

SATCOM For Net-Centric Warfare — January 2017

MilsatMagazine



Super Surveillance: SBIRS

...in the cause of national defence...

Artistic rendition of SBIRS on orbit, courtesy of Lockheed Martin.

MilsatMagazine

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DISPATCHES

Japan's SDF Launches MHI-Built X-Band Defense Satellite

The Japan Aerospace Exploration Agency (JAXA) and Mitsubishi Heavy Industries, Ltd., have launched an X-band defense communications satellite aboard an H-2A Launch Vehicle No.32 from JAXA's Tanegashima Space Center in Japan's southwestern Kagoshima prefecture.

The Kirameki-2 satellite is the first communication satellite for the Japanese Ministry of Defense, which shoulders the mission to upgrade the Self-Defense Forces' (SDF) communications network.

The Kirameki-2 satellite, operating with X-band technology, is one of three defense communications satellites that will replace three civilian satellites that are presently used by the Self-Defense Forces.

The new satellites will facilitate direct communication among units of the Ground, Maritime and Air Self-Defense Forces through a high-speed and high-capacity network and serve as a communication infrastructure, local media quoted Defense Ministry officials as saying on the day of the launch.



The JAXA launch of the Kirameki-2 satellite.

The Kirameki-2 is designed to operate over the Indian Ocean and to serve the SDF personnel taking part in U.N. peacekeeping operations in South Sudan and the anti-piracy mission in waters off Somalia, said the officials.

In 2008, Japan's Diet approved a law on general principles for the use of space, allowing non-aggressive defense use of space and overturning a decades-old policy of limiting space development to peaceful uses.

Under the law, the use and exploitation of space should be conducted to serve the security of Japan, relaxing the principle of non-military use based on a parliamentary resolution in 1969 under the war-renouncing Constitution.

The new law changes Japan's policy of space use to "non-aggression" from "non-military" and would allow Japan's defense ministry to launch its own satellites, including surveillance satellites and an early-warning satellite.

global.jaxa.jp

h2a.mhi.co.jp/en/

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Analysis of US Government and Military Satellite Market for 2017

Research and Markets has announced the addition of the "US Government and Military Satellite Market, Forecast to 2022" report to their offering.

The US government is the single largest purchaser of commercial satellite services in the world, and accounted for \$1.34 billion in 2015.

Global tensions and military conflicts around the world are driving the need for surveillance and information sharing.

Thus, satellite demand fluctuates significantly with global US relations; however, many of these regions, such as the Middle East and Africa, remain consistent, high-demand locations for US military satellite communications (MILSATCOM).

As a result, these contracts are highly competitive, with many organizations custom tailoring new satellites and ground hardware to meet the unique needs of the US government/military.

With a compound annual growth rate (CAGR) of 3.6 percent, this market is stable but is expected to average \$53.78 million per year through 2022.

This research estimates the base year market size by revenue generated through US government spending, future growth estimation through 2022, and forecast breakouts for military and on-military as well as for Department of Information Systems Agency (DISA) and non-DISA.

The base year for this research is 2015 and is accompanied by a forecast spanning from 2016 to 2022.

Also included is the base year market share for consumer satellite operators, namely Iridium, Inmarsat, SES, Eutelsat, Intelsat, and Telesat.



The global regions discussed are grouped by North America, Asia-Pacific, the Middle East, Latin America, Africa, and Europe.

Key questions this study will answer:

- **How will the government and military satellite market grow throughout the forecast period?**
- **What economic, political, and technological factors are impacting his market?**
- **What military trends are driving new adoption for satellite technology?**
- **What regions will be important/account for more US government and military spending on satellite technology?**
- **Who are the market participants and what does the competitive landscape look like?**

Key topics covered:

- » Executive Summary
- » Definitions
- » Market Overview
- » Major Growth Opportunities
- » Drivers and Restraints-Government and Military Satellite Market
- » Forecasts and Trends-Government and Military Satellite Market
- » Market Share and Competitive Analysis-Government and Military Satellite Market
- » US Government and Military Satellite Growth Opportunities
- » The Last Word

Featured companies

- » Iridium
- » Inmarsat
- » SES
- » Eutelsat
- » Intelsat
- » Telesat

For more information about this report, please visit [researchandmarkets.com/research/6m6gjk/us_government_and](https://www.researchandmarkets.com/research/6m6gjk/us_government_and)

DISPATCHES

Datum Systems' High Speed DVB S2/S2X Card Sets Connects Kiwis



Datum Systems has successfully deployed their modular and highly-efficient M7 modem platform with the newly released DVBS2X card sets to a major service provider in New Zealand.

The M7 modem with this advanced technology will connect the Chatham Islands via a high-speed IP satellite link.

This New Zealand archipelago leverages Datum's new M70 Modulator and D70 Demodulator high speed DVBS2/S2X card sets to deliver up to 350 Mbps of IP throughput. Advanced features such as higher order modulation, ACM and Sharp Carrier technology are supported.

With affordability and system flexibility, the Chatham Islands will now be able to seamlessly support growing network demands without changing modem hardware—this includes the firm's patented Smart Carrier canceling.

The M7 modem system is the best in class and most affordable modem platform for provisioning FDMA based networks over traditional FSS and High Throughput Satellites (HTS) using DVB-S2/S2X without the need to replace satellite modems.

Cards can be populated together in an existing M7 modem platform to build duplex DVB-S2/S2X links, or independently mixed with Datum's low latency FlexLDPC card sets for a truly efficient and low cost point-to-multipoint transport network. Satellite service providers, telecom operators and government/military

users can design flexible and economical point-to-point or point-to-multipoint FDMA networks based on the near Shannon limit performance and modularity of the M7 system.

"We are delighted that the M7 has been selected as the best modem platform to provide IP trunking connectivity to the Chatham Islands. With the DVB-S2/S2X cards in the M7 modem, their satellite IP network has tremendous upgrade capabilities as the network grows with additional sites and higher throughput," said David Koblinski, the Vice President of Business Development and Marketing at Datum Systems. *Our M7 platform's flexibility, reliability and efficiency are ideally suited for multi-point IP trunking applications like the Chatham Island as well as cellular backhaul, enterprise VSAT and the military."*

"The M7 modems that we installed for the Chatham Islands network provide exceptional performance and we are very pleased with the price we paid. We fully expect to add more modems to our teleport for this network and others," said Keith Ramsay, Director of Engineering and Operations, Gateway Teleport.

Datum Systems will be presenting their technologies at Booth #738 during the upcoming Satellite 2017 Conference and Exhibition, March 6 through 9, at the Walter E. Washington Convention Center in Washington, DC.

datumsystems.com/

TacComms Improve With PacStar

PacStar® has revealed that an independent research study has confirmed that warfighters using the firm's IQ-Core® Software are able to configure and manage complex networking equipment up to 10 times faster, with nine times fewer errors than comparable manual methods—the study in 2016 used active duty end users from a US Army signal brigade.

For the independent user study, conducted June/July 2016, untrained US Army end-users were asked to perform the same two tasks, once using IQ-Core Software and once using a manual (typical command line and OEM GUI) method.

The results showed that using IQ-Core Software to perform these tasks greatly improved participants' ability to complete them successfully, and drastically reduced the time spent, errors committed, and support needed.

The complexity and manual-intensive nature of tactical communications systems have, to date, required the use of costly, highly trained IT specialists. IQ-Core Software simplifies the setup and operation of tactical communications systems with an intuitive user interface, powerful wizards and alerts with common user interfaces across all hardware and software components.

As a result, warfighters without specialized IT training can easily and rapidly setup and operate tactical comms systems in challenging environments where every second counts. The study further confirmed that even experienced operators benefit from using IQ-Core Software.

pacstar.com/usability/

DISPATCHES

Eagle Vision Encompasses Bilateral Exchange Between US Military and Philippine Forces

Typhoons, tsunamis, floods and even mudslides, the Asia-Pacific Region is well-acquainted with the devastation wrought by natural disasters.

As populations increase among many Pacific nations, the need for disaster preparedness and response continues to grow. The US and its Pacific allies and partners frequently train together to address the growing need for readiness. When a disaster occurs, readiness can protect and restore the lives of millions of Pacific residents.

Readiness is the exact reason the 13th Expeditionary Air Squadron, a joint team of US Airmen and Soldiers, traveled to Clark Air Base, Philippines. The team brought with them a ground-based satellite imagery system, called Eagle Vision, a collection manager from Joint Base Pearl Harbor-Hickam, Hawaii and geospatial and imagery analysts from Fort Shafter, Hawaii.

The unit deployed to conduct a Pacific Air Forces Subject Matter Expert Exchange (SMEE) mission together with Philippine Air Force members. The SMEEs will focus on using geospatial satellite imagery, acquired by Eagle Vision, to support Humanitarian Assistance and Disaster Relief efforts.

"Eagle Vision can move all over the world, we can set up our system anywhere and start pulling down imagery from commercial satellites," said Chief Master Sgt. Reid Tsubota, Eagle Vision Superintendent with the Hawaii Air National Guard's 154th Wing from Joint Base Pearl Harbor-Hickam.

"The HADR applications of this system are incredible. In fact, this is our fourth time here in the Philippines. In 2006 we were initially supporting exercise Balikatan when the Southern Leyte mudslides occurred. Using Eagle Vision we were able to provide the

Marine Corps' first responders imagery that ultimately helped in the recovery and relief efforts," Tsubota said.

During this fourth visit, Tsubota and his team of 15 Guardsmen, assigned to the 154th Wing at Joint Base Pearl Harbor-Hickam, Hawaii, will work alongside their Philippine counterparts during a series of exchanges focused on the HADR uses Eagle Vision offers.

The two-week long Eagle Vision SMEE will culminate with a table-top exercise where Philippine and US military members will simulate a HADR response to a typhoon, a disaster the Philippines experiences. A series of smaller engagements will take place leading up to the simulation. These events are meant to help the military members from both nations discover ways to work better together.

"The US and Philippines have been allies for a long time. HADR is one of the cornerstones of our alliance. And as history has shown us, time and time again, natural disasters will occur in the Pacific. Lives will be impacted and the US and Philippines will come together to bring life-saving aid to those in need," said Lt. Col. Peter Day, the 13th Expeditionary Air Squadron's commander, leading the Eagle Vision team.

"When we think about delivering aid, most of us think about medicine, food, water and so on. What we sometimes overlook is how aid gets to the people. There's a tremendous effort taking place behind-the-scenes. That's where Eagle Vision shines," Tsubota said.

According to Tsubota, Eagle Vision provides decision-quality information. Commanders and organizations providing HADR support can use Eagle Vision's imagery for a variety of purposes including: selecting ingress and egress routes for aid; predicting the air mobility requirements of an airfield, such as viability and capacity,

for receiving relief; or ascertaining the extent and magnitude of damage caused by a disaster.

"Eagle Vision excels at providing accurate readings. During the Leyte mudslides we outlined before and after images of the affected area. The change detection helped direct resources to the hardest hit locations with the greatest need," said Master Sgt. Chad Tedrowe, an Eagle Vision Data Integration Segment engineer.

Eagle Vision uses commercially available satellites to capture scenes. Scenes are acquired from commercial satellites SPOT6 and SPOT7 and consist of 60 by 60 kilometer swathes where each pixel represents one and a half meters of ground area. Scenes are detailed and customizable to meet mission requirements. Additionally, scenes can include data integration such as geographic coordinates or elevation down to an individual pixel level of detail.

Throughout the two weeks of the exercise, US Airmen and Soldiers will exchange experiences for collecting, processing, and analyzing the satellite imagery Eagle Vision captures with their Philippine partners.

The US Air Force has five Eagle Vision systems. Eagle Vision is the Air Force's only releasable unclassified, commercial deployable satellite imagery downlink ground-station. The system is operated and maintained by a variety of Air Force specialties, making it self-sustained capability with only the need to contract diesel fuel.

Eagle Vision has been deployed to support Pacific HADR operations in India, Japan, Thailand, and the Philippines.

Story by Tech. Sgt. James Stewart
Pacific Air Forces Public Affairs

DISPATCHES

Study of the Future Needs of MILSATCOM

A study that the US Department of Defense was expected to start last fall and has finally begun, confirmed by the Pentagon—this study and analysis will address the future needs of US MILSATCOM.

The wideband *Analysis of Alternatives* (AoA) study had been signed by Frank Kendall, the undersecretary of defense for acquisition, technology, and logistics as indicated by Captain Annmarie Annicelli, an Air Force spokeswoman.

The program is anticipated to have a lifespan of approximately one year and is expected to be directed by goals and objectives of the new Trump administration.

The objective is to inform future Pentagon decisions on military satellite communications.

The Wideband Global Satcom program is scheduled to launch its final satellite in 2019, with the launch of WGS-10.



Artistic rendition of a WGS satellite.

The AoA will help the Defense Department determine what will follow WGS-10, such as the possibility of additional WGS satellites or the purchase of communications services from private companies.

"The Air Force was designated as the lead component for the program," Annicelli said. "We look forward to working with our industry and international partners over the course of the AoA to determine the best mix of military and commercial SATCOM to ensure the SATCOM architecture is resilient in a future contested environment."

Please see the GovSat Report Insights on page 30 for more in-depth information regarding AoA.

DISPATCHES

Mini, Air-Launched, Swarming UAVs



In one of the most significant tests of autonomous systems under development by the Department of Defense, the Strategic Capabilities Office (SCO), partnering with Naval Air Systems Command, successfully demonstrated one of the world's largest micro-drone swarms at China Lake, California.

The test, conducted in the fall of last year, consisted of 103 Perdix drones launched from three F/A-18 Super Hornets. The micro-drones demonstrated advanced swarm behaviors such as collective decision-making, adaptive formation flying, and self-healing.

"I congratulate the Strategic Capabilities Office for this successful demonstration," said then-Secretary of Defense Ash Carter, who created SCO in 2012. *"This is the kind of cutting-edge innovation that will keep us a step ahead of our adversaries. This demonstration will advance our development of autonomous systems."*

"Due to the complex nature of combat, Perdix are not pre-programmed synchronized individuals, they are a collective organism, sharing one distributed brain for decision-making

and adapting to each other like swarms in nature," said SCO Director William Roper. *"Because every Perdix communicates and collaborates with every other Perdix, the swarm has no leader and can gracefully adapt to drones entering or exiting the team."*

The demonstration is one of the first examples of the Pentagon using teams of small, inexpensive, autonomous systems to perform missions once achieved only by large, expensive ones.

Roper stressed the department's conception of the future battle network is one where humans will always be in the loop.

Machines and the autonomous systems being developed by the DoD, such as the micro-drones, will empower humans to make better decisions faster.

Originally designed by Massachusetts Institute of Technology engineering students, the Perdix drone was modified for military use by the scientists and engineers of MIT Lincoln Laboratory starting in 2013.



Drawing inspiration from the commercial smartphone industry, Perdix software and hardware has been continually updated in successive design generations.

Now in its sixth generation, October's test confirmed the reliability of the current all-commercial-component design under potential deployment conditions—speeds of Mach 0.6, temperatures of minus 10 degrees Celsius—and large shocks encountered during ejection from fighter flare dispensers.

As SCO works with the military Services to transition Perdix into existing programs of record, it is also partnering with the Defense Industrial Unit-Experimental, or DIUx, to find companies capable of accurately replicating Perdix using the MIT Lincoln Laboratory design—the SCO's goal is to produce Perdix at scale in batches of up to 1,000.

A fact sheet about Perdix may also be accessed at this direct link:

defense.gov/Portals/1/Documents/pubs/Perdix%20Fact%20Sheet.pdf

DISPATCHES

Norsat's GLOBETrekker 2.0 Terminals Heading to US Defense Agency

Norsat International Inc. has received an approximate \$3.3 million order for their GLOBETrekker 2.0 portable satellite terminals from a US Combat Support Agency supporting the US Department of Defense and Intelligence Community.

The GLOBETrekker 2.0 is an intelligent fly-away satellite terminal with unsurpassed reliability, advanced auto-acquire technology, and a flexible deployment platform.

A simple one touch interface and the LinkControl™ software allow for automatic satellite acquisition so less experienced operators can easily use the system while multi-tasking on other field operations setup tasks.

These military-grade, auto-acquire terminals will provide:

- **Dual-band (X- and Ku-band) connectivity to ensure access worldwide depending on the satellite and bandwidth available in the area of deployment**
- **An integrated optic module to link the Outdoor Unit (ODU) to an Indoor Unit (IDU) modem over great distance without added weight**
- **The ability to quickly and easily change the RF equipment which makes the GLOBETrekker very adaptable to meet the changing requirements of the customer**

The customer, who has worked with Norsat previously, selected the GLOBETrekker 2.0 terminal due to the functionality of the built-in spectrum analyzer, the ruggedness of the unit, the sunlight readable display and LinkControl profile, which makes the system very easy to use.

Norsat expects to start the shipments of the terminals during the first half of 2017.

norsat.com/product/globetrekker/

SBIRS' SOUND SURVEILLANCE FOR NATIONAL DEFENSE

By Silvano Payne, Senior Writer and Publisher



SBIRS launch photo: The US Air Force's 45th Space Wing supported United Launch Alliance's successful launch of the third Space Based Infrared Systems Geosynchronous Earth Orbit spacecraft aboard an Atlas V rocket from Launch Complex 41 on January 20 at 7:42 p.m. ET.

Many have written about, and expounded upon, what the true purpose of a federal government should be—there was a consensus in this matter that was determined in the US some 200 years ago—that there are six specific directions that should be addressed: defense, justice, unity, domestic tranquility, citizen betterment and ensuring liberty for all citizens.

The primary purpose—no, obligation—of a government is the protection of citizens from foreign and/or internal attack, whether of a physical or economic nature.

Certainly, in the first instance, this is no small task, given today's global conditions where all are witness to the constant and deadly incursions that intend to destroy and prevent an individual's right to "life, liberty and the pursuit of happiness."

Medieval dogmas that are mis-represented by archaic distortions of faiths, misinterpretations of policies and other malconformation of facts, drive unwarranted aggression. Such must be countered via strong intelligence to build appropriately configured defensive and offensive policies and actions.

One such crucial tool to build intelligence and surveillance knowledge to offset hostile intentions are the Space Based Infrared Systems Geosynchronous Earth Orbit (SBIRS GEO) satellites.

The latest and greatest of these spacecraft was launched on January 20 at 7:42 p.m. aboard a United Launch Alliance Atlas V rocket from Cape Canaveral Air Force Station (CCAFS).

Lockheed Martin is the spacecraft's prime contract and SBIRS was built at the company's Sunnyvale, California, facility, being flown to Florida aboard a C-5 Galaxy aircraft from nearby Moffet Federal Air Field—and the payload integrator is Northrop Grumman Electronic Systems.



the defense and intelligence communities in support of the missile early warning, missile defense, battlespace awareness, and technical intelligence mission areas.

The first and second GEO satellites were launched on an ULA Atlas V rocket from Space Launch Complex (SLC) 41 CCAS. Using updates to the Increment 1 ground system, the SBIRS Mission Control Station (MCS) manages the constellation of HEO sensors, GEO satellites as well as the legacy DSP satellites.

Increment 2, the next major SBIRS ground update, was divided into two software releases; Block 10.3 and Block 20. Block 10.3 was transitioned to operations in the fall of 2016 and replaced all of the Increment 1 software, as well as improved event detection.

The SBIRS Survivable/Endurable Evolution (S2E2) program replaced the aging MGS that was initially designed for support of DSP operations in the 1960s and supports SBIRS survivability and endurance requirements.

The SBIRS sensors are designed to provide greater flexibility and sensitivity than the DSP infrared sensor and detect short-wave and mid-wave infrared signals, allowing SBIRS to perform a broader set of missions.

These enhanced capabilities result in improved prediction accuracy for global strategic and tactical warfighters. The on-going evolution of the ground system uses improved mission processing software, resulting in increased event

Artistic rendition of the third SBIRS GEO satellite. Image is courtesy of Lockheed Martin.

The SBIRS program is the follow-on capability to the highly successful Defense Support Program (DSP). The SBIRS program was designed to provide a seamless operational transition from DSP to SBIRS and meet jointly defined requirements of



GEO Flight 3 satellite uses infrared surveillance to provide early missile warning for the US military. Artistic rendition is courtesy of Lockheed Martin.

WHAT MILITARY MISSIONS DOES SBIRS SUPPORT?

This powerful system provides infrared data in support of four mission areas:

Missile Defense

Delivery of critical information supporting the effective operation of missile defense systems



Missile Warning

Reliable, unambiguous, timely and accurate warning for theater and strategic missile launches



Battlespace Awareness

Delivery of comprehensive IR data to help characterize battlespace conditions



Technical Intelligence

Ability to characterize IR event signatures, phenomenology and threat performance data



SBIRS infographic courtesy of Lockheed Martin.

message accuracy, and reduced manpower for support and operations of the DSP and SBIRS portfolio.

The GEO spacecraft bus consists of a militarized, radiation-hardened version of the Lockheed Martin A2100 spacecraft, providing power, attitude control, command and control, and a communications subsystem with five separate mission data downlinks to meet mission requirements, including system survivability and endurance requirements. The GEO infrared payload consists of two sensors; a scanner and a step-starer.

The scanning sensor continuously scans the Earth to provide 24/7 global strategic missile warning capability. Data from the scanner also contributes to theater and intelligence missions. The step-staring sensor, with a highly-agile and highly-accurate pointing and control system, provides coverage for theater missions and intelligence areas of interest with fast revisit rates and high sensitivity. Similar to the GEO scanning sensor, the HEO sensor is a scanning sensor, with sensor pointing performed by slewing the full telescope on a gimbal.

Both the GEO and HEO infrared sensors gather raw, unprocessed data that are down-linked to the ground, so that the same radiometric scene observed in space will be available on the ground for processing. The GEO sensors also perform on-board signal processing and transmit detected events to the ground, in addition to the unprocessed raw data.

This latest launch was the third SBIRS satellite to gain orbit and was pushed from CCAFS to advance the replacement of the legacy Defense Support Program (DSP) constellation, which has been in operation since 1970.

A fourth SBIRS satellite is currently in production, with the propulsion module having been already completed for this spacecraft—before the planned launch in 2017, this flight will move through final assembly, integration and test operations.

Brigadier General Wayne Monteith, the commander of the 45th Space Wing and the mission Launch Decision Authority, heartily congratulated ULA, SMC and the entire integrated team who ensured the success of this, the first of potentially 30-plus launches in 2017. "Once again," he added, "the entire team worked hand-in-hand to make this another successful launch for the Air Force and our nation. This launch clearly demonstrates the successful collaboration we have with our mission partners as we continue to shape the future of America's space operations and showcase why the 45th Space Wing is the 'World's Premier Gateway to Space.'"



The prime contractor for SBIRS is Lockheed Martin. Northrop Grumman is the payload contractor. Photo: Lockheed Martin.

SBIRS brings the critically-needed capabilities of missile launch warning and defence (identifying significant heat events), battlespace awareness and technical intelligence to the forefront, as the spacecraft brings global and persistent infrared surveillance capabilities to the armed forces.

If an enemy ICBM launch is detected, SBIRS detects that missile's thermal signature to relay that data to the missile defense forces to negate that incoming threat. Also detectable will be indications of human activity, from military actions to forest fires, small explosions to land clearing and so on.

There are two main sensors, with one undertaking large geographic area scans and the other perpetual, small area surveillance. A combination of these two sensors will afford a more timely alert should missiles be launched anywhere across the globe.

When a launch is detected, data is transmitted from SBIRS to the data processing center that plots the exact position of the missile launch, the threat presented and the trajectory of the missile, which in turn leads to a final assessment as to the action required to counter the potential menace to the nation.

GLOBAL, PERSISTENT, INFRARED SURVEILLANCE

SBIRS is an orbiting network of satellites with flexible ground processing and control systems to provide a continuous view of the Earth's surface. SBIRS collects and transmits infrared (IR) data that is vital for early missile warning and defense.

GROUND SYSTEM

HEO PAYLOAD

- Ground assets manage data from satellites, payloads and the legacy Defense Support
- Program using a distributed, high-availability server architecture

Key Functions:

- Mission planning/payload tasking
- Constellation management/telemetry tracking and commanding
- Mission processing, event reporting and data distribution

Ground Control:

- Operating modes include normal, survivable and endurable
- Worldwide primary and backup mission control stations, relay ground stations

The newest missile warning satellites are based on the modernized A2100 spacecraft—a no-cost update that reduces costs and cycle times while increasing the potential to incorporate future, modernized sensor suites.

BEYOND MISSILE WARNING

A powerful asset for situational awareness, data from SBIRS is being applied across areas such as battlespace awareness, intelligence and 24/7 tactical alerts. Additionally, the Air Force's Data Utilization Lab is bringing together government, industry and academia to better understand how SBIRS data can be applied for both civil and military applications.



The radomes, lightly referred to as "golf balls," on Buckley Air Force Base, Colorado, house and protect satellite dishes and other crucial space operations equipment. The purpose of the giant spheres is to protect the equipment from the weather. Photo is courtesy of US Air Force / Airman 1st Class Emily E. Amyotte.

Once SBIRS was on orbit, the airmen from the 460th Operations Group made history by successfully completing the first series of satellite and antenna communications from the satellite from January 28-30 from Block 10, which is the new operations floor at Buckley Air Force Base, Colorado.

This was the first step in transforming Block 10 into the new, consolidated operations floor for Defense Support Program, Highly Elliptical Orbit (HEO) and Geostationary satellites. Currently, each type of satellite communication platform is in a separate location across Colorado, making efficient communication difficult.

By bringing the three units together, the SBIRS constellation is now consolidated under a single roof. Wing and operations group leadership were at Block 10 on January 28, waiting to see history made—a celebration broke out when the commands to SBIRS were successfully returned.

"The intent of Block 10 is to bring all three platforms here in one place to the Mission Control Station," said Captain Natasha Rosario, the 2nd Space Warning Squadron SBIRS satellite engineering chief. *"It was kind of fun. They sent the very first one, which was on DSP, and everyone clapped after the first command went out. They were like, 'yes it worked!'"*

A full year-and-a-half could be required until all three platforms are working on the Block 10 floor. When that does occur, Block 10 will then be known as Mission Control Station 2, Rosario said. There will be a period of checking out the Block 10 system and software, assuring the ground software delivery can be executed flawlessly.

"We've put testing and rehearsals and practices in place to make sure that we not only check out the system, but that the people are also ready and bringing those two things together as well," Rosario said.



The SBIRS satellite upon build completion. Photo is courtesy of Lockheed Martin.

Starting with live, single communication, which is what they have already initiated, the 460th OG will continue testing their communication with only one satellite or antenna at a time.

The second stage, which will be communicating with two satellites or antennas simultaneously, will then start in the next month or two—for example, communicating with GEO and HEO simultaneously. An estimated year from this writing, the 460th OG will have full, simultaneous communication with the entire SBIRS constellation.

This advancement means a great deal for the 460th OG and Team Buckley. The squadron will almost double in size and many OG Airmen will have to undertake additional hours of training to keep up with the transition to Block 10.

Airmen from the other Colorado SBIRS locations are scheduled to move to Buckley to finish the transition and unify the SBIRS constellation.

"This is a major milestone for a multi-billion dollar system toward a critical national mission in which we have been diligently working for a very long time," said Colonel Michael Jackson, the 460th OG commander.

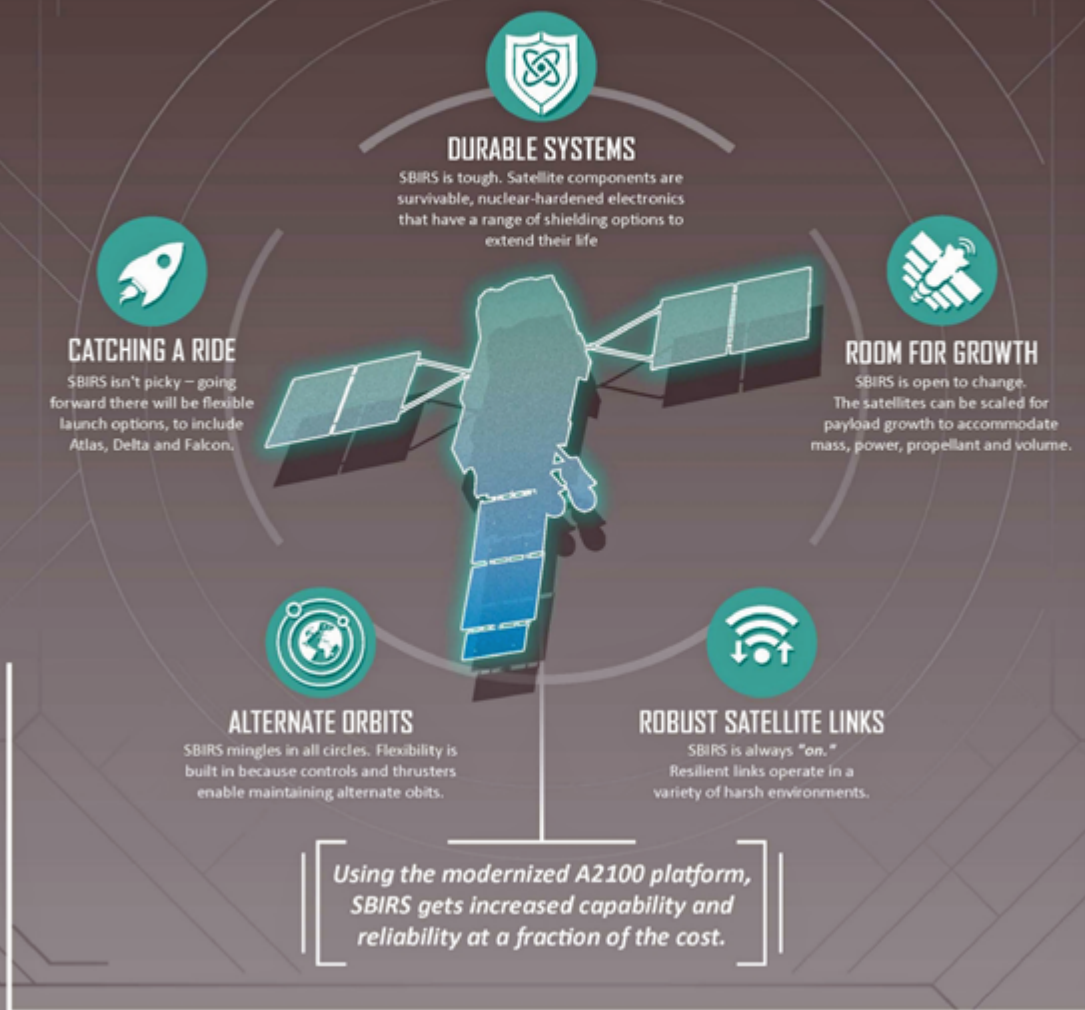
Additionally, for the first time, infrared data from the Lockheed Martin-built SBIRS will be available for new military and civilian uses at the Air Force's recently opened data utilization lab in Boulder, Colorado.

While SBIRS' primary mission is strategic missile warning, the system can support a wide range of research and development projects across the field of remote sensing, which is the monitoring, observing and gathering of information on the Earth and atmosphere from space.

"SBIRS uses powerful overhead sensors that collect and transmit significant amounts of infrared data," said David Sheridan, vice president of Lockheed Martin's Overhead Persistent Infrared (OPIR) systems mission area. *"By giving researchers access to this data, our objective is for them to find new, innovative uses for improving situational awareness—whether it is for tactical military missions, natural disasters or even firefighting."*

THE RESILIENCE OF SBIRS

PROVIDING GLOBAL, PERSISTENT INFRARED SURVEILLANCE



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"In an effort to develop, test and transition new or enhanced capabilities, the data utilization lab will provide an opportunity for users, data consumers and third-party developers to access these sensor feeds—providing an open framework architecture to host new tools, algorithms and processing solutions," said Lt. Colonel Ross Johnston of the Air Force Space and Missile Systems Center.

Along with government and industry teams, academic organizations, like the University of Colorado, will use the data provided by the lab to facilitate collaboration and support research in areas that include monitoring the Earth's surface to determine the potential for forest fires or informing critical decisions during active fires.

"The benefit of having public-private partnerships is that we can bring together different stakeholders, in addition to doing research, and understand how we can use data from space assets to solve societal issues," said Scott Palo, associate dean for research at the University of Colorado's College of Engineering and Applied Science. "We can also provide opportunities for

In the past year, the Air Force has seen a growing demand from the military, intelligence and civil communities, as well as academia, for remote sensing capabilities.

For areas such as battlespace awareness, intelligence and 24/7 tactical alerts, promising solutions developed in the lab will be considered for operational applications at the SBIRS Mission Control Station, OPIR Battlespace Awareness Center at Buckley Air Force Base, Colorado.

students, as well as small and medium-sized businesses, to connect with industry and government and develop a broader vision that we can all build upon."

Word was received from Lockheed Martin that SBIRS GEO Flight 3 is responding fully to commands, as planned, and that event occurred approximately 37 minutes after lift-off.

"After a successful ULA launch, signal acquisition is the first critical event in SBIRS' mission to support the Air Force with early missile warning and defense," said David Sheridan, vice president of Lockheed Martin's Overhead Persistent Infrared (OPIR) systems mission area. "With communications now established, our job begins to deliver SBIRS to its final orbit so we can complete deployments and operational testing in anticipation of the satellite's formal acceptance by the Air Force."

"Adding this third geostationary satellite to the SBIRS constellation continues our proud legacy of providing best-of-class OPIR solutions that provide real-time, 24/7 data to our military and allies," said Robert Mehlretter, vice president, Northrop Grumman Military and Civil Space. "We are looking forward to seeing our sensors capture the first light of real-time world events shortly, and seeing this data delivered to the warfighter will make us proud."

The satellite will now begin the transition to the final location in geosynchronous orbit, approximately 22,000 miles above the Earth. There, the satellite's solar arrays, light shade and antennas will be deployed to initiate early, on orbit testing.

SBIRS GEO-1 and GEO-2, which were launched in 2011 and 2013 respectively, continue to meet or exceed performance expectations. The satellites' sensor pointing accuracy and sensitivity for detection of targets significantly exceed specifications.

While SBIRS' primary mission is strategic missile warning, infrared data will also be made available for new qualified military and

civilian applications at the Air Force's recently opened Tools, Applications and Processing Lab in Boulder, Colorado.

The next satellite, GEO Flight 4, will undergo final assembly, integration and test prior to its planned 2017 launch. SBIRS GEO-5 and GEO-6, which are currently in production, incorporate a new common spacecraft bus, the modernized A2100, to dramatically reduce costs and cycle times while increasing the potential to incorporate future, modernized sensor suites.



Photo of the ULA Atlas V rocket carrying SBIRS GEO Flight 3 satellite from Space Launch Complex-41 at 7:42 p.m. ET. Photo is courtesy of ULA.

A sure indicator of the effectiveness of satellite surveillance for intelligence purposes is the drive by China in the development of their anti-satellite (ASAT) weaponry.

become the workhorse of the Atlas V fleet and has delivered half of all of the Atlas V missions to date. She added, "I can't think of a better way to kick off the new year."

One example of the Chinese intent to enhance these capabilities was their launch of their SC-19 missile a few years ago that used kinetic energy versus an obsolete orbiting satellite. The resultant "warning light" strobed across the globe and the Pentagon realized efforts had to be expended to counter such spatial threats—without the intelligence provided by the superior technologies of the satellite, accessing the tools and information available to defend a nation become severely crippled or, heaven-forbid, totally non-existent.

And therein rests one of the more important reasons for the commitment by the USAF of more than \$5 billion over the next five years in development of technologies to counter such adversarial threats to spacecraft. One such effort is the "hardening" of satellites in order for them to become immune to electronic warfare attacks.

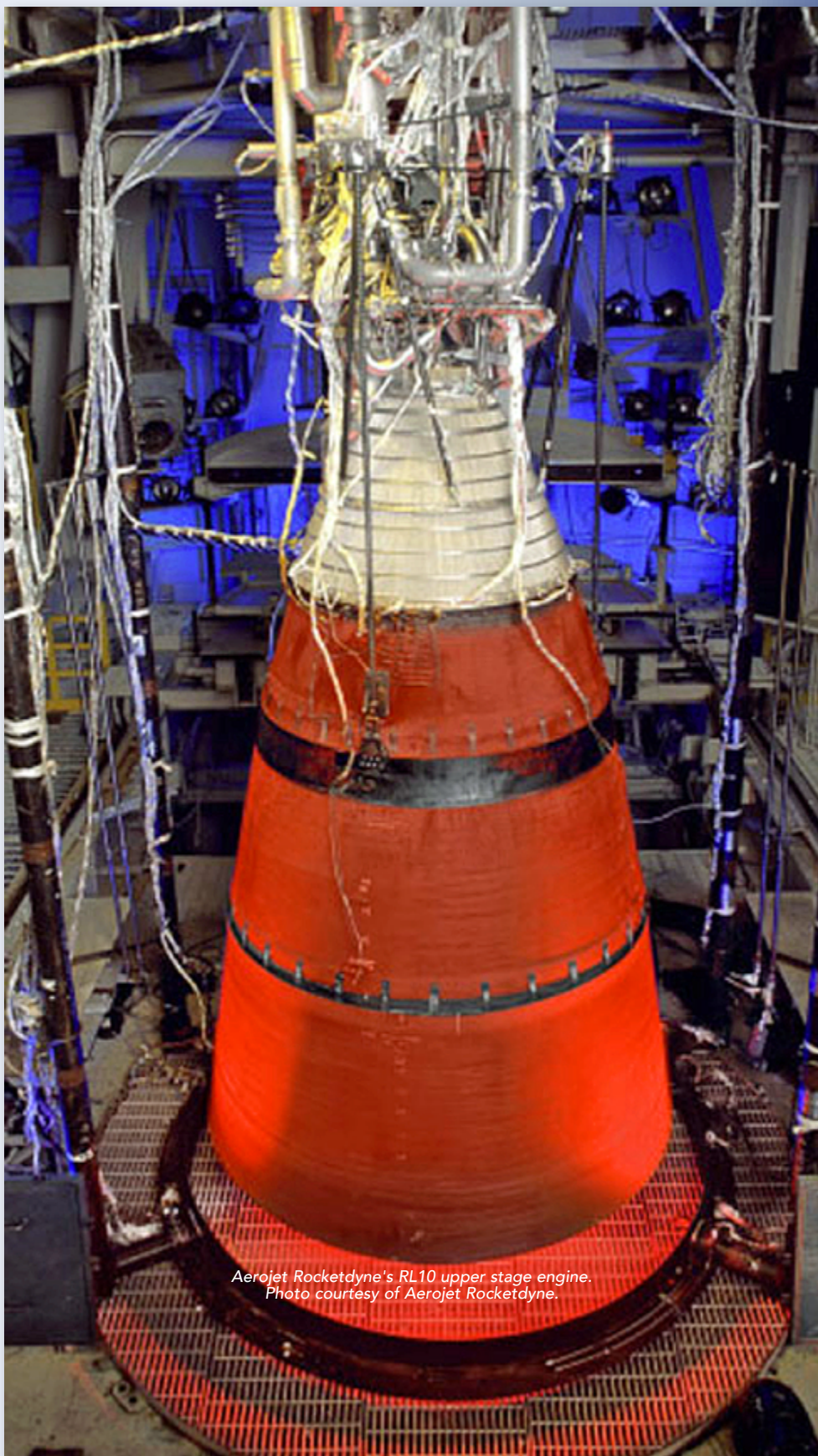
Another undertaking was by the Defense Advanced Research Projects Agency, known as DARPA, whose wide-angle space view can detect launch concerns as well as asteroids that threaten the planet.

There are also efforts underway to develop GPS-denied environments for satellites that would allow positioning navigation as well as timing mechanics to function without that technology.

For United Launch Alliance (ULA), this was the first of 11 planned launches for this year and the 116th successful launch since the company's formation in December of 2006.

The 401 configuration of the Atlas V Evolved Expendable Launch Vehicle (EELV) included a 4 meter in diameter large payload fairing (LPF). Propulsion was provided by the RD AMROSS RD-180 engine, with the Centaur upper stage powered by the Aerojet Rocketdyne RL10C engine.

Laura Maginnis, the Vice President at ULA for Government Satellite Launches, indicated that the 401 configuration has



Aerojet Rocketdyne's RL10 upper stage engine.
Photo courtesy of Aerojet Rocketdyne.

Supporting this crucial launch was Aerojet Rocketdyne, Inc., whose propulsion systems on the Atlas V included the RL10C-1 upper-stage engine, six helium pressurization tanks, and 12 Centaur upper-stage Reaction Control System thrusters (RCS). Additionally, Aerojet Rocketdyne provided 18 monopropellant hydrazine thrusters on the GEO Flight 3 satellite.

Aerojet Rocketdyne's RL10C-1 upper-stage engine ignited after separation of the first stage to place the payload into orbit, helped by the Centaur RCS thrusters and pressurization tanks. The RL10C-1 delivers 22,890 pounds of thrust to power the Atlas V upper stage, using cryogenic liquid hydrogen and liquid oxygen propellants. The RL10C-1 was developed from the RL10 family of upper-stage engines, which have accumulated one of the most impressive track records of accomplishments in the history of space propulsion.

More than 475 RL10 engines have supported launches over the last 50 years, playing a vital role in placing military, government and commercial satellites into orbit, and powering scientific space-probes on every interplanetary mission in our solar system. Aerojet Rocketdyne provided 12 MR-106 monopropellant hydrazine thrusters in four modules on the Atlas V Centaur upper-stage, which provided roll, pitch and yaw control, as well as settling burns. The GEO Flight 3 satellite has 18 monopropellant hydrazine thrusters onboard: 12 MR-103G 0.2-lbf thrusters and six MR-106L 5-lbf thrusters.

Once separated from the launch vehicle, the 18 thrusters on the GEO Flight 3 satellite provided stationkeeping, three-axis control and de-spinning of the reaction wheels throughout the mission. They also provide attitude control during orbit-raising, as well as the impulse needed for final decommissioning of the satellite.

ARDÉ, a subsidiary of Aerojet Rocketdyne based in New Jersey, provided the pressure vessels on the first and second stages of the launch vehicle.

"It's an honor to know our propulsion systems helped place another critical satellite into orbit in support of our nation's defense—one that will provide key capabilities in the areas of missile warning, missile defense, technical intelligence and battlespace awareness," said Aerojet Rocketdyne CEO and President Eileen Drake.

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lockheedmartin.com
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rocket.com



TOP GUN AMPLIFIERS...

A GENERAL DYNAMICS SATCOM TECHNOLOGIES PERSPECTIVE

By Crissy Pierson, Business Line Manager, RF Electronic Products, General Dynamics Mission Systems' SATCOM Technologies



SATCOM providers face significant risk if an equipment problem disrupts the link to a satellite.

When critical applications go offline, customers lose confidence and revenue is lost as providers scramble to recover the link. As a result, most satellite Earth stations employ brute-force redundancy to reduce the risk, but at significant cost and increased complexity.

When the final amplifier stage is a single tube and thus a single failure point, having a second amplifier immediately available is a pragmatic solution.

In response to this risk, General Dynamics SATCOM Technologies have designed hot-swappable amplifiers to ensure continuous up time, through the outstanding reliability and demonstrated viability and practicality of solid-state amplifiers.

General Dynamics' ModuMAX high power amplifiers provide proven reliability and the simplest plug-and-play, hot-swappable design available in medium and high power RF amplifier systems.

For more than 15 years in the field, no ModuMAX system has ever gone offline, making the amplifier the preferred choice of broadcasters, telecommunications services, and teleports that require 100 percent uptime. In addition to commercial applications, the ModuMAX is also used by governments and militaries worldwide, including a scientific research location in Antarctica.

PATENTED MODULAR ARCHITECTURE

ModuMAX SSPAs are completely modular RF amplifier systems. Patented technology uses hot-swappable, plug-

in RF modules, power supplies, and electronic assemblies to maximize performance and minimize downtime in SATCOM systems. Solid-state power amplifiers (SSPAs) consist of multiple transistors in parallel, and naturally contain a degree of built-in redundancy.

Using multiple RF modules, power supply modules and cooling fans, ModuMAX SSPAs are extremely reliable and fault-tolerant. One fault-tolerant ModuMAX SSPA can replace a redundant pair of conventionally designed high power amplifiers, yielding significant installation savings and reduced operating costs. The systems' modularity, compactness, and built-in self-redundancy mean a lot smaller footprint and simplified waveguide runs when compared to switched redundant configurations.

Due to the amplifier's internal architecture and unique operating features, such as single-module failure compensation and configurable power, ModuMAX eliminates the need for a redundant, stand-by unit in most applications.

ModuMAX SSPAs consist of eight identical and fully inter-changeable RF plug-in modules that operate in parallel. Loss of a single module causes a drop of approximately 1.2 dB in maximum output power—without the momentary interruption of signal caused by redundant switchover systems.

As uplink amplifiers are only needed to operate at maximum output power in extreme signal fades, the ModuMAX Automatic Power control feature can maintain continuous output power levels in most failure conditions. RF modules can be hot-swapped while the system is operating and without disrupting the signal. Spare RF modules are affordable, since they contain only a fraction of the RF power transistors in the SSPA.

CONFIGURABLE POWER

ModuMAX SSPAs combine the RF output power from eight identical, fully interchangeable RF plug-in modules (16 in a phase-combined system) to obtain the rated power capacity. These modules can be individually turned on or off via either local or remote control. Installations can exploit this feature to reduce prime power consumption during times when the required RF output power is lower than the maximum linear power capacity of the amplifier.





This ability to adjust the number of enabled RF modules to match the output power requirement is called configurable power. Since power consumption is approximately proportional to the number of enabled RF modules, configurable power allows significant reduction in prime power consumption while still meeting the system RF power requirements for some applications. Additionally, the amplifier modules can also be employed in an N+X redundancy configuration where, in the event of a fault occurring in the online modules, the available spare modules can be brought on line rapidly via M&C.

PHASE-COMBINED SYSTEMS

A pair of ModuMAX SSPAs can be phase-combined in a single rack utilizing a fixed (hybrid) or variable phase

combining (VPC) system. The VPC system affords flexibility to configure the system for operation using either ModuMAX SSPA individually (single mode), or using both simultaneously (phase-combined mode) to nearly double the system output power. A phase-combined ModuMAX system has a total of 16 RF modules (eight in each of 2 RF units); with 16 modules, loss of one module causes only about 0.6 dB drop in output power.

EASE-OF-OPERATION

ModuMAX systems are easy to operate. All features can be fully remote controlled through standard RS-232/-422/-485 and network interfaces. For quick and easy manual access, the most commonly used controls are located on the front panel.

SERVICING FAST & EASY

The hot-swappable 'plug-and-play' RF modules are accessible from the front panel. Modules can be removed and replaced while the SSPA continues to operate—no need to shut down for servicing, and no need for calibration. The needed simple hand tools (wrench, nut driver) are included and conveniently stored within the amplifier chassis. Any of the fans in the air-cooling system can be easily removed and replaced, without taking the SSPA off-line. Even the power supply modules are redundant and hot swappable.

FORCED AIR COOLING

ModuMAX also incorporates redundancy into its integral forced-air cooling system. Sufficient margin is built into the design to tolerate the loss of one cooling fan.

Fans are monitored for rotational speed, and failure of a fan is indicated on the control panel display and to the M&C system. In the event of a fan failure, the SSPA can continue to operate until a replacement is installed. The air cooling system utilizes separate rear panel air intake and exhaust ducts and can be vented either outdoors or into the room.

WORLDWIDE POWER

For most systems, operating power is supplied by three identical, hot-swappable plug-in power supply modules in a rack-mount chassis; higher output systems require six modules (two PS chassis) per RF unit for full "N+1" redundancy.

If a PS module fails, the remaining ones can supply 100 percent of the required load current and the faulted module can be hot-swapped without interrupting system operation. ModuMAX SSPAs can be connected to 120/208 Vac or 230/400 Vac three-phase sources, or to single-phase 180–264 Vac, supporting installation worldwide.

Key features include...

- **True High-Power HOT-SWAP Modular System**
 - Switchless redundancy
 - No switching, no external hot standby required
- **Configurable Power Levels**
 - N+X redundancy in a single system
 - Configure operating RF power level as required for application and mission
- **Extremely Low MTTR**
 - Less than three minutes for module replacement
- **Full Diagnostics**
- **Intelligent, Ultra-High Efficiency Power Supply System**
- **Single Module Failure Compensation Feature**
- **Three-Year All-Inclusive Warranty**

Additional information available at:
gdsatcom.com/electronics.php

Crissy Pierson is the Business Line Manager of RF Electronic Products for General Dynamics Mission Systems' SATCOM Technologies. In this role she is responsible for new product development, establishing product roadmaps, designating sustaining engineering projects, program management, supporting proposals and improving the overall customer experience.

Ms. Pierson has worked at General Dynamics Mission Systems for over eight years and has held a number of roles including International Account Manager and Sales Manager for RF Electronics and has also supported the VSAT group as a Sales Manager before becoming the Business Line Manager for RF Electronics.

Ms. Pierson holds BS and MBA degrees from DeSales University with concentrations in International Business and Marketing along with Project Management certification from Villanova University.

THE HPA CORNER: INSIGHTS — AN ALLIANCE UPDATE

By Al Tadros, Hosted Payload Alliance Chair

Now that 2016 has come to a close, I'd like to reflect on the progress we've made on the Hosted Payload Alliance's (HPA) goals, as well as provide some insight on the current state of hosted payloads in today's satellite industry.

The HPA has cultivated awareness of the benefits of hosting government payloads on commercial satellites through open discussion with government and industry leaders. We will continue this discussion into 2017 in order for hosted payloads to further contribute to the overall space architecture.

The satellite communications industry remained vibrant during 2016, with ample opportunities for LEO, MEO and GEO satellite hosted payloads.

The cadence of satellite launches continued to increase, and there were more than 65 commercially procured satellite launches in 2015¹.

In 2016 there were roughly 80 launches. This heavy activity drove down launch costs and provided more opportunities for hosted payloads to share a ride into space.

Additionally, the average number of start-up space investors per year grew from 19 to 55 over the last five years², encouraging growth in satellite and fueling the proliferation of Low Earth Orbit (LEO) satellites.

As opportunities for hosted payloads continued to build, our efforts to inform and bridge communications of the benefits to all parties became increasingly important.

For the fourth year in a row, HPA representatives met with approximately 45 congressional offices to advocate for increased implementation of hosted payloads. In response, Senators Mark Warner (D-Va.) and Tim Kaine (D-Va.) sent a letter to Deputy Undersecretary of the Air Force for Space Winston Beauchamp requesting an assessment and future plans to incorporate commercially hosted payloads into the Air Force space architecture.

US Representative Jim Bridenstine (R-OK) also reached out to the HPA and we were happy to provide language suggestions regarding hosted payloads for the National Defense Authorization Act (NDAA). Bridenstine's American Space Renaissance Act (ASRA), which was introduced in the House of Representatives this year, also includes language that specifically encourages the use of hosted payloads.

The ASRA requires the Secretary of Defense to leverage hosted payloads to the maximum extent practicable.

ASRA is a tremendous milestone for government access to commercially leveraged solutions.



Overall, the HPA was encouraged by the success of our government outreach efforts and we look forward to continuing the conversation next year.

Partly enabled by the HoPS IDIQ contract, which is meant to help normalize hosted payload use, government organizations have committed to a number of hosted payloads, including the TEMPO air pollutants monitoring payload and NOAA's SARSat (Search And Rescue Satellite Aided Tracking) payload.

However, there were also some missed opportunities for public-private collaboration, including the STPSat-6 multipurpose experimental satellite whose payloads were strong candidates for hosting on commercial communications satellite.

The cost, schedule and risk are less favorable with this chosen approach as compared to hosting the payloads on commercial GEO satellite. Furthermore, the opportunity to demonstrate the sustainable approach of hosting payloads on commercial satellites, which can proliferate these payloads in an operational constellation, has been passed up.

Finally, the opportunity to host the communications related payloads on a commercial GEO satellite could have benefited from a transition path for commercial SATCOM industry to invest and continue to develop and perpetuate these technologies for the ultimate benefit of the USAF. We must ensure that awareness of these capabilities doesn't go unnoticed.

Hosted Payload Alliance members constantly communicated the benefits and opportunities of hosting government payloads on commercial satellites.

Over the course of the year, the HPA participated in a number of public forums, including panels at the Small Payload Rideshare Symposium at the Museum of Flight in Seattle, Washington and SATELLITE 2016 in Washington D.C.

I also represented the HPA at the Hosted Payload and Smallsat Summit in Washington` D.C., where I provided an

update on hosted payloads called the “*Hosted Payload State of the Union.*”

In my presentation at the Hosted Payload and Smallsat Summit, I emphasized that our continued engagement with both government and industry is critically important.

This remains true today and our successes over the past year, such as the ASRA and the NDAA amendment, are proof that our efforts to highlight the opportunities that hosted payloads can offer the government and public sectors have been successful.

It is important to now leverage these successes for our continued promotion of hosted payloads and commercial acquisition strategies—which will ultimately result in a more robust space architecture and greater value to taxpayers.

I look forward to participating in and advocating for the continued evolution of hosted payload solutions in the coming year.

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hostedpayloadalliance.org/

Established in 2011, The Hosted Payload Alliance (HPA) is a satellite industry alliance whose purpose is to increase awareness of the benefits of hosted government payloads on commercial satellites. The HPA seeks to bring together government and industry in an open dialogue to identify and promote the benefits of hosted payloads. The HPA:

- *Serves as a bridge between government and private industry to foster open communication between potential users and providers of hosted payload capabilities*
- *Builds awareness of the benefits to be realized from hosted payloads on commercial satellites*
- *Provides a forum for discussions, ranging from policy to specific missions, related to acquisition and operation of hosted payloads*
- *Acts as a source of subject-matter expertise to educate stakeholders in industry and government.*



In December of last year, *Defense One* (a National Journal Group publication) sponsored a Space and Satellite Communications Morning Briefing that was underwritten by SES Government Solutions (SES GS).

The event featured a panel of space experts from the military and federal government and was well attended by satellite industry professionals, contractors and military decision makers.

I had the opportunity to attend the event and listen to the all-star panel discuss the challenges, changes and opportunities facing the military's space operations and satellite infrastructure.

The panel included:

- *Winston Beauchamp – Director, Principal Department of Defense Space Advisor Staff and Deputy Under Secretary (Space), US Air Force*
- *Chirag Parikh – Director of Source Strategies, National Geospatial-Intelligence Agency (NGA)*
- *Robert Tarleton, Jr. – Director, MILSATCOM Systems Directorate, Space and Missile Systems Center, Air Force Space Command, Los Angeles Air Force Base, California*
- *Brian Weeden – Technical Advisor, Secure World Foundation*

Despite representing separate entities, all four of the panelists had a similar perspective on space—the US needs to adopt new technology and expedite acquisition processes quickly to ensure continued mission assurance and superiority. There are multiple trends and changes in the domain that are forcing the military's hand.



WE'RE NOT ALONE ANYMORE

Paramount among the changes and challenges facing our nation in space is that space is no longer host to a party of two. There are an ever-increasing number of players in space.

This challenge was highlighted by Dr. Weeden when he said, *"We've been doing things in space since the 1950s. And it's only been in the last decade or so that those that work in the field have started to see a pretty drastic amount of change, and that's being driven by several trends. One of those is that space is becoming more international. Early on, only two countries were operating in space, now there are more than 60 countries that have at least one satellite, and more of them joining the club every year."*

However, it's not just other governments that are starting to launch and maintain satellite constellations. As Dr. Weeden explained, there is an increasing field of commercial satellite providers that are launching spacecraft for a wide range of capabilities and use cases.

According to Dr. Weeden, *"Space started as a government endeavor, but that's changing very rapidly. We're on the cusp of seeing a revolution or renaissance in commercial space that will see it start doing all sorts of interesting things that government has done in the past...and also a whole bunch of new things we haven't seen before."*

This congestion in space is not a new topic of discussion. In fact, we've covered the issues and challenges that can arise from the expanding ecosystem of satellites in space at great length and in great detail in the past on the *Government Satellite Report*.

Ultimately, increased congestion greatly increases the chances of collisions between spacecraft. The increased investment of foreign nations—and adversaries in particular—into their satellite constellations only serves to erode the advantage that space used to provide to the United States military.

What's more, the US military's reliance on satellite and the advantages that satellites deliver in theater are no longer exclusive or unknown. Our adversaries know that MILSATCOM is mission critical to the military, and will look for any way to take MILSATCOM and other satellite capabilities away from our military during conflicts.

This sentiment was shared by Mr. Parikh when he said, *"...the environment has changed. War is extending to space. Some are now considering [space] part of a conventional conflict."*

If war is extending to space, then US satellite infrastructure and the capabilities they deliver need to be protected to ensure they're available to the warfighter during conflicts.

BUILDING A NEW, MORE RESILIENT ARCHITECTURE

These new challenges and changes in space come at an interesting and pivotal time in our nation's space infrastructure. The Department of Defense (DoD) is now looking forward to the next space architecture for 2030 and beyond.

Regardless of what decisions the military makes regarding its future satellite infrastructure, a focus on resiliency is guaranteed. One of the ways that the military is exploring to help increase resiliency and enable other benefits is to look to those outside of the US government and military for support—including commercial industry and international allies.

This sentiment was reflected by Mr. Parikh, who said, *"We are in a huge transition phase right now. We are already—in the government—talking about the architecture after next. And so as we try to figure out what's happening in 2030, we have to first figure out what's happening in the commercial climate, what's happening in the foreign climate, understand what's happening in the security climate, and then—based upon that—apply our capabilities towards what we do best, which is solve the hard problems with the resources that we have and then leverage commercial and foreign capabilities to the maximum extent practical."*

The future vision for the military satellite infrastructure is expected to be established in an upcoming Analysis of Alternatives (AoA) that will be conducted by the DoD. This AoA is expected to begin shortly, and will function to identify the path forward for military satellite communications.

Despite the fact that the process for completing the AoA has yet to begin, almost all experts—including the panelists at the event—agree that MILSATCOM will play a vital role in the future of the government satellite infrastructure when it's completed and released.

One of those reasons involves private industry's ability to bring new and innovative satellite technologies to market faster than the government could ever dream of. The other relates directly to one of the largest challenges facing us in space—resiliency.

MORE LAYERS MEANS MORE MISSION ASSURANCE

The existing constellations of purpose-built military satellites, WGS, is capable and effective for delivering communications and capabilities to warfighters in theater. They're also easy targets for adversaries.

During a conflict, adversaries may look to eliminate US MILSATCOM and other capabilities delivered via satellite, and there are multiple ways they can accomplish that —

including jamming and kinetic attacks. If these capabilities are being delivered exclusively through the WGS satellite constellation, targeting the correct satellite and compromising them is exceptionally simple.

The military can change this by distributing their MILSATCOM capabilities and delivering them via multiple layers or constellations of satellites—it then becomes increasingly difficult to identify which satellites are carrying mission-critical communications and capabilities and makes it more difficult to attack them.

This point was validated by Mr. Beauchamp who said, *"... If we can evolve from an architecture where we deliver capability from a single layer of identical nodes in space to one where we maintain the exquisite national systems that we have and that we have enjoyed the services of for so long, and augment them with systems that are delivered with commercial capability, international capability and possibly something that is responsive in nature, then it would be very difficult for any of those threats to hold our capability at risk because they wouldn't know where the capability is being delivered from."*

In addition to the distribution of MILSATCOM signals and capabilities, commercial providers can also help increase mission assurance through their advanced HTS technology.

Today, commercial SATCOM (COMSATCOM) providers are building and launching a new generation of High Throughput Satellites (HTS) that use high powered spot beams to deliver higher throughputs and increased bandwidth. These high powered spot beams can also be useful in helping protect satellite signals from jamming.

According to Mr. Beauchamp, *"...on the COMSATCOM side, (we're) going to take advantage of the industrial trend towards smaller spot beams of higher power so that jammers would have to be much more numerous and much more close to the action than they would have before to deny a signal."*

With benefits that align directly with the military's need to increase mission assurance and protect satellite capabilities, it's no surprise that COMSATCOM is will be a significant mission partner in the future. The challenge for the DoD will be to accurately incorporate the capabilities and benefits of COMSATCOM in their developing AoA.

Ultimately, the largest trend that was discussed at the event was the need for the government and military's space infrastructure to change in the face of a drastically more congested and contested domain.

This topic was well-illustrated by Dr. Brian Weeden, a panelist and Technical Advisor at the Secure World Foundation, when he said, *"There's...a growing use of space for military and national security purposes by the US and other countries."*



"[AoA's] typically take around 18 months or so. But this one is going to be complex because we've got commercial partners in the planning and conduct of the AoA, as well as international partners that are participating as well," said Robert Tarleton, Jr, the Director of the MILSATCOM Systems Directorate, Space and Missile Systems Center (SMC), Air Force Space Command.

LOOKING AHEAD — THE BEST PATH FORWARD

A more congested and contested domain has led the military to look forward to the future of their space and satellite infrastructure for 2030 and beyond. As we discussed earlier in this article, this is beginning with an *Analysis of Alternatives* (AoA) for military wideband satellite, which will analyze all possible ways in which the military can build a next-generation space and satellite network that will deliver the mission assurance that the military needs in space today, and into the future.

WHAT IS THE CURRENT STATUS OF AOA?

The AoA is, unfortunately, complex and intricate, with many disparate organizations and parties involved in its development. Instead of being done entirely with input from the DoD and Air Force, this AoA is being drafted with input from international partners and private industry—including the COMSATCOM providers whose networks will undoubtedly become more relied on to carry military communications and capabilities during conflicts.

This more complex AoA has taken significantly more time to coordinate and start than many outside of the government had anticipated. As of yet, the completion date remains "TBD."

According to Robert Tarleton, Jr, the Director of the MILSATCOM Systems Directorate, SMC, Air Force Space Command, "It'll be done when we've answered all of the questions that we have to address. [AoA's] typically take around 18 months or so. But this one is going to be complex because we've got commercial partners in the planning and conduct of the AoA, as well as international partners that are participating as well."

However, Mr. Tarleton did insinuate that COMSATCOM could be playing a larger role in MILSATCOM needs in the future when he said, "...purpose built satellite, commercial systems – that's hard to figure out right now. There's going to be some mix, there's no doubt about it. But the AoA isn't being shaped with just input from international and industry partners, alone. There are other intelligence and information sources that are expected to help define and shape the AoA—and subsequently the nation's military satellite infrastructure—moving forward.

"We hoped to initially have—at contract award—access to the whole constellation of whichever company we had bought from, equal to the bandwidth we had bought. With the funding and some of the other regulations we had run

And all of these things together generate challenges—physical congestion, greater frequency congestion, and also the potential for space to be part of future conflicts. That's a huge set of challenges—and also opportunities—that the military is trying to deal with."

Space is becoming increasingly incorporated in conflict planning and military exercises. CNN recently highlighted this new battleground in their special "War in Space: The Next Battlefield," which premiered last month.

The domain is being relied on more heavily for the delivery of actionable intelligence and mission-critical capabilities and communications in theater. It's also becoming a capability that the military is looking to better share and integrate with both international partners and the intelligence community.

These necessary changes were extolled by Mr. Winston Beauchamp when he said, "Just look at all of the changes that we've made just in the last year. We've changed the way we exercise. In July at the Red Flag exercise, the Air Expeditionary Commander—someone that has always been an air operator—was Colonel Deanna Burke, the Commander of the 50th Space Wing. We changed the way the relationship between air and space operates. We changed how we collaborate with our international partners..."

"We've changed the way we present space forces to the combatant commanders by building a space mission force that understands what it takes to operate through a contested environment. We changed our Op centers and are well on the road to modernizing our battle management command and control capability. And we've changed the way we integrate with our intelligence community partners – much closer collaboration than ever—because—when you're in a contested environment—you have to understand what your partners are doing in response to a threat..."

These changes aren't the only result of the shifting space domain.

into, we just weren't able to do that. We're actually going to not have that capability available to us until after the satellite itself is launched," Tarleton said regarding the changes to the Pathfinder Two Program.

THE PATH FORWARD

In addition to gathering intelligence and information for the creation of the AoA from international partners and experts in private industry, the military is also conducting a series of Pathfinder and Pilot Programs. These programs are designed to create insights and information into the feasibility of disparate purchasing and operating models for SATCOM services.

The first COMSATCOM Pathfinder, which involved the Air Force acquiring a transponder on an on orbit satellite over Africa, was widely considered a success by decision makers in the DoD.

However, the next Pathfinder program, Pathfinder Two, has met some internal resistance and has been delayed and subsequently altered from its original intent and design — to purchase a transponder prior to launch and then have the ability to trade capacity on that transponder for capacity on other satellites that are providing coverage in geographic areas of need.

According to Mr. Tarleton, *"The intent was to look at the business and acquisition processes. So, what has actually changed is our approach to how we're going to do Pathfinder Two. We hoped to initially have—at contract award—access to the whole constellation of whichever company we had bought from, equal to the bandwidth we had bought. With the funding and some of the other regulations we had run into, we just weren't able to do that. We're actually going to not have that capability available to us until after the satellite itself is launched."*

But, despite these setbacks, the military is optimistic that some Pathfinder data—as well as learning from other pilot programs—can be incorporated into the wideband AoA. However, they'll have to move fast to complete Pathfinder Two, and its successor—Pathfinder Three. Unfortunately, similar setbacks and challenges in how the military is using funds could make it difficult for these programs to be completed in time to influence the AoA.

According to Mr. Tarleton, *"With Pathfinder Three, we are also trying to get the funds recolored. That's going to have to happen very quickly. And, an action was taken and I'm not sure if that's going to be able to be completed on time..."*

Whether findings from the Pathfinder programs are incorporated or not, the wideband AoA marks a clear and deliberate attempt by the military to evolve their space and satellite infrastructure to better meet the challenges of an increasingly congested and contested domain.

By incorporating private industry in both the planning and construction of the nation's next-generation satellite network, the military is working hard to ensure that this network not only can deliver communications and capabilities effectively and efficiently to the warfighter, but also has the mission assurance necessary to ensure that these capabilities are never compromised.

*Featured image courtesy of Defense One

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This article is republished, courtesy of The Government Satellite Report (GSR) and Executive Editor Ryan Schradin. He is a communications expert and journalist with more than a decade of experience and has edited and contributed to multiple, popular, online trade publications that are focused on government technology, satellite, unified communications and network infrastructure. His work includes editing and writing for the GovSat Report, The Modern Network, Public Sector View, and Cloud Sprawl.

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