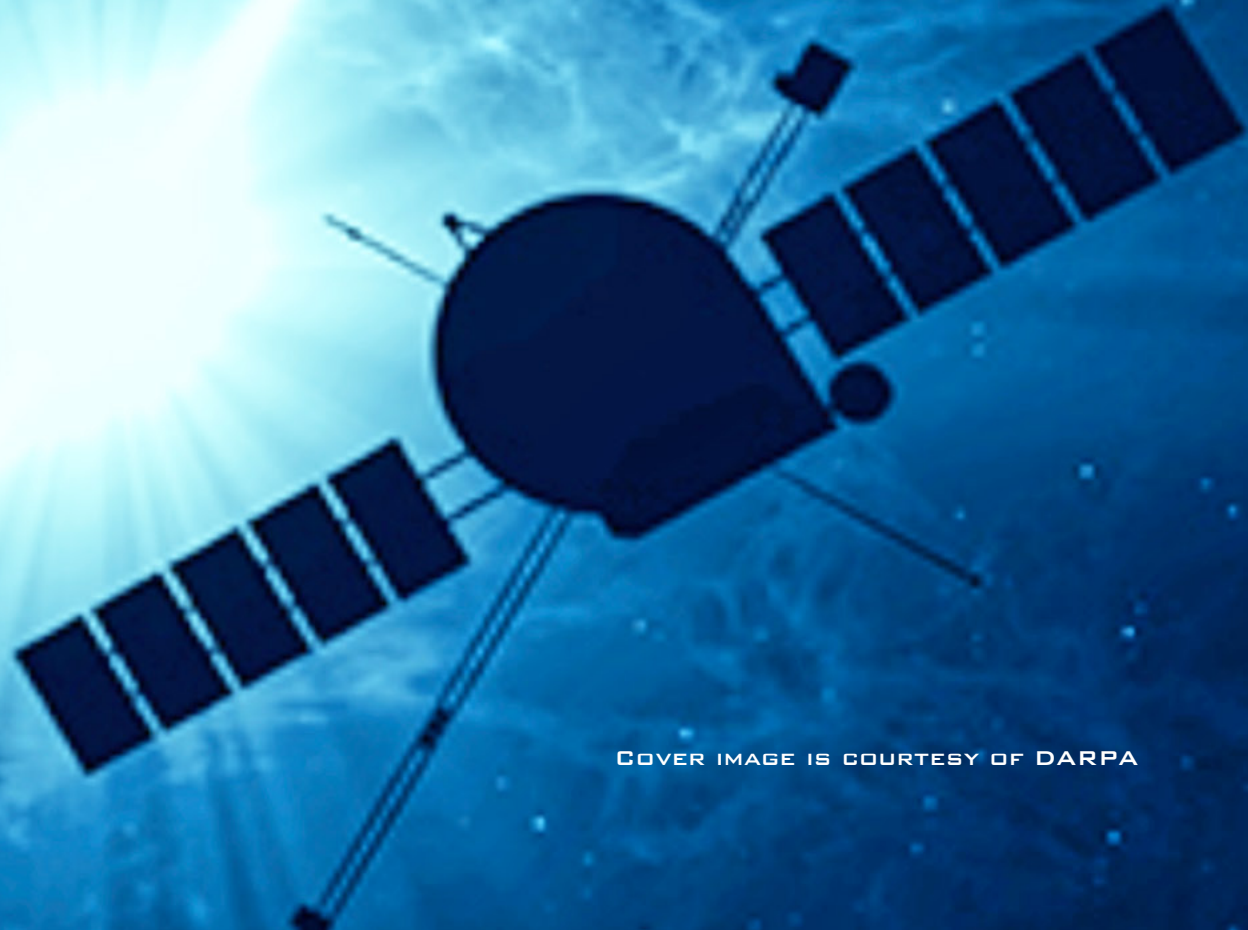


Next Generation Space Defense

MILSATMAGAZINE

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Karl Fuchs
Senior Contributor, iDirect Government

This issue's authors

BIS Research Editorial

Dave Micha

Ryan Schradin

Joel Schroeder

SSC Editorial Team

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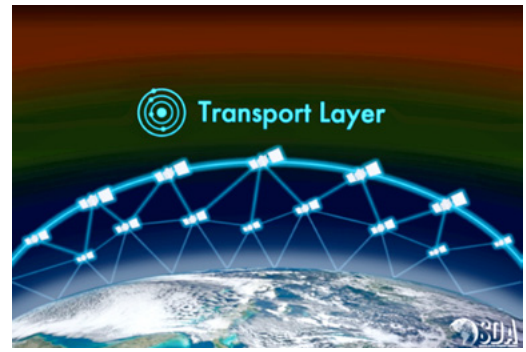
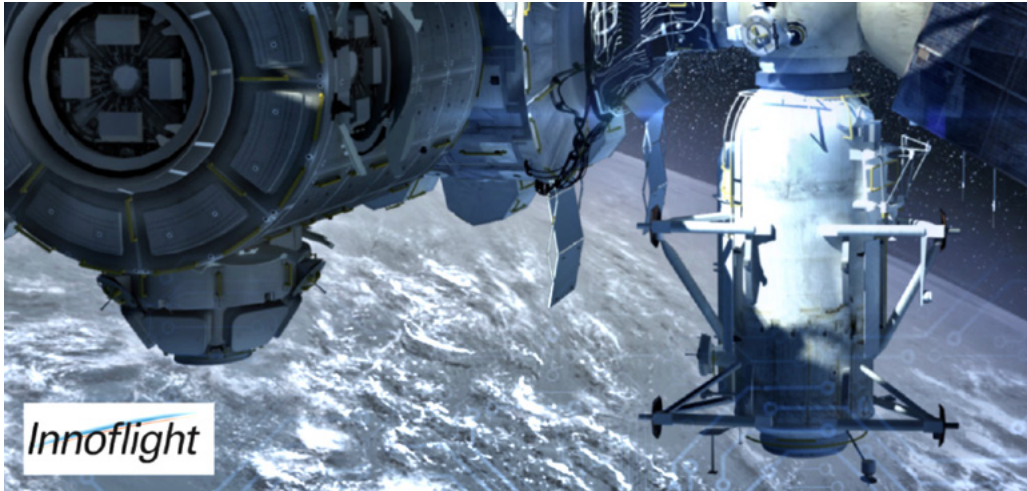
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DISPATCHES

Innoflight selected by Northrop Grumman as strategic space avionics supplier



Innoflight has been selected by Northrop Grumman Corporation as a strategic avionics supplier for the Space Development Agency (SDA) Tranche 1 Transport Layer (T1TL) program.

Last year, SDA announced the award of three prototype agreements worth approximately \$1.8 billion to establish the foundation for T1TL, a mesh network of 126 optically interconnected *Space Vehicles (SV)* that will provide a resilient, low-latency, high-volume data transport communication system, and be ready for launch by September 2024.

Northrop Grumman was one of the awardees and is responsible for providing 42 SVs to be deployed in two, LEO, orbital planes. The T1TL objective is to form the

initial warfighting capability tranche of the Proliferated Warfighter Space Architecture (PWSA). For T1TL, Innoflight will leverage its range of flight proven products to advance its technologies to higher levels.

Specifically, Innoflight will be delivering to Northrop Grumman **S-band software-defined radios (SDRs)** for **Telemetry, Tracking, and Control (TT&C)** data links, Type-1 “*bulk*” and “*mesh network*” **End Cryptographic Units (ECUs)**, network Internet Protocol (IP) routers with **Multi-Protocol Label Switching (MPLS)**, network Ethernet switches, flight processors with on-orbit data storage — including **Battle Management Command, Control and Communications (BMC3)**, and precision navigation timing. Innoflight products to be delivered for SDA T1TL

“Innoflight is proud that Northrop Grumman selected Innoflight for the T1TL program. We have been working diligently with Northrop Grumman for some time and we believe our joint expertise will be beneficial to successfully deliver cutting-edge technology at volume to support our warfighters,” said **Jeff Janick**, Innoflight CEO and President. “Our strong collaboration has already yielded significant progress towards completing the design of advanced SV sub-systems in scope.”



Innoflight products to be delivered for SDA T1TL

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U.S. Air Force + Northrop Grumman conduct Sentinel static fire test



The U.S. Air Force (USAF) and Northrop Grumman conducted a static fire test on March 2, 2023, for the LGM-35A Sentinel weapon system at Northrop Grumman's facility in Promontory, Utah.

This open-air test is the first in a series of static fire tests that will validate the design and performance of Sentinel's three-stage propulsion system during its development.

The Stage-1 solid rocket motor (SRM) tested is the largest of Sentinel's three stages and the first SRM to fire upon missile launch.

"This test is just one part of our comprehensive ground and flight test program designed to help us shake down the design as we approach its critical design review. By testing early, we reduce risk to the overall weapon system schedule," said Maj. Gen. **John Newberry**, Air Force Nuclear Weapons Center commander and Air Force program executive officer for strategic systems.

The test results are currently being analyzed by a team of experts from AFNWC and Northrop Grumman.

"This test shows that the Sentinel program is now in the phase of its development where physical hardware is being tested in real-world conditions," **Newberry** said. "It is further evidence that AFNWC will successfully deliver this capability to the warfighter."

"This static fire highlights the advances we've made in digital engineering and gives us confidence in our ability to translate that into hardware build and test as we continue to make progress on the path to flight testing," said **Sarah Willoughby**, vice president, Sentinel, Northrop Grumman.

"The results allow us to validate and anchor our stage-one motor performance before entering qualification testing and completing system analyses, key to lowering risk as we mature the Sentinel design and advance towards critical design review. Our investments in digital design, test and advanced manufacturing help to ensure we develop this next-generation missile more affordably and with innovation at its core, delivering to the Air Force a safe, secure, reliable and flexible capability."

Northrop Grumman also leveraged advanced testing equipment that allowed for increased data collection to better understand motor characteristics.

The USAF plans to replace the fielded **Minuteman III** intercontinental ballistic missile with the next-generation Sentinel system that is currently in development by Northrop Grumman. The Sentinel acquisition program represents the modernization of the land-based leg of the U.S. nuclear triad.

L3Harris Viper Shield EW system awarded long-lead material contract



L3Harris Technologies (NYSE:LHX) has received an undefinitized contract from Lockheed Martin to procure long-lead material for the Viper Shield electronic warfare (EW) system to accelerate global product delivery.

In late 2022, Viper Shield successfully completed the critical design review milestone with Lockheed Martin and the U.S. Air Force. Viper Shield also demonstrated interoperability with the new **APG-83 Active Electronically Scanned Array radar** during testing at the **Lockheed Martin Systems Integration Lab**.

The **AN/ALQ-254(V)1 Viper Shield** supports the Lockheed Martin **F-16 Block 70/72** aircraft production for the global F-16 fleet and was designed as the baseline EW system for the aircraft.

This contract, in conjunction with a future full-rate contract award for Viper Shield ship sets, will enable planned production EW capability deliveries for customers worldwide.

The Viper Shield program remains on schedule and is slated for installation on the next-generation F-16 aircraft for multiple international air defense forces.

Viper Shield will return again to the Lockheed Martin Systems Integration Lab later this year with newly integrated hardware and software to test the next planned increment of capabilities with the F-16 Block 70/72 aircraft.

"Viper Shield protects next-generation F-16 fighters from previously unimaginable threats by providing a radio frequency shield, a warning receiver and jamming system, around the aircraft," said **Ed Zoiss**, President, Space and Airborne Systems, L3Harris. "This contract puts us one step closer to equipping our global customers with the most advanced EW system to safely complete missions in increasingly complex battlespace scenarios."



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SSC delivers the first hosted payload to Japan in historic USSF partnership

Space Systems Command's (SSC) Space Domain Awareness & Combat Power (SDACP) Directorate has delivered the first of two payloads to Japan, placing the United States and Japan one step closer to the launch of two, U.S.-hosted payloads on Japan's GEO-based Quasi-Zenith Satellite System (QZSS).



Quasi-Zenith Satellite System components are securely loaded on a transport vehicle inside the 66th Logistics Readiness Squadron facility at Hanscom Air Force Base, Mass., Jan. 5, 2023. (U.S. Air Force photo by Todd Maki)



Artistic rendition of the QZSS constellation, courtesy of Mitsubishi Electric.

QZSS-HP's mission as a pacesetter partnership with Japan is not complete, but the development, test, and delivery of the first hosted payload demonstrates exactly the kind of partnership spirit needed for the Space Force to set the stage for future success.

"This delivery of the first spaceflight-ready payload represents an important milestone for QZSS-HP. While a lot of work remains, I'm happy to report that we're on track to meet our commitments," said **Lt. Col. Brian Fredrickson**, program manager and representative of SDACP's Space Domain Awareness Delta. "QZSS-HP has benefited tremendously from being categorized as a prototype, as it has enabled the program to be responsive and move with speed."

"We've worked hard to move from concept and requirements development through the design phase, and into assembly, integration, and test of the two hosted payloads very quickly. We're excited for our next steps and to work with our Japanese partners," said **Capt. Alex Woodard**, deputy program manager.

"This is an exciting and important mission," said 1st Lt. Joe Santiago, QZSS-HP's logistics & security lead, adding that the delivery would not be possible without Space Force's partnership with Air Mobility Command to secure safe transit from Hanscom Air Force Base's 66th Air Base Wing in Massachusetts to Yokota Air Base's 374th Airlift Wing in Japan. "QZSS-HP's success depends on the contributions of a number of mission partners on the US side, including our partners at Yokota and Hanscom."

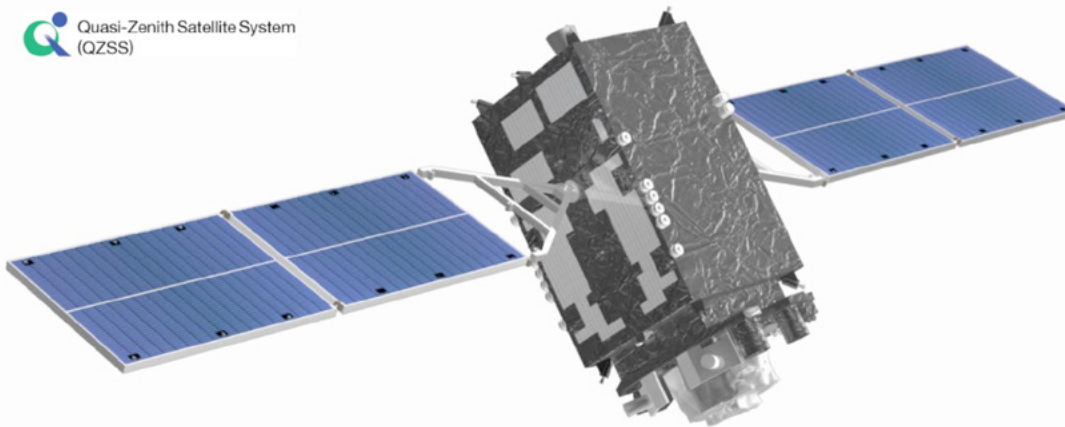
2nd Lt. Danielle Katz, the program's ground lead, added, "QZSS-HP is also making great strides in proving out the end-to-end connectivity with Japan to support on-orbit testing and operations."

Space Systems Command is the U.S. Space Force's field command responsible for acquiring and delivering resilient war fighting capabilities to protect our nation's strategic advantage in and from space.

SSC manages an \$11 billion space acquisition budget for the Department of Defense and works in partnership with joint forces, industry, government agencies, academic and allied organizations to accelerate innovation and outpace emerging threats. Our actions today are making the world a better space for tomorrow.

The payload deliveries follow the historic *Memorandum of Understanding (MoU)* signed two years ago between *Japan's National Space Policy Secretariat (NSPS)* and the *U.S. Space Force*.

As the payloads arrive in Japan, the program will then begin the next stage of integration to the two QZSS host satellites and to prepare for launch. The two launches will expand the QZSS constellation to a total of seven.



Artistic rendition of Japan's Quasi-Zenith Satellite System

The QZSS-HP program demonstrates a shared commitment to increase space partnerships in alignment with both allies' national space policies, central to the U.S. Space Force's priority of expanding cooperation to contribute to integrated deterrence and international security.

The QZSS-HP mission has been supported by SSC since its inception in 2018 as a rapid acquisition and pacesetter partnership effort with Japan.

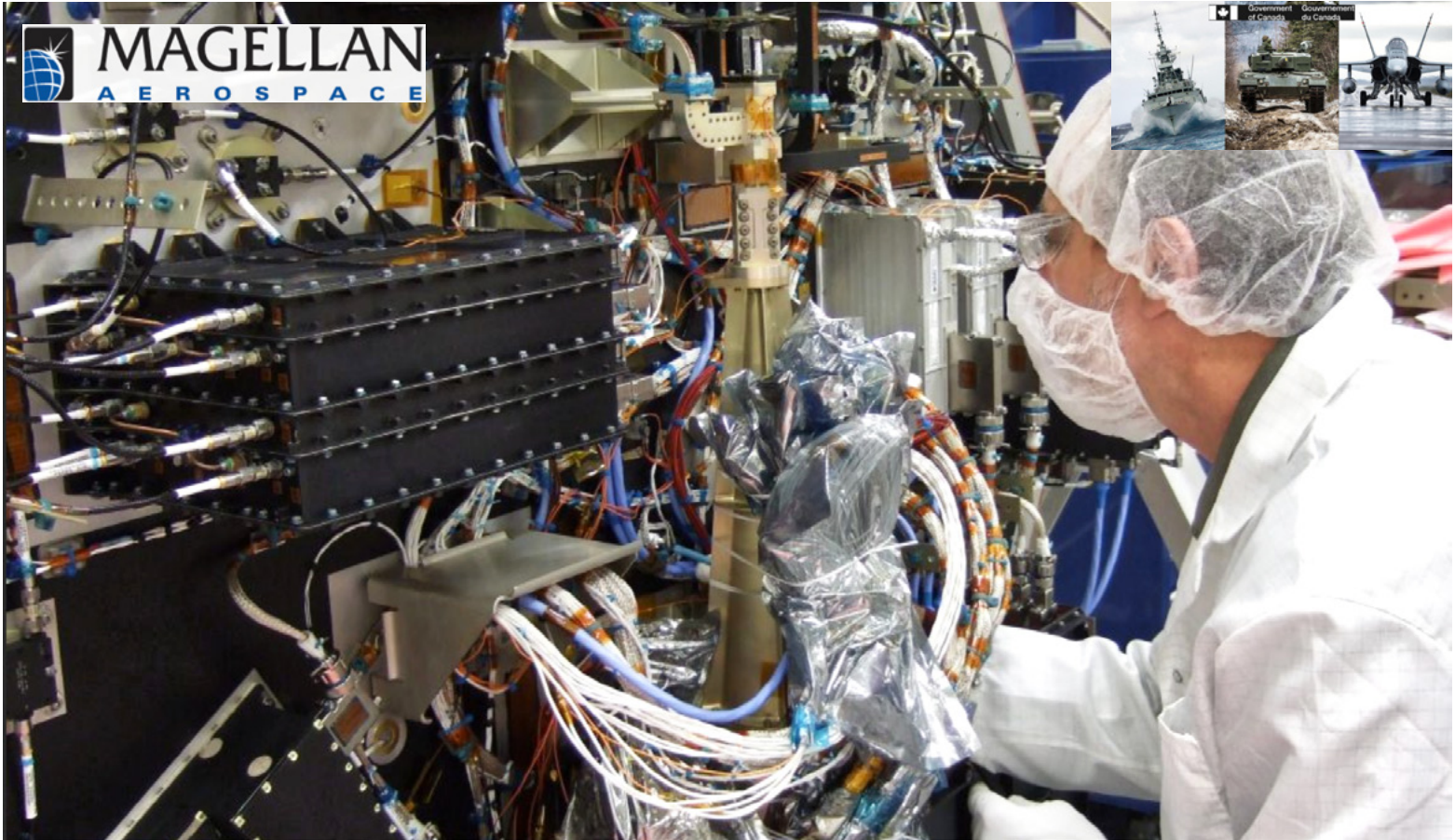
On the U.S. side, **Massachusetts Institute of Technology Lincoln Laboratories (MIT/LL)** is the prime payload developer for QZSS-HP. MIT/LL and SSC have led the development from a concept in 2018 to ready to deliver hardware in 2023. In the next phase,

MIT/LL and USSF personnel will mobilize to Japan to support the integration and test efforts with their Japanese partners until completion of the launch of both QZSS host satellites.

DISPATCHES

Magellan Aerospace awarded SDA smallsat contract by Canadian government

Magellan Aerospace Corporation ("Magellan") has received a contract from the [Government of Canada](#) to design, build, launch, and operate the Redwing smallsat.

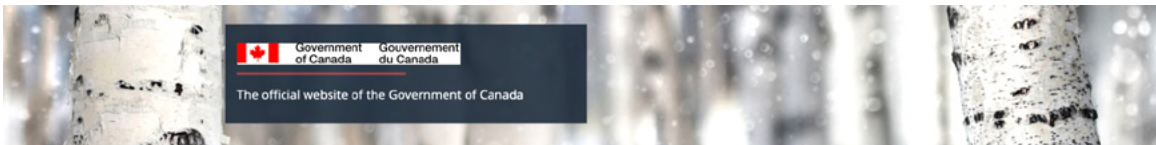


Directed by the [Department of National Defence's](#) science and technology organization, [Defence Research and Development Canada \(DRDC\)](#), the \$15.8 million Redwing contract represents the next generation of spacecraft technology for [Space Domain Awareness \(SDA\)](#) technology demonstration.

near real-time tasking to respond to evolving space events. Redwing will provide a risk reduction role by helping to ensure continued Canadian access to critical space capabilities, such as communications, remote sensing as well as weather services.

of North America by increasing understanding of what is in orbit above North America and other continental regions.

According to [Haydn Martin](#), Magellan's Vice President, Business Development, Marketing and Commercial, "The Redwing mission will leverage Magellan's solid heritage in building high-quality space systems, while establishing new spacecraft technologies and mission capabilities. We are very proud to be supporting DRDC and the Government of Canada in this exciting endeavor."



When launched in 2026, Redwing will perform space object tracking to characterize an increasingly congested orbital environment, observe higher detail on space objects, and provide

Redwing will also provide the [Canadian Armed Forces](#) with a platform for experimental characterization of space objects, supporting a critical role within Canada's space operations community. Redwing also supports the defence

For more than 60 years, Magellan has been a reliable supplier of space systems to the Canadian and global markets. Redwing will be designed and built by the Magellan's Winnipeg facility, which produced the platforms, or buses, for the highly successful SCISAT-1, CASSIOPE, and RADARSAT Constellation Mission satellites. Magellan will also oversee the development and operations of the overall Redwing mission, including contributions from both industrial and academic partners.

Defence Research and Development Canada





SPACE AS A WARFIGHTING DOMAIN

Evolving concerns and required solutions

Authors: BIS Research Editorial Team

A Brief History Of Evolution

For decades, space has remained a commercial domain despite the military forces initiating some of the first space programs and missions. Although primed by defense requirements, space was preempted by the commercial domain as the influence of space in enabling an enhanced quality of life for citizens across the globe took precedence over the ability to strengthen military capabilities.

Commercial satellite operators and civilian space agencies dominated the space domain with multiple missions across Earth Observation (EO), communication, navigation, and deep space exploration.

Along this journey, the defense agencies remained active in maintaining a certain set of space capabilities before migrating to using commercial versions.

It proved convenient to allow the commercial space market participants to design, develop, deploy, and maintain the space assets while the capabilities were used by the defense agencies. The convenience and its preference have only grown over the decades.

The defense entities responsible for managing the military space capabilities evolved into space commands reporting to air force leadership. The space commands evolved across the forces globally, maintaining the trend of them being a subset of one of the military services, with the air force being the most common. Such began to change as the space industry evolved, especially when the industry opened to a large number of commercial market participants.

Although at a slow pace, the space industry developed reliable technologies, which traditionally took a long time in the research and development phase before being commercialized.

With multiple commercial participants entering the industry, the technology development activities scaled up in magnitude. The consequence was a positive wave of enhanced and new space capabilities that started delivering value across applications and markets.

The space commands leveraged these developments and evolved into a phase where the military stakeholders remained primary customers who started following the commercial space markets, unlike the initial years when they conducted many technology development efforts internally.

Resurgence Of The Arms Race NexGen Missile Defense Systems

With evolving geopolitical conditions, military forces expanded their capabilities and operations, which integrated space capabilities in multiple ways. Space commands evolved their roles to be key enablers of capabilities across air, land, and sea domains.

Military capabilities today are rather incomplete when detached from space capabilities. What used to be interesting, nice-to-haves, became absolute-must-haves, making space commands more responsible — however, space commands remained subsets within existing services (*mostly the air forces*).

The post-world-war spending on missile defense declined until the recent past. The threat perceptions demanded relevant deterrence capabilities over and above missile defense solutions. However, this started to change as hypersonic platforms gained prominence a few years ago in the missile defense domain. Adding to this was the persistent perception within military forces that the missile defense systems were aging and needed an upgrade as the post-world-war requirements were no longer relevant.

This renewed focus on missile defense systems brought in the need for persistent, forward-looking, sensing capabilities, *i.e.*, military satellite-based *intelligence, surveillance, and reconnaissance (ISR)* capabilities.

The same grew stronger with the entry of hypersonic technologies within the military domain. Platforms operating in new high-speed regimes (*upwards of Mach 5*) have rendered the existing detect, track, and engage capabilities null and void.

While the missile defense domain was experiencing the emergence of new requirements, it also received the attention of political leadership which demonstrated the intent to fulfill the needs through suitable investments for the enhancement and development of nexgen capabilities, pivoting on hypersonic technology.

This trickled down into the management structure of military forces — space commands started assuming larger roles and responsibilities. The U.S. administration's declaration of the need for a dedicated [U.S. Space Force \(USSF\)](#) finally pushed the [U.S. Space Command](#) to evolve into a separate military service alongside the army, navy, and air force.

Similar circumstances evolved across the globe decades ago but were not sustainable over the long term. For instance, the **Russian Space Force** was formed in the early '90s but was later dissolved and recreated as a subset of the **Russian Aerospace Force** as of 2015.

The U.S., the Republic of China, Russia, France, and Iran have dedicated military services that specialize in military space capabilities. Many forces continue operating their respective space commands as subsets of existing services and there are multiple joint and multinational space commands. India, in 2018, for example, announced their **Defense Space Agency**, a tri-service agency, is expected to evolve into a military command specializing in space warfare capabilities. The birth of the space forces indicates the evolving need for broader space capabilities and confirms that space is a warfighting domain moving forward.

Space Forces + The New World Order in Space

Unlike the air, land, and sea domains, where threats are experienced and perceived in a real and physical sense, the same does not exist in the space domain. In space, the assets experience six degrees of freedom (*similar to underwater conditions but heavily dependent on gravity*) and operate in a vastness that, although measurable, is overwhelming for the warfighter used to perceiving physical space in non-space domains. As a result, the space domain is experienced more in terms of data and frequency of updates than physical parameters, such as the number of units and the territories they cover. All the EO satellites (*say, in polar orbits, for example*) orbit all territories capturing imagery of every piece of land they fly over. This means the space domain manifests itself more digitally than any other domain.

This naturally uncanny way of imposing itself on downstream actors makes the space domain all the more unique. Space forces, as a consequence, focus on establishing their capabilities' edge based on parameters that are measurable more digitally in the downstream segment than concentrating on the upstream segment. Of course, having more satellites on-orbit is important, but mere numbers make little sense to the space forces. They, therefore, focus on space capabilities from a technology incubation, deployment, and scalability standpoint.

Space forces need access to a wide range of space technologies in a continuously evolving format such that they can be customized and deployed on demand. They also require multiple options in each segment of the space capabilities (*EO, communication, navigation*) so they can be scaled up in magnitude and deployed across the globe as per emerging requirements.

Unlike the other domains where military deterrence is often a consequence of responsive actions following the detection of adversaries' actions, space forces need to consider future actions as the time taken to develop and deploy space capabilities is a critical defining parameter for establishing a competitive edge over adversaries.

If the country's political intent covers objectives across the globe responding to diverse geopolitical developments and the consequent collaborative military operations, the respective space forces have a much stronger mandate to present a broader and deeper capture of space capabilities in order to continually be pre-emptive and competitive to enable other services as well as establish their own territorial control and deterrence.

Evolving Concerns + Responsive Behavior

With the exponential growth of the New Space market, multiple commercial satellite operators and downstream service providers have entered the space industry with unique capabilities. **BIS Research's** space database indicates that, within the 2022-2032 timeline, 43,425 satellites are expected to be launched, covering 155 constellation operators, most of whom are commercial NewSpace operators.

Of these 43,425 satellites, approximately 7,673 are expected to be EO satellites. Space forces need not depend on building, launching and operating their constellation but can easily acquire multiple, commercial solutions. They can realize space capabilities much more quickly and in shorter spans of time than ever before experienced.

Many space actors also means growth in the number of space objects — more debris and more congestion as the global constellations represent thousands of satellites, mostly in **Low Earth Orbit (LEO)**. This, in turn, indicates the growing risks of collision and interference, compromising space missions directly and indirectly in many ways. The way out is to have a comprehensive portfolio of **space situational awareness (SSA)** capabilities that can help the space forces determine who is doing what, where... and when. This domain awareness is critical in establishing the fundamental perception of threats in orbit, most of which are unintentional (*without deliberate hostile intent in the backend*).

A small anomaly, such as a system failure on-orbit, could be easily perceived as a result of a deliberate act of hostility that can quickly escalate into armed conflict in other domains. Conflicting geopolitical stances could result in non-peaceful use of space capabilities to sabotage adversaries' space capabilities, however civilian they might be.

The need for domain-level awareness of space objects, space actors, and their on-orbit activities is imperative. The commercial market is already responding to this evolving situation.

BIS Research's recent study titled **Space Situational Awareness (SSA) Services Market - An Analysis of Debris Mitigation, Domain Awareness & Traffic Management Capabilities** estimates the commercial services market to be \$125.7 million in 2022, and that is expected to grow to \$172.7 million in 2032, with a CAGR of 3.3%.

Similar to the risk of unprecedented orbital events, space forces are enduring the stress of the still-evolving ability to conclusively detect, track and engage hypersonic missiles. The space-based ISR capabilities are critical in ensuring the final operational capabilities of next-gen missile defense architectures — how quickly the system can detect a hypersonic target and how persistently can the same be tracked to enable a successful engagement.

The offensive, defensive and support measures within missile defense systems are going through an upgrade, with the space piece remaining the most critical component.

Space forces play a key role in establishing this new age version of classic military deterrence capability. BIS Research's study titled **Advanced Missile Defense System Market - A Global and Regional Analysis** estimates the missile defense market to be \$21.81 billion in 2022 and expected to grow up to \$27.05 billion in 2032, increasing by a CAGR of 2.18%.

Next Steps + Commercial Opportunities

Space forces are focusing on accessing a wide range of space technologies to ensure they can scale up and deploy the relevant technologies as, and when, the needs arise. This means that the investment in research and development will grow while also opening the doors for multiple commercial space market participants. This is largely because it is unrealistic to integrate such a broad portfolio of space technology development vertically, and therefore, engaging the commercial participants to take charge of technology development is the logical response.

This emerging trend will create multiple opportunities for incumbents and startups in the space industry. **SciTech Inc.**, a company founded in 1979, received a contract for \$272 million from the USSF for **Mission Data Processing Application Provider**, which will enable the USSF's missile warning capabilities.

Similarly, the USSF recently announced that the organization would select a group of vendors to award a contract worth \$50 million (*indefinite delivery/indefinite quantity — IDIQ*) to procure satellites ranging from 12U to 180 kg smallsats. This indicates that multiple New Space market participants, especially startups and small businesses, will gain from such dedicated New Space-focused procurement programs.

The growth of the hypersonic capabilities will have further cascading impacts on space forces such that the spending on space capabilities will remain the critical determining factor of any competitive edge within the ongoing arms race within the missile defense domain.

BIS Research's defense practice estimates the supersonic and hypersonic aircraft market to be \$4.13 billion in 2022, which is expected to grow up to \$5.40 billion in 2032, growing by a CAGR of 2.73%. Interestingly, some of the commercial companies developing hypersonic technologies are being funded by military agencies, clearly indicating the military forces' expanding engagement of commercial market participants. The same trend will also be observed in the space domain, and the space forces will remain the key customers who will make those investments.

Conclusion

As of this writing, not all countries have space forces active — however, that is just the case of military space capabilities being controlled by respective space commands operating as subsets of existing services.

This is set to change, as the perception of holding superior space capabilities is increasingly understood as part of establishing additional military deterrence in space and other domains. While the civilian use of space is the focus of discussion within the industry, the military users, specifically the space forces, are challenging this notion as they have the mandate of establishing standalone deterrence in the space domain covering a wide range of capabilities going beyond Earth-orbit operations.

With more space forces coming into play, the militarization of the space domain is expected to grow, moving forward. The fact that most of the activity will remain on the digital front will remain a unique constant, closely engaging multiple commercial space market participants.

Unlike other domains, space forces will not constantly be engaging with adversaries in the physical sense. They would rather be active in maintaining their portfolio of capabilities that will let them share the domain awareness with their allies such that everyone knows who is doing what and where without necessarily infringing on each other. Space as a warfighting domain is already a reality, except that this domain will not serve as a platform for physical engagements.

The consequences can be detrimental to everyone involved in the long run. Therefore, the militarization of the space domain is more focused on preventing armed conflicts rather than creating new avenues for infringements. Interestingly, the commercial space market participants will play a critical role in enabling the evolution of space as a warfighting domain through capabilities designed for peaceful applications, only to ensure the space domain remains a platform for everyone involved forever.

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Author Arun Kumar Sampathkumar is the principal analyst within the Aerospace & Defense unit of BIS Research. With a background in aerospace engineering and an MBA, he has over 8 years of experience covering aerospace, defense and security verticals. Being passionate about small satellites, he has been monitoring the NewSpace markets, delivering market insights to government and commercial stakeholders.



GOVERNMENT SATELLITE REPORT

Creating a Unified, Global, Satellite Network to Power Joint, Multi-Domain Operations

Author: Ryan Schradin

In a keynote address at the IIITSEC Conference, General David W. Allvin, the Vice Chief of Staff of the U.S. Air Force, told attendees, “...none of us is as smart as all of us. And the situation we find ourselves in — this country — is going to require just the very best of us all.”

Gen. Allvin’s sentiment was an eloquent way to say that the U.S. military will need to work as a single unit and not disparate services — and will need to work hand-in-hand with coalition and industry partners — if it’s going to be victorious in the battles of the future.

This is not the first time we’ve heard a senior leader from one of America’s military branches discuss the need for collaboration to ensure success against the near-peer adversaries of tomorrow. This has been one of the fundamental cornerstones of the [U.S. Department of Defense](#) (DoD) as it builds its future force for the year 2030 and beyond.

However, collaboration, integration, and interoperability in one domain, in particular, have long been a challenge for the military. In space, where allied and industry partners each bring their own constellations of spacecraft and ground networks, getting everything to work together remains a challenge. That challenge only grows more significant as the space domain continues to evolve from a benign domain into a warfighting domain.

To learn more about the need for interoperable space and ground networks as joint multi-domain operations become essential, GSR discussed this need with **Ram Rao**, the *Director of Business Development Engineering, Technologies, and Solutions* at [SES Space & Defense](#). During this discussion, Ram was asked about the challenges that an austere space domain creates for the DoD, the technological challenges that the military faces when trying to integrate satellite networks with coalition and industry partners, and what some industry leaders are doing to make the seamless management of unified global networks a possibility for our military.

It’s apparent that the battles of tomorrow will cross domains — requiring capabilities to be delivered from the space and cyber domains to joint warfighters from the U.S. and its allies on land, in the air, and at sea. How do military networks become more complex and complicated when the space domain and space capabilities are added to the equation?



Gen. David W. Allvin



Ram Rao

RAM RAO

Correct. The U.S. DoD’s **JADC2** framework is all about our warfighters and decision-makers from every service area — such as the Army, Navy, Air Force, Marine Corps, Coast Guard, National Guard, and now the Space Force — participating in and sharing quality data to make effective and timely decisions before our adversaries can act. Of course,

“...the interaction between different networks is not as integrated, automated, or seamless. It’s often done through the direct interfacing of circuits with VPN or HTTPS connections. Or lower-tech, less efficient methods are utilized — such as email, DVD, or paper.” — Ram Rao

this seems easy at a high level, but it’s very complicated to implement, albeit required.

It is not a secret anymore that our adversaries — especially China and Russia — have been advancing and testing their space and cyber war capabilities in the last few years. In fact, they’ve been developing and testing these capabilities aggressively in the space domain over the past year.

We have read about *anti-satellite* (ASAT) tests conducted by Russia and China that resulted in the destruction of satellites in orbit. We also have witnessed China grabbing its satellite from the GEO orbit and maneuvering into a graveyard orbit. It is obvious they are preparing and testing various capabilities that can enable them to deny our nation’s access to satellite connectivity. Capabilities like these have turned space from a benign environment into a warfighting domain.

Warfighting in domains such as land, water, and air has existed for a long time. There have been hundreds or thousands of strategies and tactics developed in these domains that have evolved. The space

domain is a new warfighting domain, and defensive and offensive capabilities are still being developed and tested.

Also, in space, there are no area limits or rules. The traditional warfighting domains have rules of engagement and occur in space-restricted arenas. Space is huge, there are no established rules of engagement, and the capabilities are still evolving. This makes the space domain much more complicated.

What impact does the introduction of commercial satellite services have on the resiliency and assuredness of space capabilities?



RAM RAO

The DoD figured out long ago that the commercial industry and the integration of COMSATCOM services into their MILSATCOM solutions is crucial for mission-critical capabilities. I believe that integrating LEO, MEO, and GEO capabilities from the U.S. military, allied militaries, and commercial partners is a massive deterrent to our adversaries.

These capabilities tremendously increase our resiliency in space and on the ground, making it difficult for adversaries to deny our satellite capabilities. The high speed, high bandwidth, low latency, and pole-to-pole coverage that COMSATCOM can provide is unparalleled and well-positioned for integration with MILSATCOM.

What challenges does the added complexity of integrating multiple satellite resources and services create from a network transparency, assurance, and management standpoint?

RAM RAO

There are multiple challenges. But the government and its industry partners are well aware of these challenges and are working collaboratively to solve them.

When we say COMSATCOM and MILSATCOM, we're not just referring to two disparate networks. We are talking about hundreds, if not thousands, of disparate networks that need to be integrated worldwide.

Network transparency, assurance, and management require agreed-upon visibility and a standardized network interface. For example, the U.S. Space Force Enterprise Management & Control (EM&C) system requires network management systems from different DoD and commercial networks to be integrated at different levels.

That is a challenging task. Every participating COMSATCOM network may not follow the same standards. Also, when we start integrating the satellite capabilities of allied and coalition nations, we have to expect that different countries may follow different standards.

Assurance requirements for all countries are not the same. It's difficult to ensure that various networks align on multiple requirements, including access levels. However,

leading COMSATCOM industry players like SES Space & Defense have the infrastructure, capability, and experience necessary to integrate and operate as a part of a global military network.

How is the visualization and management of the whole military network – including military and commercial space assets and capabilities – done today? What tools exist that enable the military to see and manage everything?

“The DoD figured out long ago that the commercial industry and the integration of COMSATCOM services into their MILSATCOM solutions is crucial for mission-critical capabilities. I believe that integrating LEO, MEO, and GEO capabilities from the U.S. military, allied militaries, and commercial partners is a massive deterrent to our adversaries.” — Ram Rao

RAM RAO

Most individual networks with their network management systems (NMS) have required visualization and management capabilities. However, the interaction between different networks is not as integrated, automated, or seamless. It's often done through the direct interfacing of circuits with VPN or HTTPS connections. Or lower-tech, less efficient methods are used — such as email, DVD, or paper.

Not only is this laborious, but it doesn't move at the pace of battle. Speed of delivery — especially during warfighting times — is a top priority for every military decision-maker.

A number of tools and platforms are being developed and introduced across the industry that provides a unified view of the network. Solutions such as the [Information & Communications Technology \(ICT\) Portal](#) by SES Space & Defense provides transparent and consolidated network visibility improving performance and operational decision that can enable military users to see their entire network — including space and ground assets — on a single pane of glass. This new solution gives the military transparency into everything on their networks and allows for the easier management and operations of both terrestrial and space network assets and capabilities.

You talked about the sheer number of different space and ground networks that the DoD needs to see and manage as they work to integrate their own space assets with those of coalition and industry partners. How does the lack of a single, all-encompassing view of the network impact the military's ability to manage its networks to overcome denied or disrupted capabilities or services? How does this impact the warfighter in the field?

RAM RAO

I have heard every high-ranking official in our military discuss the need to increase the speed of delivery and the speed of operations. But to accomplish this, they need end-to-end communications and data-centric global networks.

They are also looking to reduce the latency in satellite networks from the 600ms offered by satellites in *Geosynchronous Orbit* (GEO) to the 150 to 50 ms offered by satellites in *Lower Earth Orbit* (LEO) and *Medium Earth Orbit* (MEO).

Timing is everything for warfighters. It's no surprise that our adversaries are working

“The U.S. DoD's JADC2 framework is all about our warfighters and decision-makers from every service area...participating in and sharing quality data to make effective and timely decisions before our adversaries can act. Of course, this seems easy at a high level, but it's very complicated to implement, albeit required.” — Ram Rao

towards pursuing efficient delivery capabilities. To continue to compete and win in the future, we need to remain faster and more effective despite their efforts.

Global integration of our networks is crucial for seamless connectivity from one end of Earth to the other through various space and ground connections. The lack of a unified network will significantly and adversely impact the speed at which we deliver information and capabilities to warfighters, drastically reducing their

U.S. Soldiers from the 2nd Stryker Cavalry Regiment, set up a Satellite Transportable Terminal (STT) system at Orzysz, Poland. The STT is an optimized, over-the-horizon communications system ideally suited for tactical communications missions. (U.S. Army photos by Charles Rosemond, Training Support Team Orzysz)



effectiveness. However, with an integrated, resilient network – and agreed-upon access – there should not be any denials or disruptions.

What is the Information & Communications Technology (ICT) Portal? What was the initial concept and intention for the portal? What tools or capabilities does the ICT Portal give to military and government users?

RAM RAO

The ICT Portal is a flagship capability SES Space & Defense offers to customers and mission partners as a part of the company’s network solutions. The ICT Portal is a web-based **NetOps** set of tools providing end-to-end situational awareness in a consumable “single pane of glass” user interface. The consolidated network visibility provides our mission partners something they generally don’t have with COMSATCOM networks – a near real-time view into the network.

Even when COMSATCOM networks work in tandem with MILSATCOM networks, the ICT Portal gives users a view of their space segment, teleports, gateways, hubs, and terrestrial circuits – all the way to the individual user terminals.

The ICT Portal offers users five views into their network – each with multiple capabilities. These capabilities and functionality include an operational dashboard, terminal console, capacity management tool, and reporting tools. Within each capability view are a variety of sub-views, each with dozens or sometimes hundreds of data points to observe, filter, and use to improve the understanding of the SATCOM network.

SES Space & Defense’s intention has always been to support our mission partners with capabilities that deliver complete visibility and transparency into their networks and provide the situational awareness required to make timely, informed decisions.

Can you provide an example of how and why the ICT Portal could be useful to the military doing a mission or operation? What could it enable them to do?

RAM RAO

Our ICT Portal’s satellite coverage overlays allow users to see both EIRP and G/T maps of the satellite coverage in their network. The intent of this capability is to show users their satellite coverage within the deployment area.

This enables them to know – before they deploy – the minimum terminal specification required in that location. For example, if they are in the 50 dBW contour, they will need a minimum of a 1.2 meter antenna with a four-watt BUC. Users can also select multiple footprints to see where they have overlapping or redundant coverage. This capability immensely helps quick and efficient planning.

Another useful example is the company’s **VSAT Point Assist** tool. While it is best practice to always do a site survey prior to deploying a VSAT terminal, we understand that it’s not always

possible for DoD missions. The VSAT Point Assist tool provides field techs with a way to do site surveys virtually.

The VSAT Point Assist tool allows users to input a location and choose a satellite. It then generates an estimated pointing angle and provides other necessary information, such as elevation and azimuth angles. Users can also drag the icon to different locations to ensure a clear path to the satellite.

The goal is to enable the military to conduct site surveys without a physical presence in theater and save significant time and costs while allowing them to better prepare for missions in advance.

Another useful example I’ll share is the **ICT Portal Weather Overlay** capability that offers more than 150 different options of illustrating near real-time, historical, and forecasted weather information. This tool allows users to select as many of these events as they want and add them to the active list – such as active fire points, lightning strikes, tropical cyclones, and other live weather events. They can even see hurricanes and their paths.

These overlays are essential to improve situational awareness for our warfighters. It allows them to visualize how rain, snow, or ice may affect satellite connections and identify any alternatives they may have.

Is the ICT Portal available now? If not, when will it be available? Also, who will be able to use this offering?

RAM RAO

The ICT Portal is available for SES Space & Defense network customers and is being used by some of the firm’s current government partners.

We are continually working with our customers to improve and expand the capabilities of the ICT Portal. We have an extensive road map to add new capabilities and features to the ICT Portal, including AI/ML (Artificial Intelligence / Machine Language) capabilities, a complete cyber monitoring package, and fully customizable reporting packages. We also plan to enable select mission partners to control portions of the network as needed for critical mission success.

To learn more about the **SES Space & Defense ICT Portal**, or to request a demonstration, [select this direct link...](#)

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“Our ICT Portal’s satellite coverage overlays allow users to see both EIRP and G/T maps of the satellite coverage in their network. The intent of this capability is to show users their satellite coverage within the deployment area.” – Ram Rao



Ryan Schradin

Ryan Schradin is a communications expert and journalist with more than a decade of experience. Ryan has edited and contributed to multiple popular online trade publications focused on the satellite, unified communications and network infrastructure industries. In addition to editing content and establishing editorial direction, Ryan also contributes articles about satellite news and trends and has also conducted written and podcast interviews for GovSat.

DISPATCHES

Boeing + Shield AI to collaborate on AI + autonomy for defense programs



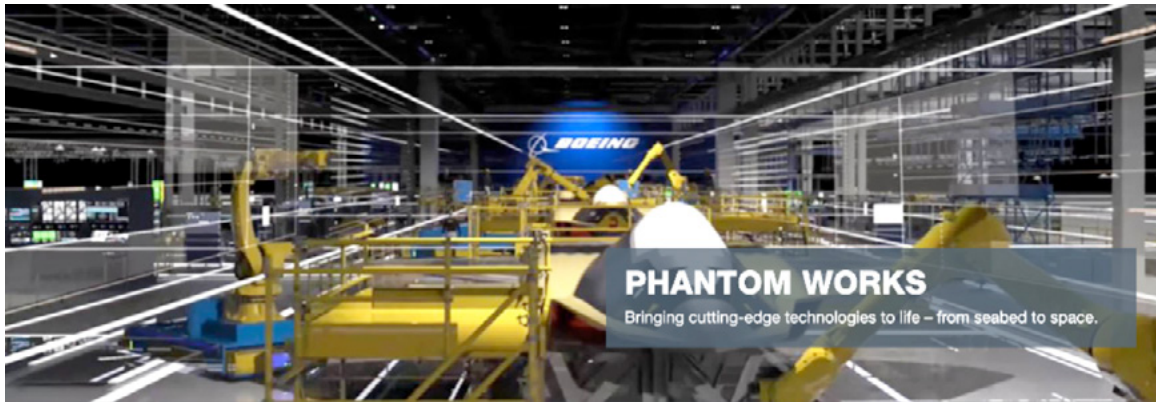
Boeing [NYSE: BA] and **Shield AI** have signed a Memorandum of Understanding (MoU) to explore strategic collaboration in the areas of autonomous capabilities and artificial intelligence (AI) on current and future defense programs. The agreement will be managed by **Boeing Phantom Works**.

Shield AI created Hivemind, an AI pilot that has flown a variety of aircraft. According to the company, the AI pilot can also enable swarms of drones and aircraft to operate autonomously without GPS, communications or a human pilot in the cockpit.

Shield AI's synthetic environments combined with human-machine tactics and behaviors.

Testing and learning in real physics simulations reduces engineering cycle times and enables rapid real-world deployment.

"Boeing continues to leverage talent from across the enterprise to make great strides in autonomous capabilities and programs in recent years," said **Steve Nordlund**, vice president and general manager for Boeing's Air Dominance organization. *"Collaborating with Shield AI, the leader in AI pilots, will accelerate our ability to deliver these capabilities to the warfighter."*



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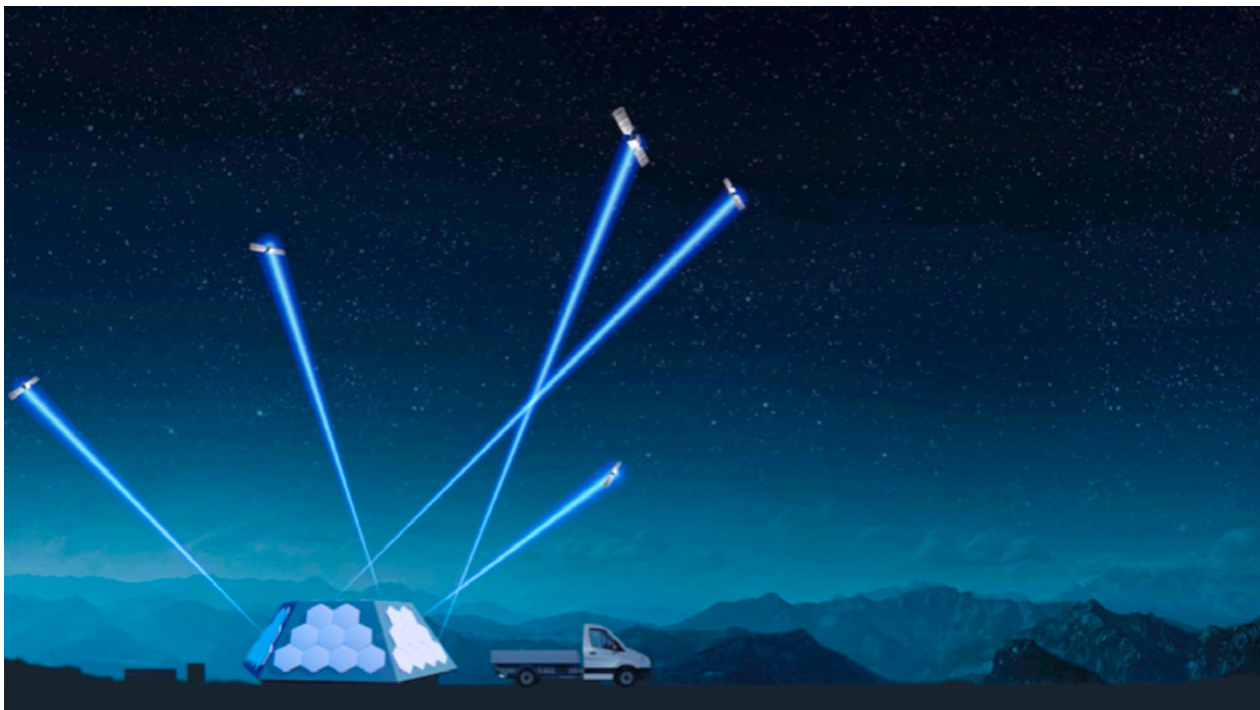
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DISPATCHES

AFRL selects ThinKom for nexgen gateway solution



ThinKom's solution brings significant advantages to comparable parabolic or ESA options.

The low-profile design enables "hide-in-plain-sight" installations, unobtrusively fitting in areas where a parabolic dish would be easily detected or otherwise unwelcome.

The design also offers near-zero wind loading, requires minimal real estate and allows multiple arrays to be closely collocated without risk of blockage.

At the same time, the ThinKom gateway array delivers the high spectral efficiency its VICTS technology is known for, with low prime power draw.

The modular structure also dramatically improves system resiliency and redundancy. An installation site could, for example, swap out one damaged aperture while all others in the array remain

active. The relatively small size of each component allows those swaps to occur with just a couple technicians, rather than requiring heavy-lift equipment.

The United States Air Force Research Laboratory (AFRL) has contracted with ThinKom Solutions, Inc. to deliver a modular and scalable phased-array antenna solution to support ground segment operations.

Growing demand for satellite broadband and Earth observation via *Low Earth Orbit* (LEO) and *Medium Earth Orbit* (MEO) constellations requires more beams to track the multitude of satellites overhead. ThinKom's new modular approach can provide multiple independent beams, each connecting to a different satellite while managed by a proprietary digital beamformer.

The array repoints from a setting satellite to a rising one nearly instantly, matching a key advantage of *electronically steered antennas* (ESAs). Alternatively, with the multiple antenna modules available, the ThinKom gateway array can deliver make-before-break handovers for truly uninterrupted communications.

"The next generation of satellite networks requires a new paradigm in the ground segment," said **Bill Milroy**, ThinKom Chairman and Chief Technology Officer. "ThinKom has a strong history of delivering high-performance antenna hardware to the US government. We are excited to extend that relationship with the AFRL, taking our proven technology, and scaling it up to deliver future-proof gateway connectivity to every orbit and every frequency."

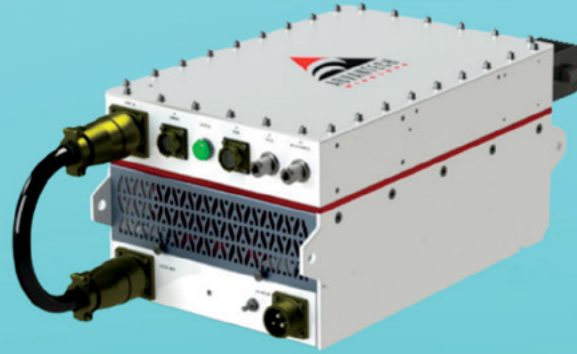


The new ThinKom gateway array delivers a fully customizable solution, allowing for multi-beam, multi-orbit, multi-frequency services in a compact, low-power, resilient design.

Built on ThinKom's field-proven, patented **VICTS (Variable Inclination Continuous Transverse Stub)** technology, it is a modular system enabled by digitally combining independently controlled antennas into compact, highly efficient **arrays**.

ThinKom's software-defined, modular gateway is fully customizable, depending on the specific implementation requirements. This dynamic flexibility delivers improved performance in key use cases and was recently recognized as the 'Satellite Technology of the Year.'





Introducing **GENESIS** - the new series of Ku-band SSPAs and BUCs from Advantech Wireless Technologies.

GENESIS epitomizes the latest in hardware and software technologies, making it the most feature-rich satcom SSPA in the industry. Initially available in 200W, and 250W variants, GENESIS delivers a host of high-end features, including some that are unique to the **GENESIS** family:

- Secure SNMPv3 interface
- Modular construction – fast production & simple serviceability
- Full M&C capability with embedded Webserver
- Field-removable power supply and fans
- Forward and reflected power monitoring & true RMS power detection
- Device-level monitoring for detailed fault analysis and diagnostics
- Embedded logic to manage multi-amplifier redundant and phase-combined systems, negating the need for any external controllers.

Additional frequency bands and higher power levels based on the **GENESIS** platform will become available in the coming months.



DISPATCHES

Raytheon I&S developing mission planning + C2 systems for USAF



Raytheon BBN has been awarded a contract by the U.S. Air Force (USAF) to develop a rocket cargo mission planning, and Command and Control (C2) system for the USAF — this contract has a potential value of \$8.7 million over four years and is part of the U.S. Air Force 2030 Science & Technology Strategy's transformational science and technology portfolio.

They will also work to identify coordination points across mission-planning and C2 stakeholders and propose solutions to address existing gaps in knowledge, organizations and processes.

Success of the system relies on careful design and development of complex collaborative planning, and C2 processes and tools across multiple government and commercial organizations.

Use cases will include high profile rapid delivery of DoD mission cargo and humanitarian aid.

"The tool we create must enable the Air Force to plan, coordinate and conduct a rocket cargo mission within hours," said **Beth DePass**, Raytheon BBN principal investigator for the project. "At its core, this is a logistics challenge of epic proportions. Although the cargo would initially be pre-packaged and stored at the launch site for rapid loading, there are still tremendous challenges with how the DoD will safely load, launch, and deliver under very tight timing constraints.

"We will be taking into consideration pre-flight testing, weather conditions, launch approvals, and many other variables, to deliver that cargo precisely where it's needed, when it's needed, faster than current delivery methods. We will iterate with multiple DOD stakeholders, the Air Force, and the Space Force to ensure we have the best solution to one of their greatest challenges."

Work on this contract will be conducted in Cambridge, Massachusetts; Asheville, North Carolina; Mountain View, California; Stanford, California; Austin, Texas; and Fort Wayne, Indiana.

Raytheon BBN is a subsidiary of Raytheon Intelligence & Space, a business of Raytheon Technologies.



During the initial 30 month effort, the Raytheon BBN team will develop mission planning and C2 concepts, identify and develop initial rocket cargo workflows and processes, and design advanced human-machine interfaces based on cognitive engineering principles.

Raytheon BBN will leverage its extensive experience developing and maintaining logistics and planning tools used by the **Department of Defense**, such as the *Analysis of Mobility Platform*, or AMP, *Global Mission Scheduling*, or GMS, and the *Rapid Course of Action Tool*, or RCAT, to provide the capability to support the rocket cargo mission.



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Defense Primer: Procurement

Authors: Heidi M. Peters, Analyst in U.S. Defense Acquisition Policy + Brendan W. McGarry, Analyst in U.S. Defense Budget

Background

While procurement implies a process of obtaining goods or services, the word also refers to a specific title and associated accounts within the annual [National Defense Authorization Act \(NDAA\)](#) and [Department of Defense Appropriations Act](#).

Appropriations for Procurement

The [Department of Defense](#) (DoD) procurement appropriations title provides funds for non-construction-related investment costs — the costs to acquire capital assets, such as an F-35 Joint Strike Fighter aircraft or a Virginia-class submarine. Investment costs are distinguished from expenses—the costs of resources consumed in operating the department, such as food and fuel. DoD uses procurement appropriations to obtain various categories of materiel, including...

- New military hardware (e.g., satellites, aircraft, ships, armored vehicles, and radios);
- Upgrades to existing equipment, including service life extension or re-manufacturing programs;
- Weapons and ammunition (e.g., air-to-air missiles and rifle rounds)
- Spares and repair parts

Procurement funding provided to the department in a given fiscal year can usually be obligated over a period of three years. The most prominent exception is Navy Shipbuilding and Conversion funding, which is available for five years. The [Department of Defense Appropriations Act, 2023 \(Division C of P.L. 117-328\)](#) provided \$162.2 billion for procurement accounts (see [Table 1](#)).

Defense Authorization and Appropriations Resources

CRS In Focus IF10516, [Defense Primer: Navigating the NDAA](#)
CRS In Focus IF10515, [Defense Primer: The NDAA Process](#)
CRS In Focus IF10514, [Defense Primer: Defense Appropriations Process](#)

How is DoD Procurement Funded?

In general, Congress appropriates money for defense procurement under a policy of full funding, which requires funding the entire procurement cost of end-items (e.g., [AIM-9 Sidewinder missiles](#) or [KC-46A refueling tankers](#)) in one fiscal year.

In other words, the total funding necessary to acquire a usable end-item is approved by Congress in a single fiscal year, even though related work may span many years.

In some cases, programs have been procured using incremental funding, a funding policy typically associated with research and development activities. Under incremental funding, a system's cost is divided into two or more annual portions, or increments, that can reflect the need to make annual progress payments to the contractor as the system is built. Incremental funding has principally been used to procure certain ships and submarines.

Exceptions to Full Funding

• Multiyear Procurement.

Under [10 U.S.C. §2306b](#), Congress sometimes authorizes multiyear procurement (MYP) for programs.

MYP can achieve savings by committing to buy items from a contractor over multiple years for a reduced price per unit.

Qualifying for MYP requires a program to achieve savings in estimated costs, receive sufficient funding, and procure items unlikely to substantially change over the multiyear period.

Examples include ships (e.g., Virginia-class submarines and DDG-51 Arleigh Burke-class destroyers); aircraft (e.g., UH-60 Black Hawk helicopters, MV-22 Osprey tilt-rotor aircraft, and C-130J Super Hercules cargo planes); and munitions (e.g., M142 High Mobility Artillery Rocket Systems, or HIMARS, and MGM-140 Army Tactical Missile Systems, or ATACMS).

Table 1. Funding for DOD Procurement Accounts in the Department of Defense Appropriations Act, 2023

Account (Acronym)	\$ (billions)
Aircraft Procurement, Army (APA)	\$3.8
Missile Procurement, Army (MIPA)	\$3.8
Procurement of Weapons and Tracked Combat Vehicles, Army (WTCV)	\$4.5
Procurement of Ammunition, Army (PAA)	\$2.8
Other Procurement, Army (OPA)	\$8.7
Aircraft Procurement, Navy (APN)	\$19.0
Weapons Procurement, Navy (WPN)	\$4.8
Procurement of Ammunition, Navy and Marine Corps (PANMC)	\$0.9
Shipbuilding and Conversion, Navy (SCN)	\$32.0
Other Procurement, Navy (OPN)	\$12.1
Procurement, Marine Corps (PMC)	\$3.7
Aircraft Procurement, Air Force (APAF)	\$22.2
Missile Procurement, Air Force (MPAF)	\$3.0
Procurement of Ammunition, Air Force (PAAF)	\$0.9
Other Procurement, Air Force (OPAF)	\$28.0
Procurement, Space Force (PSF)	\$4.5
Procurement, Defense-Wide (PDW)	\$6.1
Defense Production Act Purchases	\$0.4
National Guard and Reserve Equipment	\$1.0
TOTAL	\$162.2

Source: CRS analysis of Department of Defense Appropriations Act, 2023 (Division C of P.L. 117-328) and accompanying explanatory statement.

Note: Totals do not include emergency funding provided in the Additional Ukraine Supplemental Appropriations Act, 2023 or the Disaster Relief Supplemental Appropriations Act, 2023 (Division M and Division N, respectively, of P.L. 117-328).

Advance Procurement.

More commonly, programs receive advance procurement funds for components of a unit that need to be purchased long before the unit itself is purchased. For programs using MYP, advance procurement may also be used to achieve economic order quantity, which is defined as buying enough of an item to minimize the total cost.

When Does a Program Enter Procurement?

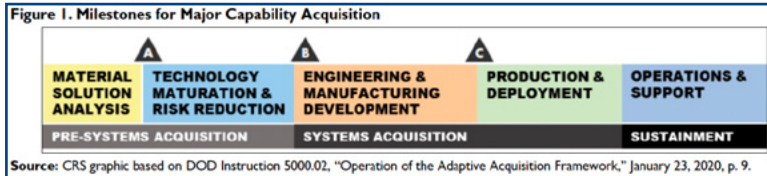
Programs that produce a major capability (e.g., an aircraft carrier or armored fighting vehicle) usually enter procurement after they receive **Milestone C** approval in the [Defense Acquisition System](#).

Prior to procurement, programs are considered to be in development and generally funded through **Research, Development, Test and Evaluation (RDT&E)** appropriations.

Some programs will receive procurement funds before a formal Milestone C approval. See **Figure 1** for an overview of milestones associated with major capability acquisition, one pathway within DOD's adaptive acquisition framework.

**How Else Does DOD Purchase Goods and Services?
How Does Procurement Relate to Defense Contracting?**

DoD is authorized and appropriated procurement funding for non-construction investments. DoD typically uses funding other than procurement to purchase services (e.g., research,



architectural design, or cleaning services) and smaller goods (e.g., gauze or light bulbs) because such purchases are considered to be expenses rather than investments and are funded in other parts of DoD's budget.

Relevant Statutes

Title 10, U.S. Code, Part IV—Service, Supply, and Procurement.

CRS Products

For information on the Defense Acquisition System, see CRS Report RL34026, *Defense Acquisitions: How DOD Acquires Weapon Systems and Recent Efforts to Reform the Process*

For information on the full funding policy in DOD procurement, see CRS Report RL31404, *Defense Procurement: Full Funding Policy—Background, Issues, and Options for Congress*

For information on special cases of procurement, see CRS Report R41909, *Multiyear Procurement (MYP) and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress*

For information on RDT&E funding see CRS In Focus IF10553, *Defense Primer: RDT&E*.

For general information on defense procurement and contract acquisition, see CRS In Focus IF10600, *Defense Primer: Department of Defense Contractors* and CRS Report R44010, *Defense Acquisitions: How and Where DOD Spends Its Contracting Dollars*

Other Resources

DOD Comptroller, Defense Budget Materials, <http://comptroller.defense.gov/Budget-Materials>

DOD 7000.14-R, "Financial Management Regulation," *Budget Formulation and Presentation: Procurement Appropriations*, vol. 2B, ch. 4, November 2017, at https://comptroller.defense.gov/Portals/45/documents/fmr/Volume_02b.pdf



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SPACE SYSTEMS COMMAND SPACE-BASED WEATHER DATA FORECAST... CRITICAL INFORMATIONAL ADVANTAGE FOR JOINT WARFIGHTERS



Authors: Space Systems Command Editorial Team

This article's subject matter experts



Lt. Col.
Joseph Maguadog



Col. Brian Denaro



USAF Col.
Brian Kabat [ret].



Col. Dennis
Birchenough

SSC's and the U.S. Space Force's pivot to a proliferated architecture for delivering cloud characterization and weather imagery

The cubesat was launched on January 3, 2023, aboard [SpaceX's Transporter-6](#) commercial rideshare mission from [Cape Canaveral Space Force Station](#), Florida. The cubesat was originally planned to complete a one-year, *Low Earth Orbit* (LEO) demonstration.

The OSS EWS cubesat prototype is a novel solution provided by a non-traditional supplier, which could potentially satisfy all EWS requirements at a lower cost by using an innovative combination of commercial cameras and *microbolometer* (*thermal imaging*) technology.

Space Systems Command's (SSC) resiliency mindset extends beyond innovative engineering solutions. Finding novel acquisition approaches, especially when things don't go as planned is one of our competitive advantages in the race to resilience.

The OSS EWS cubesat prototype is a novel solution provided by a non-traditional supplier, which could potentially satisfy all EWS requirements at a lower cost by using an innovative combination of commercial cameras and microbolometer technology.

Earlier this year, an *Electro-Optical/Infrared Weather System* (EWS) cubesat prototype satellite did not separate from the launch vehicle and will not be able to complete its intended one-year, on-orbit technology demonstration.

Undeterred, SSC worked with the satellite vendor, [Orion Space Systems](#) (OSS), to rapidly build and launch another satellite prototype on-orbit in just eight months.

The EWS cubesat technical demonstration prototype is part of a suite of EWS competitive prototyping efforts, pathfinding



Launched January, 2023 with OSS cubesat image [inset]



Artistic rendition of a DSMP satellite, courtesy of SSC



Artistic rendition of the General Atomics smallsat

EWS for cloud characterization and theater weather imagery capabilities.

“Although we were unable to see our first EWS cubesat prototype complete the on-orbit portion of the demonstration, we are excited that our rapid acquisition of an affordable second cubesat ensures we will still meet our EWS technology demonstration timeline,” said Lt. Col. **Joseph Maguadog**, SSC’s EWS materiel leader/program manager. “This follow-on opportunity will provide us the ability to assess the full potential of this cubesat design and still inform future materiel solutions for delivering cloud characterization and theater weather imagery,” Maguadog said. “Because of the unity of effort between SSC and our industry partners at OSS, we will be back on-track in only a matter of months, not years.”

In addition to the EWS cubesat technology demonstration developed by OSS, there are two other EWS efforts providing operational capability to warfighters. *Electro Optical/Infrared* (EO/IR) data for cloud characterization is one of the key **GO/NO-GO** criteria for the **U.S. Department of Defense’s** in-theater air operations.

“I am extremely encouraged by our team’s ability to rapidly acquire a second prototype in less than 30 days, with a plan to be on-orbit just eight months later,” said Col. **Brian Denaro**, SSC’s program executive officer for Space Sensing. “EWS continues to blaze the trail on numerous space acquisition tenants. The program is building smaller satellites while minimizing non-recurring engineering, and utilizing a firm-fixed-price contract to bound development and delivery risk.”

Legacy: A single DMSP system for all Space-Based Environmental Monitoring

For decades, the **Defense Meteorological Satellite Program (DMSP)** has been providing all space-based weather capabilities for our warfighters. DMSP originated as a classified project in the 1960s and provided images of cloud cover and other weather data, day and night. Congress terminated the program in 2015 before the 20th satellite could be launched.



Artistic rendition of the WSF-M satellite, courtesy of Ball Aerospace

Visitors to SSC can view that final, unlaunched DMSP satellite on display in the command’s **Heritage Center**, pictured below. Although DMSP is still operational and meeting warfighter needs today, the increasingly contested space domain necessitates a move toward a more resilient, disaggregated mission architecture to maximize flexibility.



Photo of SSC’s Heritage Center at Los Angeles Air Force Base.

“Since the Vietnam era, weather satellites have provided critical information for coalition forces to leverage the natural environment to its advantage,” said U.S. Air Force Col. (ret.) **Brian Kabat**, career weather officer. “Analysts rely on space-based capabilities, where traditional weather observations do not exist. Satellite data is the lifeblood of every forecast model, enabling the detection of mission-limiting dust storms and allowing naval forces to circumnavigate tropical cyclones, while helping determine which weapons systems might be most effective at a given point in time.”

“As new technology emerges, we can get it on orbit faster and cheaper,” said Col. **Dennis Birchenough**, SSC’s senior materiel leader, Environmental & Tactical Surveillance Delta, responsible for planning, acquiring, and delivering space weather capabilities.

Evolution of EO/IR Development



Orion Space Solutions Cubesat Technology Demonstration



Approx 2% the size of DMSP

General Atomics Smallsat Operational Demonstration



Approx 30% the size of DMSP

Defense Meteorological Satellite Program (DMSP)



Theater weather imagery tracks atmospheric phenomena such as dust storms and ash clouds that can hamper DoD missions, allowing the theater commanders to plan and execute the missions accordingly.

To provide these critical capabilities, EWS is developing a smallsat prototype for intended operational use in LEO. Developed by [General Atomics](#), the operational smallsat prototype (*artistic rendition, upper right column*) is scheduled to launch in 2025 and will inform future plans for proliferated LEO EO/IR capabilities.

EWS also is continuing to partner with the [National Oceanic and Atmospheric Administration](#) (NOAA), expanding upon the first **EWS-Geostationary (EWS-G)** satellite, which became operational in 2020, providing increased refresh rates over the Indian Ocean for cloud characterization and theater weather imagery.

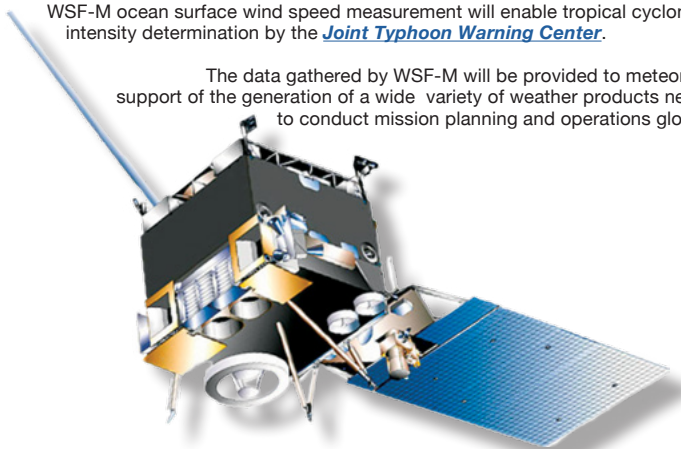
This interagency partnership has enabled the U.S. to leverage surplus NOAA capabilities to deliver mission capability quickly and affordably.

WSF-M for ocean surface vector winds, tropical cyclone intensity, snow depth, soil moisture and sea ice characterization capabilities

Using nexgen space-based passive microwave sensing technology, [Ball Aerospace](#) is developing two spacecraft, the first of which is scheduled to launch early in 2024 for U.S. and Allied warfighter operational use.

WSF-M ocean surface wind speed measurement will enable tropical cyclone intensity determination by the [Joint Typhoon Warning Center](#).

The data gathered by WSF-M will be provided to meteorologists in support of the generation of a wide variety of weather products necessary to conduct mission planning and operations globally daily.



Artistic rendition of COSMIC-2

COSMIC-2 for ionospheric density and scintillation, electric field and auroral characterization capabilities

SSC's long-standing partnership with NOAA, the [National Space Organization Taiwan \(TASA\)](#), and academia produced a COSMIC-2 network of six, ionospheric-sensing smallsats (*pictured, lower left column*) that was declared fully operational in 2022. The COSMIC-2 system is providing unprecedented coverage and refresh in support of equatorial space weather applications. These systems are also providing global atmospheric temperature and moisture data for weather forecast models.

This successful partnership is a pathfinder for expanded international and academic collaborative development to deliver space-based weather capabilities.

Coming Pivot Toward Layered Resiliency: Smartly Scaling Commercial and Partner Solutions

Building on the more-resilient, disaggregated, space-based weather mission architecture currently in development, SSC is exploring additional layered resiliency that fully leverages the potential of commercial and partner solutions.

SSC, in collaboration with the U.S. Air Force, is planning to scale the adoption of commercial technology and services across the weather mission, building off SSC's 2022 *Electro-Optical/Infrared Weather Data as a Service* study, which reviewed how commercial data could meet the USSF's cloud characterization, and weather imagery requirements.

Advancements in commercial microwave sensing, and commercial **synthetic aperture radar (SAR)** hold particular promise for potential application to the USSF's weather requirements for ocean surface vector winds, tropical cyclone intensity, snow depth, soil moisture, and sea ice characterization. SSC is interested in other commercial solutions, both on-orbit and ground-based, that also address these requirements.

SSC also is exploring additional opportunities to leverage interagency capability and international partner opportunities, building on the success of the EWS-G (NOAA) and COSMIC-2 (Taiwan and academia) efforts.

"SSC's pivot toward a more resilient, proliferated, hybrid architecture, one which exploits existing weather capabilities, buys commercially-available technologies and services, and builds inherently more resilient disaggregated systems, ensures our warfighters retain the critical informational advantage provided by accurate and timely weather data," Birchenough said.

Space Systems Command (SSC) is the U.S. Space Force Field Command responsible for acquiring and delivering resilient war fighting capabilities to protect our nation's strategic advantage in and from space. SSC manages an \$11 billion space acquisition budget for the Department of Defense and works in partnership with joint forces, industry, government agencies, academic and allied organizations to accelerate innovation and outpace emerging threats. Our actions today are making the world a better space for tomorrow.

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



DISPATCHES

Boeing Receives U.S. Air Force E-7 Airborne Early Warning & Control Aircraft Contract

Boeing [NYSE:BA] will start development of two, new, U.S. variants of the E-7 Airborne Early Warning & Control (AEW&C) aircraft through a \$1.2 billion Undefinitized Contract Action.

The E-7 provides a fully integrated, combat-proven, flexible command and control node that delivers multi-domain awareness in the most challenging operational environments.

The E-7's open systems architecture and agile software design enable the aircraft's capabilities to evolve and remain ahead of future threats.

The E-7 tracks multiple airborne and maritime threats simultaneously with 360-degree coverage via the Multi-role Electronically Scanned Array (MESA) sensor.

MESA provides the warfighter with critical domain awareness to detect and identify adversarial targets at long range and dynamically adjusts to emerging tactical situations.

Other E-7 operators include the Royal Australian Air Force, Republic of Korea Air Force, Turkish Air Force and the United Kingdom's Royal Air Force.

The E-7 uses a well-established supply chain which significantly reduces maintenance and logistics costs and increases mission readiness on day one.

Converted from the Next-Generation 737-700, the E-7 capitalizes on existing commercial derivative aircraft design, certification and modification processes, allowing E-7s to be fielded to meet Air Force needs.



Artistic rendition of the E-7A in flight. The E-7A will allow the U.S. Air Force to retain air dominance for decades to come. Image is courtesy of Boeing.

"The E-7 is a proven platform," said **Stu Voboril**, E-7 program vice president and general manager. "It is the only advanced aircraft that is capable of meeting the U.S. Air Force's near-term Airborne Early Warning &

Control requirement while enabling integration across the joint force."

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ENABLING THE U.S. MILITARY'S JADC2 VISION WITH INNOVATIVE TECHNOLOGIES

Intelsat's multi-orbit constellation can enable military teams with advanced capabilities that leverage 5G, AI, edge computing and 3D printing technologies for mission advantage.

Author: Dave Micha, President, Intelsat Government Communications (IGC)

The U.S. Department of Defense Joint All-Domain Command and Control (JADC2) strategy aims to enable real-time coordination of assets and enhanced communications across highly distributed land, air, sea, space and cybersecurity domains.

There is increasing government interest in understanding how innovative *software-defined satellite* (SDS) technology, multi-orbit satellite constellations and private 5G networks can work together to deliver new warfighting capabilities to the battlefield edge on demand, giving service members a perpetual advantage over adversaries.

Intelsat is leading the way in creating the first space-based unified global network to provide no-fail, anti-jammable, surge-capable broadband connectivity anywhere, anytime and on demand.

Innovative technologies, such as *artificial intelligence* (AI), edge computing and 3D printing, when enabled by a resilient, scalable, standards-based global network architecture, can give commanders a comprehensive, real-time view of the entire theater of operations, allowing them and their team members, to make more informed decisions and quickly adapt to changing situations for more effective military operations and ultimately, success in battle.

Intelsat is at the forefront of these innovations — building a unified network that will deliver no-fail ubiquitous connectivity to empower warfighters for mission success.

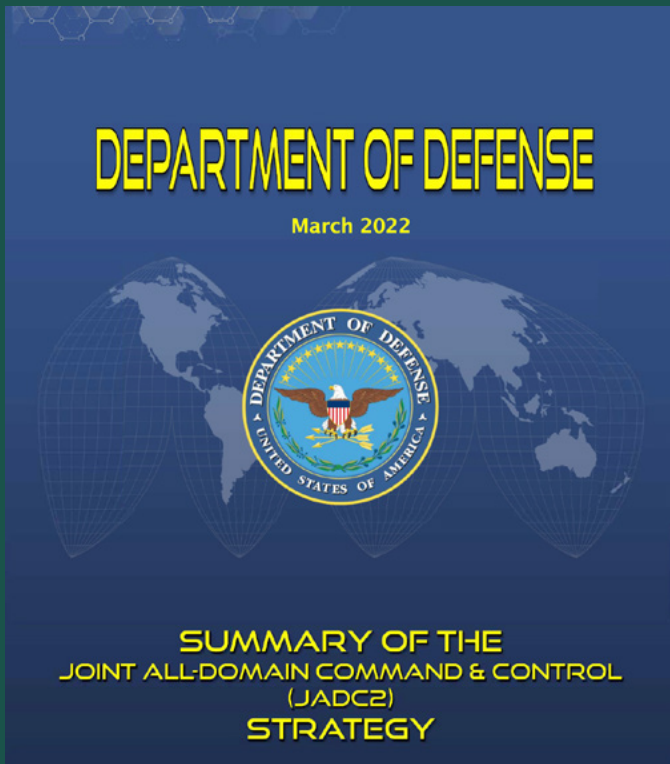
Here's how these seemingly disparate technologies can work together to help **Department of Defense** (DoD) leaders achieve JADC2 objectives:

Software-defined satellites, such as those currently being built by **Airbus**, **Thales** and **Swissto 12** for Intelsat — are a new generation of GEO SDS that can be controlled and reconfigured remotely on the fly using only software.

With SDS, time-consuming terminal reconfigurations and hardware swaps become unnecessary. With the SDS network interconnected with terrestrial and cellular networks, users gain end-to-end bandwidth management flexibility, enabling commanders and service members with granular control over network resources to respond quickly to changing situations.

For example, software-defined satellites can dynamically redirect coverage areas or change operating frequencies in response to malicious interference.

In addition, multi-layered GEO, MEO and LEO satellite networks, such as one that Intelsat can offer, will increase the resilience and end-to-end performance of connectivity, delivering high-quality mission-critical voice, video and advanced applications that give military teams the advantage over near-peer adversaries.





Private 5G networks with roaming capabilities underpinned by resilient multi-layer connectivity can provide high-speed, low-latency communication across geographically distributed operations.

Commanders can share information quickly to make agile decisions, stream video from drones and other platforms and obtain real-time telemetry from vehicles and weapons systems.

Artificial intelligence (AI) analyzes large amounts of data from various sources, such as sensors on satellites, unmanned and manned assets, edge devices and ground-based systems, to provide insights and recommendations for action.

For example, AI can detect potential threats at machine speed to warn of incoming attacks or predict potential supply chain issues before they impact the mission.

Cloud computing platforms and smart edge devices can provide a scalable and secure platform for storing and processing big data and specialized applications.

For example, tapping into cloud resources offers rapid in-memory data processing and analysis, such as image recognition and running simulations to support decision-making.



Artistic rendition of HummingSat, courtesy of Swissto12

3D printing can improve military forces' logistics, supply chain and readiness. 3D printing also enables specific aerospace and radio-frequency applications, as well as the rapid prototyping and manufacturing of smallsats, such as the **HummingSat** developed by **Swissto12** for Intelsat.

Similarly, the ability to produce near real-time replacement parts for weapons and vehicles in the field and specialized tools significantly increases military operations' effectiveness and gives troops an edge in battle.

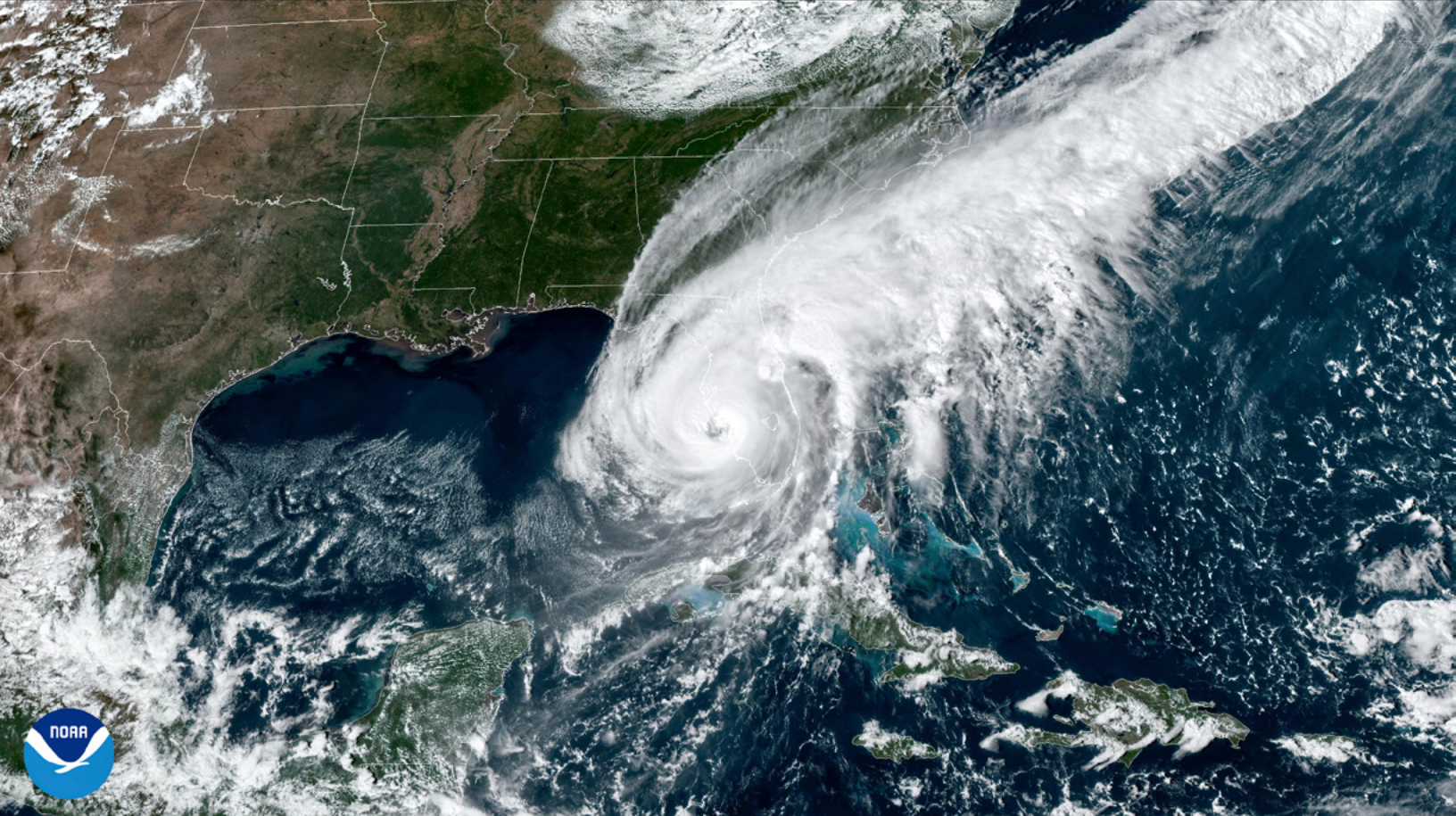
Together, when enabled by a resilient multi-layered space-based global network with SDS, these innovative technologies can provide commanders with a comprehensive, real-time view of the battlefield and enhanced capabilities, allowing them to make more informed decisions and respond quickly to changing environments, ensuring military operations' effectiveness and battle success.

www.intelsat.com



Dave Micah

Author Dave Micah has more than 35 years of industry experience and he brings a unique skillset and a wealth of experience in strategic management, new business development, and customer relationship management in the Government sector. Prior to joining Intelsat, Dave has held a number of positions at L3 Technologies spanning more than 22 years, including Chief Operating Officer of the Communications & Network Systems Segment and leading L3 Technologies' Advanced Communications Sector and Maritime Sectors. While at L3, Dave successfully integrated 27 disparate Maritime Business units into a single, integrated identity – a strategy that proved to be critical in winning top tier maritime contracts in the Undersea, Unmanned and C5ISR domains. During his tenure, Dave positioned L3 as a global leader in the Unmanned Surface Vehicle market through M&A efforts and systems demonstrations for USN and International partners. Before L3, Dave spent 13 years at Lockheed Martin in the DoD and Intelligence Program divisions.



NOAA GOES-18 visible satellite image of Hurricane Ian on September 28, 2022 as it neared landfall in Florida. Source: NOAA

THE POWER OF COLLABORATION

Intelsat's Hurricane Ian Disaster Response

Author: Joel Schroeder, Director, Land Mobile Product, Intelsat

In September of 2022, Hurricane Ian struck Florida as a Category 4 storm, causing widespread damage across the state. This was the deadliest hurricane to hit the state since 1935 and left much of Southwest Florida in shambles.

In communities where Hurricane Ian rendered cellular networks unavailable, satellite connectivity was crucial in arming first responders with a data and communications solution to support the deployment of essential personnel and mission-critical resources. Without satellite communications, communities also lost internet, voice calling capabilities, and access to life saving and property protection when the hurricane struck.

The Problem

HELP.NGO, an experienced international disaster response team trained to act quickly when existing communication networks fail in emergencies, required Intelsat's reliable and ready-to-use internet connectivity to mitigate these risks, supporting essential disaster response operations and connecting residents affected by Hurricane Ian to friends and family.

Intelsat provided HELP.NGO the resources and equipment that arrived at the disaster zone to rapidly restore connectivity.

How We Helped

HELP.NGO was able to establish connectivity — within minutes — in the affected Fort Myers area using Intelsat's **FlexMove** network and portable **Starwin** terminals. In leveraging the fully integrated broadband solution, first responders and essential personnel, leading relief and rescue operations, could quickly set up and deploy high-speed internet to manage fuel delivery operations, view high-resolution maps, as well as use data applications.



An Intelsat StarWin terminal.

HELP.NGO also used our services to extend internet access to residents of affected communities, enabling them to stay connected with loved ones and to begin mending the personal damage caused by Hurricane Ian.

Intelsat's Solution

Intelsat's multi-layered, **high-throughput satellite (HTS)** network, combined with Starwin's portable terminals, enabled HELP.NGO quickly deploy disaster response operations and maintain reliable connectivity across a wide range of disaster sites as they set up fixed, **Very Small Aperture Terminals (VSAT)** equipment.

With Intelsat's **FlexMove**, NGOs worldwide can quickly deploy to a disaster zone and immediately access reliable, ready-to-use, high-speed connectivity. From connected mobility solutions for vehicles to portable connectivity solutions for temporary network access in a fixed location, Intelsat and its partners have a range of services to meet connectivity needs in a disaster zone.

FlexMove makes satellite connectivity simple. Users can establish an internet connection within minutes with minimal technical training required. As an end-to-end managed service, the solution is ideal for emergency teams that need to respond at a moment's notice.

By decreasing network setup and knock-down time, NGOs, public safety organizations, and emergency response teams around the world can focus on what matters most during a crisis — **saving lives.**

www.intelsat.com/solutions/land-mobility/



Joel Schroeder is Head of Land Mobile at Intelsat, where he has responsibility for building and executing the market, product, and partner strategy to deliver portable and mobile satellite services across the Enterprise and Mobility vertical markets. He has broad experience in telecommunications, business development, and product management. Throughout his career, Schroeder has worked with key global customers and ecosystem partners in the transportation, energy, and first responder segments to deliver fixed, wireless and satellite connectivity solutions.



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A CONVERSATION WITH... ANDREW BOND, ETL SYSTEMS

Digitizing + Decoupling: Designing a path for even stronger SATCOM



Mr. Andrew Bond is the Sales & Marketing Director for ETL Systems. His specialty is the sales and marketing of technical communications products, with a focus on developing international brands and sales networks. He joined the ETL team in June of 2005 to support the company's expansion into new global markets and has since experienced sales growth of approximately 20% per year. Mr. Bond explains how analog signals becoming digital will impact security, government and defence applications and initiates this discussion with a look at DFI.

ANDREW BOND

The [Digital Intermediate Frequency Interoperability \(DIFI\) Consortium](#) is a working group of commercial and government organisations enabling the digital transformation of space, satellite, and related industries.

DFI is providing an open, interoperable *Digital IF/RF standard* designed to replace the natural interoperability of analog, IF signals.

One of the many benefits of Digital IF/RF (also known as *RF over IP*) is the flexibility the technology will allow, enabling the physical decoupling of antennas from modems. For example, a control center in Washington, D.C., would be able to easily switch between antennas located on the other side of the world. This means that encryption equipment could remain in a home country, retaining full control of critical operational assets and reducing exposure to risk.

How does digitizing the analog signal work?

ANDREW BOND

We are approaching the start of a new era of digitization in the satellite ground segment. We're currently working to translate our analog IF signals into digital packets that can be transported over dedicated IP networks.

This will overcome many of the traditional hurdles associated with transporting RF signals on the ground, including the inherent limit to the distances RF signals can travel in terrestrial networks from the antenna before they begin to degrade.

By taking this approach to digitize the signal, we can now physically decouple antennas from modems. This delivers a clear security benefit of being able to have encryption equipment in home territory. In addition, the technology enhances operational flexibility, continuity of operations (resilience), and quality of service.

The wider industry has already signaled its intent for the adoption of this technology with more satellite ground stations co-locating with data centres, and vice versa. For example, SES has co-located four ground stations at [Microsoft Azure](#) sites in the U.S. In line with this, a number of satellite operators and modem manufacturers are working with [Cloud/VNF](#) providers to enable virtual devices, including digital modems. The interface required between the analog and cloud/VNF environments is digital IF.

How does this assist in the context of security?

ANDREW BOND

Last year, the [U.S. Space Force's Commercial Satellite Communications Office \(CSCO\)](#) stated that, over the next two years, more than \$2 billion would be spent in commercial SATCOM contracts, buying capacity and services.

This highlights the U.S. government's growing desire to use non-military satellite constellations where such a move makes sense. This, in turn, emphasizes the potential need to place encryption and decryption technology in other countries in proximity to where signals are being received at the antennas.

The decoupling of antennas from coding equipment will allow modems and encryption equipment to stay 'behind the wire.' If you want to use an antenna in a country where security is more challenging, this could prove to significantly reduce operational risks. Governments will no longer have to have their encryption and decryption codes physically in a manned building on the other side of the world.

In addition, digital signals do not radiate, as analog signals do on coaxial cable. This makes the act of intercepting signals much more difficult. Once the signal is digitized, it's also easy to change the encryption quickly, making transmissions far more flexible, threat responsive and secure.

How quickly do you think this technology will be adopted?

ANDREW BOND

Alongside the clear security benefits, there are also large cost savings possible by improving operational efficiency. This is because all encryption, decryption and modems are centralized, which, from an efficiency point of view, makes a great deal of sense.

In essence, you can swap all localized modems, encoders and decoders and have one set of them in a home country. That removes the need to maintain a larger infrastructure, which

in turn simplifies many of the operational elements, including the size and requirement of the skilled team to maintain and operate the network.

This new technology will not make traditional RF architecture redundant though, particularly for applications with less onerous, security requirements. Organizations will be keen to maximize their existing investments and, in some cases, analog RF will make the most sense. As we move forward, we believe security applications will drive first adoption, with government organizations initially embracing the technology.

What are the top security benefits?

ANDREW BOND

Continued operational resilience, operational flexibility to route signals from a dish anywhere and 'behind the wire' encryption are the top three, key benefits.

In addition, there is less need for signal conditioning of IP. If you're running RF signals over long distances via fiber, you're going to need amplifiers and there will be isolation challenges and return loss. Digital IF is both modulation agnostic and essentially loss-less.

The resulting simplification of digitizing the signal means there is a significant reduction in the numbers of antenna feeds. Rather than having a large 'elephant trunk' of cabling coming from an antenna, that can be replaced by a single, *100GbE* connection.

There's a lot of technology to move from the multitude of coax cables to that solution as you've the RF signals must be processed into a tight IP stream, and the same in reverse. More than two years of significant research and development involvement has been necessary for the firm to arrive at a position where this can be done reliably and in a standardized way.

How will this technology evolve?

ANDREW BOND

When [ETL Systems](#) launches this product, the company will be able to encrypt a 500 MHz bandwidth carrier. That's going to be the core of the modular product — there will be four of those channels within one of ETL's digital IF/RF solutions.

As the product evolves, it will grow in functionality, scale and embedded applications. There's going to be more channels so that we'll be able to add greater bandwidth capability into a single unit of our product — for example, running multiple quad band antennas through a single modular box.

More than likely, we'll be able to increase the bandwidth in the future beyond 500 MHz, as well. Currently, this is being guided by the DIFI standard and we may see changes as the requirements change.

Digitization is not a panacea for all applications. We're still making huge investments in our analog technologies. However, I believe it's clear that, in the future, these will sit alongside digital options and the first adopters will be governments using this technology for security applications. As the price drops and the economies of scale increase, the commercial sector will take up the technology, too.

While the first working products are coming on stream now, it will likely take several years before we see a mature, digitized ground station. However, with more than 50,000 satellites predicted to be in the sky by the end of the decade, current analog ground network technology will not be able to scale to meet the tremendous increase in ground requirements. This will drive the evolution of the digital ground segment.

This is a most exciting time in the SATCOM industry as we continue to innovate and find new solutions and ways of deriving solutions for customers.

www.etlsystems.com



DISPATCHES

Northrop Grumman to enhance USAF networks



Northrop Grumman Corporation (NYSE: NOC) will participate in Phase 1 of the Common Tactical Edge Network (CTEN) consortium, an opportunity to leverage digital engineering to build and demonstrate the backbone of a connected battlespace for the U.S. Air Force.

The CTEN Phase 1 award was announced after Northrop Grumman successfully demonstrated proven network, communications and processing solutions to enable **Joint All-Domain Command and Control (JADC2)** by connecting sensors and platforms to distribute data across all domains.

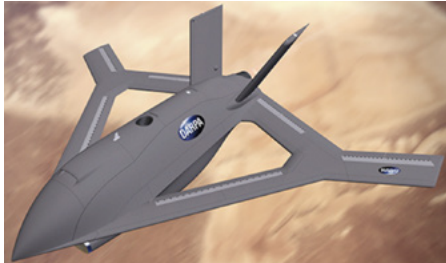
Northrop Grumman connected previously incompatible links and networks using an **Open Mission Systems (OMS)** compliant radio, **Resilient Network Controller**, **machine learning (ML)** algorithms and gateway technology.

“We provide the connectivity for military platforms, sensors and systems to communicate using open, mission-aware networking solutions,” said **Kevin Berkowitz**, senior director, network solutions, Northrop Grumman. “The CTEN demonstration and Phase 1 award are two examples of Northrop Grumman’s integrated capabilities that get the right data to the right place at the right time in support of the Department of Defense’s JADC2 vision.”

DARPA selects Aurora Flight Sciences for Phase 2 of Active Flow Control X-Plane

DARPA has selected Aurora Flight Sciences to move into the detailed design phase of the Control of Revolutionary Aircraft with Novel Effectors (CRANE) program. This follows successful completion of the project’s Phase 1 preliminary design, which resulted in an innovative testbed aircraft that used active flow control (AFC) to generate control forces in a wind tunnel test. Phase 2 will focus on detailed design and development of flight software and controls, culminating in a critical design review of an X-plane demonstrator that can fly without traditional moving flight controls on the exterior of the wings and tail.

The contract includes a **Phase 3** option in which DARPA intends to fly a 7,000-pound X-plane that addresses the two primary technical hurdles of incorporation of AFC into a full-scale aircraft and reliance on it for controlled flight. Unique features of the demonstrator aircraft will include modular wing configurations that enable future integration of advanced technologies for flight testing either by DARPA or potential transition partners.



DARPA CRANE X-Plane configuration in development for flight testing Active Flow Control (AFC) technologies

The AFC suite of technologies enables multiple opportunities for aircraft performance improvements, such as elimination of moving control surfaces, drag reduction and high angle of attack flight, thicker wings for structural efficiency and increased fuel capacity, and simplified high-lift systems.

“Over the past several decades, the active flow control community has made significant advancements that enable the integration of active flow control technologies into advanced aircraft. We are confident about completing the design and flight test of a demonstration aircraft with AFC as the primary design consideration,” said the CRANE Program Manager **Richard Wlezién**. “With a modular wing section and modular AFC effectors, the CRANE X-plane has the potential to live on as a national test asset long after the CRANE program has concluded.”



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DISPATCHES

Ball Aerospace to support national scientific + technical intelligence mission for the next decade



NOVASTAR

Ball Aerospace received a subcontract award to support the NOVASTAR program operated by the National Air and Space Intelligence Center (NASIC), located on Wright-Patterson Air Force Base near Dayton, Ohio— Ball Aerospace will be a core team member of prime contractor, Modern Technology Solutions, Inc. (MTSI).

In addition to Ball Aerospace, the MTSI team includes other companies and multiple small businesses.

NOVASTAR is an 11-year IDIQ agreement to provide scientific and technical intelligence (S&TI) support to the U.S. Air Force, Department of Defense and other national-level intelligence organizations.

NOVASTAR consolidates numerous development and intelligence analysis service contracts into one comprehensive and flexible S&TI contract. The program supports all NASIC missions and disciplines.

As part of this contract, Ball Aerospace provides technical expertise in several areas, including electro-optical and spectral research and data analysis, systems and software development, and other S&TI support services.

The NOVASTAR contract continues a long relationship between NASIC and Ball Aerospace, which has provided services to the center for more than three decades.

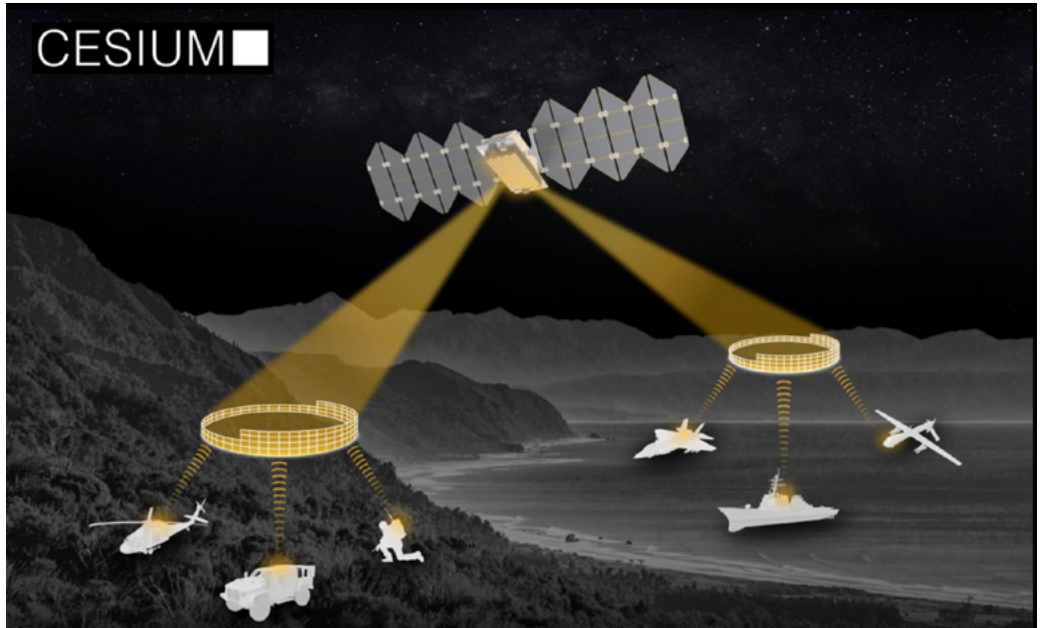
In 2019, Ball Aerospace was selected as one of multiple prime contractors on NASIC's MEGASTAR program, a program to conduct scientific and technical intelligence, spanning multiple mission areas within the center.

Ball Aerospace has received numerous prime and subcontract task order awards under this Contractor Teaming Arrangement (CTA) contract.

"This is our first collaborative opportunity with MTSI and we look forward to partnering with them on this important mission," said **Steven Smith**, vice president and general manager, Advanced Technology & Information Solutions, Ball Aerospace. "We will leverage our decades of experience in data exploitation and analysis, modern cloud-based technologies, and machine learning and artificial intelligence to support decision makers and our warfighters."



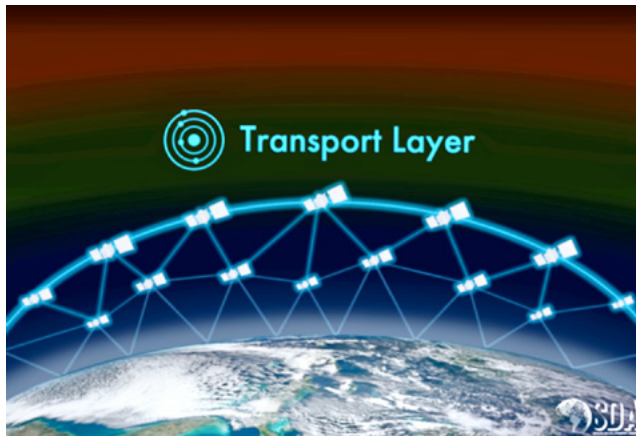
CesiumAstro wins SDA award to advance steerable antenna array development



CesiumAstro has been awarded a contract through the Department of Defense's (DoD's) Space Development Agency (SDA) to advance the company's multi-beam, L-band, active electronically scanned array (AESA) antenna.

LEO-based satellite constellation built to enable key DoD space capabilities.

Work will focus on optimizing the antenna to support U.S. and allied military forces' common operating picture across the global battlespace. The company's industry-leading experience with active phased array technology will allow it to move quickly to fulfill SDA's Transport Layer mission requirements.



CesiumAstro's flat panel AESA will strengthen SDA's information and decision advantages by using multiple beams to connect satellites to many dispersed users simultaneously, disseminating critical information to the warfighter faster.

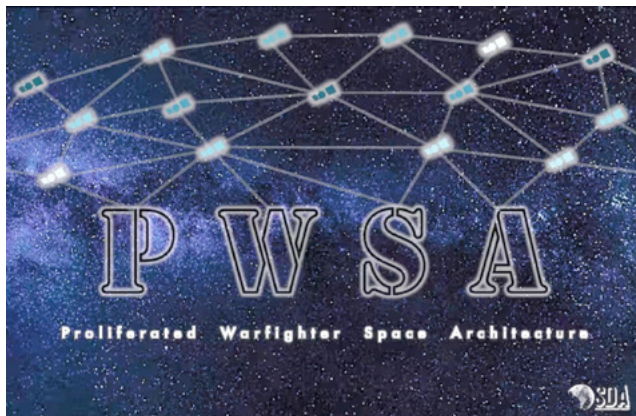
Further, the antenna directs beams without physically moving or requiring the movement of a satellite, and is software-defined to enable reprogrammable, "on the fly" adaptability to dynamic battlefields.

In committing to providing technological and military advantages for the space domain, CesiumAstro has aligned its active

phased array product roadmap to match the anticipated needs of the DoD and PWSA.

"This award spotlights the upcoming advancements in national security made possible by software-defined active phased array antennas," said **Shey Sabripour**, founder and CEO of CesiumAstro. "Providing SDA with a multi-beam array increases architecture flexibility and capacity for enhanced theater coverage."

Building upon prior efforts, CesiumAstro will continue developing the Link 16-compatible AESA ahead of the agency's migration to the Proliferated Warfighter Space Architecture (PWSA) global satellite network, the



"Our modular solution scales to support a wide variety of missions," said **Trey Pappas**, Vice President of Business Development at CesiumAstro. "As a retired Marine Corps aviation officer, I greatly appreciate this capability as a game-changer to adapt the Transport Layer to fully support tactical users across the globe."

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