SATCOM For Net-Centric Warfare

May 2014

MilsatMagazine

New and advanced technologies take center stage

Karl Fuchs tackles MILSATCOM equipment...

NGC's Edlund and MILSATCOM in adversarial environs...

Giles Peeters + the technologies of military usable OS...

The Hosted Payload Association maneuvers into...

Fast SATCOM deployments in the field from INTEGRASYS...

MDA is flying high with BlueHawk...

A handle on Hosted Payloads from NSR...

KRATOS' Gardner looks at SmallSat missions...

Command Center with ViviSat's Weston...

United Launch Alliance Atlas V launch vehicle, carrying the NROL-67 mission for the National Reconnaissance Office, is rolled to the launch pad at Space Launch Complex-41. Photo is courtesy of United Launch Alliance.

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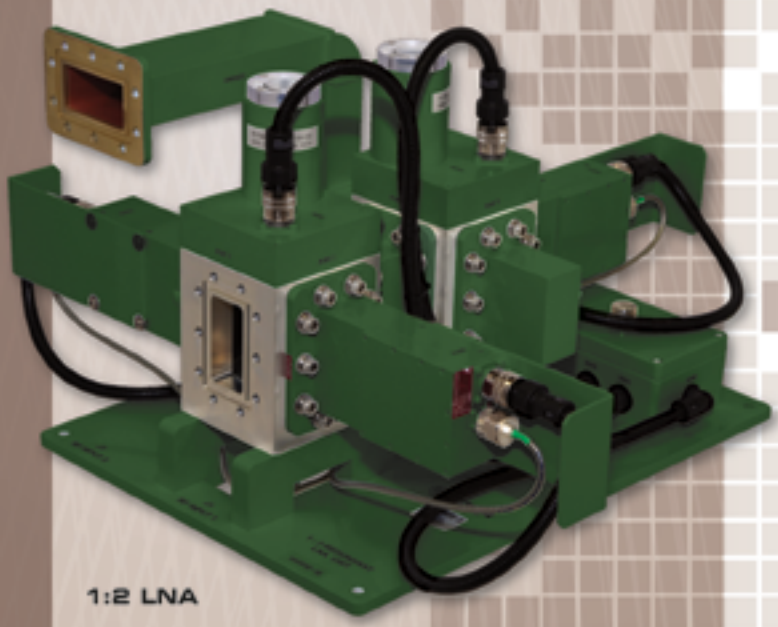

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MilsatMagazine

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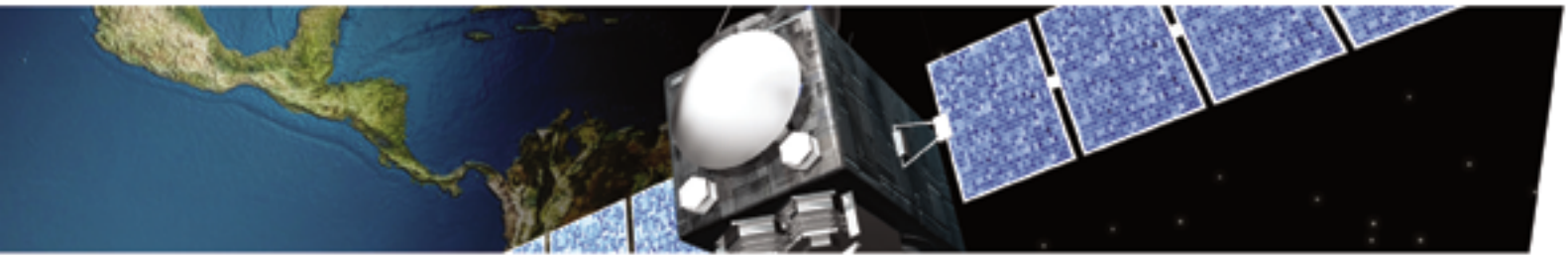
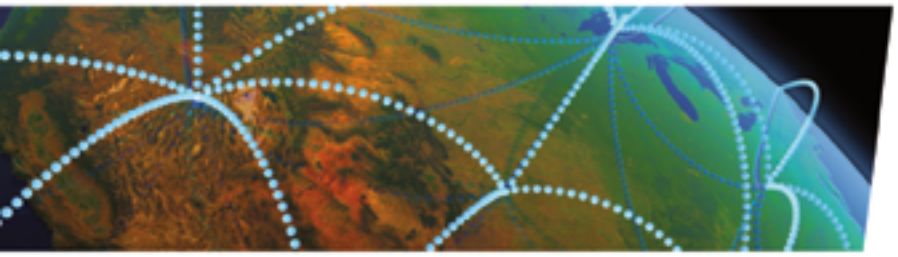
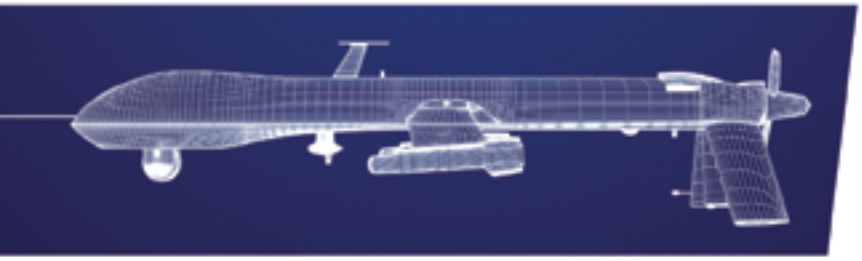
A ULA Atlas V launch vehicle carrying the NROL-67 satellite launches from Cape Canaveral. Photo is courtesy of ULA.



A lot can go right between the satellite and the ground. Or not.



Kratos Helps Assure and Protect from End- to- End



If the information doesn't get through, it won't matter whether the problem was interference, an unreliable modem or inside the IP network. The mission suffers.

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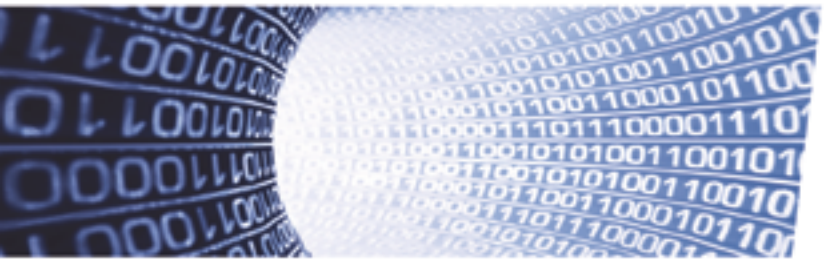

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DISPATCHES

DEPARTMENT OF DEFENSE (DOD)—SPEAKING OF SPECTRUM SHARING...

The Department of Defense has announced its electromagnetic spectrum strategy for sharing with the commercial wireless industry.

The electromagnetic spectrum is a range of frequencies of electromagnetic radiation. Electromagnetic radiation has many uses, including radio and satellite communications, radar, and GPS.

"Through its plan, DoD recognizes that meeting its own requirements amidst the growing commercial and consumer demand will require cooperation, compatibility and flexibility," said Karl Nebbia, the associate administrator of the Office of Spectrum Management at the electromagnetic spectrum strategy press briefing,

"A key focus of its plan is to establish goals and objectives to develop systems that are efficient, flexible and adaptable in their use of the spectrum."

The focus in sharing the spectrum is balancing the needs of the military and the needs of the commercial wireless industry, both of which have growing demand.

"We cannot shift in a short time frame; we just have too much equipment and too much capability that really has to be transitioned in a very thoughtful way so as not to impose a major burden on budgets and a major burden on the taxpayers," said Teri Takai, chief information officer for the Department of Defense.

In the 1990s, 12,000 troops used an average of 90 megahertz of bandwidth. Now, 3,500 troops use over three times that amount of bandwidth on average.

"The longer term spectrum needs for government agencies and industry alike can only be met through spectrum sharing. And we are looking for a top-to-bottom commitment from all stakeholders to make it happen," said Nebbia.

There are three main goals embedded in the strategy: continue improving DoD spectrum-dependent technology, increase the agility of spectrum operations, and improving participation in policy," said Takai.

"By becoming more efficient, flexible and adaptable, our systems will be better prepared to meet the demands of modern warfighting," said Takai. "This creates opportunities to utilize spectrum that is less congested, adopt commercial services and technologies where suitable, and implement spectrum-sharing technologies where feasible.

"So with all of that, again, our objective is to really work collaboratively, but always with a mind towards our mission, which is really to protect all of our citizens and all of our partners and make sure that all of our men and women in uniform have the capability that they need and are also protected from harm's way," she said.

Story by Cpl. Sarah Cherry, Marine Corps Air Station Beaufort

U.S.A.F. SPACE & MISSILE SYSTEMS CENTER (SMC)—A GENERAL CHANGE OF LEADERSHIP

There's to be a new commander, if all proceeds according to play, at the helm of the U.S.A.F.'s Space and Missile Systems Center (SMC), located at Los Angeles Air Force Base, California.

The current commander, Lieutenant General Ellen Pawlikowski, will be moving in as the assistant secretary of the Air Force for acquisition at the Pentagon, should her nomination be approved by the Senate.

Having led SMC since mid-2011, she has been described as a sterling leader by none other than the commander of Air Force Space Command, General William Shelton.

Lt. Gen. Pawlikowski is heading for D.C.

Being recommended to head up SMC is Maj. Gen. Samuel Greaves

Lt. Gen. Pawlikowski also served as the deputy director of the National Reconnaissance Officer (NRO) from 2008 through 2010.

She will be nominated to gain rank to that of Major General.

Being recommended to take her place at SMC is the current deputy director of the Missile Defense Agency (MDA), Major General Samuel Greaves, who will be additionally nominated for promotion to the rank of Lieutenant General.

Following protocol, both of these candidates must be confirmed by the Senate.

U.S.A.F. 21ST SPACE OPS—25 YEARS OF TRACKING + SPACE SUPPORT @ KAENA POINT

On February 26th Kaena Point Satellite Tracking Station celebrated 55 years of space operations.

The tracking station is located near Kaena Point above Keawaula Bay on the island of Oahu, Hawaii. Kaena Point is part of the Air Force Satellite Control Network, which consists of seven remote tracking stations located around the world.

"Kaena Point is a beautiful place to work, and has a long standing history of loyalty and service to the United States," said Charlene Kaawaloa, a longtime administrator at Kaena Point.

The site operates two AFSCN antennas used to support more than 150 Department of Defense, national and allied satellites with missions, such as communications, reconnaissance, navigation, weather and early warning.

The station is managed by the 21st Space Operations Squadron Detachment 3. Detachment 3 is a geographically separated unit of the 50th Space Wing located at Schriever Air Force Base, Colorado. Contractors provide around-the-clock manning for command and control of on-orbit satellites. Additionally, there are 15 Air Force civilians providing base operations and support.

"Being part of Detachment 3 has been an eye opening experience," said Tech. Sgt. Kyle Fenimore, Detachment 3 NCOIC. "Space has always been a hobby of mine, but I never thought I would get the chance to be directly involved in the command and control of satellites."

Construction at Kaena Point began in 1958 and operations supporting the nation's first satellite reconnaissance program, Discoverer, began in February 1959. The Discoverer program, which was declassified in 1995 and is now known as Corona, was developed to collect photographs of areas around the world including the Soviet Union and Cuba. Photographs could be taken from space without putting pilots in harm's way and violating the airspace of other nations.

Film canisters ejected from the satellite, deployed a parachute and were recovered mid-air by aircraft from Hickam Air Force Base, Hawaii. Some canisters were also recovered at sea by ships from Naval Station Pearl Harbor.

Richard Harris, Hawaii Tracking Station chief of operations, said, "As a contractor at Kaena point, I'm directly involved in keeping satellites fully operational so they can perform their mission for our military, our nation and our allied partners."

In 1966, Kaena Point supported 3,997 satellite contacts. The team consisted of 49 active-duty Air Force personnel and 182 contractors. At that time, schedules and mission orders were received via teletype and phone lines using under-sea cables linked the remote tracking station with the operations center in Sunnyvale, California.

Today, data transfers are much faster, and, with technological advances and communication equipment upgrades, the station can do more with fewer personnel. Marlon Martell, an operations and maintenance technician for the past 25 years, said, "We can now communicate with multiple operations centers at greatly increased speeds and receive near real-time changes to the mission schedule."

Today, the unit's mission is more robust and critical than ever. In 2013, Kaena Point supported 22,255 satellite contacts, which is a huge increase from the 1960s. Kaena Point supports approximately 60 satellite contacts per day.

The site retrieves data from satellites and relays commands, such as on-orbit maneuvering, programming of the satellites' on-board computers and maintaining the health of the satellite.

Kaena Point has been providing critical space support to enhance military and humanitarian relief operations for 55 years.

Many residents of Oahu have been part of the Kaena Point Satellite Tracking Station family during its long history and have played a critical role in our nation's security.

To everyone, we say "Aloha and Mahalo." We look forward to another 55 years of service to the United States of America.

Story by Major George Sanderlin, 21st Space Operations Squadron, Detachment 3

LOCKHEED MARTIN—DESIGNED TO INVESTIGATE THE WEATHER IN SPACE

Lockheed Martin engineers in Denver install the Solar Ultraviolet Imager (SUVI) on the GOES-R Sun Pointing Platform. SUVI was built at the Lockheed Martin Advanced Technology Center in Palo Alto, California. Photo is courtesy of Lockheed Martin.

Artistic rendition of a GOES-R satellite. Image is courtesy of Lockheed Martin.

Lockheed Martin delivered a new solar analysis payload that will help scientists measure and forecast space weather, which can damage satellites, electrical grids and communications systems on Earth.

The Solar Ultraviolet Imager (SUVI) instrument was integrated with the first flight vehicle of the National Oceanic and Atmospheric Administration's (NOAA) next-generation Geostationary Operational Environmental Satellite, known as GOES-R.

The GOES-R Series are designed and built by Lockheed Martin in Denver, Colorado.

"It is enormously satisfying to see the first GOES-R satellite and its instruments coming together, and it is great to see SUVI in flight configuration on the satellite's Sun-Pointing Platform," said Jeff Vanden Beukel, Lockheed Martin SUVI program director at the Advanced Technology Center in Palo Alto, California, where the instrument was built.

"We look forward to continuing our collaboration with NASA and NOAA to produce state-of-the-art scientific instruments that increase safety and improve quality of life."

SUVI will provide the required solar observational capabilities that enable NOAA's Space Weather Prediction Center in Boulder, Colorado, to monitor solar activity and to issue accurate, real-time alerts when space weather could affect the performance and reliability of technological systems in space or on the ground through the enhanced detection of coronal holes, solar flares and coronal mass ejections, as well as improved geomagnetic storm and power blackout forecasts.

Space weather can disrupt satellite operations, communications, navigation, and the distribution of electricity through power grids.

Timely forecasts of severe space weather events would help satellite operators and electrical grid technicians mitigate potential damage to such systems.

Lockheed Martin is under contract to build the first four next-generation GOES satellites (R, S, T, and U). Four of the six instruments for the GOES-R satellite have been delivered to the Denver facility and are being integrated with the spacecraft.

Once the instrument complement is completely integrated, a full suite of environmental tests will be conducted. Launch of the GOES-R satellite is scheduled for the first quarter of 2016.

Operational since 1975, the GOES program is operated by NOAA's National Environmental Satellite, Data, and Information Service and is a critical part of the U.S. satellite constellation for environmental observations.

The GOES satellites are a key element in NOAA's National Weather Service operations, providing a continuous stream of environmental information (weather imagery and sounding data) used to support weather forecasting, severe-storm tracking and meteorological research.

Along with weather forecasting, the GOES program also provides data to support space weather forecasting, public safety and scientific research to better understand land, atmosphere, ocean and climate interactions.

NOAA manages the GOES-R Program through an integrated NOAA-NASA office, staffed with personnel from both agencies and located at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

DISPATCHES

IDIRECT GOVERNMENT TECHNOLOGIES (IGT)— MANAGEMENT + OPS FOR SATNETS IS THE FOCUS

iGT announced the availability of its new Remote Access Training that brings an accelerated version of its popular classroom-based training and support onsite to customers via a secure remote access connection.

The accelerated courses focus on the operations and management of iGT satellite networks.

An iGT certified trainer teaches both the classroom and "hands-on" portion of the course to a class size limited to four students.

Remote access courses allow the students to visually see the hub configuration and monitor the status during the modified "hands-on" portion of the class.

Classes include:

- *IOM - iDirect Operation and Maintenance (IOM)*
  This entry-level course provides the student with the basic skills necessary to install software applications, and operate, manage and maintain a typical iGT satellite network.

- *Advanced IOM course*
  This training enables those who operate and manage iDirect satellite communication products and networks for the government and military to have a deeper understanding of the iGT system by giving the student knowledge and pointers for troubleshooting.

- *iQBC - iDirect Quality of Service Boot Camp*
  This course explains how iGT's GQoS feature works and shows students how to configure, manage and troubleshoot the QoS feature.

The iGT training infopage is accessible at ***http://www.idirectgt.com/training***

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HARRIS CORPORATION, U.S. NAVY, U.S. ARMY—END-TO-END COVERAGE + APPLIQUÉ APPLICATION

The U.S. Navy awarded Harris Corporation an eight-year contract valued at up to $133 million to provide shipboard terminals for crews' access to high-bandwidth voice and data communications.

Under the agreement, Harris will provide as many as 120 terminals in addition to the 70 terminals already delivered since 2008 under the indefinite delivery/indefinite quantity Commercial Broadband Satellite Program (CBSP) Unit Level Variant (ULV) contract.

The new award brings the total potential value of CBSP ULV and Force Level Variant contract awards to Harris to more than $250 million through 2022.

The program provides worldwide, commercial, end-to-end telecommunications services to the Navy.

The 1.3-meter Harris terminals offer X-band operation over existing military satellites, and the option of military/commercial Ka-band operation for future deployed satellite systems. They support essential mission requirements and provide high-speed Internet access and video communications on small combatant and support ships. Harris terminals are also used onboard Navy amphibious assault ships.

"These Harris terminals provide the Navy with access to the high-bandwidth services essential to mission-critical communications and to morale," said Ed Zoiss, vice president and general manager, Defense Programs, Harris Government Communications Systems. "Harris is delivering the next generation of military and commercial satellite capabilities to the Navy fleet."

Additionally, Harris has been awarded two indefinite delivery, indefinite quantity (IDIQ) contracts to supply the U.S. Army with Harris Soldier Radio Waveform (SRW) vehicular appliqué systems.

Harris was one of four companies that were selected to compete for orders on the contracts, which have a potential total value of $988 million.

The Harris SRW appliqué systems will be part of the Army tactical network modernization program. The Harris SRW appliqué systems consist of a Falcon III® wideband radio and small form factor wideband power amplifier.

The systems provide seamless connections between soldiers, their command centers and higher headquarters. They deliver vehicular-based voice, video and data communications for enhanced situational awareness and command and control.

Harris previously announced initial orders from the U.S. Army for the appliqué system in 2012.

"The network remains one of the Army's highest priorities," said George Helm, president, Department of Defense business, Harris RF Communications. "Our SRW appliqués deliver cost effective SRW communications in vehicular applications, connecting the soldier at the tactical edge to the network. The appliqués also address space challenges in Army vehicles that are unable to accommodate larger, manpack-based solutions."

In addition to SRW, the Harris appliqués also operate the SINCGARS and VHF/UHF line-of-sight waveforms, expanding interoperability with existing DoD radios and providing the Army with greater utility in combat.

For more information, please visit the Harris infosite at ***http://www.harris.com/***

NOAA—CERES SET FOR SHIPMENT

An artistic rendition of the JPSS-1, NOAA's next polar orbiting environmental satellite. Image credit, Ball Aerospace & Technologies Corp.

The first of five instruments that will fly on JPSS-1, NOAA's next polar orbiting environmental satellite, successfully completed pre-shipment review last week—the Clouds and the Earth's Radiant Energy System (CERES) will be on board the JPSS-1 satellite mission, which is scheduled to launch in early 2017.

CERES measures reflected sunlight and thermal radiation emitted by the Earth and builds on the highly successful legacy instruments flown on NOAA's previous Polar-orbiting Operational Environmental Satellites (POES) and NASA's Earth Observing System (EOS) missions.

Mary Kicza, assistant administrator for NOAA's Satellite and Information Service. "We're on track to have JPSS-1 ready to launch in 2017, adding to a robust satellite fleet that provides vital environmental intelligence for the nation and the world."

Long-term satellite data from CERES will help scientists and researchers understand the links between the Earth's energy balance, both incoming and outgoing, and parts of the atmosphere that affect it.

Data from CERES will also improve observations of seasonal climate forecasts, including large-scale events like El Niño and La Niña.

The CERES instrument is built by Northrop Grumman Aerospace Systems in Redondo Beach, California., and will be shipped to Ball Aerospace & Technologies Corp. in Boulder, Colorado, to be installed onto the JPSS-1 spacecraft.

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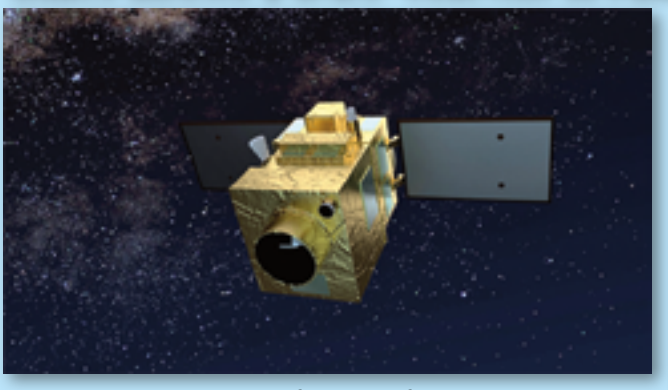
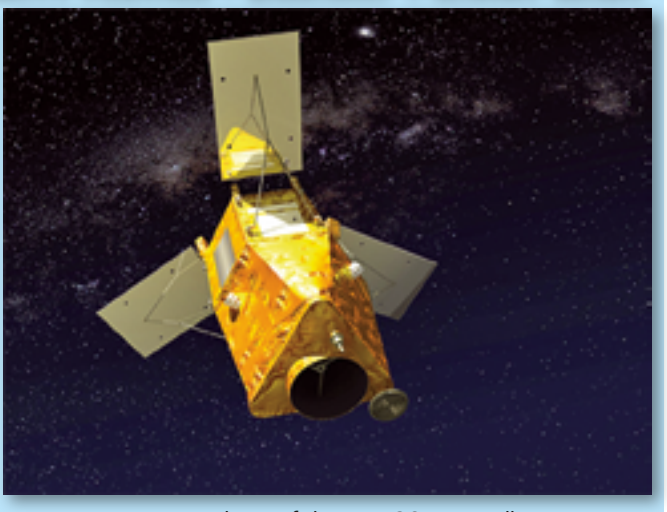


Artistic rendition of Airbus Defence & Space' Astrobus satellite platform. Image courtesy of Airbus D&S.



Artistic rendition of the KazEOSat-1 satellite. Image courtesy of Airbus Defence & Space.

Airbus Defence and Space has been selected as the sole, prime contractor to develop, construct and launch the first Earth Observation (EO) optical satellite system for Peru, with the support of the French government.

The system includes a latest-generation optical satellite with its very high-resolution instrument (from the Naomi family, combining the company's best expertise in optical instrumentation), and a ground control segment, image reception and processing center.

The project also includes a complete training program for Peruvian engineers and technicians (including satellite operations for developing tailored imaging applications).

Ahead of entry into service of the Peruvian satellite, Airbus Defence and Space will download data and images from its fleet of optical and radar satellites direct into Peru.

"With this first satellite system, Peru will acquire space capability at a very high level, and we are delighted to have been selected for our technology and expertise, particularly in the field of silicon carbide," said François Auque, Head of Space Systems, at the signing ceremony. "In winning this contract, Airbus Defence and Space reinforces its position as the world's number one exporter of Earth observation satellites of all types and resolution levels."

This program will be based on the Astrobus platform, which is designed for missions as varied as imaging (Pleiades, SPOT 6&7, Ingenio, KazEOSat-1), the environment (Sentinel-2), and meteorology (Sentinel-5p). This system also benefits from the expertise developed by Airbus Defence and Space in the field of silicone carbide (SiC) space structures and instruments.

Together with its partner Boostec, the company has created, through a series of achievements in space (Herschel, Gaia, KazEOSat-1, etc.), a new, successful, economic sector.

The SiC produced in the Midi-Pyrénées region is exported around the world.

Additionally, Airbus Defence & Space is preparing for the launch of KazEOSat-1 (formerly known as DZZ-HR), which is due to lift off on April 28, 2014, into low Sun-synchronous orbit (about 700km from Earth) on-board a Vega launcher from the European spaceport in Kourou (French Guiana).

KazEOSat-1, built on the Astrobus platform, is the Republic of Kazakhstan's first Earth Observation satellite.

It was built entirely by Airbus Defence and Space and is a very high-resolution (1 meter) satellite weighing 900kg that will provide the Republic of Kazakhstan with a complete range of civil applications, including monitoring of natural and agricultural resources, the provision of mapping data, security applications, and support for rescue operations in the event of natural disasters.

KazEOSat-1 is the high-resolution element of a space observation system that will comprise two satellites and their ground segment. The medium-resolution satellite, KazEOSat-2, is built by SSTL, a British subsidiary of Airbus Defence and Space.

These two satellites form part of "Kazakhstan's Space Plan", which also includes the construction in Astana, the capital of the Republic of Kazakhstan, of a satellite integration & test center, for which key equipment is being supplied by Airbus Defence and Space.

In 2009, Airbus Defence and Space was selected by Kazakhstan as a strategic partner in this Space Plan, and has already trained 60 engineers and technicians from Kazakhstan.

Airbus Defence and Space and the joint stock company Kazakhstan Garysh Sapary, a national company under the supervision of the National Space Agency of the Republic of Kazakhstan, have formed a joint-venture named Ghalam in order to run this center.

For further information regarding Airbus Defence and Space, please visit ***http://airbusdefenceandspace.com/***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DOD—SARS SUMMARIZATION FOR MAJOR DEFENSE ACQUISITION PROGRAMS

The Department of Defense has publicly released details on major defense acquisition program cost, schedule, and performance changes since the December 2012 reporting period.

This information is based on the Selected Acquisition Reports (SARs) submitted to the Congress for the December 2013 reporting period.

SARs summarize the latest estimates of cost, schedule, and performance status. These reports are prepared annually in conjunction with submission of the President's Budget.

Subsequent quarterly exception reports are required only for those programs experiencing unit cost increases of at least 15 percent or schedule delays of at least six months. Quarterly SARs are also submitted for initial reports, final reports, and for programs that are re-baselined at major milestone decisions.

Nunn-McCurdy Unit Cost Breaches for 2013

The December 2013 reporting period, has four programs with critical or significant Nunn-McCurdy unit cost breaches to their current or original Acquisition Program Baseline.

In accordance with the provisions of sections 2433 and 2433a of title 10, United States Code, the Department will notify Congress and provide the required unit cost breach information in the SARs for these four programs.

In addition, for the two of these programs with critical breaches, a certification determination by the Undersecretary of Defense for Acquisition, Technology and Logistics will be made no later than June 17, 2014, as required by law.

Critical Breaches: (*Unit cost increases of 25 percent or more to the current APB or of 50 percent or more to the original APB*)

Joint Tactical Radio System Handheld, Manpack, and Small Form Fit Radios (JTRS HMS)—The PAUC increased 20.0 percent and the APUC increased 19.2 percent above the current APB, due to a revision in the acquisition strategy for full rate production (including a change from a single vendor per radio to multiple vendors per radio), vehicle integration requirements not previously identified as a funding responsibility of the program, and a change in the Army fielding strategy that fields fewer radios per year.

U.S. Army

Warfighter Information Network-Tactical (WIN-T) Increment 2—Program costs increased $8,969.9 million (+174.6 percent) from $5,137.4 million to $14,107.3 million, due primarily to a quantity increase of 3,167 nodes from 2,100 to 5,267 (+$6,206.3 million), which reflected the procurement of additional training base assets and a transfer of Army assets from WIN-T Increment 3 to WIN-T Increment 2.

There were additional increases in support for fielding, new equipment training, software maintenance, and initial spares resulting from the quantity increase of 3,167 nodes (+$3,015.9.0 million). These increases were partially offset by the elimination of radio antenna requirements (-$316.6 million).

Warfighter Information Network-Tactical (WIN-T) Increment 3—Program costs decreased $14,174.6 million (-79.2 percent) from $17,890.1 million to $3,715.5 million, due primarily to a quantity decrease of 2,814 nodes from 3,513 to 699 (-$10,015.3 million) and associated schedule, engineering, and estimating allocations* (+$2,003.6 million). There were also decreases related to fewer quantities of high cost configuration items being procured (-$905.9 million) and reductions in fielding, new equipment training, hardware end of life (technology refresh), and initial spares resulting from the quantity decrease of 2,814 nodes (-$5,692.6 million).

U.S. Air Force

Evolved Expendable Launch Vehicle (EELV)—Program costs decreased $3,062.7 million (-4.3 percent) from $70,685.1 million to $67,622.4 million, due primarily to savings realized in the negotiation and award of the new 2013-2017 Phase 1 contract (-$3,770.7 million), revised cost assumptions based on the negotiated contract (-$1,511.5 million), and net decreases from a change in launch vehicle configuration requirements (-$411.3 million.

These decreases were partially offset by a quantity increase of 11 launch services from 151 to 162 (+$2,505.0 million).

MQ-9 Reaper Unmanned Aircraft System (MQ-9 Reaper)—Program costs decreased $1,451.8 million (-10.9 percent) from $13,318.2 million to $11,866.4 million, due primarily to a quantity decrease of 58 aircraft from 401 to 343 (-$962.1million), associated schedule, engineering, and estimating allocations*(+$66.9 million), and a reduction of initial spares and support equipment related to the decrease in quantity (-$432.9 million).

There were additional decreases for the removal of the Airborne Signals Intelligence payload 2C (ASIP 2C) requirement (-$280.1 million) and sequestration reductions (-$142.5 million). These decreases were partially offset by increases for a warfighter requirement for extended range retrofits and communications requirements (+$138.9 million) and the addition of production line shut down costs that were not previously estimated (+$132.7 million).

Space Based Infrared System High (SBIRS High)—Subprogram costs for the Block Buy (GEO 5-6) decreased $460.9 million (-11.9 percent) from $3,869.3 million to $3,408.4 million, due primarily to a reduced estimate to reflect a fixed price contract proposal for GEO 5-6 (-$362.4 million) and Congressional and sequestration reductions (-$118.5 million).

The entire DoD report may be accessed at

http://www.defense.gov/Releases/Release.aspx?ReleaseID=16644

* *Note:* Quantity changes are estimated based on the original SAR baseline cost-quantity relationship. Cost changes since the original baseline are separately categorized as schedule, engineering, or estimating "allocations." The total impact of a quantity change is the identified "quantity" change plus all associated "allocations."

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DARPA—PHOENIX STEPS UP TO NEW TERRESTRIAL PARADIGM... NEW CHALLENGES

Successful initial efforts have fueled the next steps toward developing technologies that would enable assembly of more flexible, scalable and cost-effective space systems on orbit.

The process of designing, developing, building and deploying satellites is long and expensive. Satellites today cannot follow the terrestrial paradigm of "assemble, repair, upgrade, reuse," and must be designed to operate without any upgrades or repairs for their entire lifespan—a methodology that drives size, complexity and ultimately cost.

These challenges apply especially to the increasing number of satellites sent every year into geosynchronous Earth orbit (GEO), approximately 22,000 miles above the Earth. Unlike objects in low Earth orbit (LEO), such as the Hubble Space Telescope, satellites in GEO are essentially unreachable with current technology.

DARPA created the Phoenix program to help address these daunting challenges. Phoenix seeks to change the current paradigm by enabling GEO robotics servicing and asset life extension, while developing new satellite architectures to reduce the cost of space-based systems.

Specifically, Phoenix's goal is to develop and demonstrate technologies that make it possible to inspect and robotically service cooperative space systems in GEO and to validate new satellite assembly architectures.

Phoenix has achieved promising Phase 1 results and has awarded eight companies prime contracts for its Phase 2 efforts.

"Phase 1 not only showed the feasibility of our robotic tools and assembly techniques, but also validated the concept that we could build new satellites on orbit by physically aggregating satlets in space," said David Barnhart, DARPA program manager.

"These successes could eventually lead to the revolutionary ability to create new, truly scalable space systems on orbit at a fraction of current costs."

Phoenix's Phase 2 efforts plan to focus on developing technologies in three primary technical areas of research:

Advanced GEO space robotics: DARPA is developing a variety of robotics technologies to address key on-orbit mission needs, including assembly, repair, asset life extension, refueling, etc., in the harsh environment of geosynchronous orbit. Development activities include the maturation of robotic arms and multiple generic and mission-specific tools. These technologies would be part of a future robotic assembly platform, the Servicer/Tender.

Satlets: A new low-cost, modular satellite architecture that can scale almost infinitely. Satlets are small independent modules (roughly 15 pounds/7 kg) that incorporate essential satellite functionality (power supplies, movement controls, sensors, etc.). Satlets share data, power and thermal management capabilities.

Satlets also physically aggregate (attach together) in different combinations that would provide capabilities to accomplish a range of diverse space missions with any type, size or shape payload. Because they are modular, they can be produced on an assembly line at low cost and integrated very quickly with different payloads. DARPA is presently focused on validating the technical concept of satlets in LEO.

Payload Orbital Delivery (POD) system: The POD would be a standardized mechanism designed to safely carry a wide variety of separable mass elements to orbit—including payloads, satlets and electronics—aboard commercial communications satellites. This approach would take advantage of the tempo and "hosted payload" services that commercial satellites now provide while enabling lower-cost delivery to GEO.

DARPA is also pursuing a possible risk-reduction flight to validate the POD technology, which could eventually provide "'FedEx®' to GEO" capabilities to make future space deliveries to high orbit much easier and faster.

"Individually or together, these technologies could help enable not just Phoenix's original concept of re-use, but a broad class of other robotically enabled missions at GEO as well," Barnhart said. "They could help satellites reach new or proper orbits, inspect satellites as part of routine maintenance or troubleshooting efforts, repair or replace worn-out components, or add or upgrade capabilities. These capabilities would enable space systems, for the first time, to have the flexibility, accessibility and resilience that designers of terrestrial systems take for granted."

DARPA has awarded prime contracts for Phase 2 of Phoenix to these companies:

- *Busek*
- *Energid Inc.*
- *Honeybee Robotics*
- *MacDonald, Dettwiler and Associates Ltd.-Canada*
- *MacDonald, Dettwiler and Associates Ltd.-U.S.*
- *NovaWurks*
- *Oceaneering Inc.*
- *Space Systems/Loral*

U.S. STRATEGIC COMMAND—SPACE CAPABILITIES INTEGRATION EXERCISE

U.S. Strategic Command (USSTRATCOM) hosted a Space Table Tabletop Exercise (TTX), bringing together key leaders from the Department of Defense and Allied nations, to discuss the integration of space capabilities which provide mission-essential functions in a congested, contested and competitive space environment.

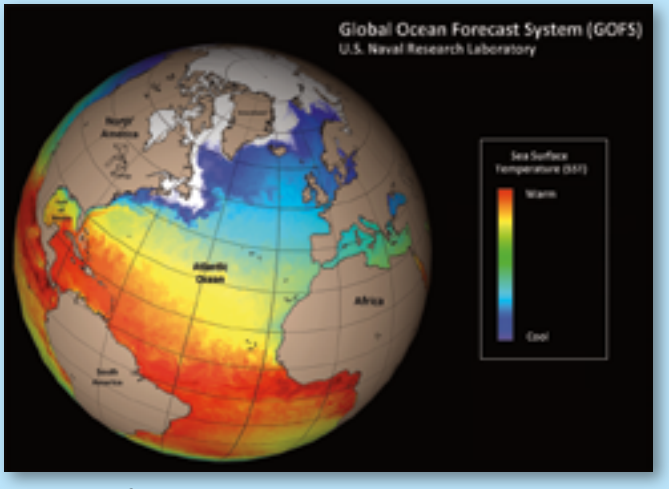
Lessons learned from the Space TTX help guide the development of capabilities, improve our ability to detect threats against U.S., international and commercial space assets and enhance the resilience of our space infrastructure.

USSTRATCOM provides Space Situational Awareness (SSA) services to increase awareness within the space domain and enhance space operations safety.

USSTRATCOM publicly shares SSA information on the Space-Track website and provides tailored information and services for owners and operators through sharing agreements to maximize spaceflight safety and the long-term sustainability of space.

Artistic rendition of an AEHF satellite. Image courtesy of Lockheed Martin.

NRL + NCEP—NAVY TRANSITIONS GLOBAL OCEAN FORECAST SYSTEM FOR PUBLIC USE



This Image from the Navy Global Ocean Forecast System (GOFS) portrays sea surface temperature (SST) on January 15, 2014. The warm tropical waters can be seen to flow through the Gulf of Mexico and northward along the eastern U.S. seaboard where the Gulf Stream separates at Cape Hatteras, off the coast of North Carolina, and flows to the east. This warm water 'conveyor-belt' alters the ice cover across the north Atlantic. Without the ocean transport of heat, global climate and weather would be dramatically changed.
(Photo: U.S. Naval Research Laboratory — Oceanography Division)

The U.S. Naval Research Laboratory (NRL) and the National Center for Environmental Prediction (NCEP) within the National Ocean and Atmospheric Administration (NOAA) have entered into a formal agreement that results in NCEP using Navy developed global ocean forecast model technology to make environmental ocean forecasts for public use.

"Development of an advanced global ocean prediction system has been a long-term Navy interest," said Dr. Gregg Jacobs, head, NRL Ocean Dynamics and Prediction Branch. "This use of Navy developed systems for global ocean forecasting represents dual use technology that will benefit civilian interests and is an excellent example of the cutting edge research that is enabled through Navy sponsored investments."

The ability to operationally predict the ocean environment and provide this critical information had been developed within the Navy through the Office of Naval Research (ONR) and NRL research and development (R&D) investments along with Oceanographer of the Navy investments resulting in the transition of systems to the Naval Oceanographic Office (NAVOCEANO).

The Naval Meteorology and Oceanography Command that oversees NAVOCEANO is responsible for providing ocean environment forecasts utilizing meteorology and oceanography, satellite and in situ monitoring systems and geospatial information and services to enable the Navy to leverage the environment and make successful strategic, tactical, and operational battle space utilization around the globe at any time.

The Navy has had requirements for predicting the ocean environment for its purposes including estimating acoustic propagation, placement of sonar arrays, determining currents for mine drift and burial, drift for search and rescue, and safety of operations on and under the ocean surface. NRL has enabled Navy operational ocean prediction of tactically relevant information.

To accomplish this task, Jacobs says three critical components are necessary to predict the open ocean environment.

"The first is access to satellite observations that measure precise sea surface height, sea surface temperature, and ice concentration with in situ observations from public sources and Navy ships; second, numerical models representing the dynamical processes capable of understanding the physics of the ocean and numerical methods for efficiently representing those physics; and lastly, the third critical component is the technology to correct the numerical models using the observations through data assimilation." These components have been implemented at the Naval Oceanographic Office for daily global ocean prediction.

Within NCEP, the observational components from satellite and from NOAA buoys around U.S. coasts are available publicly.

For the dynamical model, NCEP has adopted the Hybrid Coordinate Ocean Model (HYCOM) numerical model system developed through the National Ocean Partnership Program (NOPP) that NAVOCEANO runs to construct seven-day forecasts each day of the year.

The third critical piece provided to NCEP through the new agreement enables application of Navy technology to the civilian sector.

NOAA's NCEP has a mission to provide environment forecasts to the U.S. public and has provided meteorological information for many years.

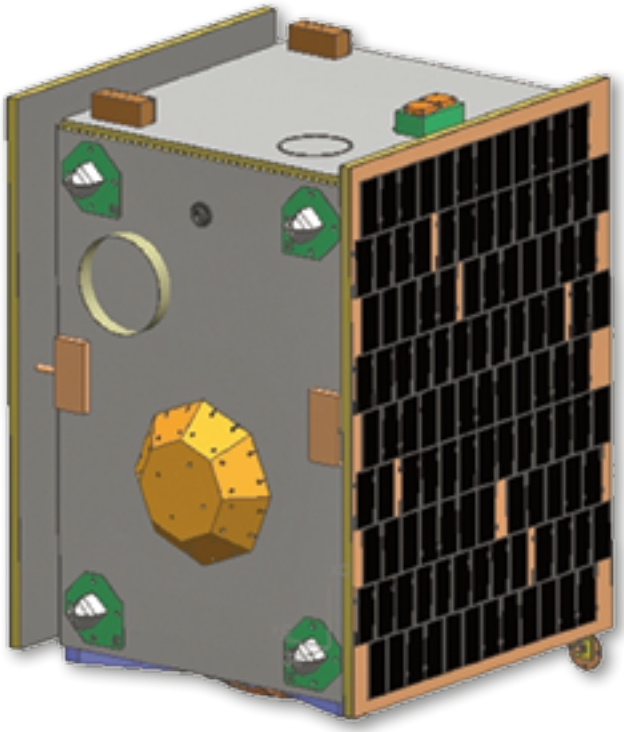
The new agreement will allow NCEP to use software developed by NRL to assimilate data necessary to maintain daily forecast accuracy that enables safe, at-sea operations, hazard mitigation, resource management, and emergency response.

"This is an example of complementary missions across agencies that, through coordinated application, leads to protecting our service personnel, who ensure the high seas are safe, and protecting our resources and citizens at home." Jacobs said.

The Naval Research Laboratory infosite is located at ***http://www.nrl.navy.mil/***

DISPATCHES

NTU—THREE YEAR TRIUMPH



Singapore's first locally-built satellite—X-SAT—has traveled nearly 700 million kilometers, captured 8,000 photographs and has completed 4,400 successful commands while orbiting Earth.

All these events were achieved while the satellite survived several solar storms, hazardous radiation and more than 30 near-collisions with space debris. The X-SAT satellite marked three years in space as of this Sunday.

The 105kg microsatellite, developed by Nanyang Technological University (NTU) and DSO National Laboratories, was launched into space on April 20, 2011, on a three-year mission.

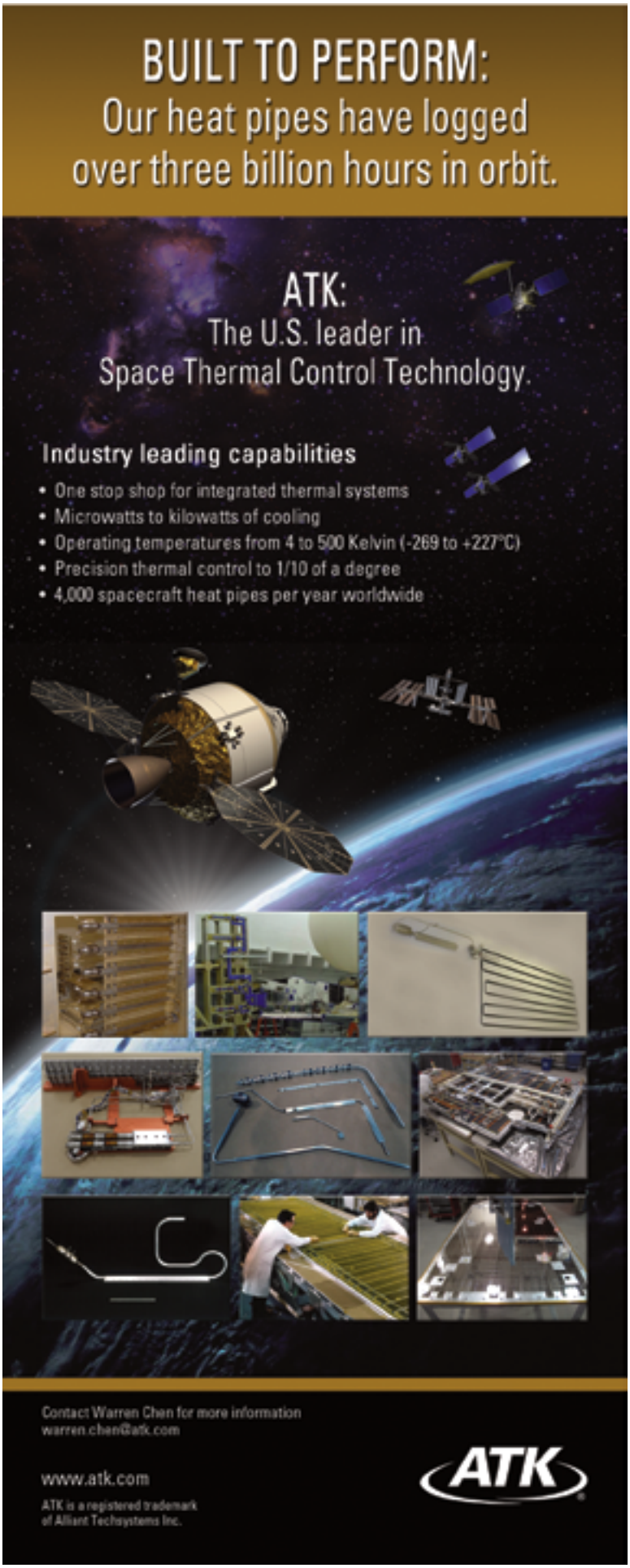
Director of NTU's Satellite Research Centre, Associate Professor Low Kay Soon, said the fully functioning X-SAT is a technological achievement, which attests to the quality of NTU's engineering expertise.

NTU is also the first university in Singapore to have a satellite program for undergraduates.

In addition to X-SAT, NTU also has another satellite orbiting the Earth which was launched on November 21st of last year. Named the VELOX-PII, it is designed, built and tested by undergraduate students.

This year, the university is set to launch another two student-built satellites, a 4.5kg nano-satellite named VELOX-I and a pico which will "piggyback" on the former and will separate from it after launch.

NTU has also embarked on building a weather satellite named the VELOX-CI and a core team from the X-SAT program is working on Singapore's first commercial remote sensing satellite, TeLEOS-1. Both TeLEOS-1 and VELOX-CI are slated for launch by late 2015.



DOD—GAMBLING WITH NATIONAL SECURITY—ESTIMATED IMPACTS FOR FY2015 DEFENSE BUDGET

Defense Department officials have released a report that documents the cuts to military forces, modernization and readiness that will be required if defense budgets are held at sequester-levels in the years beyond fiscal year 2015.

The report says sequester level budgets would result in continued force-level cuts across the military services.

- *The Army would be reduced to 420,000 active duty soldiers, along with 315,000 in the National Guard and 185,000 in the Army Reserve.*
- *The Marine Corps would drop to 175,000 active duty personnel.*
- *The Air Force would have to eliminate its entire fleet of KC-10 tankers and shrink its inventory of unmanned aerial vehicles.*
- *The Navy would be forced to mothball six destroyers and retire an aircraft carrier and its associated air wing, reducing the carrier fleet to 10, the report says.*
- *Modernization also would be significantly slowed, according to the report. Compared to plans under the fiscal 2015 budget, the department would buy eight fewer ships in the years beyond fiscal 2016—including one fewer Virginia-class submarine and three fewer DDG-51 destroyers—and would delay delivery of the new carrier John F. Kennedy by two years.*
- *The services would acquire 17 fewer joint strike fighters, five fewer KC-46 tankers, and six fewer P-8A aircraft, the report says, adding that many smaller weapons programs and funding for military construction also would see sharp cutbacks.*

In addition, the report says, the Defense Department would invest about $66 billion less in procurement and research funding compared with levels planned in the fiscal 2015 budget.

The report notes that sequester-level budgets would worsen already-existing readiness shortfalls across the force and would delay needed training to prepare the joint force for full-spectrum operations.

Overall, the report says, sequester-level cuts would result in a military that is too small to fully meet the requirements of its strategy, thereby significantly increasing national security risks both in the short- and long-term.

"As Secretary Hagel has said, under sequester-level budgets, we would be gambling that our military will not be required to respond to multiple major contingencies at the same time," officials said in the release announcing the report.

The full DoD report is available at ***http://www.defense.gov/pubs/2014_Estimated_Impacts_of_Sequestration-Level_Funding_April.pdf***

Sample chart from the report is included below: Service & Appropriation Level Impacts

$B	PB15					
	FY2015	FY2016	FY2017	FY2018	FY2019	FYDP
Army	120.3	127.2	128.9	130.2	130.8	637.4
Navy	147.7	159.5	161.2	163.7	165.9	798.0
Air Force	137.8	152.4	155.1	156.8	158.5	760.6
Defensewide	89.8	96.0	98.5	100.7	103.8	488.9
Total	495.6	535.1	543.7	551.4	559.0	2,684.8

$B	BBA/BCA					
	FY2015	FY2016	FY2017	FY2018	FY2019	FYDP
Army	120.3	119.2	121.2	124.0	126.3	611.0
Navy	147.7	147.4	152.1	156.1	160.0	763.4
Air Force	137.8	142.0	145.1	148.0	151.4	724.3
Defensewide	89.8	91.2	93.8	96.6	99.4	470.8
Total	495.6	499.8	512.3	524.7	537.1	2,569.6

$B	BBA/BCA-PB15					
	FY2015	FY2016	FY2017	FY2018	FY2019	FYDP
Army	0.0	(8.0)	(7.6)	(6.2)	(4.5)	(26.4)
Navy	0.0	(12.1)	(9.1)	(7.5)	(5.9)	(34.6)
Air Force	0.0	(10.3)	(10.1)	(8.8)	(7.0)	(36.2)
Defensewide	0.0	(4.8)	(4.6)	(4.1)	(4.4)	(18.0)
Total	0.0	(35.3)	(31.4)	(26.6)	(21.9)	(115.2)

As of 21-FEB-2014; reflects Discretionary Budget Authority

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DISPATCHES

EXELIS + FAA—ELEVATION ACCURACY FOR NATIONWIDE AIRCRAFT NET

Exelis has completed a nationwide infrastructure upgrade that will enable air traffic controllers to track aircraft with greater accuracy and reliability while giving pilots more information in the cockpit.

Exelis was selected in 2007 by the Federal Aviation Administration (FAA) to design, deploy, operate and maintain a radio network.

The network supports a satellite-based surveillance system to track aircraft with the help of GPS.

Called Automatic Dependent Surveillance-Broadcast (ADS-B), it provides more accurate aircraft location information than the current radar system.

The ADS-B program is the cornerstone of the FAA's Next Generation Air Transportation System (NexGen) initiative to modernize air traffic control in the U.S.

Under the program, Exelis has deployed 634 complex ground stations across the continental United States and in locations in Alaska, Guam, Hawaii, and approximately 100 service delivery points in FAA facilities.

The deployed system is being operated and maintained by Exelis under FAA supervision and is providing high-performance surveillance and aviation safety services that meet the technical performance measures established by the FAA. ADS-B technology enables more accurate tracking of airplanes and airport vehicles on runways and taxiways, increasing safety and efficiency.

The system significantly improves surveillance capability in areas with geographic challenges like mountains or over water.

In addition to improved safety and efficiency, ADS-B technology results in less impact to the environment and less cost to maintain.

To learn more, please visit the Exelis infosite at ***http://www.exelisinc.com/***

LASER LIGHT GLOBAL LIMITED + US FINANCE—FINANCIAL FOUNDATION FOR NEW SATNET

US Finance, Inc., a global financial solutions company, has issued a commitment to lend $24 million to Laser Light™ Global Limited, UK ("Laser Light™") to build The HALO Center™, a laser communications test and evaluation facility.

"The HALO Center™ is intended to serve as our pre-launch test, demonstration and certification facility for vendor-supplied equipment and operating system for Laser Light™'s planned Global Hybrid Satellite-Terrestrial Optical Network™, currently scheduled for deployment in 2017," said Robert H. Brumley, the CEO of Laser Light.

This center will be located in Reston, Virginia, with the funding commitment allocated for facilities, equipment and other corporate purposes that will render The HALO Center operational in late 2014.

Phil Bianca, CEO and President of US Finance, Inc., said, "We are confident that The HALO Center and Laser Light have the ability to change the face of data communications globally from this day forward."

Brumley added that the partnership with US Finance, Inc. for the initial funding commitment will enable Laser Light to open what they anticipate to be the first global, open-architect, commercial test facility and Network Operating Center (NOC) focused primarily on emerging, next-generation, Free Space Optics communications technology and operating solutions. A competitive Solicitation for these network elements is anticipated this year.

ABS Technology Architects was instrumental in the design of the facilities and the state-of-the-art architecture based on Cisco Systems, Inc. equipment for The HALO Center.

"The HALO Center™ design is intended to serve as an active, licensed 'Point of Presence' connected to the Global Grid through dual, fully redundant 100G service rings, supported by on-site data storage, co-location and hosting capabilities," said Walker Dorroh, CEO of ABS Technology Architects.

Laser Light Global Limited, UK, intends to be the Owner, Operator of the World's 1st Global Hybrid Satellite-Terrestrial All Optical Network System™. Laser Light is a registered company in the United Kingdom, and the parent company of The HALO Center, LLC and Laser Light Communications, LLC, both U.S.-registered Delaware companies.

For further information, visit ***http://www.laserlightcomms.com/***

DISPATCHES

COMTECH TELECOMMUNICATIONS—DELIVERIES FOR DCATS

Comtech Telecommunications Corp.'s Tempe, Arizona-based subsidiary, Comtech EF Data Corp., has received a $3.1 million order for SLM-5650A Satellite Modems from a government systems integrator.

The modems will be used to support the U.S. Army's Defense Communications and Army Transmission Systems (DCATS) satellite communications programs.

The SLM-5650A Satellite Modem is compliant with the strict requirements defined in MIL-STD-188-165A, modem types I, II, IV, V and VI for applications on DSCS, WGS and commercial satellites.

Data rates from 8kbps to 155Mbps and symbol rates from 32ksps to 64Msps are supported.

The modem provides standard MIL-STD-188-114 (EIA-530 / RS-422) and EIA-613 (HSSI) serial interfaces, and can be optionally configured to support G.703 and Low Voltage Differential Signaling (LVDS) serial interfaces.

It can also be optionally equipped with a 4-port 10/100/1000Base-T Ethernet Network Processor module that supports switching, routing and advanced Quality of Service protocols.

The SLM-5650A can be integrated with the Vipersat Management System (VMS) to provide fully automated network and capacity management.

An AES-256 TRANSEC module, compliant with the FIPS-140-2 NIST standard is also available as an option. All traffic (including overhead and all VMS control traffic) is encrypted when using the TRANSEC module.

Additional information is available for review at ***http://www.comtechefdata.com/products/satellite-modems/slm-5650a***

DISPATCHES

U.S. SEVENTH FLEET—WEATHER SPECIALISTS CONTRIBUTE TO PACIFIC ASSISTANCE EFFORTS

U.S. Navy Sailors use hand signals while directing helicopter operations aboard the Arleigh Burke-class guided-missile destroyer USS Kidd (DDG 100). Kidd is conducting search and rescue operations for the missing Malaysian Airlines flight MH370. (U.S. Navy photo by LS2 Karolina Karmowska-Brooks)

Seventh Fleet weather specialists, called aerographer's mates (AG), are providing critical support to Seventh Fleet's MH370 search and rescue operations during March and April 2014.

"Our initial mission was to ensure that Seventh Fleet understood the weather conditions that would occur during the search," said Cmdr. Thomas Moneymaker, U.S. Seventh Fleet oceanographer. "During the operation, we provided search and rescue ships with oceanic models of where the plane could have possibly crashed and debris drifted."

Aerographer's mates also provided meteorological support, to include reporting hazardous weather states and cloud cover to the P-3C Orion and P-8A Poseidon squadrons deployed from Command Task Force 72.

The mission of AGs is to collect, record and analyze oceanographic information throughout the Seventh Fleet area of responsibility.

Seventh Fleet AG's are essential to mission readiness because they enable U.S. Navy ships operating in the region to plan for potential weather hazards before every operation.

The 15 Seventh Fleet AG's are closely involved in pre-planning and executing bilateral exercises.

Seventh Fleet AG's are involved in exercises such as Ulchi Freedom Guardian, Key Resolve, Talisman Saber and Foal Eagle.

Before each exercise, AG's map out the weather forecasts and provide dates for which the exercises can take place.

During exercises, AG's participate in scenario briefings, weather tracking and oceanographic data management, ensuring that everything is planned and executed properly during real-time events.

Seventh Fleet AG's provide crucial information that allows ships to navigate the AOR.

"The western Pacific is notorious for tropical storms," said Senior Chief Aerographer's Mate Keith J. Chevalier, U.S. Seventh Fleet's meteorological and oceanographic division leading chief petty officer. "This area of operations has more storms than anywhere in the world."

AG's are also responsible for preparing up-to-date weather maps and oceanographic data, issuing weather forecasts and warnings, testing, calibrating and performing minor and preventative maintenance on meteorological instruments including satellite receivers, preparing balloon-carried instruments for flight, evaluating and analyzing data received and operating, programming and maintaining computers and related equipment.

Essentially, AG's provide a plan for all ships before any operation start, and keep all equipment in perfect working condition during every mission to ensure completion.

In instances such as the tsunami that devastated Sendai, Japan, AG's provided preemptive warnings to ships within areas that could be affected in an effort to remove them before the disaster struck.

The AG's tracked both the initial earthquake and the tsunami. Following the tsunami, Operation Tomodachi began in March 2013. Operation Tomodachi provided vital relief efforts to Japan citizens who were devastated by the tsunami.

The AG's were instrumental in providing updated reports on the new sea state of the affected area, therefore initiating the relief efforts.

The AG's used the experience gained by Operation Tomodachi and used it in the relief efforts for Typhoon Haiyan. On November 8, 2013, the AG's redirected ships out of the area before Haiyan made landfall in the Philippines.

Following the typhoon, the AG's provided all the ships involved in Operation Damayan, the relief effort held in the Philippines, with meteorological support as well as accurate readings of how the sea floor was affected by the storm, said Chevalier.

Chevalier concluded that AG's also play a major role in the normal day-to-day operations in the fleet, as well.

The U.S.S. Kidd engages in a search for the missing airliner. Photo is courtesy of the U.S. Navy.

Story by
Mass Communication Specialist
3rd Class Cody R. Babin,
U.S. Seventh Fleet Public Affairs

DISPATCHES

BOEING + U.S.A.F.—FIFTH GPS IIF HANDOVER OCCURS

Artistic rendition of a GPS IIF satellite. Image courtesy of Boeing.

The accuracy of the Global Positioning System (GPS) has improved with the recent handover of a fifth Boeing GPS IIF satellite to the U.S. Air Force.

The newest addition to the GPS constellation increases the precision of position, navigation and timing data sent to users around the world.

The satellite was launched on February 20, 2014. The Air Force, which operates the GPS system, and Boeing have now completed deployment and validation of the spacecraft's systems, stabilizing the vehicle and activating its navigation payload.

Craig Cooning, vice president and general manager of Space and Intelligence Systems, said, "With this latest successful handover, Boeing is maintaining a robust operating rhythm this year to support the GPS program."

Boeing is preparing the next GPS IIF satellite—the sixth of 12—for a second quarter launch.

The GPS IIF delivers improved accuracy, greater security and anti-jam capabilities while maintaining baseline legacy GPS performance.

Since the first launch in 1978, Boeing-built GPS satellites have accumulated the equivalent of more than 500 years of on-orbit operation.

The Boeing Defense, Space & Security infosite is located at ***http://www.boeing.com/boeing/bds/***

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DISPATCHES

COSTA RICA + CENTRAL AMERICA—JOINING THE GLOBAL SATFAMILY

Representatives of the Central American Aeronautics and Space Administration and scientists from the Technological Institute of Costa Rica demonstrate a tiny picosatellite to Costa Rican President Laura Chinchilla. Photo is courtesy of ACAE.

The Central American Aeronautics and Space Administration (ACAE) has officially announced that the first Central American satellite, built in Costa Rica, will be launched into space in 2016.

The satellite will collect and relay daily data on carbon dioxide to evaluate the effects of climate change.

That data will be sent to monitoring bases in tropical forests at the Santa Rosa National Park in Costa Rica's northwestern province of Guanacaste.

Information will then be broadcast to another base station at labs operated by the Technological Institute of Costa Rica (ITCR) for analysis and processing.

The project was declared of public interest by an executive decree signed Monday by President Laura Chinchilla, who leaves office in May.

"The signing of this decree is an historic event for Costa Rica that will allow the country to position itself as an innovative nation. It is a message to the world that this country is still thinking big. This project will return our people the ability to dream," ACAE President Carlos Alvarado said.

The device weighs less than 10 kilograms and technically is considered a miniature satellite, or picosatellite (pico).

The pico was developed over three years with help from ITCR experts and two Tico scientists, former NASA astronaut Franklin Chang Díaz and NASA engineer Sandra Cauffman, who also is assistant director of the MAVEN project, a mission currently studying the atmosphere of Mars.

The launch likely will take place outside of Costa Rica, which currently has no launch infrastructure.

"In order to launch the picosatellite, we could either hire a private service or sign a cooperation agreement with a space agency. We already have held conversations with South Korea and NASA," Alvarado said.

(Source: The Tico Times)

ORBCOMM + SAVI TECHNOLOGY—GOVERNMENT CARGO CONCERNS TO BE MITIGATED

Savi Journey Management screenshot.

ORBCOMM Inc., a global provider of Machine-to-Machine (M2M) solutions, has announced that its partner, Savi Technology (Savi), has been awarded a five-year U.S. Department of Defense contract as the sole provider to the $204 million RFID-IV program, which currently has a $102 million ceiling.

The RFID-IV program offers a wide range of technology solutions, including newly-upgraded Radio Frequency Identification (RFID), satellite-based, Enhanced In-Transit Visibility (EITV) and Advanced Intrusion Tracking Detection (ATID) products and services, to a wide range of government customers for global asset planning and tracking of personnel, equipment and sustainment cargo worldwide.

In support of the RFID-IV program, ORBCOMM and Savi will offer satellite and RFID tags as well as other sensor technologies using ORBCOMM's global communications networks, which will enhance the visibility and security of government cargo in transit.

ORBCOMM's advanced tracking and monitoring solutions will provide government customers with the current location of their cargo and send real-time alerts for security breaches and other anomalies such as cargo entering or exiting a geozone outside of pre-determined parameters for immediate resolution.

U.S. government customers, including the Army, Navy, Air Force, USTRANSCOM, Special Forces and Defense Logistics Agency, can now seamlessly track and secure their cargo anywhere in the world and access near-real-time operational data through existing government EITV systems or secure, dedicated web portals to meet specific mission needs.

The ORBCOMM infosite is located at ***http://www.orbcomm.com/*** For further details regarding Savi Technologies, head to ***http://www.savi.com/***

DISPATCHES

EX-IM BANK, ASIASAT + SPACEX—THREE PURCHASES + TWO LAUNCHES ARE WINNERS

Asia Broadcast Satellite (ABS) received the Deal of the Year award from the Export-Import Bank of the United States (Ex-Im Bank—the award was presented on April 24th at the Bank's 39th Annual Conference in Washington, D.C.

Ex-Im Bank recognized ABS for their purchase of three geostationary satellites, built by Space Systems/Loral (SS/L) and Boeing Satellite Systems, and two space launches provided by SpaceX.

In November 2012, the Bank authorized a total of $471 million in loans to support the transaction.

The ABS deal marked the Bank's first financing of a SpaceX launch and of a new model of Boeing satellites, the 702SP.

The 702SP is the first commercial satellite to use all-electric propulsion for orbit-raising.

The two Boeing 702SPs will launch on SpaceX Falcon 9 rockets in late 2014 and in 2015.

The ABS deal will support approximately 3,700 high tech jobs in the United States, according to Ex-Im Bank estimates derived from the Departments of Commerce and Labor data and methodology.

In addition, Ex-Im Bank's financing supported the purchase of an SS/L FS1300, C/Ka/Ku-band satellite, named ABS-2. ABS-2 successfully launched on February 6, 2014, and is one of the largest geostationary satellites in Asia. From its orbital location at 75 degrees East, the satellite will extend affordable and reliable communications and broadcast services to Africa, Asia Pacific, Europe, the Middle East and Russia/CIS countries.

Ex-Im Bank's 2014 Annual Conference focuses on the global business environment and prospects for growth.

A full listing of speakers, panelists, and moderators is available on Ex-Im's website at ***http://www.exim.gov/***.

DISPATCHES

U.S.A.F.—SHELTON DISCUSSES BUDGET CUTS AT TINKER AFB

General Shelton, commander, Air Force Space Command.

Innovation and cost-saving ideas will help ensure the Air Force keeps its warfighting readiness despite significant, ongoing budget cuts, said the commander of Air Force Space Command.

General William L. Shelton spoke to members of the 38th Cyberspace Engineering Installation Group at Tinker Air Force Base in Oklahoma.

"If there ever was a time for innovation, this is it," Shelton said. "That's the only way we're going to get through these next few years of declining budgets. We have to think our way through this. "There's that famous old saying—we've run out of money and now we have to think. That's where we're at."

Shelton praised the more than 650-member group's cutting-edge work around the globe. He listed the major achievements for 38th CEIG in the past year, including 17 quarterly and four annual awards at the wing level. Wing members also managed and implemented 216 communications modernization projects at 85 bases, Shelton said.

"That's just an amazing list of accomplishments, and I hope you're all proud of that," General Shelton said. "I hope you see it the same way I do, for the effect that it's having across the Air Force—not just inside the cyber family, but literally every Airman across the Air Force is affected by what you do. It's just tremendous work."

The 38th CEIG is described as the Air Force's premier engineering and installation group, "The backbone of the cyberspace domain."

Airmen and civilian members engineer and install cyberspace infrastructure for communications and offensive and defensive air, space and cyberspace operations.

The general said he's never seen anything like the cuts facing the military through Congress' sequestration law.

The 2011 law led to deep, across-the-board cuts when Congress failed to reach agreement on more targeted spending cuts.

"In almost a 38-year career, I've never seen anything that's this serious in terms of what we're throwing at our leadership, what we're throwing at our people and what we're expecting people to do with fewer resources," Shelton said.

In budget planning, Shelton described how Air Force leaders wrestle with directives imposed by Congress and the secretary of defense, all the while meeting the branch's mission to fight and win wars ranging from insurgencies to near-peer conflicts.

He told group members that the budget realities are "our time." It's a challenge to be embraced, he said.

"Whatever you can do to come up with solutions that really do save us money and provide additional capability across the Air Force, we're all for it," Shelton said. "I'll be the greatest champion for those solutions, because we need them."

U.S. ARMY NATIONAL GUARD—COMEX 14 INSPECTION RESULTS IN VALIDATION

Commander of the Task Force 46, Maj. Gen. Burton Francisco and his staff inspect a Satellite Transportable Terminal system and supporting generator used to support Joint Network Nodes and Command Post Nodes Communications systems.

The 46th MPC and down trace units from Kentucky, Florida and Alabama National Guards, known as Task Force 46, gathered to validate a wide array of signal assets throughout the training weekend. Francisco met with the signal soldiers from each down trace unit to witness first-hand the communications capabilities that would be used during a real-world mission. COMMEX 14 was a resounding success.

Michigan National Guard photo by Staff Sgt. Helen Miller

DISPATCHES

GENERAL DYNAMICS C4 SYSTEMS—CONNECTIVITY LAB FOR MUOS OPENS

General Dynamics C4 Systems has opened the MUOS Radio Testing Lab at its Scottsdale, Arizona, location.

The U.S. Navy-approved laboratory is one of two that supports testing for radio-terminals intended to connect with the MUOS space-ground network. The lab is equipped with hardware and software that simulates the radio's connectivity with the MUOS ground network.

"The MUOS Radio Testing Lab in Scottsdale will help the U.S. military and government to cost-effectively and efficiently add MUOS-capable radios to their communications network," said Chris Marzilli, president of General Dynamics C4 Systems.

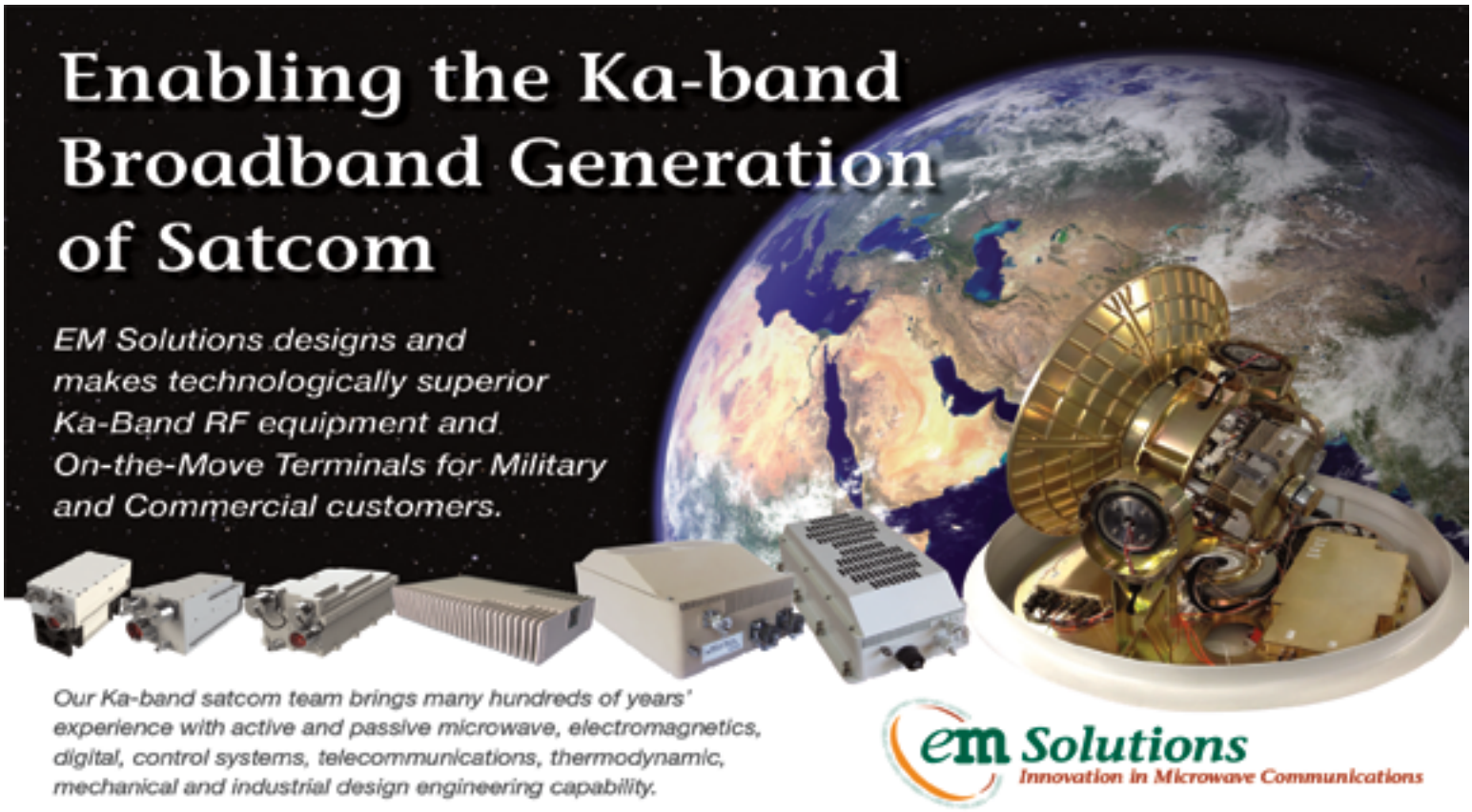
"This brings this critical operational capability even closer to being available to military and government personnel."

To test connectivity with the MUOS system, radios are provisioned with the General Dynamics-developed MUOS waveform to make secure voice calls and complete data transmissions at different data rates across the simulated MUOS network. The MUOS waveform, housed in the government waveform information repository, leverages the widely-used commercial Wideband Code Division Multiple Access (WCDMA) cell phone technology.

The first terminal to receive government authorization and enter the Scottsdale lab was Rockwell Collins' ARC-210 radio that began testing in March. Companies interested in accessing the General Dynamics C4 Systems MUOS Radio Testing Lab must first contact and receive approval from the Navy's Communications Satellite Program office, PMW 146, to authorize access to the test facility.

For more information about how General Dynamics connects satellites to ground-based command and control systems visit ***http://www.gdc4s.com/space?taxonomyCat=322***.

General Dynamics C4 Systems is a business unit of General Dynamics (NYSE: GD). More information is available online at ***http://www.gdc4s.com***.



UNITED LAUNCH ALLIANCE—ATLAS V ROCKS NROLS INTO ORBIT

By MilsatMagazine's Executive Editor

A classified launch on April 10th was successful and also created a great deal of speculation as to the purpose of the mission and the satellite's resulting orbit...

United Launch Alliance (ULA) successfully launched their second mission in just seven days with the liftoff of their Atlas V rocket carrying a payload for the National Reconnaissance Office.

This new satellite, designated NRO Launch 67 (NROL-67), lifted off from Cape Canaveral's Space Launch Complex-41 (SLC-41) on schedule at 13:45 local time (17:45 UTC) or 1:45 p.m. EDT on Thursday, April 10th.

The rocket launch had been initially delayed last month after ULA stated that an issue had developed with a range asset that was needed to support the launch.

Space Launch Complex 41 at Cape Canaveral Air Force Station is a former Titan launch pad and is now the east coast home for the Atlas V. Constructed during the 1960s, the pad has previously been used by Titan IIIC, IIIE and Titan IV rockets. ULA reported no technical problems. Weather was 90 percent favorable for the launch.

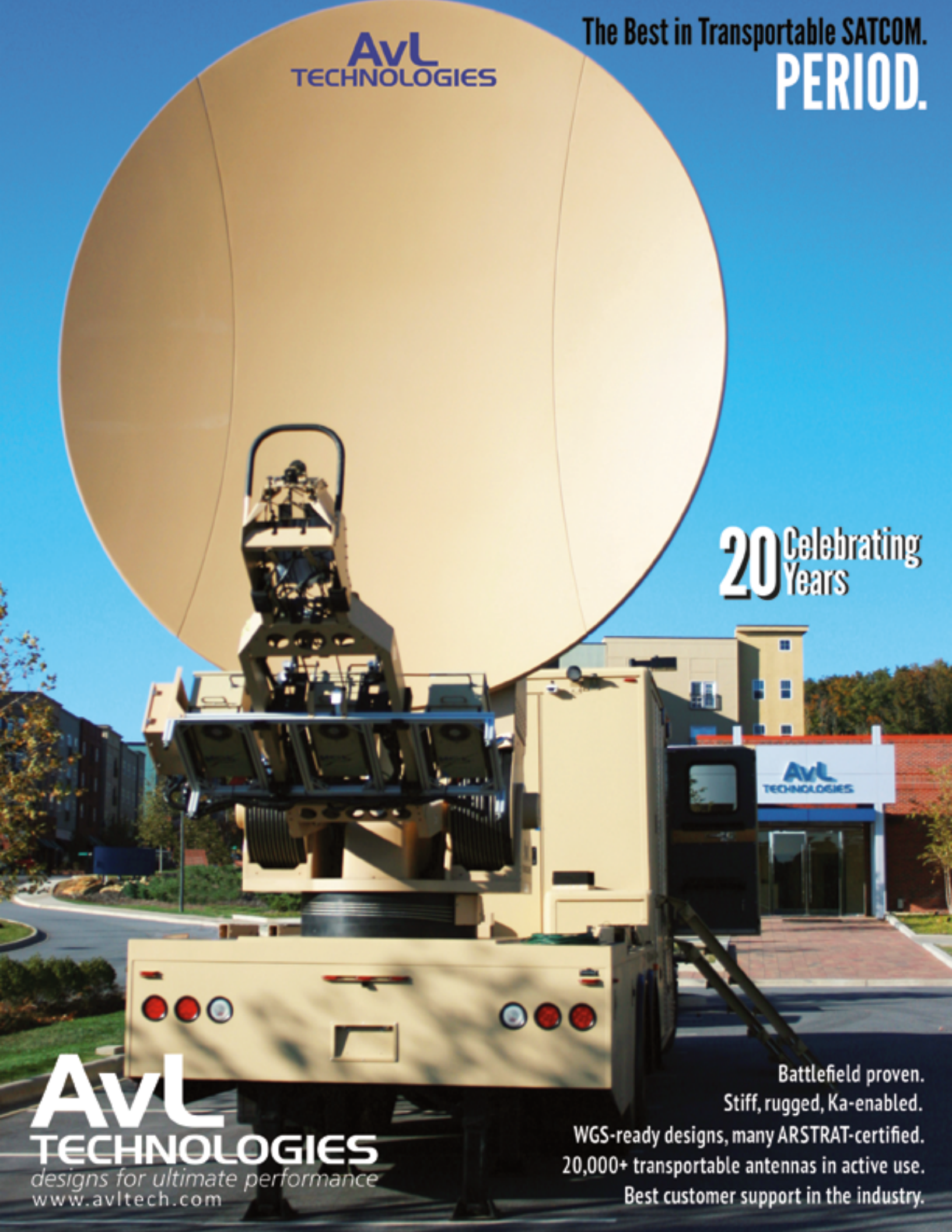
The mission of the NROL-67 payload is classified. While this has never stopped observers from identifying most NRO spacecraft ahead of their launch, this marks the first use by the NRO of an Atlas V 541 rocket, an indication that this is likely a new payload class. As such, the spacecraft is much harder to identify as there are no similar launches for comparison purposes.

Notices to airmen (NOTAMS) and hazard areas published ahead of the launch revealed that the rocket would launch to the East, over the Atlantic Ocean, into a low-inclination orbit. Such a trajectory means that the payload is almost certainly bound for a geosynchronous orbit, as other equatorial regimes are of little value for reconnaissance and intelligence gathering.

NROL-67 was, at one point, also believed to have been slated for a west coast launch, however, a launch from Vandenberg AFB in California would have been incapable of reaching a geosynchronous orbit.

The true nature of NROL-67 will be difficult to ascertain until the satellite has been sighted in orbit and observed over a period of several months.

A team of amateur observers keep track of classified satellites, posting data on such satellites' locations and orbits online. The most likely explanation is that this new satellite is the long overdue replacement for the Mercury satellites. However, this still leaves many questions unanswered.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The use of the more powerful Atlas V 541 for NROL-67 means that this payload is unlikely to be related to the Satellite Data System; however, it is still possible that it could be a newer and larger satellite, two spacecraft launching together, or a satellite being placed directly into geostationary orbit, rather than the transfer orbit usually used for such missions.

The Atlas V used for the NROL-67 mission was AV-045. The forty-sixth Atlas V to fly, this was the second launch vehicle to use the 541 configuration, which makes use of a payload fairing with a diameter of five meters, four solid rocket motors and a Centaur upper stage with a single engine. This configuration has flown just once before; when it sent the Curiosity rover on its way to Mars in November of 2011.

The first stage of the Atlas is a Common Core Booster, powered by a single RD-180 engine derived from the RD-170 series that was developed in the Soviet Union for the Zenit and Energia rockets.

The twin-chamber RD-180 is fueled by RP-1 propellant and liquid oxygen. Four of a maximum five Aerojet Solid Rocket Motors (SRMs) were used to augment the CCB's thrust at liftoff on Thursday's mission.

The second stage, the Centaur, is powered by an RL10A-4-2 engine burning liquid hydrogen and liquid oxygen. During the early stages of flight, the second stage is encapsulated with the payload inside the fairing. AV-045 sported the short variant of the five-meter fairing, measuring 20.7 meters (67.9 feet) in length and 5.4 meters (17.7 feet) in diameter.

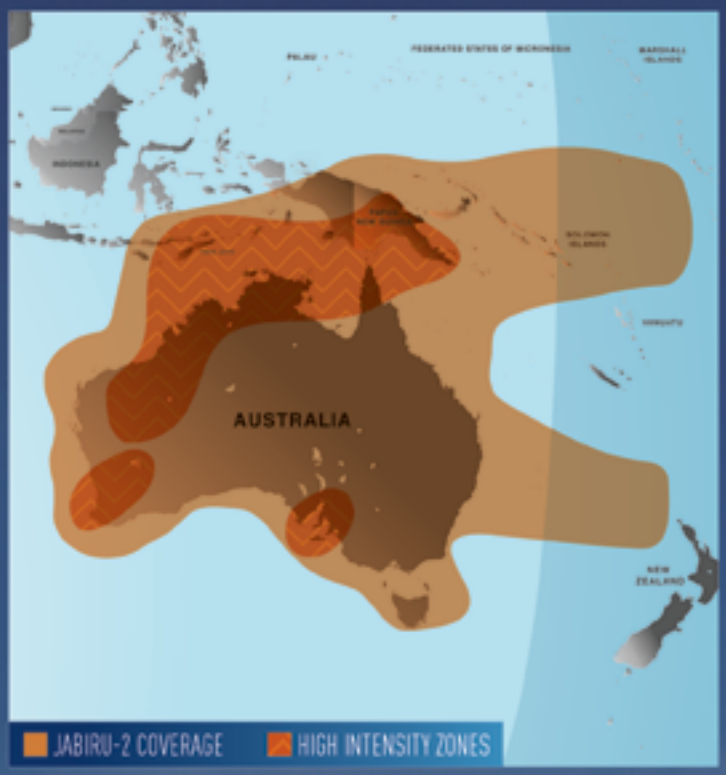
Atlas V configurations with more than three solid rocket motors require the use of a five meter fairing, as opposed to the four meter fairing which leaves the Centaur exposed, as the upper stage would not be able to withstand the loads imparted by the additional boosters. As such, its use does not necessarily mean that NROL-67 is too large to fit within a four meter fairing, such as the smaller Trumpet SIGINT satellites that operated in Molniya orbits.

AV-045's flight plan was not announced. Events in the early stages were deemed to be similar to the Mars Science Laboratory launch, with RD-180 ignition occurring at T-2.7 seconds, with the solids joining them at T-0.

Around 11/10ths of a second later, the Atlas lifted off to begin its ascent. Roll, pitch and yaw maneuvers began at around T+5.2 seconds to attain the necessary attitude to achieve its target orbit. However, the early flight was close to vertical as AV-045 climbed out of the atmosphere to reach an altitude at which fairing separation can safely occur. The solid motors burned for around 85 to 90 seconds before they separated into pairs approximately 27 seconds later.

A ULA Atlas V launch vehicle awaits the launch sequence with its NROL-67 payload. Photo is courtesy of United Launch Alliance.

Jabiru-2
Launching May 2014



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Fairing separation came around the three and a half minute mark, with the forward load reactor being jettisoned from the nose of the Centaur shortly afterwards. The load reactor is a device used to dampen vibrations within the fairing while it is attached, preventing acoustic damage to the satellite.

Direct insertion into geostationary orbit would require a three-burn profile, while a transfer orbit could be reached in two or three burns depending on mission requirements. The three-burn profile has been favored for past NRO SIGINT launches, and is also used on some of Russia's Proton launches. By contrast, the majority of geosynchronous launches use a transfer orbit, and that approach has been used in the past for the NRO's Quasar satellites.

For a typical mission to place a satellite directly into geostationary orbit, the Centaur would make an initial burn lasting around eight and a half minutes. After coasting for nine and a half minutes, the stage would restart and burn for about 265 seconds to reach its transfer orbit.

The Centaur would then begin rolling to maintain thermal control during its extended coast phase. After five hours and seven and a half minutes of coasting, the RL10 would restart for a further two minutes to place the payload into its target orbit with spacecraft separation occurring about two and a half minutes later.

The mission patch for NROL-67 depicts the winged horse Pegasus above the Earth, with the words "in scientia opportunitas" which translate to "In knowledge there is opportunity". The launch patch for NROL-67 depicts a dragon set against clouds and a full moon. The motto reads "forest fortuna adiuvat", an unusual variant spelling of "fortes fortuna adiuvat"; "fortune favors the bold".

Significantly, the depiction of the Earth prominently shows Europe, rather than North America, like most U.S. military patches. This may indicate the satellite positioning in geostationary orbit.

The dragon has long been a symbol associated with the NRO's signals intelligence missions. The suggestion has been made that the dragon's presence on a patch, which is traditionally designed by the launch team, rather than the payload team as in the current cases, may simply be coincidence—symbols have in the past been seen on launch patches as well as the more prominent payload patches.

A ULA Delta V lifts off from Cape Canaveral with the NROL-67 payload. Photo is courtesy of United Launch Alliance.

NROL-67's patches have not been circulated as widely as those from previous missions, presumably as a result of the media backlash against the patch that was issued for the NROL-39 mission last December. Coming at a time of widespread contempt for U.S. intelligence agencies, the patch—which depicted an octopus wrapping its tentacles around the world and the words "nothing is beyond our reach"—was considered to be in bad taste.

The NRO has had two or three principal constellations of spacecraft in geosynchronous orbit, each fulfilling different purposes. The Quasar or Satellite Data System (SDS) spacecraft are used to provide communications between lower-orbit reconnaissance satellites and ground stations. Three generations of SDS satellites have been launched since 1976.

The first-generation SDS constellation consisted solely of satellites in Molniya orbits; inclined elliptical trajectories which keep the satellites over high latitudes for long periods of time.

The second generation introduced a geostationary component—USA-67 was launched aboard Space Shuttle Atlantis during the STS-38 mission, along with Prowler; a one-off mission whose existence has never been officially acknowledged.

More geosynchronous satellites were introduced in the third-generation system; two spacecraft were launched to geostationary orbit at the start of the 2000s, with replacements launching in 2011 and 2012.

Quasar launches during the EELV era have made use of Atlas V 401 and Delta IV Medium+(4,2) rockets.

The remainder of the NRO's geostationary fleet is used for signals intelligence (SIGINT) of one form or another.

Orion satellites, formerly known as Magnum, are believed to be used to intercept and eavesdrop on communications, while the Mercury series pinpoints radar signals, although some reports reverse the assumed missions of these two series.

Another suggestion has been that the Mercury series is used to collect data from communications while Orion intercepts telemetry data from foreign missiles.

The most recent mission, June 2012's NROL-15, featured modifications to the Delta IV, already the most powerful rocket in America's launch fleet, to increase its payload capacity. These were rumored to be required due to the mass of the satellite.

In light of this, NROL-67 seems too small to be a part of this series, unless new technologies have enabled significant mass reductions over the earlier vehicles.

It is not known whether the Orion satellites launched in recent years carried any modifications as a result of this program or whether it was abandoned. However, there has been no sign of a new satellite taking on this combined role.

It is also possible that NROL-67 could be unrelated to the main geostationary constellations; instead, the satellite could be a one-off mission or even the start of a completely new NRO series.

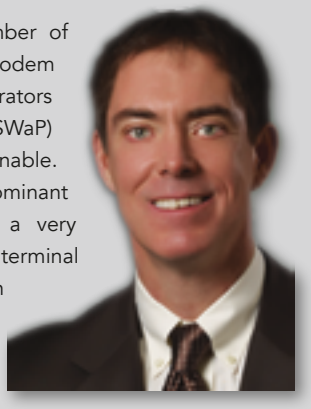
Documents leaked to the Washington Post last year by Edward Snowden hinted at a signals intelligence satellite named "Nemesis 2," which received half a billion dollars of funding during the 2011 financial year. No spacecraft could be identified as either Nemesis 2 or its presumed predecessor Nemesis 1. One possible, though conjectural, explanation is that Nemesis 1 may have been the Prowler satellite launched in November of 1990 via the Shuttle Atlantis, with a follow-up launched many years later.

One other Atlas V 541 launch for the NRO, that being NROL-42, is scheduled to liftoff from Vandenberg AFB no earlier than 2017.

REDUCING THE SIZE, WEIGHT + POWER NEEDS OF MILSATCOM EQUIPMENT

By Karl Fuchs, Senior Contributor

Today's military deployments require satellite communication equipment that is smaller, lighter, draws less power, is easier to setup and yet delivers higher bandwidth than ever before.



Fortunately, there have been a number of technological advances that allow modem manufacturers and terminal integrators to reduce size, weight and power (SWaP) to levels previously thought unobtainable. Historically, the largest and most dominant component of a very small aperture terminal (VSAT) has been the antenna.

Due to bandwidth requirements, power limitations on the BUC and the link budget constraints of the satellite, terminals have required antennas with an aperture of one meter or larger.

Many missions today require rapid deployment and man portability of high-bandwidth satellite terminals. Therefore, sub-one meter antennas are required. Many designs of next-generation terminals are incorporating flat panel antennas. For many satellite bands, most notably Ku-, spread spectrum technology is required to alleviate the problem of adjacent satellite interference encountered when utilizing sub-one meter or flat panel antennas. Therefore, satellite modems designed for man portable and sensor applications must support this demanding and power hungry feature.

Thanks to Moore's law, the general reduction of electronic components and improved printed circuit board densities have resulted in helping to decrease the physical size and weight of satellite routers. Currently deployed man portable routers require roughly 70 square inches of board space, while next-generation designs occupy less than 40 square inches. This reduction in router size enables a dramatic reduction in the terminal's footprint.

The physical size of a terminal is an important consideration. However, the true determination of portability is power consumption. Power consumption equates to batteries, and batteries are heavy. A single BB-2590 lithium battery weighs in excess of three pounds. As a rough measure, a single battery can power a standard terminal for 60 to 90 minutes. As you can easily determine, the deployed weight of a man portable terminal is a direct function of time on-the-air.

The most recent, currently deployed advancement designed to extend battery life in a time division multiple access (TDMA) system is the transmit key-line. With a transmit key-line, a TDMA modem works in concert with an intelligent BUC to power down the BUC in between the terminal's burst interval. Depending on the network traffic profile, power savings of 40 percent can be achieved using a transmit key-line enabled terminal. Advances in electronics which improve power efficiencies are driving the design of the next-generation man portable and sensor remotes.

For example, new field-programmable gate array (FPGA) architectures incorporate a central processing unit (CPU) which negates the need for a separate CPU on the printed circuit board. Not only does this architecture speed instructions and memory calls, it decreases the power requirements of the system.

Coupled with continued improvements in DC to DC power converters, these and other improvements enable next-generation satellite routers with power draws on the order of 15 to 19W. Current generation satellite routers consume in excess of 35W. The net effect is a 50 percent reduction in battery weight required for any given mission.

Another factor that impacts the physical size of a terminal and greatly impacts power consumption is heat dissipation of the electronics. Most terminals deployed today rely heavily on fans for conductive cooling. Fans have a number of drawbacks including mean time between failure implications and noise as well as sand and dust contamination of internal electronics.

The adoption of heat pipes for thermal management in man portable terminals has led to dramatic weight reductions and reliability improvements. Heat pipes are not new technology. Heat pipes have been used for quite some time in laptop PCs.

A heat pipe is a device which relies on a phase transition to extract heat from a device. The concept is not unlike pouring water on a hot surface to cool it off. When you pour water on a hot surface, the water experiences a phase transition in its evaporation. That phase transition requires a good deal of heat energy which it takes from the hot surface, thus cooling it.

A heat pipe is much more controlled than simply pouring water on a device. The liquid in a heat pipe evaporates and travels up the pipe to a cold surface. The heat energy is transferred as the vapor condensates and travels back down the pipe to repeat the cycle.

Heat pipes can use a number of different liquids with varying thermal properties, depending on the operating temperatures of the electronics. Heat pipes can reduce, or even eliminate, the dependence on fans, depending on how heat is transferred off the cold plate of the terminal.

Looking further into the future, development is under way to consolidate the entire modem functionality into an ASIC. An ASIC design would further reduce discrete components on the printed circuit board thereby reducing footprint and power draw.

Metamaterial antennas are another fascinating field of research that promises to dramatically decrease overall size and weight of terminals.

The technological advances of the past few years have brought high-bandwidth applications such as high-definition video feeds to the warfighter level. Access to this valuable information has come at a price. That price has been an increase in the soldier's load. The entire satellite industry is committed to, and working toward, providing secure, reliable, high-speed communications as conveniently as possible.

About the author

Karl Fuchs is vice president of technology for iDirect Government Technologies (iGT). He joined iGT in 2004 as the director of sales engineering, just as the satellite-based IP communications company was expanding its very small aperture satellite (VSAT) market presence into the federal government and international Internet Protocol (IP) networking world. He now works as the vice president of technology.

With more than 20 years of experience in technology and with the federal government, Fuchs leads iGT's team of federal systems engineers and serves as chief architect for new product integration.

Prior to joining iGT, Fuchs was director of systems engineering at Nortel Networks, where he oversaw the Verizon account team of systems engineers, leading the design of IP, frame relay, asynchronous transfer mode (ATM) and dense wavelength division multiplexing (DWDM) networks. Before joining Nortel, he designed IP and ATM networks for Sprint and the federal government.

Active in the satellite industry for more than 10 years, Fuchs has contributed editorial to numerous publications including Federal Computer Week, Institute for Defense and Government Advancement, COTS Journal, Military Information Technology, Via Satellite, MILSATCOM and Satellite Evolution Global. In addition, he has been a featured speaker at leading industry events including the DoD SATCOM User Workshop, ISCe, IBC, Pacific Telecommunications Council and Emergency Management Talks.

Editors note

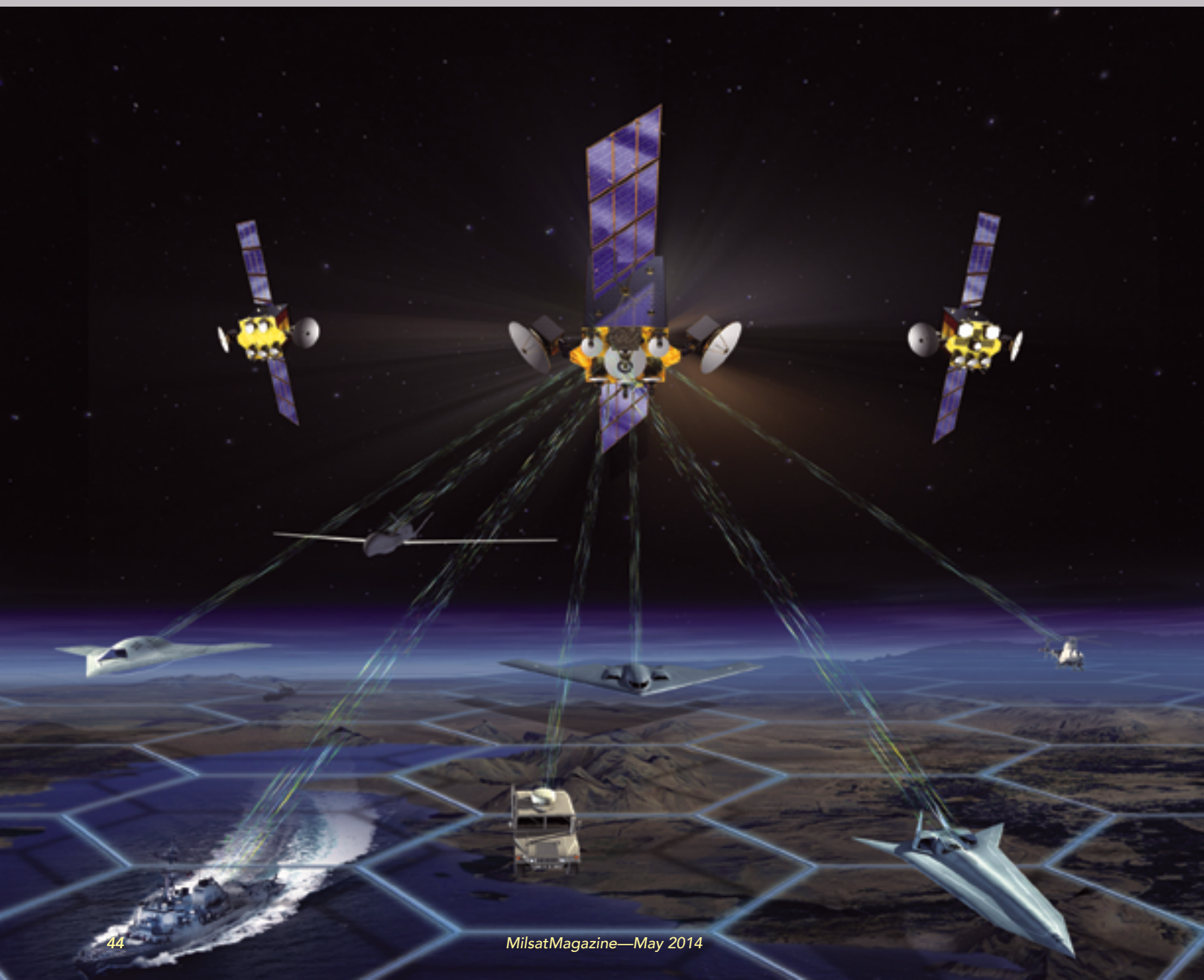
Introductory photo is courtesy of the DoD—the photo bis y Staff Sgt. Samuel Bendet, U.S. Air Force.

MEASURING MILSATCOM ASSURANCE OBJECTIVELY + INTUITIVELY IN AN ADVERSARIAL ENVIRONMENT

By Gregory Edlund, Director, Communication Systems, Chief Engineer + Architect, Space Systems, Northrop Grumman Space Systems

Given the growing importance of assured military satellite communications (MILSATCOM) to successfully execute global missions, the Department of Defense (DoD) is facing significant near-term decisions concerning the future of satellite communications. It is extremely important to make the right decisions, objectively and intuitively, as MILSATCOM systems take decades to acquire and field. Communications that are not assured potentially jeopardize mission execution with catastrophic implications for our national security.

Characterizing assured communications becomes critical in the midst of dramatically changing budget and threat environments. Two terms that have been the subject of significant debate, resilience and protection, are key to this characterization. In the past, assured communications in an adversarial environment was summarized by the term protection (e.g., for the Milstar system) and called protected communications.



Today the term resilience has gained prominence due to the rising concern of physical attacks. Resilience in today's context emphasizes a system's ability to continue providing required capabilities in the face of damaging attacks. Protection, in this light, now refers to a system's robustness and its ability to withstand threats without any degradation in capabilities. Separately, it is imperative that we understand the decisions ahead and make the right ones. To avoid confusion, we will use the term 'assured communications' to represent both resilience and protection.

A framework that objectively and intuitively defines and measures assured communications becomes imperative. This framework should identify the underlying architecture objectives that will provide the highest value in reducing risks from adversary threats. We believe the following characteristics must be clearly and simply established as the foundation for such a framework:

1) *Definition: Enabling a common understanding and dialogue among community leadership*
2) *Measurement: An intuitive and objective approach that avoids subjective dialogue and conclusions*
3) *Principles: A simple, intuitive application to space architecture and acquisition*

This article will provide such a detailed framework to objectively and intuitively assess assured communications capabilities of future MILSATCOM architectures being considered.

The Growing Importance Of Assured MILSATCOM

Mission success must always be the military's top priority. Relevant, timely and actionable communications are crucial for ensuring successful military campaigns. The denial of such capability can be disastrous. With continuing affordability and capability challenges, the DoD has turned to technology as a force multiplier.

As military systems and weapons increase in capability and complexity, MILSATCOM needs to keep pace with improvements in capacity, connectivity and protection from threats. This growing dependence and demand on communications places a heavy burden on the need for future assured MILSATCOM architectures. Adversaries can neutralize DoD systems and broader infrastructures costing billions, if not trillions, of dollars with tactics that cost significantly less, putting our national security in peril.

Currently, most of the global, mobile DoD enterprise is supported by unprotected MILSATCOM vulnerable to readily available, low-cost threats. One of the most important investment decisions our leaders face today is which communications foundation they will build upon, fully realizing the far-reaching effects on future military power as asymmetric threats to MILSATCOM are emerging precipitously.

The Dramatically Changing Threat Environment For MILSATCOM

In the past, MILSATCOM threat assessments were primarily focused on the most unique, complex weapon that an adversary could develop. The proliferation of low-cost, readily available technologies is causing dramatic upheavals in electronic, cyber and physical threat landscapes, and forcing fundamental changes in the way we look at assured MILSATCOM.

Today, adversaries have access to a wide range of readily available commercial technologies that threaten all aspects of MILSATCOM systems—from gateways, to satellite ground control, to terminals and in to space. Off-the-shelf technologies are becoming increasingly capable of degrading, disrupting and denying access to space. With a multitude of low-barrier-to-entry threats, these technologies significantly increase an adversary's asymmetric advantage and the likelihood of a low-cost weapon disabling an expensive space system. Such technologies can be fielded with very short cycle times and with little attribution. They give an adversary the ability to experiment, test, train, distribute, mobilize and reconstitute assets quickly, making threats highly reliable and very difficult to find and mitigate.

An example of where low-cost threats can be found is in the exploding worldwide global mobile communications market. Capacity and access are expanding to the far reaches of the globe. User terminals are exponentially growing in number, shrinking in cost and becoming a normal part of society. Inexpensive, ubiquitous SatCom terminals are potential jammers and disruptive barriers for achieving assured MILSATCOM in a frequency spectrum widely shared with consumers, commercial companies and adversaries. The impact of electronic threats (e.g., jamming) seriously threatens mission success.

This changing threat environment is no less true for commodity products that enable cyber and physical attacks on MILSATCOM assets. The April 2013 coordinated sniper attack on a California power substation reported in the Wall Street Journal provides ample evidence that physical, asymmetric attacks are a real, viable threat to space system ground elements. In a physical attack that took the perpetrators only 19 minutes to disable 17 giant transformers, it took nearly a month for utility workers to restore power. Many of the space systems the U.S. government employs in its MILSATCOM network share the same weakness this power substation exhibited—an inability to fend off a coordinated, asymmetric physical attack on ground assets.

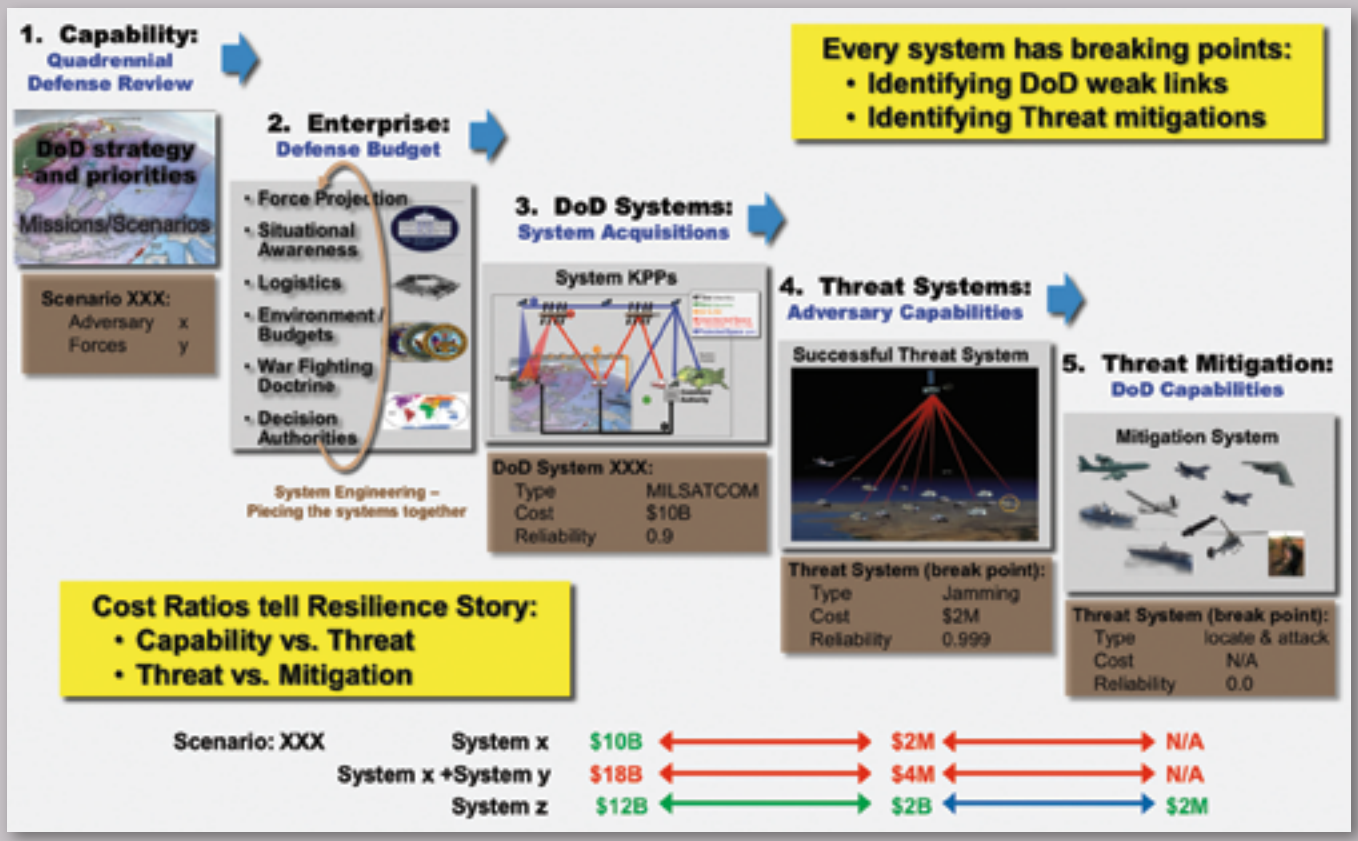


Figure 1. Breaking down the problem to assess assurance.

The Context Of Assured MILSATCOM

Defining and measuring assured MILSATCOM means understanding where and how it fits within the DoD context. The Quadrennial Defense Review sets a long-term course for assessing threats and challenges and for rebalancing strategies, capabilities and forces to address them. Rebalancing the DoD is an expansive task that looks across the services' (Army, Navy, Air Force, Marines), force projections, logistics and situational awareness capabilities, as well as the environment and doctrines that guide the concept of operations and decision-making to execute missions/scenarios critical for our national security. Being able to execute established prioritized missions requires coordinated, enterprise-wide efforts (see *Figure 1).* The enterprise must determine how different systems interact to execute missions with the best performance and investment solutions.

Enterprise assurance is tied to overall systems assurance. A threat to mission execution is, in reality, a threat to one or more enterprise systems. Each system acquired within the enterprise satisfies key performance parameters (KPPs) critical to effectively executing military capability. KPPs normally define the minimum acceptable performance threshold a system must deliver. In this light, system assurance is a measure of its ability to support the KPPs in the face of adversarial actions. For threats to be successful, it needs to 'break' a DoD system and compromise its ability to meet KPPs.

This is when breakpoints and corresponding solutions for mitigating threats become keys to understanding levels of assured MILSATCOM a system provides. An adversary will seek out "weak links" or vulnerabilities that can be exploited easily and inexpensively with maximum impact, and often with little perpetrator attribution—a definite asymmetric advantage for an enemy. Conversely, an assured MILSATCOM system will drive the asymmetry in the other direction—where an adversary must expend substantial cost and effort, and face potentially large political consequences to achieve any amount of impact.

The challenge for MILSATCOM system designers is avoiding a myopic view focusing on a particular type of threat while leaving other vulnerabilities unaddressed. Additionally, as we seek solutions to counter sophisticated threats [e.g., anti-satellite weapons (ASATs)], we must be careful to not inadvertently overlook opportunities for much simpler, less sophisticated threats. Unless a MILSATCOM system design addresses all forms of threats with a balanced approach, any investment in "partial assured MILSATCOM" is of questionable value. Consequently, an evaluation of assured MILSATCOM should focus on identifying the weakest links and potential asymmetric threats.

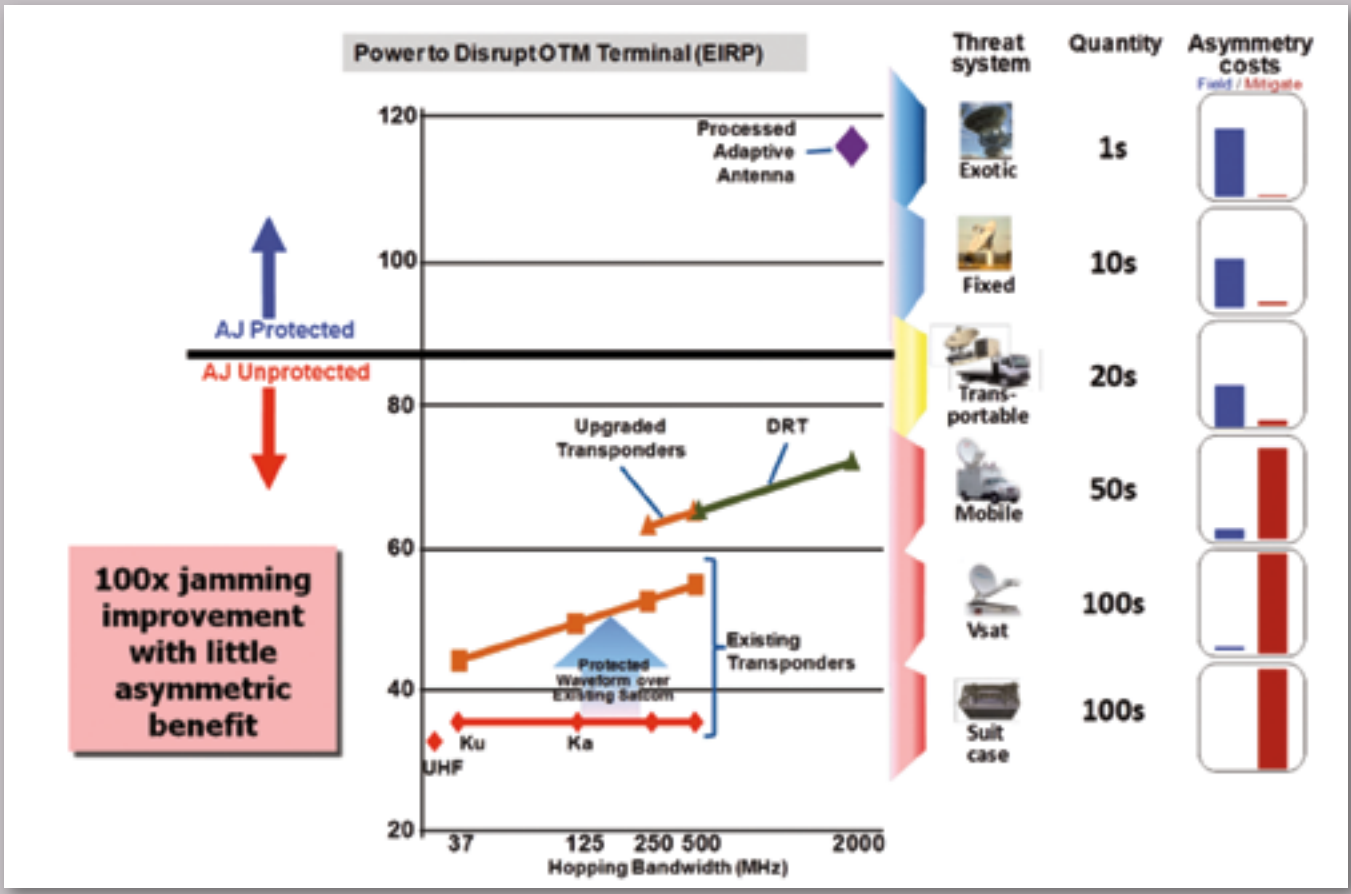


Figure 2. Jamming threats in MILSATCOM systems.

Definition Of MILSATCOM Assurance

Following the framework's guiding characteristics, we propose to define and measure assured MILSATCOM systems based on the economics of the situation, namely the threat system costs and corresponding mitigation costs. This provides a simple, well-understood tool to quantitatively assess, compare and contrast the assured communications merits of various MILSATCOM systems. Cost provides a fundamental metric to characterize system breakpoints: It is deterministic, provides an objective basis for military decisions, provides a strong intuitive foundation, and establishes a sound basis for assessing subjective criteria (geo-political, deterrence, attribution, escalation, etc.).

Assured MILSATCOM can be characterized by system breakpoints where a specific threat system compromises (breaks) mission success and mitigation solutions to such threats. An economic definition and measurement must bring light to the likelihood and consequence of a threat compromising the system. The primary economic data points in assessing assured communication are DoD enterprise and system costs, threat system costs and corresponding threat mitigation costs. Enterprise and system costs presumably will be very high and threat costs will be significantly less. In this light, characterizing assured communications revolves around threat system costs and the resulting mitigation costs.

We define assured MILSATCOM as those systems that require adversaries to adopt high-cost threats to succeed, and ones that have much lower costs for mitigating the threat. Systems vulnerable to low-cost threats, or threats with no mitigation options, do not characterize assured communications. Forcing an adversary to use very expensive tactics is critical to assured MILSATCOM. This characteristic drives many relationships affecting affordability, difficulty, complexity, attribution and likelihood and can be summarized below:

Assured MILSATCOM System = Threat System Costs >> Threat Mitigation Costs

An example of this relationship can be portrayed from physical threats (e.g., small arms, guided munitions, etc.) against systems dependent on ground nodes (e.g., hubs, gateways, teleports, and control stations). The cost of threat systems for such cases can be as low as $100s without any affordable threat mitigation options. Duplications of such nodes do little to deter (e.g., attribution, difficulty, complexity, affordability or likelihood) the significant economic advantage from such a threat.

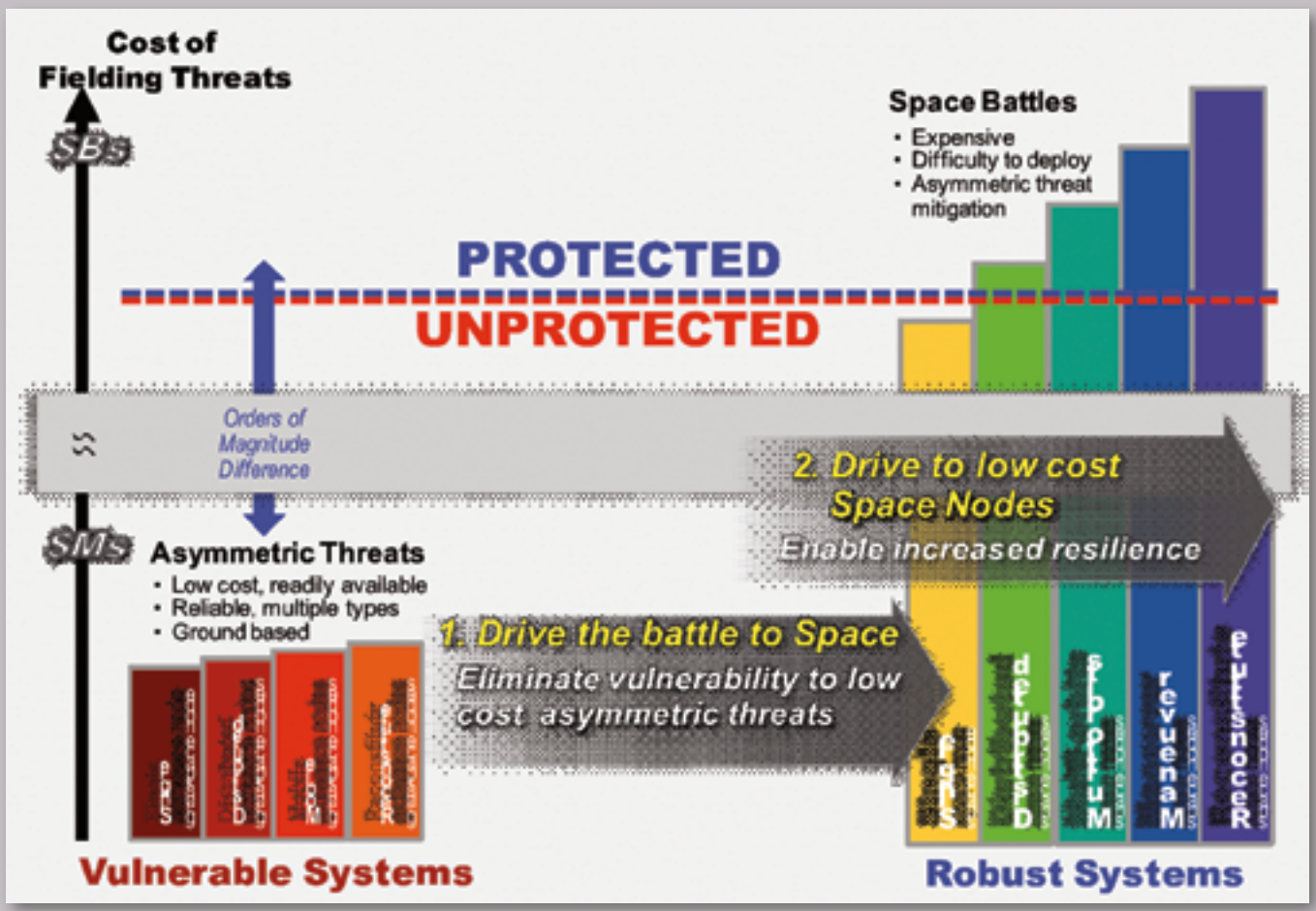


Figure 3. Summary of Assured Communications findings.

Alternatively, autonomous processed systems which avoid the vulnerability of ground nodes require the battle be waged in space force a whole different magnitude of threat system cost and numerous asymmetric mitigation options. To assess the value of different assured systems, we can compare the cost of systems with similar economics. These value assessments are directly linked to mission success, and therefore to mission value, giving decision-makers more clarity. They also yield critical insight into the exact set of elements that will create an affordable and assured MILSATCOM architecture capable of achieving national security objectives.

Measurement Of MILSATCOM Assurance

MILSATCOM systems, threat systems and threat mitigation options can be characterized using classic, established system assessment disciplines and metrics. These disciplines provide established, intuitive and verifiable characterizations by type, cost and reliability. From these characterizations, any asymmetric advantage for or over the adversary can be clearly and intuitively identified. An abundance of tools (e.g., costing and reliability) make it easy to perform these assessments. The results don't need to be highly precise—we're looking mainly for large differences (asymmetric advantages) in cost. This lends itself nicely towards achieving objective, intuitive and common understandings on weaknesses and strengths that can easily be translated into specifications for MILSATCOM systems and architectures.

Example: Using Threat and Mitigation Cost To Assess Jamming Threats

Ground-based jammers are a good way to evaluate assured MILSATCOM communications using threat and mitigation costs. *Figure 2, above*, depicts an analysis of different types of jammers used to characterize breakpoints in transponded and processed MILSATCOM systems. The cost to field each threat system was compared to the cost to mitigate the threat. In MILSATCOM systems without anti-jam capabilities (e.g., transponded systems), a large asymmetric threat cost advantage exists that allows low-cost, mobile, blinking threats with large standoff distances to easily disrupt and deny mission success.

In MILSATCOM systems with anti-jam capabilities (e.g., processed systems such as AHEF) the asymmetric threat cost advantages are reversed and adversaries need to develop very expensive, easily attributable jammers to have any noticeable effects.

In general, the results in *Figure 2* show that transponded MILSATCOM solutions provide adversaries a very high asymmetric threat advantage. To turn the advantage against the adversary, MILSATCOM systems with on-board processing forces adversaries to utilize large antennas that require fixed infrastructure to orchestrate effective jamming attacks. Large, fixed-jammer implementations with little effective standoff distances are easily attributable and become a significant asymmetric threat disadvantage for the

Figure 4. Achieving Threat Mitigation Objectives in an Architecture Implementation.

adversary. This shows that sound system investment decisions can be made by using threat system costs and corresponding threat mitigation cost relationships as a relative measure of the value of assured communications.

Principles Of MILSATCOM Assurance

Two simple, yet effective, architecture principles can be gleaned from this framework to significantly improve assured communications in MILSATCOM systems (*see Figure 4, above*). The First Principle is about minimizing system vulnerabilities to low-cost, ground-based threats to eliminate an adversary's asymmetric threat advantage. Asymmetric threat advantages allow adversaries to pursue threat escalation strategies using multiple, low-cost mobile tactics that are nearly impossible to find and eliminate in a timely manner. The equipment to carry out these threats can easily be bought in large quantities, enabling effective training and experimentation to determine best practices and designs.

This paves the way for strategies that employ significant reinforcements available to deal with mitigation issues through rapid reconstitution and recovery. These threats are available to many adversaries and can be used in coordinated attacks across multiple system nodes (e.g., primary and redundant uplink stations). This asymmetric threat advantage over MILSATCOM and space systems in general is what predominately enables the possibility of a "day without space." By eliminating these low-cost threat asymmetries, adversaries are forced to choose more costly, more attributable threats and escalation strategies and a "day without space" becomes a much more remote possibility.

The Second Principle comes by eliminating low-cost, ground-based asymmetric threat environments and driving the battle to space. That makes threat systems very expensive and more attributable, effectively turning the tables in favor of the MILSATCOM system. This forces an adversary to follow a high-cost threat escalation path before achieves any significant success. These space-based threats are substantially more difficult and time-intensive to develop and deploy. Very few adversaries have the sophisticated capabilities or wealth to pursue this path. Increasing assured communications in space can be further enhanced as we move to an architecture with low-cost space nodes. This enables MILSATCOM systems to affordably pursue architectures that are distributed with multiple orbits, making asset reconstitution possible. These nodes must still provide meaningful capability such that the system is affordable, manageable and meets the required KPPs.

For MILSATCOM assured communications to be strengthened, both principles must be intuitively understood and applied. These principles mandate a rethinking of the broader space architecture and the duplication of systems to achieve affordable, resilient capabilities.

Architecture Feature + Characteristics Of MILSATCOM Assurance

MILSATCOM acquisition teams, armed with a keen understanding of the key architecture features necessary to implement these principles, can more effectively determine where protection investments should be made. A preliminary evaluation identified the key features that drive the overall protection from electronic, physical and cyber attacks. Initial findings showed significant differences in the assured communications levels offered by different architecture types.

We identified the key elements driving these differences in Figure 4 by relating evaluation levels to underlying architecture features. Specifically, five threat mitigation objectives were identified that diminish or thwart known threats and vulnerabilities in MILSATCOM architectures, thereby minimizing opportunities for attack. The five mitigation objectives are:

(1) Secure the waveform
(2) Minimize RF access to the enemy
(3) Minimize foreign presence
(4) Minimize physical access
5) Minimize traffic concentration

The first two objectives provide resistance against electronic attacks. The third and fourth objectives address accessibility to system elements that can be exploited in physical, cyber and electronic attacks. Finally, the fifth objective constrains the scope of an attack and ensures the system's robustness against node failures. The level of assured communications against identified threats correlates directly to how well the architecture implements all five mitigation objectives. All features need to be implemented to prevent a weak link in the system architecture.

Most notably, the threat assessment revealed a strong correlation between the level of assured communications and an adversary's access to MILSATCOM system elements. Systems with significant terrestrial access points, particularly at foreign locations, exhibited the greatest amount of exposure to various threats. Such access points—satellite control facilities, gateways, hubs and fiber networks—create numerous attack paths that are more easily accessed with significant consequences. They additionally provide an entry point to find further ways to exploit the system.

Achieving threat mitigation objectives effectively and affordably requires a carefully conceived architecture implementation. Attempting to "add protection" to a particular system element without considering the total system may give an illusion of protection, but leaves critical vulnerabilities and weak links open for exploitation. In contrast, an architecture implementation that addresses the five core threat-mitigating objectives in a balanced, holistic approach yields a highly resilient SATCOM system void of weak link vulnerabilities.

One such MILSATCOM implementation that realizes these mitigation objectives has these features (*Figure 4*):

(1) On-board processing with antenna coverage discrimination
(2) Inter-satellite crosslinks and mobile continental U.S. gateways
(3) Distributed space assets

On-board processing enables the most effective waveform, anti-jam processing and the highest link sensitivity. Additionally, it enables high-performing antenna beamforming algorithms that adapt coverage to minimize the impact of jammers. This results in a highly-secure waveform and minimal RF access to adversaries. By eliminating the need for ground-based hubs, on-board processing also greatly reduces an adversary's physical access to system assets. Combining on-board processing with crosslinks allows global routing without dependence on vulnerable terrestrial fiber and eliminates the need for foreign gateways. Finally, distributed space assets reduce the concentration of traffic in any one node and minimize the impact of a node failure.

Summary

Faced with a highly-constrained defense budget and a world where adversaries have increasing access to more capable and sophisticated threats that can be used against U.S. space systems, it is critical that government and industry identify cost-effective investments for successfully executing key national security missions.

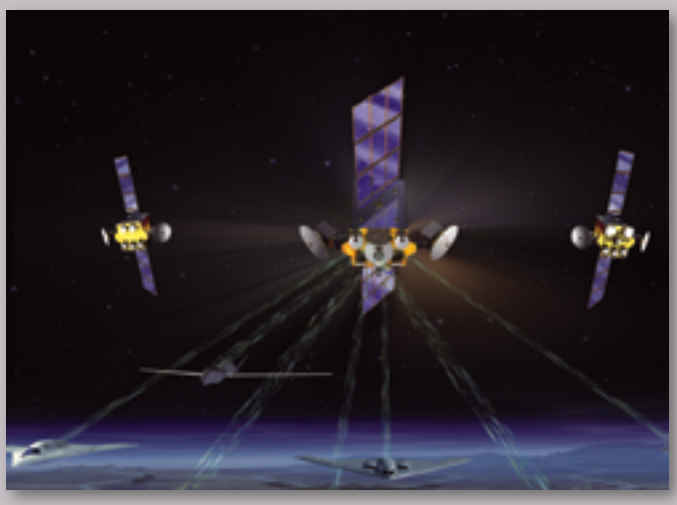
Northrop Grumman Aerospace Systems has developed an assured communications context and framework for MILSATCOM to help forge a common understanding and to ensure investments deliver the required value for system architectures, designs and acquisition. The framework provides definitions, measurement tools and guiding principles that allow an objective and intuitive assessment of assured communications capabilities of future MILSATCOM architectures being considered.

For further details regarding Northrop Grumman Space Systems division, please access
http://www.northropgrumman.com/Capabilities/space/Pages/default.aspx

About the author

Greg Edlund is Director, Communication Systems Chief Engineer and Architecture for the Space Systems business area of Northrop Grumman Aerospace Systems. He's responsible for integrating customer, user, mission and political issues with company products and technologies into high-value communication system solutions. Additionally, he leverages the sector's space and airborne knowledge, solutions and technologies to provide integrated air / space communication architecture solutions.

Prior to Northrop Grumman, Edlund worked as an independent consultant primarily for Lockheed Martin and the U.S. government developing corporate telecommunications strategies. He played key roles for Lockheed Martin in capturing both the MUOS and Advanced EHF programs. Edlund joined The Aerospace Corporation in 1983, where he spent 13 years supporting Department of Defense, civil and national space programs.



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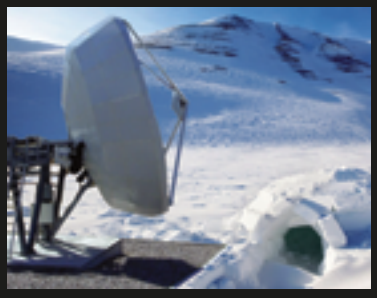

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FASTER, MORE ACCURATE MILSATCOM DEPLOYMENTS IN THE FIELD

By Alvaro Sanchez, Sales and Marketing Manager, INTEGRASYS

Military missions simply cannot succeed without reliable communications. This means satellite technology is essential for operations. MILSATCOM allows combat outposts to link directly with the command center, base compound, remote missions facilities, strategic operations, enable the use of Communications-on-the-Move (COTM) and facilitate the emergencies remediations.

High frequency (HF) radio is also needed on military missions. HF is constantly used in many operations—however, such is not always the case. For example, there are many locations in Afghanistan where communications absolutely demand satellite connectivity—for instance, between locations such as Herat and Kabul. Satellite enables soldiers to communicate worldwide in receiving their orders and assist commanders in making crucial decisions based on real-time information that is transferred though a satellite link. Therefore, high-speed broadband connectivity available anytime, anywhere, is an absolute must. Accurate satellite deployment and link budget calculations are required to quickly establish the comms line, to remain connected, and maximize communication availability and performance.

In military missions, soldiers face a major challenge in pointing, lining up, and commissioning a VSAT antenna. Accessing the satellite is time consuming as satellite operators require accurate pointing and cross-pol isolation. Traditionally, soldiers need to coordinate phone calls to the NOC (Network Operations Center) and perform the lineup, which can require more than 30 minutes.

This process is tedious and technically complex. Calls from remote areas generally require expensive satellite phones due to the lack of cellphone connectivity. On these calls, the satellite operator specialists manually guide soldiers in lining up the antenna, all based on measurements acquired at the NOC. If soldiers do not call the NOC, they are quite likely to create cross-pol and cause adjacent

satellite interferences. Poor performance is the result and the antenna lineup will need to be repeated until accurate commissioning is obtained, which requires extra time, cost and even mission failure with subsequents cost being a failed mission and loss of life.

Today, a new technology facilitates VSAT line ups in the field, minimizing the time and resources required to establish the commission. Soldiers can autonomously commission remotes using a lightweight device, such as a smartphone loaded with an intuitive app. No technical skills are required. The process is highly secure and does not require a phone call to the NOC or any cellular connection. This solution is called Satmotion Pocket. iDirect has added Satmotion Pocket to its product portfolio as the iDirect Remote Commissioning Solution in order to automate and speed up remote commissioning of iDirect networks.

Satmotion Pocket is based on a carrier monitoring system that is installed at the hub, sharing the information with multiple, simultaneous soldiers in the field. This system allows soldiers to quickly point, peak and pol by displaying accurate measurements, all accurately displayed in the soldiers' hands. This remote commissioning technology increases availability and bandwidth efficiency as the antenna is pointed accurately. Additionally, Satmotion Pocket automatically performs the 1dB compression test to calculate the BUC saturation point with just a click of a button.

The Satmotion Pocket Line Up method employs four steps:

- *Antenna Pointing: In this step, the app displays on the soldier's smartphone maps and ground references that indicate where to point the antenna. After the rough pointing is completed, the app receives the forward signal from the satellite and displays an SNR value.*

SatMotion Pocket VSAT Line Up application in use. Photo courtesy of INTEGRASYS.

SatMotion Pocket in use on a Samsung table. Image courtesy of INTEGRASYS.

- *Peak and Pol: The soldier can transmit a CW carrier and optimally adjust the power. By moving the orthomode, the cross-pol interference over 35dB is minimized, in many cases.*
- *Automatic 1dB Compression Point: A soldier presses a button in the app and Satmotion Pocket displays the BUC saturation point.*
- *Report: After the installation is finished, a complete report is generated for post-install analysis at the Hub.*

Satmotion Pocket saves a significant amount of time in antenna lineup by making the process far simpler to complete. Additionally, the device reduces interferences and maximizes communication performances. Network design plays a key role in satellite availability where link budget calculation tools are required. Integrasys has a satellite high fidelity link budget calculation tool called "GeoBeam" for satellite networks that allows them to achieve maximum communication availability for all missions.

GeoBeam analyzes the potential satellite coverage, symbol rate, and antenna size requirements, taking into account weather conditions, miss pointing and interference factors in order to maximize availability. This link budget calculation software generates an extremely accurate and comprehensive PDF report that provides Return and Forward Link Budget for a satellite network. The report includes multiple diagrams on ground maps for any given mission within the selected area. Additionally, SatMotion Pocket could be used to simulate communications on UAV missions using the AeroTackCOM plugin.

Integrasys' goal is to assist warfighters and use satellite communications more effectively by increasing communications availability and through the establishment of satellite communications in an accurate and rapid fashion. To download the SatMotion Pocket datasheet, access ***http://www.integrasys-sa.com/datasheets/satmotp.pdf***

About the author

Alvaro Sanchez is the Sales and Marketing Manager at Integrasys, responsible for the worldwide sales and marketing department, and head of the U.S. office. Alvaro is also in charge of the Satellite Product line.

A CHANGING GAME: HOW COMMERCIALIZATION IS ADVANCING MILITARY C2 SYSTEMS

By Giles Peeters, Senior Contributor

For many consumers of high technology, your mobile device does more than just connect to the web or make calls; increased choice has made this a purchase that says a lot about your identity, too.

Nowhere is this more evident than in the great battle of the operating system (OS), which sees iOS devotees and fans of Android and other OSs debating the pros and cons of their respective camps. With this choice come more questions about the potential applications of the technologies—is Apple really all show, and is Android truly the developers' platform? These are the debates now taking place in the military world and their conclusions inform huge procurement decisions such as the United States Department of Defense's (DoD) long-standing relationship with BlackBerry, for example, which it's traditionally favored for its focus on security.

Android Adoption

Google is making headway and the military potential of the Android OS, rather than Apple's iOS, is being explored by defence and security users. In this exploration, we're getting an indication of the priorities of these organizations, the characteristics they require in their communications and command and control systems, and the ways in which commercialization is changing the face of military technology.

One of the greatest benefits of Android is its openness, a feature that governments and militaries have exploited in other systems. The Windows-based mapping application FalconView is a good example. It was funded by the U.S. government and, therefore, free to use across U.S. government departments—a government off-the-shelf (GOTS) application. The U.S. decided to strip out some security features and make an open-source version, with almost all the detail and layering functionality of the U.S. military version. This has now been developed and made available to everyone and is being integrated into commercial solutions world-wide. By making it available to the commercial sector, it's been developed, improved and integrated into other solutions—something the DoD could not have done on its own—the end result is that the capability is expanded and made available to all.

Open Sesame

From its start, Google has made it its business to create an open platform for application development and distribution—it's no surprise that the next generation of tactical solutions developed by militaries were designed for Android. Parallel experiences with Apple application development, where cost and legal implications are far more prohibitive, have served to strengthen the military/Android relationship. If we had opted to develop the new Track24 Situational Command Control Tactical solution on iOS, we would be tied up in bureaucracy, not to mention financial penalty from Apple. Not so with Android; this, and other development factors, made the decision an easy one. Security forces and consumer gamers have at least one thing in common: they like free apps and the flexibility to think outside

the box. What's more, low cost no longer means a compromise on capability; that's what militaries in the U.S. and Canada have realized, and more forces in NATO and beyond have also embraced.

Freedom + Flexibility

And it's not just in permissions and licenses that OS costs diverge. When systems are not free but are in effect licensed from the developers, the maintenance of the system is also proprietary, and the user must pay for servicing by the relevant approved engineers. As expected, this doesn't sit well with militaries that have come to expect greater freedom and flexibility. From a tactical perspective, as well as at the nuts and bolts level, the more open the platform, the greater the flexibility and savings, right through the technology lifecycle.

Online Operations

This wave of commercialization has also affected the ways in which militaries' approach web-based applications. Command and control (C2) and Battlefield Management Systems (BMS) have traditionally been built to facilitate data layering (such as FalconView). These systems enable the effective integration and collation of data to provide effective command, control, communications, computers and intelligence (C4I).

Web-based applications have largely fallen short when it comes to layering and data convergence—what you see is what you get (think Google Maps). However, things are improving, and web-based applications are being increasingly used by the military as they have advantages such as reliability and better graphical user interface for operators. Now these systems are being developed with data layering/convergence in mind, such as satellite weather imagery, route planning, aircraft coordinates/designated flight paths, friendly force tracks, and so on.

Changing The Rules Of The Game

The increased commercialization of military systems is also due to the age of the users operating them. The next generation of military communications specialists are the same young men and women who engage with cutting edge consumer technology. Twenty-five years ago, the ability to operate a high speed mobile computer was considered a specialist skill; now everyone has such a device in their pocket.

When the younger generation of military professionals use systems such as Track24 Defence's SCC Titan for the first time, they navigate it intuitively. That's because a gaming interface look was created. The effect is that these command and control systems already feel familiar to users who are accustomed to the slick user experience they get on their smartphone or tablet computer. It's a similar story in a number of industries and the military is now starting to take advantage of the increased software literacy of the younger generation.

The Next Move

It's important to remember these advances should be seen not as a threat to the old guard, but as an opportunity for military communications professionals to embrace change. Better technology, harnessed in flexible, open applications, is saving lives today, and the potential for improvement is vast.

Commercialization benefits militaries by enabling long-term cost savings, both in initial capital outlay, ongoing maintenance and permissions and user training. It's not just militaries with tighter purse strings that are adopting Android applications; the United Kingdom, United States and other NATO states are deciding to invest in proven technologies that the user of the future—part operative, part consumer—will expect as standard.

Further details are available at the Track24 Defence infosite:
http://track24defence.com/

About the author

Giles Peeters started his military communications career at RAF Digby in 1997, before moving on in 1998 to the Engineering Office at 751 Signals Unit on the Falkland Islands. In 1999, Peeters joined the Defence Communications Security Agency (DCSA) Corsham, as the Duty Operations Officer of the Global Operations Security Command Center (GOSCC), before becoming the Military Liaison Officer for Signal Intelligence at GCHQ Cheltenham in 2001. Peeters then worked with the DCSA Corsham Satellite Integrated Project Team (SAT IPT) as their MOD Commercial Satellite Service Delivery Officer.

From 2004 to 2007, Peeters' significant expertise in commercial satellite communications proved invaluable in Iraq and Afghanistan, as he provided front line tactical communication and deployment capability for the Joint Helicopter Command (JHC) J6 SO2 from HQ Land Command, Wilton. Peeters' final rank was RAF Squadron Leader.

In 2007, Peeters moved to the private sector to consult for organizations such as NATO, on Blue Force tracking requirements. Now Defence Sector Director at Track24 Defence, Peeters is the driving force behind the launch of the company's COTS Blue Force tracking solution, situational Command & Control (SCC).s

Track24 Defence's new ECHO satellite BFT device.

THE HPA CORNER: HOW TO CREATE A MORE RESILIENT SPACE INFRASTRUCTURE

By Janet Nickloy, HPA Chair, Vice President of Strategy & Business Development, National Systems, Harris Corporation

In the recent Message from the Chair, penned by HPA Chair Janet Nickloy in HPA's end-of-year newsletter, she reflects on the trajectory the Alliance has taken over the past year, and outlines where the organization intends to go in 2014.

Nickloy notes, "Recent government communications indicate that hosted payloads are gaining recognition as a viable alternative for U.S. Government space missions." As industry adapts to changes taking place in the wake of increasing acceptance of hosted payloads and the steps the government has taken recently to clear legislative hurdles in order to start taking advantage of the many benefits that come with ridesharing, so too has the HPA stepped up its activities which seek to continue its mission to increase awareness of the benefits of hosted government payloads on commercial satellites.

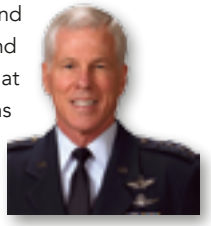
In 2014, the HPA will build on the success of our government/industry engagement program. Several events have been planned throughout the year with this is mind:

- *HPA kicked off the Hosted Payload Forum track at Satellite 2014 with a keynote panel entitled "Hosted Payload Forum: Leveraging the Commercial Space Sector for Enhanced Affordability and Resilience"*
- *The Annual Board Meeting will again be held at the 30th Space Symposium in Colorado Springs in May*
- *HPA's first international workshop will occur at the 65th International Astronautical Congress in Toronto in late September*
- *The Hosted Payload Summit on October 15 in Washington, DC, will include at least one panel hosted by HPA.*

In light of this ongoing activity, HPA members were asked:

"How can hosted payloads help the U.S. Government disaggregate its space assets to create a more resilient space infrastructure?"

"Our satellites provide a strategic advantage for the U.S., and as such, we must consider the vulnerabilities and resilience of our constellations…Beyond the necessity of finding efficiencies and cost savings, we may very well find that disaggregated or dispersed constellations of satellites will yield greater survivability, robustness and resilience in light of environmental and adversarial threats."—***General William L. Shelton, Statement to the Senate Armed Services Committee, April 24, 2013.***



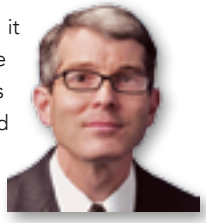
"As the use of hosted payloads becomes more prevalent within the U.S. Government's mission architectures, commercial industry's ability to provide rapid and cost effective space access will create not only a disaggregated architecture but a resilient one as well.

"Hosted Payloads on commercial satellites may be one of the best ways for the U.S. government to disaggregate its assets. Hosted payloads provide greater resiliency in a number of ways, and allow for mission critical payloads to become operational sooner. Due to the consistent cadence of commercial launches, to 10 a year, military planners have more than one opportunity to launch a capability into space. Additionally, there are many more commercial satellites than military satellites over which to disperse payloads making it more difficult for adversaries to target any one government payload.

"While hosted payloads are not a silver bullet for providing resiliency for every mission set, they are most certainly a part of the space architecture to come, particularly when considering the cost advantages, the time efficiencies and the reduced risk to the government of utilizing commercial satellites."—***Gerry Jansson, Director, Space Segment Developing, Intelsat General***

"A resilient infrastructure is one that can retain the majority of its capability in the presence of a hostile action or adverse condition. An effective means to accomplish this is by dispersing the system capability among many elements, often referred to as disaggregation. Disaggregation is favored because it provides resilience to many different types of threats simultaneously. Hosted payloads provide a means to more affordably disaggregate, by allowing a portion of the required capability to ride on any number of commercial satellites, sharing the cost of the launch and bus operations.

"The result is a system that is highly tolerant of any single payload being disabled, and also complicates an adversary's strategy by distributing the capability among a large number of different locations. The more affordably disaggregation can be provided, the greater the level of disaggregation that can be obtained for a fixed level of investment."—***Jim Mitchell, Vice President of Boeing Commercial Satellite Systems***



"When we talk about hosted payloads, it is important to note that a primary issue relative to U.S. government satellite systems is the proprietary nature of the related ground infrastructure. These are stove-piped systems, each with its own infrastructure and little or no inter-compatibility, making data transport on the ground less resilient, expensive to operate, and even more expensive to upgrade.

"Hosted payloads on commercial satellites can provide disaggregation of mission capabilities and leverage the primary communications payload for access into a remarkably resilient, redundant and widely geographically dispersed array of gateways, teleports and connecting fiber networks all using interoperable standards.

"With today's advanced encryption and data protection schemes, government missions can gain secure resiliency by directly leveraging this abundant ground infrastructure. It may well be that the secure leverage of commercial ground infrastructure, is one of the biggest benefits that hosted payloads bring."—***Eric Spittle, President, SSL Federal***

"As the U.S. Government develops it's architectures of the future it must ensure critical capabilities are sufficiently robust to survive the ever increasing environmental and adversarial threats of the space and terrestrial ecosystems. Innovation and non-traditional solutions, like hosted payloads, must be considered especially in an atmosphere where affordability is fundamental to all decisions. Not every individual system has to be equally survivable, but the overall system architecture must be designed with sufficient resilience to continue providing the needed capabilities through all levels of conflict.

"Disaggregation, the separation of dissimilar capabilities into separate payloads and/or satellites, in and of itself does not provide resilience but it most certainly enables resilience. By not putting all your eggs in one basket, systems become less complex and issues in one area do not end up delaying the entire program. Once disaggregation occurs, less exquisite capabilities can be readily hosted on commercial satellites. And because of the frequency of commercial launches, the U.S. Government is afforded the opportunity for regular and timely insertion of the latest technologies."—***Rich Pang, Senior Director, Hosted Payloads, SES Government Solutions***

Additional information is available at the HPA infosite
http://www.hostedpayloadalliance.org/

TACTICAL SMALLSATS: NEW MISSION CAPABILITIES REQUIRE SPACE + GROUND SYSTEMS TO BE IN SYNC

By Victor Gardner, Small Satellite Project Manager, Kratos Defense & Security Solutions

From NASA and the U.S. Department of Defense to industry giants and creative entrepreneurs, it's no coincidence so many organizations are embracing the weight, cost, and quick deployment advantages of small satellites (smallsats) and nano-satellites (nanos) for missions ranging from imagery to national security and essential communications for Warfighters.

The benefits of these tactical satellites are clear; space assets can be launched and fielded more rapidly, constellations provide a more responsive space architecture than a single satellite, and there is greater redundancy and resilience from adversaries.

Just as small and nano-satellites are redefining mission models in space, they are also creating new opportunities on the ground, where, in practical terms, they can function similarly to a Swiss Army knife—small satellites can provide access to remote locations, support warfighters in the field and on the move, and deliver near-real-time intelligence.

However, the smallsat's unique form factor in space is only half of the mission equation. The smallsat must also take into account what's occurring on the ground in the Command & Control (C2) system. For tactical users, such as Warfighters in the field who may only have limited satellite training, and for more urgent and immediate data retrieval needs, smallsats must be matched with a ground system that can leverage their advantages for a broad swatch of needs.

We'll explore several crucial ground control capabilities that enable tactical smallsats. These include advances in Command and Control (C2), the user-interface, tasking, and mission data retrieval.

Adaptable User Interfaces

One of the recent uses of small satellites has been to deliver communications into and out of areas that are remote, hostile, or the terrain prevents traditional satellite communications. Placing small satellites in an inclined orbit can provide enhanced coverage for tactical users in these disadvantaged locations.

For Warfighters in the field who need quick operational status of the nano or fleet, the user interface must provide a Common Operating Picture (COP). With a dashboard that includes telemetry roll-ups, this COP can show the operational status of each major subsystem of the small satellite, the communications coverage times showing when the satellite is in view, along with any procedures or alerts from real-time execution.

Combined into a single screen, the COP provides the tactical operator all of the information they need for real-time status about their satellite, and the flexibility to create new dashboards on the fly as the system evolves or mission needs dictate new requirements.

For example, a special operations unit may be using the nano for communications into and out of a high latitude region. Toward the end of life of one of the nanos, the communications officer may want the dashboards in the field updated to show the total available spacecraft bus power parameters alongside the communications payload power draw in the COP. This allows verification that there is adequate power to communicate into and out of their region, telemeters that would have been unnecessary for the majority of the mission.

Artistic rendition of Boeing's Phoenix Phantom satellite.

Imagery is courtesy of Boeing.

Enabling Multi-Tasking

Deploying imagers on the small, low unit-cost form factor of smallsats has been explored dating back to at least 2010 with the U.S. Army's Kestrel Eye program. This approach allows constellations of imagery satellites to be funded and fielded at a fraction of the weight and cost of traditional imagery satellites—which can be 100 times heavier and more costly.

The exact form factor for imagers is dependent on the requirements from the tactical user. CubeSats and nanos would easily meet the requirements for low resolution imagery, while ESPA-class smallsats would be needed for some of the higher resolution requests. The optimal architecture would include a combination of both classes of spacecraft, with each one tasked based on the tactical user's requirement.

When flown in a constellation, smallsat imagers reduce target revisit times, providing field forces with a much shorter intelligence cycle from data request to imagery receipt. Not only do the multiple imagers help accelerate tactical operations on the ground, but the constellation provides greater resiliency in orbit, lowering the risk from adversaries, and satisfying the strategic concerns of senior defense officials for disaggregation. Of course, with the capabilities from a larger number of smallsats, tactical operators also face more cumulative tasking demands, which places greater importance on automated tasking that allows hands-off or even lights-out command and control.

When using the appropriate command and control system, tasking uploads can be pre-defined and set to occur autonomously when the satellite is in view of the ground station. They can also be defined semi-autonomously, with ad hoc tasking that's initiated with minimal interaction from the user, such as a tactical commander who needs to see imagery for an area five miles north of their current position. In this case, latitude and longitude for the area are input into their mobile device, which is uploaded whenever the nano-satellite is overhead, imaging the area when in view, and sending the imagery back to the operator at the next pass or even during that current pass. To ensure the probability that each tasking will be received and the target will be imaged successfully, constraints can be incorporated into the automated procedures as well.

Likewise, if signal strength is an issue for a nano communicating with a new ground transmitter in theater, automation will be vital. Automated procedures can be set so that transmission only begins once the signal strength exceeds a certain value, where the link is known to be stable enough to transmit data. Procedures can be pre-defined to respond to anomalous events both on the ground and on the spacecraft. In addition to managing spacecraft subsystem faults and power cycling or swapping onboard components, these procedures can also automatically detect if a primary antenna control unit or other ground equipment was non-operational, switching to a backup facility instead.

Optimizing Data Retrieval

Signal tracking is another growing application for nanos that creates new demands on the ground system. Examples that illustrate the capabilities needed to support data retrieval include tracking AIS signals on ships and tracking friendly forces or adversary transmitters. In each case, the nano's payload would be recording these signals when overhead. Then, when over a downlink site, the time and location of each signal would be downloaded as mission data.

In a similar fashion to uploads, the C2 system should support automated mission data downloads, occurring as soon as the nano comes into view of the downlink site. When the download is completed, data can automatically be transferred to an end user or displayed for the tactical user.

Automated transfer of the mission data to a combatant commander, for example, is made easier through standardized interfaces such as FTP, GMSEC, or CCSDS Mission Operations Services. In other cases, however, the intelligence officer of a Naval or Coast Guard ship, for example, would want AIS signals displayed on their COP dashboard in real-time to show all of the ships in their surrounding area.

An adaptable user interface, such as the one discussed earlier, allows intelligence officers to display what was included in the latest mission data download—perhaps signals from the previous two hours—or all the signals and locations downloaded in their area of regard that week. An adaptable user interface allows either to be displayed.

A Future Of New Capabilities

Clearly, smallsats and nanos have introduced a new mission model. When used operationally, they can provide a more tactical and adaptable alternative to traditional large satellite systems. This applicability for operational military and intelligence use is creating new interest and urgency throughout Department of Defense service branches and agencies; from the U.S. Defense Advanced Research Projects Agency (DARPA), which is exploring the launch of smallsats up to 100 kilograms on 24-hour notice under the Airborne Launch Assist Space Access (ALASA) program, to the Air Force's Operationally Responsive Space (ORS) office, which is pursuing the deployment of modular space systems in under seven days to meet urgent warfighter needs.

To maximize the operational utility, small satellite ground systems need to be equally as flexible and cost effective as their space counterparts. Providing a Common Operating Picture, adaptable dashboards, automated tasking and mission data retrieval, and real-time transfer and display of mission data are the first steps in meeting these needs of the small satellite ground system. As more creative applications for smallsats come to fruition, so too will command and control innovations to enable them.

About the author

Victor Gardner is the Small Satellite Project Manager for Kratos Technology & Training Solutions, Inc., a division of Kratos Defense. He can be reached at ***victor.gardner@kratosdefense.com***

quantumCMD: Adapting C2 to SmallSat Missions

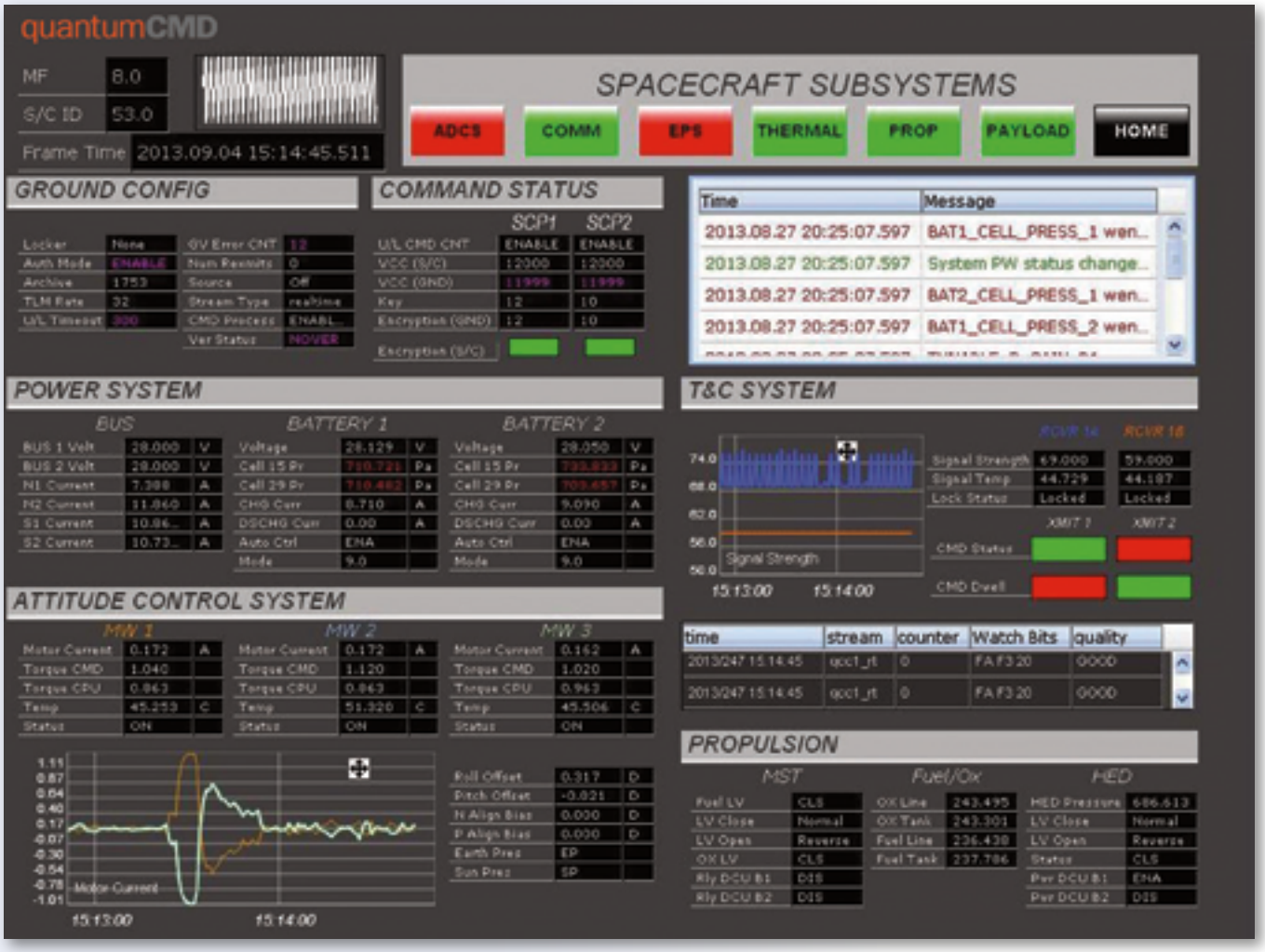
One of the great cost benefits of small satellites is that their many form factors allow flexibility to support varying operational and economic mission requirements—from minimally-capable to advanced CubeSats and microsatellites, with or without propulsion, operating in any band. This diversity means that the Command & Control (C2) system must also be flexible, which has led to quantumCMD, a low cost C2 solution designed by Kratos specifically for small satellites; one that is ready out of the box to support any smallsat, ground equipment and mission CONOPS imaginable, tactical or strategic.

quantumCMD is standards-based and features intuitive interfaces for users to easily tailor operations for their unique configurations, while dramatically reducing customization costs. Telemetry databases are large enough to support a range of spacecraft classes, including highly-capable ESPA-class small satellites that may have stringent pointing requirements, redundant and autonomous spacecraft fault management.

quantumCMD's dashboards are also highly flexible and can be quickly tailored on the fly to produce a Common Operational Picture (COP) that works for small to even very small missions. Flexible procedures support a variety of mission CONOPS, handling simple or complex routines for anything from state of health checks to mission tasking, even full lights-out operations.

Kratos, the developer of EPOCH IPS, designed quantumCMD to keep up as missions grow. quantumCMD's architecture is fully scalable, expanding modularly to protect investments as operations grow from a single CubeSat to a full and expanding constellation.

For more information about quantumCMD, please visit ***http://www.KratosDefense.com/quantumCMD***,
or, email ***info@quantumCMD.com***



Data-rich dashboards give tactical users a common operating picture of spacecraft and ground status, with drill-down ability into each subsystem and ground component for further fidelity, whether for a single satellite or fleet of smallsats.

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.

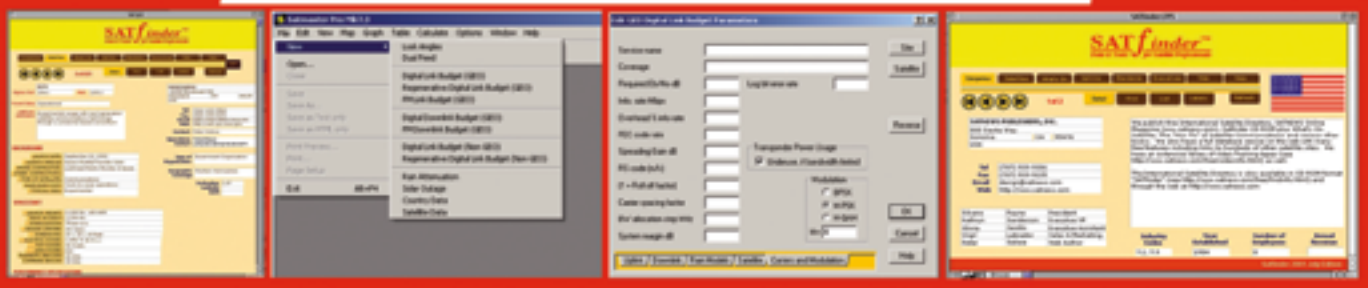
Calculates atmospheric losses and rain fade margins for any desired availability on uplink and downlink.

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

MARITIME DOMAIN AWARENESS + THE BLUEHAWK SOLUTION

By Wayne Hoyle, Director of Business Development, MDA Geospatial Services

Maritime domain awareness refers to the understanding of anything associated with a nation's maritime domain that could impact the security, safety, economy, or environment. With water covering about 70 percent of the planet, maritime domain awareness is one of the most important activities undertaken by national and international agencies.

As the amount of global maritime traffic increases, these organizations are under increasing pressure to address issues such as illegal fishing, piracy, tracking of foreign vessels, monitoring of foreign naval forces, bilge dumping and the trafficking of people and illegal goods by sea. These activities have huge economic costs, with the estimates of illegal and unreported fishing costing the global economy between $10 and $23.5 billion annually, and the economic cost of Somali piracy in 2012 estimated to be between $5.7 and $6.1 billion.

Traditionally, maritime security agencies have relied on surveillance aircraft, ships following patrol patterns and coastal radar to search for suspicious vessels and activities, an approach that is typically weather dependent, expensive, and reliant on limited resources. Recently, a myriad of additional data has become available, creating a big data problem that is overwhelming for maritime security agencies. The maritime environment is incredibly vast and complex, and with the massive amount of legal maritime traffic, finding a threat is very difficult.

To help address these challenges, MDA has developed MDA BlueHawk, a multi-sensor, unclassified maritime domain awareness and threat detection solution that provides navies, coast guards, customs, law enforcement, and fisheries with immediate access to broad-area maritime surveillance across their Exclusive Economic Zone (EEZ) and global areas of interest. Fusing space-based radar, Automatic Identification System (AIS) data, vessel registries, and other maritime information, MDA BlueHawk delivers the information and tools to help customers detect potential threats.

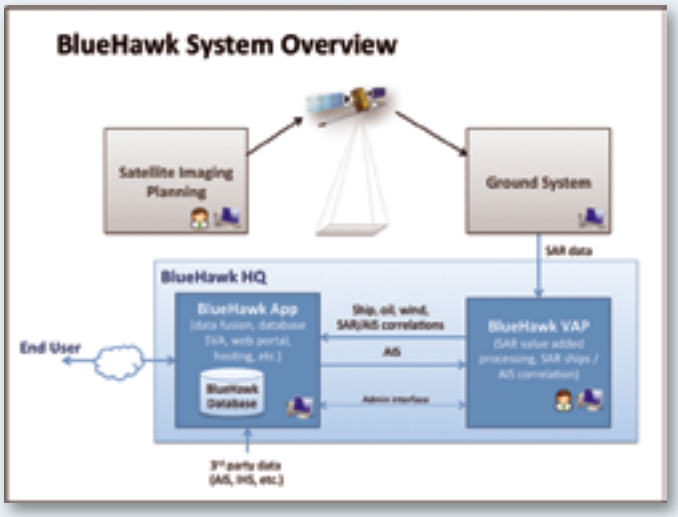
MDA BlueHawk Solution Overview

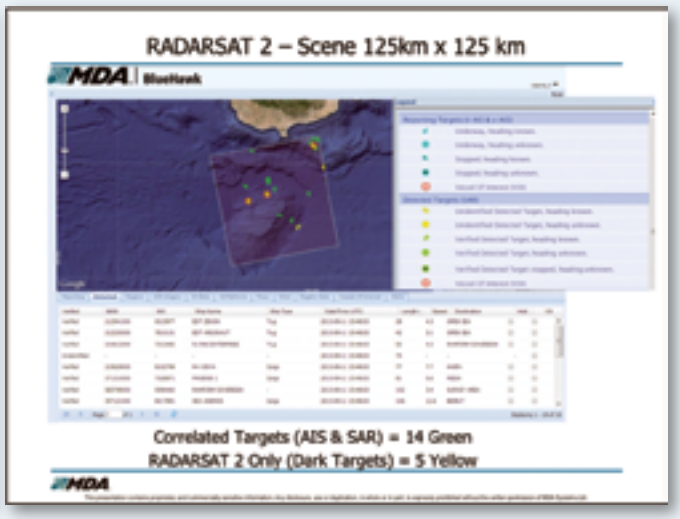
MDA BlueHawk provides for the detection of non-reporting "dark" vessels, validation of reporting vessels, and identification of oil slicks, weather, and other events. MDA BlueHawk provides both open ocean and coastal coverage through the exploitation and fusion of data from multi-sensor, space-based satellite synthetic aperture radar (SAR), satellite and terrestrial AIS, vessel registry data and other contextual data.

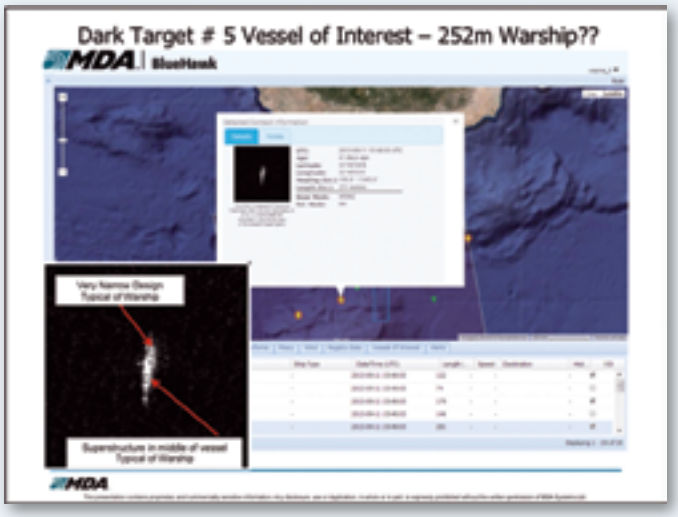
MDA BlueHawk's key features

- *Unclassified maritime domain awareness web portal*
- *Detection of non-reporting "dark" vessels including observed vessel size and heading*
- *Identification of self-reporting vessels with verification by satellite radar*
- *Coastal and open water coverage (coastal and satellite sensors)*
- *Automatically generated alerts based on suspicious behavior*
- *Historical and predicted vessel tracks*
- *Vessel registry data (e.g., IHS Fairplay)*
- *Oil slick detection*
- *Maritime weather information*
- *Available as an online service, system, or direct datafeed into customer systems*

Dark (non-reporting) vessels are indicated with yellow icons in the MDA BlueHawk display (*see the images below and on the next page*). The white information window for this dark vessel shows the radar image, observed length, and observed heading for this vessel. The 251m length and very narrow design of this dark target are typical of a warship.







MDA BlueHawk Benefits

MDA BlueHawk offers national and international maritime agencies an efficient, cost-effective way to improve overall maritime domain awareness.

Key benefits include:

- *Access a maritime picture covering vast maritime regions*
- *See both across your EEZ and globally, including open oceans*
- *See beyond your aircraft patrol boundary limits*
- *See non-reporting vessels, which may be the greatest threat*
- *See predicted routes and historical tracks of ships*
- *See oil slicks in your area of interest and identify the most likely polluters*
- *Higher resolution images provide a means to identify possible vessels of interest*

Better use of existing assets with queued dispatch

- *Rapid tasking and response of RADARSAT-2, allowing for approximately 30-90 minute latency from the time of satellite imaging until new vessel information is provided in the Common Operating Picture, which can be further reduced to less than 15 minutes with local ground station support.*
- *Sending patrol assets directly to suspicious vessels rather than patrolling empty ocean, resulting in extended range, more time "eyes on" target, and reduced fuel burn. With operating costs of maritime patrol aircraft averaging $7,500 to $11,000 per hour, the savings can be significant.*

Leverage all-weather broad-area maritime surveillance

- *SAR sensor allows for day or night imaging, independent of weather conditions*
- *RADARSAT-2 provides the broadest area coverage of any commercial SAR sensor*
- *The large number of imaging modes on RADARSAT-2 provides the flexibility to satisfy a wide variety of mission requirements*
- *MDA BlueHawk can incorporate data from other sensors (TerraSAR-X, COSMO-SkyMed, Optical) to improve coverage and revisit based on customer requirements*
- *Identify potential threats close or far from your shores*
- *Use geo-fencing to send alerts when high-risk vessels are heading towards national areas of interest*
- *Assess threats through intent analysis*

Share information with other team members, agencies, or governments

- *Unclassified data sources enable teams from multiple jurisdictions to share information and collaborate*
- *Web browser-based service can be deployed immediately, with no IT investment or maintenance*

MDA BlueHawk Delivery Options

- *Delivered as an on-line hosted solution, a customer-managed implementation or a data feed into an existing end-user system, MDA BlueHawk offers an implementation model that works with any customer's environment.*
  - » *MDA BlueHawk Online—Hosted, online web portal service*
  - » *MDA BlueHawk HQ—Customer-managed system deployment*
  - » *MDA BlueHawk DataFeed—Streaming data into existing customer systems*

MDA BlueHawk In Action

MDA BlueHawk is fully operational and is in use by a number of key customers. As an example, through MDA BlueHawk Online, MDA is supporting a national Navy with their maritime domain awareness activities. In one case, the Area of Interest for the program was initially confined to an area of 1 million km^2 over the Pacific Ocean, and then was expanded to cover the country's entire EEZ. The customer is exploring a second phase of the program, and is looking to develop a business case to acquire a maritime-optimized RADARSAT-2 ground station to improve the timeliness of their response.

Notes

[1]*Agnew DJ, Pearce J, Pramod G, Peatman T, Watson R, et al. (2009) Estimating the Worldwide Extent of Illegal Fishing. PLoS ONE 4(2): e4570. doi:10.1371/journal.pone.0004570*

[2]*Bellish, Jonathan. The Economic Cost of Somali Piracy 2012.* ***http://oceansbeyondpiracy.org/sites/default/files/attachments/View%20Full%20Report_1.pdf***

About the author

Wayne Hoyle is the Director of Business Development at MDA Geospatial Services and works with global customers in the Defense and Security sector. Much of his 30 years experience have been focused on the development and delivery of advanced systems for Maritime Situational Awareness and advanced Navigation solutions. He has worked directly with all of the 5-Eyes Navies and with many other allies. Most recently, Mr. Hoyle and his Business Development team have been delivering Maritime Domain Awareness systems which fuses data from Space based Radar and AIS sensors with users accessing the information in near real-time via a web-based portal (MDA BlueHawk™).

For additional information, please email and/or visit

Bluehawk@mdacorporation.com

http://is.mdacorporation.com/mdais_canada/Offerings/Offerings_MDABlueHawk.aspx

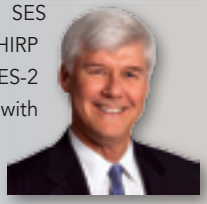
NSR ANALYSIS: HOSTED PAYLOADS— A BALANCING ACT FOR OPERATORS + MANUFACTURERS

By Carolyn Belle, Analyst, Northern Sky Research (NSR)

Hosted payload has become a catchphrase within the satellite industry in recent years, and with the first U.S. Hosted Payload Solutions (HoPS) program contracts expected this June, it will draw more attention and expectations in the overall manufacturing market. A growing base of pilot programs and alternative hosting methods from manufacturers support an expansion of the use of hosted payloads, yet challenges remain before the model attains sufficient maturity to be implemented across the spectrum of potential applications.

Benefits Of Cost + Schedule

A main piece of the hosted payload value proposition has always been, and will continue to be, cost savings for both the primary operator and the hosted payload owner. This is a more significant driver for GEO hosted payloads, where higher manufacturing and launch costs heighten the savings of using only part of a satellite.



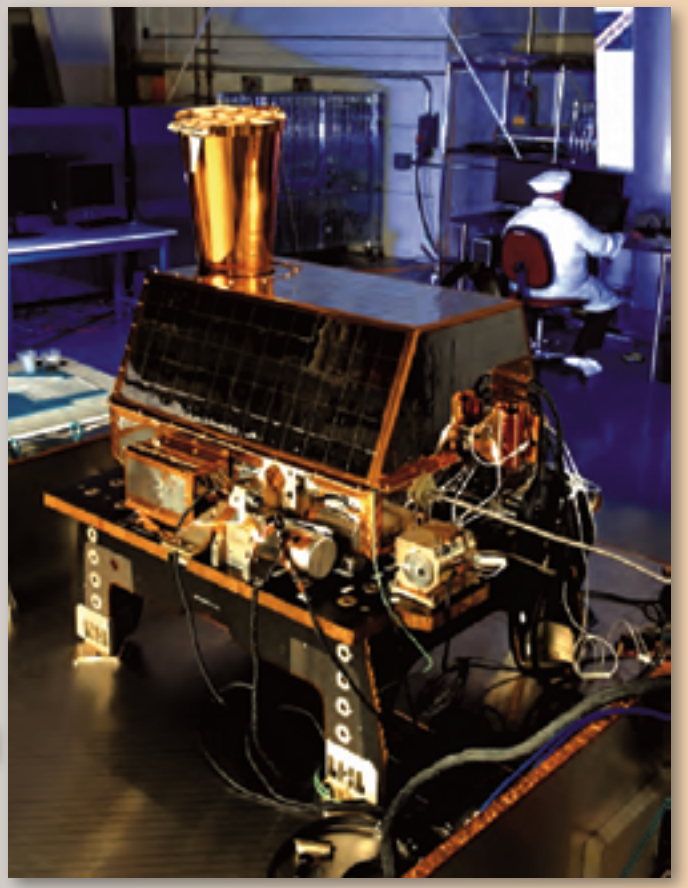
Tip Osterthaler, SES GS

According to Tip Osterthaler, president of SES Government Solutions, the U.S. Air Force's CHIRP technology demonstration payload onboard SES-2 cost only 15 percent of what an Air Force satellite with the same payload could have cost, providing equivalent data that will be integrated into the military's modernization planning over the coming years. The value of cost savings applies equally to operational payloads or technology development missions, and to government and military projects or commercial ventures.

Commercial satellite programs are fast to market, giving hosted payloads an advantage compared to the long timelines that plague most government and military platforms. Though this is likely a stronger driver for technology development payloads requiring verification before being used in a full-scale project, operational missions that can be readied in a short period of time also benefit from speedy implementation.

The three-year turnaround from WAAS concept definition to operational service onboard Galaxy 15 and Anik F1R, including a full year of on-orbit testing and verification, allowed the FAA to quickly and effectively provide enhanced navigation services to the aviation industry. When hosted payloads provide a faster return on investment they boost the business case of such enterprises, a factor that will contribute to their increased adoption by the commercial sector.

The inclusion of Aireon payloads onboard all 66 Iridium NEXT satellites launching between 2015 and 2017 highlights the beneficial ability to quickly create a distributed architecture by using a large number of host satellites. Surprisingly, it is this privately-owned company that has created the biggest hosted payload program yet, when government customers are traditionally considered the main target market.



SES Government Solutions hosted the first ever experimental U.S. Air Force sensor on an SES satellite operating over the United States. CHIRP (Commercially Hosted Infrared Payload) was successfully launched on September 21, 2011 from Kourou, French Guiana. Photo courtesy of SES GS.

The number of commercially-owned hosted payloads in orbit will increase through the 2010s as Aireon launches, with a surge in diversity of hosted payload applications and owners coming towards the end of the decade. This will be largely focused on LEO platforms.

Rethinking The Operational Structure

These positive market forecasts are spurred by new concepts that may allow more hosted payloads to fly simultaneously and alleviate some constraints imposed by subordinating hosted payload requirements to a primary payload. Iridium, Surrey Satellite Technology-US, and ViviSat are all offering platforms that provide a satellite bus and orbital guidelines, but instead of housing a primary payload provide space for a number of hosted payloads. This increase in the mass, power, and volume available to the hosted payloads will enable potential applications that have previously been too demanding on satellite resources, opening the door to more commercial participation in the market.

Each of these platforms offers further distinct advantages that will drive growth. The ViviSat Mission Extension Vehicle (MEV) will provide a different hosting environment than presently available onboard communications satellites, thereby opening new opportunities in GEO. ViviSat also uniquely allows the hosted payload to become primary when the MEV is between satellite life extension missions, an attribute that will attract a specific subset of missions.

For many applications, the inconsistent line of sight inherent in LEO is problematic; Iridium's PRIME program addresses this weakness. PRIME satellites will link to the NEXT constellation of 66 satellites, routing communication through the constellation and thereby providing contact with the hosted payload at any point in its orbit. PRIME will enable more innovative ideas and technology development missions to be implemented—applications that require both a low orbit and constant communications, but do not have sufficient capital to create the necessary constellation independently.

Challenges + Impediments

However, the complications of implementing a hosted payload project cannot be overlooked when forecasting the role it might play in the satellite market in coming years. Schedule slippage is a key risk. The CHIRP payload was one year behind schedule, a consequence of complexity that not only added $17 million to the total program cost (thereby diminishing but not negating the cost savings of using a hosted payload) but also required a change in the launch order of SES satellites to ensure regional coverage while waiting to launch SES-2 until CHIRP was ready. Addressing this concern requires more advance planning and upfront investment in the payload even before securing an appropriate hosting partner, an uncertainty that could become a sticking point for strapped government budgets.

Both the primary operator and hosted payload owner are pushed to make compromises during the joint project, and both business cases generally evolve. While this level of balancing should be proportionate to the requirements of the hosted payload, some hosted payload owners still expect too much accommodation from their host and are insufficiently willing to innovate. If this continues unabated, it will restrain the number of hosted payloads launched.

Furthermore, best practices for matching hosted payload designs with potential commercial hosting partners remain ambiguous. The puzzle-piecing approach taken by SST-US to compile proposed payloads into a set for integration on an Orbital Test Bed satellite could allow the creation of a hosted payload catalog for later recombination into a series of OTB satellites. In the case of WAAS, Lockheed Martin as the payload manufacturer was responsible for matching the payload with a suitable host satellite. Alternately, some operators already suggest inclusion of a hosted payload within RFPs issued, seeking to explore how hosting another payload could improve their business case.

While early hosted payload projects have laid groundwork for contractual issues that must be addressed, the contract process must be further streamlined to both facilitate participation and reduce and/or allocate risks. This is of particular importance for government and military missions. CHIRP established a foundation for the way commercial operators must think about transmitting sensitive military data without risking security, yet additional thinking is required. The question of priority in the case of a partial satellite or subsystem failure must be clarified. As more hosted payload projects are undertaken these concerns will decrease in importance, but the unfamiliarity with hosted payload contracts is a present limitation.

Bottom Line

The market potential for GEO and LEO hosted payloads is diverging: New opportunities in LEO will lead to higher growth in this market (especially for commercially owned payloads), while the GEO hosted payload market will continue to be dominated by government and military customers and experience slow growth until the above concerns are further addressed.

Hosted payloads are not a magic solution for the cost restrictions of government and military programs, nor are they applicable to all business cases. Ultimately, hosted payloads will be a niche market for applications and remain a low cost avenue for technology demonstration.

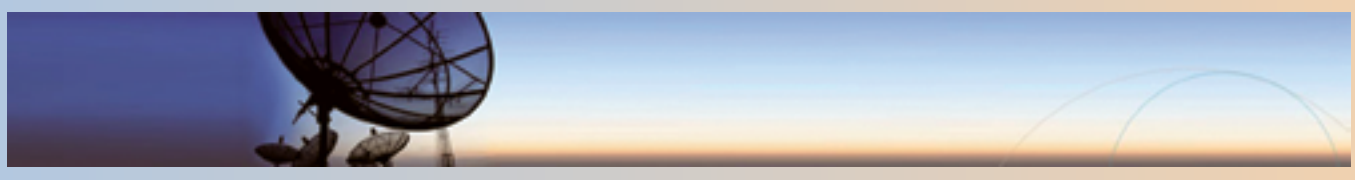
Editor's note

Information in this article was extracted from the new NSR report Satellite Manufacturing and Launch Services, 3rd Edition, which now includes the industry's only segmentation on the Hosted Payload market. Complete information on the company may be found at ***http://www.nsr.com****. For additional details regarding the Satellite Manufacturing and Launch Services, 3rd Edition, report, access* ***http://www.nsr.com/research-reports/satellite-communications/satellite-manufacturing-launch-services-3rd-edition/.***

About the author

Carolyn. Belle joined NSR as an analyst in 2014, focusing on satellite launching and manufacturing, as well as Earth observation. Ms. Belle comes to NSR from the Research and Analysis team at the Space Foundation, where she contributed to the creation of The Space Report 2014. Her research efforts primarily addressed new and emerging space products and services.

Ms. Belle received a Master's degree in Space Management from International Space University and her Bachelor's degree from The Colorado College with a focus in Biology and Chemistry. Ms. Belle has completed several internships at the NASA Ames Research Center.



COMMAND CENTER: MAJOR GENERAL, USAF (RET.) CRAIG P. WESTON PRESIDENT + CEO, U.S. SPACE LLC, & CEO + PRESIDENT, VIVISAT

Craig Weston is President and Chief Executive Officer of U.S. Space, LLC, a U.S.-owned provider of dedicated, commercial space solutions to serve the interest of the nation and its coalition partners and commercial enterprises worldwide.

He also holds these same positions with ViviSat LLC, a joint venture dedicated to life extension of on orbit satellites, and U.S. Space Mobile Communications LLC, a joint venture that provides end-to-end mobile satellite communications solutions.

Previously, he was a Vice President and Deputy Director of a business unit with SRA International, a $1.5 billion information technology and services company based in Fairfax, Virginia.

A retired Air Force Major General, he spent a large part of his career developing, launching and operating communications, infrared warning and reconnaissance satellites. At various points in his career, Gen. Weston was involved in the development and fielding of air launched munitions, airborne high energy laser weapons, airborne and ground warning and surveillance systems, command and control information systems, as well as foreign military sales and international security assistance. His last active duty assignment was in Kabul, Afghanistan, where he brokered international collaboration to rebuild the Afghan defense, police and legal sectors, as well as to disarm militia forces and begin counter-narcotics operations.

Gen. Weston earned a Bachelor of Science degree in Engineering Mechanics and a Master of Science in Aeronautical Engineering. He is an Associate Fellow of the American Institute of Aeronautics and Astronautics and serves on the board of directors of the National Capital Area Council of the Boy Scouts of America.

MilsatMagazine (MSM)

We've been hearing a lot about ViviSat and satellite servicing in general as a breakthrough technology in the industry. How has ViviSat evolved since it was established in 2010?

Craig Weston

Since creating ViviSat in 2010 we've confirmed there is a real market for satellite servicing and are making great progress in bringing it to reality!

You may recall that ViviSat is a joint venture between ATK and U.S. Space. ATK brings a wealth of experience in successfully building, launching and operating smaller satellites as well as several decades of experience in working with NASA on manned satellite servicing, to include several repairs of the Hubble Space Telescope.

U.S. Space contributes its extensive experience in commercial satellite marketing, finance and operations to the venture. This is a terrific blend of talents which serves us well in bringing ViviSat to the market.

MSM

How did you become involved at the executive level with these firms? What enticed you to join U.S. Space?

Craig Weston

I was attracted to U.S. Space by the high caliber of people I would be working with, the entrepreneurial spirit of the firm and its innovative business model, which I thought would be helpful to our government. We are in the business of offering existing or wholly new products and services in a different fashion. Since our business model is a blend of government and commercial practices, it was not difficult for us to team with ATK in order to deliver ViviSat's unique satellite servicing capability to both the commercial and government markets.

MSM

What exactly is satellite servicing and how would customers benefit?

Craig Weston

The initial market is the 430 plus active satellites at geosynchronous orbit, of which about 75 are within three years of retirement at any time. The primary reason for retiring these satellites and taking them out of operations is because they run out of station keeping propellant and cannot maintain the orbital position needed to accomplish their missions.

Our first offering in the satellite servicing arena is that of a Mission Extension Vehicle (MEV), an independent satellite "jet pack" that attaches to a client satellite to provide auxiliary propulsion. Our MEV can prolong the life of a satellite that is running out of propellant and delay the cost for a replacement satellite; change the orbit inclination of a communications satellite to make it more profitable; raise the orbit of a stranded satellite to make it commercially viable and move a satellite to a another orbital position to open up a market in a new area of the globe.

Our service is offered on a leased basis in which the customer pays for services delivered. We can provide MEV life extension services from one month to 15 years. When the customer no longer needs our service, the MEV will move on to the next customer. In this way, the customer only pays for service time they need.

We see a similar need in the government market. In the case of U.S. government satellites, which can cost in excess of one billion dollars each, extending the life of one of these satellites can defer by a number of years the large capital investment of replacing it. This will be a great benefit to our government in the lean budget years ahead of us.

We intend to follow up this "keep it simple" approach to satellite servicing with an incremental evolution in services to offer robotic repair, replacement, and refueling. With this range of services, we foresee commercial satellite operators making satellite servicing an integral part of their satellite fleet planning process.

MSM

What is the state of technology for this mission? Has this been done before?

Craig Weston

The technology and operations for rendezvousing and docking with another satellite is well proven. It is currently being accomplished in Low Earth Orbit (LEO) by multiple nations and the two commercial providers who regularly dock with the International Space Station to transfer cargo and people.

In most ways, our MEV operates like a traditional satellite. The only thing unique about the MEV is the docking mechanism in order to dock with a client satellite that is not specifically designed for docking and the fact we are performing this docking at geosynchronous altitude. We have a proprietary design to perform the docking which we are currently validating in ATK's Robotic Rendezvous, Proximity Operations and Docking (RPOD) Laboratory and will then demonstrate on orbit by docking with a residual satellite before we dock with our first client.

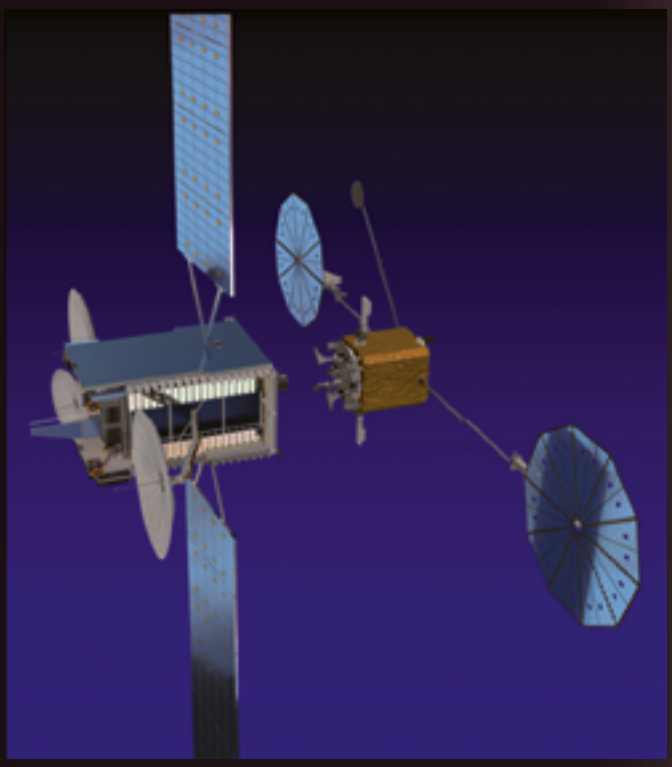
This docking operation at GEO is actually lower risk than that of a low Earth docking, since the lighting will be better, there are less disturbance forces and the natural relative rates between the two satellites are much slower. To the last point, our rendezvous and docking operation will be accomplished slowly over a period of days, using way-points in a fail safe manner in which a positive command will be needed to go the next step in approaching the client. In the final approach to our clients' satellites, the rate of closure will be on the order of centimeters per minute; very slow. The risk of a collision and orbit debris is much less than that of the low Earth orbit dockings already being accomplished today.

MSM

How soon will your service be available?

Craig Weston

We routinely receive calls asking us to perform satellite relocations and rescue missions, as if we are on orbit and available today; and nearly every customer we call on tells us that if we were in orbit today they would use us. This is a good indicator of the demand for our service and we are working as fast as we can to make it available.



MEV (right) rendezvousing with a client satellite (left). Image courtesy of ViviSat.

We plan to start construction of our first MEVs later this year and will be operational in 2018. We signed up our initial clients for the first three MEVs and are well underway with financing, licensing, insuring and designing the details of our service, so we are making great progress on all fronts.

MSM

How does the ViviSat model differ from those being offered by other companies and agencies?

Craig Weston

A business model proposed by others is that of actually refueling the propellant tanks of a satellite, so the client can use its own propulsion system to extend the life of the satellite. We believe the ViviSat "keep it simple" jet pack approach of providing auxiliary propulsion via our MEV is more cost effective and lower risk to our initial clients. We hope to work with and learn from NASA and DARPA, through existing programs such as the Restore and Phoenix programs, to burn down the risks associated with the more complex and riskier approach of refueling and repair. We will then inject these technologies into our commercial offering in an incremental, risk managed evolution that our customers will accept.

Our approach is also more versatile in some instances, since it can be used to take over for a satellite with a damaged or inoperable propulsion or attitude control system. Refueling a satellite in this state will have no effect.

MSM

How does the MEV capture a satellite without damaging either vehicle?

Craig Weston

The MEV is designed to be compatible with roughly 80 percent of the satellites at GEO altitude. We use a proprietary Rendezvous, Proximity Operations and Docking (RPOD) payload design to rendezvous with, and attach, the MEV to the apogee thruster nozzle and the launch adaptor ring on the client spacecraft. The apogee thruster is used by the client satellite at the beginning of its life to raise its orbit to GEO altitude after launch and is then no longer used.

The RPOD system will be validated in ATK's Robotic RPOD Laboratory and will then be demonstrated on orbit by docking with a residual satellite before we dock with our first client. An excellent animated video of this process can be seen at our company website, which is located at ***http://www.vivisat.com***.

MSM

Given the impetus for satellite reuse due to the costs of manufacturing and launch, do you foresee a fleet of MEVs being available for numerous and/or simultaneous missions?

Craig Weston

We do anticipate operating a fleet of MEVs on orbit. Our plan is to launch the MEVs two at a time to economize on launch costs and to serve multiple customers simultaneously. With a mission life of 15 years for each MEV and great demand for satellite life extension, it's reasonable to assume 10 or more MEV's on orbit at the same time, performing satellite servicing for multiple clients.

MSM

New propulsion technologies that are moving away from hydrazine (MMH) are on the horizon, ranging from electrospray, Hydroxyl Ammonium Nitrate (HAN), electron bombardment within an ion thruster, Ecaps to nuclear and more—how would MEV operate with new propulsion technologies?

Craig Weston

ViviSat's current mission extension offering is not dependent on the propulsion technology of the client as long as it has a standard liquid apogee engine and launch adaptor ring. These features are standard on most of the GEO satellites of the vintage we are planning to service.

Our MEV essentially replaces the on-board propulsion system of the client satellite, whether that need is due to lack of propellant or damage to the system. In the future we intend to have the capability to replenish expendables on board client satellites and will need to invest in the proper technologies to replenish those most in demand on orbit.

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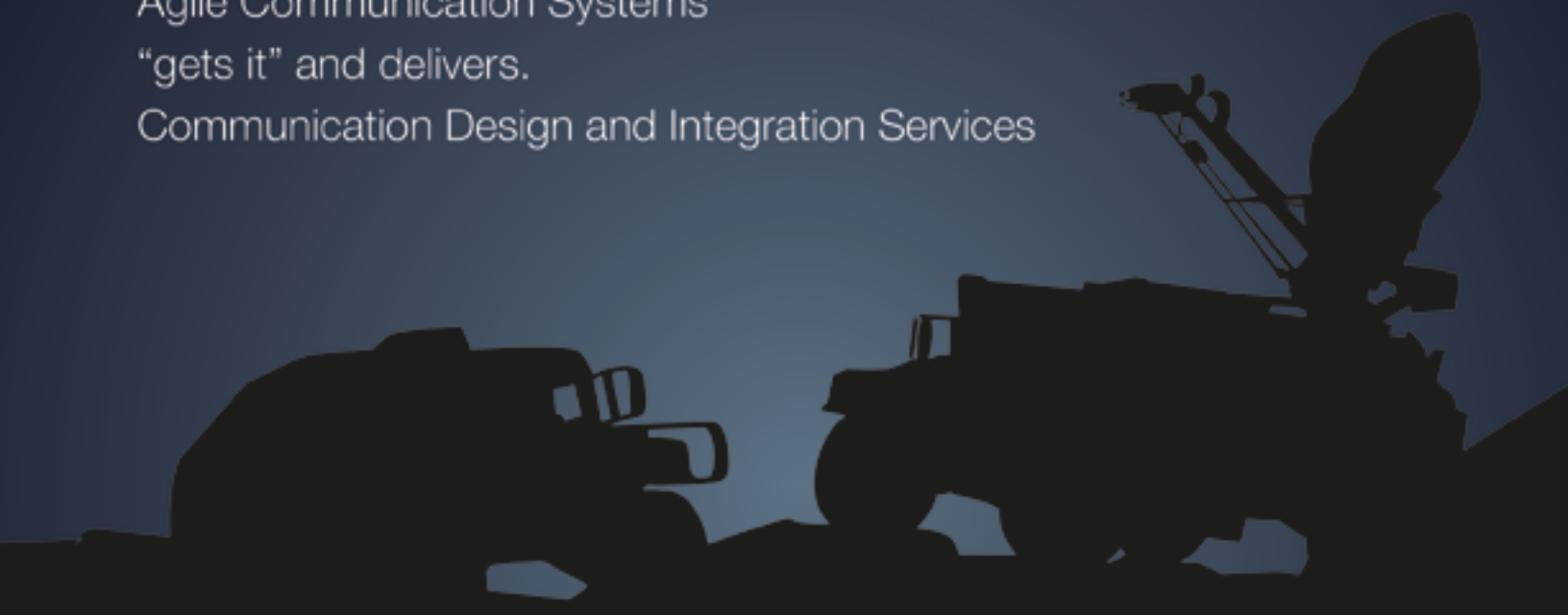

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Given the immediate need for satellite servicing and repurposing, where do you see the satellite servicing heading over the next year or two? What kind of future do you envision for satellite servicing over the long term?

Craig Weston

After we become operational in 2018 and the benefits of life extension are demonstrated, I expect there will be great demand from satellite operators around the world. The initial customers are using this service on satellites that have already been replaced, as a means to grow new orbital roles with the hopes of demonstrating demand that will justify the purchase of a new satellite at that orbit location.

The next customers may be new entrants looking for a means to enter the satellite communications market at a lower cost than the purchase of a new satellite, which breaks down barriers to entry in the comsat market. In the future we see this service's primary role to be that of improving the economics for an operator. Hence my earlier comment that I can easily foresee a fleet of 10 or more MEVs on orbit servicing the growing demand for servicing.

As the next step in this roadmap, we plan to field MEVs with a robotic arm and end inefficient tools to conduct simple repairs like unsnagging a stuck solar array that didn't deploy or removing and replacing a battery pack. We also think we can design the means to replenish consumables like propellants and cryogens.

Over the long term, we envision a full spectrum of Maintenance, Repair and Overhaul (MRO) in space, with satellites designed for MRO, just like aircraft. As part of space logistics, we anticipate transportation as being an industry in itself, almost like replicating FedEx in space. We will also see construction of large space platforms, such as having a Bechtel in space for major infrastructure builds, which can be bases for exploration and other industries.

At each step along this roadmap we will enable other space industries, in near Earth and for deep space. ViviSat intends to be the global leader in this evolution towards space logistics.

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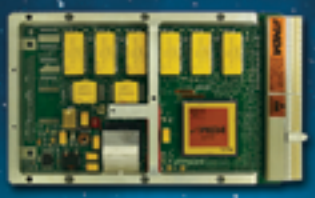

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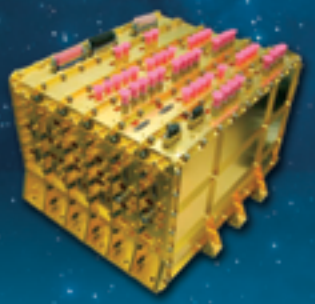

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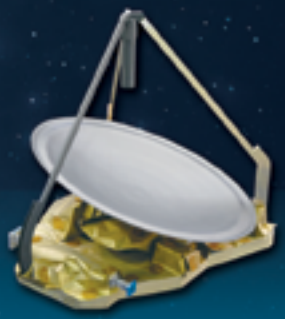

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