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March 2020 issue

Artistic rendition of a USAF FAB-T satellite. Image is courtesy of SMC.

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BUILDING THE U.S. SPACE FORCE



Senior officials from the Department of Defense and U.S. Space Force provided the most specific details to date on February 5 as to how the newly born Space Force is constructed, the organization's structure and the philosophy guiding the decisions for bringing the first new military service since 1947 into full reality.

Lt. Gen. David Thompson

In broad terms, the Space Force must ensure the U.S. continues its superiority in

space. Getting there, however, demands that the Space Force be "lean and agile" and mission-focused, said Lt. Gen. *David Thompson*, U.S. Space Force Vice Commander.

"It must be both cost effective and minimize bureaucracy while also infusing "innovation and improvements," said Thompson, who was joined by Deputy Assistant Secretary of Defense for Space Policy *Stephen Kitay*, Assistant Secretary for Space Acquisition and Integration, *Shawn Barnes*, and Maj. Gen. *Clint Crosier*, who leads the Space Force's planning office.

The senior civilian and military leaders provided new details about Space Force during a 40-minute Pentagon news conference that included a status update on Space Force implementation efforts and insight into a 21-page report that was delivered to Congress on February 3. The report, which is required by Congress, outlines what has been achieved since the Space Force was launched on December 20, 2019, and what lies ahead.

Thompson offered a clear justification for why the Space Force is needed and why it must be a separate and independent branch of the military. More nations are active in space, he said, which means there is an increasing challenge and threat to the nation's use of that domain by potential adversaries. He added that they are fielding weapons systems. They have communicated the intent to take the nation's use of space away from the U.S. in conflict. Part of the rationale for creating the space force was to elevate the focus on this domain and the capabilities needed to the same level Space Force has with the other services.

In comments after the briefing, Crosier said an additional and important effort is training future Space Force personnel. The U.S. Air Force Academy and the Space Force, for example, have entered into a cooperative agreement to establish a Space Force Detachment at the Academy in the summer of 2020. He also said that leaders are exploring a Space Training and Readiness Command option within existing resources that will focus on doctrine, space training and education as well as readiness.



A successful Space Force is a strategic imperative for U.S. national security, the officials said. It will bring greater focus and capability to space training, warfighting and overall readiness, at a time when space is more congested and contentious while also playing a central role in everyday commerce, communication and national security.

A team of senior officers and officials from the Space Force and the Department of the Air Force have been formulating policies and details for moving the Space Force from an idea to a functioning reality which ensures the nation can "compete, deter and win in an era of great power competition."

The officials noted that the Space Force is being constructed from a "clean sheet." They also insisted that the Space Force is necessary. As space becomes more crowded and contested, they suggested that the United States could lose its long-held advantage in space. Yielding dominance in space, they said, would undermine the nation's prosperity and erode the ability of the United States military to deter aggression, defend the homeland, and project power abroad.

The officials said the new service will rely on "centers" to develop doctrine and operational standards that are specific to space. The goal is to create systems and practices that ensure space superiority and robust command and control of space forces. They also said that the U.S. Air Force Academy will begin offering course work directly related to the Space Force mission.

"We are trying to approach this from a clean slate perspective," Crosier said of how planning is viewed. "We want to infuse innovation and have a mission-focused force."

The intent to be a "flat" organization means the Space Force will turn to the U.S. Air Force for many important support functions, such as civil engineering, information technology support and financial management. That will leave space force personnel the freedom to focus solely – and intently – or operations, doctrine and achieving their missions, the officials said.

Article by Charles Pope, Secretary of the Air Force Public Affairs

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U.S. WILL NOT LET CHINA, RUSSIA DENY ITS SPACE SUPERIORITY, DOD OFFICIALS STATE

Space systems underpin virtually every weapon system in the Defense Department's arsenal, a senior DoD official told Congress.

As Space Force General *John W. "Jay" Raymond*, the Chief of Space Operations said, "We can no longer assume that our space superiority is a given... If deterrence fails, we must be ready to fight for space superiority."

However, many systems were designed for an era when there were few threats in space, Dr. James H. Anderson, performing the duties of Deputy Undersecretary of Defense for Policy, said at a hearing of the House Armed Services Committee's Strategic Forces Subcommittee. This is not the case today, he added, as China and Russia both seek to be able to deny the United States and its allies the advantages of space.

China and Russia are developing sophisticated on-orbit capabilities and an array of counter-space weapons capable of targeting nearly every class of U.S. space asset, Anderson told the House panel. They are expanding their space capabilities, he said, and have created military space forces that they are training and equipping to prevail in future crises and conflicts.

The United States is responding by "transforming its space enterprise, fielding resilient architectures, developing space warfighting expertise and working closely with allies in combined operations," he said.

The fiscal year 2021 defense budget request provides \$18 billion for space programs, including \$111 million to support stand-up of the U.S. Space Force, Anderson said. It also provides funding for the new space combatant command — U.S. Space Command — and the Space Development Agency, which will accelerate the development and fielding of military space capabilities necessary to ensure U.S. and allied technological and military advantages.



The SpaceX Falcon 9 rocket lifts off of Pad 40 at Cape Canaveral Air Force Station, Florida, on January 29, 2020, with Starlink satellite payload.

In his written testimony, Anderson said the United States is actively pursuing opportunities with allies and partners to build combined space operations and interoperable, or even integrated, architecture. The flagship of this integration is the Combined Space Operations Center at Vandenberg Air Force Base, California, with embedded British, Canadian and Australian exchange personnel working side by side with U.S. personnel.

"We have recently added Germany and France to the Combined Space Operations initiative," he noted.

U.S. Space Command, along with the Space Force, will deter aggression from conflict and do so from a position of strength, the general said. "Accordingly," he added, "we will remain ready to defend U.S. and allied freedom of action in space. We will deliver space combat power for the joint and coalition force and we're going to develop joint warfighters to serve in, to and from the space domain."

A related video is available for viewing at

<https://www.defense.gov/Watch/Video/video/741087/>

The article is by David Vergun of DOD News



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USAF'S DMSP-14 DECOMMISSIONED

After 118,052 Orbits, the United States Air Force's (USAF) DMSP Flight 14 is now decommissioned

On February 11, after more than 22 years of providing vital global weather data to the U.S. and its allies, Defense Meteorological Satellite Program (DMSP) Flight 14 was decommissioned after completing 118,052 orbits of the Earth.

End of Life (EOL) procedures were accomplished by operators at the National Oceanic and Atmospheric Administration (NOAA) Satellite Operations Facility (NSOF) in Suitland, Maryland, under the direction of United States Space Force's 50th Space Wing. Space and Missiles Systems Center (SMC) technical experts worked in concert with the rest of the team to ensure the EOL procedures were effectively and efficiently executed.

The remaining four operational DMSP satellites continue to provide a resilient capability for collecting and disseminating global environmental data in support of operations around the world.

The DMSP satellites continue to be sustained past their original three to five year design life. At the time of its decommissioning, F-14 was in operations for more than 22 years. According to the program office, the longevity of DMSP is a testament to the work of each and every person that has been a part of the program, and to the multi-agency partnerships that have been fostered since the beginning of DMSP.

SMC remains at the forefront of providing the next generation of modernized space based environmental monitoring capabilities, ensuring the critical weather mission will continue in the future.

The Weather System Follow-on – Microwave (WSF-M) program will be holding its critical design review during the week of March 31.

WSF-M satellites will provide the next generation passive microwave sensing capability that provides ocean surface wind speed and direction measurements, supports tropical cyclone intensity prediction, and will also host an energetic charged particle sensor for measurement of the local space environment.

The first WSF-M satellite is expected to be operational in Fiscal Year 2024.

The U.S. Space Force's Space and Missile Systems Center, located at Los Angeles Air Force Base in El Segundo, California, is the Center of Excellence for acquiring and developing military space systems.

SMC's portfolio includes the Global Positioning System, military satellite communications, defense meteorological satellites, space launch, range systems, satellite control networks, space-based infrared systems and space situational awareness capabilities.



DMSP-14 lifts off aboard a Titan 23G rocket from Vandenberg Air Force Base, California, April 4, 1997. Photo is courtesy of the USAF.

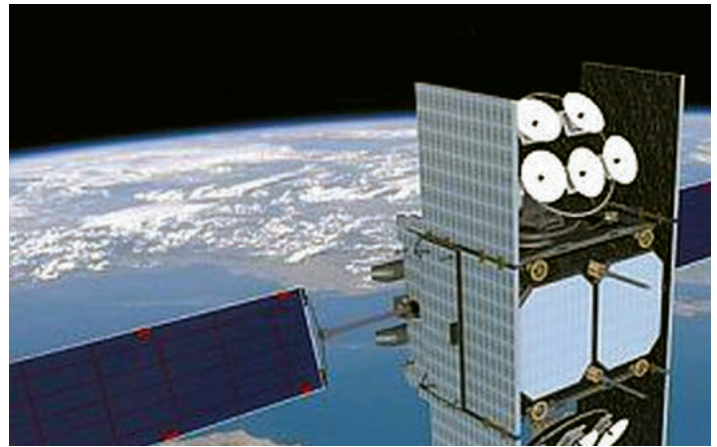
NORTHROP GRUMMAN TO DEVELOP PROTECTED SATCOM PROTOTYPES FOR SMC

Northrop Grumman Corporation (NYSE: NOC) has been selected by the U.S. Space Force's Space and Missile Systems Center to develop a Protected Tactical SATCOM (PTS) rapid prototype payload for an on-orbit demonstration of assured tactical communications — the company was selected for the award through the Space Enterprise Consortium.

Space and Missile Systems Center's acquisition approach emphasized collaboration with Northrop Grumman to define and accelerate a program with streamlined processes, rapid prototyping and non-traditional suppliers.

Leveraging four decades of developing and operating protected payloads to support next generation protected SATCOM technology for contested environments, the company is using numerous non-traditional suppliers to help infuse more innovation and affordability into the lifecycle of the program in areas such as cybersecurity, architecture and test.

As the next generation in operational capability for the protected communications mission, PTS will represent Northrop Grumman's capacity for rapid prototyping for quick deployment.



Artistic rendition of the Protected Tactical SATCOM payload will use the protected tactical waveform to provide anti-jamming communications to war fighters globally. Image is courtesy of U.S. Air Force Space Command.

Cyrus Dhalla, VP, Communications Systems, Northrop Grumman, said that since the first protected communications mission, Northrop Grumman has been advancing technology to stay ahead of threats and help ensure this mission-enabling capability. Partnering with the Space Force, the Northrop Grumman team will demonstrate rapid prototyping by developing and delivering a PTS payload to enhance anti-jamming capabilities for our nation's tactical forces.

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FULL MOBILE ISR REALIZED VIA SPACECOM AND GET SAT SATCOM TECH

Spacecom (Tel Aviv Stock Exchange: SCC), the operator of the AMOS satellite fleet, and **Get SAT**, a producer of small, lightweight SATCOM terminals for airborne, ground, and maritime applications, have revealed that using AMOS-17's steerable Ka-band HTS beams and Get SAT's miniaturized Micro-SAT SATCOM terminals have resulted in full, mobile broadband, SATCOM capabilities for ISR (Intelligence, Surveillance and Reconnaissance) applications.

Enabled by AMOS-17's powerful Ka-band HTS beams and extremely small terminals at both ends, the team created a small footprint, high capacity, true tactical solution for deployed units.

Get SAT's micronized efficient Micro-SAT terminal demonstrated a return channel of more than 10 Mbps, thereby offering breakthrough SWaP (Size, Weight and Power) for broadband communications required by various ISR sensors.

By using a transportable 1.2 meter, Ka-band hub and the capabilities of Spacecom's AMOS-17 digital payload, the team created an ideal configuration for Communications On-The-Move (COTM) applications in the Middle East, Africa, Europe and Asia.

Kfir Benjamin, Get SAT CEO, said that this news is incredible for a market that is starved for secure, nimble, mobile ISR. Get SAT's SWaP goes above and beyond current offerings. With AMOS-17's steerable Ka-band HTS beams, Get SAT's miniaturized terminals produce extremely effective transmission and reception via a single small antenna. No longer does one have to seek miniaturized terminals for secure and reliable high data rates for tactical units using mobile platforms: Get SAT has them.

Get SAT offers highly versatile, mobile solutions for applications requiring small terminals. Based on the firm's patented InterFLAT panel antenna, a miniaturized interlaced antenna combining both receive and

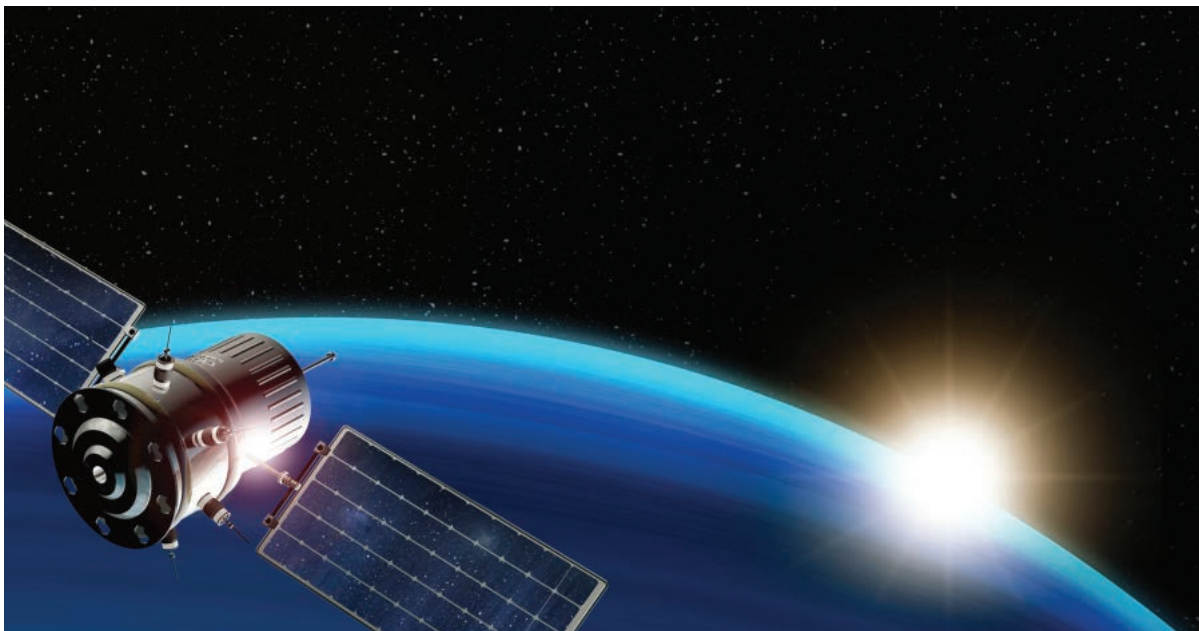


transmit elements on one panel, and fast-tracking technologies, Get SAT's micronized terminals establish a new generation of standards for lightweight, small-sized and low power consumption communication devices for on-the-move applications.

AMOS-17's digital payload capabilities offer extensive C-band HTS coverage, regional Ku-Band and steerable Ka-band HTS beams that can be combined to maximize throughput and efficiency. The satellite's unique tri-band digital payload offers secure and resilient SATCOM solutions over major areas of interest.

According to *Eran Shapiro*, Director of Business and Technology Ventures at Spacecom, the test's amazing results demonstrate how AMOS-17's payload performance, advanced flexible digital processor platform and optimal location at 17°E add value and open new opportunities for mobile ISR users. Get SAT's micronized terminals are changing the mobile broadband communications landscape.

When coupled with AMOS-17, Spacecom brings new vectors of flexibility and possibilities to commercial and government markets, while opening new markets.



SPACEBRIDGE DELIVERS BORDER SECURITY PROGRAM TO SOUTH AMERICA

SpaceBridge Inc. has delivered to a principal South American defense entity a geographically redundant Military Satellite Communication Network System for the largest border security program in South America.

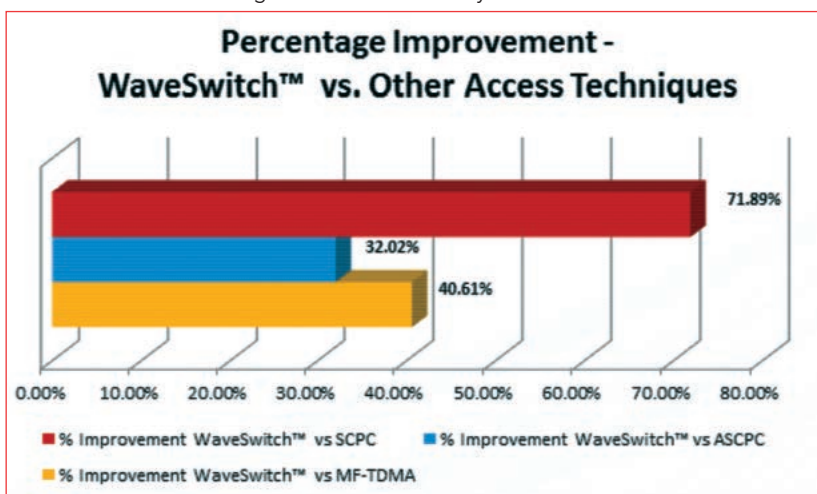
SpaceBridge was selected and delivered to the Communications and Electronic Warfare Command of the South American army, geographically redundant satellite communications (SATCOM) platforms.

The delivered network incorporates SpaceBridge's ASAT™ VSAT platform for Satellite Broadband Multi-service applications, including WaveSwitch™ multi-waveform switching technology, the company's adaptive waveform optimization for fixed and mobile SATCOM solutions for enabling various mission critical entities to operate tactical applications in real time.

WaveSwitch™, the dynamic access scheme, enables on-the-fly switching between various SCPC and MF-TDMA waveforms based on the running applications and set up triggers. All this

is aimed by means of a distinctive technology that is in line with directives of the country's national defense strategy.

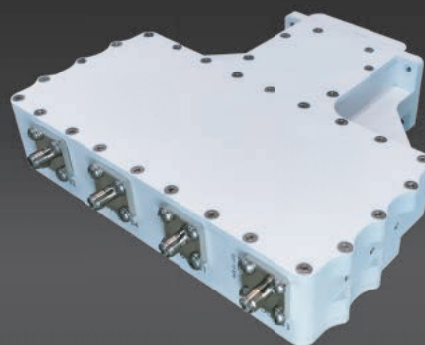
David Gelerman, President and CEO at SpaceBridge Inc., said that the company has a proven track record in providing five nines (99.999% availability) VSAT communication equipment to key defence agencies in deployments around the globe for mission critical applications. SpaceBridge is pleased to deliver the most advanced VSAT platform that provides a superior end-to-end satellite solution, with size weight and power ("SWaP") in compliance with restrictive military standards, saving OPEX for the government and military customers.



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ORBIT LOGIC DEALT INTO DARPA'S BLACKJACK TEAM

Orbit Logic has announced that the company is a member of the **Scientific Systems Company, Inc. (SSCI)**, the **Defense Advanced Research Projects Agency (DARPA) Blackjack Pit Boss** team.

The DARPA Blackjack program aims to demonstrate the capabilities of a Proliferated Low Earth Orbit (P-LEO) system through a variety of on-orbit experiments using 20, low-cost smallsats, each carrying payloads relevant to select military missions.

Pit Boss is the computing and encryption hardware and modular software element of Blackjack that is intended to enable Tasking, Collection, Processing, Exploitation, and Dissemination (TCPED) to occur autonomously on-orbit within the P-LEO constellation at mission speed.

Orbit Logic is contributing software and engineering services for both ground software and flight software portions of SSCI's Pit Boss solution.

Orbit Logic will provide space system autonomy software expertise to the SSCI team with knowledge derived from development of their Autonomous Planning System (APS) flight software and SpyMeSat ground software.

APS enables autonomous onboard planning and re-planning in response to data requests and events, including coordination between satellites.

Orbit Logic's SpyMeSat is a commercially available mobile app that enables users with the ability to browse and request commercial imagery data products and request new imagery tasks, while providing situational awareness of all on-orbit assets.

SSCI VP of Research and Development, Dr. **Owen Brown**, said that the company is incredibly fortunate to have Orbit Logic as a part of the team. Their proven space software products and innovative, highly experienced engineering staff are vital assets for the firm's development of a complex, first of its kind, autonomy system for satellite constellations.



LASER COMMS A REALITY FROM GENERAL ATOMICS AERONAUTICAL SYSTEMS

General Atomics Aeronautical Systems, Inc. has successfully ground tested their Airborne Laser Communication System (ALCoS) by establishing a link with a GEO satellite.

GA-ASI conducted the test with Tesat-Spacecom (TESAT), using their GEO Laser Communication Terminal (LCT), the LCT 135. This was the first demonstration of an air-to-space lasercom system with Size, Weight and Power (SWAP) that is compatible with a Medium-altitude, Long-endurance (MALE) Remotely Piloted Aircraft (RPA).

GA-ASI tested the ALCoS from an optical observatory located on Tenerife in the Canary Islands and closed link with Tesat's LCT 135 terminal onboard the GEO satellite Alphasat. The test successfully demonstrated acquisition and tracking, and sufficient power to close the link with the LCT 135. GA-ASI is completing the development of the flight system for use on a GA-ASI-produced MQ-9 RPA.

ALCoS is the result of a five-year, GA-ASI-funded effort to deliver Low Probability of Intercept (LPI), Low Probability of Detect (LPD) communications link to the MQ-9.

With 300 times the data carrying capacity of conventional RF SATCOM systems, ALCoS will be able to operate as a gateway to the Joint Aerial Network for forward-deployed forces.

The system has the capability to work in two optical wavelengths, 1064nm and 1550nm. TESAT brings more than 12 years of experience with deployed lasercom systems for space. TESAT's LCT 135 terminals are currently in use on seven satellites on orbit. These LCTs make more than 60 satellite-to-satellite links over a distance of 45,000 km. per day and have logged more than 30,000 links total.



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SUCCESSFUL TEST OF METHANE ENGINE BY AFRL AND NASA

The **U.S. Air Force Research Laboratory, NASA's Space Technology Mission Directorate and Masten Space Systems Inc.** have successfully tested a liquid methane rocket engine, the first of its kind tested at AFRL.

AFRL and Masten signed a Cooperative Research and Development Agreement in December of 2018. The agreement enabled Masten to test the Broadsword 25K engine at AFRL's rocket testing facility at Edwards Air Force Base in Test Area 1-125 and to complete NASA's Tipping Point contract requirement of a ten second hot fire test.

The Broadsword 25K engine required a large supply of high-pressure gaseous nitrogen to pressure feed their engine. AFRL's Aerospace Systems Directorate and their Rocket Propulsion Division at Edwards AFB has the capability at Test Area 1-125 to deliver a large supply of high-pressure gaseous nitrogen.

The hot fire campaign started in July 2019 with four hot fire tests before the final test of 10 seconds of combustion. These hot fire tests validated the tune ignition and start-up transients of the engine.

The culmination of testing ended on December 10, 2019 when Masten completed their Broadsword 25K engine test of 10 seconds of steady state combustion. The success of these hot fire tests validated Broadsword's startup transient and steady state performance with the new technology developed under the Tipping Point program.

"Working on the 25K Broadsword Tipping Point has been a wonderful project," said **Matthew Kuhns**, Chief Engineer at Masten Space Systems and principle investigator on Tipping Point. "The successful hot fire testing paves the way for exciting new high performance rocket engine designs," he added.

"The Rocket Propulsion Division is leveraging our existing research and development test capabilities by partnering with new and non-traditional defense contractors in order to accelerate speed of discovery," said **Julie Carlile**, deputy chief, Rocket Propulsion Division. "Collaborating with Masten provided this opportunity utilizing our established propulsion testing infrastructure to assist the commercial space sector's emerging small launch capabilities and lunar science missions," she said.

The Tipping Point public-private partnership is an innovative way NASA helps industry develop promising space technologies that could benefit future commercial and government missions.

Masten was founded by CTO **David Masten** in 2004 and is located in Mojave, California. Masten's main focus is "enabling space transportation and reliable planetary landers for the Earth, Moon, Mars, and beyond. We are a passionate company of inventors, creators and builders with goals that include landing our own vehicle on the moon," according to the company website.

NASA's Space Technology Mission Directorate, which invests in and develops transformative space technologies to enable future missions, selected Masten for a Tipping Point award to mature the M10A 25,000 lbf liquid oxygen/methane Broadsword Engine in 2017.

NASA Tipping Point contracts are awarded to companies with technologies that are on the verge of maturation and are likely to benefit both NASA and the commercial space market.

The AFRL Rocket Lab at Edwards AFB has played a key role in advancing rocket engine technologies for the nation since 1952. AFRL has been a prominent player in nearly every liquid rocket engine developed and flown by the United States. This testing is a trailblazer for future liquid methane engine tests and partnerships among the commercial rocket industries.



The Masten 25k lbf thrust Broadsword rocket engine. Photo/Matthew Kuhns.

LEONARDO DRS CLAIMS TOP SPOT

With recent wins of two major U.S. Department of Defense commercial satellite communication (COMSATCOM) contracts, **Leonardo DRS** stated the company has continued their fifth consecutive year as the top provider of COMSATCOM to the U.S government.

The use of commercial satellites for customer communication needs has been a strength of the Leonardo DRS Global Enterprise Solutions (GES) business for more than 20 years. In that time, the company has developed success in engineering, managing, and supporting large-scale, mission-critical global communications by combining the strengths of top satellite operators, teleport operators, terrestrial transport providers, satellite equipment manufacturers, and skilled small business partners.

The company builds solutions that take advantage of the firm's global communications network; an RMF-authorized, carrier-grade MPLS global network with redundant, self-healing fiber circuits connected to globally dispersed Internet Points of Presence (PoPs) and globally diverse teleports that provide redundant access to the entire COMSAT and MILSAT arc. The Leonardo DRS Global Enterprise Solutions business also provides mission-critical information and communications technology



* Source: GpvWEom IQ Total Federal Market Overview - Top Contractors 2015-2019.

solutions to the DoD and the U.S. Federal Government. The firm's services include end-to-end global communications, satellite communications, teleport services, fiber and wireless terrestrial back-haul, managed network services and applications, cyber security, network operations, and enterprise IT solutions.

David Fields, SVP of the Global Enterprise Solutions business, said understanding customer needs and delivering an entire, resilient global communications solution that includes the dedicated support of the company's entire team is the top priority. Leonardo DRS' behind-the-scenes work is what makes the company proud to be the consistent leader in commercial satellite communications over the last five years.

SECURITY BREACHES & MALICIOUS HACKERS ARE EVERYWHERE



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NORTHROP GRUMMAN'S OMEGA ENGINE TEST

Northrop Grumman Corporation (NYSE: NOC) has successfully conducted a full-scale static fire test of the second stage of the company's Omega rocket today in Promontory, Utah.

Developed to support the U.S. Space Force's National Security Space Launch program, the Omega Launch System remains on track for its first certification flight in spring 2021.

During this test, the second stage motor fired for full-duration, approximately 140 seconds, burning nearly 340,000 pounds of solid propellant to produce upwards of 785,000 pounds of thrust.

The test verified the motor's ballistics and thermal performance as well as steering control and performance in a cold-conditioned environment. The test team collected more than 500 channels of data to aid in verifying the motor.

In October 2018, the U.S. Air Force awarded Northrop Grumman a \$792 million Launch Services Agreement to complete detailed design and verification of the Omega space launch vehicle and launch sites.

This cold test, in conjunction with the successful hot static fire in May 2019, subjected Omega's motors to the most extreme propellant temperatures the rocket will experience during storage, transport, stacking and launch.

Northrop Grumman has leveraged its flight proven technologies and extensive experience launching critical payloads in the development of the Omega launch system.

The rocket was designed to accommodate national security payloads while also serving the civil and commercial markets.

In preparation for Omega's inaugural flight, Northrop Grumman now occupies High Bay 2 as the first commercial tenant in NASA's historic Vehicle Assembly Building at Kennedy Space Center.

Construction crews are currently modifying Mobile Launch Platform-3 to serve as Omega's assembly and launch platform at Pad 39B.

Charlie Precourt, VP, Propulsion Systems, Northrop Grumman, said the company designed Omega to use the most reliable propulsion available to ensure exceptional mission assurance for customers.

This firing is a significant accomplishment that demonstrates a domestic solution for the RD-180 rocket engine replacement.



Photo of the test firing is courtesy of Northrop Grumman.

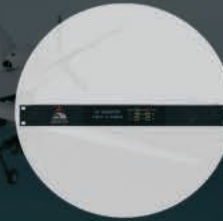
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**X-Band SSPAs/BUcs
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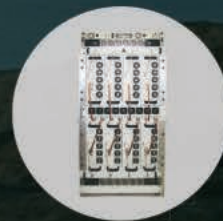
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SMC'S SUCCESSFUL MISSION DEPLOYES AEROSPACE ROGUE CUBESATS FROM ISS

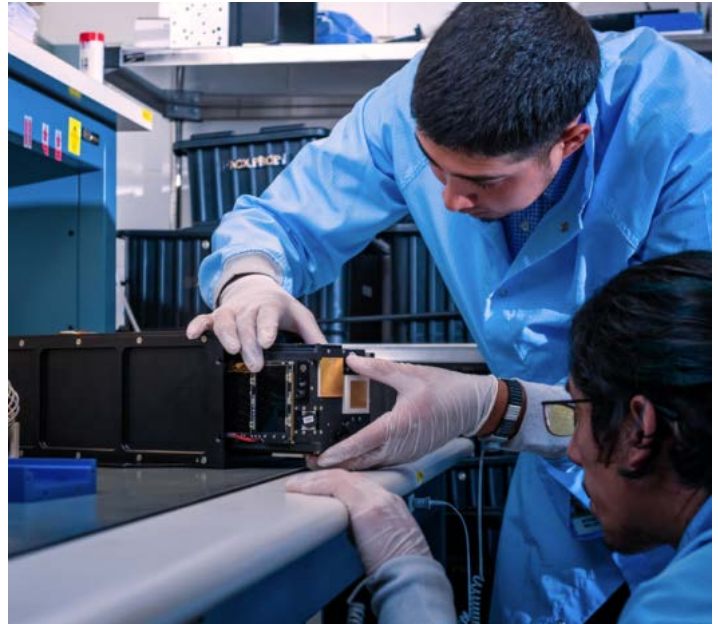
Mission accomplished on behalf of the U.S. Space Force's Space and Missile Systems Center and its mission partners as they successfully deployed Aerospace's Rogue Alpha and Rogue Beta CubeSats from the Northrop Grumman Cygnus capsule at 1 p.m. and 4:10 p.m. respectively, on January 31, 2020, marking the beginning of the program's mission experiment plan.

The plan involves the two satellites using their short-wave infrared sensors to create a baseline for processing cloud backgrounds and inform future low Earth orbit satellites.

The U.S. Air Force will also use this program's unclassified data to investigate potential uses of the capability.

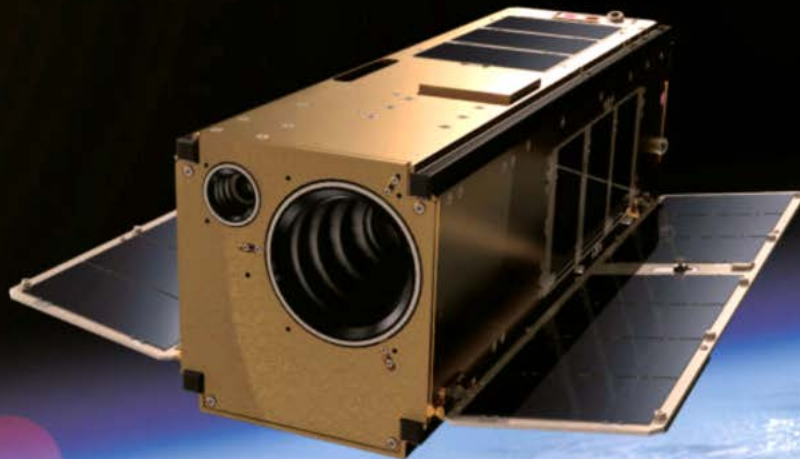
Col. *Dennis Bythewood*, Program Executive Officer for Space Development, said that the Space and Missile Systems Center is proud of this team's accomplishments and the speed at which this program developed.

The cubesats were designed, built, and tested by The Aerospace Corporation, a national nonprofit corporation that operates as a federally funded research and development center dedicated to advancing the nation's missions in space.



Jeff Emdee, General Manager of the Space Development Division at The Aerospace Corporation, said that the company is proud to present its Rogue cubesats to support the Space Force's mission of achieving a secure and resilient space architecture. Each three-unit CubeSat is about the size of a shoe box and contains both visible and infrared sensing, as well as a laser communications downlink, that will allow them to explore operations in Low Earth Orbit to benefit future system concepts.

Aerospace Corporation's cubesat that was developed for the USAF. Image is courtesy of the company.





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L3HARRIS PDR FOR USAF EXPERIMENTAL SATELLITE PROGRAM SUCCESSFULLY PASSED

L3Harris Technologies (NYSE:LHX) has reached a major milestone in the U.S. Air Force's Navigation Technology Satellite-3 (NTS-3) project and has passed the preliminary design review that defines the spacecraft's path to delivery and allows the program to move to the next phase of development.

NTS-3 is an experimental program examining ways to improve the resiliency of the military's positioning, navigation and timing capabilities. It will also develop key technologies relevant to the Global Positioning System (GPS) constellation, with the goal of future transition to the GPS III F program.

In collaboration with the Air Force Research Laboratory (AFRL), Space and Missile Systems Center (SMC) and the United States Space Force (USAF), L3Harris is combining experimental antennas, flexible and secure signals, increased automation, and use of commercial command and control assets.

The Space Enterprise Consortium selected L3Harris for the \$84-million contract in 2018 as the prime system integrator to design, develop, integrate and test NTS-3, including ground mission applications.

L3Harris has more than 40 years of experience transmitting GPS navigation signals. The company's technology has been onboard every GPS satellite ever launched.

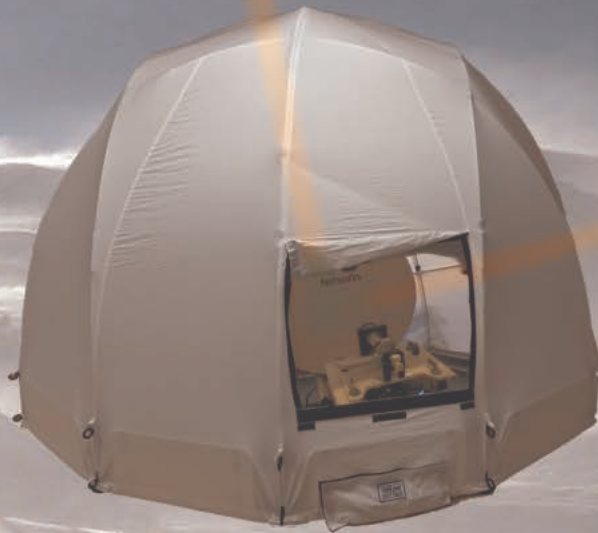
Arlen Biersgreen, Air Force NTS-3 Program Manager, said the NTS-3 vanguard is an experimental, end-to-end demonstration of agile, resilient space-based positioning, navigation, and timing. It has the potential for game-changing advancements to the way the Air Force provides these critical capabilities to warfighters across the Department of Defense. The commitment demonstrated by United States Space Force to partner with AFRL and support technology transition was a key element in NTS-3 being designated as an Air Force vanguard in September 2019.

Ed Zoiss, President, Space and Airborne Systems, L3Harris, noted that the company has moved from contract award to finishing an early design review in under one year, which is an amazing accomplishment for a satellite development program that normally takes twice that amount of time. L3 Harris has proven the company can move quickly to support the U.S. Air Force's go-fast mission requirements.



Artistic rendition of the NTS-3 in geostationary orbit. NTS-3 will be based on Northrop Grumman Innovation System's ESPASat bus, building on Eagle's flight heritage. Image is courtesy of 2d Lt. Jacob Lutz, AFRL/RV

WALTON DE-ICE



New LEO / MEO Design

The **Portable Radome** makes satellite networks more survivable and deployable into extreme and harsh environments. Protect transportable antennas and equipment from, snow, ice, burning sun, sandstorms, torrential rains, up to 85 mile-per-hour winds, and more.

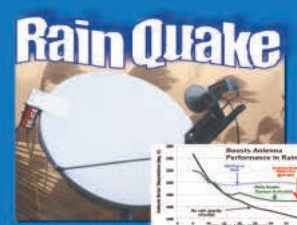
- Single-person setup in less than an hour — conventional radomes can take days.
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VISION FOR SATCOM ENTERPRISE SIGNED BY CHIEF OF SPACE OPS, GENERAL RAYMOND

General Jay Raymond, Chief of Space Operations, U.S. Space Force (USSF), and Commander, U.S. Space Command, recently signed the USSF Vision for Enterprise Satellite Communications (SATCOM).

The Enterprise SATCOM Vision outlines the new Service's vision to evolve SATCOM into a single enterprise that can continue to deliver effects to warfighters from and through a contested, degraded and operationally-limited (CDO) environment.

The new USSF vision includes emphasis on the speed needed in developing future SATCOM capabilities. The vision states, "We must move faster than our adversaries to ensure warfighters receive the operational benefits of an integrated SATCOM enterprise capable of delivering SATCOM effects in CDO environments. We must adopt faster acquisition processes and faster command and control constructs to maintain the advantage in any conflict."

"Despite the global, instantaneous reach of our satellite communications systems, which includes both military and commercial capabilities, the current loose federation of SATCOM systems needs to improve in resiliency, robustness, flexibility, and manageability," said Major General Raymond.

Bill Liquori, USSF Director of Strategic Requirements, Architectures and Analysis. A team of experts from USSF, the Space and Missile Systems Center (SMC), and the Space Force Commercial SATCOM Office have been instrumental in identifying and defining the key requirements and concepts in the vision document.

The single, integrated SATCOM enterprise will enhance integration between the military and private sectors, with a goal to enable warfighters with the ability to transition between their networks and terminals to alternate resources with little or no disruption.



Gen. Jay Raymond, Chief of Space Operations, U.S. Space Force, and Commander, U.S. Space Command, signing the USSF Vision for Enterprise Satellite Communications (SATCOM). DoD photo is courtesy of Patrick Morrow.



Key elements of the vision include...

- *Global Situational Awareness & Common Operating Picture*
- *Command & Control Management System*
- *SATCOM terminals*
- *SATCOM governance*
- *Acquisition & Provisioning*

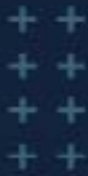
USSF has several immediate priorities to deliver the single, integrated SATCOM enterprise, including establishing a team of core experts who can analyze and orchestrate the multi-faceted enterprise. That team will quickly need to develop a roadmap to ensure near-term budgeting priorities are in-line with the SATCOM vision.

Additionally, USSF will develop a flexible modem interface (FMI) standard to support agile SATCOM roaming for Department of Defense users and develop a strategy to replace the current Wideband Global SATCOM (WGS) capability. USSF will continue engaging commercial partners to evaluate opportunities that may complement or possibly replace portions of a traditional military SATCOM purpose-built system.

The signing of the USSF Enterprise SATCOM Vision comes after a number of recent events that gave the command an opportunity to transform how SATCOM is procured, managed and delivered to USSPACECOM and other combatant commands around the world.

On December 12, 2018, Air Force Space Command assumed sole responsibility for the procurement of COMSATCOM services on behalf of the DoD. Then AFSPC hosted a SATCOM Industry Day to engage industrial partners early in the vision drafting process. They provided numerous valuable inputs that shaped the final vision. On May 28, 2019, the Secretaries of the Air Force and Navy agreed to transfer responsibility for the future narrowband capability from the Navy to the Air Force as a prudent step to consolidate space capabilities.

AFSPC was re-designated as the USSF as an initial step in the establishment of the USSF on December 20, 2019.



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Space & Missile Systems Center

Transforming Space Acquisition and Development
#SpaceStartsHere

A successful Space Force is a strategic imperative for U.S. national security. It will bring greater focus and capability to space warfighting, training and overall readiness, at a time when space is more congested and contested, while also playing a central role in everyday commerce, communication and national defense.

The Space and Missile Systems Center (SMC), headquartered in El Segundo, California, serves as the U.S. Space Force center of excellence for acquiring and developing military space systems.

The timing could not be better. Last year, SMC completed the largest transformation in its 65 year history. The re-architecture created a more nimble powerhouse focused on enterprise operations across mission areas. Enhancing partnerships; both commercial and allied; fostering innovation; embracing a culture of ownership and risk tolerance; and executing with speed, creates the new paradigm!

Four Program Executive Officers (PEOs) with acquisition decision authority oversee more than 100 SMC programs. This effort eliminated layers of bureaucracy, flattened the organization, and aligned more than 1,200 personnel and decision makers closer to their programs and teams. The new SMC model has instantiated a culture of continuous innovation and process improvement that will continue to serve national security and the warfighter for the long term.

SMC is in lock step with the U.S. Space Force to infuse innovation and a mission-focused force to protect the global commons of space.



John F. Thompson
Lieutenant General, USAF
Commander, Space and Missile
Systems Center

“The threat in space to our national security is very real. We’re making huge strides in our journey of transforming space acquisition and delivering war winning space capability.”

Lt Gen John Thompson

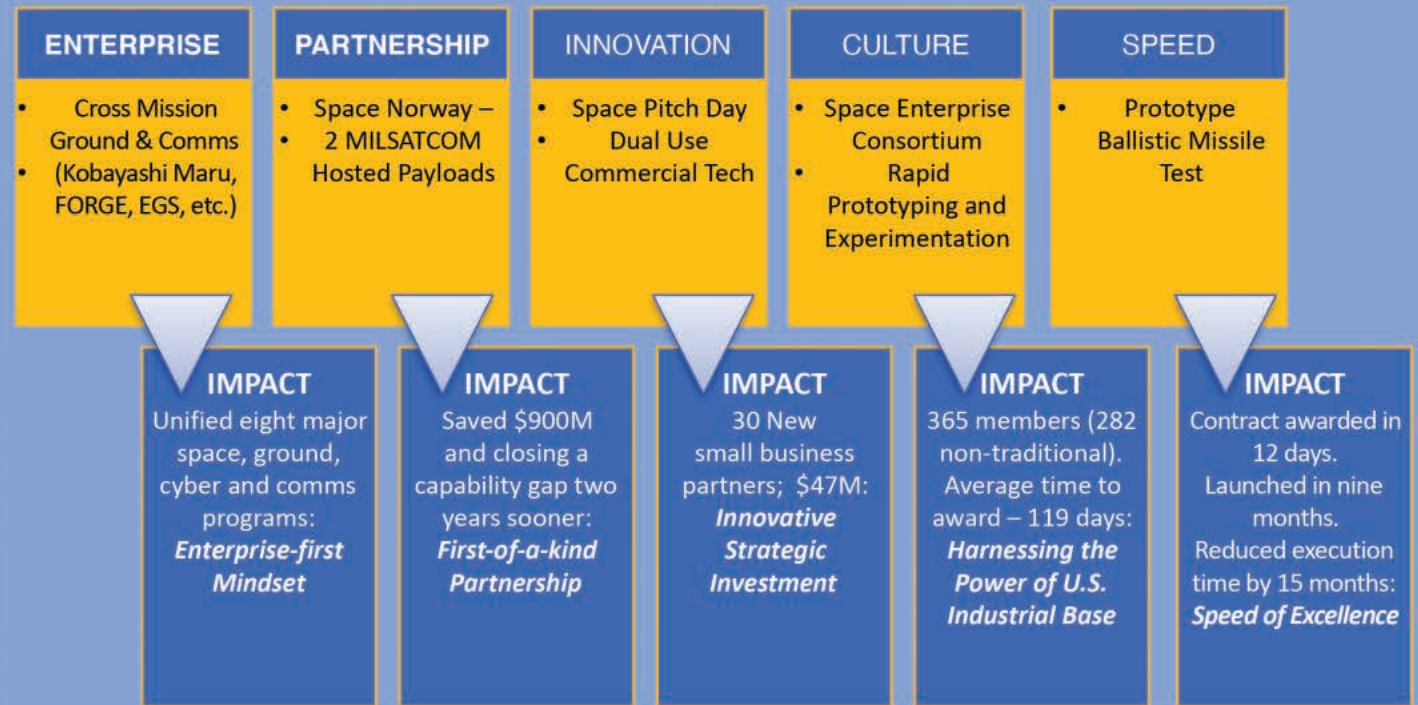
SMC Mission Areas

1. Positioning, Navigation & Timing
2. Launch Enterprise
3. Cross Mission Ground and Comms
4. Satellite Communications
5. Innovation and Prototyping
6. Missile Warning and Environmental Monitoring
7. Special Programs



The Impact of E.P.I.C. Speed

SMC is fielding fast, relevant and affordable game-changing solutions in support of our nation and the world. As an example, SMC awarded more than \$22 million dollars in same-day contracts to 30 non-traditional small business companies and start-ups at the organization's inaugural Air Force Space Pitch Day. The next Space Pitch Day is scheduled to take place this coming November.



Did you know?

- SMC is responsible for approximately 84% of the DOD Space Budget.
- SMC's team of ~6,000 space professionals represents a combined 100,000 years of space development experience.
- Space capability is critical to the American way of life and the modern global economy.
- Today, almost all joint operations rely on the space capabilities acquired and fielded by SMC.

Meet our experts at
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COMMAND CENTER: TROY DAWSON

Vice President, Government Satellite Systems, The Boeing Company



Troy Dawson is Vice President of Government Satellite Systems, leading a family of programs for DoD, civil and proprietary customers delivering end-to-end satellite, ground and network solutions. Prior to this role, he was Vice President of C-17 Services, a business within Boeing Global Services, providing the U.S. Air Force and eight international customers with innovative lifecycle sustainment solutions and

capability enhancements for a worldwide fleet of 275 C-17 Globemaster III aircraft.

Over his 28-year career with Boeing, Mr. Dawson has served in key leadership roles including president of Spectrolab, a wholly-owned Boeing subsidiary recognized as a leading supplier of solar cells and advanced lighting and sensor products; director of Satellite Platform Products, where he was responsible for design and manufacturing of spacecraft bus subsystems; and deputy program director of the Wideband Global SATCOM Block II program, leading the execution and delivery for a fleet of six high capacity communications satellites for the U.S. Air Force.

Why do you feel that it is important for the government to leverage commercial technologies, and does the Government gain significant advantages working with contractors that serve commercial and government markets?

Troy Dawson (TD)

The commercial market drives technology development at a rapid pace. It is important for us to leverage this to ensure that we field capability faster than our adversaries. Starting in the 1990s, we developed phased arrays, regenerative payloads, and digital channelizers for commercial customers and programs. We then tailored that technology to military applications, which evolved into the WGS constellation. Today, the WGS constellation handles more than 75 percent of Department of Defense (DoD) communications traffic supporting warfighters around the world and multi-domain military operations.

In 2017, Boeing developed a new generation of software-defined communications payloads to meet evolving commercial demands. We were able to deploy this advanced state-of-the-art technology that enables our warfighter to rapidly reconfigure capability and counter real-time threats.

The government gains powerful advantages by contracting with companies that serve both commercial and government markets. Now more than ever, the Department of Defense recognizes the need to adopt commercial best practices to keep up with changing threat environment.

Adopting commercial technology allows for lower cost with shorter and higher confident schedules. We capture the benefit of lower life cycle cost as we use a common supply base to minimize obsolescence and maintain a healthy manufacturing base. This approach is critical to keeping the U.S. military industrial base agile and relevant, especially as space is now recognized as a warfighting domain.

What are your thoughts on the current government acquisitions process and do you have any suggestions for how it can be improved?

TD

The government acquisition process has changed significantly for some customers in the last couple of years. The opportunities proven through the U.S. Space Force's Space and Missile Systems Center (SMC) 2.0 initiative and their use of Section 804 authorities have provided rapid contracting and prototyping that we hadn't seen for some time.

As readers may already be aware, several MILSATCOM programs are either "pacesetter" programs for SMC or use Section 804 authorities — we are seeing the benefits and the culture change. This, coupled with the stand-up of the Space Force and the organization's targeted clean sheet approach, we believe will continue to accelerate fielding capabilities quicker to the warfighter.

Another area the government should consider focusing on is the Joint Capabilities Integration and Development System (JCIDS) process and how the warfighter determines what they need. Given the rapidly evolving threat you will not have the time to wait and field a capability before you can learn the counter to the counter measure, and how the warfighter asks for that needs to be modernized in line with rapid prototyping and development.

This means future systems will need to have modularity, flexibility, adaptability and the agility to enable adjustments either in design, production or on-orbit operations. We are excited to see that the new Vice Chairman has already publicly stated he is going to take this challenge on and Boeing looks forward to supporting this objective.

From your perspective, what is the outlook (future) for the government satellite market and its use of commercial technologies going forward?

TD

I believe the outlook is very positive. We believe future missions will require a hybrid solution where the government will aspire to own some of its assets to provide the full responsibility and capability necessary to ensure the resiliency requirements and the military control required.

In peacetime, the government will want to be able to utilize commercial services. We support both, and we build both commercial and military-owned and operated services. I believe that we will also see a demand for smaller satellites and larger diversified constellations. This doesn't necessarily mean that large and medium class satellites will disappear. The type of satellite needed will ultimately be mission dependent.

The establishment of the United States Space Force demonstrates how important the market is for space superiority, not only to protect the military assets, but to also protect our way of life. The fact that our economy relies on tons of data moving across these satellites makes it a vital priority.

The space domain is now used for connectivity, information and national security. It is as important as any other domain that we have. The U.S. military and government and our society as a whole place high demand on space capabilities that must be available and operational when they are needed.

Would you provide an update on the WGS program and Boeing's current role?

TD

WGS-10, launched on March 15, 2019, was accepted by the U.S. Air Force (USAF) in July 2019. All ten Boeing-built WGS satellites are currently on orbit and providing world-wide high data rate communications for the DoD.

Throughout the history of the WGS program, we've leveraged our commercial capabilities and our internal research and development when building the WGS constellation.

We are continuing that trend with WGS-11, which will include upgraded phased array antennas, providing more bandwidth and flexibility to our customer.

The WGS-11 satellite will offer twice the capability of a current WGS satellite, with military-unique features that enable secure assured connectivity in contested environments.

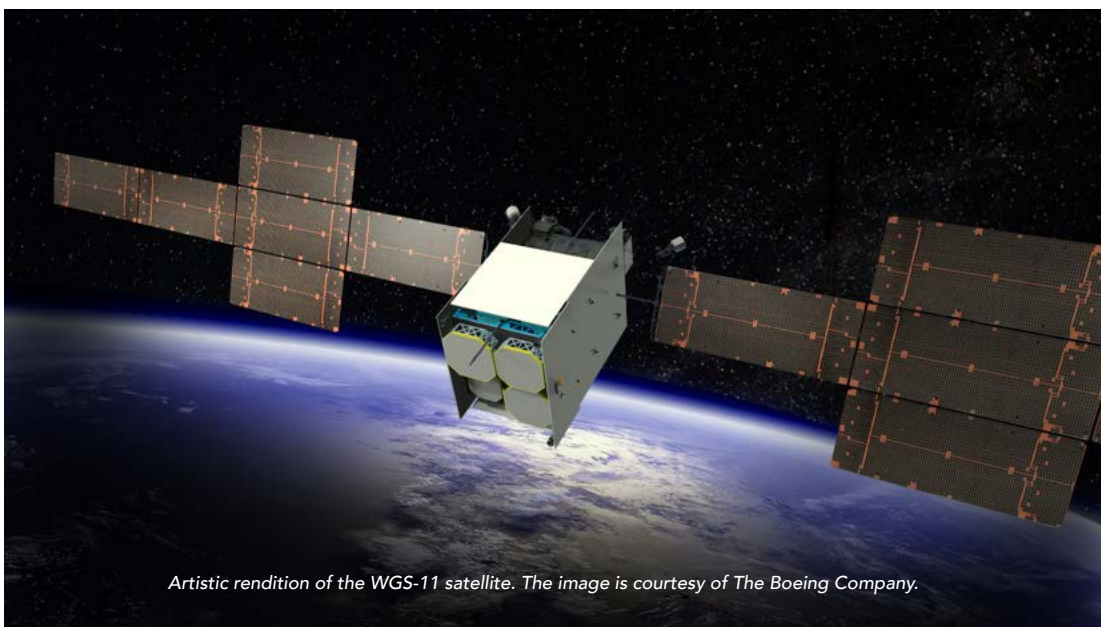
The Boeing and U.S. Space Force Space and Missile Center's (SMC) team successfully completed a Systems Requirement Review recently that allows us to move forward with the development of the satellite.

We look forward to our continued partnership with the U.S. Space Force providing flexible, anytime, anywhere broadband communications to the warfighter and to delivering this critically important asset to the Space Force in 2024.

Mr. Dawson, What is the current state of Boeing's government satellite business?

TD

Boeing Government Satellite Systems delivers the company's major satellite and ground solutions for military and civil communications, intelligence, national defense and other classified programs. Our Government business is strong and healthy, with significant growth now and projected in the future as new mission needs have increased. This growth is providing our employees expanding opportunities to innovate, design and develop next generation solutions to meet the national security demands of the next decade and beyond.



Artistic rendition of the WGS-11 satellite. The image is courtesy of The Boeing Company.

TRASC

Tactical Removable Airborne Satellite Communications



SOLVING C-130 AIRCRAFT COMMS CHALLENGES

The Tactical Removable Airborne Satellite Communications (TRASC) Solution

by Karl Fuchs, iDirectGov Senior Vice President and MilsatMagazine Senior Contributor

It's ever important in today's environment for the military to have reliable and secure communications to ensure mission success wherever they operate. In fact, the armed forces have been working on variations of airborne satellite communications' (SATCOM) capability for more than 15 years. Still today, the challenges to provide integrated communications on a C-130 aircraft are complicated and costly.

First, performing permanent communications system upgrades on aircraft is more than a three-year process. System requirements, modification planning, reviews, analysis, scheduling aircraft down time and budgets are key drivers in any aircraft system upgrade.

Secondly, modifying an entire fleet of aircraft is a major budget driver, especially with such a large fleet of C-130 aircraft. It can cost \$1.5 million to \$2 million per C-130 plane to modify and install airborne SATCOM systems. Obviously, there needs to be a better way.

To support the military's need for quick, reliable, secure and cost-effective military satellite communications for C-130 aircraft, a commercial off-the-shelf (COTS) solution was reviewed for its flight worthiness and viability.

COTS Advantages

COTS offers multiple benefits to meet the warfighter's needs. The fact that the best implementations and strongest technologies have been chosen not by an RFP review committee, but by the invisible hand of the market, guarantees the military works with vendors who have the best solutions that have been vetted by the commercial market.

This overlap gives the Department of Defense (DoD) an excellent opportunity to leverage COTS products. Leveraging COTS equipment also breaks the cycle of development and change order cost overruns. A communication system based on COTS equipment has a much more

deterministic budget.

The costs of a COTS-deployed solution are more predictable, and the total cost of ownership will be much lower with COTS equipment. The main reason is that instead of technology development costs being shouldered exclusively by the DoD, development is amortized across countless commercial customers.

Leveraging COTS equipment for DoD satellite communications dramatically reduces development costs. It also brings cutting-edge technology to the warfighter much more quickly.

Keeping this in mind, R4 Integration, Inc. (R4), *iDirectGov*, UltiSat and SelectTech Geospatial teamed to combine the best-in-class COTS components into a sophisticated airborne terminal known as the **Tactical Removable Airborne Satellite Communications** (TRASC) solution. Designed for C-130 military transport aircraft, the TRASC turnkey solution is designed to deliver the latest SATCOM technology to the warfighter.

TRASC Solution

The TRASC system includes R4's C-130 hatch or wing shoulder panel that is based on a U.S. Air Force-and Federal Aviation Administration (FAA)-approved design for a multi-purpose hatch system; UltiSat's multi-band 18-inch parabolic Ku/Ka dual-band antenna that features ideal size, weight and power (SWaP) thanks to its lightweight, robust carbon fiber composite frame and high data rates; and SelectTech's Roll-On/Roll-Off (RO/RO) transit case integrated with the iDirectGov 9800 AR Satellite Router, aircraft-grade power supply and gateway router. The TRASC solution features components that are integrated, tested and airworthy-certified.

TRASC Advantages vs. Fixed Antenna Solution	
Legacy SATCOM Solution	TRACS Airborne Solution
Cost: \$1.5 million to \$2 million per C-130 to modify and install airborne SATCOM	Cost: \$600,000 to \$800,000 per C-130
Installation time: 3 years to modify / install	Installation time: 15 minutes
Bands: Only available on the contract service band	Bands: TRASC works with various Ka-, Ku - X-band or a combination of these
Permanent installation: Fitted for life on one C-130 plane	Flexible installation: Roll-on/roll-off so the military can switch out systems



At the heart of TRASC is iDirectGov's Federal Information Processing Standards (FIPS) 140-2 Level 3-certified 9800 AR Satellite Router that's designed to meet the highest levels of transmission security (TRANSEC) and support high data rates while moving at 1,000 miles per hour. The satellite router meets the rigorous environmental test standards for MIL-STD 810G, MIL-STD-461G, MIL-STD-704F and DO-160G.

TRASC's unique 18-inch parabolic antenna is the only dual-band antenna that can support both military and commercial Ka frequencies. TRASC works with various Ka, Ku, X-band or a combination of these to support voice and data for C-130 airborne applications.

TRASC is fully FAA-compliant, works on all C-130 variants and is compatible with existing iDirectGov hub-based SATCOM networks.

The multi-purpose hatch TRASC system provides the customer the ability to immediately field a system. It also provides an operational capability without the long delays associated with the normal acquisition and implementation process.

TRASC does not require any permanent modification to the aircraft. Because the system isn't a permanent modification, it can be moved from aircraft to aircraft as needed as a roll-on/roll-off system, saving the DoD millions of dollars.

In addition, the airborne SATCOM system can be removed from the aircraft when it needs to be serviced without grounding the aircraft or causing any integral damage. These aspects are significant improvements over a permanent modification.

Not only is the military able to field a new capability, they also benefit in always having the latest in technology as well as lower acquisition costs due to not needing to permanently modify every aircraft in the fleet. The TRASC solution enables the military to only install the system where it is needed, which reduces the total number of systems the military needs to accomplish its mission.

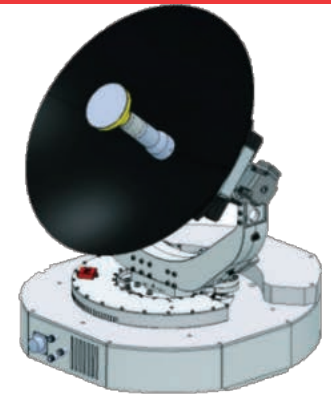
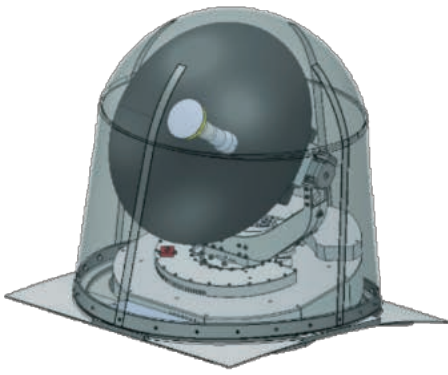
Results

The military can reconfigure the aircraft for SATCOM equipment without redesigning the aircraft, resulting in a fast time to use for the warfighter and cost-effectiveness.

Airborne communications can be added to any C-130 in about 15 minutes with the hatch system. Without the hatch system, it is a three-year process and \$1.5 million to \$2 million per C-130 plane to install permanent airborne communication systems. With the hatch system, it costs \$600,000 to \$800,000 per aircraft.



iDirectGov's 9800 AR Airborne Satellite Router.



From left to right: Shoulder panel mount - RORO transit case with iDirectGov 9800 AR - Hatch mount without radome

Because the entire airborne communications solution is a self-contained RO/RO solution, the military can transport the system between aircraft. This means that using TRASC changes the operational environment of transport aircraft by enabling the warfighter to have information connectivity en-route and not be dependent on only a few aircraft that may have a wideband SATCOM capability.

In-flight testing while streaming high-definition video from the aircraft was demonstrated and proved the ability to deliver a high throughput and transportable communications-on-the-move (COTM) SATCOM solution. There is no degradation in the aircraft's mission capability by installing the TRASC system.

Early results provide the warfighter with more options than legacy systems currently provide. The multiple-band TRASC solution enables the warfighter to compete for satellite services so that the military can obtain the best value service to meet mission needs.

In the past, warfighters were relegated to only one SATCOM service and had to pay whatever that contract rate was at the time of service. They had no other options as their previous system solution was a dedicated solution to one service provider.

Examples where TRASC can be used to fully realize the very best wideband SATCOM capability includes: Executive (DV) Communications; special mission situational awareness; and

Intelligence, Surveillance and Reconnaissance (ISR) on non-traditional ISR platforms such as the C-130.

To demonstrate its airborne modem's capability, iDirectGov performed an in-flight test while streaming high-definition video from an aircraft to prove the ability to deliver a high-throughput and transportable Comms-On-The-Move (COTM) SATCOM solution.

As TRASC is a newly developed airborne communications system, R4 has started delivering the first 10 systems to customers in 2019. There are additional orders for 50 more TRASC systems in 2020.

In conclusion, when the military needs communications technology to perform a mission, it becomes a costly and time-consuming endeavor to start from scratch to build a solution.

The TRASC COTS solution — and the partnership with best-in-class providers-enables the DoD to speed up time-to-market and reduce development costs all while meeting mission requirements.

Because the military measures success in terms of how fast it can field a new technology and provide capability down range to the warfighter, TRASC changes the game for the military and its C-130 fleet of aircraft. TRASC enables the warfighter to become immediately effective without having to wait years for the technology to make its way through the fleet through upgrades.

Karl Fuchs is the Senior Vice President of Technology at

iDirectGov. Fuchs leads iDirectGov's team of federal systems engineers and serves as chief architect for new



product integration. Fuchs has more than 20 years of experience in the areas of technology and the federal government and is a Senior Contributor to MilsatMagazine.

COTS SOLUTIONS THAT COMBINE TO COMPLETE TRASC SOLUTION

- R4's C-130 hatch or wing shoulder panel based on a U.S. Air Force and Federal Aviation Administration (FAA)-approved design for a multi-purpose hatch system
- UltiSat's multi-band 18-inch parabolic Ku/Ka dual-band antenna features ideal size, weight and power (SWaP) and high data rate
- SelectTech's Roll-On/Roll-Off (RO/RO) capability transit case
- iDirectGov 9800 AR Satellite Router, power supply and gateway router



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AN INTEGRATED SATCOM ARCHITECTURE

by Rebecca Cowen-Hirsch, Senior Vice President of Government Strategy and Policy, Inmarsat Government

Over the past year, the U.S. government has taken a number of actions and implemented the first steps of strategies that promise to redefine how it acquires satellite communications (SATCOM).

These incrementally progress toward the goal of developing an integrated SATCOM architecture of the future with enhanced capabilities, resiliency and affordability by intentionally leveraging commercial SATCOM (COMSATCOM). In particular, a few developments stand out as key indicators of progress:

During the 35th Space Symposium in April 2019, consistent with the National Defense Strategy, top government leaders repeatedly spoke about the essential role that COMSATCOM plays in their space strategies. According to former U.S. Air Force Secretary *Heather Wilson*, “We must be able to leverage *innovation in the commercial space industry* to stay at the forefront of technology and ensure our access to space.”

COMSATCOM procurement responsibility *made its transition* from the Defense Information Systems Agency (DISA) to U.S. Air Force Space Command (AFSPC). According to General John W. “Jay” Raymond, U.S. Space Command and (then) AFSPC Commander, “Our vision is for users to be able to connect quickly among different satellite constellations or service providers.” This transfer means AFSPC will oversee procurement of nearly all military and commercial SATCOM for the Department of Defense (DoD), and will afford it the opportunity to manage SATCOM as an enterprise, integrating delivery of all SATCOM, commercial AND military, services in the future and increasing efficiency and effectiveness for the joint force.

The budget submission for fiscal year (FY) 2019 included \$8 billion of additional funding for space over the next five years, fully embracing the new strategy that recognizes space as a crucial domain for national security. The *National Defense Strategy* acknowledges an increasingly complex global security environment: “These changes require a clear-eyed appraisal of the threats we face, acknowledgement of the changing character of warfare, and a transformation of how the Department conducts business.” Thus, it shifts focus onto highly mobile mission sets to support advancements in intelligence, surveillance and reconnaissance, demanding resilient SATCOM, inclusive of COMSATCOM.

The FY 2019 appropriation of \$49.5 million in U.S. Air Force budget created a new *program of record for “commercial (SATCOM) integration.”* The program is intended to pursue a wideband and narrowband communications architecture and acquisition strategy that includes both government and

commercial SATCOM networks. Government leaders and DoD officials have indicated that they are seeking a comprehensive long-term plan to buy COMSATCOM via a seamless, integrated network structure, and that meaningful changes in SATCOM procurement are required to make this happen.

The U.S. government is shifting away from the traditional lowest price technically available (LPTA) approach to COMSATCOM acquisition. The *Defense Federal Acquisition Regulation Supplement (DFARS)* and the full Federal Acquisition Regulation (FAR) were updated for applicability across the entire federal sector. In an extremely positive shift, LPTA now will only be applicable when “DOD would realize little or no additional innovation or future technological advantage by using a different methodology,” *according to the GAO*. Thus, when COMSATCOM is integrated into the critical infrastructure as part of the integrated SATCOM architecture, performance measures of merit are essential discriminators.

The Pentagon’s *release of some of its conclusions about the U.S. Air Force’s Analysis of Alternatives (AoA)* for a follow-on to the Wideband Global SATCOM (WGS) system underscored the urgency for a forward-looking partnership between the government and the commercial satellite industry to ensure available solutions are fully considered as part of the recapitalization process.

On August 29, the President officially reestablished U.S. Space Command as the Defense Department’s 11th unified combatant command – a new separate service for space operations. Space has become a “vital domain” that is critical to the nation’s security and economy and is no longer a benign environment, *General Raymond said*. The command will have a “sharper mission focus on protecting and defending space assets, will have a stronger unified structure with our intelligence partners and a closer connection to partners and other U.S. warfighting commands.”

The National Defense Authorization Act for Fiscal Year 2020 created the U.S. Space Force as the sixth branch of the U.S. armed forces. As part of its oversight of COMSATCOM acquisition, the branch unveiled its satellite communications strategy, U.S. Space Force Vision for Satellite Communications in January 2020, which calls for an integrated network of commercial and military satcom services.

Looking forward, the government may consider the following next steps:

Implement a “commercial first” strategy. Once it is acknowledged that integrated SATCOM is a critical enabler for mission success, dated or skewed arguments regarding “fee vs. free” become irrelevant. Rather, the resiliency of the integrated communication paths for mission execution is the driver. The commercial SATCOM industry understands this requirement and has invested heavily into improving SATCOM mobility, flexibility, redundancy, throughput, resiliency and protection.

A strategy that places “commercial first” to leverage these operationally relevant, enhanced capabilities from the commercial sector incorporated into the baseline DoD architecture, ensures consistent, robust innovation and technology upgrades that benefit the serviceman and woman and the operational planners. This also allows future military SATCOM investments to focus on niche unique capabilities while benefiting from the commercial ubiquity and organically invested R&D that arrives without upfront cost to agency customers, while inserting optimum capability, flexibility and resiliency for end users.

Leverage SATCOM as a Service. SATCOM as a Service has emerged as the satellite acquisition model for the modern age, enabling users’ access to mission-critical, reliable connectivity, anytime, anywhere. Designed for global mobility, SATCOM as a Service provides a critical end-to-end communications infrastructure that is owned and managed by trusted commercial owner operators and includes the space and ground segment elements that deliver globally-available and seamless connectivity. Shifting towards this service acquisition strategy allows military experts to focus on mission execution rather than network management. Satcom as a Service users then can simply connect anytime and anywhere, thus realizing the enhanced operational benefits with no R&D budget burden on their part. Yet, it allows operations to leverage technology advancements, capabilities and encryption provided as a managed service, thus enabling the desired flexibility, resiliency, security and cost-efficiency governments require. Additionally, this model evolves away from the dated method of inefficient and costly leased spectrum or MHz model, when military operators had to “guess” as to where, when and how much bandwidth they would use. With SATCOM as a Service’s always-on capability, the quality of service is assured and pricing is predictable. It eliminates budget uncertainty for DoD customers, while providing integrated SATCOM capability interoperable with and right alongside of military SATCOM capabilities.

Budget commitment. The FY 2019 appropriation for COMSATCOM represented a promising launch point for laying the groundwork of establishing these interoperable yet heterogeneous networks. To further advance successfully in this direction, DoD leaders should include procurement as well as Operations & Maintenance (O&M) funding within the Future Years Defense Program (FYDP) to intentionally acquire COMSATCOM as part of the overall architecture, rather than as an afterthought. This kind of long-range planning and budgeting lays the foundation of strategic SATCOM acquisition necessary for operations in today’s contested environment to meet the increasing demands of mission operations.

Execute real change in the acquisition of SATCOM. Despite all of the progress made and the leadership messages, there may still be a cultural resistance to the embracing of operationally available commercial technology advancements in favor of clinging to well-established yet dated acquisition models. Unfortunately, this prohibits government users from leveraging the entire range of advanced commercial solutions already available that will enable them to do their jobs more effectively. Acquisition professionals are obligated to supply government planners and operators with a “fully stocked toolshed” for their SATCOM needs. This should include modern, commercially-developed capabilities as the foundation to augment legacy SATCOM and, in time a finite set of potentially purpose-built platforms for their unique unmet needs. Without this well-stocked toolshed, an essential, fully integrated architecture comprised of heterogenous networks, interoperable and roaming modern capabilities, true SATCOM resiliency will remain out-of-reach.

Future Prospects

Inmarsat is encouraged by the momentum established over the past year. While much remains to accomplish though with the continued collaboration and partnership with the COMSATCOM industry, we will continue to progress toward an integrated SATCOM architecture of the future. Given the leadership in place, the demand signals from operations and advanced capabilities from commercial operationally available and planned, there is much to anticipate as we look to the future. I, for one, will be watching closely as we enter this new year to see what real progress will be made toward an integrated SATCOM architecture.

I am hopeful for real transformation that will best serve the mission and our valued customers for many years to come — as long as we keep moving forward together.

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Ms. Cowen-Hirsch has more than 25 years of defense, aerospace and executive leadership experience. She served in the U.S. Department of Defense (DoD) as the Program Executive Officer for SATCOM, Teleport, and Services at DISA and the first Vice Component Acquisition Executive for DISA. She established the Defense Spectrum Office, serving as its first Director.

She is a rated experimental flight test engineer and became the first female civilian Mission Commander for the Advanced Range Instrumentation Aircraft (ARIA) mission. She was awarded the Exemplary Service Medal for her service to the DoD. Ms. Cowen-Hirsch received her Bachelor of Science degree in Electrical Engineering from the University of Kentucky and she is a Senior Contributor to MilsatMagazine.



SURVEY: U.S. WARFIGHTERS LACK TECHNOLOGY CAPABILITIES FOR TODAY'S MISSIONS

by Kim Hampson, Marketing Director, Viasat Government Systems

A staggering 98 percent of warfighters point to 'complete loss of connectivity on the battlefield'

Defense agencies are falling short of battlefield expectations when it comes to military communications technology. That's according to a survey conducted by Government Business Council, in partnership with Viasat's Government Systems business.

The Government Business Council and Viasat last year released results from the first-ever *State of Military Communications* survey — and it's clear more must be done to provide better communications technology to our men and women in uniform.

A staggering 98 percent of respondents said their communications technology is sometimes disrupted to a point where they're left with a complete loss of connectivity on the battlefield.

In addition, more than half of respondents said they are dissatisfied with the capacity of their current tactical communications architecture, which is insufficient to support the same kind of cloud connectivity they're used to at home in their civilian lives.

"The findings of this study clearly indicate warfighters feel strongly that they do not have the levels of connectivity they need for today's missions," said Ken Peterman, President of Viasat's Government Systems business. "Technical leadership in sectors like mobile networking and broadband satellite communications is clearly in the private sector now and the technology gap is continuing to widen; the Department of Defense (DoD) has simply been unable to keep up. There is an immediate need to supply high-speed, secure, flexible and ubiquitous connectivity and technology capabilities to our men in uniform to maintain a tactical edge and deter escalating threats from near-peer adversaries."

Today it's clear the digital information age is changing the nature of war. Mission success increasingly depends on real-time information exchange and comprehensive battlefield awareness, but this is only possible so long as the DoD prioritizes communications for the warfighter.

The *State of Military Communications* survey set out to understand whether current modernization efforts are providing warfighters with the capabilities needed to succeed across today's battlespace and stay ahead of adversaries.

Among some of the key findings, the survey revealed...:

Expectations of connectivity on the battlefield are high, but largely unmet: Sixty-eight percent of survey respondents say they expect the same level of connectivity and access to trusted and timely information on the battlefield as they get in the civilian world. But less than half of respondents (46 percent) feel they have the level of connectivity needed to successfully execute their mission objectives. And 98% of respondents say they are disrupted to a point where they are left with a complete loss of connectivity on the battlefield.

At risk of falling behind new threats: Only 27 percent of respondents believe the DoD's budget priorities for communications technology allow the U.S. to effectively keep pace with escalating geopolitical threats.

Organizations are facing significant barriers to network modernization efforts: Respondents noted that the three biggest challenges facing their organizations' network modernization efforts are an inability to keep pace with commercial technology, procurement inefficiencies and limited funding. 70 percent of respondents feel that adopting new acquisition processes would allow their organization to update technologies at the speed of relevance.

Emerging cloud-based systems, artificial intelligence and machine learning capabilities will be critical to future mission success: More than 60 percent of respondents agree cloud-enabled technologies will play an increasingly significant role in enhancing and accelerating the U.S. military's decision-making capabilities. In addition, 81 percent of respondents agree it's critical for U.S. military forces to have access to modernized end-to-end satellite and terrestrial networks to make cloud-enabled technologies and the Internet of Battlefield Things a reality across the battlespace.

Adjustments are Needed

"We have young men and women in uniform who have far better connectivity at home than when they're on missions," Peterman said. "The results of this survey forces us to confront the reality that the status quo isn't working."

Peterman believes adjusting the current acquisition system to keep pace with private-sector technology trajectories is the best path forward.

"Today's warfighters want military technology to provide the same level of security, reliability and quality of service as the civilian cellphone in their pockets," Peterman continued. "To make these capabilities a reality, the DoD must reform its acquisition system to get new technology to troops quicker and match the speed at which technology improves in the private sector."

Viasat believes senior leaders in the DoD are beginning to recognize today's acquisition problem, but the *State of Military Communications* study findings illustrate much more needs to be done to improve the capabilities of today's warfighter.

Moving forward, it will be critical for DoD leaders to turn their focus toward transforming the status quo by adapting to better leverage private-sector capabilities. This will allow military connectivity to keep pace with accelerating private sector technology.

"The *State of Military Communications* study truly captured the opinions of those most impacted by the capabilities of today's military communications technology," Peterman said. "We believe this survey will be a valuable resource for the DoD and industry leaders as our military forces look to modernize technology capabilities across the battlespace."

Ultimately, Viasat hopes the first *State of Military Communications* survey will raise awareness about the scale and scope of current issues related to the state of current military communications technology as well as offering insights about potential solutions.

About the survey

More than 330 U.S. active military and DoD civilians from across the nation participated in this study, 50 percent of whom held positions at the GS/GM-13 level or above (including Senior Executive service).

Respondents represented all branches of the military, as well as a range of agencies within the Office of the Secretary of Defense, and spanned each of the organizational designators (Manpower and Personnel, Intelligence and Security, Operations, Logistics, Planning and Strategy, Communications and Information Systems, Installations and Training, and Finance and Contracts).

Obtain a complete report of the survey results at this direct infolink:

https://cdn.govexec.com/media/gbc/docs/the-state-of-military-comms-2019_compressed.pdf

Author Kim Hampson has been tracking the defense industry for more than 10 the years and serves as Marketing Director for Viasat Government Systems.



THE U.S. SPACE FORCE LAUNCH

Government Satellite Report: by Ryan Schradin, Executive Editor, GSR

History was made at the end of December when President Donald Trump signed the FY2020 National Defense Authorization Act (NDAA), which officially established the United States Space Force as the newest branch of the United States military.

Another historical “first” happened shortly after, when Vice President Mike Pence swore in General John “Jay” Raymond, the former Commander of the U.S. Air Force Space Command, as the U.S. Space Force’s first-ever Chief of Space Operations. According to Military.com, he will be joined by the, “Roughly 16,000 active-duty and civilian personnel that make up Air Force Space Command.”

While many late-night television pundits have mocked the creation of the Space Force (USSF) — the need for a Space Force is no laughing matter. In fact, it’s something that has been a common topic of conversation in the space and satellite industry for more than a decade.

Making the Case for a Space Force

Since 2007, when China demonstrated its ability to successfully destroy a satellite in orbit with a kinetic attack, there has been one universal theme that we have heard reflected in the comments from industry and military

speakers at every satellite and space conference and exposition — space is no longer a benign environment.

This sentiment was reflected in comments by Gen. Raymond, himself, who once said, “There’s great alignment in our nation today that space is a warfighting domain, just like air, land and sea... [we’re] at a strategic inflection point and that’s a point where we used to operate in a benign domain, but today we’re operating in a contested domain.”

The concept of space being a contested environment is not a welcome one for the military, which has long held a technological edge over its adversaries largely in thanks to U.S. assets in space. As Colonel Steve Butow, the Space Portfolio Director at the Defense Innovation Unit, once said, “...we use technology as our offset. If we lose our technological offset, we have to fight a fair fight, and that’s not what we want to do. We want to have technological capabilities that keep us in a dominant position in all domains.” Many of those technological offsets are only available to the warfighter, thanks to satellites.

Military intelligence, surveillance and reconnaissance (ISR) operations rely on space resources. Military communications travel over satellites to get to American warfighters deployed in places with no terrestrial networks,



This photo of General Raymond is courtesy of U.S. Air Force Senior Airman Melody Howley.



the more innovative, less expensive and more resilient alternative for the military. As the CEO of commercial satellite provider, SES GS, Pete Hoene recently said, "Over the past ten years, what we've found is that commercial has taken over in terms of investment and innovation."

However, despite the benefits, the military continues to invest in new communications satellites for its own constellation and continues to purchase commercial satellite capacity on the spot market – which often results in higher prices and less availability. The satellite industry has long called for the military to start thinking of commercial capability as part of an integrated satellite architecture that includes

or where terrestrial networks are untrusted or denied. Satellites are even essential for military position, navigation and timing (PNT).

Understanding the role satellite plays in successful military operations and that our satellites are vulnerable to attack and interference from adversaries makes the necessity for the Space Force clear. This new branch of the military will train a new generation of space professionals and acquire the space capabilities and technologies needed to compete in a new warfighting domain and maintain our technological offset.

This is clearly reflected in the USSF's mission statement:

The USSF is a military service that organizes, trains, and equips space forces in order to protect U.S. and allied interests in space and to provide space capabilities to the joint force. USSF responsibilities include developing military space professionals, acquiring military space systems, maturing the military doctrine for space power, and organizing space forces to present to our Combatant Commands.

There's one part of that mission statement that has the space and satellite industry the most excited – the part about the Space Force being responsible for "acquiring military space systems."

A Single Authority for Space Acquisition?

The Space Force just launched and it's expected to be officially stood up over the course of the next 18 months. It's still early, and it's hard for any industry pundits on the outside looking in to say exactly how its creation will impact the way in which the military interacts with the satellite industry.

However, there is some optimism across the satellite industry that having a dedicated military branch with the responsibility of acquiring space systems and resources could help to ensure a better working relationship between the military and private industry.

Traditionally, the military has relied on purpose-build, custom satellite solutions that it finances, launches and manages itself to meet its needs for space capabilities. However, as we've discussed in numerous articles on this very publication, the overarching belief is that commercial satellites are

military satellites, but that has yet to truly come to pass.

The creation of the Space Force – a single entity tasked with ensuring our military's continued dominance and technological advantage in the warfighting domain of space – could be the spark that finally ignites that change in attitudes and culture. And the individual at the top of that new military branch has illustrated a desire to work more closely with industry in the future.

"I think what we'll see in the future is a more hybrid architecture which would provide us with more resiliency," Gen. Raymond told GSR during last year's Air Force Association Air, Space and Cyber Conference. *"We're here to work with industry and I think that the relationships that we have and that were provided to us by the National Defense Authorization Act will provide us great advantage."*

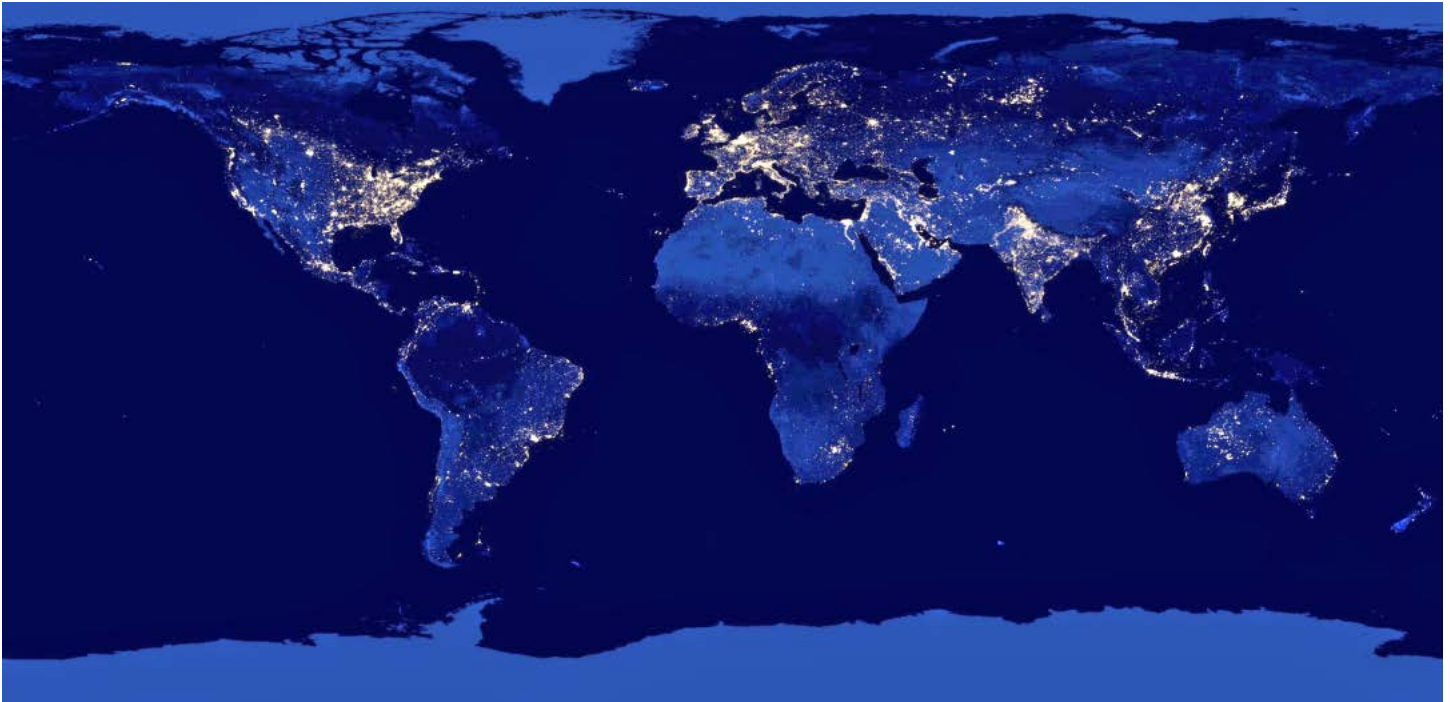
Time will only tell what impact the Space Force will have on America's tactical and technological advantage in space, and on the military's relationship with the satellite industry. But it is further validation that space is an austere environment that will pose new challenges – and exciting new opportunities — for our military moving forward.

*The post, Official Space Force Launch, first appeared on GovSat and is reprinted with permission from **SES GS**.*

Ryan Schradin is the Executive Editor of GovSat Report. A communications expert and journalist with over a decade of experience, Ryan has edited and contributed to multiple popular online trade publications focused on government technology, satellite, unified communications and network infrastructure. His work



includes editing and writing for the GovSat Report, The Modern Network, Public Sector View, and Cloud Sprawl. His work for the GovSat Report includes editing content, establishing editorial direction, contributing articles about satellite news and trends, and conducting both written and podcast interviews. Ryan also contributes to the publication's industry event and conference coverage, providing in-depth reporting from leading satellite shows.



UNRIVALED CERTAINTY FOR EMERGENCY SATCOMS

by Hank Zbierski, Chief Catalyst, IsoTropic Networks

Perhaps it's because our world feels so much smaller today and we are much more aware due to social media and rolling news, but the frequency of disastrous events seems to be increasing.

From week to week, we are experiencing extreme weather and events, both natural and manmade, from cyclones and tsunamis to droughts and earthquakes to war and terrorist attacks. Disasters pose big challenges for governments and NGOs all over the world. These events cause destruction of infrastructure, homes and businesses. They pull families apart, displace people and often it is the most poverty-stricken and least developed areas of the planet that are hit. As we reflect on the ongoing wildfires in Australia - just one of the catastrophes befalling the planet — we realise how critical it is to have access to communications in times of extreme need.

Emergency communications are essential in the immediate aftermath of any disruptive event. When first responders arrive on the scene, robust, easy-to-deploy communications must be available to enable them to lift the fog of confusion that follows. Infrastructure is often badly damaged, or completely wiped out, making it extremely difficult to communicate at a time where communications mean the difference between life and death.

These agencies face their own, unique challenges in terms of communications and there is no one-size-fits-all solution. Communications for the disaster response community depend very much on what is available in any given area and NGOs work with local communications providers to try to find the best way around the problem. For example, some Wi-Fi or cellular coverage may be available but only in certain areas and in areas where coverage is not available, satellite becomes the de-facto solution, providing the emergency response community with an instant solution that can bridge the gaps in infrastructure.

In the immediate aftermath of a disaster, access to the internet and voice communications are absolutely critical. The internet has become a necessary communications medium for NGOs and first responders and is used to collect and send data from collaborative cloud platforms that have been specially developed for use by relief agencies. The internet is also used to communicate between with headquarters and with the team in the field, via email and instant messaging as well as allowing teams to keep in touch with international news and developments.

For individuals and families affected by a disaster, access to satellite connectivity enables them to make the most important communications of their lives. It enables them to contact family and loved ones to let them know where they are and what medical state they are in.

The Isotropic Approach

Wisconsin-based **Isotropic** has been serving the emergency response community with its highly reliable connectivity solutions for many years but today the team is experiencing an increase in demand.

"We have had clients from multiple verticals deployed on many of the past natural disasters and organized public gatherings including hurricanes in Puerto Rico, Bahamas, Florida, Texas and the Eastern Seaboard, organized public gatherings in Nevada, wildfires in California, flooding and tornadoes in Wisconsin, tornadoes in the Midwest and many more," explained Hank Zbierski, Chief Catalyst and Co-Founder, Isotropic. "Our services allowed residents and citizens affected by the above disasters to communicate with loved ones to notify of their safety, they allowed for dispatching of resources and emergency response, communications between the responders and relief aid to those affected."

Zbierski explained that the increase in demand is largely due to the increased number of users on existing local cellular networks as well as the desire to partition secure voice and data communications onto a separate network that is not available to the general public.

Zbierski highlighted the excess strain that is placed upon cellular carriers' capacity by increased users, driving up application and web-based communication products. By using satellite communications through Isotropic Networks, emergency responders operate on a different isolated "pipe" of bandwidth that provides unrivaled certainty that they will be able to operate as effectively and efficiently as possible.

Isotropic Networks provides emergency communications, VoIP and interoperability to the emergency responder community. Data via satellite is critical to ensure that emergency responders can access their software applications while performing USAR (Urban Search and Rescue) operations and other types of response.

These software applications are critical in maintaining personnel accountability, asset allocation and environmental monitoring. Isotropic's emergency communications plans also provide VoIP which allows for reliable voice communications where cellular service may not be reliable.

Seamless Interoperability

Interoperability is an important buzzword in mission-critical communications. No matter how a user is connected to the internet, they must be able to communicate in a seamless way, with no interruptions to service. Isotropic offers several options that ensure seamless interoperability such as a scalable platform that can connect land mobile radios (LMR) with cellular phones, laptop computers and desktop computers.



command and control facilities.

"Our interop platform allows users to stream live drone video in real time to anywhere in the world regardless of how each viewer is connected to the internet," said Zbierski. "Drone video can capture real time search and rescue operations, natural disaster assessments and aerial monitoring during large scale public gatherings all seamlessly streamed onsite and/or offsite



Over and Above, Always

For the team at Isotropic, it's more than simply providing a service and they consistently go beyond to ensure that their clients, some of which have been with Isotropic since the very beginning, are getting the very best service possible (in the event of any problems with the service, the team don't hesitate to use the corporate jet to troubleshoot in person).

"We consistently invest in our infrastructure to ensure that we can deliver the highest quality of service in the most efficient manner possible," continued Zbierski. "We don't just sell our clients a product and service. We invest the time up front to make sure they are getting the best hardware for their applications resulting in the highest reliability and service levels in the industry."

Satellite as an Enabler

Satellite may be viewed as an expensive communications medium, but putting a price on knowing that your service will simply work every time, no matter what the situation, is priceless. The fact that satellite technology can connect anywhere is placing it firmly at the top of many emergency responders' connectivity checklist.

Zbierski concluded by stating, *"We see emergency satcom as the primary source of communications for emergency responders. With the ability to interoperate between satellite and terrestrial networks simultaneously it can re-shape the way agencies are communicating at any size event.*

Author Hank Zbierski is the Chief Catalyst at Isotropic Networks





STRATEGICALLY DISAGGREGATING LEO DATA LINKS

by Chris Badgett, Vice President of Technology, Kratos Space

Avoiding Interference

During World War I, hundreds of men were trapped in a small depression on the side of a hill in the Argonne Forest behind enemy lines. Allied troops, not knowing their location, were subjecting them to "friendly fire." Every messenger sent out of the depression to get help was killed or intercepted by the Germans. The leader of this battalion, Major Charles White Whittlesey, began dispatching messages by carrier pigeon. He only had three pigeons and the first two were immediately shot down by the Germans. But the remaining pigeon, "Cher Ami," successfully flew back to division headquarters, saving the lives of 194 men.



Cher Ami, the carrier pigeon which carried a message from the Lost Battalion to the 77th Division on October 4, 1918.

Resilience can come in many forms. Resiliency for Cher Ami could have been in the form of hundreds of pigeons covering her trail as she rose to the sky, obfuscating her location. Today resiliency could entail multiple satellites transmitting the same critical data, distributing the overall risk of being compromised. Communication

technology has vastly improved from the days of carrier pigeons, yet transmitting resilient, secure information during conflict can still be challenging. With the advent of satellites and UAVs, we now have the ability to see the battlefield from the air and communicate critical information to the ground with relative ease. However, it does not take away from Cher Ami's situation, which was to avoid detection by the enemy and their ongoing efforts to interfere with her mission.

Resiliency for Military and Commercial Applications

For satellite communication, the difficulties with transmitting data are not limited to the military as commercial operations are also affected by parties

intentionally interfering with missions. The DoD and commercial sector both seek methods to avoid interference. New and innovative technologies such as digital ground and cloud-enabled virtualized processing are creating unique answers for avoidance alternatives and they can be readily applied to small satellites.

Resiliency tactics are relevant to small satellites because this type of constellation is increasingly becoming popular to COMSATCOM and MILSATCOM. The costs to launch objects into space have dropped by orders of magnitude, and small satellites can be developed faster with smaller teams that are less costly. Rapid improvements in technological capability as well as declining cost through standardized parts and production processes have made smallsats more useful, helping to predict weather, improve maritime awareness of suspicious vehicles, detect illegal logging and improve military communication capabilities.

The U.S. Army Space and Missile Defense Command (SMC) received its first image from a small, low-cost, satellite prototype designed to provide near real-time images to the tactical-level ground Soldier.

Architectural Design Innovation

Improvements in digital signal processing technology are influencing how engineers design their ground data systems architecture. Digital architectures bring security and resiliency to the forefront of design. Of great significance is that technical mastery now exists for the conversion of analog to digital RF. Digitized RF can keep its fidelity and be transported with time deterministic latency with no data loss, enabling signals to be transported via commercial means into a general compute infrastructure. When considering the overall costs of Low Earth Orbit (LEO) satellites and the power being brought with resilience, accurate digitization, virtualization and cloud computing, many small satellite operators are not even considering large proprietary hardware and are going directly towards virtualized solutions.

Virtualized processes can effectively and efficiently remove dependence on proprietary and expensive hardware. Satellite communications can be set up for automated operations, bringing convenience and lower labor costs. New machines can be added when needed, bringing the ability to scale



Artist rendition of multiple domains and proliferated LEO constellation with network of ground entry points (GEP).



22nd Space Operations Squadron mission commander overseeing the Air Force Satellite Control Network antennas.

resources dynamically. Improved bandwidth capabilities allowing for reliable narrowband and wideband operations can be leveraged in conjunction with large scale cloud computing through private clouds or large cloud enterprises such as AWS, Azure, and others.

Through the use of virtual solutions, resilient and redundant architectures can be deployed supporting both small and large LEO constellations. Key features of fully integrated, virtualized ground system architecture include digital IF and container/VM based software modems, FEPs, and gateways. These features, available now, are leveraged to increase security (just-in-time deployments), reduce hardware and architectural footprint, and enable Cloud-based proficiency.

Resilience is Integral to the Design

Commercial satellite antenna networks with cloud competencies, such as AWS, KSAT, Capella and Atlas, are creating self-service portals for on-demand requests from small satellite operators. These networks have the potential of delivering hundreds of Ground Entry Points (GEP) across the Earth. If one node or GEP goes down, the ability to remap operations to a separate node will be inherent to their software defined network.

In the future, LEO constellations could constitute hundreds or possibly thousands of small satellites. With thousands of satellites in an orbit, all connected, if one satellite goes down, another could easily take its place. Major Whittlesey only had three pigeons and once they were down, the ability to save his troops would have been lost. What if he could have communicated with 10 different satellites? Even if two satellites went down, eight would have been successful at receiving his message and stopping the friendly fire.

With software-defined networks and virtualized command and control (C2) comes the ability to communicate through multiple ground entry points, rendering the power to quickly instantiate services on demand.

Kratos has proven that deployment automation can be used to spin up a new satellite command and control stack in less than 10 minutes. Military satellite communications are no longer tied to permanent ground stations,

nor are they tied to specific satellites but are limited to network infrastructure decisions such as bandwidth, connectivity, and trust.

This strategy and the others mentioned are all tactics to disaggregate satellite communication capabilities. By increasing the number and diversity of targets, the adversary's capability to successfully interfere with a mission becomes more complicated. These resilience strategies give the Warfighter operational advantage and improve mission survivability.

Benefits of Continuous Innovation

Digital technologies are changing and improving ground to satellite communication faster than ever before. Those that wait to transform risk falling behind their peers, particularly near peer adversaries. An entire ground system, composed of virtual network functions that used to be deployed in specialized hardware, can now be constantly upgraded one function at a time, with new functions added as needed. Virtual and software defined ground solutions can be continuously updated and evolved to stay ahead of threats.

A proliferated LEO constellation with a software defined network, virtualized C2, and multiple ground entry points mean that those like Major Whittlesey and his troops, who benefitted from a lone pigeon surviving a 25 mile flight, will have more options to ensure mission success.

Today, survival is not necessarily linked to size or strength but to the ability to change — to move quickly, adapt, seize opportunities, and be agile. Digital ground and virtual technologies are extending our ground to satellite communication power with a multitude of possibilities for LEO going forward.

Chris Badgett is Vice President of Technology for Kratos Space. He has been instrumental in designing the capability for the military to take advantage of virtual ground solutions and the ability to securely leverage the power of cloud computing and global antenna networks. Prior to Kratos, Mr. Badgett served in the Air Force as a weapons engineer in the Air Force Research Lab. Chris has also worked in the Space Development and Test Wing as a program manager for a satellite system developed by Ball Aerospace. Mr. Badgett holds a BS in Electrical Engineering from University of Tennessee and an MS in Space Systems from the Air Force Institute of Technology.





CLOSING THE GAP FOR THOSE DEPLOYED FAR FROM HOME

Thousands of military personnel are deployed every year in foreign countries as part of embassy and consulate security, peacekeeping and diplomatic missions, or military operations. Deployments abroad may last several months and keeping the morale of troops and other military personnel high is key to the mission success.

In a world where access to digital entertainment and information is easily accessible in most urban areas, it is hard to imagine being deployed to a mission abroad with limited or no access to the web, social media or messenger apps to remain in touch with families and friends back at home.

The Spanish Ministry of Defense (MoD) took a step forward last year by starting a program to improve the morale, welfare and recreation services of troops that were deployed in operational zones abroad. The Spanish MoD uses the X-band satellite capacities of the SPAINSAT and XTAR-EUR satellites that are operated by Hisdesat, the Spanish governmental satellite service provider and XTAR LLC, respectively.

More than 2,500 troops deployed across several countries in Eastern Europe, the Middle East and Africa, as well as navy soldiers performing missions in the Atlantic and Indian ocean regions, now have access to a

variety of secure communications and entertainment services that include access to the Internet, voice calls, distance e-learning, streaming of live TV channels and multimedia content to a quality level that was not previously available.

This time, the service providers involved had the opportunity to design a service from scratch, according to the vision and objectives of the Spanish MoD to improve the morale of those troops deployed in zones of operations while keeping security risks that a new network may bring as low as possible.

Designing a new, purpose-built, secure communications network improves the variety of services and enhances the experience to end users and also allows for the implementation of security aspects at the center of the service.

In this mission, a new satellite transport network has been designed and implemented by **Santander Teleport** that centralizes all traffic and delivers the service securely, via encrypted links and communicating to the data centers of Telefónica in Madrid and the Centre for Information and Communication Technologies and Systems of the Spanish MoD (CESTIC).



The satellite network is monitored and managed 24/7 from the Santander Teleport NOC.



Spanish military personnel deployed abroad enjoying the new welfare services upgrade.



The Hisdesat-owned satellites on-orbit.

This is accomplished via private circuits and avoids silo networks that are contracted to local providers to serve individual sites. That is a model that increases the risks of network tampering or monitoring by third party actors.

On the other hand, the use of a dedicated and secure managed network allows for total control of the satellite capacity available and improves efficiencies, as large pools of bandwidth are only shared across all of the land sites and navy ships. Furthermore, several traffic-management layers have been deployed that include encryption, quality of service, prioritization, data compression acceleration and optimization, boosting the experience from the end user point of view and squeezing the most out of the limited spectrum available.

For all the vessels where a high-throughput X-band terminal is not yet available, Global Xpress® links from Inmarsat have been implemented. The GX traffic is landed in a teleport in Amsterdam and routed directly to Telefonica and CESTIC through dedicated private circuits as well.

From now on, military end users far from home will have access to multimedia content that includes customized live TV channels containing news and sports events as well as streaming content from a variety of TV shows, documentaries and movies that are regularly refreshed.

All of this content is provided by Movistar+ — that guarantees the quality and streaming rights.

Users will be able to access all of this content and communicate with families and friends back home through their own mobile devices (BYOD),

thanks to specially designed mobile apps that allow user-friendly access to all these services while ensuring access to the network is secure.

In order to manage a smooth delivery of these services, and taking into consideration the difficulties in logistics and security that surrounds a network deployment in a military environment, the network has been designed to be used with standard satellite nodes that consist of a VSAT terminals, traffic optimization devices, Wi-Fi controllers and access points, content servers, and networking devices initially installed to more than 11 terrestrial locations and 18 vessels.

Having standard nodes also allows for easier maintenance and better management of equipment spares. Moreover, two pilot nodes, one in a military base in Madrid and one at Santander Teleport, serve as a testbed for monitoring, troubleshooting and soak testing future service upgrades and improvements.

The experience of going from concept to an actual delivered service has been extremely positive for all parties, including the companies involved in service delivery (Hisdesat with XTAR LLC and Santander Teleport as partners, and Telefonica together with Movistar+ and Inmarsat), to the main contractor (the Spanish MoD).

The impact of the telecommunications and, more specifically the Internet, has been transformational in a way that has dramatically improved productivity and interactivity as well as revolutionizing the way in which users communicate and engage in their social habits.

People have become extremely dependent upon communications due to the huge benefits and comforts the technology provides. When separated from home and loved ones, a lack of access to Internet can be harming and disruptive to the morale of those brave men and women serving abroad.

If one element is undisputable, that is that satellite communications is key to enabling ubiquitous access to all those entertainment and communications applications that all are so used to using these days — the ability to communicate successfully is essential to closing the emotional gap that is suffered by those serving their nations far from their homes.

www.santanderteleport.com



Paradigm's HORNET terminals in use during their deployment in Burkina Faso during U.S. Africa Command's Operation Flintlock.

SINGLE SATCOM SOLUTIONS FOR MULTI-OPERATIONAL REQUIREMENTS

by Ulf Sandberg, Managing Director, Paradigm Communications Systems Ltd.

Increasingly, military forces around the world require constantly connected high data throughput communication capabilities when in the field. High quality video streaming and data backhaul are necessary not only for situational awareness and information gathering but also for welfare comms and internet access for personnel. It follows that the easier it is to use this equipment then the more effective and successful it will be.

Paradigm's guiding principle of simplifying satellite communications has enabled this type of technology to be much more accessible to the mobile soldier. More specifically, Paradigm has made huge advances in simplifying the setup and pointing processes, and in modularizing terminals for rapid deployment.

A significant step forward has been to remove the need for trained SATCOM engineers who were previously required to setup, point and

operate satellite terminals, the result being that satellite communications can become as ubiquitous as the smartphone. Paradigm's developments mean that less training is now required to enable the setup of reliable communications in any location and to provide higher bandwidth than previously available from other comms equipment with comparable training requirements. This translates into soldiers and mobile units who can then focus more easily and quickly on the task in hand, with the confidence that their communications kit is delivering high bandwidth in both static and on-the-move situations, anywhere in the world.

The success of Paradigm's ongoing simplification of SATCOM has been based on the development of the PIM® — the Paradigm Interface Module — an environmentally rugged terminal controller designed to provide a common level of operation to all satellite terminals. Its simplicity and ease-of-use has made it extremely popular and led to it being integrated into many non-Paradigm terminals to also enable quick and rapid access to key satellite constellations and networks.

The PIM minimizes training because it is straight forward to use and because it is integrated into so many different terminals, each of which adopt the same straightforward pointing process. It makes it easy for non-skilled users to setup and point a satellite terminal, simplifying a process to one that only requires basic training at most. Actions such as pointing the terminal, getting it operational on a satellite and transmitting and receiving data can now take less than a minute to perform, with the user guided by easy-to-follow, simple instructions delivered via the PIM's basic unit interface.

To assist the operator to point the satellite terminal, the PIM provides all the required cues using the on-board control interface; no spectrum analysers,



laptops, PC's or external equipment is necessary. The user follows straightforward visual guidance, with optional audio guidance available. These simple-to-follow instructions are all that's needed to enable rapid, accurate terminal pointing.

The ruggedized PIM represents an easy-to-use interface across many different satellite terminals, thus enabling Defence Forces to standardize on equipment. Additionally, the technical agility and versatility of the PIM allows it to be integrated with all types of SATCOM terminals and modem technologies; so other manufacturers can, and do, use it as the brain of their system, further standardizing the process of satellite communication. The PIM's array of integrated modem technology also allows for a military level encryption feature, adding over-the-air security, but maintaining all the simplicity of pointing and rugged operation. By reducing the training requirements and reducing the differences between terminals down to situational and environmental use driven features, Paradigm has created a range of VSATs that meet every operational need.

The PIM optimizes the ease-of-use and commonality of the Comms-On-The-Move (COTM) and Comms-On-The-Pause (COTP) MANTA terminal and is an integral part of ultra-portable, backpackable terminals, such as the SWARM®. However, it also has a key role to play in systems designed for longer term setups such as Paradigm's HORNET and CONNECT100T terminals. The HORNET terminals use segmented, carbon fiber antennas and are compact and rugged. Deployment is straightforward and does not require any tools. Similar to all PIM-enabled terminals, pointing is simple and fast.

The HORNET terminals already have a solid track record of field deployments. During 2019, HORNET terminals were deployed in Burkina Faso during Operation Flintlock, the U.S. Africa Command's premier special operations forces exercise. Approximately 2,000 personnel from more than 30 African and western nations participated in the operation and the HORNET was used to keep the mix of multinational soldiers connected to family and friends throughout.

At the same time on the other side of the world, HORNET terminals provided fast, reliable and critical communications for the Argentine Antarctic Summer Campaign. Both crew and scientists at the bases and on board the icebreaker vessel benefitted from the high speed internet access

providing both welfare comms and data transfer for operational activities such as the transfer of up-to-the-minute maps of navigation routes and meteorological information.

The latest edition of the HORNET has been optimized to provide an interchangeable, modular solution to increase flexibility and efficiency for the user. It is lightweight and crucially can now be packed into a single IATA compliant case or backpack. Its modularity allows the user to interchange between different sized antennas, RF modules and frequency bands to give a single communication node for multiple operational requirements. These single case HORNET terminals are designed to balance high-speed data throughput with portability. Maintaining the courier-friendly and airline compliant case design, the HORNET terminals provide a positive balance between lightweight, rugged and data throughput.

This extends the advantage of standardization the PIM brings to even greater lengths. By adopting the HORNET, the same simple-to-use terminal can be configured for X-, Ku-, Ka- and Mil-Ka frequency bands over 60, 80 and 100 cm. antennas with a range of RF modules. Operations can thus continue seamlessly as locations, network coverage and link budgets evolve.

As an example, a short, info-gathering mission to a remote location can be supported with the smaller 60 cm. aperture on a low power and low frequency configuration. This will enable the team to remain connected to their chain of command for situational awareness via voice calls and small data files.

For an extended and more complex operation where the communications setup requires a higher data throughput and improved cost efficiency, the antenna and RF module can be swapped out for the larger 80 or 100 cm. on a higher Ku- or Ka-Band frequency. Now the unit can reliably and safely transmit hi-res photos and full motion video files as well as providing internet access and email services for the soldiers. The antenna size, multi-RF and complete multi-power flexibility of the terminal are thus able to support all link budget requirements.

All Paradigm terminals have been field-proven in theater from operations in the desert providing broadcast quality video network connectivity, to operations at extreme altitude in ultra-cold temperatures to maintain welfare data communications channels. They provide simple, easy to use VSAT setups, tried and tested, with standardized operations across all of the major satellite operators. Paradigm maintains close working relationships with partners and key customers to deliver enhancements and developments for all their terminals to suit any specific requirements.

Paradigm regularly supports both commercial and military events and exhibitions around the world, with the range of PIM-enabled terminals and Paradigm's terminal design and engineering capability all on display.

The website — www.paracomm.co.uk — is always up-to-date with details of these. Additionally demonstrations can be arranged for key global locations by contacting the firm's sales team at sales@paracomm.co.uk.



Author Ulf Sandberg is the Managing Director at Paradigm Communications Systems Ltd., based in Alton in the United Kingdom.





SMALLSAT LAUNCHES CONTINUE TO RISE

by Andrew de Naray, Space Foundation

Just as the developed world has evolved to depend on space for everyday communications and data collection, so have defense operations. Larger satellites have been used for military purposes since the dawn of the Space Age, but there has been a growing interest in the feasibility of using various forms of small satellites (smallsats) to support tactical operations.

Although there is no universally accepted definition of a smallsat, and numerous subcategories exist, they are commonly defined as satellites that weigh 500 kg. or less. More companies are deploying smallsats each year for myriad purposes, and the small launch vehicle market and launch providers are responding by expanding to support those satellite operators' needs.

According to research from the Space Foundation, in the last five years, the number of smallsats in space has increased 175.6 percent, while the number of smallsat operators have more than doubled.

For decades, the use of satellites was economically and legislatively restricted to providing civil and defense communications, primarily for voice transmission and television, as well as Earth Observation (EO) for meteorology needs. Building satellites required expensive, high-tech capabilities, and development of launch vehicles was also costly, making space accessible only to wealthy and technologically advanced nations.

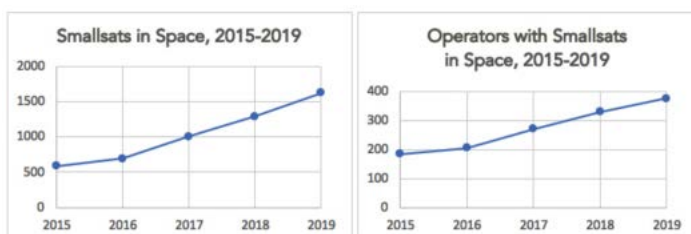
This dynamic began to shift at the beginning of the 21st century with the evolution of advanced microelectronics, enabling the fabrication of smaller satellites built in modest facilities and launched in vehicles that had room to spare for secondary payloads. Over the last decade, smallsats have increasingly demonstrated their ability to support a range of missions, effectively contributing to commercial, institutional, and educational efforts at a lower cost for technologically developing nations and new space players.

Subsequently, there has also been an increased willingness to adopt smallsat technology in the military and defense intelligence communities. The U.S. Army is currently testing three different smallsat-based programs with the objective of providing direct support (via communications, navigation, reconnaissance, and more) from Low Earth Orbit (LEO) to tactical units on the ground.

The U.S. Army's longstanding interest in building an orbital presence in LEO to track missile threats — particularly fast, unpredictable hypersonic weapons — has become one of the Department of Defense's top priorities and smallsats are expected to play an increasing role.

The greatest hindrance to faster growth in the smallsat sector has been the cost and availability of launch vehicles and services. That need has not only led to development of lower-cost launch vehicles, it has kick-started a spaceport building boom, concurrently creating a surge in small launcher developments from both national agencies and the private sector.

To date, about 50 new small launch vehicles are in various stages of development. Likewise, spaceport upgrades and new spaceport development are at an all-time high, with 40 active launch sites on five different continents around the globe. Adding to this current capacity, 10



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IceCube, the first smallsat project managed by Goddard Space Flight Center's Wallops Flight Facility, weighs 10 pounds and is about the size of a loaf of bread. Photo is courtesy of NASA.

more spaceports are in development in the U.S., Sweden, Australia and Canada, with another 13 more proposed in eight countries, according to **"The Space Report 2019, Q4."**

In the United States, through the development of a second small vehicle launch location at Wallops Island on the Eastern Shore of Virginia, the U.S.-based startup Rocket Lab is poised to capture an even larger share of U.S. defense revenues. As reported on the company's website, their newest spaceport *"Tailored specifically for U.S. government small satellite missions, Launch Complex 2 can support up to 12 missions per year."*

Likewise, Pacific Spaceport Complex-Alaska (PSCA), operated by Alaska Aerospace, is positioning its facilities to support increased commercial operations for smallsat operators in the coming years.

Additional launch providers accommodating smallsat payload launches in the U.S. include: Spaceport Camden in Camden County, Georgia; Spaceport America in Sierra County, New Mexico; and Space Exploration Technologies Corp. in Cameron County, Texas.

In Australia, three spaceports are being developed to support smallsat deployments using small launch vehicles. Arnhem Space Centre is located in the far northern region of Nhulunbuy. Equatorial Launch Australia (ELA) will be working with NASA to develop Arnhem into a sounding rocket launch site and orbital launch site. On the southern Australian coast, Southern Launch is developing the Whalers Way Orbital Launch Complex into a polar orbital launch site for smallsats. Gilmour Space Technologies is planning mobile small vehicle launches near Bowen, Australia.

The U.K.'s Virgin Orbit, an aspiring smallsat launch company backed by billionaire **Richard Branson**, has signed an initial agreement to develop smallsat launch capabilities for the U.K.'s Royal Air Force. Virgin Orbit's method for launching employs smaller rockets that attach to the wing of a modified Boeing 747, which then separate at a high altitude, traveling the rest of the way to LEO carrying light payloads.

British-based OneWeb and Starlink from SpaceX have begun on-orbit testing of constellations of smallsats. OneWeb expects to launch 900 smallsats, while SpaceX plans to launch 40,000, with each individual satellite weighing under 500 lbs. (~227 kg.).

If the Bureau of Labor Statistics occupational outlook is any indicator, this growth will likely continue to create even more demand for skilled STEM talent. The BLS estimates that by 2028, employment of aerospace engineers will increase by 2 percent and employment of aerospace engineering and operations technicians will increase by 4 percent. In both cases, the Bureau cites new developments in smallsats and advances of the commercial space sector as drivers of this growth. With that growth comes new opportunities for the smallsat community to prove its abilities to satisfy client demands, and also to evolve and provide more capabilities not yet imagined. This will be growth worth tracking.

*Andrew de Naray is a research writer and editor with **The Space Report** that is published by **Space Foundation**.*



About the Space Symposium: Presented by the Space Foundation, the 36th Space Symposium will take place March 30-April 2, 2020, at The Broadmoor in Colorado Springs, Colorado, USA, bringing together thousands of space professionals from the world's leading spacefaring countries to discuss and plan the future of space. See the agenda and registration information at www.spacesymposium.org.

About The Space Report: Presented by the Space Foundation, The Space Report is the authoritative guide to global space industry activity. For more than a decade, the Space Foundation Research & Analysis team has gathered an ever-expanding collection of information about the global space industry, government policies and priorities, and evolving trends in education and the space workforce that influences space activity. The Space Report is now offered quarterly as an online service that provides subscribers with access to historical research, as well as new data sets that have never appeared in reports. For more information, see www.thespacereport.org.

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