways. The company saw an opportunity to use SAR to monitor the Earth, including the 75% that is either covered in the darkness of night or obscured by clouds.

"*Our team at Capella Space is thrilled to become the first commercial SAR company to demonstrate compatibility with the SDA's National Defense Space Architecture and standards*," said ***Christian Lenz***, CTO at Capella Space. "Enabling our satellites to integrate with the new SDA *architecture efficiently is a critical step for us to work seamlessly with the U.S. defense and intelligence sector. We are proud to be able to work with the SDA in demonstrating this cutting-edge technology*."

"*We are honored to be selected as the optical communications terminal vendor for Capella Space's integration work with the SDA. The announcement today highlights the importance of standardization and compatibility within the industry*," said ***Bulent Altan***, CEO of Mynaric, "*Our recently announced CONDOR Mk3 is fully compliant to the SDA's interoperability standard and a natural match for Capella's innovative approach integrating commercial capabilities with governmental customers*."

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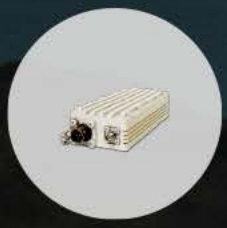

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GEOSPATIAL INTELLIGENCE COMMUNITY SHOULD LEVERAGE MORE COMMERCIAL TECHNOLOGY

National Geospatial-Intelligence Agency (NGA) Director Vice Adm. *Robert Sharp*, in his role as the GEOINT Functional Manager, recently published the National System for Geospatial Intelligence Enterprise Commercial GEOINT Strategy 2021-2025, calling on the GEOINT community to leverage more commercial technologies and methods to help the enterprise move faster and grow stronger.

"*By taking a community approach to commercial GEOINT – one that aligns with our overarching NSG strategic goals, we continue to pave a way forward that not only benefits and supports our global national security needs but expands our partnerships within the growing sector of commercial GEOINT – giving access to responsive and innovative tools and capabilities that will help us meet the challenges of the 21st century and beyond*," Sharp said.

The NSG is the combination of technology, policies, capabilities, doctrine, activities, people, data and communities necessary to produce GEOINT in an integrated multi-intelligence, multi-domain environment. The strategy sets a variety of initiatives in four different areas:

Drive unity of effort
Diversify sources and build capacity through partnerships
Improve data security and develop processes to mitigate risks
Influence and foster commercial capabilities

Multiple other U.S. strategies – the **National Strategy for Space**, **National Defense Strategy** and **Defense Space Strategy** – played a key role in developing this strategy because of their references to the criticality of strengthening and leveraging private sector innovation for national security. Deliberate industry engagement that is well-planned and interoperable across our enterprise will generate synergy across the NSG.

SEEKING TO SHAPE NATO'S FUTURE SURVEILLANCE + CONTROL ARE NORTHROP GRUMMAN + AIRBUS

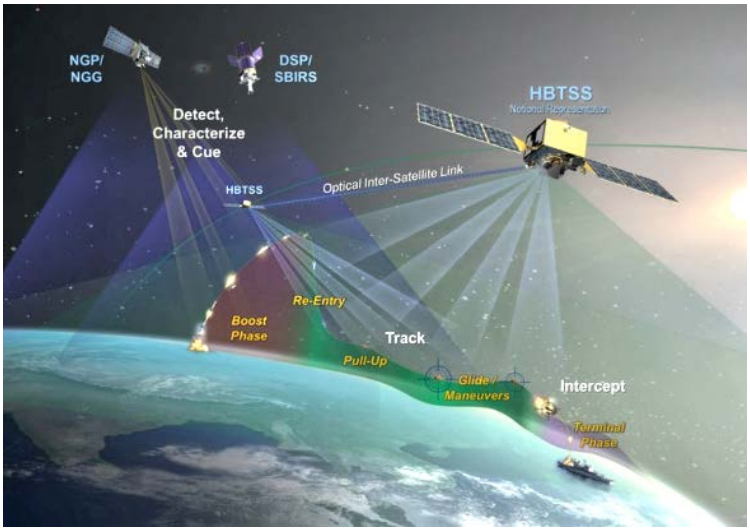
Northrop Grumman Corporation **(NYSE: NOC) and *Airbus Defence and Space*, together with seven industrial players, have established *ASPAARO*, the *Atlantic Strategic Partnership for Advanced All-domain Resilient Operations*. ASPAARO will bid to undertake the *Risk Reduction and Feasibility Studies* (*RRFS*) for the NATO Support and Procurement Agency as part of the *Alliance Future Surveillance and Control* (*AFSC*) program.**

The feasibility studies are a key milestone in the AFSC program which aims to support NATO and NATO nations as they consider the Alliance's future tactical surveillance, command and control capabilities after the current ***Airborne Warning and Control System*** (***AWACS***) fleet reaches the end of its service life in 2035.

Following the delivery of a High-level Technical Concept in 2020 by three of the team members (**Airbus**, **Lockheed Martin** and **MDA Ltd.**), Airbus continues to support NATO in the concept stage of the AFSC program together with Northrop Grumman and a strong transatlantic team including Lockheed Martin (US), BAE Systems (UK), KONGSBERG (Norway), MDA (Canada), GMV (Spain), Exence (Poland) and IBM (US).

ASPAARO offers an unparalleled set of skills and capabilities that will address the threats of today and tomorrow and will fulfill the Alliance's requirements across all domains. The industry team will leverage its multi-domain concepts, advanced technologies and integrated designs to pave the way to a fully interoperable architecture between NATO nations while further driving innovation through combined access, investments and experience.

HYPERSONIC + BALLISTIC TRACKING SPACE SENSOR CDR COMPLETED BY NORTHROP GRUMMAN FOR THE MISSILE DEFENSE AGENCY



Hypersonic and Ballistic Tracking Space Sensor satellites will provide continuous tracking and handoff to enable targeting of enemy missiles launched from land, sea or air. Image is courtesy of Northrop Grumman.

Northrop Grumman Corporation (NYSE: NOC) recently completed the critical design review (CDR) of the Hypersonic and Ballistic Tracking Space Sensor (HBTSS) prototype for the U.S. Missile Defense Agency (MDA).

The review establishes the company's technical approach for precise, timely sensor coverage to defeat ballistic and hypersonic missiles. HBTSS satellites will provide continuous tracking and handoff to enable targeting of enemy missiles launched from land, sea or air.

They are a critical part of the Overhead Persistent Infrared (OPIR) multi-layered constellation of satellites, which can sense heat signatures to detect and track missiles from their earliest stages of launch through interception.

HBTSS satellites are also designed to track threats with near global reach when prompted by other OPIR systems, well before they come into view of U.S. ground-based defenses.

Northrop Grumman received a $153 million contract from the MDA earlier this year for the Phase IIB portion of the HBTSS program and is on schedule to deliver the HBTSS prototype in 2023. After the HBTSS prototype is delivered, the company will conduct an on-orbit test to demonstrate its ability to continuously track and rapidly process its observations of hypersonic threats, as well as its ability to effectively hand off the information so the missile is intercepted.

ELBIT SYSTEMS DEMOS HETEROGENEOUS SWARM CAPABILITY

Elbit Systems has demonstrated to the RAS Concept Development & Experimentation Program of the Royal Netherlands Army the company's *Robotic Autonomous Systems* (RAS) capabilities for *Intelligence Surveillance and Reconnaissance* (ISR) missions using heterogeneous autonomous swarms.

Taking place in northern Israel, the demonstration deployed swarms comprising of the PROBOT Unmanned Ground Vehicle and two types of ***Vertical Takeoff and Landing mini Unmanned Aircraft System*** (**VTOL mini-UAS**) including the ***THOR***, all powered by the ***TORCH-X*** RAS software suite (*Command and Control application, Autonomy Kits, Planning tools*).

Torch-X™ RAS is an advanced solution that maximizes the effectiveness of Manned/ Unmanned Teaming (MUM-T), enabling synchronized autonomous operations involving ground and aerial unmanned platforms of heterogenic fleets. Torch-X™ RAS is a platform agnostic solution that provides automated mission management aided by AI / ML, as well as full autonomy solutions for the platform level.

During the capability demonstration, different robotic pairings operated as swarms autonomously performing three types of operational missions. The missions included planning, navigating to predefined points, allocating sectors and the performance of various ISR tasks.

Equipped with Autonomy Kits and Electro-Optical payloads, a swarm of three THOR VTOL mini-UASs and PROBOT UGV performed a "point of interest" reconnaissance mission. The TORCH-X RAS Command and Control application used the THOR VTOL mini-UAS swarm to dominate the area of interest and deployed the PROBOT UGV to complete the intelligence picture.

The THOR vertical takeoff and landing (VTOL) Mini - Unmanned Aircraft Systems (UAS) is a low altitude multi-rotor platform, designed for a wide range of surveillance and reconnaissance missions.

Real-time video feeds were transmitted by all four platforms, while Artificial Intelligence (AI) powered Automatic Target Recognition (ATR) and designation capabilities enabled effective target acquisition.

In a second mission scenario, two VTOL mini-UASs were dispatched to resupply front line forces. Taking-off from different destinations, the two platforms navigated to predefined locations conducted accurate landing and autonomously returned to their home bases upon mission completion.

The third mission was an airborne deployment of Unattended Ground Sensors (UGS) using two THOR VTOL mini-UASs quipped with sensor dispensers. Operating as a swarm, the two THORs arrived at pre-defined points accurately off-loading the miniature Lonely Rider UGS enabling data collection from ground sensors designed to enhance the ISR combat picture.

The demonstration highlighted the capability of the TORCH-X RAS powered solution to enable heterogeneous formations of unmanned platforms, of different makers, equipped with both proprietary and third party payloads, to act as a cohesive unit conducting synchronized autonomous multi-domain operations.

LOCKHEED MARTIN + KEYSIGHT TEST 5G SOLUTIONS FOR AEROSPACE + DEFENSE COMMS

Lockheed Martin **(NYSE: LMT) and** ***Keysight Technologies, Inc*****. (NYSE: KEYS) are collaborating to advance 5G in support of mission-critical communications for aerospace and defense applications.**

The companies are actively collaborating on a ***5G.MIL***™ testbed that Lockheed Martin teams will use to advance 5G capabilities for multiple applications.

5G brings high-speed data rates, connection density, trustworthiness and low latencies to wireless communications networks. The collaboration advances Lockheed Martin's 5G.MIL vision to support secure and resilient connectivity for defense and national security applications. It also aims to adapt commercial 5G technology to meet tactical communications needs in terrestrial and non-terrestrial networks operated by the **Department of Defense**.

Working with Keysight on automated test cases to evaluate cyber security and vulnerabilities across all 5G components and interfaces, Lockheed Martin is also able to determine the cyber resiliency of its 5G-enabled solutions across the lifecycle — from development through operations.

The testbed, which reached initial operational capability in July, will help Lockheed Martin's 5G.MIL teams quickly verify interoperability and performance with a wide range of 5G assets and simulate reliable and secure communications. Since that time, both companies have worked together to emulate, test and validate **5G Open Radio Access Network** and **Non-Terrestrial Network communications.**

Through a strategic MoU, the companies will incorporate additional capabilities to support emerging research and development needs and to remain current with the latest 5G advancements and beyond.

ENABLING THE TACTICAL EDGE IN DEGRADED ENVIRONMENTS

All-domain sensor-to-shooter situational Understanding

Author: Dominic Perez, CISSP (Certified Information Systems Security Professional), Chief Technology Officer, Curtiss-Wright Defense Solutions

To optimize overall situational understanding (SU) in the battlefield, the U.S. Army, Air Force, Navy and SOF are seeking new programs. These programs will adopt a variety of compute and bandwidth intensive technologies, such as cloud-based networks, and will drive far greater use of sensor data, video, big data analytics, artificial intelligence (AI), and machine learning (ML) to deliver the command and control information that warfighters need.

These new programs, such as ***Joint All-Domain Command and Control*** (***JADC2***) and the ***US Air Force Advanced Battle Management System*** (***ABMS***), will enable better coordination of deployed forces and enable the fielding of new capabilities to ensure that our warfighters have maximum SU and high-speed decision support.

Army Chief of Staff Gen. ***James McConville*** calls that "*decision dominance*" as described in his March 2021 report entitled ***Army Multi-Domain Transformation: Ready to Win in Competition and Conflict***. The report describes an expanded battlefield — coupled with short-, mid-, and long-range precision fires to engage and destroy adversary land, air, and sea capabilities — that necessitates a transformation of how command control is executed at every echelon.

"Decision dominance is a desired state in which commanders sense, understand, decide, act, and assess faster and more effectively than their adversaries," the report states. "*Decision dominance is enabled by convergence, the ability to see, sense, communicate, shoot, and move at speed and scale, connecting all sensors with the best shooter and the right C2 node.*"

Next generation capabilities, including video, AI and ML, are compute and bandwidth hungry. As they proliferate in the battlefield, processing needs to happen locally at maximum speeds.

As warfighters become increasingly dependent on the cloud to deliver these capabilities, solutions need to be developed to ensure that access is maintained in disconnected, intermittent, limited (DIL) environments. To enable the next generation of SU capabilities, the DoD is looking to deploy cloud replication between remote computing nodes and the cloud to provide a backup that ensures continuity of operations in the case of network outages or low bandwidth.

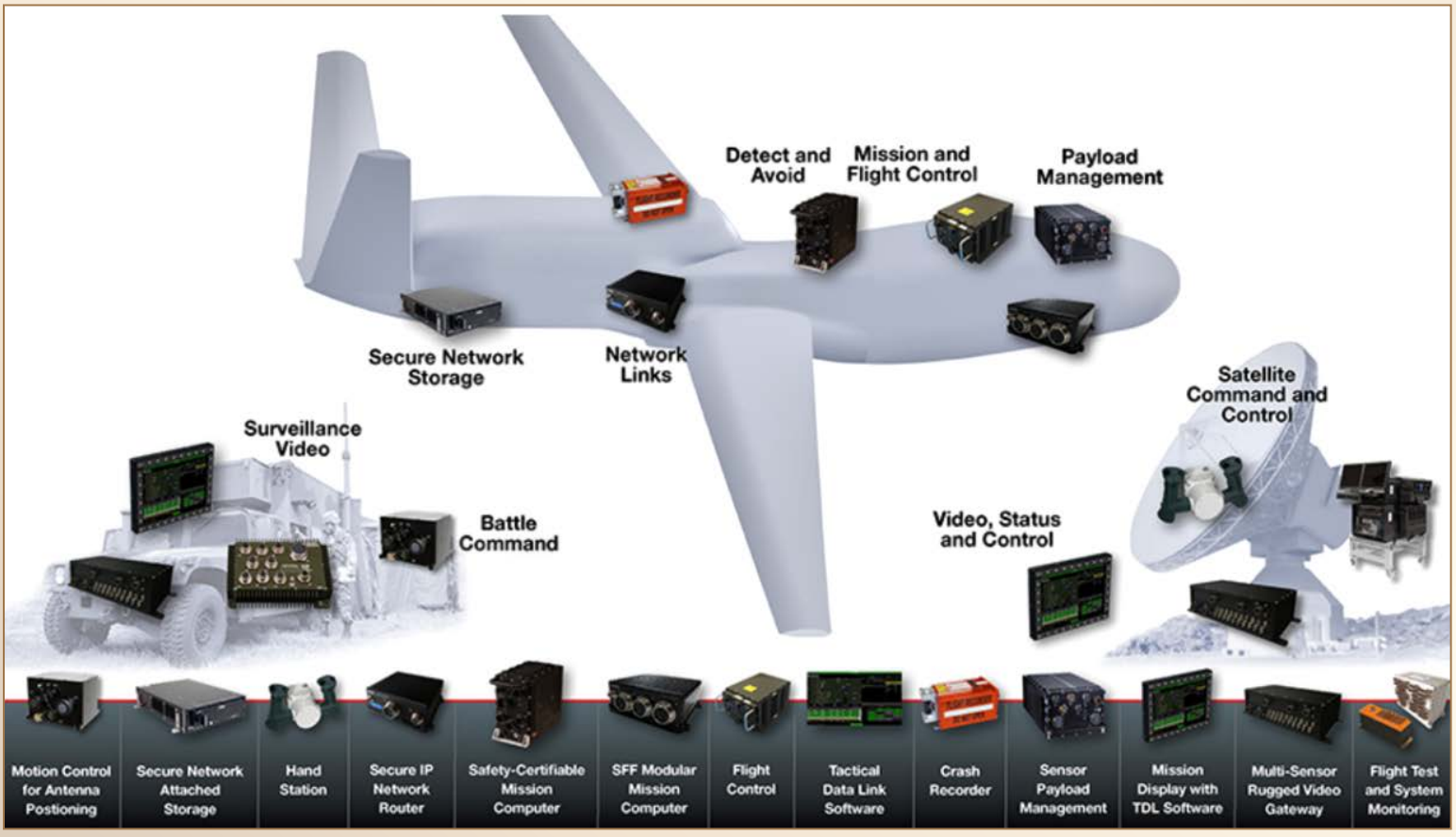
Several programs provide examples of how the DoD is seeking to deliver these cloud-based capabilities. The ***Air Force ABMS program*** establishes a federated cloud system that will provide secure processing from a security cloud called ***CloudONE***. It also defines a local cloud, ***EdgeONE***, that will provide continued security in case communications with CloudONE are disconnected.

Another example is provided by a recently issued ***request for proposal*** (**RFP**) from the U.S. Navy to industry to support ***Manned-Unmanned Air Vehicle Team Tactical Cloud analysis.*** The Navy is seeking an approach for providing backup services in case the tactical unit becomes temporarily disconnected from the wider tactical network.

Complicating the matter, no single cloud provider can meet all of the DoD's requirements. As the JEDI fight dragged on for years, the cloud industry was undergoing rapid change from the single-source contract approach the Defense Department was then taking toward a so-called "multi-cloud" model of more than one vendor.

"*What you're seeing is across every enterprise — healthcare, financial services, government agencies, retail. Enterprises are choosing multi-cloud to meet service complexity*," ***Will Grannis***, managing director of Google Cloud's office of the CTO, told *MarketWatch* in October of 2021. "*Multi-cloud is here to stay, and that is reflected by what is happening with the [DoD's] Joint Warfighting Cloud Capability (JWCC.).*"

The ***U.S. Army's Integrated Visual Augmentation System (IVAS) program*** provides example of the potential and challenges surrounding these capabilities. IVAS, which includes a new ***Ruggedized Heads-Up Display*** (**HUD**), and body-borne compute pack, integrates next generation 24/7 situational awareness tools and high-resolution digital sensors to improve the warfighter's sensing, decision making, target acquisition, and target engagement.



These capabilities will provide the increased lethality, mobility, and situational awareness necessary to achieve overmatch against our current and future adversaries in any domain. While the IVAS contract is currently embroiled in contacting and funding battles with Congress, it does represent the long-term vision for sensor-to-shooter connectivity.

To realize IVAS in the field will require a tremendous amount of data to be acquired, processed, augmented and redistributed.

The data IVAS uses will be far more than can be transported across the WAN to large datacenters, even with enterprise grade connection. What's more, when operating in DIL environments, this intensive processing must be done locally to the warfighter at the tactical edge.

To make these new capabilities a reality, these programs must overcome several key challenges:

a) *The need to maintain and improve mobility, giving commanders options to maneuver without being tied down to large fixed computing infrastructure*

b) *The need to maintain SA, and ensure C2 services are available, even in communications DIL environments – in the era of electronic warfare and contested spectrum*

c) *The ability to support multiple types of cloud infrastructure, as no one cloud offering is expected to meet all need*

To realize the capabilities required to support sensor-to-shooter SU at the tactical edge, military organizations will require a new class of rugged, fieldable, network processing and data storage solutions that can provide tactical and expeditionary teams access to all the data and compute resources they need.

These systems will need to be able to provide cloud-like services, maintaining high operational availability of applications and data, even in DIL environments where WAN connectivity is not assured. What's more, these systems will need to integrate seamlessly with leading public, government and private cloud providers.

The good news is that new technologies are becoming available that can address these challenges. They include high performance, low size, weight and power (SWaP) tactical, standards-based computing and storage platforms that can be deployed at the tactical edge – and that can host any number of compute and storage replication software infrastructure.

Another critical emerging technology is computing and storage infrastructure and infrastructure software capable of multi-cloud replication, along with support for virtualization and containers.

Earlier efforts to bring these levels of performance and service to the battlefield involved trying to deploy huge sets of standard datacenter equipment, installed in shipping containers or 19" data-center-like equipment racks.

These systems proved to be too large and hard to transport, significantly limiting their mobility. In addition, these standard solutions are power hungry, which adds additional burden on mobility

Higher performance, small form factor servers, combined with new approaches to distributed processing, offer the potential to move smaller slices of processing even closer to the edge and improve mobility.

Standard 19" rack mount datacenter equipment is not designed to withstand harsh environments and not designed to operate on the move – leading to concerns about equipment failure and loss of availability of mission critical communications. Instead, systems designed to meet military environmental standards, such as **MIL-STD-810**, should be used. These rugged systems can operate optimally when exposed to the harsh temperatures, vibration, shock and EMI typical of battlefield conditions.

To meet requirements for mobility, and support integration into the types of platforms on which they might be mounted, sensor-to-shooter solutions will need to provide high reliability compute and storage in a small SWaP-optimized form factor designed for mission-critical applications.

Solutions that can deliver the high-density compute, storage and networking infrastructure needed to handle such large data loads are available today.

These modular systems can be optimized for program needs, so that functionality, including the number of CPU cores, GPU cores, and solid-state storage density can be maximized depending on program needs.

When these systems are based on industry standard processors and GPUs from vendors such as Intel and NVIDIA, they are compatible with a wide variety of applications and can meet the needs of a vast array of C5ISR use cases including data gathering, analytics/AI, ML and SA.

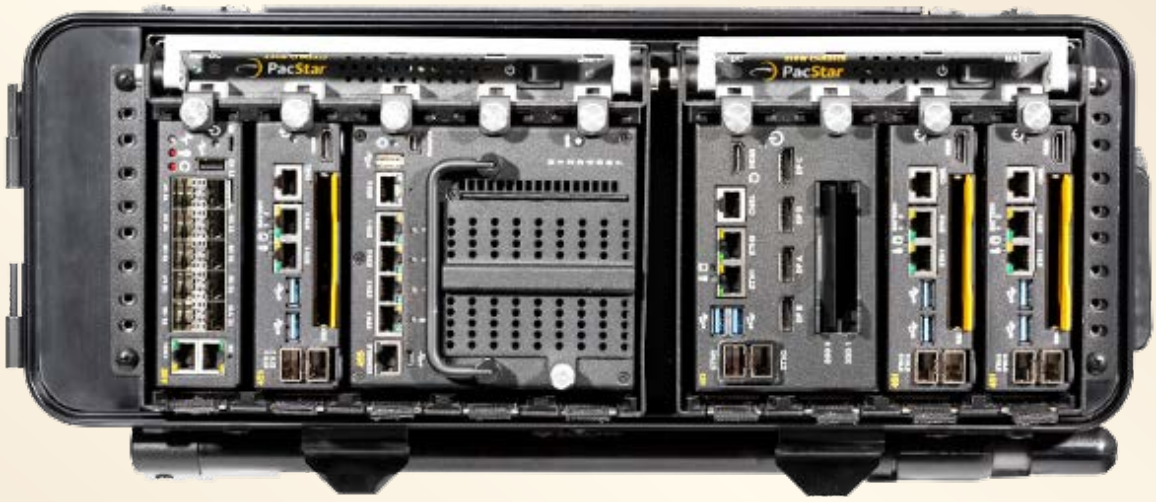
That means a new class of modular datacenter can be fielded designed to support emerging distributed processing, storage/replication and the hyper-convergence infrastructure software needed to deliver mobile cloud services.

An example of two such systems available today that can support sensor fusion and mobile cloud applications at the tactical edge are ***Curtiss-Wright's PacStar Modular Data Center (MDC)*** and the ***Tactical Fusion System (TFS)***

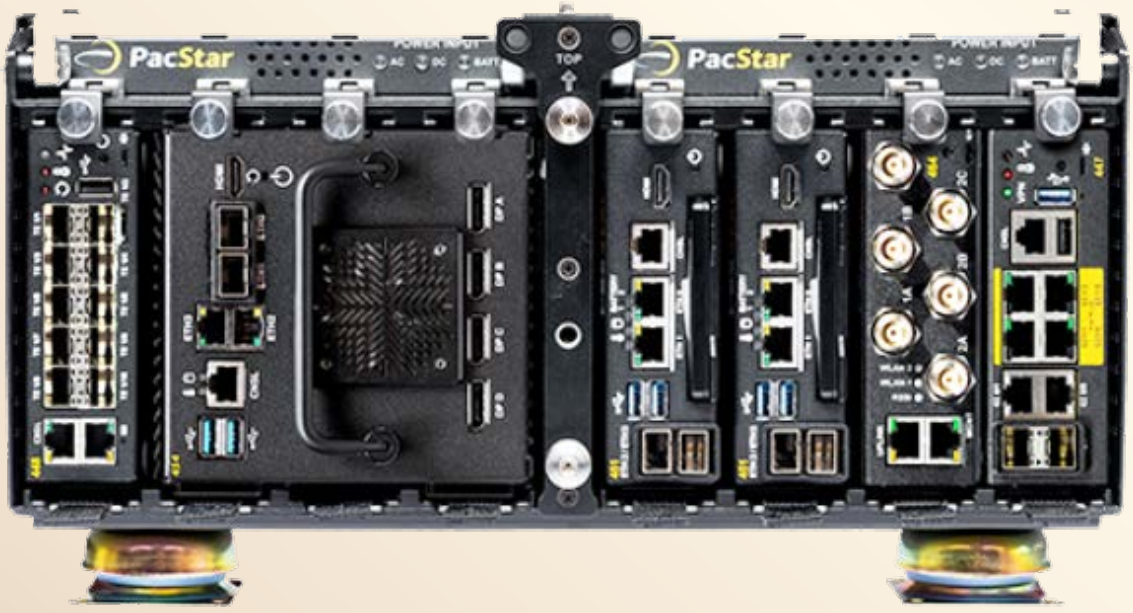
These COTS-based, modular tactical and expeditionary rugged systems (*both pictured below*) use proven small form factor modules for compute, storage, and networking functions and feature industry leading reduction in SWaP.

They can be deployed dismounted, in FOBs, command posts, ground vehicles, and aircraft, as well as in upper echelons – for military, intelligence, law enforcement, and Homeland Security use.

Depending on the specific use case, PacStar MDC and TFS configurations can include a mix of compute modules, storage modules, and GPU modules, along with the company's switching/routing modules.



Curtiss-Wright PacStar's Modular Data Center (MDC).



Curtiss-Wright PacStar's Tactical Fusion System (TFS).

With this new class of high capacity, rugged, small form-factor hardware, it's now possible to deploy emerging software infrastructures to automate the distributed processing and storage, communications and cloud replication required to ensure SA is maintained to the edge of the battlefield.

Today, large enterprise software companies are rapidly developing new technologies to ensure that data and applications can move seamlessly from the cloud to the edge and back, with little operator intervention.

Several key technologies enabling this include application virtualization and containerization, network virtualization, and ***hyper-converged storage infrastructure*** (**HCI**).

Application virtualization and containerization are technologies that decouple applications from the underlying hardware, allowing multiple applications to run securely on a single server.

This approach optimizes SWaP by reducing the number of servers required to deliver the needed processing. Virtualization and containerization also enable applications to be replicated or moved from server to server, and from cloud to edge, to balance the availability of computing resources or minimize latency over network connections.

For tactical organizations, this offers the potential to move applications closer to the warfighter to reduce processing delays and provide processing even in DIL environments.

HCI technologies decouple the storage of application data from hardware. They eliminate reliance on today's legacy network attached storage (NAS) or storage area network (SAN) architectures.

These new technologies are foundational for replication of data between cloud and edge processing — enabling warfighters to take copies of cloud data into theater, and replicate changes to data over DIL connections when appropriate.

HCI also provides local data replication for deployed organizations with a need for high reliability – ensuring that data is available in-theater even in the event of a server or disk failure.

New advances in these technologies are rapidly improving the ability of tactical organizations to replicate data between any of the major cloud providers and move applications between the edge and cloud, providing maximum mobility and maneuver options for our warfighters.

As the DoD moves forward with awarding contracts under the ***Joint Warfighting Cloud Capability*** (**JWCC**) it's important that the infrastructure software deployed to the field is not tied to a single cloud vendor or application stack.

In the long term, this can be achieved by rewriting legacy applications in cloud native applications that use containers and **Kubernetes**, an open-source container-orchestration system for automating computer application deployment, scaling, and management.

Until we reach the day where all applications use these modern software development and deployment models, a path must be established for the blending of legacy and new developments and continuous, evolutionary improvements.

VMware Virtual Cloud Foundation provides one possible path forward. This powerful collection of software, which bundles the hypervisor, hyper-converged storage, container support, and advanced security features, has the ability to synchronize with multiple public and private cloud infrastructures.

The benefits of a converged compute/GPU/storage/networking system combined with a modern software infrastructure at the edge of tactical network are numerous. This approach can support a diverse array of use cases when operating in DIL environments, including:

- *Processing and analyzing video in visible and IR spectrum for target identification, tracking and handoff,*
- *Integrating multiple sensor input from multiple end points, including from wireless sources*
- *Supporting situational awareness, C2 and mission command applications,*
- *Distributing data, including geographic information and point-of-interest information to tactical squads,*
- *Executing computer vision, AI and ML algorithms with low latency.*

The hardware and software are available today to realize the goal of the new all-domain situational awareness-driven warfighting doctrine.

These rugged, deployable systems, with support for sensor-to-shooter SU and connectivity at the tactical edge in degraded environments, are poised to bring the benefits of cloud-based computing and the new capabilities it supports to the warfighter.

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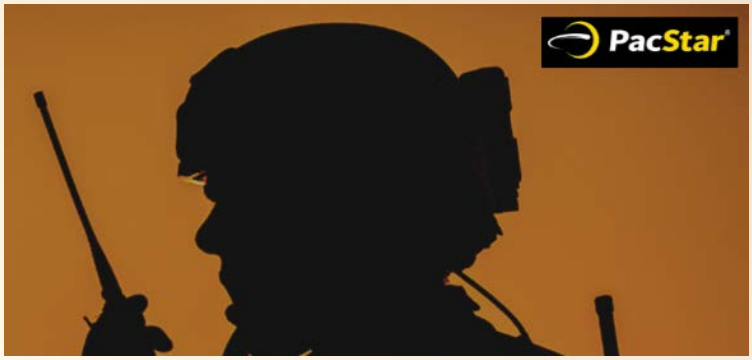

Author Dominic Perez, CISSP (Certified Information Systems Security Professional), Chief Technology Officer, Curtiss-Wright Defense Solutions, has been with PacStar for more than 13 years and, in that time, he has supported development of PacStar's rugged, tactical hardware and IQ-Core Software serving as the subject matter expert for compute, virtualization and virtualized network functions. Dominic is part of the PacStar team that won tactical networking equipment and software awards for numerous DoD tactical programs including the US Army T2C2, US Army SFAB, US Army ESB-E, PM TN Secure Wireless Small Form Factor, PEO-C3T TCNO, and US Marine Corps NOTM vehicle-mount and deployable communications programs

Dominic currently leads the teams developing PacStar's Commercial Solutions for Classified, Modular Data Center, and Tactical Fusion System product lines deploying cutting edge secure communications, edge data processing, and rapid sensor to shooter situational awareness to the warfighter at the tactical edge systems in the face of disconnected, limited, and intermittent (DIL) comms environments.

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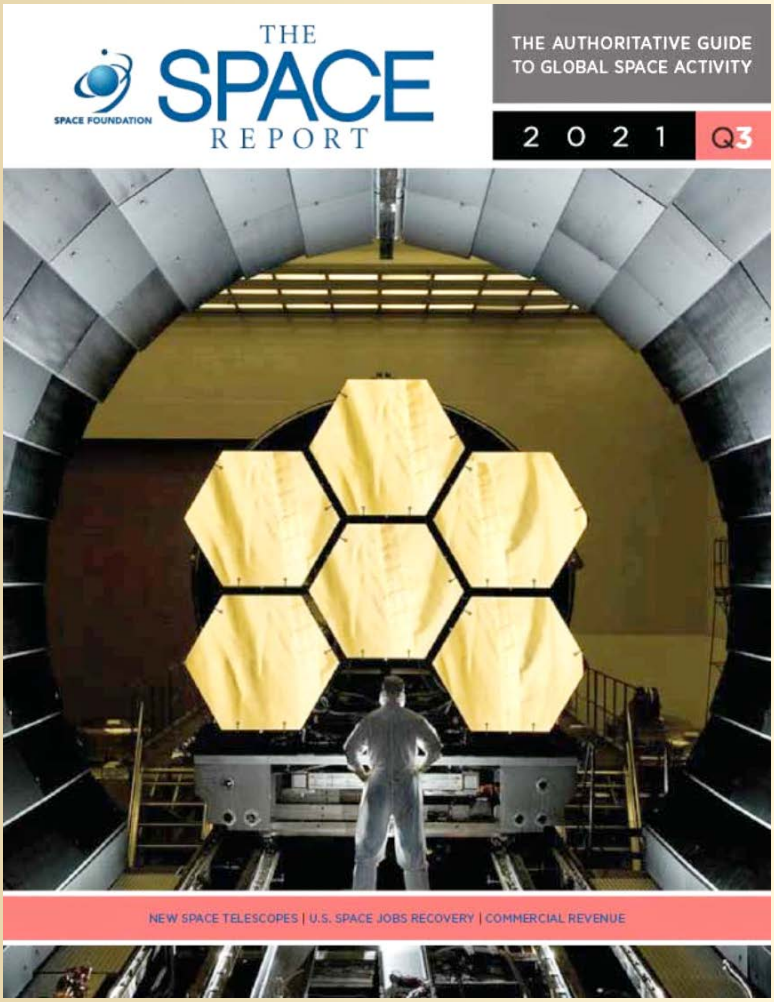
THE SPACE REPORT 2021 Q3

The Authoritative Guide to Global Space Activity — Executive Summary

Author: Lesley Conn, Managing Editor of the Space Report, Space Foundation



The idea of "Space for all" was further validated with the flights of Space X Inspiration4 in September and Blue Origin's second mission in October. Eight civilians, ranging in age from 29 to 90-year-old "Star Trek" actor William Shatner, climbed into capsules, departed Earth, and for at least a few minutes, experienced weightlessness and the off-world perspective of seeing Earth from space.

Space tourism will not be the final frontier, as **NASA** reminded all on October 21 in announcing that the unpiloted ***Artemis 1*** lunar orbit mission might be a "go" as early as February, 2022.

The Space Report Q3 provides analysis of space-sector employment and job growth in key areas post- pandemic, shares quarterly investment and stock market activity, and details advancements in the space industry, including new space telescopes and robotic-assist work gloves first used by astronauts on the International Space Station.

Here are highlights from the Q3 edition:

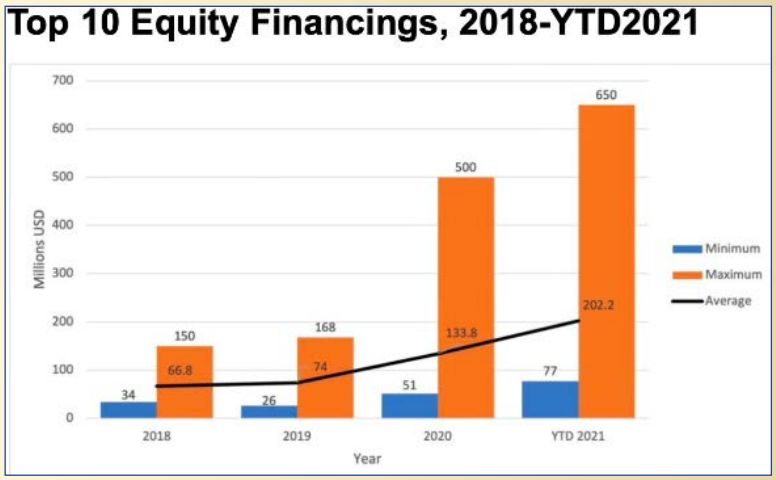
1| Space Infrastructure

The James Webb Space Telescope, set to launch in December, will be the first of a new generation of space telescopes, but it will be joined by at least five others within the decade. To obtain next-generation observations, engineers have designed a range of new technologies, including novel cooling systems, foldable mirrors, and high-tech pointing gear. Future telescopes also have greater onboard storage and downlink capabilities, increasing the amount of data scientists can collect. The Q3 edition provides a detailed look at JWST and five other telescopes.

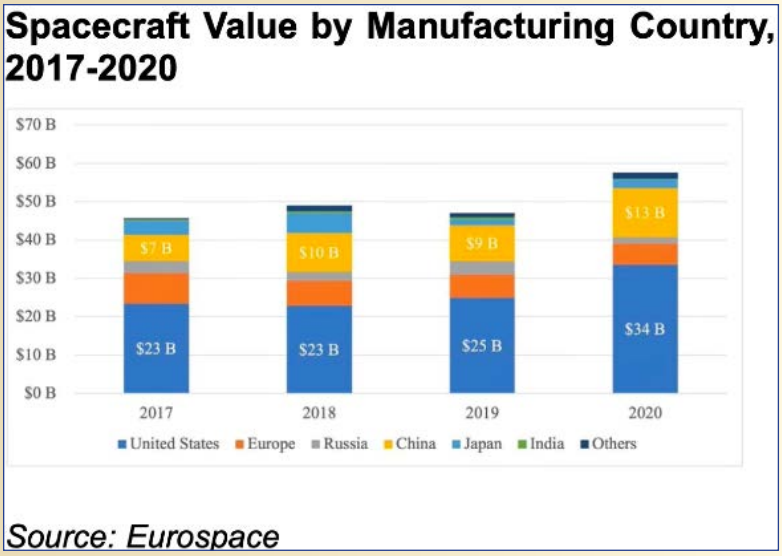
2 | The Space Economy

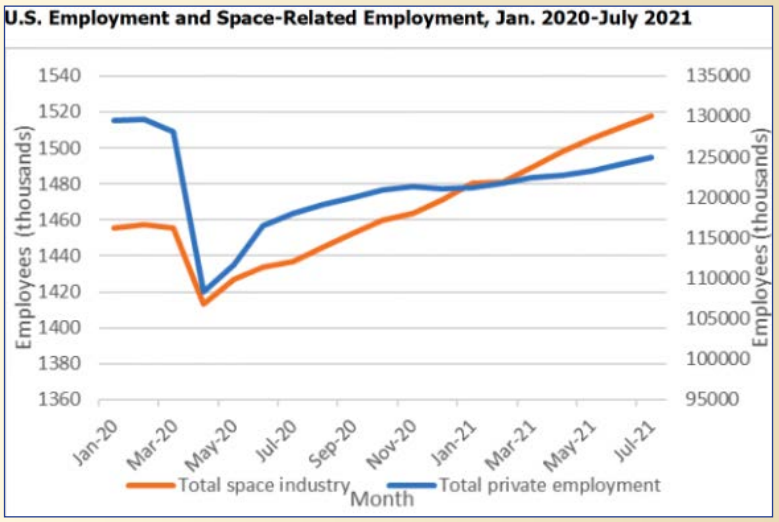
Equity financing activity in the space sector posted another near-record high in Q3 21 following the prior quarter's all-time high. Third-quarter equity financings nearly doubled to 55 from 28 in the same period of last year (Q3 20), according to ***Quilty Analytics*** *analysis. In dollar value of those disclosed transactions, Q3 21 recorded $9.8 billion in investment activity, up from $6.6 billion in Q3 20.*

Since 2018, the higher volume has been matched by greater investment per transaction, resulting in a 200% increase in the average value of the 10 largest transactions examined in the last four years. The maximum transaction value has jumped more than 300%.



Note: Table includes only satellite and space companies that announced venture-like financings. Source: Quilty Analytics.





Note: Both functions are graphing total employment in thousands for their respective industries; however, they are graphed on separate scales to illustrate the similar trends. Total space industry employment is scaled on the left while total private employment is scaled on the right.
Source: Space Foundation, U.S. Bureau of Labor Statistics

From 2017 to 2020, the latest year for which data is available, manufacturing revenue associated with commercial payloads recorded a 134% increase. Human spaceflight logged a 14% increase over the same time, and revenue for military spacecraft grew 10%. Those revenue gains, however, were not spread equally across the top countries in space.

Europe and Japan saw manufacturing value fall since 2018, while Russia and India saw declines of more than 50% from 2019. China's spacecraft value rose 88%, followed by the United States with 48% growth.

3| Space Workforce

Space employment in the United States has continued to be resilient to the global pandemic. The initial drop in the workforce due to COVID-19 in April 2020 was only 2.9% compared to the total U.S. private sector drop of 15.4%. The industry had a slow initial recovery but has been maintaining growth at a near constant rate since July 2020. By late 2020, the space industry workforce had surpassed pre-pandemic levels while the U.S. private sector was still 3.5% below pre-pandemic employment.

One sector in the U.S. space industry — Guided missiles, space vehicles, and parts — saw almost no initial employment drop due to the pandemic in April 2020 and continued to steadily grow over the past year. Compared to U.S. total private employment, which has only increased 4.1% from July 2015 to July 2021, this sector has grown by 33.3% over the same period, according to monthly statistics from the U.S. Bureau of Labor Statistics. (*Please see the chart at the top of the right column.*)

Purchasing Options

The Space Report is widely recognized as the definitive body of information about the global space industry. This report contains worldwide space facts and figures and is illustrated with photographs, charts, and graphs detailing the benefits of space exploration and utilization, the challenges facing the space sector, opportunities for future growth, and the major factors shaping the industry.

The Space Report serves as a resource for government and business leaders, educators, financial analysts, students, and space-related businesses. For more than a decade, The Space Report has chronicled the growth of the space community from around the world.

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Author Lesley Conn is the managing editor of The Space Report and the senior manager of Research & Analysis at Space Foundation in Colorado Springs, Colorado. Previously, she was a writer and editor at Gulfstream Aerospace and an award-winning investigative journalist. For additional information, please visit ***www.spacefoundation.org***.

EUROPE NEEDS TO ACCELERATE...

...The Provisioning Of SATCOM to Defense and Security Missions

Author: Stéphane Chenard, Senior Associate Consultant, Euroconsult

Satellite communications (SATCOM) have been an essential part of defense and security missions for at least 30 years, since dishes first mushroomed and secure satellites first overflowed with traffic on and over the battlefields of Operation Desert Storm in Iraq, in 1991.

Thirty years later, satellites are only becoming more necessary. Apart from the technology having become so much more powerful and user-friendly, the security environment itself requires far better communications.

High-performance air defense missiles proliferate, making it increasingly hazardous to send fighter pilots or bomber crews on missions. A multitude of counter-drone systems are also being fielded to shut the door on UAVs.

This is a deep change: Air superiority has been essential in recent theaters, where (to simplify) one side had fighter-bombers and combat drones, and the other side was powerless to stop them. The all-seeing eye of UAVs, and the real-time intelligence and surveillance they deliver, have assumed such importance that the new strategic concept of information superiority emerged in parallel — knowing so much about the situation, and keeping all dispersed elements so much on the same page, as to be unbeatable by a foe still lost in the old-style "*fog of war*." The later has not quite become an element of the past, but knowledge really is power. Reliable, uninterrupted communications are, of course, a key ingredient in providing information superiority.

Armed forces around the world retain a steady interest in airpower in general, and in UAVs in particular. If anything, the latter are getting better and better connected, as satellite links, previously a luxury reserved for the very largest platforms, can now be fitted on smaller and cheaper aircraft — a useful development, if the latter are getting more likely to be shot down or are to benefit a broader range of missions.

However a world with more denied airspace might also be one with more stand-off weapons, sent from planes or ships at a safe distance that are hundreds of kilometers away. These require even better co-ordination, enhanced decision making, all based on more timely intelligence, given the risks of striking an objective without actually having eyes on the target.

Meanwhile, public opinion is observing and commenting on social media and may be worked upon by increasingly astute, information warfare operators. The commander-in-chief may still order a strike in secret; however, the commando's movements, the strike itself, and any collateral damage, may be publicized and may have to be dealt with in near real time.

The stakes are only increasing if near-peer conflict scenarios (*think U.S. versus China*) become more likely, as defense planning now tends to assume. The plane or helicopter that carries the commando may no longer be on its own but must stay in the loop, receiving the latest intelligence, updating the mission plan until the last minute, reporting in detail on what happened or didn't happen before disinformation can flow, and leaving open the possibility of a recall if objectives have changed.

Finally, the very definition of national security is evolving, as dealing with terrorism and natural disasters are becoming part of the military mission. This also makes it necessary for police and firefighters to deploy some of

the highly efficient and secure logistics, intelligence and communication systems that previously had only been the preserve of the military.

Cyclones shut down cellular networks, police radios may be jammed and a large wildfire can move as fast and as treacherously as any battlefield. Satellites fly high over all of these elements and carry on with their missions.

From the standpoint of communications these megatrends all point in the same direction: Secure, highly reliable and deployable communications are no longer a luxury or an arcane toy for some specialist Signal Corps to keep in stock for special occasions. They are now as integral and indispensable to operations as boots and bullets (or firehoses).

The satellite industry has long received the message and churns out ever smaller, more tactical, easier-to-deploy and powerful user equipment, with touchscreens and apps instead of toggle switches, antennas that fit in a backpack and transmit from a helicopter in flight or from a storm-tossed patrol boat, and modems efficient enough for hand-carried equipment to receive surveillance imagery in full, high-definition glory.

Satellite imagery is becoming less expensive and ubiquitous and flows from observation systems that have been designed for fast and seamless communication, unimpeded, to hand-held devices. The satellites themselves can stand up beams and dodge jammers with more agility than ever before experienced.

Their commercial operators and service providers are deploying a full array of secure cloud solutions to make the communication loop flexible and painless. Most operators have the security clearances and procedures in place to work with the military. While this may not be tough enough for all circumstances or against the most sophisticated adversaries, such has proven sufficient for the vast majority of missions, up to and including meeting the fairly sensitive requirements of surveillance feeds from UAVs.

In Europe, a continent now on the cutting edge of satellite technology, the ***European Defense Agency*** (***EDA***) has established a single-window procurement system to help the EU Member States navigate to the correct commercial equipment and bandwidth, amid the vast choice of products which the industry now has on offer.

The customers in this case encompass the countries' military forces, the civilian and military personnel they deploy abroad in peacekeeping missions under the EU's ***Common Security and Defence Policy***, but also border police, firefighters and embassies, a modern view of the security community which surely deserves emulation elsewhere.

In France and Italy, critical infrastructure operators such as electrical utilities also have access to secure terminals and capacity in full recognition of the role these civilian organizations play in national security. A separate EDA project, the **EDA Govsatcom Pooling and Sharing Demonstration**, is in place to also provide access to government-owned satellites for the missions and operations that require even more secure communications than the commercial systems can currently provide.

Whether the world's ministries of defense know and appreciate all this is less clear. Historically, SATCOM has been the high-end, expensive option, fit only for the biggest command tents and capital ships and associated with heavy terminals that require massive cargo planes, containers full of cables, trained technicians, noisy generators, communication circuits that had to be planned days in advance and barely allowed for a phone connection.

Line-of-sight radios were clearly the common man's solution, for all their limitations. Satellites were billion-dollar items whose cost had to be traded off against that of ships, planes and munitions — a vision that is no longer so accurate— unfortunately, the media focuses on "*multi-billion-dollar*" internet constellations and that discourse is not helping to dispel such inaccurate considerations.

These misconceptions are becoming more dangerous. A defense force whose naval communication systems lags years behind that of passing cruise ships, or whose sensor-fusion specialists push toggle switches when the TV station down the road has automated workflows, needs to move out of the ivory tower and update itself — otherwise, they are at risk of some extremely negative surprises (*even the U.S. Air Force found on occasion how much the organization had to learn from HBO and ESPN, as it struggled with the video streams with its drones and discovered the joys of multichannel playout in the mid-2000s*).

A closer dialogue between industry and government and between the gray suits (or the T-shirts) and the uniforms, must be encouraged and pushed together from both sides of the equation. The industry, which tends to sell to ministers, generals and acquisition agencies, cannot force its way to the sergeants and the corporals who really need those crucial wares — the time has definitely arrived for them to also obtain the use of the absolutely critical SATCOM technologies to support their front-line needs.

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Author Stéphane Chenard has more than 25 years experience in the satellite industry. He handles numerous consulting assignments to assess the market for future satellite application and evaluate investment risk and business plans for a wide variety of clients, and is a major contributor to Eurconsult's research reports.

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GOVERNMENT SATELLITE REPORT (GSR)

Connectivity in the cold — Providing Comms To Thule Air Base

Author: Ryan Schradin, Executive Editor, Government Satellite Report

SES Government Solutions (SES GS) recently announced that the company had been selected by the U.S. Department of Defense (DoD) to deliver mission-critical communications services to Thule Air Base.

While this may not sound like a particularly interesting or noteworthy contract — providing satellite services to a military base — this particular base comes with its own set of challenges that make military satellite communications (MILSATCOM) both essential and incredibly difficult to deliver.

That's because Thule Air Base isn't the average U.S. military base. Thule is the furthest north of all U.S. military bases – strategically located between the United States and two of the nation's largest adversaries. That extreme northerly location — and the harsh conditions that come with it — can wreak havoc on satellite terminals and signals.

To learn more about the challenges that Thule Air Base poses to satellite providers, GSR recently sat down with ***Philip Harlow***, the Vice President of Capture and Pursuit Management at ***SES GS***.

During the discussion, Philip was asked about why satellite is so important for Thule Air Base, why it's challenging to deliver, and why C-band, GEO satellites are optimal for meeting this particular base's requirements.

SES GS recently announced that it had been awarded a $14.5M contract to deliver satellite services to Thule Air Base. What is so different and unique about Thule Air Base?

PHILIP HARLOW

Philip Harlow

Thule Air Base is located in an incredibly harsh and austere environment. For this base, in particular, the criticality of the communications is acute, and the ability to deliver [those communications] takes a great amount of effort.

Geographically, Thule Air Base is America's furthest north base. It's also further east than much of the continental United States. There are very few satellites that service that geographic area. The location makes it incredibly difficult to get the signal from that part of Greenland to its final destination securely and in a single hop.

"…in the case of Thule Air Base, the military actually uses the commercial satellite service to transmit operational traffic. There is a lot of mission-critical sensor data and other information that the military relies on commercial satellite to deliver." – Philip Harlow

In fact, for most satellite providers, getting the signal to and from Thule without going through a commercial gateway is nearly impossible.

Thankfully, SES has a good deal of experience working in austere environments across the globe — including Afghanistan, parts of Africa, the Arctic, and Antarctic. These are all places where the environments are very different and present their own set of challenges.

We've been servicing Thule for more than 20 years. In that time, we've demonstrated our ability to install and maintain the infrastructure necessary to deliver the service that the user relies upon in an assured, reliable way.

What impact can the northern location and harsh climate have on the satellite services being delivered to the Air Base?

PHILIP HARLOW

The intense cold and dry environment that far north expedites wear and tear and makes the physical hardware brittle. This has a massive impact on the "health" of the materials and hardware that comprise the terminals and stations.

For that reason, we've sheltered the antenna in a giant radome. It's in the cold all the time. Metals become brittle. Fluids freeze quickly. Cables and connectors freeze, stiffen, and become brittle — this makes them difficult to move around. All of these factors combine to make the area around Thule Air Base largely inhospitable to satellite terminals and hardware.

What's worse is that the winter is quite long up there. This makes repairing and replacing things difficult because it must be done in a very short window during the summer. If maintenance needs to be done in the middle of the winter, it's difficult work that must be done quickly, so there needs to be people on site that are knowledgeable and well-trained on the equipment and maintenance.

That's just the impact on the satellite hardware. From a signal perspective, the low elevation angle also impacts the signal quality. The low elevation angle, coupled with the snowfields surrounding the base, lends itself to scintillation. This is a phenomenon where reflections of the signal off water and snowfields creates an environment where the signal is effectively interfering with itself.

What kinds of use cases are there for satellite services to bases like Thule?

PHILIP HARLOW

When we're talking about commercial satellite services in the military, we're typically talking about use cases that include non-operational services — checking email, Internet access, etc. However, in the case of Thule Air Base, the military actually uses the commercial satellite service to transmit operational traffic. There is a lot of mission-critical sensor data and other information that the military relies on commercial satellite to deliver.

While Thule is certainly remote and geographically isolated, it provides an essential piece of the puzzle for military situational awareness and our nation's defense strategy. This base is located in an incredibly strategic position between the United States and some of its largest adversaries. This means that communications are absolutely essential in this location — and other remote locations like it.

However, in many other remote locations, there is fiber connectivity in addition to satellite connectivity. That fiber is often a single thread, so satellite is essential for redundancy and mission assurance, but the fiber is there to provide communications — that's not the case at Thule Air Base.

With the military increasingly deploying sensors and other devices into these remote locations at the edge, the amount of data that needs to be pushed back in real-time is massive. Thule only has satellite connectivity to carry that data back to those that need to analyze it.

For this reason, we recently doubled the throughput of the satellite link that we're providing to Thule Air Base. This is allowing us to support them operationally as well as deliver ***morale, welfare and recreation*** (**MWR**) services for the people that are deployed in this very harsh, very remote location.

The satellite service that SES GS will be delivering to Thule Air Base is a C-band service. What does that mean? Why is that important for that region? How is that different from what satellite service providers usually offer the military?

PHILIP HARLOW

C-band has a much longer wavelength than Ku-band and other commercially available satellite signals. This means that it isn't as negatively impacted by environmental and atmospheric factors.

C-band satellite signals can operate at lower elevation angles, exactly what is needed at Thule Air Base, with minimal scintillation. C-band is also much less affected by atmospheric attenuation or "rain fade." This occurs when the signal is absorbed or nullified by atmospheric rain, snow, or ice — all of which are common and prevalent in the area around Thule Air Base.

C-band has proven its ability to deliver much more reliable service — even at lower elevation angles. In fact, we used C-band satellite signals to deliver communications in Afghanistan, where we experienced frequent dust storms. In those situations, the C-band has not been as negatively impacted.

Also, Ku-band spotbeams are often much smaller than C-band. C-band hemi beams can cover almost an entire hemisphere, making it easier to get the signal to and from Thule Air Base to its final destination in a single hop. Ku-band often doesn't cover areas as remote as this part of Greenland because of the smaller size of the beam, and the limited use they would receive.

"The intense cold and dry environment that far north expedites wear and tear and makes the physical hardware brittle. This has a massive impact on the "health" of the materials and hardware that comprise the terminals and stations." – Philip Harlow

"With the military increasingly deploying sensors and other devices into these remote locations at the edge, the amount of data that needs to be pushed back in real-time is massive. And Thule only has satellite connectivity to carry that data back to those that need to analyze it." – Philip Harlow

Why would the DoD select GEO satellite services for this region when we're starting to see Lower Earth Orbit (LEO) constellations coming online? Aren't LEO constellations capable of offering even lower latencies than GEO?

PHILIP HARLOW

There are a number of reasons, but the first and most important involves availability. LEO fleets aren't fully deployed yet and don't provide the 24/7 global coverage that is needed for a location as strategically important as Thule Air Base.

Availability aside, LEO satellites have a reach that is limited. The small spot beam from a LEO satellite can't get the signal from Thule to any place of importance. To get the signal to or from Thule Air Base, a LEO satellite would need to connect to a ground station somewhere else within the beam. Considering the small size of a LEO spot beam, that ground station would still be in a harsh, austere environment — in a place like Newfoundland and Labrador.

The satellite provider wouldn't want to put a ground station there, even if they could do so.

Finally, LEO satellites need to be tracked across the sky. In cold, harsh environments, the more moving parts in the terminal and antenna, the more prone it is to failure. Any mechanical steering antenna capable of tracking the LEO satellites through the sky would be more prone to breakage and failure.

With GEO, the antenna doesn't need to move. The beam covers enough area that the signal can be transmitted without going through a commercial gateway or to an intermediate ground station. The satellites needed to deliver the service are already deployed and operating in orbit today.

SES is unique in that it can offer the DoD a multi-orbit solution — combining satellites in GEO and NGSO orbits. Is this something available for Thule? Is this something that the DoD would want to explore and that SES would want to make available to them?

PHILIP HARLOW

We're always working to create and offer new, innovative solutions to our customers. However, those solutions need to be in line with their requirements and need to make both financial and technological sense for them.

Today, with what SES has available to service the DoD — and Thule Air Base, in particular — there simply isn't a need or business case to deliver access to Thule Air Base via LEO or a satellite other than GEO. We've evaluated all options for servicing this station, and the best value for the customer is using GEO for this Air Base. It's the best option for their budget, and for their requirements.

To learn more about the service SES GS is delivering to Thule Air Base, click this direct link to read the official announcement.

The opening image was captured by Air Force Tech. Sgt. David Buchanan. The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement.

The post Connectivity in the cold – providing communications to Thule Air Base appeared first on GovSat.

ses-gs.com/govsat

Ryan Schradin

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

DISA'S STRATEGIC PRIORITIES + INNOVATION DRIVERS

Presented at the 2021 AFCEA TechNet Cyber Event

Author: Devon L. Suits, Office of Strategic Communication and Public Affairs

The increasing pace of change throughout the cyberspace battlefield requires Defense Information Systems Agency's mission to move at the "velocity of action to win," while meeting the needs of the warfighter across the globe, the agency's lead officer stated.

Lt. Gen. Robert J. Skinner

In the past five years, China accelerated its cyber capabilities at an alarming rate and continues to use the domain and data to support their own agenda, said U.S. Air Force Lt. Gen. ***Robert J. Skinner***, ***DISA*** director and JFHQ-DODIN commander, during the 2021 AFCEA TechNet Cyber conference.

Along with China, near-peer competitors, non-state actors and extremist organizations, have demonstrated their cyber-related capacities by challenging military, industry and government networks.

"*The Department of Defense Information Network is made up of 300 million Internet Protocol version 4, or IP, address spaces*," Skinner said, adding that the DODIN is the third-largest network behind the U.S. and China. "*The ability to command and control, secure, operate and defend the DOD's network is important*."

Prior to the COVID-19 pandemic, close to 80% of the DISA personnel were operating on-site. In-place numbers have decreased to less than 20%, as the agency continues to work remotely to deliver tools and systems to support the warfighter and DOD at a rapid rate.

Moving forward, DISA must convey a "*transparency of understanding" with mission partners and industry to collaborate and determine enterprise-wide solutions. The agency will also need continued support from industry partners to ensure the fidelity of future networks*.

Organizational redesign, new strategic plan DISA recently completed a budgetary review and an organizational restructure to generate efficiencies across the force. Leaders also released a strategic plan to sharpen DISA's mission across five lines of effort through fiscal year 2024, Skinner said.

These LOEs include:

- ***Prioritize command and control, or C2***
- ***Drive force readiness through innovation***
- ***Leverage data as a center of gravity***
- ***Harmonize cybersecurity and the user experience***
- ***Empower the workforce***

"*We came up with an organizational structure to reduce complexity and enable greater interaction and collaboration with industry*," Skinner explained.

Prioritize Command + Control

Command and Control information (C&C) is a dependable enabler for the warfighter and mission partners. Under the strategic plan and first LOE, DISA will prioritize C2 systems and capabilities to gain a "*high ground*" advantage over near-peer competitors and outside threats, he said.

"*The No.1 area in my eyes continues to be command and control. As a combat support agency, we cannot fail in our ability to deliver C2 to our senior leaders to the tactical edge*," Skinner said. "*DISA must enable the distribution of information across future battlefields through Joint All-Domain Command and Control*."

Under the DOD-led initiative, JADC2 will connect sensors from the Army, Marine Corps, Navy, Air Force and Space Force system into one network to streamline C2 operations.

Lt. General Skinner giving his presentation at the AFCEA event..

"*DISA is at the heart of C2 and the heart of JADC2. That is why we are prioritizing command and control,*" the General said. "*We have to organize the battlespace to ensure 100% is secured.*"

Drive Force Readiness

The agency's second LOE, drive force readiness through innovation, will target DISA's speed of innovation and modernization.

Proper integration with industry partners is crucial to the way ahead, as DISA continues to drive readiness through times of fiscal uncertainty. Skinner mentioned the need for enterprise-wide solutions to ensure that the DOD is receiving the best value for their investment.

"*Help us drive that force readiness into the future,*" he said. "*I need industry's help to not play the other services against each other in pricing.*"

Enterprise Innovation + Integration Center

The enterprise innovation and integration center will also help reduce the time required to develop, secure, test and field new IT capabilities and services, and stay relevant at the speed of change.

The LOE would also incorporate artificial intelligence and machine learning solutions to streamline processes.

Data is a vital strategic asset and a key enabler to C2, as it drives mission effectiveness through proper dissemination and utilization.

"*There is so much data out there, it makes you head spin,*" Skinner said. "*If you own the data — you will own the high ground at the end of the day.*"

Skinner said that DISA recently added a chief data officer position to develop initiatives under this LOE further. The agency will also need industry support to harness AI and machine learning to create scalable and secure solutions as the agency advances a big data analytics platform, he said.

Harmonize Cybersecurity

Tied to DISA's fourth LOE, harmonize cybersecurity and the user experience, leaders have taken actions to enhance and centralize threat-based defense proficiencies.

Zero-trust security, for example, improved the identity management architecture across the networks creating a strict authentication process for all trusted or untrusted networks, devices, and users.

Additionally, the ***Thunderdome*** program will further improve the zero-trust environment and allow the DOD to protect its data throughout the growing cloud-based environment.

"*We will not be successful in the future, if we don't have proper and secure identity management,*" Skinner said. "*The CAC has been an amazing piece of the puzzle from a security standpoint, but it is 10 to 15 years old. There is better technology out there today that can serve as a primary means of authentication,*" he said.

Empower The Workforce

The final LOE, empower the workforce, will focus on proper recruiting and retention efforts to maintain the DISA mission, Skinner said. An abundance of available cyber-related careers across the U.S. puts DISA in direct competition with other civilian, government or military organizations.

DISA remains committed to developing and growing a diverse group of talent.

To properly leverage the growing workforce, leaders must work to remove "*institutional silliness out,*" or "*artificial barriers that prevent growth,*" he said.

Available for reading is DISA's Strategic Plan FY22-24
at this direct infolink…

Artistic rendition of IAI satellites on-orbit. Image is courtesy of IAI.

MCS – REDUCING RISK + IMPROVING SATCOM

IAI **has created a new niche in the geostationary orbit (GEO) satellites market with a satellite that provides the identical services of a full-size satellite, but supports less channels, thereby supplying users with their specific needs.**

The new Mini Communications Satellite, or MCS, was introduced at the *International Astronautical Congress* (IAC) in Dubai.

Operating from GEO orbit, communications satellites are often large, heavy, and expensive to build and launch. That's why they are suitable for operators that require large capacity and diverse needs.

In parallel to the company's full-scale GEO satellite programs, IAI has developed the concept for smaller, more agile communications satellites that perform the same, crucial functions at a much lower cost.

The Mini Communications Satellite

Unlike the full-size communications satellites that weigh as much as 10 tons and is carried as the primary payload on a large launcher, IAI's new ***Mini Communications Satellite*** (**MCS**) weighs roughly 700 kg., carrying a digital communication payload weighing up to 200 kg.

Due to its light weight, the satellite can be launched together with other satellites in a 'rideshare' mission, significantly lowering launch costs.

The MCS provides multi-zone communication services that cater best for government users with specific communications needs, or commercial operators that need quick response and agility. With flexible launch configurations, MCS makes an excellent choice, compared to large satellites that may take years to build, and deploy.

The lightweight all-electric and fully digital satellites enable customers to launch a complete sovereign operation, initially at a lower capacity, gradually growing as the demand for their services increases, by configuring the original satellite to meet higher capacity or launch new satellites to the same space segment.

The MCS provides an agile platform developed and deployed with minimal risks, that can be software upgraded throughout its 14-years life in orbit, enabling users to adapt and configure the satellite to the user needs over time. IAI offers the MCS for about a third of the cost of the much larger and heavier communications satellites.

The MCS is fully, digital system that possesses flexible multi-band communication payloads that support flexible applications.

With up to four steerable dish antennas with a maximum size of 2x2.5 meters, the satellite operates simultaneously in the Ka-/Ku-band (*or other frequency bands*), with eight active high-power amplifiers consuming up to 2,000 watt

Artistic rendition of an IAI MCS satellite. Image is courtesy of IAI.

of power. Based on IAI's heritage sub systems, the fully redundant platform ensures a 14-year mission at a high level of reliability.

The satellite's command systems and development architecture allow for applications loading from a ground station during the satellite's in-space operation, to adjust and modify assignments in accordance with changing communication needs.

Reducing Risk, Increasing Availability

The all- digital payload is fully programmable using FPGA based digital hardware and a **Software Defined Radio** (**SDR**) platform supported with unique RF converters, enabling on-orbit mission frequency plan updates.

The mission control architecture enables assigning different service providers with 'virtual payloads' service segments that can be adjusted to the usage profile and needs over time.

Based on market needs and technological feasibility studies, IAI has entered the MCS concept development and will soon enter the market launch phase.

While the MCS has fewer transponders, compared to the full-size satellite, the satellite enables customers to launch new services faster and with minimal risk.

According to IAI simulations, a group of such satellites can perform the same service and scale as larger GEO communications satellites, when grouped at a single geosynchronous 'slot' in space.

The MCS is based on IAI's long heritage of ***Amos*** and ***Dror*** — Israel's National Communication Satellite — and the ***Opsat*** and ***Tecsar*** reconnaissance and scientific research satellites — compact, smallsats.

Most of the smallsats' capabilities were developed in-house by IAI, including the advanced digital communication payload and "space smartphone" to be integrated in the MCS, capabilities. These provide operators with the required flexibility throughout the mission life of the satellite.

www.iai.co.il/

—INTEROPERABILITY—

Propelling the U.S. to the front of the Global SATCOM race

Author: Theresa Condor, Chief Operating Officer, Weather, Aviation, Earth Intelligence + Space Services, Spire Federal

To those in the SATCOM industry, there should be no hesitations when stating that we are in an almost frenetic, global, space race.

Countries are investing more in space and the development of space capabilities and satellites than ever before experienced. Last year, U.S. space program spending was the highest in the world.

However, when it comes to capabilities, from shortwave infrared to ***synthetic aperture radar*** (**SAR**) persistence, from video to pan resolution, the U.S. is facing stiff competition and, in some cases, falling behind. While discouraging on some levels, there is hope — these comparisons often fail to account for the grind behind the scenes — especially with the military.

The proposed defense budget for fiscal year 2022 asks for more than $20 billion for military space and space-based systems, including a communications network, space sensors and experimental satellites. This marks an emphasis on U.S. defense capabilities in space as well as the continued development of ***Joint-All Command and Control*** (**JADC2**), the foundational ***Department of Defense*** (**DoD**) strategy dedicated to creating a high-bandwidth, resilient communications network that handles large amounts of data.

DoD leaders are looking to work with the industry on a far more frequent basis — Chief of Space Operations, General Jay Raymond — has said he wants to further integrate with industry and that there is no mission area where commercial services cannot contribute their expertise and technologies.

The call for public-private partnerships leads to a common discussion — the need for interoperability. In the context of technology, interoperability refers to the ability of different technologies (software, applications, systems, and more) to connect and communicate. Ideally, this cross communication allows for collaboration and data and information sharing without a large amount of effort from an end user.

Some individuals in both government and industry had previously pushed against interoperability, preferring to continue to use legacy hardware already in place or to maintain proprietary technology (*which usually does not allow*

for easy collaboration across technologies). As technology advances, this preference will not be sustainable and brings with it tradeoffs in innovation, security and mission effectiveness.

By committing to an environment of interoperability, government and industry can further advance space capabilities and propel the U.S. to the front of the new "*space race.*"

However, for private and public organizations to move toward an interoperable future, both must see the benefits. For industry, is it worth it to work with the government? As private space companies innovate and propel the industry further along, does working with the government and, specifically, the DoD help or hinder companies?

How Government Supports Industry

When debating whether to commit to interoperability, private companies should remember all the work that the government has done — and continues to do — to support the space industry.

Throughout history, government has been crucial to the development and success of space exploration through myriad ways. The U.S. government has passed legislation to create government agencies and services to support the exploration and development of space — from NASA in 1958 to the U.S. Space Force (USSF) in 2019. These organizations share commonalities with private space companies in their missions and desire to learn more about space and our planet from space.

Then there are the policies and initiatives that the U.S. government has enacted to support the industry. A recent example is the revival of the ***National Space Council*** in 2017. This organization operates as an office of policy development and is intended to coordinate civilian, commercial and national security efforts in space. With this council in place, more coordinated efforts between industry and the government will, hopefully, take place.

Policies and initiatives can provide more funding for research and development and the creation of new businesses as well as offering support to small businesses that possess unique solutions and allowing major companies to innovate and push the industry forward. In the U.S. today, several large space companies owe their success or founding to U.S. industrial policies that supported their work and funding.

In addition to several projects such as the ***Defense Advanced Research Projects Agency*** (**DARPA**) *Launch Challenge,* these efforts also support increased collaboration with private industry. DARPA was created by the military to demonstrate new and groundbreaking capabilities from small launch providers to address emerging DoD needs.

Another way the government supports the space field is through purchasing power. By being a customer, the government can, and does, generate industry success. Most space companies would not exist without having a government customer.

The real space champions are being created by the government leaning into their role as customers early on in the firm's development. Having government as a customer provides a strong customer recommendation for industry as well as directions and missions for crucially needed new research and innovation.

Benefits To Working With Government

By supporting industry, the government benefits from the increased development and innovation that private companies accomplish. On the other hand, private companies that decide to work with the government benefit in numerous ways.

Leaning in to servicing government can be an advantage as it allows industry to have more input, ultimately creating a product government needs. If companies build hardware and software that fits government mission needs, they then have the freedom in how they develop those products and technologies and the final, viable result.

Key requirements for the U.S. government and defense are often needed for other global government and commercial customers. Keeping those needs in mind is beneficial in serving a company's total addressable market.

Government Needs

As private companies work toward developing new capabilities within MILSATCOM, of importance is that they remember the needs of the U.S. government and defense which include

connectivity, mission resiliency, redundancy, flexibility, security and more. Ensuring technologies are easily accessible and ultimately implementable are important, all the while maintaining a high level of security.

As space capabilities advance and missions become increasingly complex, government customers are no longer looking for one image or a single data source. An increased revisit rate or an increased image resolution should be paired with algorithms and analytics to help place the data in context.

Government end users are looking to detect changes and interpret the data in order to quickly make critical decisions. An end user on the battlefield often does not have the time to analyze massive amounts of data when making decisions that could involve human lives and shorten missions — they need information, in context, as rapidly as humanly possible.

With that in mind, there is a growing interest in loading supercomputers on satellites themselves. In the future, the device itself will be able to analyze literally gigabytes of data on the fly and come up with advice on what the end user should do and send it to the end user directly. Such capabilities would be far faster than sending that data to the ground and then attempting to analyze that information on the ground.

The Need For Interoperability

No matter the development targets, for these private-public partnerships to be successful, government and enterprise must ensure full interoperability. Overall, government agencies should balance supporting industry by allowing for innovation, and organizations should keep the government end user in mind when developing new capabilities.

As the world continues to explore space and its environs, the U.S. should take the SATCOM race seriously and invest in commercial capabilities. The federal government should not make the same mistakes of the past and try to lock down innovation and progress — the government must encourage companies to innovate and collaboratively work together.

This is the path of commitment the U.S. needs to ensure continued global leadership in the ever-growing and increasingly challenging, global space race.

spire.com/federal/

As part of the early team at Spire, Theresa focused on building the initial business case and then took a lead role in business development, fundraising and corporate partnerships as the company transitioned from the Ardusat project into Nanosatisfi and eventually Spire Global. She signed Spire's first international MoU, first LOI, and first million-dollar contract. After being appointed Executive Vice President and General Manager of Spire Space Services and Earth Intelligence, Theresa is now Chief Operating Officer and oversees Spire's Weather, Aviation, Earth Intelligence, and Space Services business units worldwide. Prior to Spire, Theresa spent the past decade working in emerging markets. Most recently, Theresa managed the Latin America trade syndications desk for Citibank in New York, working at the intersection of supply chain management, global trade, and development finance at the height of the financial crisis. Theresa studied at Cornell University, The London School of Economics, and Columbia School of International and Public Affairs (SIPA).

LOCKHEED MARTIN CONTRACTED TO BUILD THREE GPS III FOLLOW ON SATELLITES BY USSF

Artistic rendition of a GPS IIIF satellite. Image is courtesy of Lockheed Martin.

The *U.S. Space Force (USSF)* has exercised their second contract option, valued at approximately $737 million, for the procurement of three additional *GPS III Follow On (GPS IIIF)* space vehicles (SVs) from *Lockheed Martin*.

This contract option is for GPS IIIF space vehicles 15, 16 and 17 (SV15-17).

GPS IIIF satellites build off the innovative design of Lockheed Martin's next generation GPS III satellites (SV 01-10), which provide three times greater accuracy, up to eight times improved anti-jamming capability and increased resiliency, in addition to modernization, compared to legacy GPS satellites in today's constellation.

GPS III also adds a new L1C civil signal that is compatible with other global navigation satellite systems, such as Galileo.

GPS III/IIIF support a USSF effort to modernize the current GPS satellite constellation.

The GPS IIIF SV11-12 satellites were included in the original September 2018 GPS IIIF contract award to Lockheed Martin to build up to 22 GPS IIIF satellites. Under that contract, the government exercised the first GPS IIIF production option for SV13-14 in October 2020.

GPS IIIF SV13 and beyond will incorporate the company's ***LM2100 Combat Bus***™, an enhanced space vehicle that provides even greater resiliency and cyber-hardening against growing threats, as well as improved spacecraft power, propulsion and electronics. This evolved bus incorporates many common components and procedures to streamline manufacturing.

LM2100 Combat Bus vehicles are also capable of hosting Lockheed Martin's Augmentation System Port Interface (ASPIN), which would allow for future, on-orbit servicing and upgrade opportunities.

As of this writing, Lockheed Martin is close to finishing production on the original GPS III SV1-10 contract. GPS III SV01-05 have been launched and handed over to the USSF for on-orbit operations.

GPS III SV06-08 have been completed and placed in storage at the company's facility waiting for the USSF to call them up for launch. SV09 is a fully integrated space vehicle now going through final testing.

On October 26, 2021, the final GPS III satellite of the original GPS III contract — GPS III SV10 — completed an operation known as "core mate" to assemble it into a full space vehicle at Lockheed Martin's GPS III Processing Facility. It will proceed into the vehicle testing campaign before the yea's end.

"*GPS IIIF satellites will add new capabilities and advanced technology to the GPS constellation, including Regional Military Protection (RMP); an upgraded Nuclear Detection Detonation System (NDS) payload; a safety-improving Search and Rescue payload; and an accuracy-enhancing Laser Retroreflector Array (LRA),*" said ***Dave Hatch***, Lockheed Martin's GPS IIIF program management director. "*The RMP capability further reinforces GPS III/IIIF as a warfighting system, providing up to 60x greater anti-jamming for our warfighters operating in contested environments.*"

U.S. SPACE FORCE RECOGNIZES GEORGIA TECH AS A NEW STRATEGIC PARTNER

Lt. General Nina M. Armagno, U.S. Space Force director of staff, with Georgia Tech Executive Vice President for Research Chaouki T. Abdallah and Provost Steven W. McLaughlin (L to R).

United States military agencies often look to the Georgia Institute of Technology to recruit highly skilled workers, drawing from the Institute's expertise in fields such as aerospace engineering and cybersecurity. Today, with modern warfare increasingly fought via satellite control networks, a new branch of the U.S. military has taken notice of Georgia Tech.

On November 11, Georgia Tech and the U.S. Space Force launched a strategic partnership to develop a high-caliber aerospace workforce and collaborate on advanced aerospace research. As part of a comprehensive agreement, the two parties signed a memorandum of understanding, making Georgia Tech the newest member of the U.S. Space Force's University Partnership Program.

Lt. General Nina M. Armagno, U.S. Space Force director of staff, joined Georgia Tech Provost Steven W. McLaughlin and Executive Vice President for Research Chaouki T. Abdallah to sign the agreement. The signing ceremony, on Veterans Day, occurred on the Georgia Tech's campus.

The U.S. Space Force established the **University Partnership Program** to identify, develop, and retain a diverse, STEM-capable workforce to further its mission to protect U.S. and allied interests in space. Through the partnership, the Space Force will seek to recruit new members and also create educational and leadership development programs for existing Space Force employees. Georgia Tech was selected for its outstanding aerospace engineering research, its expertise in national defense and security, the diversity of its students, and its robust ROTC program.

Georgia Tech joins 11 universities selected for the U.S. Space Force University Partnership Program in fiscal year 2021. They include **Howard University**, **Massachusetts Institute of Technology**, **North Carolina Agricultural and Technical State University**, **Purdue Universit**y, **University of Colorado Boulder**, **University of Colorado Colorado Springs**, **University of North Dakota**, **University of Southern California**, **University of Texas at Austin**, and **University of Texas at El Paso**.

The institutions were selected based on four criteria: the quality of STEM degree offerings and space-related research laboratories and initiatives; ROTC program strength; diversity of student population; and degrees and programming designed to support military, veterans, and their families in pursuing higher education.

The signing ceremony was the culmination of a daylong campus visit for Lt. General Armagno and the Space Force delegation. In the morning, she met with Air Force ROTC students and gave a public talk at the Sam Nunn School of International Affairs about the Space Force's integration into the U.S. military. In the afternoon, she held a discussion with aerospace engineering students, toured the Space Systems Design Lab, and received an overview of the Georgia Space Grant Consortium and Aerospace Engineering Outreach.

As a next step, Georgia Tech and the Space Force will outline specific implementation milestones to meet the program's objectives. This initial work will include establishing educational programs such as scholarships, internships, and mentorship opportunities, and identifying specific research areas of mutual benefit to the Space Force and Georgia Tech.

"*At the heart of the Space Force's University Partnership Program is the need to advance our science and technology to build the next generation of space capabilities, while developing the workforce of the future*," ***Armagno*** said. "*With its reputation as a leader in cutting-edge aerospace research, we are confident that Georgia Tech will be an outstanding partner*."

"Georgia Tech is proud of its longstanding collaborations with NASA and the Department of Defense to help achieve strategic national objectives," ***Abdallah*** said. "*We look forward to charting bold new areas of research with the Space Force and leveraging our expertise in aerospace engineering and national security to address today's most complex space-based military challenges*."

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