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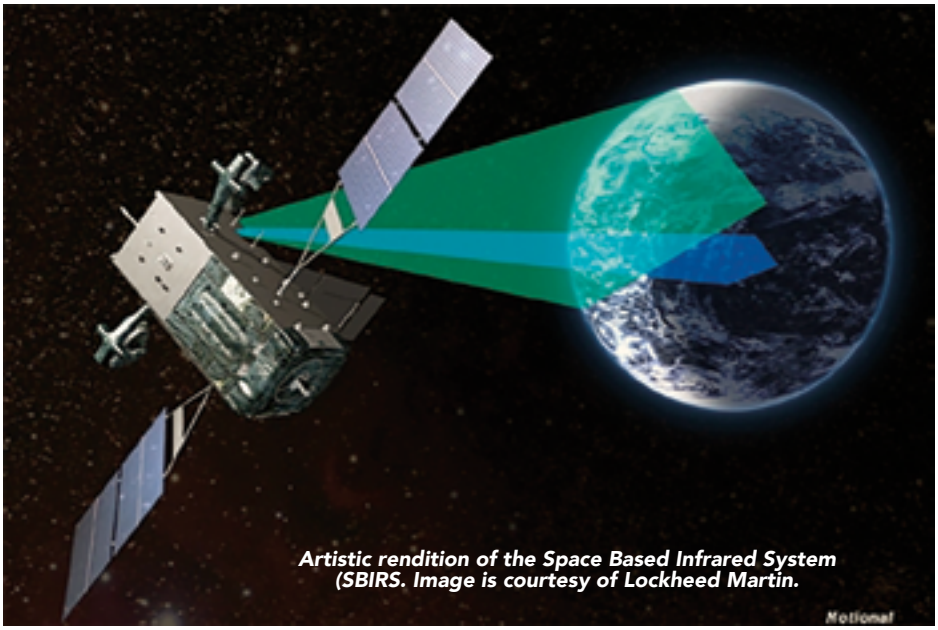
NO COST INVOLVED TO U.S.A.F. FOR SBIRS UPDATE



Artistic rendition of the Space Based Infrared System (SBIRS. Image is courtesy of Lockheed Martin.

The U.S. Air Force's newest infrared surveillance and missile warning satellites will be based on Lockheed Martin's modernized A2100 spacecraft, an update that improves system affordability and resiliency while also adding the flexibility to use future payloads.

The fifth and sixth Space Based Infrared System (SBIRS) Geosynchronous Earth Orbit (GEO) satellites will receive this advanced spacecraft technology at no additional cost to the existing fixed-price contract.

The SBIRS program is responsible for America's early missile warning and infrared surveillance missions, which are crucial to global security.

In response to the Department of Defense's need for more affordable and resilient systems, the U.S. Air Force and Lockheed Martin worked to add the A2100 bus update to the 2014 SBIRS block-buy contract, which already saved the U.S.A.F. more than $1 billion.

The modernized A2100 adds further affordability by using common components, streamlined manufacturing and has a flexible design that reduces the cost to incorporate future, modernized sensor suites. The modernized A2100 builds on a flight-proven bus that is the foundation for more than 40 satellites in orbit today.

Through an internally-funded, multi-year modernization effort, Lockheed Martin has enhanced the spacecraft's power, propulsion and electronics, while also adopting the latest advanced manufacturing techniques to decrease production costs and timelines.

"Through the leadership of the Air Force's Space and Missile Systems Center, we have been working to address the Department of Defense's Better Buying Power and Bending the Cost Curve initiatives to deliver more value per dollar on this vital national security system," said David Sheridan, Lockheed Martin vice president and SBIRS program manager. "SBIRS has been providing outstanding global coverage for the Air Force, and migration to the modernized A2100 will help keep SBIRS ahead of America's adversaries while dramatically reducing costs and cycle times."

www.lockheedmartin.com/us/products/sbirs.html

NATO'S GLOBAL HAWKS

Expanding NATO's joint intelligence, surveillance and reconnaissance (ISR) capability, Northrop Grumman Corporation and its industry partners together with NATO leaders have unveiled the first NATO Alliance Ground Surveillance (AGS) aircraft to an audience of customers, distinguished guests, employees and community leaders.

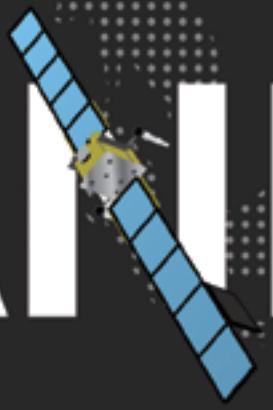
The unmanned aircraft, a wide area surveillance Global Hawk, is part of a broader system of systems solution that will advance the Alliance's evolving ISR needs during a full range of NATO's missions such as protection of ground troops and civilian populations, border control and maritime safety, the fight against terrorism, crisis management and humanitarian assistance in natural disasters.

The NATO-owned and operated program comprises five air vehicles and fixed, mobile and transportable ground stations. Northrop Grumman's primary industrial team includes Airbus Defence and Space (Germany), Selex ES (Italy) and Kongsberg (Norway), as well as leading defense companies from all participating countries.

With the ability to fly for up to 30 hours at a time, the high-altitude long-endurance system will provide NATO leaders with persistent global situational awareness. The aircraft is equipped with leading-edge technology, including the Multi-Platform Radar Technology Insertion Program (MP-RTIP) sensor. The MP-RTIP will provide critical data to commanders during operations in any weather, day or night. The NATO AGS system will also be able to fuse sensor data, continuously detect and track moving objects and provide detailed imagery.

The industries of the 15 participating nations (Bulgaria, Czech Republic, Denmark, Estonia, Germany, Italy, Latvia, Lithuania, Luxembourg, Norway, Poland, Romania, Slovakia, Slovenia and the United States), are each contributing to the delivery of the AGS system. All 28 Alliance nations will take part in the long-term support of the program.

LOUD AND CLEAR



YOU ASKED FOR MILITARY SATCOM OVER ASIA-PAC. MESSAGE RECEIVED.

During 2015 Skynet 5A will move to its new location: 97° East. For the first time, military-grade, protected X-Band and UHF will be available to US government customers operating in Asia-Pac. Skynet 5A provides tailored and interference-resilient services with exceptional throughput. It is fully interoperable and complies with MUOS, WGS and DODIN/DISN systems and services, as well as MAC 1. In short, it offers complementary services for those that already have X-Band and delivers a new level of communications for those that don't. Find out more at satcom-airbusds.com

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PIONEERING THE FUTURE TOGETHER

AIRBUS DEFENSE & SPACE

THE U.S. ARMY TO FOCUS ON CYBER STRATEGY IN TACTICAL ENVIRONMENTS

The Army is analyzing cyberspace requirements and outlining potential technical investments based on its Cyber Materiel Development Strategy, released earlier this year.

Doctrinal, operational, acquisition and research and development communities, for Army materiel development, worked together for more than two years on the comprehensive strategy, which looks at where Army cyberspace capabilities are and what lies ahead.

"The Army must be prepared to operate and fight within the cyberspace domain," said Assistant Secretary of the Army for Acquisition, Logistics and Technology Heidi Shyu. "It is essential... that we use our limited acquisition and science and technology resources to identify and address critical Army specific problem sets and capability gaps. Where possible, we must leverage the best solutions and ideas available through our partnerships and collaboration within the Department of Defense, other government agencies, industry and academia."

Shyu appointed Henry Muller, director of the U.S. Army Communications-Electronics Research, Development and Engineering Center, or CERDEC, as the Army Cyber Task Force lead.

"In less than two decades, cyberspace has radically transformed how the Army operates and wages war," Muller said. "Unlike the other physical domains, cyberspace will continue to grow and is projected to reach over 100 billion connected devices within just the next 10 years."

"These monetary and technological investments may determine how dominant the Army will remain in the future," Muller said.

The Department of Defense has identified cyber as an operational domain much like air, land, maritime and space; however, no military service has been assigned the cyber domain. Additionally, the Army still operates in a fiscally-constrained environment, where spending and allocation of resources cannot address all aspects of cyber, said Giorgio Bertoli, CERDEC Intelligence and Information Warfare Directorate, acting chief scientist and lead action officer for the strategy.

"Cyber is hard to predict," Bertoli said. "One of the challenges is the technology turnover rate is very high. Adoption for new technology is also increasing as the public becomes more and more comfortable embracing new technological advancements."

"You can predict that processing power is going to keep increasing; you can keep predicting bandwidth wired and wireless, is going to keep going up; you can predict new technologies like quantum computing will eventually come to pass," Bertoli said. "The hard part to predict is how are they going to be used? What are the new applications these technical advances are going to enable?"

The Army identified that it needs to make advances in several Army-unique problem sets. One such area is the Army's tactical operations center, where military specific operations occur. While its enterprise level network is similar to commercial businesses, the tactical network faces military-unique defensive and offensive challenges.

Tactical networks have limited bandwidth with high-bit error rates, high latency, intermittent connectivity, and roaming infrastructure and users.

"On top of that, you have other related data like mission command data that are passing over these very limited bandwidth channels to begin with. Any security you pass over these channels degrades what other traffic they can send," said Steven Lucas, chief engineer, CERDEC Space and Terrestrial Communications Directorate, Cyber Security and Information Assurance Division.

The Army is unique in that it operates for extended periods within adversarial environments.

"We're highly reliant on distributed communications systems, which are more prone to interception because you are in close proximity to the enemy within radio line of sight range," Bertoli said.

One aspect of defending the tactical network includes intrusion detection. "Intrusion detection allows a sensor to detect potentially malicious activity on a specific node, such as a handheld device or a laptop, and limit the user's capabilities," Lucas said.

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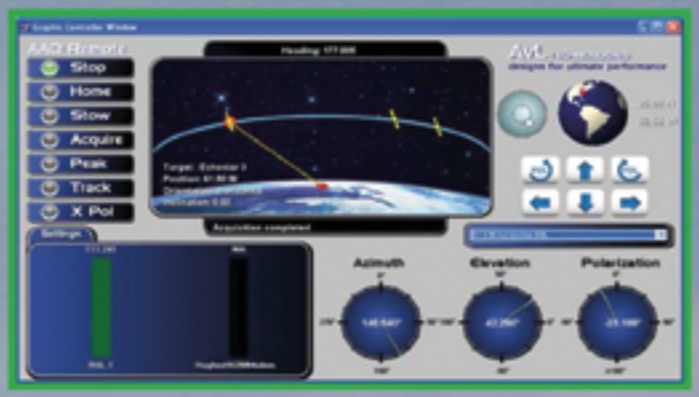

AvL TECHNOLOGIES

www.avltech.com

"With respect to intrusion detection, you have sensors that are doing the detection of malicious activity, either on the network or at the host level, and whenever they detect something they feed it up to this higher authority," Lucas said. "Because of our environment, that connection between the authority and the actual detector may not always be there."

If the intrusion detection sensor spots potential malicious code on a handheld device, it might limit data transmission capabilities but still allow the Soldier to use the voice capabilities. The intrusion detection software would continue to monitor the device before determining if it needs to come off the network.

Another aspect of defending the network includes software assurance. Typically, one vendor does not develop code for single software application, but rather multiple vendors contribute to the code and then integrate it into one package.

CERDEC and the U.S. Army Research Laboratory have developed various techniques, such as fuzzing, to analyze binary code to identify potential holes in the software.

"Fuzzing is where you throw garbage at the executable code and try to get the software to do something that it wasn't designed to do," Lucas said. "Then through analysis, you can see if there was a buffer overflow or a memory leak where now it opens a potentially exploitable window into that software."

From the research and development side, CERDEC wants to perform the majority of software analysis upfront before the system is fielded. Not only will it protect Soldiers from using vulnerable software, but it will also save the Army time and money in development and sustainment.

"Software analysis is a continuous process you need to do, and then we also have developed capabilities to where ultimately we don't want to wait to the very end just before the application goes out to the field," Lucas said. "Do it up front, do it during the actual coded development and writing, where you can ultimately save."

Based on a calculation done on a mission command application, if a vulnerability in a system was found during the development cycle instead of the pre-deployment phase, the government could save roughly $30 million over the entire program lifecycle, he said.

An additional tactical concern is access control and identity management at all levels across the network, as there may be a mixture of cleared and uncleared users.

Most employees associated with the government are familiar with the Common Access Card, or CAC, which allows two-factor identification to gain access to government-issued computers.

This form of two-factor identification works adequately for stationary systems in an enterprise and non-dynamic environment, such as an office cubicle; however, a CAC is not the most practical access control and identity management tool for many environments, Lucas said.

"Ultimately how you come up with or maintain that trust consistently across the network is very hard to do," Lucas said. "From a device perspective, the user needs to have trust in the device, which provides the information to them to make decisions. You want to ensure that nobody can just add a device of their own, like an enemy laptop, to the network. You want the devices themselves to be trusted."

CERDEC is working with project managers and the chief information officer/G6 to research, design, develop, and test state-of-the-art identity management systems, which will work in the unique tactical environment.

The Army Cyber Strategy calls for the continued effort to further protect its tactical networks, but it also calls for research and development on how the Army can leverage its own sensors and exploit enemy capabilities.

"Offensive Cyberspace Operations provide a military commander a non-kinetic capability option that eliminates or minimizes the physical damage caused by other traditional forms of military engagement," Bertoli said.

"One of the key things we've been pushing for a while now is that we need to do a better job of leveraging our tactical assets to improve CEMA [cyber electromagnetic activities] situational awareness," Bertoli said.

As part of the strategy, the Army will continue to determine how it can best leverage sensors that are already in the field to enable such cyber capabilities.

To make these offensive and defensive advances, the Army needs to base its development on a modular and flexible architecture to ensure it can keep with the continually increasing advancements in cyberspace.

It is impractical for the Army to chase after every new technology to defeat it; however, it is possible and fundamentally important to further develop architecture frameworks, which will minimize the amount of new code needed to deal with new technologies, Bertoli said.

"In order to achieve this, you need to have some pretty extensive laboratory infrastructure like we have here at APG [Aberdeen Proving Ground], and those labs have to be constantly updated to keep up with the churn of technology," Bertoli said.

"Though a great first step, the Army is still working at defining its role and doctrine as related to cyberspace operations. This, coupled with the rapid pace of technical innovation within the domain will require the S&T [science and technology], operational, doctrinal and acquisition communities to maintain close working relationship and to ensure this strategy remains current," Bertoli said.

Editor's Note: This article originally appeared in the May/June 2015 issue of Army Technology Magazine (***armytechnologymagazine.com/***), which focuses on Future Computing.

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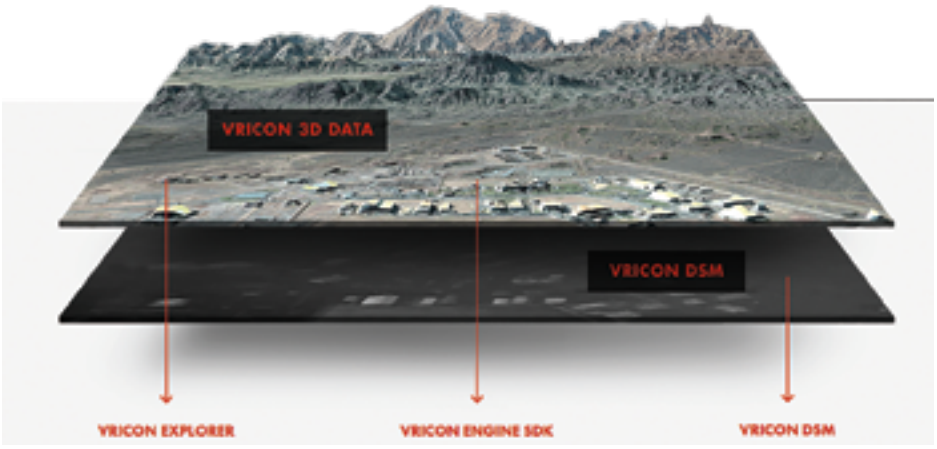

Defense and security company Saab and DigitalGlobe, Inc. have created a joint venture—Vricon, Inc.—to produce photo-realistic 3D products and digital elevation models globally for enterprise and government geospatial markets with unmatched coverage and delivery timelines.

Vricon combines Saab's unique 3D technology and know-how with DigitalGlobe's unrivaled archive, which contains billions of square kilometers of the world's highest quality commercial satellite imagery.

Together, the Vricon joint venture will establish high scale production capabilities that will make highly accurate photo-realistic 3D products and elevation data of the Earth, accessible via its unique visualization platform and standard based data formats.

Vricon serves the entire professional geospatial market, with an initial focus on defense, security, and infrastructure.

Vricon's technology enables imagery content to accurately represent all visible objects on the Earth in 3D, and its products provide customers with unmatched value and utility, superior coverage relative to aerial-derived elevation models, and superior fidelity and availability relative to other satellite-derived models.

DigitalGlobe and Saab will combine their strengths to both support and own Vricon. Under the agreement, Vricon will be headquartered in Reston, Virginia, with ownership set up as 50 percent DigitalGlobe and 50 percent Saab.

"Our customers will benefit from global access to geospatial data of unprecedented quality. It is a win-win situation with long-term value creation for both parent companies, which will give us a market position ahead of competition," said Magnus Brege, CEO at Vricon.

"By combining DigitalGlobe's unrivaled imagery archive with Saab's leading edge technology, we will deliver the globe in 3D at a scale never before possible," said Jeffrey R. Tarr, DigitalGlobe President and Chief Executive Officer. "By delivering this breakthrough product to our customers, this collaboration will drive growth and shareowner value creation."

"The establishment of Vricon is another great example of Saab's ability to leverage innovation and transform it into business value," said Dan Jangblad, Head of Saab business area Industrial Products and Services. "Together with DigitalGlobe, we are taking our revolutionary new 3D technology and applying it to benefit our global customer base. At the same time, we also take another step forward on our long-term path for growth in the United States."

www.vricon.com/
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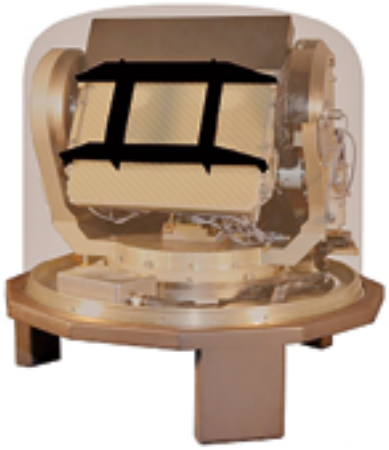
CPI OFFERS NEW COTM UNITS



Communications & Power Industries (CPI) in Camarillo, California, has rolled-out their GMA-100QB antenna system to link military ground vehicles with unmanned aircraft.

The GMA-100QB Communications-On-The-Move antenna (COTM) provides On-The-Move (OTM), Line Of Sight (LOS) bi-directional communications capability to link military vehicles to unmanned aerial systems (UAS) in L-, S-, C-, and Ku-bands.

Capable of Churchville B OTM performance, the GMA-100QB is equipped with high performance motors and drives on both axes to handle high dynamic loads.

The antenna is stabilized by internal AHRS, allowing independence from vehicle data. The receiver with built in received signal strength indicator (RSSI) enables the antenna to scan the sky rapidly for available signals and point to the desired airborne asset, eliminating the delay of external modem decoding of the signal. Embedded amplifiers on transmit/receive at all bands allow a full communications system with only the addition of external DC power and a modem.

The GMA-100QB includes a compact multiband high gain directional antenna array, enabling long range LOS datalinks, and a broadband omnidirectional antenna for close-in/overhead communications. Frequency band and antenna selection is electronically commanded.

www.cpii.com/

DISPATCHES

GENERAL DYNAMICS MOVING AHEAD WITH WIN-T

The U.S. Army received approval to move forward with full rate production of the Warfighter Information Network – Tactical (WIN-T) Increment 2 system.

Designed and built by General Dynamics, WIN-T Increment 2 provides commanders and soldiers with an unprecedented ability to communicate, share information and intelligence while on patrol, with connectivity rivaling that found in a stationary command post.

The action follows an Acquisition Decision Memorandum (ADM) issued by the office of the U.S. Undersecretary of Defense for Acquisition, Technology and Logistics. The ADM authorizes the Army to proceed to full rate production and fielding of its mobile tactical communications backbone network to all remaining Army units projected to receive the WIN-T Increment 2 system through 2028.

"This is an important milestone and we'll continue to support the Army as it fields this vital mission command and communications system throughout its global force," said Chris Marzilli, president of General Dynamics Mission Systems.

WIN-T Increment 2 is integrated into Mine Resistant Ambush Protected (MRAP), High Mobility Multi-purpose Wheeled Vehicles (HMMWV) and Stryker vehicles. To date, four division headquarters and 12 brigade combat teams have WIN-T Increment 2.

The system successfully served Army units supporting the Security Force Assistance Brigades in Afghanistan by replacing the fixed communications infrastructure dismantled when the U.S. military closed its operating bases.

Last summer, WIN-T provided the 'communications grid' for humanitarian operations responding to the Ebola epidemic in West Africa.

Production of the WIN-T system occurs primarily at General Dynamics' facility in Taunton, Massachusetts, and supports hundreds of jobs at General Dynamics and supplier locations nationwide.

More information about WIN-T, tactical radios, satellite communications and the cyber-defense products that make up the Soldier's Network is available at ***www.thesoldiersnetwork.com***.

YOUR VIGILANCE IS SHOWING @ HAWAII NATIONAL GUARD MAKANI PAHILI 2015 EXERCISE

Among the many agencies that represent the brick and mortar that support command during the Exercise Vigilant Guard/Makani Pahili 2015 in Hawaii, the 199th Weather Flight represents a keystone that provides critical weather forecasts to decision makers.

Vigilant Guard is a United States Northern Command and National Guard Bureau sponsored exercise program. Exercises are held in a different state each year test the homeland response. Makani Pahili is Hawaii's yearly statewide hurricane preparedness exercise is being held in conjunction with Vigilant Guard.

The Hawaii Air National Guard 199th Weather Flight's primary mission is to provide weather forecasts for the Hawaii Army National Guard's 29th Infantry Brigade Combat Team.

Represented by Hawaii Air National Guard, Maj. Dana Uehara, the weather flight "predicts weather conditions at a point in time that will determine when command will launch recovery and relief efforts. They will plan the mission based on the information the weather flight provides."

Uehara is a staff weather officer for the weather flight as a traditional guardsman and also serves as a civilian satellite analyst for the 17th Operations Weather Squadron on the active duty side. Before the Guard, Uehara had served 10 years of active duty as a weather analyst in Travis Air Force Base, Korea, U.S. Army, Pacific (USARPAC) and finally the Air Force Weather Agency in Offutt Air Force Base, Nebraska.

The observations generated by Uehara are derived from Terminal Aerodrome Forecast (TAF) reports released by the National Weather Service and the Central Pacific Hurricane Center. Uehara decodes the TAF data and extracts wind speed and direction, temperature, and weather elements such as showers, thunderstorms and lightning.

Maj. Dana Uehara, 199th Weather Flight, Hawaii Air National Guard, discusses weather forecasts with leadership during exercise Vigilant Guard/Makani Pahili 2015 at the Joint Task Force 5-0 command center in the Hawaii National Guard (HING) Diamond Head Headquarters, Hawaii, June 2, 2015.

Uehara interprets Terminal Aerodrome Forecasts (TAFs) released by the National Weather Service and the Central Pacific Hurricane Center to produce his assessment.

(U.S. Air National Guard photo by Airman 1st Class Robert Cabuco)

These factors are used to determine when to begin relief efforts, send out surveillance teams to assess damage, and release air reconnaissance and recovery teams.

Aviators specifically request visibility conditions, cloud heights and ceilings to assist in determining flight plans. Uehara reports the storm's current position and path, determines impacted areas, and the strength of tropical storm force winds.

Last year, Uehara was activated for the state active duty in response to the real-world threat of Hurricane Anna. He set up shop at the Joint Operations Center (JOC) and put to use what he is now practicing in the Exercise Vigilant Guard/Makani Pahili 2015.

From left: Capt. Michael Kennedy, Maj. Aaron Blanchard and 2nd Lt. Aaron Hew Len of the 93rd Civil Support Team discuss operational procedures for a simulated chemical spill during Vigilant Guard/Makani Pahili 2015 at Honolulu Harbor Pier 29 June 4 in Honolulu.

Vigilant Guard/Makani Pahili 2015 is a United States Northern Command and National Guard Bureau sponsored exercise program that provides the State of Hawaii and the Hawaii National Guard an opportunity to improve collaborative efforts during domestic emergencies and catastrophic events. (U.S. Army National Guard photo by Staff Sgt. Ryan Sheldon)

There are many challenges when interpreting the various models produced by the data. "Each forecast begins with an analysis of the hurricane's current location and intensity. If the models give different results, the forecaster has to decide which one to use for the official forecast or compute a median result," says Uehara.

The JTF 5-0 gathers information from many agencies to make decisions during catastrophic events. The 199th Weather Flight provides critical input that will guide leadership's decisions and keep everyone safe through the storm.

Story by Airman 1st Class Robert Cabuco, 154th Wing Public Affairs, U.S. Air Force

DISPATCHES

NAL RESEARCH + NAVAL SURFACE WARFARE CENTER

NAL Research Inc., Manassas, Virginia, is being awarded an $8,840,563 cost-plus-fixed-fee contract to support integrating existing, new or modified Iridium devices and Iridium network capabilities such as global data broadcast.

This Iridium support also includes training and documentation on the use of these sensors and the dissemination of data to the user.

Naval Surface Warfare Center, Dahlgren Division (NSWCDD) provides various government agencies and activities with persistent intelligence, surveillance, and reconnaissance (ISR) capabilities.

The persistence in detecting, identifying, and characterizing changes in a target's status anywhere and anytime requires a new set of devices.

The persistent ISR capability provided by this acquisition will provides NSWCDD with the ability to provide new tagging, tracking and locating devices and surveillance capabilities of the Iridium network capable of continued observational access to multiple targets operating in their area of responsibility.

Work will be performed in Manassas, Virginia, and is expected to be completed by May 2020. Fiscal 2015 research, development, test and evaluation funding in the amount of $100,000 will be obligated at the time of award and will not expire at the end of the current fiscal year.

This contract was not competitively procured in accordance with FAR 6.302-1 and DFARS 206.302-1 - full-and-open competition need not be provided for when the contractor is the sole responsible source that is able to satisfy agency requirements. The Naval Surface Warfare Center, Dahlgren Division, Dahlgren, Virginia, is the contracting activity (N00178-15-D-2013).

www.nalresearch.com/index.html
www.navsea.navy.mil/nswc/default.aspx

GEOINT TEAM @ HANSCOM AFB HOSTS TECHNICAL EXCHANGE EVENT

Hanscom Air Force Base' Geospatial Intelligence, or GEOINT, team hosted a Technical Exchange Meeting June 17 at the Conference Center and discussed initiatives and new technologies in the area, along with how the team can assist Air Force Life Cycle Management Center program offices.

As the National Geospatial-Intelligence Agency defines it, GEOINT is "intelligence about the human activity on Earth derived from the exploitation and analysis of imagery and geospatial information and data that describes, assesses and visually depicts physical features and geographically referenced activities on the Earth."

"GEOINT answers the main question of 'where?'" said Jay Vaughn, team lead. "Where you are, where others are located."

Many of Hanscom's programs use or depend on GEOINT data, and not only ones within the intelligence, surveillance and reconnaissance portfolios that immediately come to mind.

"Often personnel don't realize that they are using GEOINT," said Master Sgt. Elisabeth Wells, geospatial analyst. "For example, programs that use coordinates and maps are using GEOINT."

Programs from command and control to foreign military sales and cyber all have potential GEOINT requirements. The team here can provide guidance on maturing Acquisition Intelligence requirements for those programs to achieve required milestone documentation and identify any program deficiencies early within the acquisition life cycle.

Vaughn explained that as organizations, including NGA, are looking to increase efficiencies, update products and provide effective services, Hanscom programs will need to keep pace with those agency changes and technology.

Using GPS as an example, he said if the company you bought your GPS from decided not to update its maps anymore, you could easily find yourself lost. He doesn't want that to happen to LCMC programs.

"In this environment, it's more important than ever before to ensure you're knowledgeable about the GEOINT requirements within your programs, and the INH team here can be the conduit," Vaughn said.

This is the main reason they hosted the GEOINT day. Topics included an ISIS Operations Update, the World Magnetic Model, Immersive GEOINT and Analytics and the GEOINT and Targeting Demonstration, Innovation, Collaboration and Engagement Laboratory (GT-DICE Lab).

John Burkert, chief for Targeting and GEOINT Capabilities for the Air Force, provided a presentation on the current state of AF GEOINT.

In addition to Hanscom and NGA participants, representatives from the MITRE Corp., MIT Lincoln Laboratory and academia, including Harvard and Boston University, are scheduled to attend. VTC connections have also been made available for other LCMC bases to tie into the GEOINT TEM presentations.

"We want to ensure the topics address how GEOINT affects programs, what programs need and how to get involved," said Tech Sgt. Justin Calvaruzo, geospatial analyst.

A unique tool that the team here offers is the GT-DICE Lab. Located in the Hanscom Collaboration and Innovation Center, or HCIC, with a secondary location for higher classification projects, it provides access for collaboration, engagement and development among acquisition programs with GEOINT and NGA-supported capabilities or processes. Current systems are: GEOINT Product Library, a GEOINT ESRI machine, a Targeting Analyst Workstation and a Common Geopositioning System.

"We want this effort to be an engineering sandbox where various program offices can collaborate on, utilize and leverage GEOINT needs, ultimately gaining efficiencies," said A.J. Bonoldi, Acquisition Intelligence Division deputy.

Hanscom is also only one of two locations within Air Force Materiel Command where an NGA liaison is located who can assist in advocating for stronger GEOINT planning, programming and integration.

For program personnel who might not know where to begin, the GEOINT team can provide Intelligence Sensitivity Surveys to see if a program produces, consumes, processes or influences intelligence information. From there, the team can provide deep dives as to what extent a program is GEOINT-dependent and what data, products and services the program requires.

"We are hosting this day and offer these services to ensure the Hanscom and LCMC community is aware of GEOINT requirements," said Bonoldi. "We want them to be informed about GEOINT early in the acquisition process so we can help them identify program requirements and develop a sustainable roadmap for program development and sustainment."

X-BAND SATELLITE PROVISIONING FOR NORWEGIAN FORCES BY AIRBUS DEFENCE & SPACE

Airbus Defence and Space has signed a four-year framework agreement with the Norwegian Defence Logistic Organisation (NDLO) for the provision of X-band satellite capacity and has committed to deliver up to 30Mhz of capacity annually on the Skynet military satellite constellation.

Skynet will augment the Norwegian forces' existing secure communications in maritime, land and aeronautical applications across Northern Europe, the Arctic and for Allied nations missions globally.

Under the Skynet PFI (Private Finance Initiative) contract, Airbus Defence and Space owns and operates the hardened Skynet 5 X-band satellite constellation and the ground network to provide all Beyond Line of Sight (BLOS) communications to UK Ministry of Defence.

The contract also enables other NATO and Allied governments to use Skynet to augment their existing services and to benefit from the unique Skynet performance attributes, especially when associated with small and disadvantaged terminals, ensuring reliable communications even on the edge of cover.

Airbus Defence and Space's ability to deliver secure, high bandwidth X-band capacity for defence customers meets all requirements presented by the NDLO based on its current national and international needs in addition to its future scope.

Anders Øygarden, Head of Sales GC Nordic at Airbus Defence and Space, said, "All divisions within Norwegian Defence, located both in Norway and in international theaters, will now have the opportunity to procure the most powerful satellite capacity available in the market today via the Skynet X-band satellite constellation. The solution is specifically designed for the Norwegian Defence operational requirements."

UAV COMMUNICATIONS: MEETING MISSION REQUIREMENTS

By Karl Fuchs, Senior Contributor + Vice President of Technology, iDirect Government

Unlike other aircraft, Unmanned Aerial Vehicles (UAVs) owe their entire existence to communications.

While it is certainly true that almost all aircraft have some form of communications capability, excluding a class of extremely sophisticated, completely autonomous vehicles, a UAV cannot operate—let alone perform—a useful mission without communications.

There are essentially two broad methods for enabling communications with a UAV. These include Line-Of-Sight (LOS) and Beyond-Line-Of-Sight (BOLS). With LOS, as the name implies, there should be no obstructions or physical blockages between the UAV and the ground station.

Enabling either of these UAV modes of communications can pose quite a challenge for a number of reasons. For both LOS and BOLS UAV modes, the physical size and power consumption of the communications package is of paramount importance.

A number of new field-programmable gate array (FPGA) and processor technologies have enabled substantial power reductions in satellite modems. Most notably, System-on-a-Chip (SoC) FPGA architectures in which the processor is embedded in the FPGA eliminate the need for a separate central processing unit (CPU). The integration of the CPU and FPGA greatly reduces power consumption and footprint and increases processing power.

Another consideration for UAV communications systems is the physical environment. In almost all cases, UAVs are unpressurized, with an operating ceiling in excess of 55,000 feet. This unpressurized environment makes heat dissipation quite problematic for Commercial-Off-The-Shelf (COTS) communications equipment. Furthermore, many COTS electronic components, including capacitors, are not designed to operate at low atmospheric pressures and can rupture. As such, purpose built transmission solutions are required.

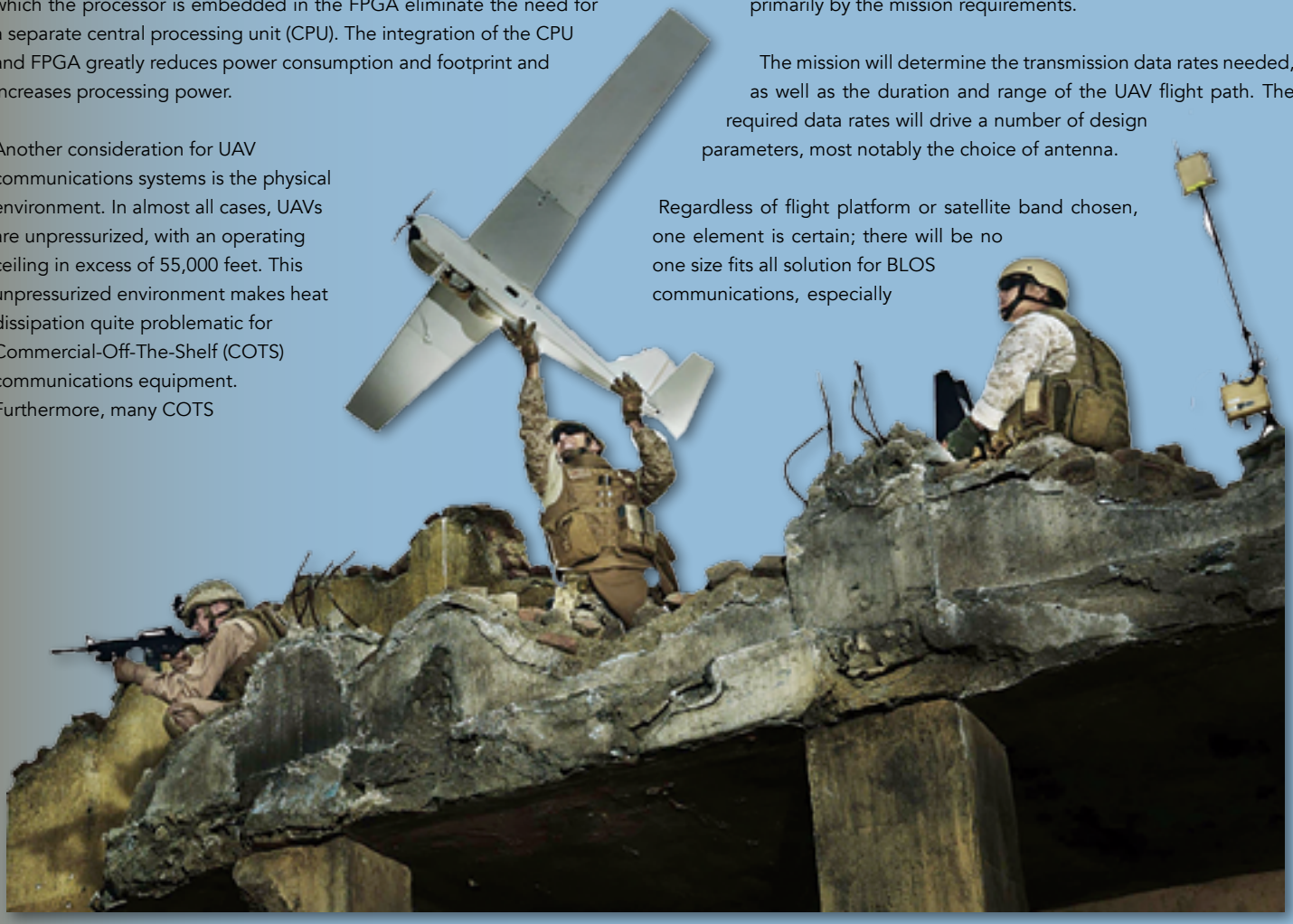
The LOS mode of communications has a number of advantages, with the greatest being the very high transmission rates which can be achieved using limited power and leveraging relatively compact antennas and low wattage transmitters. The obvious disadvantages of LOS communications include the constraints on the location of the receiving terminal and the accompanying limitation on the range of the UAV.

The most problematic of these is the location of the receiving terminal. With LOS communications, the receiving terminal must be in the same operating area as the UAV, which is often hostile. When the constraints of LOS communications do not meet the mission requirements, UAV operators must rely on BLOS.

There are a number of important decisions to be made when enabling a UAV for BLOS communications. These decisions will be driven primarily by the mission requirements.

The mission will determine the transmission data rates needed, as well as the duration and range of the UAV flight path. The required data rates will drive a number of design parameters, most notably the choice of antenna.

Regardless of flight platform or satellite band chosen, one element is certain; there will be no one size fits all solution for BLOS communications, especially



when an antenna selection must be made. As such, it is paramount that antenna and modem manufacturers leverage industry standards such as OpenAMIP or supply a protocol translator enabling a best of breed antenna solution.

As mentioned above, very high data rates can be achieved with little power, straightforward waveforms and relatively small antennas in LOS communications. The problem is much more complex if the mission requires BLOS.

BLOS communications require bouncing a signal off a relay—*e.g.*, a geosynchronous satellite or a radio reflector such as the troposphere. The most reliable and most frequently used for communications is the geosynchronous satellite. However, transmitting a broadband signal to a geosynchronous satellite using the ultra-small antennas found on UAVs offers a number of challenges.

The first is the simple link budget challenge. Ultra-small antennas limit the maximum return channel capacity that can be realized from a UAV. In addition, ultra-small antennas can lead to a phenomenon known as Adjacent Satellite Interference (ASI).

ASI can occur because the focus of these small antennas is not as sharp as larger antennas and this results in a greater amount of energy being dispersed over a wider area. This is especially true in the case when a commercial satellite band is used, particularly Ku-band whose orbits are separated by only two degrees.

The solution to this ASI problem is a waveform technology known as spread spectrum. Spread spectrum, as the name implies, spreads the waveform out, thus lowering the power density so the adjacent satellite interference is minimized. Unfortunately, spread spectrum is a rather inefficient use of bandwidth. If possible, leveraging X- or Ka-band will allow the use of ultra-small antennas without the need for spread spectrum, as satellites in these bands tend to be spaced further apart.

The advent of new, High Throughput Satellites (HTS) will fundamentally change the complexion of BLOS for UAVs. The worldwide coverage of HTS constellations will enable truly global missions.

The spot-beam architecture of HTS translates to greater power and more uniform beam contours, which will allow higher transmission rates from smaller antennas. These satellite transmission power improvements will enable BLOS communications on a whole new class of catapult or even hand-launched UAVs.

Without a doubt, UAVs have become the fastest-growing market segment in the satellite industry. It has taken advancements in a number of adjacent industries to enable this very unique and challenging market segment.

Karl Fuchs is vice president of technology for iDirect Government; ***kfuchs@idirectgov.com****.*

Editor's note*: The image at the start of this article is courtesy of AeroVironment and pictures the company's Puma AE (All Environment) UAS.*

THE CONVERGENCE OF DOD + COMMERCIAL PROTECTED COMMS APPLICATIONS

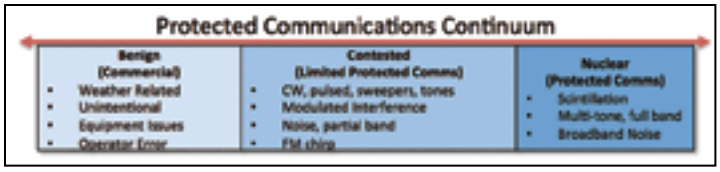
By Steve Williams, Business Area Manager of Signals Instrumentation and Chris Badgett, Business Area Manager, Mission Data Processing—RT Logic, a Kratos Company

Over the past several years, DoD and commercial protected communications technologies have been converging.

Protected communications is a general term used to represent actions taken beyond the normal SATCOM transmission to reliably transmit and receive signals. Protected SATCOM goes beyond typical approaches related to increasing the overall link budget.

For DoD, Protected MILSATCOM is often implemented by an extremely high frequency service for strategic and tactical purposes. Strategically, protected MILSATCOM must provide low probability of interception/detection/exploitation (LPI/LPD/LPE), survivable, anti-scintillation and anti-jam communications, as well as command and control services in all operational environments: nuclear, contested and benign. Tactically, protected MILSATCOM must be able to provide anti-jam and LPI/LPD/LPE communications in both contested and benign operational environments. Commercially, protected communications attempts to minimize interference in the benign environment.

Although space based solutions exist, from the perspective of a ground system provider, protected communication solutions traditionally include increasing the resilience of the waveform or taking action to minimize interference. This is a large solution space; however, we will limit this article to actions taken in the RF or waveform domain.



What is driving the need for protected communications? There are several performance-impacting risks to SATCOM links.

The first risk to existing communications systems is from interference (intentional or unintentional) impacting user availability and thus revenue.

Second are risks to satellite communications as spectrum demand increases, which will put pressure on existing systems.

Third, technology has been slow to develop/embrace/embed new communications and protection techniques, leaving many systems vulnerable to interference.

These risks fall across a wide continuum of difficultly from a benign environment to a highly degraded one as in a nuclear scintillated condition.

Against these risks, various approaches can mitigate risks to user communications. The mitigation steps fall into the general categories of: a) sense, b) learn and adapt, c) protect and harden, and d) fight through.

To "Sense" a threat, users need to quickly know when something is wrong and when communications are being degraded or interrupted. In this regard, automatic signal monitoring is a desired approach and should go beyond simple spectrum analyzer mask analysis of bandwidth, center frequency and power level. In-depth and real-time threat sensing capabilities must include blind determination of interference modulation type, data rate, coding scheme, modulation error ratio (MER), error vector magnitude (EVM) and bit error rate (BER) to assist in attribution and eventual mitigation.

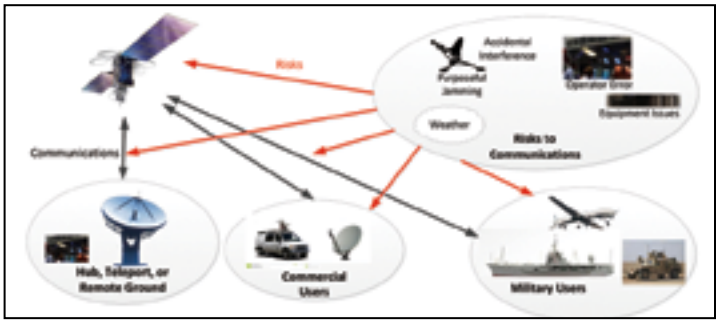


Figure 1. Protected Communication has been converging between DoD and commercial applications.

"Learn and Adapt" tools should provide data trending, analysis and the ability to understand what interference and risk is occurring in the environment over time. Effective data logging and monitoring should store historical, time-tagged measurement data for future trend analysis.

Such a repository is useful for predicting equipment failures, communications outages, and impending electronic attack preceded by detectable signal trends. Historical data can also be exploited to differentiate equipment problems from operator error, and between accidental or intentional interference.

When received or transmitted signals do not match parametric expectations, or are determined to be affected by interference, automatic alerts and data logging must take place. This assures that already time-crunched operators are not relegated to constant vigil or control over the monitoring system.

This type of signal sorting and logging can occur on a single SATCOM link, for a teleport, across an enterprise or even a battle group. Consolidating information at the enterprise level allows users and operators a Spectral Common Operational Picture (SCOP) of the threat environment.

To "Protect and Harden," the next line of protection is to provide solutions that protect against the threats. A protection alternative is geolocating and identifying sources of interference due to equipment failure, operator error, intentional jamming, or unauthorized users.

Signal Geolocation systems pinpoint the Earth location of the disrupting signal. Once a physical location estimate of the transmitter is available, an assessment of friendly (accidental) or hostile (intentional) interference can

proceed. Assisting in this determination, geolocation data can be combined with other location-specific intelligence.

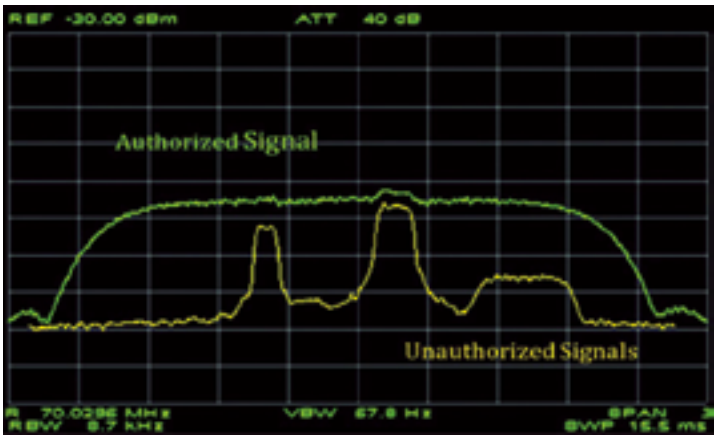


Figure 2. Monitoring and Detection enables you to know when your RF Link is experiencing interference, whether accidental or deliberate.

The fastest and most accurate geolocation systems today receive SATCOM signals via two Earth-Satellite-Earth paths. They typically look at two signals during a geolocation—the interfering signal and a reference signal from a known location, as shown in ***Figure 3*** on the next page.

The last method for protection is to "Fight Through" which is to provide solutions that fight through threats using advanced signal processing. One example is to add more robustness at the waveform level to enhance LPI/LPD/LPE. Frequency Hopping and Direct Sequence Spread Spectrum (DSSS) are typical methods to help counter interference and jamming.

The Protected Tactical Waveform (PTW) is a new approach that uses frequency-hopping spread spectrum (FHSS) to provide greater anti-jamming capability and aims to combine features of the current MILSATCOM protected waveform and the commercial waveforms such as Digital Video Broadcast (DVB.) This hybrid strategy tries to obtain a balance between protection and affordability.

TEST + TRAINING CAPABILITIES

As with any material solution, test and simulation is an important element of each of the four protection mitigation steps (sensing, learn and adapt, protect and harden, and fight through).

Channel Simulators, Transponder Simulators and Satellite Signal Emulators are extremely valuable during the development and test of link-protecting modems, receivers, transmitters and waveforms. These advanced instruments can generate nominal and worst-case SATCOM test signals within a controlled and secure lab environment. Engineers can then design and tune their firmware, software and hardware for unimpeded communications even under degraded and highly contested signal conditions.

In the laboratory, Channel Simulators and Transponder Simulators create physics-compliant signals indistinguishable from their real world counterparts. These signals include propagation effects modeling, interference injection,

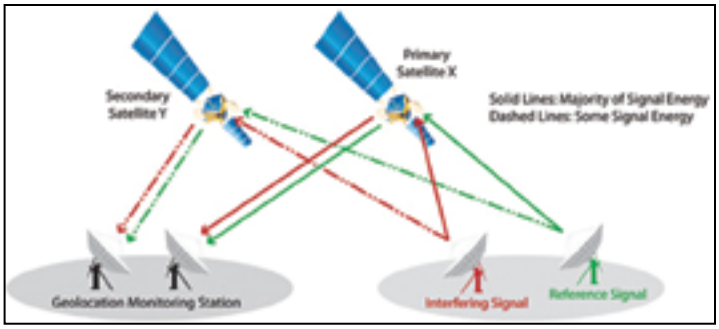


Figure 3: Geolocation systems today use a two-path solution to find interfering signals.

motion-related Doppler shift, atmospheric and multipath fading, path delay, and atmospheric noise profiles. Furthermore, these systems can simulate spacecraft equipment effects, duplicating amplitude and phase response and introducing linear and non-linear signal distortions.

High fidelity Satellite Signal Emulators accurately represent complex uplink and downlink signals, and are valuable tools for system developers, testers and trainers. These instruments fully emulate complex communications systems found on the emerging generation of channelized, multi-beamed satellites, such as the Wideband Global SATCOM (WGS) constellation.

By enabling deeper, repeatable, continuous training strategies these solutions allow operators to understand exactly how their equipment will perform under challenging signal conditions, giving them valuable experience to hasten recognition of signal issues, differentiate causes, and restore link performance and function.

INTEGRATED SOLUTIONS

An integrated system combines the primary protected SATCOM waveform with augmentation of spectral monitoring and geolocation, and built-in training. An integrated solution is unique and aligns to future capability that use modems as sensors in a spectrally aware manner as depicted in ***Figure 4,*** below. This provides the best of both worlds for protection.

With a spectral aware modem, cognitive radio (CR) capabilities can be furthered perused. CR has applications in commercial Ka-band High Throughput Satellite (HTS). Cognitive approaches offer new ideas to increase spectrum utilization. Ongoing research looks at CR applications to service future high density fixed satellite services while trying to minimize interference to existing users[1].

Protected Communication has a wide aperture of material solutions that leverage capabilities from both Defense and Commercial applications. SATCOM links are vital infrastructure elements in commercial, as well as military command and control (C2) and data transport applications. Due to their mission-critical nature, the function and performance of these links must be protected with great attention, constancy and attention to detail.

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Chris Badgett is the Business Area Manager of Mission Data Processing at RT Logic and may be reached at cbadgett@rtlogic.com.

References

[1] *Cognitive Spectrum Utilization in Ka-Band Multibeam Satellite Communications, IEEE Mar15*

About the companies...

Assuring Satellite Performance...From the Ground Up

RT Logic, a Kratos Company, is the leading supplier of ground-based equipment for space/ground communications. Ninety percent of America's space missions use Kratos and RT Logic products during their test, launch, or on-orbit phase. RT Logic products test spacecraft communication subsystems at every major U.S. satellite factory, and support space-lift operations at the national launch ranges. These systems form the backbone of the majority of the nation's operational satellite Telemetry, Tracking and Command Systems (TT&C) ground networks and downlink critical high rate remote sensing mission data from LEO, HEO, and GEO satellites.

Kratos' RT Logic specializes in developing COTS and tailored products for monitoring, detecting, characterizing and mitigating RF interference and other challenges to protected communications. RT Logic's line of test equipment also includes channel simulators, signal emulators, UAV, target and missile testers, as well as range test systems. These systems enable comprehensive test and training activities without actual flights of assets through real-time, hardware-in-the-loop emulation of propagation effects, rather than computer-based, off-line simulation.

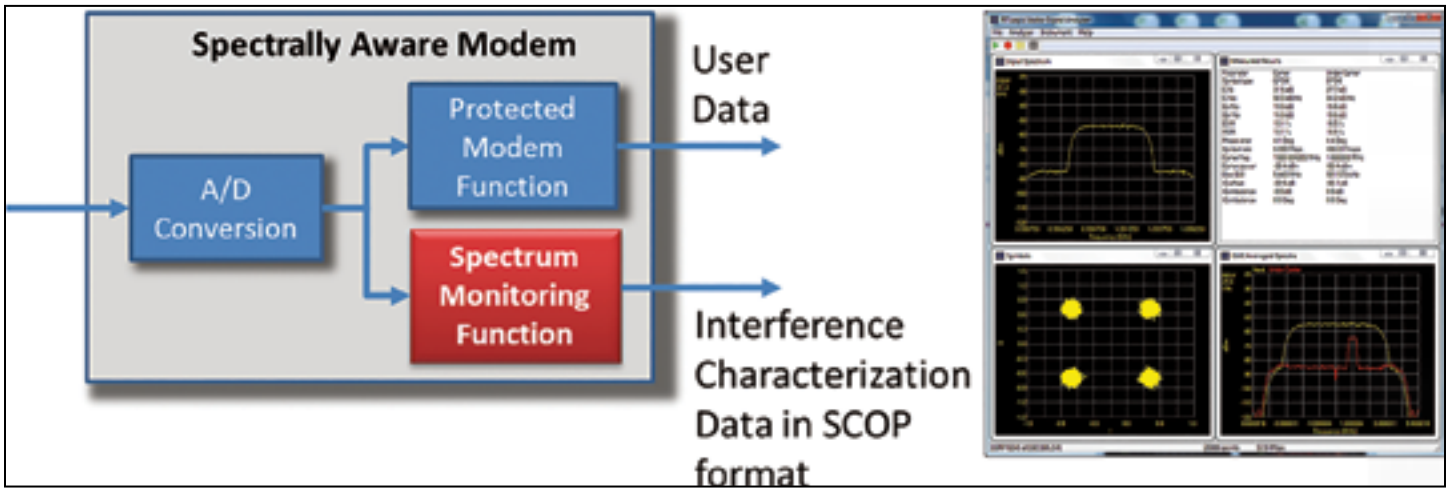


Figure 4. An Integrated Solution offers waveform protection and spectral monitoring.

EN ROUTE: A KEY DIFFERENTIATOR FOR COTM TERMINALS

By John Logan, Program Director, EM Solutions

Just as today's mobile phone user expects to roam across different countries and networks with a common handset, so, too, does the modern Defense Force user demand true broadband services across a range of different satellite options—without having to use multiple SATCOM terminals or experience an outage while swapping different RF kits.

EM Solutions has such an On-The-Move (OTM) , maritime, tri-band terminal currently under development. This new terminal will allow seamless access to SATCOM services over a range of satellites and will also counter troubling effects, such as geographical location or rain fade.

Although one or two simultaneous Comms-On-The-Move (COTM) terminals in X- and Ka-band already exist in the market place, the new EM Solutions product offers some key differences.

Ka-band OTM operation on the WGS satellite constellation imposes stringent constraints on pointing-error control. These constraints are due to a combination of regulatory, antenna pattern and link-budget considerations that are required to efficiently use the available bandwidth on these satellites.

For example, during transmission, it is important that the beam is pointed directly at the desired satellite, rather than off-center, where it may leak to another satellite or reduce the desired signal level below its detectable threshold. While the actual pointing-error requirement for a Satellite-On-The-Move (SOTM) terminal will depend on a number of parameters, such is likely to be on the order of a few tenths of a degree.

This degree of pointing accuracy is quite difficult to achieve with an open-loop tracking system that relies solely on inertial measurement systems to steer the antenna. Furthermore, inertial measurement systems rely on GPS measurements made at a frequency that cannot account for beam refraction through the radome.

This means that such systems are susceptible to radome variations and large offset errors that depend on the angle of incidence and the RF frequency of the measurement signal. EM Solutions has adopted a closed-loop tracking system that directly measures the pointing-error using the satellite signal itself for all three bands of the Tri-band terminal.

SIMULTANEOUS X-/KA-BANDS

The EM Solutions Tri-band terminal offers three bands: military X-band, military Ka-band and commercial Ka-band. The same feed and antenna supports all three bands without the need to swap any RF equipment. The Ka-band Diamond Series BUC also allows the user to select which bands inside the 3GHz spectrum—from 28GHz to 31GHz—are to be electronically switched.

EM Solutions Diamond Series Model 360 Ka-Multiband nanoBUC™.

Simultaneous X- and military Ka- operation can occur on military satellites, such as WGS or Optus C1. However, the terminal also supports simultaneous operation on X-band and commercial Ka-band, if a satellite that supports these two bands is available, as shown in ***Figure 1***.

Polarization switching between LHCP and RHCP is handled by electronically switching the Tx and Rx for both bands.

If the terminal experiences congestion, rain fade, or unfavorable atmospherics on the Ka-band military payload, the terminal will continue to use the X-band payload, as shown in ***Figure 2*** on the next page.

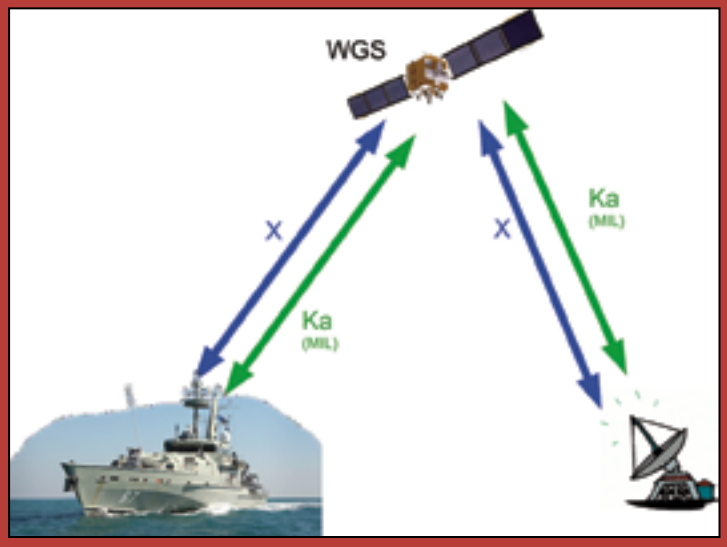


Figure 1. The terminal allows simultaneous X- and Ka- communications on WGS.

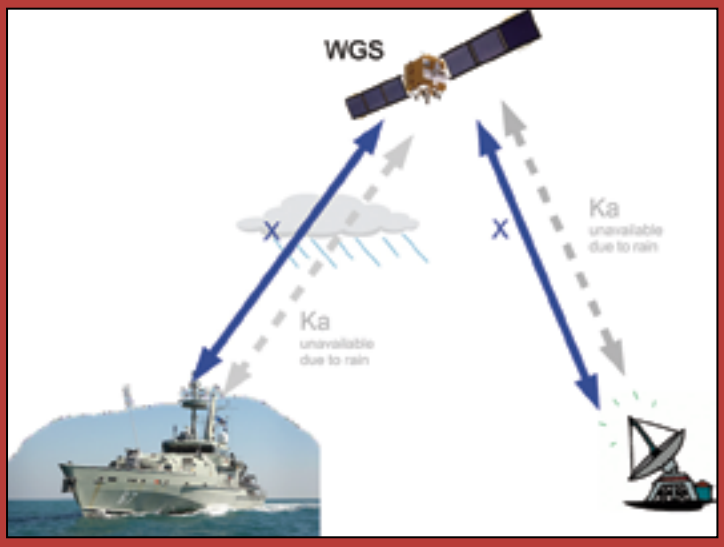


Figure 2. X-band operation can continue during Ka- outages due to weather. Below deck equipment provides detection of Ka- outage and traffic prioritization and routing.

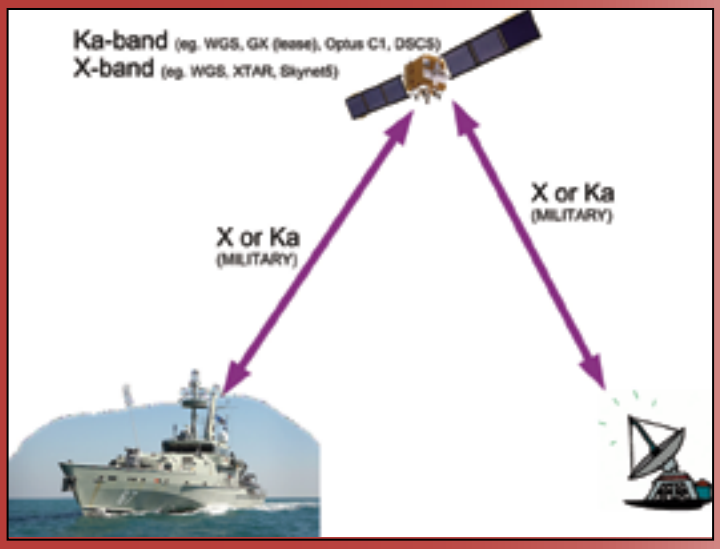


Figure 3. Operation on a single military X- or Ka-band.

The Tri-band terminal will automatically close-loop track the satellite beacon with either the X- or Ka-band RF receiver, depending on the beacon strength.

MONOPULSE TRACKING ON BOTH X- + KA-BAND

The Tri-band terminal feed design supports X-band and both military and commercial Ka-bands and also uses monopulse tracking in both X-band and Ka-band. This is a complicated achievement, as the Ka-band horn must be placed inside the X-band horn without affecting the performance of one interacting with the other.

This means that the Tri-band terminal can operate in Ka-band (commercial or military) mode only and track a Ka-band only satellite, and similarly, operate in X-band mode only and track an X-band only satellite. The X-band and Ka-band tracking are independent of each other.

The monopulse tracking in both bands reduces the power consumption of the terminal, as there is no need to mechanically scan the antenna to perform conical scans or step track pointing, and also increases tracking performance.

When tracking a satellite with both X- and Ka-band transponders, the terminal can switch tracking between the X- and Ka- beacons without introducing significant pointing errors. This allows the terminal to switch from X- to Ka- tracking at the end of a Ka- outage (e.g. due to weather) without disturbing X-band communications.

The Ka-band tracking is expected to give the best tracking performance in clear sky conditions. However, the terminal will continuously monitor the signal quality of both X- and Ka- beacons and will automatically use the band that provides the optimal pointing performance.

The terminal can track common satellite beacons such as CW signals and lightly modulated telemetry signals that have a prominent CW component (*e.g.*, WGS beacons). Also possible is the ability to track data carriers (*e.g.*, DVB-S2, QPSK) with the antenna control unit's (ACU's) signal processing capability.

The Tri-band terminal has three main tracking modes:

- *Search*
- *Track*
- *Gyro hold*

Search Mode

In search mode, the terminal scans a region of the sky looking for a satellite beacon to use for tracking. Search is an open loop pointing mode. The terminal combines information from the GPS location and AHRS (Attitude and Heading Reference System) with knowledge of the satellite's longitude to determine where to point the antenna with respect to the vessel.

With this information, the terminal calculates the pointing direction, relative to the vessel, at which the satellite should be found. A small patch of sky is then scanned around this pointing direction. At all times, the Tx is inhibited when the terminal is in search mode. Once the satellite beacon is located, the terminal switches to tracking mode.

Track Mode

In track mode, the terminal uses monopulse to estimate the current pointing error, which is used to steer the antenna back toward the actual satellite position. "Track" is a closed-loop tracking mode. The Tx is not inhibited when the terminal is in track mode and the estimated pointing error falls within the regulatory and user configured thresholds. The monopulse tracking approach uses a signal from the satellite, normally the beacon. If the beacon is suddenly lost (*e.g.*, due to an obstruction), the terminal will enter gyro hold mode.

Gyro Hold Mode

In gyro hold mode, the terminal uses feedback from embedded gyros to keep the antenna pointed toward the satellite. This enables faster reacquisition once the obstruction has been cleared and the satellite beacon is detected again.

After being in gyro hold for a certain length of time, the BUCs are automatically muted to prevent interference with other satellites due to accumulated pointing error caused by gyro drift. If the satellite beacon is successfully found, the terminal will return almost instantly to track mode. If the satellite beacon is not found within a certain period, the terminal will return to search mode.

THREE AXIS BALANCED TERMINAL

One of the most important features of the EM Solutions Tri-band terminal is the use of a third axis, which is referred to as cross-elevation (this is in addition to the traditional elevation and azimuth axes). The concept of "letting the antenna remain still" has been used throughout the design of the system and this can be seen by the use of contactless, low friction, direct drive motors rather than having gearboxes or drive belts.

Having this balanced axis is important as the antenna's inertia keeps the antenna still, despite motion of the vehicle underneath it. Thus, the antenna naturally tends to maintain pointing even while on a moving vehicle.

This is not the case for a two-axis (azimuth over elevation) system. Two-axis systems have difficulty tracking satellites directly above the antenna (*i.e.*, perpendicular to the base of the antenna). This problem is often called the "key-hole effect".

The keyhole effect requires two-axis terminals to rotate rapidly in azimuth when tracking satellites that are directly overhead. This results in degraded tracking performance when the satellite is at high elevation angles.

Note that the attitude (*i.e.*, pitch, roll and yaw) of the vehicle is important, as the keyhole effect depends on the elevation angle to the satellite relative to the base of the antenna. Even if a two-axis terminal can operate properly if driven on level roads, the keyhole effect may be present if the antenna is driven on sloping or uneven terrain that causes the vehicle to pitch, roll and yaw.

OPERATION ON COMMERCIAL KA-BAND

The third band of the Ti-band terminal is commercial Ka-band for use on services such as Inmarsat GX. The terminal can switch electronically to the 29-31 GHz bands. Again, all polarization switching is performed electronically.

In commercial mode, the embedded GX (or commercial) modem is given control of satellite selection and all RF settings and the modem will communicate with the terminal's antenna-control-unit via OpenAMIP.

This article summarizes the operations of a Tri-band terminal with dual X- and Ka-band closed loop monopulse tracking that can operate on both military X- and Ka-band as well as on commercial Ka-band. The combined experience of EM Solutions' other monopulse COTM terminals in Ka-band and Ku-band has been used in the Tri-band terminal development.

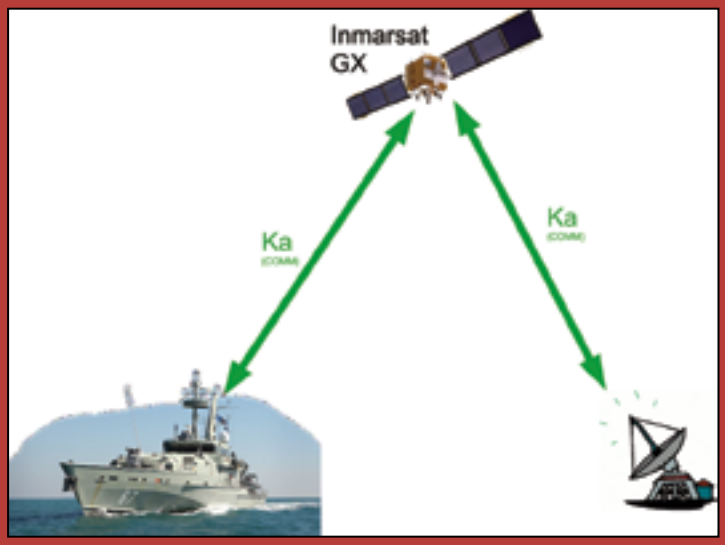


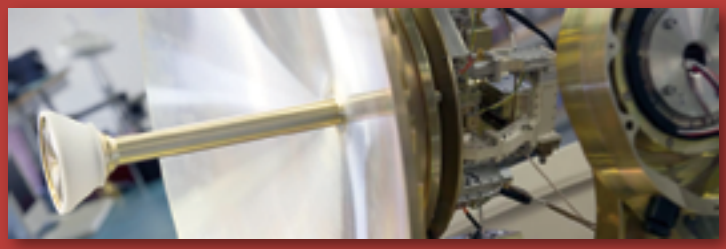
Figure 4. Operation on commercial Ka-band satellites including Inmarsat GX. Commercial satellites with military Ka-band transponders are also supported.

EM Solutions expects to have the Tri-band terminal ready for sea trials by Q4 of 2015.

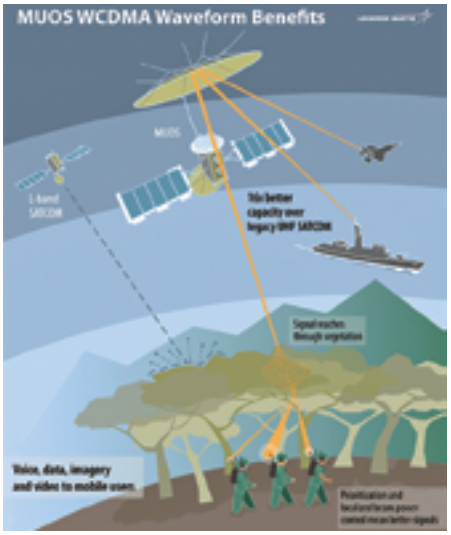
Additional information regarding EM Solutions may be viewed at http://***www.emsolutions.com.au/***

John Logan has more than 20 years of industrial experience in the satellite telecommunications and electronics industry. John is EM Solutions' Product Manager for the COTM business within Australia for the Australian Defence Forces and international prime contractors who purchase EM Solutions equipment to integrate with their systems.

Acknowledgement
The support and cooperation of the Defense Science and Technology Organization (DSTO) through its Capability Technology Development program, which made this work possible, is gratefully acknowledged.



LMC'S MUOS-3 GAINS THE OK



Following successful completion of on orbit testing, the U.S. Navy has accepted the third Lockheed Martin-built Mobile User Objective System (MUOS) satellite.

Launched on January 20, MUOS-3 is the latest addition to a network of orbiting satellites and relay ground stations that is revolutionizing secure communications for mobile military forces.

Users with operational MUOS terminals can seamlessly connect around the globe, beyond line-of-sight, with new smart phone-like capabilities, including simultaneous and crystal-clear voice, video and mission data, on a high-speed Internet Protocol-based system. With on-orbit testing complete, MUOS-3 is being relocated to its on orbit operational slot in preparation for operational acceptance.

The MUOS network is expected to provide near global coverage before year end. MUOS-1 and MUOS-2, launched respectively in 2012 and 2013, are already operational and providing high-quality voice communications. Lockheed Martin handed over the last of four required ground stations to the Navy in February. MUOS-4 is expected to launch later this year.

"MUOS is a game-changer in communications for every branch of our military, which all have mobile users who will benefit from these new capabilities," said Iris Bombelyn, Lockheed Martin's vice president for narrowband communications.

PROPOSALS REQUESTED BY SMC

The Space and Missile Systems Center released a formal solicitation seeking proposals for shared public-private investments in rocket propulsion system prototypes.

This solicitation is part of a comprehensive Air Force plan to transition off the Russian supplied RD-180 propulsion system used on the Atlas V rocket by investing in industry launch solutions with the ultimate goal to competitively procure launch services in a robust domestic launch market.

The Air Force will award a portfolio of investments on a rolling basis in up to four of industry's Rocket Propulsion System (RPS) solutions. These investments, which will last approximately 12-18 months, will build the foundation for awarding separate investments in industry's launch system solutions and secure launch service commitments from invested companies.

Concurrently, the Air Force will continue to competitively award launch services contracts to certified providers who demonstrate the capability to design, produce, qualify, and deliver launch systems and provide the mission assurance support required to deliver national security space satellites to orbit.

"The end goal of our strategy is to have two or more domestic, commercially viable launch providers that also meet national security space requirements," said Lt. Gen. Samuel A. Greaves, the Air Force's Program Executive Officer for Space and the Commander of SMC. "This is essential in order to solidify U.S. assured access to space, transition the EELV program away from strategic foreign reliance, and support the U.S. launch industry's commercial viability in the global market."

MIDS JTRS FOR VIASAT

ViaSat Inc., Carlsbad, California, is being awarded a maximum potential $478,600,000 indefinite-delivery/indefinite-quantity contract (N00039-15-D-0008) for the production, development and sustainment of the Multifunctional Information Distribution System (MIDS) Joint Tactical Radio Systems (JTRS) terminals.

The MIDS JTRS terminal is a four-channel software defined radio that delivers existing Link 16 with concurrent multi-netting-4 and tactical air navigation functionality, as well as three channels for future growth, including JTRS advanced networking waveforms such as tactical targeting network technology, multifunction advanced data link, intra-flight data link and other advanced networking waveforms.

The MIDS JTRS terminal is a line-of-sight radio system for collecting and transmitting broadband, jam-resistant, secure data and voice across a variety of air, sea and ground platforms.

The MIDS program office mission is to develop, field and support interoperable, affordable and secure MIDS tactical data link and programmable networking technologies and capabilities for the joint, coalition and international warfighter.

Work will be performed in Carlsbad, California, and work is expected to be completed by May 27, 2020.

www.viasat.com/

HPA CORNER: RECONFIGURABLE PAYLOADS

By Robert B. Clark, Hosted Payload Manager, Harris Corporation

The concept of reconfigurable space-based capabilities is gaining traction in our industry, as evidenced by the lively Satellite 2015 panel. Increasing the application of this approach will change the way we design, build, deploy, and use our platforms.

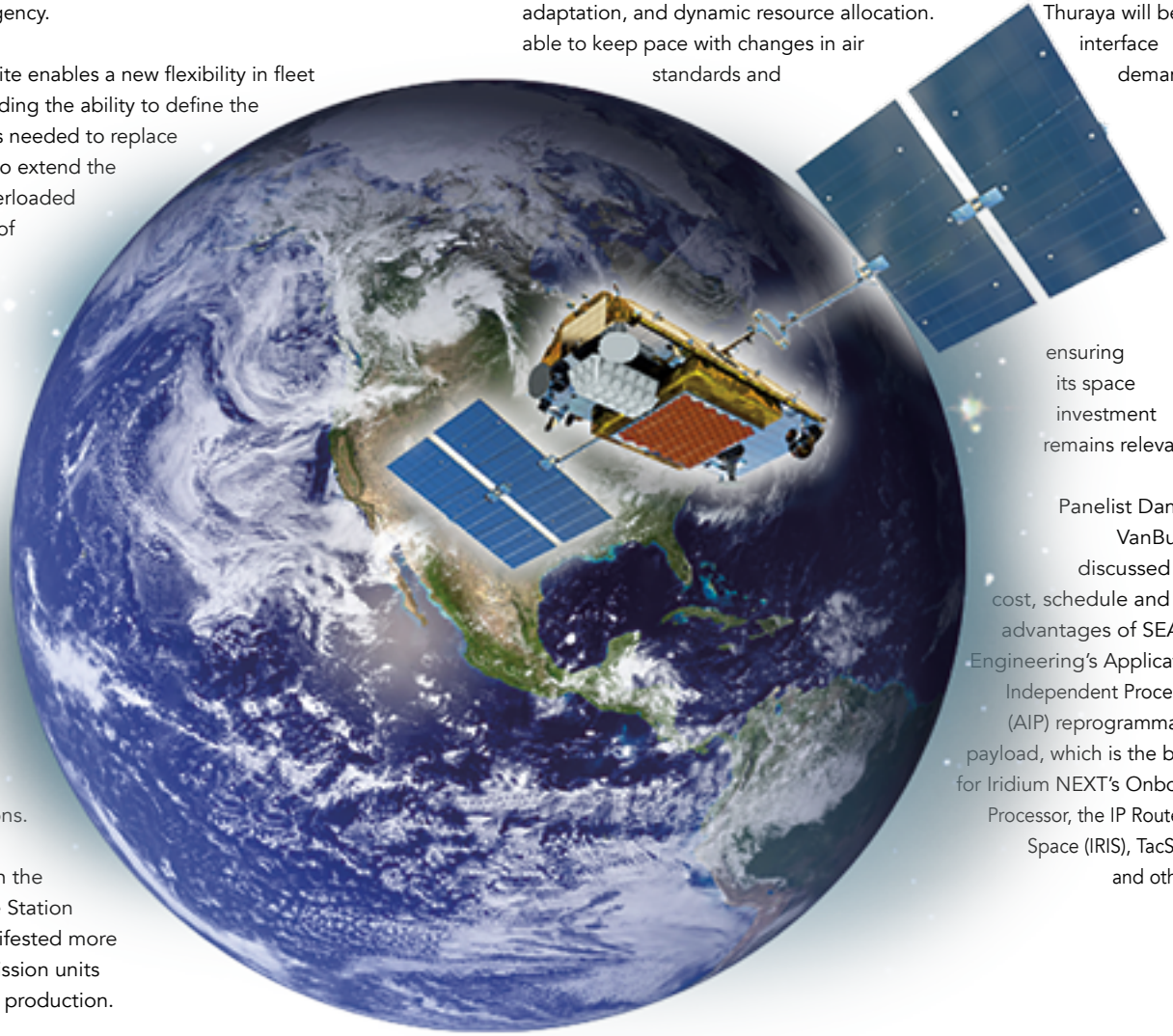
On March 16, 2015, Satellite 2015 attendees were treated to several perspectives on the industry push to make our space-based assets more flexible, and, therefore, more useful. Nate Conn, President of OMNI Space Access and OMNI Consulting Services, moderated a panel entitled "*Software-Defined Hosted Payloads: What are the Benefits of Reconfigurable Architectures?*"

Panelist Hector Fenech discussed Eutelsat's software-defined Quantum satellite that will electronically synthesize receive and transmit functions in the Ku-band, including on-board jamming detection and mitigation. The satellite development was announced by the company in December of 2014. The first satellite, to be launched in 2018, will be primed and manufactured by Airbus Defense and Space (ADS) in the UK using its innovative flexible payload technology and a new platform from its affiliate, Surrey Satellite Technology Ltd. (SSTL). Both developments are supported by the UK Space Agency.

The Quantum satellite enables a new flexibility in fleet management, providing the ability to define the satellite functions as needed to replace a failed satellite or to extend the capability for an overloaded satellite in the face of changing demand.

Panelist Alan Mast discussed how the Harris AppSTAR™ software defined payload has been adapted to missions including a Ka-band radio, a Synthetic Aperture RADAR, an air traffic surveillance receiver, and multiple additional user-defined missions. The AppSTAR™ platform is flying on the International Space Station today and has manifested more than 200 hosted mission units delivered and/or in production.

Panelist Ahmed Ali Al Shamsi discussed the Thuraya vision of a software defined payload as a design that evolves with technology while in orbit—a unifying theme for the panelists. Key aspects of the Thuraya vision include flexible beam forming, gain management, air interface definition adaptation, and dynamic resource allocation. Thuraya will be able to keep pace with changes in air interface standards and demand, ensuring its space investment remains relevant.



Panelist Damon VanBuren discussed the cost, schedule and risk advantages of SEAKR Engineering's Application Independent Processor (AIP) reprogrammable payload, which is the basis for Iridium NEXT's Onboard Processor, the IP Router in Space (IRIS), TacSat-3 and others.

SEAKR's experience has shown that the benefits of reconfiguration begins on the ground in accommodating requirements changes during development, and ultimately extending to on-orbit flexibility.

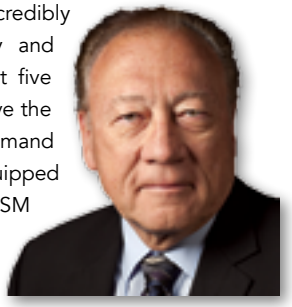
[The feature graphic on the opening page of this column is courtesy of Harris Corporation.]

This column's question for HPA Members is…

From your perspective, as members of the Hosted Payload Alliance, how are reconfigurable payloads changing the way you do business now and over the next five years?

"The challenge is to find the ideal compromise between advanced reconfigurable payloads that provide flexibility and the costs of those payloads. In the latest SES satellites coming into the market place starting with SES-12, we have invested in advancing the state of the art in high throughput design options and the associated hardware required to make these features available to the market place. Several of our new satellites will include digital signal processors, commonly referred to digital transparent processor (DTP) or channelizers.

"The advent of reconfigurable payloads, or "software defined payloads", will mean the ability for an operator to adapt to changing business needs which may be different from when the satellite was first designed. DTP's along with Active Phased Array antennas (APAs) give the operator the flexibility to reshape coverage areas and performance to suit changing customer requirements in near-real-time instead of having to wait for a new satellite to be launched." —***Tim Deaver***, Corporate Vice President, Development **SES Government Solutions**



"Reconfigurable payloads are incredibly important to Aireon's overall strategy and mission-critical decisions. Over the next five years, we need to make sure that we have the flexibility to tactically meet the growing demand of air traffic. By tracking ADS-B equipped aircraft from space using the AireonSM payload hosted on the Iridium NEXT constellation, consisting of 66 low-orbit satellites, Aireon will be able to provide 100 percent global surveillance to ANSPs, airlines, regulators and airports. The ability to reconfigure the Aireon payloads allows new features and capabilities to be uploaded at any time. This ensures that Aireon will be able to deliver a global capability and meet the needs of aviation now, in five years and beyond as the aviation industry growth matures into new standards and services." —***Dennis Diekelman***, Development Program Manager, **Aireon**

"Reconfigurable payloads allow operators to adjust their on-board capability over the life of a mission to meet ever-changing operating environments. Examples include the ability to reconfigure coverage areas, transmit power, and connectivity to better serve the users. The Boeing-built Wideband Global SATCOM (WGS) spacecraft provides such capabilities through the use of phased array antennas allowing shapeable coverage, steerable spot beams, and a digital channelizer that can connect any receive-antenna beam to any transmit-beam. This flexibility allows service to be quickly and easily moved globally as demand shifts, and connect users with terminals operating at different frequencies to communicate seamlessly with one another. Reconfigurability is thus instrumental in preserving the utility and value of the payload over the satellite's 10 – 15 year lifespan, despite changing conditions. Boeing sees more compact versions of these reconfigurable payloads as prime candidates for hosting on commercial spacecraft.

"Reconfigurability also can reduce risk. One of the barriers preventing the wider adoption of hosted payloads is the inability of government customers to make financial and mission commitments prior to the start of satellite construction. This forces operators to take on significant financial risk in the event that the government customer's mission needs change over time. Reconfigurable payloads, by their nature, provide greater flexibility in terms of meeting changing mission needs, which in turn lowers the satellite operator's risk profile." —***Jim Mitchell***, Vice President, **Boeing Commercial Satellite Services**

"Hosted payloads have significantly changed the space business in a positive way; creating a new market that provides affordable access to space for small companies, start-ups and larger organizations, while helping satellite providers close their business plans for launch. As a result, satellite developers, such as Iridium, now plan for excess capacity and resources to support their hosted payload customers' missions; like Aireon, which relies on Harris' AppSTAR™ software defined payload on Iridium NEXT.

"In the future, hosted payloads will move from being a dedicated purchased solution to more of a lease model, where customers pay for only the satellite resources and time they need to meet their business needs. This dynamic use case will force hosted payloads to be much more flexible and reconfigurable and able to support a broad range of missions in space. The push for reconfigurability will ultimately bring even more value, business innovation and new services to space customers." —***Dr. Frank Bourne***, Director of Research and Development, **Harris Government Communications Systems**

"Future satellites should be flexible and reconfigurable in orbit to meet customer requirements for 1) a competitive cost per bit; 2) a service tailored to their needs; and 3) a service that can be rapidly implemented. This flexibility could include:

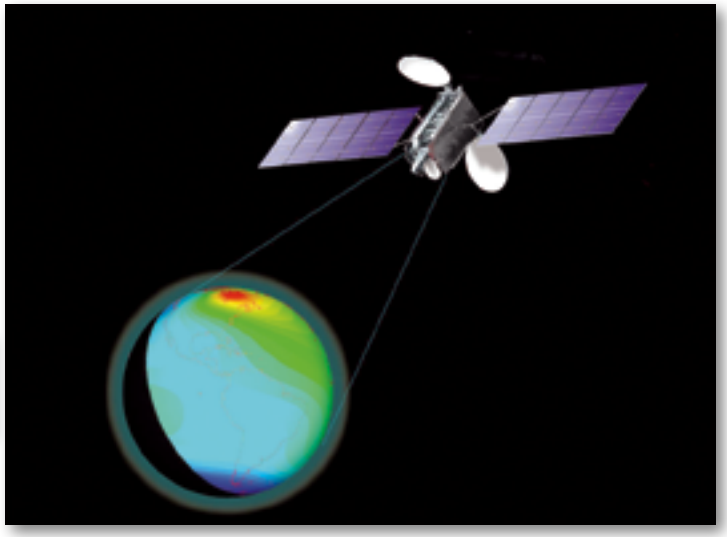
- *Frequency selection/change in orbit*
- *Adjustment in uplink and downlink power allocation over a given area on Earth in orbit*
- *A change in allocated bandwidth over a given coverage area in-orbit*
- *In-orbit connectivity between coverage areas with a digital payload*
- *Modification of the coverage area once the satellite is in-orbit with such tools as on board beam forming or active array antennas.*

If you carry these ideas to their full potential, you obtain what we call a "software defined" satellite, i.e. a satellite that is basically identical on the ground and can be configured to the customer's needs once in-orbit. It is plausible to think of a concept where the satellite manufacturer would "pre-build" these standard satellites ahead of the demand. At the request of a customer, they could be launched in record time and configured to meet the mission demand once in-orbit. This will lower the recurring cost of the satellites and reduce the time to market." —***Jean-Luc Froeliger,*** Vice President, Satellite Operations and Engineering, **Intelsat**

A message from HPA Chair Nicole Robinson

"As we move into the second half of 2015, we have much we can be proud of as an Alliance in the development of commercially hosted government payloads. Earlier this year, we saw encouraging language in the National Defense Authorization Act supporting this means of accessing space, witnessed the clear advocacy of hosted payloads by Congressman Jim Bridenstine of Oklahoma in a number of external engagements, and revealed the signing of two new hosted payload deals with the NASA GOLD mission as well as the WAAS payload with the FAA. It is clear the hosted payload community is alive and well and the Alliance is playing a significant role in these developments.

"In recent weeks, the HPA engaged our member companies in a survey as well as a series of interviews to understand areas where we truly have excelled in recent years and areas where perhaps we could focus more attention. Through that exploration, we recognized the value in the Alliance's ability to shape and influence such works as the Space Transportation Policy, the CIO Guidance on military spectrum payloads on board commercial satellites, as well as the continued reference to hosted payloads throughout various legislative initiatives. Going forward, we will commit to focusing much of our attention as an Alliance to continuing senior-level engagements across the government to leverage this momentum and continue to educate on the limitless potential and value industry can provide in this regard.



Artistic rendition of NASA's Global-scale Observations of the Limb and Disk (GOLD) mission will examine the response of the upper atmosphere to forcing from the Sun, the magnetosphere and the lower atmosphere. Image is courtesy of NASA.

"Specifically, the HPA is actively engaged in the development of messaging and a call plan related to the ongoing Analysis of Alternatives (AoA) for various space-based capabilities in the Department of Defense. In the weeks ahead, we will be engaging offices involved in the development and review of the SBIRS AoA, Protected AoA as well as the Wideband AoA to ensure the commercially hosted government payload voice and value proposition has been considered.

"The first half of 2015 has proven strong in the area of hosted payloads, however it is clear there is much work yet to be done. I'm confident that with the highly influential and technically astute participants within our Alliance, we will be successful in our effort to engage in the AoA process and more broadly, ensure the hosted payload message is heard, understood and leveraged in the growth of commercially provided government space capability in the future."

About the Hosted Payload Alliance (www.hostedpayloadalliance.org/)

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

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

SatFinder

Satellite Database & Calculation Software

DATABASE

Information on over 500 satellites (orbital location, frequencies, EIRP, G/T, SFD, bandwidth, programming etc.)

Information on 9,000 companies (address, tel, fax, web, products, services and contact names etc.)

Information on 19,000 executives in the commercial satellite industry.

800 hundred EIRP, G/T & SFD maps in color not published anywhere else.

CALCULATION

Has full up-down digital link budget calculators with input provision for uplink power control (UPC), ALC, various interferences and multiple carriers.

Finds HPA size, uplink power requirements, bandwidth and power usage per carrier.

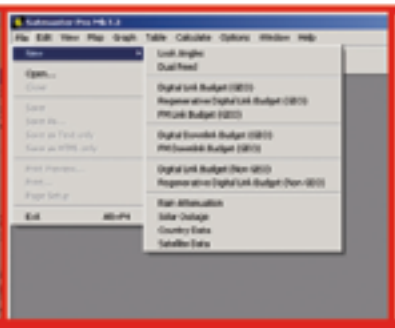
Calculates atmospheric losses and rain fade margins for any desired availability on uplink and downlink.

Handles BPSK, QPSK, M-PSK or M-QAM with any FEC code rate.

Determines power or bandwidth limited modes and calculates the power equivalent bandwidth, if appropriate.

Provision for RS codes or 'Turbo' modems. Option for rain up AND rain down scenarios where uplink and downlink are from/to the same city.

UPDATED QUARTERLY!



http://www.satnews.com/satfinder

SMALL PACKAGES ARE AN ANSWER FOR INTELLIGENCE COMMUNITY RELIEF

By AJ Clark, President, Thermopylae Sciences & Technology (TST)

For all of the hue and cry about small satellites, you would think they were invented yesterday.

In fact, the first U.S. satellite sent successfully into orbit was Explorer 1, launched in 1958 in answer to the Soviet Union's Sputnik. Explorer 1 weighed slightly less than 31 pounds, of which just over 18 pounds were instruments.

Nanosats and their slightly bigger microsat cousins are really undergoing a renaissance for use in space. However, the emphasis is no longer on just getting them into orbit. Well, there is some emphasis there—more about that later. Now the focus is on what happens when the small satellites are aloft. In essence, the ambitious movement toward smallsats is part of a continuum that started when the space race believed in a bigger-is-better, more expensive path, and then the focus began to circle back when more expensive became too expensive.

With fiscal restraints, the Intelligence Community (IC) is looking toward doing more with less. Nanosatellites and their kin could well provide a reliable solution for all concerned.

POTENTIAL… + LIMITATIONS

Any answer has to be couched with an understanding of what small satellites can actually accomplish—and what is beyond their current capabilities. For the purpose of clarity, nanosats, microsats, CubeSats will be called smallsats for this article.

What exactly do the IC's need and what will be required to satisfy their demands? Also to consider is exactly what are the IC's capabilities and how should smallsats "grow" to accomplish their missions? All of those elements are going to determine the development of various smallsat capabilities, as well as for another emerging technology that is also competing for the investment dollar—Unmanned Aerial Systems (UAS) or, as they are otherwise known, Remotely Piloted Aircraft (RPA).

Smallsat growth will be built on a foundation of lower cost and will have to include information collection quality and the rapidity and viability of their downlinks. What happens when an image from a nanosatellite or other small platform arrives at the ground station and then joins a river of intelligence through a processing funnel for dissemination to interested parties? Smallsat produced intelligence isn't the end all but part of a beginning as the role this platform can play in the intelligence-gathering ecosystem can be substantial.

That ecosystem is layered, from the small UAS/RPA, the medium altitude UAV to the larger aerial systems, such as the Global Hawk, to the larger satellites that provide imagery from space. There is a sweet spot that smallsats can fill, that being their ability to offer a frequency of visit the large satellites cannot approach. However, when it comes to the breadth of coverage, smallsats cannot match the image resolution of either the higher altitude UAV/RPA or the satellite—at least, not yet.

Smallsats from Orbital ATK
Left to right—A100, A150, A200, A500, and A700.
Image is courtesy of Orbital ATK.

Part of the IC's approach to the use of smallsats, then, rests in the changes to the overall mentality that is driven by the Concepts of Operation (CONOPS). This would include instructing a watch commander to seek out the "latest image," no matter its source.

The smallsats inject another decision that must be made in reacting to a crisis: determining whether 100, lower-resolution, but fresher, smallsat images have more value than an older, but higher-resolution, large sat image to help formulate the proper response to an event. The answer could well reside in determining if there is enough time to await a larger satellite to be properly positioned to provide a newer, higher scale image, or not. Immediacy of data could well be the decision maker for the use of a smallsat.

CUE + TIP

Making that decision also points to the valuable potential that rests with smallsats: allowing them to serve as relatively inexpensive "bird dogs" for their billion-dollar bigger brethren. By using the pictures from smallsats to tip and cue the larger platforms, their data can be used to determine if there is sufficient value to justify the expense of repositioning a larger satellite.

The challenge of image resolution can be mitigated through a smallsat attribute: they can be arranged in constellations that allow their products to be, in effect, crowd-sourced. This allows their single-sensor limitations to be overcome through the combination of smallsat sensors by grouping their platforms.

The resolution challenge eventually can be overcome through the trend of sensor miniaturization and by more, frequent, lower-cost launches that allow the satellites to carry the latest and greatest smallsat technology as soon as such is produced, rather than having to wait—sometimes years—for similar technology to be aggregated with other sensors on a larger satellite.

For all of their capabilities, many of the largest and most expensive satellites in use by the IC are carrying dated technology. In example, Digital Globe's World View-3 satellite, launched in August of 2014, is the only platform in orbit that is capable of transmitting 30-centimeter resolution images, which will become the gold standard in the field.

As smallsats proliferate, particularly in relation to the paucity of larger satellites that government and industry can support, economics are going to drive additional investment in the quality of the sensors the smallsats will carry.

GETTING SATELLITES UP

The problems with smallsats rest at the extreme ends of their continuum—launching them without consideration for the larger, overall mission, and in meshing and leveraging the data they send back for analysis.

Solutions to the launch issue are being worked on at several levels. In the commercial arena, companies such as Garvey Spacecraft, Ventions, ARCA,Tranquility Aerospace, Virgin Galactic and SpaceX, to mention only a few, are heavily involved in producing solutions.

On the military side, the U.S. Army's Soldier-Warfighter Operationally Responsive Deployer for Space (SWORDS) is seeking an on-demand launcher that could place a 25 kilogram payload into LEO within 24 hours notice for less than $1 million. The Defense Advanced Research Projects Agency (DARPA) states their organization is working on an Airborne Launch Assist Space Access (ALASA) program that has the goal of pushing a 45-kilogram payload into space for $300,000—by 2020.

Both government programs are responses to a vision of smallsats becoming tactical weapons due to their quick response and capability to provide added intelligence resources for troops on the ground. Smallsats also enhance over-the-horizon communications, an attribute often forgotten when considering their value. That potential has brought the U.S. Army back into the satellite business after an absence of a half-century, despite the fact that the U.S. Army has been the largest consumer of satellite imagery in the armed forces.

Special Operations (Spec Ops) are also in the nanosatellite business. Spec Ops piggybacked eight CubeSats, measuring 10-by-10-by-10 centimeters and weighing only 1.4 pounds each, with 21 other satellites from various interests, in a Minotaur rocket launched from Wallops Island, Virginia, in November of 2013. As part of the Prometheus program, the satellites were designed to serve as communication relays for Spec Ops' far-flung missions.

As of this writing, consistent and inexpensive smallsat launch solutions are not yet in place. Crucial development decisions—and additional investment—remain on the engineering table.

A RACE WORTH THE RUNNING

What happens when nanosatellites pump thousands more images per day into pipes that are already strained—and in many cases, failing—to accommodate the already existing data from signals intelligence, UAS/RPA sensors and big satellite imagery and video? Then, mix in the increased emphasis on open source data from social media environments and the data blockage is extremely concerning. The amount and types of data being captured today vastly outpaces the ability of legacy computing infrastructures and technologies to manage the interpretation and distribution processes to the IC community in a timely manner.

The case, then, becomes one of the IC always attempting to catch up with smallsat technology that continues to race ahead, propelled largely by commercial SATCOM builders and purveyors. This is a race definitely worth the running, as smallsats have so much to offer the IC, just as they had much to offer at the start of the space race more than six decades ago.

AJ Clark is the President of Thermopylae Sciences & Technology (TST), a leading provider of web-based geospatial capabilities, mobile software framework and applications, situational awareness, and cloud computing solutions for the U.S. military. To learn more about TST, please visit ***http://www.t-sciences.com/.***