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September 2014

MilsatMagazine

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Cover image: Artistic rendition of an ISR satellite on orbit.

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AIR FORCE ASSOCIATION—GENERAL HOSTAGE DISCUSSES COMBAT MISSION READINESS

Gen. Mike Hostage speaks to Air Force Association members about maintaining mission readiness despite fiscal challenges, July 29, 2014, in Arlington, Virginia. The AFA engagement was a part of a breakfast series to allow senior Air Force leaders to speak to the public and media about critical issues affecting the military. Hostage is the commander of Air Combat Command.

U.S. Air Force photo
Staff Sgt. Carlin Leslie.

Maintaining combat mission readiness in the midst of sequestration and budget cuts is a top concern for Air Combat Command and its commander General Mike Hostage.

The general drove those points home during remarks to members of the Air Force Association and the media during a recent AFA monthly senior leader breakfast in Arlington, Virginia.

"Readiness is the linchpin for Air Combat Command, and my contract to our Airman is, 'I won't send you if you're not ready, so I'm going to make you ready,'" Hostage said.

According to Hostage, budget constraints have impacted the command's ability to produce combat power. Decisions made now and during the next few years will be critical to ensuring a combat-ready Air Force, despite a reduced size. However, Hostage noted that his job remains to produce dominant combat air power with whatever resources the nation allots him.

"This is a turbulent world and bad stuff is going to happen somewhere," Hostage said. "The nation will turn to us and say, 'Defend us.' We can't whine and complain. We have to be ready." During his speech, the general emphasized the need for Airmen to be honest in their assessments of capabilities.

"Tell me what your limit is, stop at that point, and I'll either fix that limit or we'll deal with it until the time comes when we can remove that limit," Hostage said. Despite ongoing challenges, Hostage said he remains confident in the today's Airmen and the future of the service.

"We still have the best Air Force on the planet and we can continue to be so if we go down the right paths," he said.

The Air Force Association infosite is located at ***http://www.afa.org/home***

Story by Cassie Gerhardstein,
Air Force Public Affairs, Pentagon

MIDDLE EASTERN NATION RECEIVES MODERNIZATION PROGRAM

Harris Corporation has received an $88 million order to provide a country in the Middle East with Falcon III® wideband tactical radios and accessories as part of an overall modernization effort.

The system leverages the latest software-defined radios from the Harris Falcon III® RF-7800 family. This includes the RF-7800H, the first wideband HF tactical radio, delivering expanded data capabilities for long-range, beyond-line-of-sight environments; the RF-7850M, for wideband mobile ad-hoc networking; and the RF-7800S, a lightweight soldier personal radio for full-duplex voice and data communications over 2 kilometers. The order also includes vehicular and base station systems, accessories, spares, and training services.

"Harris' strong presence in the region, combined with our continued investment in a leading-edge Falcon portfolio of tactical communications products and systems, enables us to transition our customers from legacy, voice-dominated communications to modern networked wideband system solutions," said Brendan O'Connell, president, International business, Harris RF Communications. "These advanced communications systems will support the customer's current and future operational requirements for simultaneous secure voice and high-bandwidth data across a wide range of missions."

To download the RF-7800M PDF applications guide, access ***http://rf.harris.com/media/RF-7800M_Apps_Handbook_tcm26-12261.pdf***

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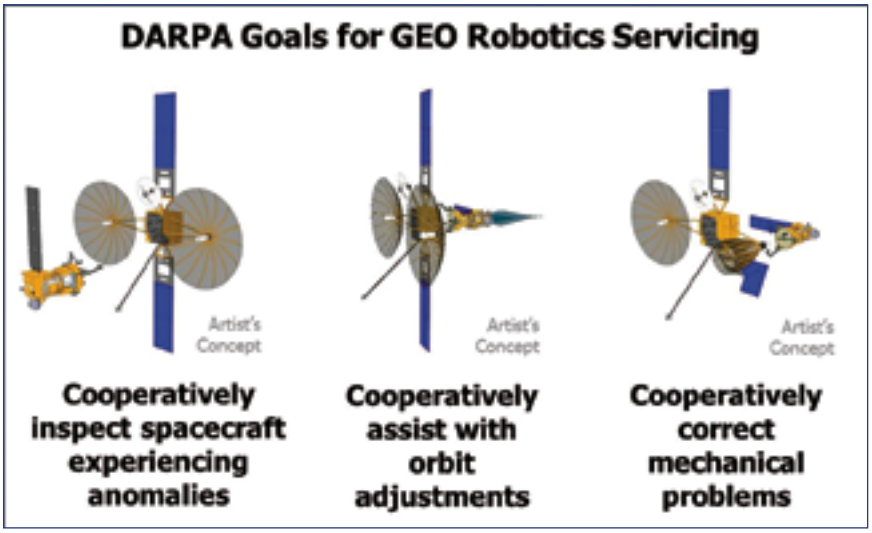
DISPATCHES

DARPA: CREATION OF ROBOTIC SATELLITE-SERVICING CAPABILITIES IN GEO



An increasing number of expensive, mission-critical satellites are launched every year into Geostationary Earth Orbit (GEO), approximately 22,000 miles (36,000 kilometers) 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. As a result, these satellites are designed to operate without any upgrades or repairs for their entire lifespan—a methodology that demands increased size, complexity and cost.

The ability to safely and cooperatively interact with satellites in GEO would immediately revolutionize military and commercial space operations alike, lowering satellite construction and deployment costs and improving satellite lifespan, resilience and reliability.

To expedite these potential benefits, DARPA is considering a flight demonstration to introduce DARPA-developed space robotics capabilities in GEO within the next five years. As the majority of satellites in GEO are commercially owned, DARPA is particularly interested in establishing a public-private partnership that would make cooperative robotic servicing available to both military and commercial GEO satellite owners on a fee-for-service basis. The partnership would help develop near-term technical capabilities and significantly contribute toward the creation of a sustainable, commercially owned-and-operated space robotics enterprise.

DARPA has issued a Request for Information (RFI) (***http://go.usa.gov/yBdJ***) seeking technical, security and business insights to support the agency's pursuit of these goals.

"We're asking the space community to think hard about how they want the future of space operations to look and how GEO robotics could help," said Gordon Roesler, DARPA program manager. "Their insights are essential as we take the first concrete steps toward viable satellite-servicing capabilities in GEO. If we're successful, we will significantly accelerate development of a capacity to maximize the utility of current space infrastructure and enhance the capabilities of future systems."

The RFI invites input in two primary areas:

- ***Technical characteristics for a robotic servicer that would integrate DARPA-developed space robotics technologies into commercially available spacecraft designed for GEO. Building on DARPA's Phoenix program and more than a decade of the agency's other investments in space robotics, the jointly developed GEO robotic servicer would support a variety of multi-year on-orbit missions, including:***
  - » *Cooperative inspection of functional spacecraft that may have experienced anomalies while operating in GEO*
  - » *Cooperative correction of mechanical problems, such as solar array and antenna deployment malfunctions*
  - » *Cooperative assistance with orbit change maneuvers, including relocation or transfer to disposal orbit*
- ***Business arrangements and practices that would best facilitate a commercial spacecraft servicing enterprise that is long-lived and self-sustaining, and would achieve the greatest value for U.S. national and economic security. DARPA envisions that a non-traditional acquisition instrument may be appropriate to establish this partnership. DARPA wishes to consider creative solutions in this domain and thus desires industry input for structuring the commercial partnership solicitation.***

"Creating a public-private partnership is an innovative way to ensure that GEO robotic servicing gets community buy-in to succeed long term," Roesler said. Moreover, he said, a public-private partnership would support the White House's National Security Space Strategy of 2011, which states, "Strategic

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DISPATCHES

DARPA (CONTINUED)

partnerships with commercial firms will be pursued in areas that both stabilize costs and improve the resilience of space architectures on which we rely."

DARPA is aware of current industry-led servicing development efforts, particularly those aiming to enable on-orbit refueling and satellite life extension. The agency welcomes information on possible early-opportunity collaborations or partnerships involving such missions, including technology demonstration and maturation, data sharing, or testing.

DARPA anticipates that responders may fall into one of three general categories: hardware/software developers (e.g., spacecraft providers and ground system developers); satellite servicing organizations; and service clients, such as commercial communications satellite operators. Responders should describe how their organizational capabilities and past experience with any of the following areas would contribute to the success of the program:

- *Spacecraft development, integration, testing and on-orbit operations*
- *On-orbit servicing technology development and/or business case analysis*
- *Robotics technologies, including hardware (sensors, actuators, etc.) and software (control, teleoperations, etc.)*
- *Satellite fleet ownership, operation and management*

Responses are due November 3, 2014, to ***DARPA-SN-14-51@darpa.mil*** by 12:00 PM Eastern Time. All technical and administrative correspondence and questions regarding this announcement and how to respond should be sent to the aforementioned email address.

DOD: SEEKING INDUSTRY COLLABORATION

With potential adversaries spending significant amounts to nose ahead of U.S. technology investments, Defense Department industry partnership remains critical, the Pentagon's director of unmanned warfare and intelligence, surveillance and reconnaissance said at the recent Southeastern New England Defense Industry Alliance's Defense Innovation Days conference.

As the DoD fiscal year 2016 budget shapes up to be "less than planned for," the director said, the United States faces the challenge of spending money on current assets while keeping future investments robust.

"The U.S. enjoyed a significant... asymmetric capability over the last 10 years," he told the audience of defense industry leaders. "There are folks trying to find an asymmetric capability against us, and they're spending big bucks to get there... so our challenge is to stay ahead of them, and that is going to be tough in a fiscally tight environment."

While DoD historically tends to "hunker down and collapse back on core mission areas" to retain force structure, the need for innovation and creative ideas persists, he said. "This could be a great opportunity to force DOD to think outside the box, to move well beyond where we currently are today, but we can only do that with creative and innovative ideas," he added.

The director noted recent ISR capability procurement, such as Pointers, Hunters and Predators.

"All that capability has been procured, delivered and used by the warfighter since 9/11," he said. "So I am absolutely convinced that industry can respond to DoD's need for innovation and excellent ideas that put DoD where we need to be."

The Defense Department will work to make the requirements, acquisition and budget process better suited for innovation, the director said, noting that Frank Kendall, undersecretary of defense for acquisition, technology and logistics, has worked hard to make the system more flexible by making "sorely needed" changes.

"At every turn," he added, "industry rose to the challenge and exceeded DoD's expectations when we asked for help, and in many cases, they actually knew better than DoD did what we needed."
By and large, the director said, innovative companies putting their own ideas into programs and bringing those capabilities forward has helped to keep progress steady.

"DoD needs your help, and we need to partner with you at every level in that technology development process."

Story by Amaani Lyle
DoD News, Defense Media Activity

DISPATCHES

NORTHROP GRUMMAN + US NAVY—MANNED, UNMANNED FLIGHT OPS INTEGRATED

Northrop Grumman Corporation and the U.S. Navy offered a glimpse of the future of carrier aviation on August 17th by conducting a series of cooperative flights from the aircraft carrier, USS Theodore Roosevelt (CVN 71), using an X-47B Unmanned Air System (UCAS) and an F/A-18 Hornet.

The flights—the first time manned and unmanned carrier aircraft have operated together in the same carrier controlled landing pattern at the same time—occurred in the Eastern Atlantic. They offered Northrop Grumman and the Navy an opportunity to collect data that will help reduce risks associated with integrating unmanned aircraft with conventional manned carrier operations.

"The X-47B has demonstrated that it can operate seamlessly with conventional carrier assets in one of the most demanding environments in the world," said Capt. Beau Duarte, the Navy's UCAS program manager.

During the flights, the X-47B flew in the landing pattern with the F/18-Hornet at approach speeds of 120 miles per hour, at a pattern altitude of 1,200 feet. Mission operators aboard the USS Theodore Roosevelt had full control of the X-47B during flight maneuvers that involved several planned precision approaches to the carrier.

At the completion of the manned/unmanned flight trials, the X-47B landed safely aboard CVN 71, catching and quickly releasing the arresting cable before folding its wings and taxiing clear of the landing area. Northrop Grumman designed and produced the program's two X-47B air vehicles.

DISPATCHES

ORBIT COMMUNICATIONS—AIRBORNE ASSETS ACQUIRED

ORBIT Communication Systems Ltd. has received an order exceeding $500K to supply its comprehensive airborne satellite communication solution to a leading unmanned aerial vehicle (UAV) manufacturer.

ORBIT will supply the UAV manufacturer with its end-to-end AirLNK™ B-LOS solution, which comprises both airborne and ground segments.

This turnkey solution features ORBIT's AirTRx 60cm VSAT, to be used for broadband Ku-band satellite communication, along with supplementary equipment, a compatible ground station and on-site support services.

Ofer Greenberger, ORBIT's CEO, said, "ORBIT continues to extend its penetration into the Airborne Satellite Communication Market. We are proud to have been selected as a supplier of end-to-end satellite communication systems for unmanned aerial vehicles. ORBIT's AirLNK B-LOS offers an optimal solution for beyond-line-of-sight broadband communication between the aircraft and the ground station. This order is yet another vote of confidence from the UAV market in ORBIT's proven solutions and technological capabilities."

ORBIT's communications systems are installed in thousands of military and civilian aircrafts worldwide. All systems meet international standards, and are considered as best-in-class based on their proven performance and durability in the harshest of environments.

The ORBIT Communications infosite:
http://www.orbit-cs.com/

ROCKWELL COLLINS—PROTOTYPE PULLS IN GALILEO SIGNAL

Rockwell Collins has successfully received and tracked a Galileo satellite signal using a prototype Global Navigation Satellite System (GNSS) receiver designed for secure military use.

Last year, Rockwell Collins received a $2 million contract from the Air Force Research Laboratory (AFRL) and the GPS Directorate to develop and demonstrate a Secure Software Defined Radio (S-SDR) Global Navigation Satellite System (GNSS) receiver capability.

GNSS typically refers to the collection of equipment that can receive signals from multiple navigation satellite systems including the United States NAVSTAR Global Positioning System (GPS), the Russian GLONASS system, the European Galileo system and the emerging Chinese Beidou system, as well as the various augmentation systems such as Wide Area Augmentation System and the European Geostationary Navigation Overlay System.

By using multiple available satellite signals, improved and more robust signal availability may be obtained, enabling a compatible GNSS receiver to deliver superior position determination that can improve navigation performance and signal availability.

Hosted in a software defined radio, the S-SDR program will develop the security architecture required for receiver equipment approvals and certifications. The arrival of modernized GPS signals and other global constellations is changing the way the U.S. military and its allies accomplish secure GNSS-based positioning, navigation and timing.

The European Galileo constellation coming on line during 2015, including its open signals and secure Public Regulated Service, is expected to provide an opportunity for improved robustness in satellite based navigation, in both commercial and government applications.

More than 35 years ago, Rockwell Collins assisted the U.S. Air Force in developing GPS technology. That legacy continued when the company created the world's first all-digital miniature GPS receiver under contract with DARPA. Over the years, Rockwell Collins has produced more than 50 GPS products and delivered more than 1 million GPS receivers for commercial avionics and government applications.

The GNSS receiver technology being provided for the S-SDR program will continue this legacy of providing leading edge GNSS solutions.

For further information, please visit the Rockwell Collins infosite at
http://www.rockwellcollins.com/

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DISPATCHES

SES GOVERNMENT SOLUTIONS (SES GS) + DISA—A WIN-T WIN

MRAP with WIN-T POP. Photo Credit: U.S. Army.

SES Government Solutions (SES GS) has been awarded a contract to provide satellite capacity to support the Army Warfighter Information Network-Tactical (WIN-T).

SES GS was awarded the five-year contract through Defense Information Systems Agency (DISA) as a subcontractor to small business company AIS Engineering, Inc. (AIS).

The innovative solution designed by the AIS and SES GS team is supported entirely by SES satellites. SES satellite capacity will provide support for U.S. Army research and development activities as well for testing new applications for mobile missions.

With more than three decades of experience serving the U.S. Government, SES GS has a long-standing relationship with the U.S. Army and has been supporting the WIN-T program for six years.

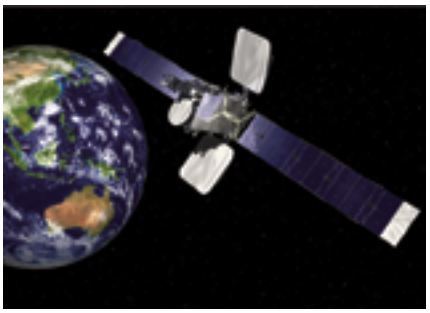
The SES GS infosite may be accessed at ***http://www.ses-gs.com/***

Additional information regarding WIN-T may be gleaned at ***http://peoc3t.army.mil/wint/***

INTELSAT GENERAL CORPORATION + DRS TECHNOLOGIES—U.S. CENTRAL COMMAND SERVICES CONTINUE

Intelsat General Corp. received a one-year contract renewal for satellite capacity from DRS Technologies, one of several previously referenced renewals that were received in the 2014 third quarter under the Future Commercial Satellite Communications Acquisition (FCSA) vehicle.

Under the contract, entering its third year, Intelsat General is supplying satellite services to DRS Technologies, a division of Finmeccanica, in support of U.S. Central Command requirements in Afghanistan.



Artistic rendition of the Intelsat 18 satellite, used to supply capacity to the armed forces during Iraqi Freedom.

The service, which initially began in August 2012, is using 180MHz of Ku-band capacity on an Intelsat 9 series satellite over southwest Asia.

"Even though U.S. troops are being withdrawn from Afghanistan, the Pentagon will continue to provide support to Afghan forces," said Kay Sears, President of Intelsat General. "Our satellite connectivity will continue to play a key role in that support."

"DRS and Intelsat General have teamed to support the Allied and Afghan forces with quality satellite capacity that provides connectivity for their critical communications missions," said Jim Scott, General Manager of Global Enterprise Solutions for DRS.

The Intelsat General infosite may be reached at ***http://www.intelsatgeneral.com/***

Additional information regarding DRS Technologies may be found at ***http://www.drs.com/***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DISPATCHES

U.S. ARMY—VSAT RETROGRADE OPS IN AFGHANISTAN'S SALANG PASS

The 10th Sustainment Brigade works together to disassemble the satellite dish at the top of the Salang Pass, in support of retrograde operations. The Salang Pass meanders through the Hindu Kush Mountains and has been called one of the most dangerous roads in the world.
Photo is courtesy of the U.S. Army

Soldiers assigned to the 10th Sustainment Brigade Sustainment Automation Support Management Office contributed to retrograde operations by recovering logistics information systems.

The SASMO team successfully recovered the first very small aperture terminal (VSAT), a device used to transmit and receive data signal through a satellite, established in Afghanistan from the top of the Salang Pass. The team also recovered a radio frequency in-transit visibility kit, a system that traces the identity, status and location of cargo from one location to another via satellite. The Salang Pass meanders through the Hindu Kush Mountains and has been called one of the most dangerous roads in the world.

As International Security Assistance Force transitions from partnered combat operations to train, advise and assist operations, commanders will adjust the size of their force and the amount of equipment in their area to meet the new mission. "There are currently hundreds of VSATs throughout the theater of operation," said Chief Warrant Officer 4 Robert Kay, a Norwalk, Ohio native, SASMO officer in charge. "The goal is to reduce that number to less than 50."

Reducing the number of VSATs in theater is a part of the retrograde mission put in place by U.S. Army G4.

The 10th SBDE has been successful with balancing the retrograde and sustainment missions simultaneously.

In the early morning hours the brigade's convoy security team prepared for the long trek through the Salang Pass, which is approximately 45-kilometers long, by conducting their pre-combat checks and pre-combat inspections before rolling through the entrance control point.

Soldiers assigned to the 330th Movement Control Battalion played a vital role in the success of the mission by providing a heavy expanded mobility tactical truck

The Salang Pass meanders through the Hindu Kush Mountains and has been called one of the most dangerous roads in the world.
Photo by Sgt. Michael K. Selvage,
10th Sustainment Brigade Public Affairs NCO

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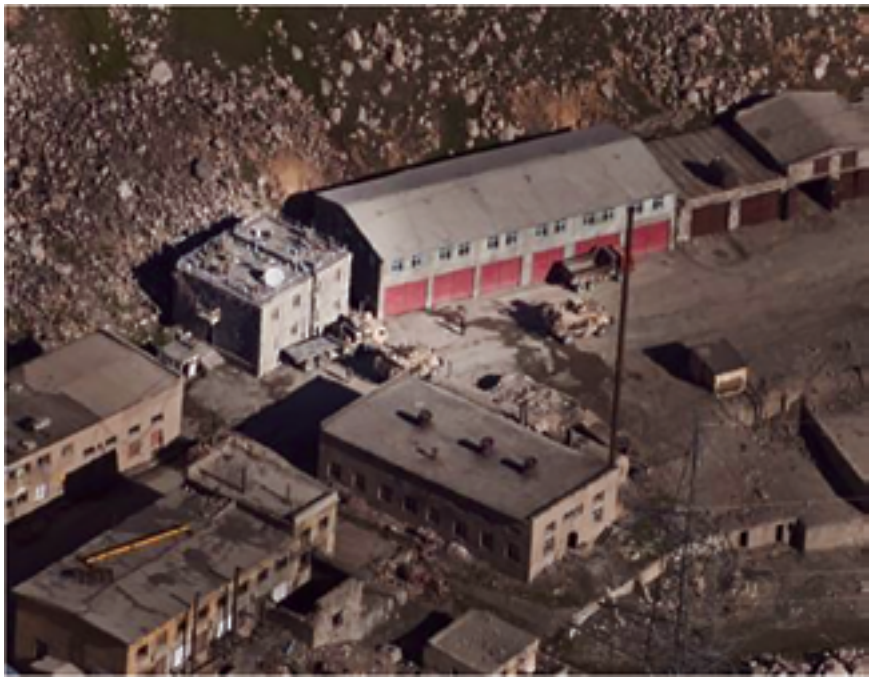
U.S. ARMY—VSAT RETROGRADE (CONTINUED)



Soldiers from the convoy escort team provide security while the sustainment automation support management office team and other members of the convoy, all assigned to the 10th Sustainment Brigade, work together to disassemble the logistics information systems on the roof of a building at the top of the Salang Pass in support of retrograde operations.

Photo by Sgt. Michael K. Selvage, 10th Sustainment Brigade Public Affairs NCO.

with a load handling system in place of a flat bed.

After the convoy made it to the top of the pass, which is 12,723 feet above sea level, Soldiers from the CST provided security while the SASMO team and other members of the convoy headed to the location of the equipment, which was on the roof of a stone building, to conduct their mission.

Spc. Kenneth Jobin, a Staten Island, New York native, SASMO technician, said the disassembly of the VSAT was estimated to take as long as four hours, but with the help of Sgt. Hanson Thomas, an Orange, New Jersey native, truck commander and Spc. Drake Baldwin, a Dayton, Ohio native, utilities equipment repairer, both assigned to the 10th SBDE, the work was finished within a half hour.

For the VSAT to be completely retrograded, all components had to be accounted for and secured. If not, the Army would have lost more than $96,000, which was one of the many factors that went into the planning process of the mission. The same thing applied to the RFI-TV, which saved the Army more than $23,000.

"We had to account for every single piece of the equipment," said Jobin. "Every nut, bolt and cable... I mean everything." The biggest issue that arose was the mere size of the VSAT and the welded bars of metal some might call stairs leading to the roof of the stone building, especially as such was deemed unsafe to try and carry parts of the VSAT down the stairs.

An NCO made the decision to use ratchet straps to lower the components of the VSAT and RFI-TV down the side of the building alleviating any safety hazards

Soldiers lowered the equipment to the ground and secured it to the HEMTT.

This may seem like a difficult task, but teamwork ensured the mission was accomplished in a timely manner.

Once everything was accounted for and secured, the convoy made its way back down the treacherous roads of the pass and back to the motor pool for an after action review. Matériel and equipment recovered from Afghanistan will increase the readiness of U.S. forces at home and prepare them for future operations.

The retrograde mission was a success, saving the Army more than $100,000, in part to the coordination and teamwork of the Muleskinner team and the Soldiers of the 330th MCB.

Story by Sgt. Michael Selvage, U.S. Army, 10th Sustainment Brigade Public Affairs Office

Soldiers assigned to the 10th Sustainment Brigade and the 330th Movement Control Battalion load and secure the recovered logistics information systems on the back of a heavy expanded mobility tactical truck with a load handling system in place of a flat bed at the top of the Salang Pass in support of retrograde operations.

Photo courtesy of U.S. Army.

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DISPATCHES

LINK MICROTEK… THESE JOINTS ARE JUMPING…

The latest addition to Link Microtek's expanding range of in-house manufactured microwave rotary joints is the AMCORJD-Ku dual-channel coaxial device, which has been specifically designed for use in the low-profile antennas that are a key element of Ku-band Satellite-On-The-Move (SOTM) high-data-rate communication systems. These systems are typically deployed on military or commercial mobile platforms such as vehicles or airplanes.

As well as featuring a height of only 31.6mm, the new rotary joint is equipped with right-angled coaxial connectors to minimize the vertical space required for cables.

The offering also offers high-current capability on the receive channel, which means that both the antenna's LNB and the motors that keep the antenna locked on to the satellite can be powered via the rotary joint.

This eliminates the need for additional slip rings and saving even more space. The transmit channel has a frequency range of 13.75 to 14.5GHz, with a power rating of 40W CW, a maximum VSWR of 1.4:1 and a typical insertion loss of just 0.6dB.

The receive channel can handle DC to 2.15GHz at a microwave power of up to 1W CW, while typical VSWR and insertion loss are specified as 1.5:1 and 0.5dB respectively. Maximum current rating for the receive channel is 2A at 24V DC.

Manufactured at Link Microtek's premises in Basingstoke, UK, the AMCORJD-Ku rotary joint features an intricate internal design consisting of over 40 separate precision-engineered parts.

The body of the device is fabricated from aluminum with an Iridite finish and measures 36.0mm in diameter and 31.6mm in height excluding the female SMA-type coaxial connectors.

The device incorporates a 63.5mm-diameter bulkhead flange as standard. Other rotary-joint configurations and sizes are available on request, tailored to suit specific antenna requirements.

For further information, please visit
http://www.linkmicrotek.com/

DISPATCHES

TRACK24 DEFENCE + NOBLE—BLUE FORCE TRACKING INVESTMENT

The Norwegian Battle Lab & Experimentation (NOBLE) has procured trackers and accessories from Track24 Defence in order to conduct experimentation activities related to blue force tracking.

The investment and the deal was conducted through Swedish military C4ISR specialist, MilDef Systems AB. The solution will provide beyond line-of-sight command and control capability at short notice.

Johan Pakarinen, managing director at MilDef Systems AB, said, "Having spent more than ten years in the Swedish armed forces, I understand tactical communications requirements. Traditionally these systems are complicated to setup and require a lot of training and bandwidth. The Track24 Defence solution offers a cost effective way to quickly increase capability and it's easy for operators to use; an hour's training enables them to power up the Track24 units and instantly secure beyond line-of-sight communication for their operations. Combining the advanced tracking devices with tablet computers running Track24 Defence's SCC Tactical software gives commanders blue force tracking and command and control capability wherever they are in the world."

Neil Perriton, Track24 Defence BFT specialist, said, "NOBLE's requirements mirrored those of a number of our military customers: They need a cost effective solution that could be deployed quickly."

The solution will be fully operational by September of 2014.

The Track24 Defence infosite is located at ***http://www.track24defence.com/***

DISPATCHES

U.S. ARMY—IN-FLIGHT SITUATIONAL AWARENESS FOR RAPID RESPONSE FORCES

U.S. Army paratroopers with the 3rd Battalion, 319th Field Artillery Regiment, 1st Brigade Combat Team, 82nd Airborne Division, wait for takeoff in an Air Force C-17 aircraft before an airdrop as part of Joint Operational Access Exercise 13-03 at Fort Bragg, North Carolina. The Army's new Enroute Mission Command Capability will soon provide in-flight Internet and mission command capabilities to elements of the 82nd Airborne Division that respond as part of the joint Global Response Force.

Photo Credit: DoD photo by Tech. Sgt. Bradley C. Church, U.S. Air Force

With help from the Army's new in-flight Internet and mission command capability, commanders of Global Response Force units will be able to plan missions in the air, while their Soldiers receive operational updates and watch full-motion video of upcoming drop zones before their parachutes ever open.

"The ability to understand a situation gives you the ability to take appropriate action, and if the GRF (Global Response Force) can understand a situation before they get to their drop location, then they can be more effective from the moment boots hit the ground," said Lt. Col. Joel Babbitt, product manager for Warfighter Information Network-Tactical, or WIN-T, Increment 1, which manages the new in-flight capability for the Army. "Instead of landing on the ground, analyzing the situation and developing execution plans, they can hit the ground executing."

The joint GRF essentially consists of two components—the Air Force that supplies and sustains the C17 and C130 aircraft, and the Army's XVIII Airborne Corps, primarily the 82nd Airborne Division. The GRF needs to be able to rapidly deploy at a moment's notice and effectively command and control forces from the air.

To help meet these requirements, the Army's new Enroute Mission Command Capability, or EMC2, is being installed on C17 aircraft. The U.S. Special Operations Command, known as USSOCOM, which oversees the special operations component commands of each service, already has aircraft outfitted with their own version of this in-flight capability.

The Army's EMC2 system integrated on additional C17s would expand that initial USSOCOM capability, supporting the increased expeditionary nature of today's forces.

The Army began testing of EMC2 installed on the C17s at multiple locations this summer. On the current timeline, equipment is expected to be issued to the XVIII Airborne Corps by the end of the calendar year.

EMC2 provides Internet service, mission command applications, full-motion video (FMV), intelligence products and collaborative planning tools along with a complete office suite of computers and voice phones—all onboard an airplane. It enables en-route mission command, so that as the situation develops in the destination target area, commanders will be able to get updates, understand changes on the ground and be able to adjust their plan to accommodate for those changes, Babbitt said.

"It will be a transformation in the situational awareness and effectiveness of the GRF in the first several hours of ground operations," he said.

One of the main components of EMC2 is the Fixed Install Satellite Antenna, or FISA, which provides the Internet connection for the C17. Similar to the capability being used and implemented by today's commercial airlines, FISA posed a low technical risk for Army adoption.

From a frequency perspective, the Army is looking to utilize both Ku (commercial) and the military Ka-band in one antenna on the C17s for optimum bandwidth and efficiency.

"The FISA provides a fourfold increase in bandwidth so that a new host of services can be employed on board, increasing capability for GRF units to plan and maintain critical situational awareness in the air," said Capt. Mindy Brown, EMC2 lead for PdM WIN-T Increment 1.

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DISPATCHES

U.S. ARMY—RAPID RESPONSE FORCES (CONTINUED)

The U.S. military already has satellites, airplanes and drones that provide SD and HD FMV. With EMC2, those feeds can now be displayed on board the aircraft on LED screens, along with integrated marquees and an intercom system.

"Being able to see the airfield where you are going to be landing, to see that drop zone, helps Soldiers get their heads fully into the operation so they are better prepared for the mission at hand," Brown said.

The key capability of EMC2 does not just reside in the antenna, but also in the incorporation of the Key leader Enroute Node. It will provide airborne units with broadband reach-back data capability; secure Voice Over Internet Protocol communications between task force commanders and combatant commanders; as well as communication between aircraft.

"For the GRF, EMC2 is an absolutely disruptive technology to the traditional way of doing business, and will transform operations," Babbitt said.

As part of the GRF mission, with the Air Force providing the aircraft, the Army's 82nd Airborne Division has deployment-ready paratroopers and infantrymen who can provide an immediate military capability on the ground in a very short period of time to any location worldwide.

In 1991, in its role as GRF, the 82nd Airborne was the first force on the front line between Saudi Arabia and Kuwait, shortly after Kuwait was invaded by Saddam Hussein's troops. The GRF was also activated for a humanitarian mission during the earthquake in Haiti, in 2010.

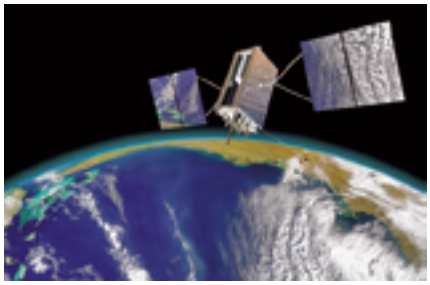
Well-equipped, rapidly deployable units such as the GRF are a vital part of the

Army's evolving force structure as it strives to become a leaner, more capable and expeditionary force. Advanced network capabilities such as EMC2 will continue to increase force mobility and agility by making it easier for Soldiers to get the information they need to be successful, anytime, anywhere.

"EMC2 will not only enable the Airborne Task Force commander to better understand developing situations, but it will also increase the situational awareness for all of the joint servicemen and women in the aircraft," Babbitt said. "It really comes down to mental preparation and the ability to plan 'on the fly.'"

Story by Amy Walker, PEO C3T

LOCKHEED MARTIN—TWO HUNDRED COLLECTIVE YEARS... AND COUNTING...



Artistic rendition of a GPS III satellite on orbit. Image courtesy of Lockheed Martin.

The U.S. Air Force's fleet of Global Positioning System (GPS) Block IIR and IIR-M satellites, manufactured by Lockheed Martin [NYSE: LMT], have reached 200 collective years of operational life.

These 20 satellites—about two thirds of the current GPS constellation— help deliver precise positioning, navigation and timing services to more than one billion global military, civilian and commercial users every day. Originally launched between 1997 and 2009 to add capabilities to the GPS constellation and to replace other aging satellites, the 12 GPS IIR and eight IIR-M satellites have maintained an unprecedented availability record of 99.96 percent. That represents only 10 minutes of downtime per satellite during all their years of operation.

This spring, the IIR-M satellites played a major role in the continued modernization of the GPS constellation. To help manufacturers develop and test next generation advanced civil GPS receivers, under the direction of Air Force Space Command and in collaboration with the Department of Transportation, these satellites began early broadcasting of test civilian navigation, or CNAV, messages on a new signal planned for all future satellites.

Making these milestones even more significant is the fact that the GPS IIR and IIR-M satellites were designed to last 7.5 years, or collectively about 150 years. All 12 IIR satellites are currently operating beyond their design life with the oldest operating for more than 16.5 years. Three of eight GPS IIR-M satellites have surpassed their expected life span and all satellites will have done so in 2017.

To meet evolving GPS user demands, Lockheed Martin is already developing the next generation GPS III satellites, which will deliver three times better accuracy, provide up to eight times improved anti-jamming capabilities, and include enhancements which extend spacecraft life to 15 years, 25 percent longer than the newest Block IIF satellites. GPS III will be the first generation of GPS satellite with a new L1C civil signal designed to make it interoperable with other international global navigation satellite systems.

The Lockheed Martin GPS infosite is located at ***http://www.lockheedmartin.com/us/products/gps.html***

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DISPATCHES

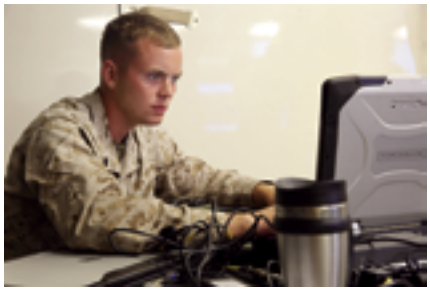
U.S.M.C.—FIRST MOBILITY EXERCISE FOR MTACS-28

Members of Marine Tactical Air Control Squadron 28 recently participated in their first mobility exercise in Sunset Park at Cherry Point, North Carolina.

The exercise, held in preparation for the upcoming exercise Bold Alligator in October, tested the squadron's ability to move a tactical air command center forward to support the ground scheme of maneuver.

"This exercise is important because as we are getting back to our amphibious roots, we need to be able to move quickly," said Gunnery Sgt. Cliff Brown, the TACC chief within the exercise. "A TACC normally supports Marine Expeditionary Brigades or Marine Expeditionary Forces, and we don't have the opportunity to train with that a lot, so we are just laying out the groundwork and fixing the bugs."

A TACC is capable of possessing the ability to provide data link infrastructures, radar pictures, satellites and maintain visibility of all aircraft within the operational area.



Cpl. Ryan Madden works within Marine Tactical Air Control Squadron 28's tactical air command center at Sunset Park at Marine Corps Air Station Cherry Point, N.C. during a mobility exercise. The exercise tested the squadron's ability to move a tactical air command center, the main component, forward to support the ground scheme of maneuver. Madden is a tactical data systems administrator with the squadron.

Photo by Lance Cpl. Victor A. Arriaga

Along with the TACC, the exercise also contains components such as Humvees and modular extendable rigid wall shelters, which contain the display board, the eyes and ears that allow the commander to see what is going on, said Staff Sgt. Tremaine C. McCallum, the staff non-commissioned officer in charge of the exercise.

"The MOBEX and TACC will provide the wing commanding general with the command and control which will provide the accurate information needed to get the mission done," he said.

The exercise allowed the Marines of MTACS-28 to brush up on perishable skills.

"The MOBEX is a huge benefit to the squadron because when we train to support a MEF-level contingency, we don't get to really work with motor transport, utilities or S-4 as much as we would like to," said Brown.

"It's going to really work the skills that haven't been worked in a long time, because of the nature of the beast that we are normally going to support a higher level echelon."

TACC's are made up of coordinators and operators who work together for the exercise to run as smoothly as possible.

"Your coordinators are going to be your staff non-commissioned officers, and your operators are going to be your junior Marines," said McCallum.

Cpl. Michael Allen, a TACC operator during the exercise, said he was one of many responsible for the coordination and movement of the TACC from one location to the other and believes the exercise is important for the squadron to grow.

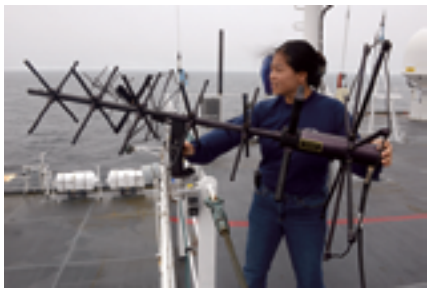
"This exercise is important so we do not lose any of our skills, so when something happens in the real world, we don't forget how to do it," said Allen.

"For our first MOBEX, this is going great. We set up the whole thing in a day and a half, and I'm looking forward to the next one.," he added.

Story by Lance Cpl. Victor Arriaga, 2nd Marine Aircraft Wing & Marine Corps, Air Station Cherry Point

DISPATCHES

COAST GUARD RESEARCH AND DEVELOPMENT CENTER—ARCTIC SHIELD OPS



Amy Sun, an advanced program lead for Lockheed-Martin, adjusts a UHF antenna aboard the Coast Guard Cutter Healy while underway near Alaska. Sun works with narrowband military satellite systems and is aboard the Healy to test the capabilities of the Mobile User Objective System in the Arctic. USCG photo by Petty Officer 1st Class Shawn Eggert.

A team of scientists from the Coast Guard Research and Development Center, New London, Connecticut, headed out aboard the Coast Guard Cutter Healy for a series of technology evaluations in the Arctic and conducted operations off the North Slope.

The RDC is leading a multi-agency and international team to support Arctic Shield 2014, a 17th Coast Guard District initiative. The purpose of their month-long evaluation is to improve Coast Guard capabilities in the Arctic region, specifically in the areas of boat operations, communications, navigational safety and oil spill response.

The RDC is collaborating with the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory to assess improvements made to Coast Guard boats using commercial off the shelf products to enhance capability in a cold weather environment. The RDC is also assessing Arctic communications. Over the past year, the team has been modeling High Frequency, Very High Frequency, and Ultra High Frequency coverage in the Arctic region. While onboard the Healy, the team will validate their communications coverage models and use the information to improve future coverage predictions.

Additionally, U.S. Northern Command and its contractor, Lockheed Martin Corp., will help the RDC assess Mobile User Objective System satellite coverage at high latitudes. MUOS delivers secure voice and high-speed data to mobile users using an advanced waveform similar to cell phone technology. Understanding the extents of its coverage could have marked impacts on Arctic communications.

"The ability to communicate weather, ice and other safety information is going to be vital to vessel traffic as more mariners look to northern waters as a means of passage, commerce or recreation. This is a tool that benefits anyone with a stake in the Arctic Ocean," said Lt. Cmdr. Mike Turner, RDC Arctic navigation lead.

The RDC will also continue its study of oil spill response in ice. The National Oceanic and Atmospheric Administration, the National Science Foundation, the National Ice Center, Space and Naval Warfare Systems Command, the University of Cambridge and the University of Washington's Applied Physics Laboratory are providing personnel, unmanned technologies and resources to help the RDC better understand how to detect and track a simulated oil spill as it moves in the water near the ice edge.

The science team wrapped up operations on August 30 and returned to New London to deconstruct collected data.

Story by Lt. Keely Higbie, U.S.C.G.

DISPATCHES

CPI SATCOM—UPLINK SUPPORT FOR BRAZILIAN MINISTRY OF DEFENSE

CPI Satcom's 500 W CW Ka-band ODU

Communications & Power Industries (CPI) Satcom Division has been selected to supply high power uplink amplifiers (HPAs) to support the Brazilian government's new Geostationary Defense and Strategic Communications Satellite (SGDC).

CPI will provide 500W continuous wave (CW) Ka-band TWTAs, which will be used for critical telemetry, tracking and control.

The SGDC satellite will be dedicated to strategic communications for the Brazilian Ministry of Defense, and broadband services for the Ministry of Telecommunications.

The launching and operation of the satellite will be performed by Visiona Tecnologia Espacial S.A, a joint venture between Telebras Telecomunicacoes Brasileiras S.A. and Embraer Defense and Security.

Andy Tafler, President of CPI Satcom Division, said, "We have spent considerable time and investment to become a leading supplier of amplifiers operating in this frequency range, and are happy to see our efforts recognized in the marketplace."

CPI has shipped more than 2,000 Ka-band high power amplifiers to customers around the world, and is also a leading supplier of HPAs for uplinks in all standard operating frequency bands. Most of the company's products are ANATEL certified for import to Brazil.

The CPI Satcom Division infosite:
http://www.cpii.com

NASA + BALL AEROSPACE & TECHNOLOGY CORP.—MOD AWARDED FOR JPSS-2

A sole source contract modification has been awarded to Ball Aerospace and Technology Corp. of Boulder, Colorado, for the Ozone Mapping and Profiling Suite (OMPS) for flight on the Joint Polar Satellite System-2 (JPSS-2) mission.

The JPSS-2 mission is funded by the National Oceanic and Atmospheric Administration (NOAA) to provide global environmental data in low Earth polar orbit in support of NOAA's mission—NASA is the acquisition agent for the flight systems and components of the ground system.

This is a cost-plus-award-fee modification in the amount of $113 million. This action extends the period of performance of the contract from November 2013 through May 2021.

Under this contract, Ball Aerospace and Technology will manufacture, test and deliver the OMPS instrument, support instrument integration on the JPSS-2 spacecraft and provide launch and post-launch support.

The OMPS instrument will be similar to the OMPS currently flying on the joint NASA-NOAA Suomi NPP mission and planned for the JPSS-1 mission. JPSS-1 is being planned for launch in 2016 and JPSS-2 is planned for launch in 2021.

OMPS will monitor ozone from space, collect total column and vertical profile ozone data, and continue the current daily global data provided by the Solar Backscatter Ultraviolet radiometer-2 and Total Ozone Mapping Spectrometer.

The collection of this data contributes to fulfilling the U.S. treaty obligation to monitor the ozone depletion for the Montreal Protocol to ensure no gaps on ozone coverage.

For information about NASA, agency programs and JPSS-2 (respectively), please visit the NASA infosites at
http://www.nasa.gov
and
http://www.jpss.noaa.gov/satellites.html

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SATCOM-ON-THE-MOVE WHILE OFF-ROAD... FACT OR FICTION?

By Dr. R. Gilmore, Managing Director and Chief Executive Officer, EM Solutions Pty Ltd.

A stroll through the exhibition hall at any of the major satellite communications conferences may seem the same, year after year. Same lights, same booths, same (bad) food, same suits.

This year, one element has been different—the number of exhibitors with on-the-move terminals has doubled. At one conference, I counted at least five Chinese manufacturers, two Korean, four American, and one Australian exhibitor all offering terminals that claim to communicate with either Ku- or Ka- band satellites at high data rates on-the-move.

For good reason. Increasingly, defense forces around the world have recognized the growing need for bandwidth—anywhere, any time—preferably while moving. VHF and UHF radios have served on-the-move applications for years, but such radios are inherently bandwidth limited. Terrestrial microwave radios offer greater bandwidth, but require line-of-sight to the horizon for backhaul, and stabilized antennas to maintain pointing back to base while the node is moving.

Satellite offers a solution that provides both sufficient bandwidth and, as it is pointed skywards rather than toward the horizon, is less likely to be obscured while in motion. Fewer obstructions mean

Off-road testing in Australia

higher availability and a potentially simpler stabilization platform. Satellite communications, with higher gain antennas, also offers more protection against intercept or locating where transmissions are originating from, so is almost covert by definition.

However, "on-the-move" (OTM), or Communications-On-The-Move (COTM), can mean many things to different people—not all COTM terminals are the same. Of course, all are intended to find and keep the antenna pointing towards the fixed position of the geosynchronous satellite, independent of the platform motion.

Most will find the satellite while on-the-pause *(i.e.*, stationary), however fewer will keep pointing to the satellite when the motion becomes rough. Fewer still will be able to acquire the satellite while on the move. Others will only be able to maintain a pre-acquired pointing direction that has been achieved while stationary. Others will not be able to compensate for the sudden violent motion that can be experienced in situations such as rough sea or off-road, and are too slow to respond to such changes. Others will take an excessively long time to recover from a blockage, such as occurs frequently on land, or when there is a restricted range of motion or fade when the apparent satellite position is close to the horizon.

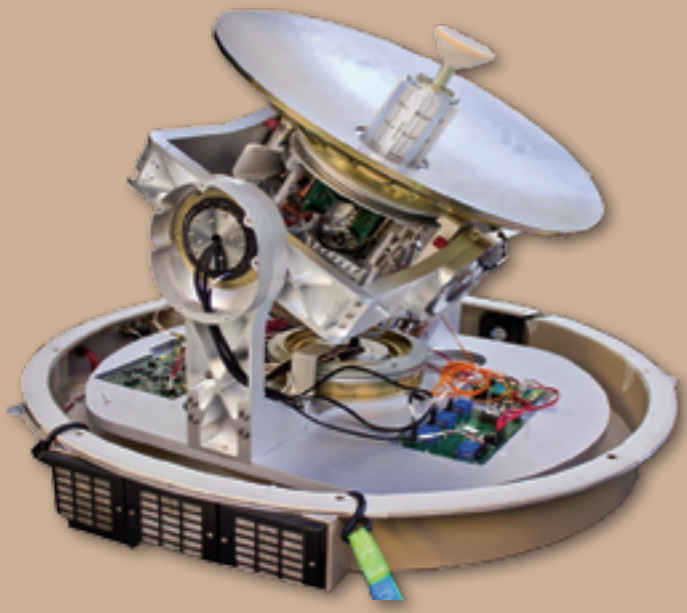


Figure 1. Ku-band off-road OTM terminal

Terminals developed for one application often can not be easily transferred to another, as between maritime and airborne. For example, COM airborne applications are engineered with flat-panel antenna arrays and only avoid interference with other satellites because of the constrained nature of flight.

Defense and commercial customers are coming to realize that not all on-the-move terminals are created equal. This article describes some of the key differences that can result in either great or poor availability of the satellite link when real-world environments are encountered.

Off-road OTM Terminal System Requirements

Most high data rate SATCOM terminals operate in Ku- or Ka-band, so this article focuses only on these two bands. The majority of existing maritime terminals are still Ku-band, although demand for Ka-band variants is slowly starting to emerge.

In the design of any satellite ground terminal, the link budget must be carefully calculated to determine the required gain (G/T) of its receiver and the effective radiated power (EIRP) of its transmitter. These two parameters, and the equivalent parameters of the satellite transponder and antenna itself, ultimately determine the mechanical and electrical characteristics of the terminal that can be developed for any application.

The first challenge to reconcile is that G/T is a variable while on-the-move, unless the antenna is mechanically repositioned to maintain a constant subtended antenna area perpendicular to the satellite boresight.

Off-road requirements for OTM terminals can be more challenging than those for maritime (in spite of the lower price expectations). An off-road terminal can be subject to more frequent and longer blockages from obstructions (particularly in the case of Ka-band frequencies, where even overhead foliage can block transmission) and more turbulent motion. The range of motion can also be greater, requiring look angles that range from the satellite being directly overhead through to the roof line, for instance in the case where the vehicle is on a steep slope. The DC power available from a vehicle can also be limited by the capability of the vehicle battery or auxiliary power system.

EM Solutions was tasked with developing an off-road, on-the-move system for use with the Japanese WINDS satellite, which operates in Ka-band at transmit frequencies around 28GHz. The basis for this was EM Solutions' WGS-compliant terminal that also operated in the upper end of Ka-band.

Although a flat antenna with its low profile would clearly be the preferred choice, our analysis determined that there are two problems with such a choice: (a) basic physics, where the subtended (perpendicular) antenna area in the direction of the satellite determines the system gain, and is very low unless the antenna is tilted to maintain antenna gain at low look angles, and (b), the radiation pattern on transmit, where a flat panel generates sidelobes off-beam as the beam is steered. Both of these issues mitigate against the low profile actually being achieved with a flat panel antenna, so as to maintain high link availability at low look angles means the antenna must be tilted anyway. A phased array solution would also struggle to simultaneously demonstrate compliance with requirements for sidelobes/ESD (ITU-R S.580-6 and ITU-R S.524-9) while sharing the same physical aperture at 18GHz for receive and 28GHz for transmit.

Although a cylindrical antenna somewhat lowers the profile, this has the problem of keyhole effect. This is when the satellite is directly overhead and the vehicle momentarily pitches or rolls through vertical. A cylindrical antenna with its asymmetric sidelobe pattern would be forced to rotate rapidly through 180 degrees of azimuth in order to avoid spraying surrounding satellites with unwanted emissions.

In our view, the standard, common parabolic antenna with its symmetrical radiation pattern is the only antenna that can be guaranteed to be compliant with emitted spectral density (ESD) and sidelobe interference requirements as the off-road vehicle rocks and rolls around the beam line to the satellite—and that can maintain the high gain required to ensure high link availability. A parabolic solution is also compatible with multiple bands, as the core feed structure for the solution EM Solutions has developed can be changed between Ku- and Ka-bands independently of the reflector. The solution also handles different receive and transmit frequencies relatively simply, and both circular and linear polarization.

An antenna of 650mm in diameter was selected, resulting in an antenna gain of approximately 42.5dB (including the feed and radome losses) at 28GHz. Working backwards from the link budget, it was determined that a 40W (Psat) or 20W (Plin) BUC was required to achieve the desired 54Mbps data rate. This is an exceptionally high uplink data rate to support from an OTM terminal, made possible only by the combination of high EIRP (saturated) of 58.5dBW and the unique nature of the WINDS satellite.

Figure 2. OTM terminal fitted to Vehicle in Japan

Unlike the WGS military satellites, the Ka-band signal in the WINDS satellite is linearly polarized, rather than circular. This is uncommon for Ka-band satellites and required a fourth rotational axis, that of the antenna feed itself, to be incorporated into the system design. The function of this fourth axis is to rotate the antenna waveguide feed so its polarization matches that of the incoming signal.

An additional control loop was fitted to monitor the polarization, as it is initially unknown and variable, and this was used to drive a fourth motor fitted within the antenna that is dedicated to rotating the waveguide feed about its axis. A similar solution is required for Ku-band terminals, as shown in *Figure 1*, as these signals are also typically linearly polarized.

Demonstration that the terminal could maintain a pointing error less than 0.2 degrees was required for the customer to attain a Japanese Radio License.

Almost all OTM terminals track the satellite with a combination of INU (inertial navigation unit) and GPS compass data, using the coordinates of the satellite, the current vehicle location, and its motion to estimate the satellite direction. Such a system, in theory at least, can recover from obstructions by maintaining the pre-acquired coordinates and known motion of the vehicle to determine the optimum pointing direction, although INUs with the required accuracy and drift stability are quite costly. A further complication is that GPS compasses are susceptible to errors with off-road terminals and can cause the terminal to lose lock.

Unfortunately, with such a system, there is no way of knowing with certainty whether the antenna is correctly pointed, except by RSSI level from the modem to indicate a signal is being received. The terminal then becomes modem dependent and suffers a considerable delay in its responding to a go or no-go alarm, as the RSSI signal takes some time to calculate.

We have taken a different approach. A much more reliable method of tracking is to use the transmitted beacon from the satellite itself as an indicator of the satellite location. Such a system is then GPS immune, as GPS coordinates are only needed to hasten initial acquisition upon startup. The specifications of the associated INU can also be much looser, reducing cost.

In our system, the circularly polarized WINDS telemetry beacon was used for tracking with the WINDS terminal described earlier. However, as the platform is moving, the satellite beacon, which is used to estimate the pointing error, suffers Doppler shift. Uncertainty in the beacon frequency is consequently quite large. This is due to drift in the satellite's own local oscillator as well as the Doppler shifts caused by vehicle motion. The frequency offset can be several hundred kHz, and the Doppler shift can change at a few kHz per second with the vehicle's maneuvers. These frequency offsets must be canceled internally by the system controller.

A further challenge is that the received beacon level can be low, and the carrier/noise ratio often is only a few dB. This requires careful filtering, especially digital filtering, to ensure the beacon can be recovered to a level useful enough to use for tracking. The spectrum around the beacon from the WINDS satellite is shown in *Figure 3*.

A mechanical approach to achieve a high level of pointing accuracy is to use a three-axis system, for azimuth, elevation, and a third cross elevation axis, to allow rotation throughout the entire sky. The additional degree of freedom in cross elevation allows direct overhead pointing to overcome the keyhole effect. As noted earlier, the keyhole effect is a major problem for systems using two-axis drives, such as

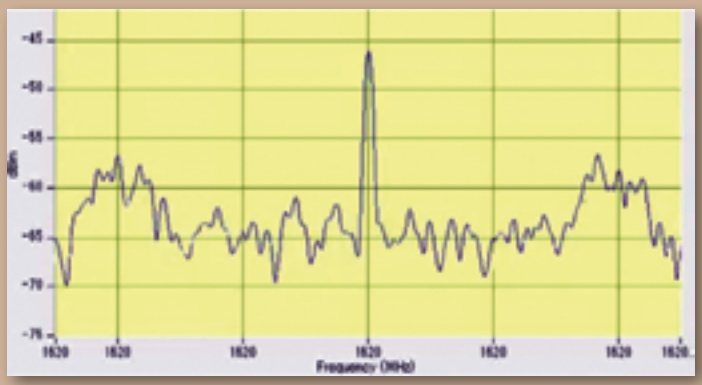


Figure 3. WINDS Telemetry Beacon

those with low profile cylindrical antennas, effectively creating a blind spot directly above the vehicle.

Adding the cross elevation axis slightly increases the height and cost of the terminal as more mechanical and control system design is required. However, this terminal vastly reduces the pointing error as the low friction cross-elevation axis allows for a much faster reaction than rotating the azimuth axis through a full half-circle would allow on its own.

Many terminals point the antenna using motors that are either geared to gimbals, or connected to them through a belt drive (similar to a fan belt in a car). Such systems are sticky and have high friction, and any vehicle motion is transferred through the drive system to the antenna, resulting in momentary mis-pointing regardless of how quickly the response is of the control system.

Quite apart from the mechanical slack that such a system introduces into the pointing error, the bigger challenge in off-road vehicles is that angular accelerations are so extreme that, due to friction, the system recovery time is too slow to respond before the next angular shock arrives. The overall mechanical bandwidth of the motion control system must be an important consideration when matching on-the-move terminals to a vehicle, be it land, marine, or air-based.

The best way to reduce friction and achieve the highest mechanical bandwidth is to use low friction, contactless motors within the gimbals, and to position the center of gravity of the antenna, feed, and associated electronics at the intersection of the elevation and cross-elevation axes. In this way, the movable antenna system is balanced. If there was zero friction, the antenna system would not move at all, and remain pointing in the same direction, in spite of any underlying platform motion. This maximally decouples the vehicle motion from the pointing system, reducing the size of the motors needed to drive the antenna, and the power they consume, an important consideration in vehicle terminals.

Antenna Pattern I Interference To Other Operators

Measurements on the 650mm parabolic antenna conducted at EM Solutions' outdoor antenna test range revealed the power contained in any sidelobe is within the tight limits set by certification and regulatory authorities such as ARSTRAT (for the WGS system), or in the present case, ITU. *Figure 4* shows the predicted and measured values for ESD, as well as the ITU and WGS specification limits, at an azimuthal range varying about the central beam by ±30 degrees.

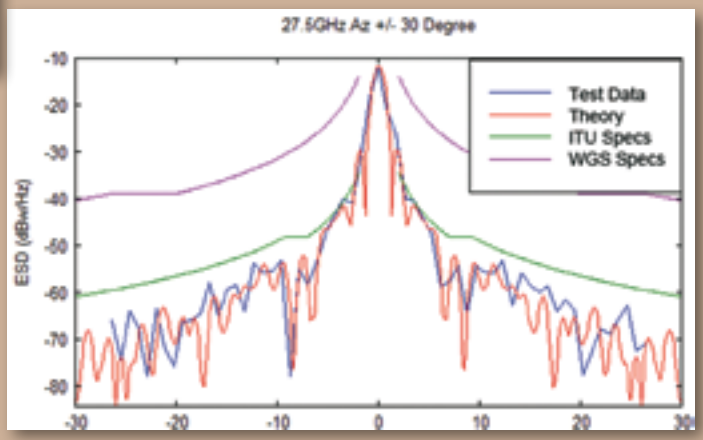


Figure 4. Plot of the theoretical and measured emitted power spectral density from the OTM antenna. The ITU and WGS specifications are shown for comparison.

The ESD is at maximum when the terminal is operated at the maximum linear power and the minimum symbol rate and is shown for the worst case condition. All measured and predicted ESD plots are referenced with respect to -12dBW/Hz at bore sight, corresponding to a symbol rate of 6Mbaud and linear power of 44dBm. *Figure 4* also shows how closely the measured data follows the predicted results, subject to limitations on the step size used for ±2 degrees.

Acquisition Pointing System Results—Stationary + OTM

To track the beacon emitted by the satellite to indicate its location, EM Solutions uses a "closed loop" monopulse system that is supplemented with data from MEMs gyros to point the antenna accurately.

Monopulse tracking is a radar technique that (conceptually) measures the phase difference of a signal across two closely spaced slots on the feed, on either side of the main signal path. From symmetry, the phase difference will be zero if the antenna is pointed directly towards the beacon, and the zero will be a sharp null at this point. In combination with the main signal path, which has a broader beamwidth, exceptional pointing accuracy to within a fraction of the antenna beamwidth can be achieved.

In addition, the phase difference provides a measure of how far off-boresight the antenna is pointing, as the measured phase difference across the two slots is proportional to the deviation from true boresight along the axes of the slot. The gyros are used to provide short term stabilization of the antenna, while long term stability is provided by the closed loop monopulse tracking.

Monopulse systems are, therefore, able to estimate the pointing error without any mechanical scanning and without needing to deliberately mis-point the antenna. This maximizes link gain and consequently link availability. Such also keeps the power consumption lower than most other terminals which use only RSSI as an indicator of pointing accuracy, as to find a maximum the antenna must be constantly moved off maximum (in an intentional conical scan) to be certain the antenna was indeed centered around a maximum. With a monopulse technique, the antenna is held stationary rather than intentionally swept in a constant scanning motion.

A majority of all of the other OTM terminals are "open loop," since their sole control mechanism is through calculation using GPS and INU data that is unrelated to feedback from the satellite itself. The closed loop system described here, using monopulse, can provide pointing error measurements that can be used to derive the pointing loss for certification purposes.

This method of measuring pointing loss is not affected by scintillation, which can corrupt pointing loss calculations based on spectrum analyzer measurements of beacon levels.

Figure 5 shows a verification graph of the actual errors introduced in the OTM terminal by manually driving the terminal off boresight and measuring the displacement with the encoders on the terminal. This can then be compared to errors as measured by the monopulse feed. There is excellent correlation between these two measurements which can provide evidence of achieving a nominated pointing loss.

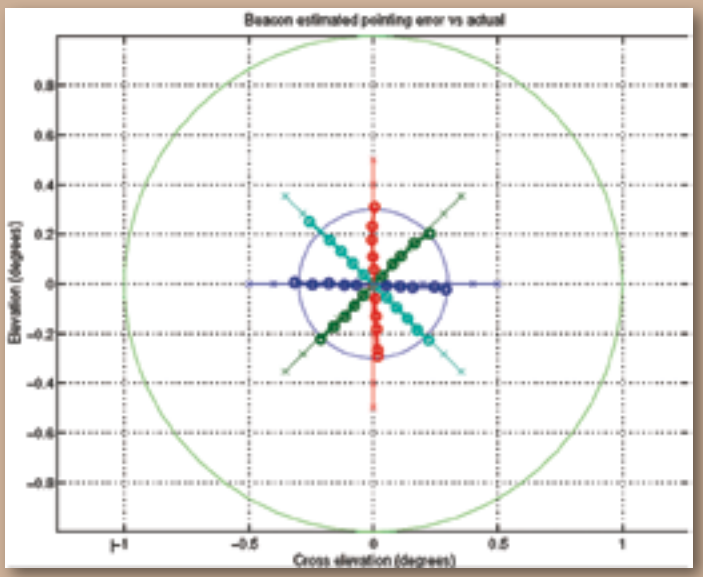


Figure 5. Monopulse Factory Verification

Pointing error plots such as those in *Figure 6* can then be produced by the monopulse closed loop tracking system in the field. The motion shown here was generated by a 6 degree-of-freedom motion table to simulate both off- and on-road conditions. Tests were performed over 24 hour periods and the motion was divided into 4 x 6 hour blocks consisting of 6 hours motion, 6 hour no motion (static), 6 hours of motion and 6 hours static.

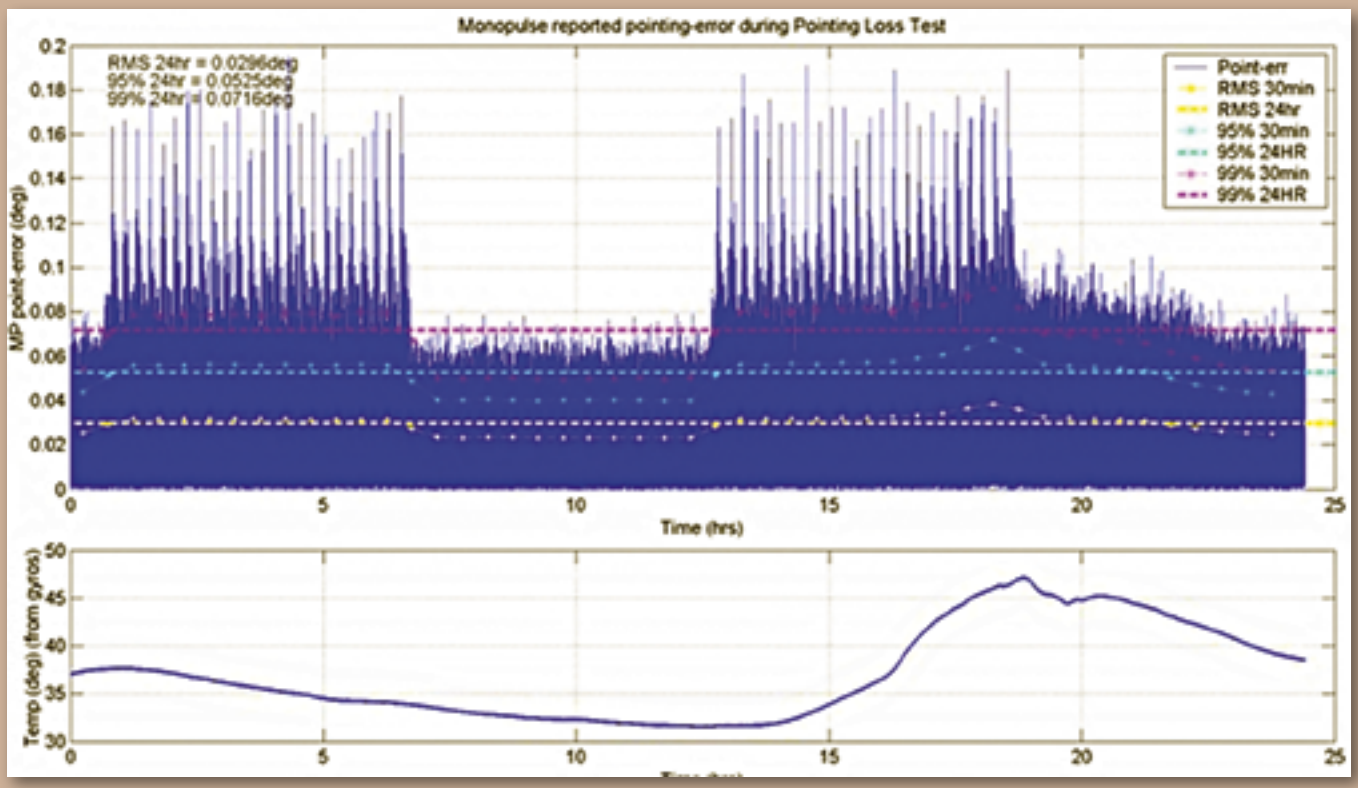


Figure 6. Measured Pointing Error Over 24 hours

The 6 hours of motion was further divided into 6 x 1 hour cycles. Each 1 hour cycle consisting of 15min of static, 15min of sealed road, 15min of unimproved road and 15 min of off road motion.

The diurnal temperature variation is also shown in the lower graph of *Figure 6* for reference purposes.

The measured pointing loss shows a maximum of no more than 0.2 degrees off-boresight over 24 hours.

Testing for performance off-road should involve:

- ***Off- road testing***
  Such a test includes turns, stops, varying road conditions, and higher speed travel, checking for pointing error.

- ***On-the-move tracking***
  This test involves acquiring the beacon while stationary, then driving through short to medium duration obstructions, such as trees, while staying on the move.

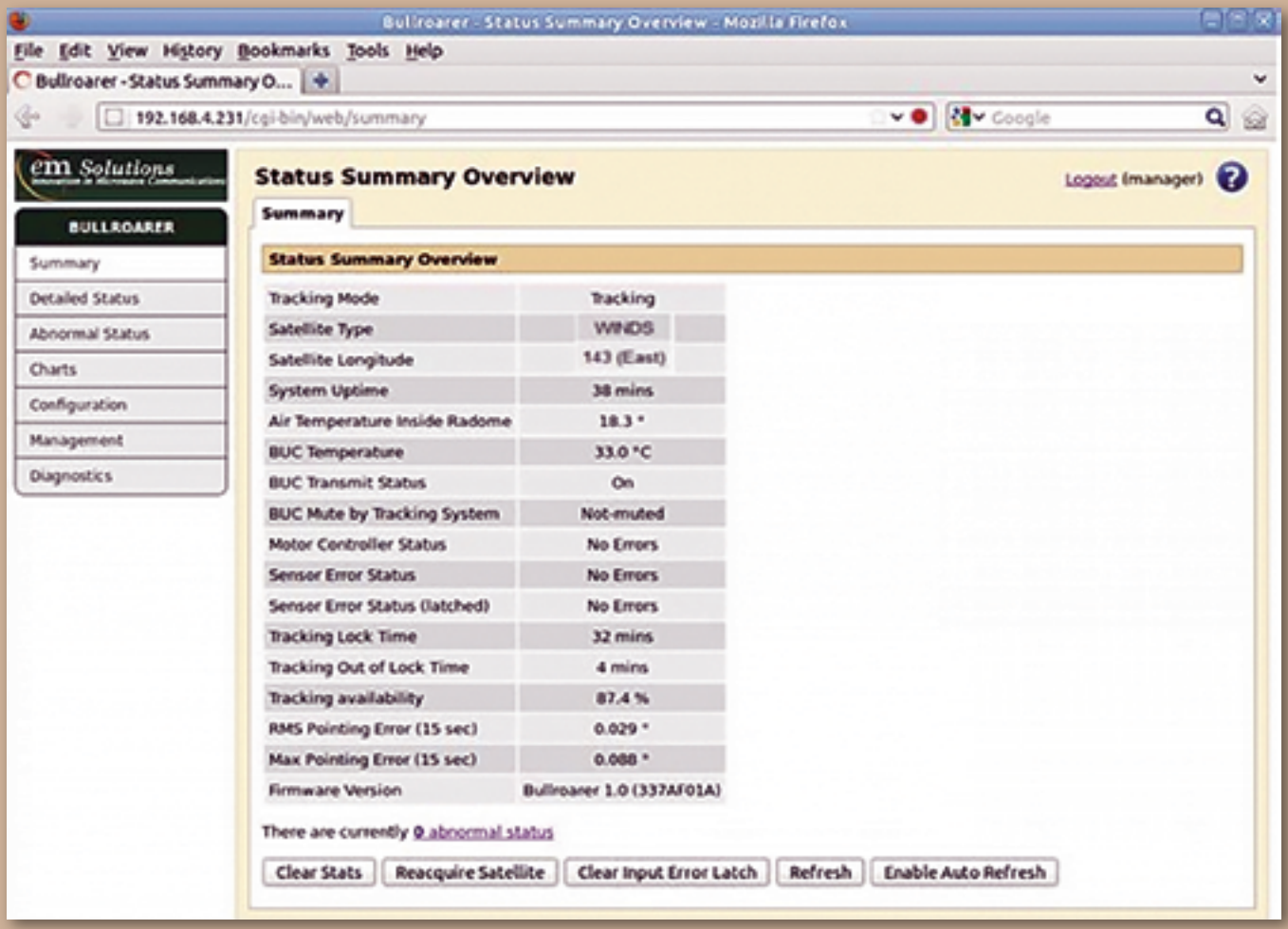


Figure 7. OTM GUI Reported Pointing Loss

The OTM terminal includes a web-based GUI that reports on the status of critical indicators. *Figure 7* above presents the summary page reported by the terminal. As can be seen, the terminal will provide both the maximum pointing error and RMS pointing error calculation as part of the GUI for the user to monitor in real time.

Recovery After Blockage

Off-road terrain can be unique for its violent motion and also for path interference susceptibility from overhead foliage or man-made structures. Recovery after such blocking is an important consideration.

- ***On-the-move acquisition***
  This test entails staying in an obstruction for a longer period, perhaps two minutes, then driving out of it and staying on the move. The terminal must reacquire while in motion.

- ***Stationary obstruction***
  In this test, the vehicle is parked in front of an obstruction for several minutes, then moved out of the obstruction to test for reacquisition.

- ***Cold starts***

Figure 9. Acceptance testing on a military vehicle.

The acquisition time from a cold start is measured, both stationary and while on-the-move.

Achieving satisfactory outcomes requires a good understanding of the terminal motion control system and its dynamics. Careful attention must also be paid to the INU gyro control loop, and the satellite heading and elevation calculations, as these are used within a higher bandwidth motion control loop. Monopulse tracking achieves unparalleled accuracy (less than 0.2 degree error) in all off-road tests, and reacquisition of the beacon in 20 seconds (on average) while moving, after being in obstruction for 2 minutes, and never failing to reacquire on-the-move, even while turning.

GPS Immunity

GPS independence is important for military communications due to the possibility of local jamming. INU open loop pointing requires heading information and constant GPS updates to prevent gyro drift and is therefore vulnerable to GPS attack. The EM Solutions OTM terminal is immune from such attacks as it does not require GPS for acquisition, tracking or polarization adjustments.

Acquisition

During acquisition, the terminal's position on Earth is required to calculate a look angle for its initial search, but in the absence of GPS data, this can be entered manually. The terminal's inexpensive and ITAR-free INU and gyros do not require a GPS input.

Tracking

Closed loop beacon tracking clearly does not require any GPS data as the monopulse feed maintains pointing accuracy better than 0.2 degrees on its own.

Polarization

GPS compasses are often used to provide heading information required for polarization corrections when tracking with OTM terminals. GPS compasses work well in the maritime or aviation environment where there are relatively few obstructions. However, in the land environment, their operation is inhibited by regular obstructions or multipath caused by nearby objects causing the compass to 'unlock' and provide no heading information. Subsequent 'lock' time can be in the order of minutes even in clear sky conditions.

In place of a GPS compass, EM Solutions uses the data obtained by tracking the satellite combined with its approximate position on Earth and a proprietary algorithm to calculate the correct polarization.

These features provide GPS immunity to the terminal and have been incorporated to provide similar functionality to the original terminal developed for the Australian Defense Forces.

Data Rates OTM

The terminals were fitted to mobile communication nodes and OTM testing conducted by the customer in Japan over the WINDS satellite. The data rates of 54Mbps uplink and 155Mbps downlink were confirmed while on the move.

Conclusion

Many terminals lay claim to operating "on-the-move." Few are suited to off-road conditions, where high frequency vibrations in all three axes makes acquisition on-the-move and reacquisition after obstruction slow at best, and impossible at worst.

This article has described a family of terminals that have been developed to track the satellite using a closed-loop tracking system that relies on a signal from the satellite itself for its direction, rather than an outside source. Such a system, using a monopulse technique, is able to achieve sub-degree pointing accuracy that maintains the highest possible link margin and link availability of any system.

Broadband on-the-move satellite communications terminals of this type now offer true mobility and high data throughputs to military users and first responders, even under the most demanding and severe on-the-move conditions experienced off-road. The support of our partner, Jepico and NICT Japan, in developing the terminal described in this article is greatly appreciated.

There's additional information at the EM Solutions infosite:
http://www.emsolutions.com.au/

About the author

Rowan Gilmore joined EM Solutions as a Director in 2007 and became Managing Director and CEO in October 2011. His role is to lead EM Solutions to achieve its vision to become a world-leading company recognized for offering technologically superior microwave modules and systems for next generation broadband communications.

EXPEDITIONARY FORCES ARE THE FUTURE OF INTERNATIONAL MILITARY DEPLOYMENTS

By Giles Peeters, Senior Contributor

As of the beginning of July, the U.S. has sent nearly 800 personnel to Iraq to support the government and protect its in-country presence against Islamic militants. As the army disintegrated and ISIS progressed across northern Iraq, capturing the provincial capitals of Mosul and Tikrit, the White House realized that nine years of combat in the region, and the hard fought democratic progress that came with it, could soon be undone.

In order to prevent this, an initial wave of 270 U.S. military personnel were deployed in early June to support the transfer of staff from the U.S. Embassy in Baghdad to the U.S. Consulates General in Basra and Erbil and to the Iraq Support Unit in Amman. They were followed by further reinforcements to support the Iraq military, as along with a drone presence to help them run effective counter-insurgency operations.

After a long drawn out conflict in Iraq costing billions of dollars, followed by a similar war-amongst-the-people type conflict in Afghanistan, Western governments have little appetite for full scale military deployments. They're expensive, from a human and economic perspective, and as we've witnessed in Iraq over recent months, not a long term solution. Even though billions have been spent training the Iraq army, it is not yet up to the task of deterring organized rebels.

The current Iraqi situation combined with events unfolding in Ukraine indicates the need for a new type of fighting force—*the expeditionary army*.

No longer will we witness large scale deployments of troops into foreign countries. Smaller, specialized units with a training or support remit will prove more effective. Not only will they offer finely tuned support, but they'll be agile and innocuous, which will assist in diplomatic relations and hopefully relieve tensions between the dispatching and receiving countries.

However, this change in strategy greatly affects the tactics employed once on the ground. Unlike in Iraq and Afghanistan where huge forward operating bases emerged from the desert sands, these expeditionary forces will more often than not find themselves alone with limited in-country supporting infrastructure. There certainly won't be an established radio communications bubble. Forces will rely on beyond line-of-sight communications to maintain contact with HQ and securely submit situation and contact reports.

Pay As You Go

The very nature of expeditionary forces means it will be hard to budget for them. A drawn out combat operation has obvious operational requirements that can be discussed by administration and costed

accordingly, but even then, adapting military assets is expensive and takes time. The allied Land Rovers used in Afghanistan are a good example of this. Insurgents increased the use of improvised explosive devices as they realized allied transport was vulnerable. Reacting to this took time and resulted in troops strapping scrap metal to the bottom of their vehicles to deflect the blasts.

This was a situation in which allied militaries had time to procure a suitable solution but still struggled. With the advent of the expeditionary force, time is not an available luxury. Instead, militaries need to approach military procurement on a pay-per-play basis, purchasing exactly what they need—when they need it. This would be difficult for a larger military, but buying mission critical equipment for a smaller force consisting of a few hundred troops is a realistic proposition. This is especially true of military communications and tracking solutions.

Without an established military presence in the destination country, communications will be limited. The nature of most operations will mean a force will likely be entering a destabilized region with minimal infrastructure and won't have an opportunity to install combat net radio, or even send a text message. If they have HF radio, they are faced with the prospect of limited functionality as atmospheric conditions can render even HF radio useless. Radio will be vital for the troops on the ground moving within close proximity to one another, but in order to coordinate effectively with HQ, and contribute intelligence to the common operational picture, secure BLOS communications is required.

Allied operations have traditionally struggled with limited MILSATCOM availability—procuring private sector satellite data services from companies such as Inmarsat and Iridium, in the event that an expeditionary force needs to be deployed, makes financial and operational sense—it doesn't need to be maintained when not required, it's interoperable and data can be encrypted whereas satellite phones are typically unsecured—even if the expeditionary force consists of multiple allies, they all benefit from the same secure satellite service and equipment.

Commercial off-the-shelf (COTS) solutions are also suitable for a variety of missions. The current situation in Baghdad is a good example. As the equipment is quick to procure and can be used anywhere in the world, it's easy to supply civilians with compatible devices. When moving embassy personnel for example, you can equip them with SATCOM devices and set up a geofence on your blue force tracking (BFT) software. If any of these users then encounter insurgents, or stray from a convoy traveling between provinces, they can quickly and easily hit notification buttons which route situational data into the common operational picture alerting all friendly forces in the nearby area.

Accessible and Deniable

Future expeditionary forces will often be reacting to global events. Insurgents in Iraq and militia in Ukraine don't wait for the latest procurement cycle to reach its conclusion. Decades ago, if your one-time pad was captured by enemy forces, they could decrypt all communications and the operation would be compromised. Nowadays, when combined with the right software, SATCOM devices can be located and zeroed. In addition, they can also be AES256 encrypted—equivalent to U.S. 'Suite B' security—almost impossible to crack.

Love Thy Neighbor

I was responsible for MoD communications throughout a large part of the conflict in Afghanistan and I was also heavily involved in the UK's Iraq deployment, as well. In both conflicts, we faced the same problem—effectively and securely communicating with allies.

When a European helicopter is hovering over a U.S. Humvee and neither can communicate with one another as they are both using different encryption keys, then mission effectiveness is severely compromised. Expeditionary forces won't be dipping into an allied equipment pool (even allies are reluctant to share technology), but they can procure interoperable solutions quickly and easily from a single supplier and share the same encryption keys.

Nation states are learning that occupations are not the way forward. Iraq has demonstrated that it doesn't lead to a stable environment—once the U.S. forces left the region, even though they invested billions of dollars in training and technology for the incumbent Iraq army, they were soon required to return and support.

To ensure long term stability, armies will need to deploy small groups of military personnel. Whether they act in an advisory fashion or offer technology and military support, the communications they use will change and weigh in favor of quick to deploy, easily attainable BLOS data communications as opposed to infrastructures that require extensive setup up and maintenance.

About the author

Giles Peeters is the Defence Sector Director at Track24 Defence, and is the driving force behind the company's commercial-off-the-shelf (COTS), beyond line-of-sight, blue force tracking solution, Situational Command & Control (SCC) TITAN.

EMBRACE CHANGING BORDER SECURITY SATELLITE NETWORK ENVIRONMENTS: A NEWTEC PERSPECTIVE

By Koen Willems, Market Director Government & Defense, Newtec

Looking at world history, borders and territories have been a source of dispute, inter and intra-state conflicts, crime and migration issues. Borders are internationally arbitrated demarcation lines among sovereign states, federated states and other sub-national or international entities (Schengen area, European Community etc.).

Due to political, social and economical dynamics that occur over time, national borders are subject to movement and change. There are some strong driving forces that challenge governments to preserve their borders, sustain political stability or to safeguard the socio-economic living standard and cultural heritage in their country. These forces are globalization, immigration, economic and political drivers as well as new information and communication technologies. All are closely related and have a high rate of interaction. Recent events clearly indicate that the border discussion is a hot topic.

Here are some of the latest examples coming from the IBRU, Centre for Borders Research, from Durham University:

- *'Boat migrants' deaths continued rise in irregular migration to Europe' (July 2014)*
- *'Indonesia and the Philippines settle maritime border dispute' (June 2014)*
- *U.S. Homeland Security to increase surveillance along Arizona-Mexico border (March 2014)*
- *Britain and Argentina in new dispute regarding oil drilling in the Falklands/Malvinas (December 2013)*

As such, border security is likely to remain high on the political agendas of different nations. By securing borders, governments have the difficult task of protecting their nation from threats such as terrorism, illegal trade, crime and immigration pull and push factors.

Borders have to be secured but they must also ensure that a country remains competitive and open for business as a destination of choice for tourism, trade investment and education.

The Challenges

Setting up an effective border security system comes with a set of challenges that are related to the geography and economy of a country, the identified threats on a border and the nation's policy on how to deal with those threats.

Brazil, for example, has 10 neighboring countries with 16,885km of border and a coastline stretching more than 7,491km. Moreover, when taking a border control system into account, the Brazilian government has to deal with a wide geographical diversity that includes the Amazon rain forest, the Andes mountain ranges and deserts.

Economic factors can also be key and the financial status of a country and the threat to disruption of the economic prosperity will define how many resources (financial, technology, work force) can be pulled in for border security programs. More developed nations have greater means to run such programs as compared to African countries that need to deal with more persistent humanitarian or internal conflicts. Moreover, the search for new natural resources will increase border tensions—take, for example, oil exploration and drilling at the North Pole.

More attention will go to border areas that are under continuous pressure—in example, the conflict in the Ukraine, the recent Israeli and Palestinian clashes in Gaza, the surge of 70,000 unaccompanied children crossing into the U.S., and the Syrian civil war that puts pressure on Turkey, Iraq and Lebanon with an enormous number of refugees to deal with as well as ISIS activities.

Each nation's policy on how to deal with border security will differ according to what situations they face. Through Schengen agreements, 26 European countries have abolished passport and any other type of border control at their common borders. Simultaneously, a large number of European countries have unified their efforts in Frontex to protect external borders. (*Frontex promotes, coordinates and develops European border management in line with the European Union (EU) fundamental rights charter that applies the concept of Integrated Border Management. Frontex assists border authorities from different EU countries to work together. Frontex's full title is the European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union. The agency was established in 2004 to reinforce and streamline cooperation between national border authorities. In pursuit of this goal, Frontex has several operational areas which are defined in the founding Frontex Regulation and a subsequent amendment.*)

Overcoming these challenges and running an effective border security policy can only happen when linking processes, technologies and organizational structures cooperate through an integrated program. Access to a common data set that is updated at regular intervals at each point of intervention is a key feature for modern-day border security management. Satellite will always be an inherent part of such a strategy.

Security + Satellites

Border security and satellite technology are closely linked. Earth observation (EO), surveillance and communications in border security programs rely heavily on satellite technologies. EO and other surveillance systems help to monitor and report movement in the more remote areas of a country along the border, enabling intelligence to be received despite difficult terrain conditions, such as mountain ranges, sea, tropical forest; and climate including desert or thinly populated regions.

Satellite communications allow border security authorities to exchange information or critical data access by headquarter units, by border checkpoints or by on-the-move border patrol units. In such a scenario, SATCOM will be used as a primary or secondary communication channel. When the border checkpoint or gate is located in an area that is well provisioned with terrestrial communications, the SATCOM solution will function as a backup system to make certain the exchange of mission-critical data remains fully available, even when natural or man-made disasters strike or the terrestrial infrastructure is temporarily unreliable. When border patrol units are on-the-move (land/sea/air), or border gates and ground surveillance systems are installed in remote locations, satellite will more than likely be the primary communication channel.

How To Embrace The Complexities

With the increased complexity of threats, conflicts and accelerated global immigration, governments will take on multi-level border security programs as they seek solutions in order to respond to different challenges and, at the same time, facilitate legitimate access. When deploying a satellite communications platform for a border security system, a wide variety of services and applications need to be taken into consideration:

- ***Surveillance Data Relay and Exchange***
  Surveillance and detection systems are installed at regular intervals along border perimeter fences, on observation towers and on aerostats. The product of different sensor technologies such as standard and high definition CCTV multispectral, infrared and motion detection systems are relayed over satellite towards the operational headquarters for processing, to facilitate quick decision making or to update the border security database. The acquired products are redistributed, either in real-time or after initial processing, to the different border security entities or even different national/international agencies.
- ***Internet Access***
  Remote checkpoints and border gates need access to the Internet and the border security network over satellite in order to perform daily tasks such as frontier policing, identity management and database access. At the same time email, ERP, VoIP, video conferencing and other office applications are required for administration purposes. To increase the efficiency of border security operations, biometric identification, face and number plate recognition services are added to the satellite communications traffic.

- ***Communications-on-the-Move (COTM)***
  Border agents patrol in land vehicles and maritime vessels with surveillance and detection systems installed on these mobile observation platforms. Air surveillance capabilities are provided by manned and unmanned airborne platforms. Beyond line of sight satellite communications will be used in these cases to relay real-time information to operational and local headquarters.

The combination of these services and applications will improve the efficiency of border security operations. However, the deployment of bandwidth consuming sensor technologies and the increased throughput of video, data and voice traffic over satellite, puts pressure on available satellite bandwidths as well as on allocated budgets for border security.

The complexity of border security operations calls for a comprehensive, flexible and all-encompassing SATCOM platform that can satisfy different applications, services and traffic types. The satellite platform needs to embrace the complexities that come with border security operations such as mobility, service availability, stringent budgets and more data and must also able to maximize efficiency in order to respect budgets and to make the most of throughput.

The Newtec Solution

In the border security ecosystem a satellite network must take multiple platforms into account as well as technologies, services, applications, agencies and stakeholders that need to interact with one another. To match the challenges and complexity of border security operations over satellite, Newtec offers an innovative multi-service platform called Newtec Dialog®. This multi-purpose satellite VSAT platform is highly scalable and flexible and allows border security agencies to build and adapt their infrastructure according to the operations at hand.

From a central hub, the border security network can be deployed on multiple satellites in C-, Ku-, Ka- or X-band. Newtec Dialog will give border security authorities the power to support different services and applications while making hassle-free decisions on the technology to use. (*Please see figure 1 below.*)

The Dialog platform is built around three core concepts that have been executed all through the architecture, the supporting technologies and the implementation of the platform. These core concepts are Flexibility, Scalability and Efficiency. They can easily be translated towards the everyday border security operational reality.

Flexibility

Border security operations call for high flexibility to respond to changing environments, threats and daily interventions. Newtec Dialog is built for flexibility and will help authorities embrace changing environments. The flexibility of the system is reflected in the ability to support multiple services such as sensor video, biometric data, voice, database access and applications such as surveillance, on-the-move, Internet access and data exchange. Moreover, these services can be tailored according to the application requirements through the bandwidth management and advanced hierarchical Quality of Service tools inside Newtec Dialog.

The relay of surveillance sensor data will be bound to different QoS and priority rules compared to the Internet access services used to run the remote border checkpoint office administration. The border security agency can allocate different throughputs, CIRs and PIRs depending on the different required traffic types and services from remote checkpoints.

Newtec Dialog can also take into consideration whether the border checkpoint needs to handle a lot of continuous data traffic or sporadic access.

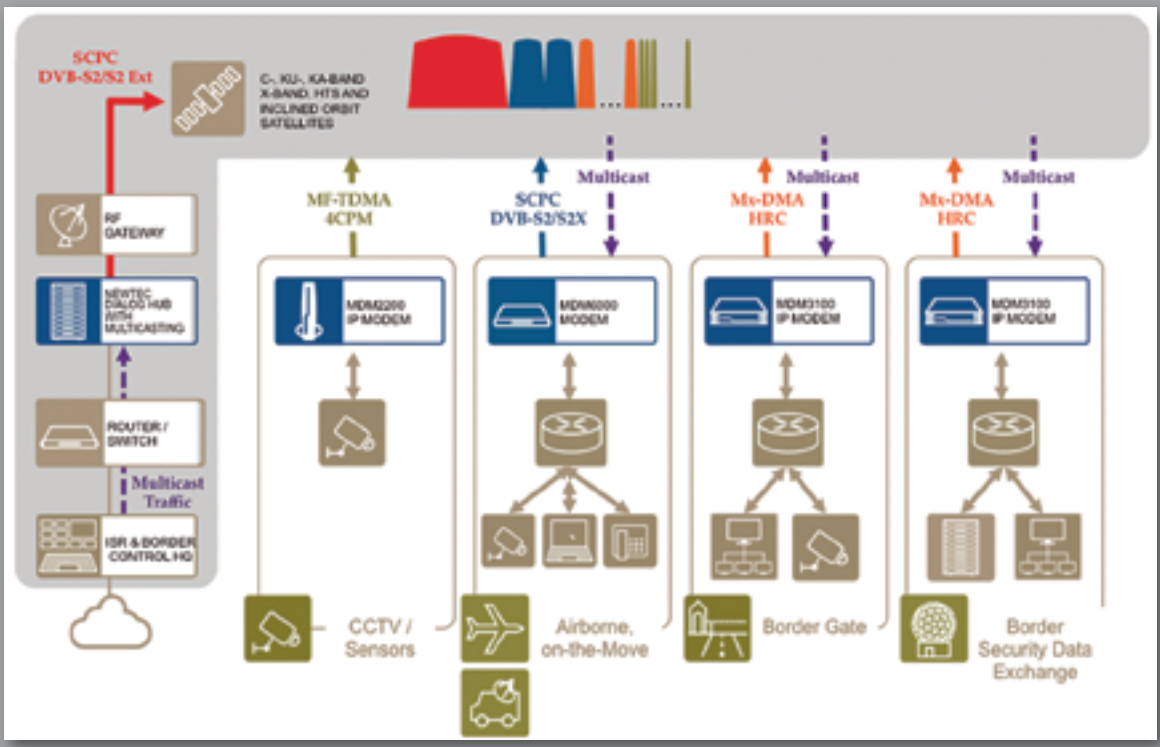


Figure 1: Newtec Dialog network design for border security application

The type of modem or terminal that is connected to the Newtec Dialog hub inside the border security headquarters can also be adapted. A versatile modem and terminal portfolio will support different types of remotes and applications from surveillance data relay, to Internet access, to on-the-move platforms. If the remote has stringent size, weight and power (SWAP) requirements, Newtec has different OEM boards that can fit dedicated, fixed, fly-away or manpack satellite terminals.

Newtec Dialog is independent of satellite frequency and constellation. As such, the satellite network infrastructure can easily be groomed towards another satellite if operational elements change toward a new conflict area in another part of the country, or if contracts with satellite operators or service providers change.

Scalability

The Newtec Dialog platform can be used for an existing satellite based border security network or can grow as more structural border security elements are put in place. The platform scales to every type of satellite network: from a small network with few remotes and a single service, up to the largest satellite networks with multi-service capabilities. The platform can also be scaled from single coverage to multi-spot, multi-gateway High Throughput Satellite (HTS) networks.

The Dialog platform hub hardware, license structure and technology elements enable low, up-front CAPEX investment. As such, the satellite network can initially be deployed on 'hotspots' along the border and gradually extend by adding remotes, for example at checkpoints, surveillance sensors, airborne platforms. Throughput rates can also be added, as well as services including video, data, voice and different traffic types.

Efficiency

Efficiency is defined at both technology and operational levels in the Newtec Dialog platform and provides the border security agency with the extra bandwidth above border regions that have limited satellite coverage. More throughput will be achieved within the same bandwidth, giving the agencies the chance to increase their network with extra services or extra remotes. Additionally, the platform will allocate every bit to the designated user at maximum service availability in order to meet the most demanding Service Level Agreements (SLA). As such, ambitious border security programs can still be achieved within high government budgets.

The network design of a border security system will be different compared to a traditional VSAT enterprise network where you would find a big forward pipe connecting multiple remotes and small return channels. In a border security satellite network you would still need

an efficient common forward from the hub towards the remotes, but in some cases the traffic coming from the remotes can be quite considerable. This is mainly the case when the border security network connects to bandwidth hungry surveillance sensors that need to relay data and video back to the hub at the operational headquarters. Obviously, the satellite transmission technology must be adapted according to the services that are running over the return link.

When implemented, Newtec Dialog assists the border security agency to select the best transmission technology for their particular application. The border security operator can select any of three different satellite return technologies in Newtec Dialog, whichever one would be most appropriate for the required services: MF-TDMA, SCPC or Newtec Mx-DMA.

- ***MF-TDMA (Multi-Frequency Time-Division Multiple Access)*** *typically targets highly overbooked and bursty traffic services such as low rate SCADA and Internet access from small remote checkpoints*
- ***SCPC (Single Channel per Carrier)*** *has more applicability in continuous high data and video rate return links such as high rate sensor relay and border security network backbones*
- ***The Newtec Mx-DMA*** *return technology incorporates the best features of MF-TDMA and SCPC technologies and at the same time solves the difficult choice of whether to select one or the other. SCPC-like efficiencies are reached while maintaining the MF-TDMA-like bandwidth allocation flexibility. Compared to other technologies in the market, it does not switch between MF-TDMA and SCPC, which typically results in packet and performance loss. Bandwidth and throughput are allocated on the fly. If the border network traffic becomes more important due to increased pressure on remote border locations, extra bandwidth will auto-dynamically be assigned to the carrier based on QoS and priority rules.*
  The entire operation is performed seamlessly without any data packets being lost. The implementation of Mx-DMA typically results in a doubling of transponder throughput using the same bandwidth, or alternatively reducing the required space segment capacity by 50 percent. The new technology also ensures low jitter and delay, perfect for applications like voice traffic between different checkpoints and headquarters and streaming sensor video. Newtec Mx-DMA can, as such, be applied for typical sensor, data/video exchange, remote border office, voice and Internet access applications

As well as throughput efficiency, Newtec Dialog also ensures service availability to increase the effectiveness of border security operations and also integrates the well-known and field proven FlexACM® technology. Even in harsh and hostile conditions, it is important to have the satellite links available to exchange mission critical border security traffic and not to lose data.

The unique and auto-adaptive technology incorporated inside Newtec's FlexACM takes care of any fading condition in order to avoid link or data losses. Fading conditions are usually because an operator has chosen Ka-, Ku-, X-band, HTS or Inclined Orbit Satellite, or for environmental (rain and dust), shadowing effects (mobility) or interference between two adjacent satellites. FlexACM ensures these will no longer interrupt satellite conditions.

Once sensor, identity, biometric and intelligence data have been collected and processed at the border security operational headquarters, that information needs to be redistributed toward the border gates, on-the-move patrol units and national/international agencies to make certain these entities work with the latest and most up-to-date information. The multicasting technology inside Newtec Dialog will make sure that the information is distributed towards the designated border security entities in a reliable and efficient manner.

Meeting 21st Century Challenges

Building or transforming a border security system to meet 21st century challenges is no easy task. Borders have to adapt to changing threats and pressures. Innovative satellite solutions should be a major part of any border security network as these technologies provide an opportunity to address the complex issues and enhance border security, facilitate legitimate trade and travel, improve efficiency, reduce costs, and provide a more flexible and resilient system even for remote border check points and border patrols on-the-move.

Successful border security satellite networks are resilient to changing environments and everyday operational realities. The Newtec Dialog platform allows border security network operators to build, adapt and extend their infrastructure easily according to pressing threats on certain borders, planned government budgets and increasing complexity of border security operations.

The flexibility, scalability and efficiency of the Newtec Dialog Platform are directly related to the agility and success of border security operations. A wide spectrum of border security applications, services and traffic types can be covered on a single platform. At the same time, important throughput gains up to 50 percent can be achieved as compared to traditional MF-TDMA and SCPC networks. This gives the border security operator extra means to increase mission-critical traffic within the same bandwidth with maximum service availability.

Newtec Dialog offers border security agencies the peace of mind to focus on their core tasks with a scalable and efficient multi-service VSAT platform that embraces the changes and challenges that go hand-in-hand with border security operations over satellite.

For more information on Newtec Dialog, visit the Newtec website:
http://www.newtec.eu/

About the author

Koen Willems started his career in 1998 with Lernout&Hauspie as a project manager in the Consulting & Services division. More recently, he joined Toshiba as a Product Marketing Manager for the Benelux and, later, for the European market. In a total of 6 years, Koen contributed to all of the major Toshiba Retail IT product releases. Mr. Willems is, currently the Market Director for Government and Defense for Newtec.

CONTRACT FOR HOSTED PAYLOAD SOLUTIONS AWARDED BY SMC

By U.S.A.F. Space & Missile Systems Center Hosted Payloads Office

Over the last five years, the U.S. Air Force Space Command's Space and Missile Systems Center (SMC) built the momentum to change the acquisition paradigm and is pursuing alternative ways to ensure space system resiliency and affordability.

A key catalyst for exploring this new paradigm was the Commercially Hosted Infrared Program (CHIRP) sensor, launched in September of 2011 as a hosted payload on an SES commercial communications satellite. According to Lieutenant General Sam Greaves, commander of SMC, "CHIRP proved the viability of commercially hosted OPIR payloads."

Lt. General Sam Greaves, Commander, Space & Missile Systems Center.

Artistic rendition of the SES-2 satellite on orbit, with CHiRP hosted payload aboard. Image is courtesy of Orbital Sciences.

The CHIRP experience highlighted the utility of partnering with industry, spurring SMC to stand up the Hosted Payload Office in 2011. The Hosted Payloads Office is committed to assessing the utility of employing hosted payloads to provide resilient, affordable military space capabilities during a time of austere budgets. It is SMC's centralized office whose responsibility is to identify, match, and manage hosted payload opportunities and developments among Industry, U.S. Government, and international market participants.

SMC took a large step to alter the status quo for how the Department of Defense and other government agencies acquire space systems by awarding the Hosted Payload Solutions (HoPS) Contract on July 10 , 2014. The HoPS contract is an Indefinite-Delivery-Indefinite-Quantity (IDIQ) contract that creates a pool of qualified vendors to fulfill the U.S. Government's need for various hosted payload missions.

The contract provides flexibility for procuring approximately six hosted payloads for a total value of up to $494,900,000. The HoPS IDIQ contract procures fully-functioning on-orbit and ground systems services for government-furnished hosted payloads on commercial platforms. The contract also allows for hosted payload studies that may materialize into future missions.

Operationally, space mission concepts of operation and program transition timelines are key elements of any hosting arrangement. Hosted payloads must be tightly integrated with operational mission architectures, ensuring required capabilities are delivered. Ground infrastructures must make appropriate accommodations for the hosted payload data stream.

Considerations must be made for mission and information assurance, as well. Inserting commercially procured host satellites, commercially provided ground infrastructure for command and control and data dissemination, and commercially procured launch vehicles into these operational constructs spreads the costs of the entire system out to all the partners. Barring things such as specialized mission assurance or unique host satellite requirements, IDIQ government sensor customers can reasonably expect to pay the same price as any other commercially provided hosted payload.

In order to maximize hosting opportunities, the IDIQ contract synchronizes the Government Payload Office's procurement process with commercial satellite procurement lead times allowing industry

partners the chance to develop win-win business scenarios. In addition, the HoPS contract provides the flexibility to support early studies that enable payload design efforts and commit to flight processing later when the payload's schedule for commercial satellite processing is assured. The HoPS contract is designed to allow disparate payload and commercial satellite schedules to be synchronized enhancing hosted payload flight opportunities and reducing schedule risk for both the Government and the commercial host.

Companies competed to be included in two lanes: geosynchronous orbit (GEO) hosting opportunities and/or medium-earth orbit / low-earth orbit (MEO/LEO) hosting opportunities.

The 12 GEO lane vendors are:

- **Astrium Services Government, Inc.**
- **Eutelsat America Corp.**
- **Harris Corp. Government Communications Systems Business Unit**
- **Intelsat General Corp.**
- **Lockheed Martin Corp.**
- **Merging Excellence and Innovation Tech, Inc.**
- **Orbital Sciences Corp.**
- **SES Government Solutions**
- **Space Systems/Loral, LLC**
- **Surrey Satellite Technology**
- **The Boeing Co.**
- **ViviSat, LLC**

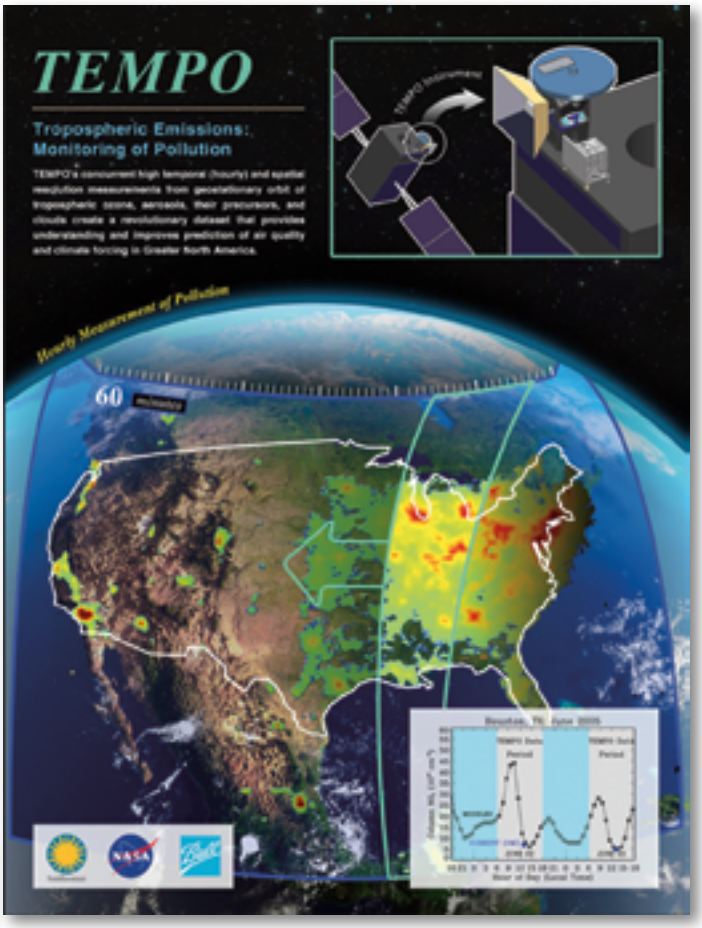
The eight MEO/LEO lane vendors are:

- **Astrium Services Government, Inc.**
- **Exoterra Resources**
- **Harris Corp. Government Communications Systems Business Unit**
- **Millennium Engineering & Integration Company**

SSL artistic rendition of the GEO satellite with a NASA hosted payload.

- **Orbital Sciences Corp.**
- **Space Systems/Loral, LLC**
- **Surrey Satellite Technology**
- **The Boeing Co.**

SMC further proved its commitment to leading the way for U.S. Government hosted payloads by awarding the IDIQ contract's first competitive mission study delivery order for the National Aeronautics and Space Administration's (NASA) Tropospheric Emissions: Monitoring of Pollution (TEMPO) mission.



The three GEO lane IDIQ partners selected to examine the feasibility of accommodating the TEMPO instrument as a hosted payload included:

- **Orbital Sciences Corp.**
- **Space Systems/Loral LLC**
- **The Boeing Co.**

Continuing its strong partnership with SMC, NASA is evaluating hosting the TEMPO payload on a commercially provided satellite leveraging the HoPS IDIQ contract. NASA has already released draft acquisition documents to the GEO lane partners asking for their feedback. The HoPS IDIQ contract award is a major milestone for the hosted payload community in achieving more affordable, disaggregated, and resilient space systems. SMC is excited to enter into this first-of-a-kind venture with our IDIQ partners.

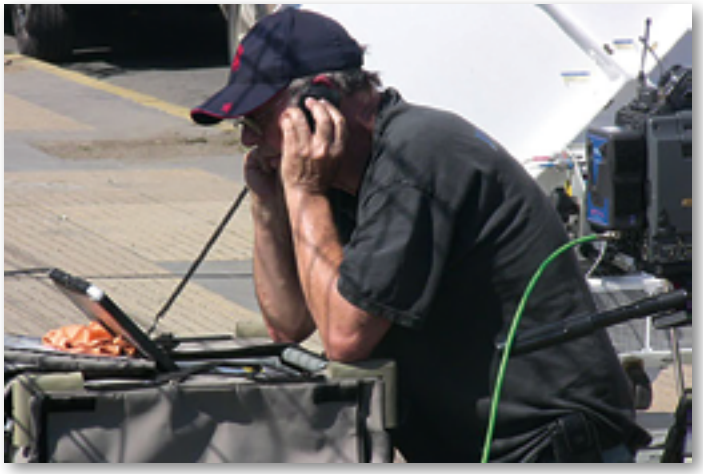
A NORSAT "CASE IN POINT"—DISASTER TRUCK

Norsat provides Roger Hawkins, President of Disaster Truck, with a Norsat Newslink Terminal and accessories. Roger uses his Newslink terminal to travel the world and cover major world events.

Previously hired by various news networks worldwide, Roger is now shifting focus to concentrate his efforts on providing communication in remote environments for non-profit aid organizations. Roger is a long time Norsat customer—this article illustrates how Norsat has helped to enable Roger on each of his unique and compelling missions.

Disaster Truck uses Norsat's flyaway satellite terminal, The NewsLink, to capture and broadcast breaking news events globally.

Roger describes the Disaster Truck organization as a fantasy. "It is a symbol for hard working freelance photographers and news gatherers who risk their lives to capture events so that the public can have access to truthful information about what is really happening in the world." These stories provide the public with information that they could not otherwise see or have access to. His use of the iconic image of the World War II "Duck" (an amphibious vehicle that could go anywhere during times of crisis) implies that Disaster Truck can act as a beacon of hope by providing key communications in challenging situations.



Roger Hawkins at work for the Disaster Truck organization.

Roger Hawkins' broadcasting career started when he joined CBS News as a satellite coordinator in 1987. He didn't know much about satellites at the time, as his previous career was installing and maintaining local area computer networks. Satellite technology took off right around the time Roger began working as a remote news producer, initiating live shots from reporters for CBS affiliates in the U.S. and 77 foreign clients around the world.

Disaster Truck—The Early Years

In 2005, Hurricane Katrina devastated New Orleans. Roger explained how he was "disappointed at how little the U.S. did as a country in terms of rescue and rehabilitation." He recalls that at that time, the world just watched as "hundreds died waiting to be rescued." That was when he conceptualized Disaster Truck, a telecommunications organization that would provide news organizations with the ability to broadcast breaking news events around the world during times of crisis.

He searched for a high quality transportable unit and, through a contact at CBS, he found out about Norsat's flyway terminals. In 2006, he purchased a Norsat NewsLink flyaway VSAT terminal—a ruggedized, lightweight and portable terminal designed for news gathering in challenging environments.

He bought the unit without knowing how to operate it and without even having a prospective project. In April of 2007, The Associated Press' Middle Eastern Services unit was asked to broadcast live shots from Guantanamo Bay, Cuba, to cover the military hearings for certain foreign detainees. A freelance cameraman and colleague of Roger's alerted the Associated Press of Roger's recently acquired Newslink, and three days later, they were broadcasting live from the famous naval base. The foreign television journalists included two Australian television networks, the CBC, France 24, as well as Al Jazeera and Al-Arabiya from the Middle East. Over the next 20 months, Roger would return to Guantanamo Bay four more times for the Associated Press.

Roger says this was when he realized the significance of his Norsat NewsLink terminal in facilitating his missions. Being rugged, portable and airline checkable, he remarked that he could pack it up at a moment's notice and take it with him anywhere in the world.

Earthquake in Haiti

In January 2010, a 7.0 magnitude earthquake devastated Haiti. Although CBS owned three Newslink terminals, none of them were close enough to the Caribbean island to begin broadcasting quickly. CBS chartered a plane to fly into the Dominican Republic overnight with Roger and his NewsLink terminal. The generator, however, did not arrive with the terminal. Unable to generate enough power, Roger and his crew industriously wired up two Haitian taxi cabs and were able to create enough electricity to power the uplink and camera.

Arriving 21 hours later was the prominent American reporter, Katie Couric, to cover the devastation. During his time in Haiti, Japan's national public broadcasting organization, NHK, asked him to work with their organization. Roger formed some strong partnerships with NHK Japan and they hired him four more times following the earthquake in Haiti.

A successful set up of the Norsat Newslink terminal with cobbled together power for coverage of the Haitian earthquake.

Chile

Only two months after the Haitian earthquake in 2010, there was an 8.8 magnitude earthquake in Conceptión, Chile. Roger traveled with the team at NHK to the roughest parts of Chile to stream live to New York and through a cable back to Japan. One of the reasons NHK hired Roger and Disaster Truck was because he was willing to go to lengths that others simply wouldn't attempt. He credits the Norsat NewsLink with enabling him to do this, by allowing him to access communications in areas where infrastructure was damaged or non-existent.

Communications established for coverage of the Chilean earthquake.

Also in 2010, the infamous Copiapo, Chile, mine collapse occurred. Roger was present with NHK, arriving at the beginning and staying until after the rescue. He recalled that "When the rescuers completed a hole approximately 18 inches in diameter to send down food and water, NHK sent down a video camera. We showed them how to use the camera and for two and a half weeks they were able to interview each other and record messages for their loved ones who were waiting for them to be rescued." They were able to cut 60 hours of video tape from the miners and subsequently made an Emmy-Award winning documentary on their experience.

Disaster Truck and Norsat

Disaster Truck has relied heavily on Norsat technology and support to capture these news events, and the Norsat NewsLink terminal has traveled with Roger all over the globe to capture it all. Roger claims that throughout his fascinating freelance career, he has always found "Norsat equipment to be rugged and reliable enough to function in any environmental condition."

The U.S. military has also selected Norsat for many of the same reasons that Roger cited in this article. Roger recalled one instance at the Naval Station in Guantanamo Bay when he found that a small part of the terminal had been damaged during a trip back from China. Fortunately, the Joint Task Force at Guantanamo Bay had the same Norsat terminal. The military allowed Roger to borrow their part and he was then able to get his terminal working again.

Roger also notes that Norsat customer support has been helpful and responsive when answering his questions. Roger said that he is constantly pushing the terminal to its limits—demanding more and more out of it with each mission. "It's not a problem with Norsat—they have a can-do attitude right along with me and we work together. Norsat customer support is stellar. I always say that if there isn't a way, just keep trying, and they get that," said Roger. "They have really gone above and beyond with any request I've ever had".

Roger's Newslink in operation in Haiti.

Norsat Upgrades

Norsat completed an upgrade for Roger when he needed a new RF transmitter module (BUC). "I was originally working with a 25 Watt BUC and I upgraded to an 80 Watt BUC in 2010. I can say with confidence that this has been the best modification I could have made to the product" he stated.

With the 80 Watt upgrade, he easily doubled his bandwidth to 9MB, with power in reserve, in most locations on the globe. "This upgrade turned a terminal I was already pleased with into an extremely high powered unit that I have used to cover news events all over the world."

Roger on location with single individual control of the Norsat terminal.

said Roger. The most recent upgrade made for Roger's NewsLink was the migration to an MPEG 4 encoder/modulator which enabled him to produce a true HD television signal without the use of any external equipment. This improved HD NewsLink travels in three suitcases and can be easily operated by one individual.

Ease of Use

In addition to excellent customer support, Roger noted how easy the terminal has been to use. When he was in Concepción, Chile, covering the earthquake, he was in front of an apartment building that had split in half. He was able to set up his Norsat NewsLink on the sidewalk and find the satellite between two large buildings. Many times, his team was so far south that the satellite was only 20 degrees above the horizon, which would have normally made satellite acquisition difficult. The Norsat NewsLink had no trouble acquiring the satellite and transmission was underway in a matter of minutes

What's Next for Disaster Truck?

Disaster Truck has recently been busy covering conferences of UN peace groups working in conflicted areas around the globe. As of late, the organization's coverage has focused most heavily on the Israel-Palestine conflict. Disaster Truck is currently going through a period of re-conceptualization, inquiring into different ways to illuminate the work of Non-Government Organizations (NGOs) who provide peace keeping services worldwide.

The Passion for Communication

Norsat is committed to helping customers get the most out of their products, and Disaster Truck embodies Norsat's mission of being a leading provider of innovative communication solutions that enable the transmission of data, audio and video for remote and challenging applications. Disaster Truck's mantra is to always be able to supply real, unbiased information to the people no matter what the risk, or environmental limitation.

All images are courtesy of Roger Hawkins and Disaster Truck—to find out more about Disaster Truck, visit ***www.disastertruck.com***

Norsat and the U.S. Mobile Public Affairs Detachment

Norsat recently caught up with one of their military customers—he explained how Norsat's technology has provided vital communication links for the U.S. Army.

SSG Brian Allen is a former Staff Sergeant for the Mobile Public Affairs Detachment. He worked with Norsat Newslink terminals to deliver content to military families and the public through news affiliates using DVIDS (Defense Video & Imagery Distribution System).

SSG Allen was based at a Multi-National Division in Northern Iraq. That particular division used a Norsat Newslink terminal to provide real-time communication with the U.S. and to broadcast interviews from high-ranking officials about military activities, concerns and special events in-theater. The Mobile Public Affairs' Norsat Newslink terminal also enabled their detachment to "tell the soldier's story", enabling them to give b-roll and packages to news affiliates.

SSG Allen said that these lines of communication were key for increasing morale in the Soldiers and their families by allowing the transmission of "shout outs." Through these broadcast messages, Soldiers were given the chance to regularly send love to their families.

This is just one example of how Norsat's technology has helped to provide communications around the globe for a variety of unique situations and environments.

About Norsat Terminals

Norsat's Flyaway Satellite Terminals are extremely rugged and transportable and are designed for newsgathering in challenging environments. Conveniently packaged in industrial cases and supported by advanced pointing tools, customers such as Roger Hawkins, featured in the first article, are able to set up and begin transmitting in a matter of minutes, without having to possess technical expertise.

Norsat's Flyaway systems are field proven, rugged and reliable. With units continuously operating for more than eight years (by military and civilian customers) in locations including Afghanistan, Iraq, and Haiti, users like Roger rely upon the extreme durability of Norsat's Satellite Solutions for broadcast quality transmission when it matters most.

Norsat's LinkControl™ software seamlessly integrates all the tools needed for Satellite News Gathering with an easy to use interface and advanced capabilities.

Norsat terminals feature tool-free setup and an intuitive deployment strategy. Norsat's flyaway terminals are available in aperture sizes of 45 centimeters to 3.8 meters and include HD support with one or more airline checkable cases.

The Norsat Int'l infosite is located at ***www.norsat.com***

NEW YORK CITY TRACKS FIREFIGHTERS TO SCENE WITH NRL RADIO TAGS + AUTOMATED DISPLAY

By Kyra Wiens, Public Affairs Specialist, U.S. Naval Research Laboratory (NRL)

On 15 of its vehicles, New York City Fire Department (FDNY) can now automatically see which firefighters are nearby via the department's onboard computer and then relay that information to the city's Operations Center. The system was invented by David DeRieux of the U.S. Naval Research Laboratory (NRL) Space Systems, along with Michael Manning of Manning RF and in close partnership with FDNY.

Since the 9/11 terrorist attacks, New York City has been pursuing ways to better coordinate the 14,000 firefighters and emergency response it employs. (Prior to 9/11, the FDNY used a paper/carbon-copy ride list—Battalion Form 4 (BF4)—to account for who's present.)

NRL's system is based on an active radio frequency identifier (RFID) tag carried by each firefighter, similar to E-ZPass or how retail tracks inventory. "It's in a little sealed plastic—it looks like a little key fob, actually," said George Arthur, an NRL engineer who contributed to the project. "They're positioned over the left breast, inside the bunker coat in a little Kevlar pocket that's sewn in there. And it just sends out a little ping every five seconds: here I am, here I am, here I am."

Fire Department New York uses a U.S. Naval Research Laboratory (NRL) system to automatically track firefighters. "That's the intention with this device, to make sure everyone's accounted for," said David DeRieux, one of the inventors.

Fire Department New York asked the U.S. Naval Research Laboratory (NRL) to build a system for tracking firefighters during local and city-wide events. "As soon as [the driver] turns the ignition on," says David DeRieux, one of the inventors, "this thing comes up. When they get on the scene, everyone takes off, they all disappear. Then eventually they come back for a roll call situation, and the captain can tell instantly everyone is within so many feet of the truck."
Photo: U.S. Naval Research Laboratory

Fire Department New York uses a U.S. Naval Research Laboratory (NRL) system to automatically track firefighters. "That's the intention with this device, to make sure everyone's accounted for," says David DeRieux, one of the inventors. The NRL worked with firefighters to determine where to add the RFID pocket.

A radio receiver on the vehicle picks up the pings and builds a table of identifiers. "It just listens and said, 'Okay, 1234, that's Jessica Smith,' so we know Jessica Smith is nearby," said DeRieux. "Periodically, a program that's running on their MDT [mobile data terminal], their onboard computer, quizzes this reader and said, 'Let me have everything.'"

The table of every firefighter on or near the vehicle is displayed on the MDT screen (*see photo to the right*). "As soon as [the driver] turns the ignition on," said DeRieux, "this thing comes up. When they get on the scene, everyone takes off, they all disappear. Then eventually they come back for a roll call situation, and the captain can tell instantly everyone is within so many feet of the truck."

The MDT also sends this accounting to the FDNY Operations Center in Brooklyn, using a commercial modem. "They actually have a massive display, twice the size of my wall," said DeRieux, "and on there this data gets projected. So they know what truck just showed up on scene, who was on the truck." To coordinate personnel during a city-wide disaster, this real-time information would be unimaginably valuable. "During 9/11 there were thousands of firefighters, it was a big problem," said DeRieux.

The data is also archived. "If there were a HAZMAT release," said Arthur, "they could go back and immediately see the firefighters who were on duty."

On April 23rd, the Federal Laboratory Consortium awarded NRL for Excellence in Technology Transfer. "Technology transfer is very important," said Arthur. "Doing things here [at NRL] that are beneficial, not just to the warfighter, but also to the average citizen."

NRL worked closely with FDNY throughout the years of development. "They gave us very good feedback," said Arthur. "They'd say, 'That's kind of what I want, but can you do this and can you change that?' They pretty much knew what they wanted and that was just all the difference in the world."

They also had the opportunity to spend time in New York getting to know the firefighters and their needs, and see them in action. "They're an impressive bunch to talk to, very big-hearted," said Arthur. "There's one guy, Chief [of Logistics Ronald] Spadafora, who's got this thick Brooklyn accent, rides a Harley to work. Well he's got two Masters degrees, he flies all over the world [giving] lectures on fire science. He's written a couple books."

NRL worked with FDNY to develop RFID system to track personnel. David DeRieux (right) of the U.S. Naval Research Laboratory (NRL) invented a system for Fire Department New York to automatically track firefighters. The requirements? "It has to be easy to use, reliable, and cheap," said George Arthur (left). (Photo: U.S. Naval Research Laboratory)

The relationship started with a fortuitous meeting in 2002. "I recognized the guy next to me," said DeRieux. "Turns out, his name was [Battalion Chief] Joe Pfiefer." Pfiefer was the first chief to take command on 9/11. "[Pfiefer] brings me into his office and he said, 'We've got a problem. We need a way to keep track of our firefighters. Worse yet, some firefighters, who become dazed and confused during an operation, may not make it out of the building, or they end up in the wrong area for roll call.'"

NRL's system was needed so the other truck would be able to automatically relay through the Operations Center, "He's over at Engine number whatever so he's all right," said DeRieux. "That's the intention with this device, to make sure everyone's accounted for."

Working with FDNY led to an unexpected spin-off: the city liked the program's interface so much, they asked NRL to make a similar drag-and-drop program they could use to schedule personnel assignments. Said Arthur, "Now EBF4 is the standard scheduling tool New York City uses for their firefighters. NRL wrote it."

One of FDNY's primary requirements, said Arthur, was, "It has to be easy to use, reliable, and cheap."

So DeRieux turned to Michael Manning, who had a private company already working on RFID, to provide the hardware for NRL's program. Said Arthur, "All the hardware came off the shelf; the secret sauce is the software. Anybody can go out and buy the RFID components, but if they don't have our program it's just a bunch of dumb computer parts."

Using all off-the-shelf hardware kept costs low. "The readers cost around $1,100 a piece in the quantities we buy them, that might come down a bit," said Arthur. "The tags cost about $20 a piece."

The tags are active RFID; so, unlike passive RFID, the batteries will run out in three to four years, depending on how often they're programmed to transmit. But active gives greater range and the ability to transmit more data. Said Arthur, "If you used the same amount of equipment, you could conceivably load it with the oxygen the guy had left, and the temperature in the area."

"We have given them the piece that lets them track from the vehicle to the fireground or the event," said Arthur. "If we could drop in a complementary piece, where we could track firefighters while they're in the building, that would save so many lives."

"Indoor tracking," said DeRieux, "it's a very tough nut to crack."

NRL's system is simply, "I detect a signal or I don't"—but an indoor system would need to pin a precise point in three-dimensional space. "I've always said down to six inches," said Arthur, "because that's the approximate thickness of a wall. You don't want to track a firefighter only to find yourself on the wrong side of a wall."

A system built by U.S. Naval Research Laboratory (NRL) monitors firefighters nearby, and lists their names on the computer display. "If we could drop in a complementary piece, where we could track firefighters while they're in the building, that would save so many lives," said George Arthur, an engineer from NRL who managed the project.
Photo courtesy of U.S. Naval Research Laboratory

The tracking systems Arthur has reviewed start at a known, fixed point, then uses sensors to estimate where you've gone. "Gyroscopes know which direction you're moving and there are movement sensors that estimate how fast you're moving. An altimeter tells whether you've gone up or down in the building."

He adds, "But the problem is chaos." Say the system is accurate plus or minus an inch on each step. The firefighter's first step from the known point is accurate within an inch; but the second step is plus or minus an inch based on a guess that was also plus or minus an inch. "And the longer you're out walking around," said Arthur, "the more those inaccuracies compound."

Additionally, the firefighters may be behind metal walls, they may be 100 floors up from a data receiver, and an altimeter may not give reliable data "because in a building that's on fire you're going to have all kinds of changes in air pressure."

A separate avenue of research, particularly if NRL were to put a new system in another city or perhaps aboard a naval ship to track fire control teams, would focus on improving the hardware. "We started implementing this system in 2007," said Arthur, "and everything's come a long way since then." Today, there are passive RFID tags that, unlike FDNY's system, can last indefinitely. They're also ruggedized and wouldn't have to be removed before laundering.

Be it for U.S. Marines or firefighters, for talking to spacecraft or talking to Brooklyn, NRL is a place where engineers solve problems. Said Arthur, "I'm kind of a nuts and bolts guy. I'm an engineer who can change a tire. I like to fix things, take things apart."

About the author

Kyra Wiens is a Public Affairs Specialist for the U.S. Naval Research Laboratory (NRL). She's written about the lab's achievements in alternative energy, biochemistry, space science, and more. She's also an All American triathlete.

SATELLITE TECHNOLOGY FOR TRAINING ANYWHERE

By Tony Bardo, Assistant Vice President of Government Solutions, Hughes

In the modern era of military missions, satellite broadband has proven itself to be hugely beneficial in enabling connectivity virtually anywhere, especially for warfighters in remote areas. However, there's another role that many don't recognize, even though this role has been just as vital to ensuring mission success—training.

Since the early 1990s, satellite broadband has helped to keep military personnel fully educated for the task at hand by enabling the delivery of distance learning programs and remote job training through two primary vehicles: the Government Education & Training Network (GETN), and Defense Education & Training Network (DETN).

GETN was pioneered by the Air Force in 1992 in an effort to encourage agencies to share their distance learning programs and common facilities. Shortly thereafter, DETN was developed within the GETN community to serve the Department of Defense (DoD) specifically, while simultaneously sharing technology, like satellite, and programs across federal organizations through GETN.

Since their inception, these networks have been used extensively—with more than 10,000 hours broadcast every year—for distance learning and training programs on virtually any subject that can be taught in a platform environment, such as combat equipment repair and medical training. Why are agencies selecting this distance method over other, in-person training programs?

The answer is simple and all comes down to cost. Satellite-enabled training programs are ubiquitous and cost-effective, available virtually

anywhere in the contiguous United States (CONUS) and in select areas overseas. In fact, DETN provided over 215,000 student-hours of training last year at an estimated cost to the Government of only $2.50 per student-hour of training.

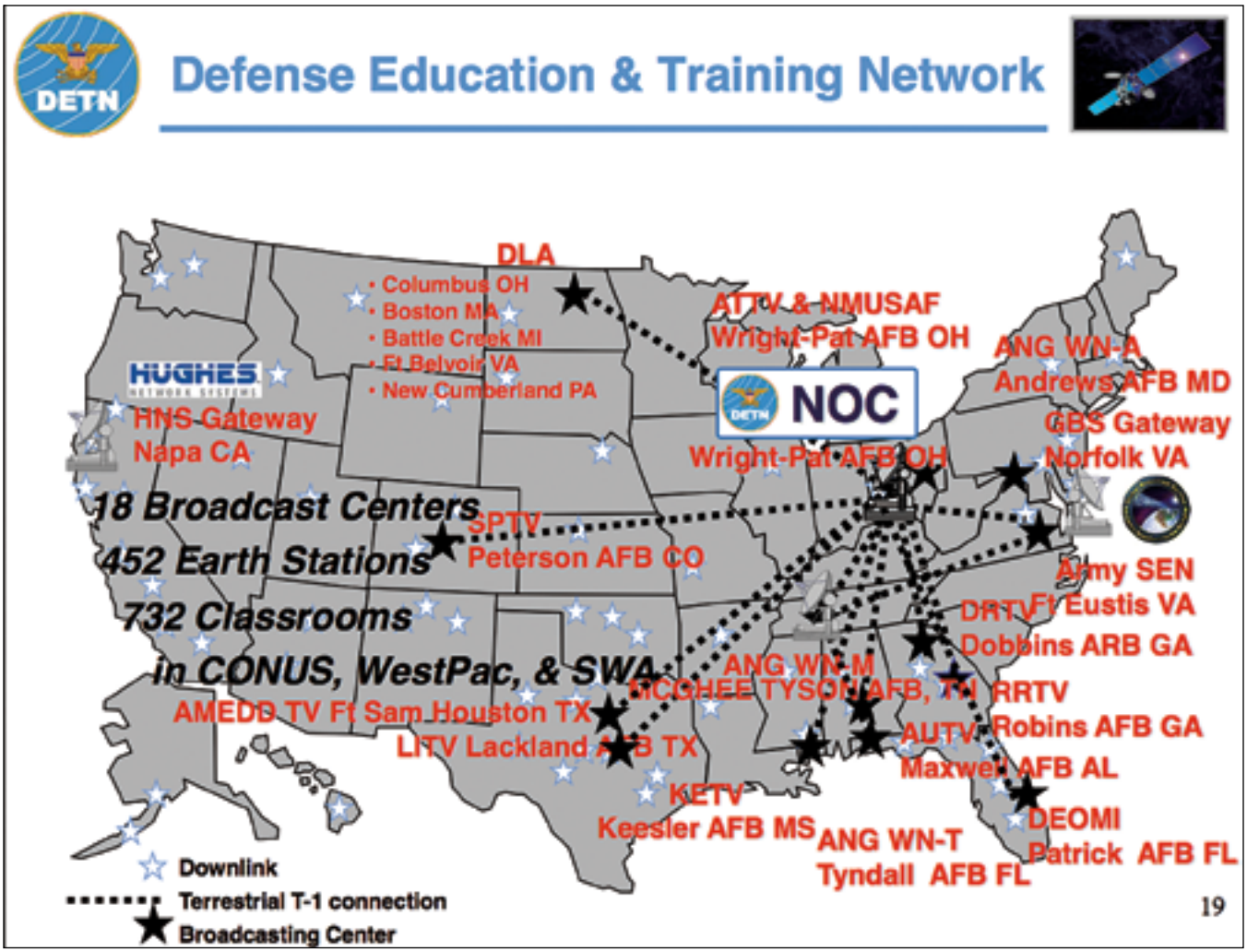
Training Benefits

Using GETN and DETN for training, the DoD community saves millions of dollars each year on travel expenses. In the past, staff ranging from executives to warfighters would attend in-person training sessions, which meant airplane tickets, hotel rooms, and even food, all had to be pre-arranged and paid for by the agency.

Now, with GETN and DETN, agencies can participate in training programs at low cost and in virtually any environment. These networks meet a variety of training and education needs, offering field courses on subjects like aircraft maintenance and terrorism response, and even personal training on topics ranging from leadership and finance to professional military education. While proven to be beneficial, they are now ready for an update, with two major initiatives underway to improve them.

Upgrading GETN and DETN

To expand DETN, more broadcast centers will be installed, both CONUS and outside the contiguous U.S. (OCONUS), to provide content uplink capabilities for all DoD health centers, hospitals, and clinics. This will mean that eventually all DoD health facilities will have immediate access to training programs needed to keep personnel informed on the latest advances and practices in medicine, improving the quality of healthcare available to DoD patients. Currently in the early stages of implementation, funding is being received from the DoD/Veterans Affairs (VA) Joint Incentive Program.



Meanwhile, GETN is also obtaining a facelift. To keep up with technology advances, the network has recently upgraded to HD television systems with high-threshold audio return, providing improved quality experiences to users. Due to the cost of technology constantly declining as new technologies release, this higher-quality training will be available at a lower cost than previously experienced.

These new initiatives, while imperative for the growth of these programs, also serve another purpose—they offer significant cost savings for agencies in a challenged budget environment. With the expansion of DETN, fewer personnel will need to travel for conferences and training, meaning these monies can be allocated elsewhere. At the same time, GETN improvements will vastly decrease the cost per hour of broadcasting lessons, which adds up to a savings in the millions of dollars across the various agencies every year.

Looking Forward

Thanks to satellite, the future of GETN and DETN looks bright. With highly secure satellite broadband delivery networks available virtually everywhere, and as bandwidth capacity grows and costs continue to improve, there is a huge opportunity to rapidly expand training programs of all subject matter.

As DETN continues to expand its reach and increase the number of student-hours of training, we can look forward to seeing how this cost-effective medium impact in the world of defense training in the years ahead.

The Hughes Government infosite: ***www.government.hughes.com***

About the author

"Tony" Bardo has more than 30 years' experience with strategic communication technologies that serve the complex needs of government. Since joining Hughes in January 2006, Bardo has served as assistant vice president of Government Solutions, where he is focused on providing Hughes managed network broadband solutions and applications to Federal, State, and Local governments. Bardo also served as Chair of the Networks and Telecommunications Shared Interest Group (SIG) for the Industry Advisory Council, an advisory body to the American Council for Technology (ACT).

Before joining Hughes, Bardo was with Qwest Government Services and he also spent 14 years with the government markets group at MCI where he held the position of executive director for civilian agencies.

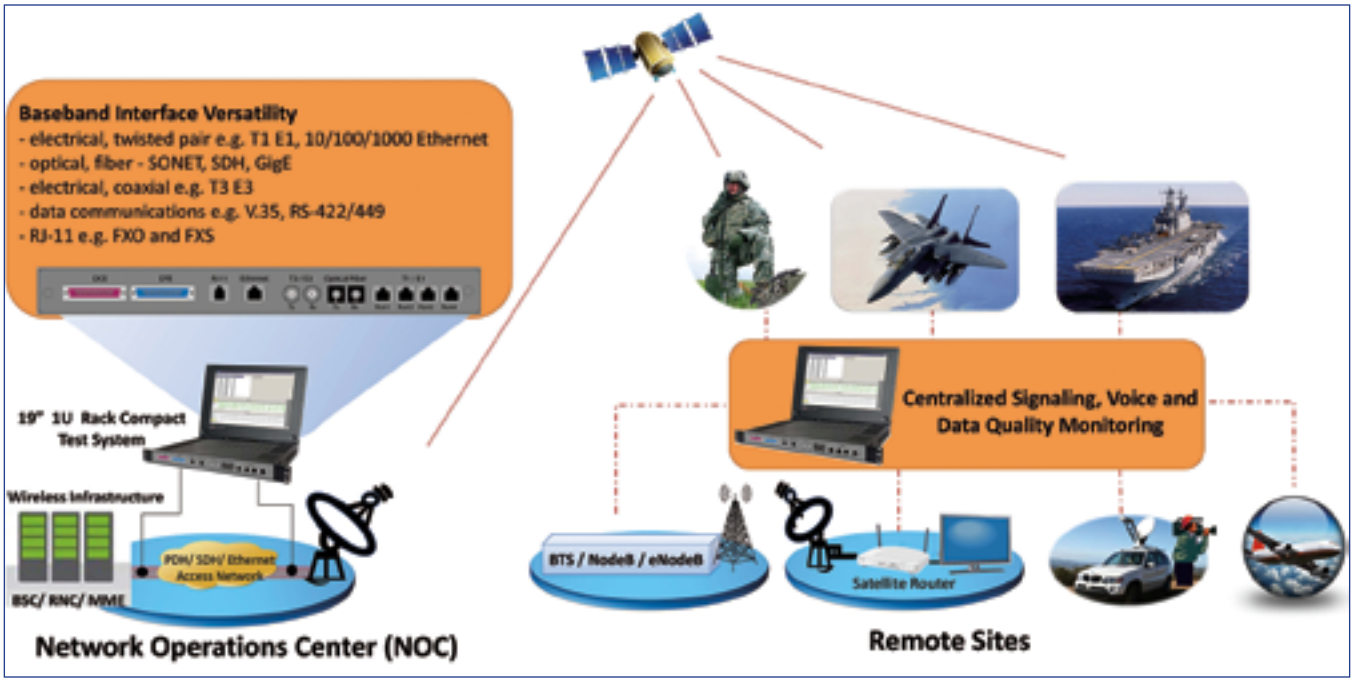
UNIVERSAL TEST & MONITORING PLATFORM FOR SATCOM — ANY INTERFACE, ANY BANDWIDTH, ANY PROTOCOL —

Satellite transmission has many advantages for military and governmental sectors. It is especially attractive because its feature-set encompasses secure transmission, disaster restoral, broadband capability and quick deployment for "on the move" and "fixed" applications. In fact, Mobile and Telecom operators use satellite based backhaul in mobile networks due to its cost effectiveness for sparsely populated areas, its bandwidth efficiency, and its applicability in 4G, 3G, 2.5G, and 2G technologies.

To ensure performance and reliability, these operators must have the ability to remotely monitor, maintain, and intrusively test satellite circuits and networks. A single compact platform with all-interface flexibility, support for wide data rates from a single voice channel to Gigabit pipes, and broad protocol emulation and analysis capability would be ideal. Current conventional test equipment available in the market requires additional multiplexing / de-multiplexing equipment with substantial cabling that invariably results in a bulky solution. This is especially the case with broadband rates. GL's test platform, properly packaged with plug-in interfaces and features, comes close to meeting the challenge with a single, portable, configurable solution.

The diagram below depicts many satellite applications: direct satellite Internet access from an airplane (military or commercial), mobile terrestrial broadband applications, IP video, mobile backhaul, portable satellite radio, and others. All of these applications require monitoring and testing at a conventional baseband interface, such as 4-wire analog, 2-wire FXO, Datacom interfaces (V.35 and RS-422), Ethernet (10/100/1000 Mbps), and channelized and unchannelized TDM interfaces (T1, E1, T3, E3, OC-3/STM-1, or OC-12/STM-4). The services and protocols that these interfaces must support can be analog voice, fax, low to very high speed data, low to high speed video, and IP applications encompassing voice, video, image, and data. Examples of the type of performance monitoring and control that can be achieved includes:

- *Drill down into an individual voice channel of an STM-1 trunk (from among thousands of voice channels)*
- *Remotely monitor, store, record, each and every voice call, collect call records 24/7*
- *Test and assess voice and data quality of tactical voice communications in the field using live speech and data, for one analog interface or many simultaneously*
- *"In motion" mobile data quality as a function of geography, time of day, data rate, uplink/downlink, plot data on Google maps or other mapping software*
- *Assess remotely, and non-intrusively 24/7 backhaul transmission performance, listen to audio over active Abis, IuB, or S1 trunks,*
- *Collect performance data daily, weekly, monthly, or over an extended period of time*
- *Perform remote protocol analysis of individual transactions of complex IP protocols*



Versatile Interfaces + Rates—is one important key for a compact but **universal test platform**:

1. **RJ-11 with FXO, FXS, 4-wire, PTT**—*for one to many voice or fax channels - many military communications systems require instant secure intelligible voice communications whether in a remote mountainous location or on a moving transport vehicle. Fax is also a necessity. Sometimes, fax is demodulated before satellite transmission and then remodulated at the distant end. The device under test could be a military radio, IP radio, modem, router, gateway, etc. Usually the interface is analog audio. Test and measurement capability involves QoS metrics—voice intelligibility, quality, connection time, efficiency, and reliability.*
2. **Data Communications Interfaces**—*voice, video, and data may be available through datacom (serial) interfaces such as V.35, RS-232, RS-422/449, RS-485, or special baseband coding (e.g. Manchester, inverted Manchester, NRZI, Manchester Differential, Bi-Phase (Manchester FM-0, Manchester FM-1). These interfaces usually use Layer 2 protocols - supporting Frame Relay, HDLC, PPP, ATM, Async, and others. Encryption may be a part of the system through the use of IP or serial crypto devices.*
3. **Ethernet / IP**—*10/100/1000 bps is ubiquitous for both management and traffic. Internet Protocol is dominant across this interface and can handle voice, video, and data at variable rates (consequently it is replacing TDM more and more). However the myriad of protocols, routing, and security pose special concerns. Testing at all layers (MAC, IP, UDP, TCP, and higher) is a definite requirement. 2G, 2.5G, 3G, and 4G are all migrating to IP from T1 E1. Satellite backhaul from BTS (2G) via Abis, Node B (3G) via IuB, and eNodeB (4G) via S1 to their corresponding BSC (2G), RNC (3G), and MME (4G) is common for sparse demographics. Even for metro architectures, backhaul via fiber is common for efficiency reasons.*
4. **T1 E1 and Fractional T1 E1**—*are common interfaces in the telecom world and, likewise, in satellite circuits and networks. In military applications, T1 E1 tend to be used in "unchannelized" and perhaps even "unframed" modes. Unchannelized is simply the aggregation of multiple timeslots (one or all) into one hyperchannel. Unframed mode uses the framing bits (8 kbps in T1, 64 kbps in E1) for traffic. Since satellite capacity is generally expensive and lower in bandwidth than terrestrial, TDM with compression and/or packetization with compression techniques are frequently used to improve efficiency.*
5. **T3 E3 STS-1 HSSI**—*broadband satellite applications are becoming more common such as imaging, video conferencing, streaming video (MPEG-3), and Web. Point--to-point and point-to-multipoint applications are common, for example, TDMA uplink and TDM downlink for a community of terminals that access a central gateway.*
6. **OC-3 / STM-1 / OC-12 / STM-4**—*Over all satellite, these rates have several applications: IP video, unchannelized PPP with IP, and mobile network backhaul. Backhaul over satellite is popular for all mobile network technologies - 2G, 3G, and 4G (LTE), since voice is transported in compressed form resulting in capacity gains of 4x to 6x. For example, at a dense BTS site with over 10,000 voice channels (AMR narrowband -compressed speech), can be backhauled with a single STM-1 pipe to the BSC site. There it may be uncompressed to PCM (ulaw or Alaw) prior to forwarding to the PSTN.*

Protocol Emulation & Analysis—is another aspect of a successful test platform. The GL Product Configuration table on the next page shows how the interfaces and rates can be plugged-in to a 19-inch chassis to accommodate required features. A fully configured test system may contain all or some of the identified GL products mentioned below—this provides interfaces from analog to OC-12 / STM-4 in a very compact system (show below).

All of these plug-in products can be configured (as appropriate) with protocol emulators and analyzers, some are listed below (not inclusive):

- *TDM - CAS, HDLC, ISDN, PPP, ML-PPP, SS7, Frame Relay, GR-303, GSM, TRAU, CDMA 2000, GPRS, ATM, UMTS, V5.x and FDL.*
- *IP - SIP, SIP-I, SIP-T, Skinny, H.323, Megaco, MGCP, RTP, RTCP, T.38, H.264, Diameter, Radius, SIGTRAN, GSMoIP, UMTSoIP (including IuCS, IuH, IuPS), LTE (including S1, eGTP, X2AP), GPRS, SGSN and GGSN.*
- *Codecs - uLaw, ALaw, G.722, G.722.1, G.722.2, G.729 (including A/B), Speex, AMR (including NB/WB), iLBC, EVRC, EVRC-B, EVRC-C, GSM (FR, EFR, HR), and G.726.*

Of particular note, is the provision of channelized and unchannelized access for T3 E3 and OC-3 STM-1. This feature provides access to all DS0s or sub channels within T1s and E1s in the OC-3 and STM-1; similarly for T3 E3. The channelization feature saves enormous space, power, and cabling. Being able to assess content deep

within a multiplexed stream provides improved visibility into dense transmission signals.

Unlike the old days, when mobile services were restricted by regulation and technology, the landscape has now changed dramatically with less regulation; technology is meeting the demand for information anywhere anytime. Satellite technology with its inherent advantage of connectivity is also keeping pace.

The demand for broadband IP is also not stationary—it pervades business and personal aspects. Voice, email, Internet, video, image services are in demand whether on a plane or in a car. Carriers such as Inmarsat and ViaSat offer these services very competitively. Satellites are no longer relegated to geosynchronous orbit; LEOs, MEOs, and spotbeams are revolutionizing the space. Portable test equipment that addresses this new market with a broad set of configurable interfaces, data rates, and IP and legacy protocol suites can be very valuable for diagnostics and maintenance. One such possibility has been discussed in this article.

The GL Communications infosite for further details:
http://gl.com/

Plug-In GL Product → / Interfaces / Services ↓	Universal Telephony Adapter	T1 E1 FXO FXS Datacom	T3 E3	Ethernet	OC-3 / STM-1 / OC-12 / STM-4
Analog					
RJ-11 2Wire Voice	x	x			
FXO FXS	x	x			
4Wire	x	x			
PTT	x				
Fax	x	x			
T1 E1					
Channelized		x	x		x
Fractional		x	x		x
Unchannelized		x	x		x
Unframed		x	x		x
Voice, Data, Fax, Video		x	x		x
Most all IP, ATM, and TDM Protocols - incl. Frame Relay and Wireless Infrastructure Protocols		x	x	x	x
DataCom					
RS-232, V.35, RS-422/449		x			
Manchester		x			
Async, HDLC, PPP		x			
Most all IP and Synchronous Protocols - incl. Frame Relay		x			
Ethernet					
IP - Most all IP Protocols, incl Wireless Infrastructure Protocols				x	
Voice, Fax, Data, Video				x	
T3 E3					
Channelized			x		
Unchannelized			x		
TDM, IP, ATM, Frame Relay			x		
Most all IP, ATM, and TDM Protocols - incl. Frame Relay			x		
OC-3 STM-1 OC-12 STM-4 Ethernet					
Channelized OC-3, STM-1 Only					x
Unchannelized					x
Most all IP, ATM, & TDM Protocols, incl Frame Relay and Wireless Infrastructure Protocols					x

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THE LIMITLESS FUTURE OF MICROSATS

By AJ Clark, President, Thermopylae Sciences and Technology

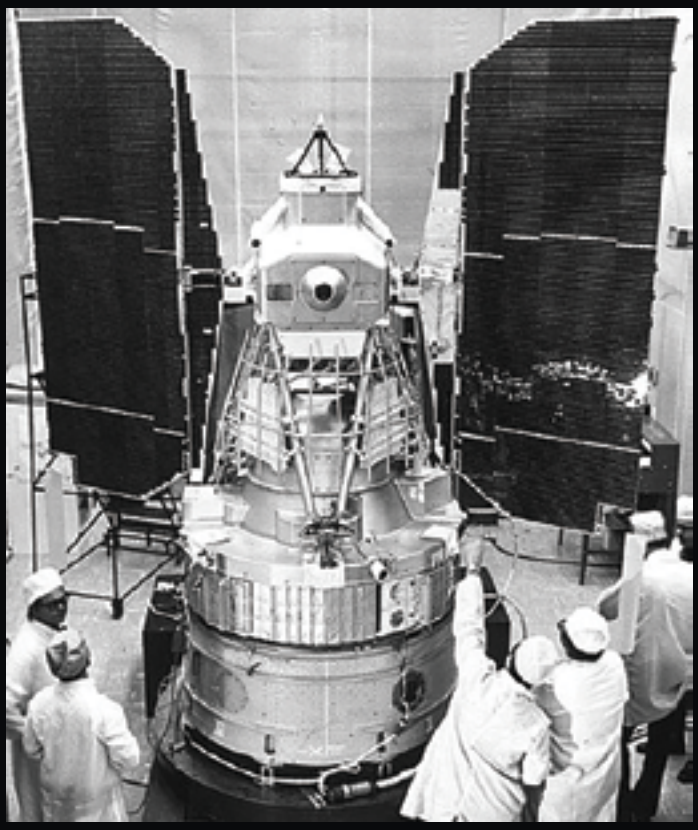
Satellites get smaller, less expensive and easier to build out of what might seem to be spare parts, and companies that develop them and advance the technology are springing up as fast as capital can be found to feed them and the imaginations that are stirred to develop new uses for them.

SkyBox, created from a business plan written for a Stanford graduate entrepreneurship course and funded with $3 million in seed money, commanded $500 million from Google only five years and one satellite later. Planet Labs, the product of three former NASA scientists who built their first satellite in a garage in Cupertino, California, in 2012, launched 28 satellites in one fell swoop less than two years later, with 100 more satellites forecast to be on orbit in short order.

The thread that runs through the two companies and their competitors is that they use satellites that would fit on your dining room table—some on your placemat at the table—to take high-definition images from Low Earth Orbit (LEO). The nanosatellite (nanosat) ranges between 2.2 and 22 pounds and can be launched in clusters from rockets built by emerging companies, who are cutting their launch prices in competition for the business of delivering payloads into space.

To some extent, the nanosats are the progeny of the Earth Resources Technology Satellite-1—later Landsat 1—sent aloft in 1972 to provide the first commercially available images of the planet. However, nowadays the upstarts cost a fraction of the $850 million (in today's dollars) of the Landsat 1 cost, yet still find a way to produce vivid images from assets built from components designed for cell phones and laptop computers and assembled to fit into a shoe box-sized, or smaller, container.

"Essentially anybody can do it, because a combination of miniaturization, simplification and availability of technology for building small satellites has made it accessible in a way that has never been before," James. P. Lloyd, associate professor of astronomy and mechanical and aerospace engineering at Cornell University told the New York Times.



Landsat-1 upon completion of its build.

Imaginations soar—in all directions. For instance, what is to keep rogue interests—i.e., terrorists—from adding to the nanosat constellation?

For one consideration, there is the technical capability to build a satellite, the wherewithal to buy a ride into orbit, the means to develop an Earth station to retrieve what the satellite sends back, and the sophistication to create algorithms to make sense all the involved technologies. Priorities come into play—the funding for all of that would buy a lot of rifles for a great number of fighters.

For another, there is *Article Six* of the *Outer Space Treaty*, which mandates licensing and inspection of rocket payloads by its

signatories, which include Iran and North Korea, along with the United States.

"It also makes a nation responsible for the activities of the satellites, both before launch and after," said Henry R. Hertzfeld, research professor of Space Policy and International Affairs at the Space Policy Institute of George Washington University.

Still, there are questions about the Outer Space Treaty's enforceability as technical capability and opportunity expand—a future investment in space for nefarious purposes could be yet another story.

Global Strategic Trends – Out to 2045, a report by the United Kingdom Ministry of Defense's Development Concepts and Doctrine Centre (DCDC) that was released in July, warns that a terrorist's satellite is likely over the next three decades, as development costs decline and private company payload launch capabilities increase.
The think tank also warns of potential satellite-generated GPS and military and civilian communications disruption, as well as signalv jamming and even piracy by a group or groups that take advantage of an inability of governments to forge international space agreements to thwart such activities.

More important for now is that this report acknowledges that a satellite isn't necessary if the group's primary aim is to see images of its enemy.

"Already, those who wish to discover weaknesses in the security arrangements of sensitive infrastructure can buy high resolution imagery from companies that operate Earth observation spacecraft," the DCDC said. Even easier, and cheaper, are unmanned aerial vehicles that are becoming universally available and offer portability and flexibility to deliver pictures of an enemy to troops in the field.

Beyond that, there is an understanding that "with any technology, there is always a thought that it could be used for evil," said Kevin Pomfret, executive director of the Center for Spatial Law, a Richmond, Virginia, organization. "I'm sure that when Henry Ford built his assembly line he wasn't thinking about how hoodlums would outrun law enforcement in his cars. With any new technology, you have to weigh the benefits and see that they outweigh the detractions."

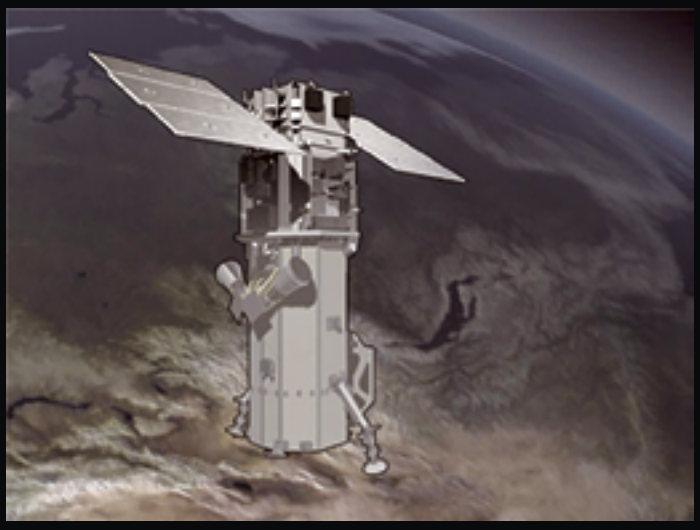
That's why, rather than imagining a James Bond Dr. No movie script of nefarious activity, companies that are pioneering the nanosat expansion today focus their imaginations on real value, rather than potential for mischief later. They see the field of satellite imagery as a means to exploit a burgeoning geospatial intelligence capability for business, for science and education and for humanity.

When Google acquired SkyBox in June, the idea was that the images would be used as a geospatial data fusion tool with Google maps, which then would be even more valuable if those images were more plentiful and— even more importantly—timely. If they were collected daily or even more often than the current annually or less often image captures, their utility and validity would increase a thousand fold.

SkyBox, which has two satellites about the size of a phone book on orbit, plans to have six in space by 2016, offering visuals of the entire Earth twice a day, all the while consuming less power than a 100w light bulb. When the company's 24-satellite constellation is complete in 2018, three images daily are planned, with a resultant capability of near-constant monitoring of traffic patterns, commercial customer activity gauging and daily crop reports—along with instantly available emergency and humanitarian relief use.

When combined with military capabilities—and remember that the National Geospatial-Intelligence Agency uses commercial imagery for about 90 percent of its products—companies such as SkyBox

Thermopylae Sciences & Technology uses the web to relay EO-based emergency data to users. Image courtesy of TST.



Artistic rendition of DigitalGlobe's WorldView-3 satellite.

and its nanosat competitors, Planet Labs and others, offer the potential for what NGA Director Letitia Long told the recent 30th Space Symposium attendees in Colorado in May was "the Holy Grail in intelligence: persistency." It can do so at a fraction of the cost of developing and launching constellations of Landsats.

A nanosat learning curve that already is accelerating was spurred recently when the U.S. Commerce Department ruled that commercial satellite images available for sale could be even more vivid and offer greater detail. The agency's previous standard allowed for objects of no more detail than 50 centimeters per pixel for a commercial image from space, and while that has served for decades, more recent technology and fast evolving ways to use the pictures have created a demand for more fidelity.

With that in mind, DigitalGlobe, a $3 billion company and the world's leader in commercial high-resolution in satellite imagery, petitioned to be allowed to sell pictures with 31 centimeters per pixel, with a potential increase to 25 centimeters. DigitalGlobe does 60 percent of its business with the NGA, and also is a Google Earth supplier.

Commerce consulted with the Intelligence Community and State Department and agreed to an increase in offered resolution.
DigitalGlobe was scheduled to launch its WorldView-3 satellite in mid-August, and a 180-day countdown to 25 centimeter images begins when the rocket leaves the launching pad.

Can nanosats and their imaging capabilities be far behind, and at a fraction of the cost of the $650 million WorldView-3? SkyBox's constellation will be comprised of satellites about the size of an under-bar refrigerator. Competitor Planet Labs launched Flock 1, called "doves," which was comprised of 28 10x10x30-centimeter satellites, from Wallops Island, Virginia, to the International Space Station in December. They were deployed into LEO in January. Eventually, Planet Labs will launch 100 more of their "doves," and their efforts will, in effect, crowd-source images.

A fleet of 24 satellites on orbit is Skybox Imaging's constellation plan. Image courtesy of Skybox Imaging.

Other competitors have their own ideas, some offering images themselves, others offering information from the analysis of the images. Still other companies with different ideas are visions in entrepreneurs' eyes while awaiting capital investment. That investment is coming, because a booming $2 billion global commercial satellite imagery business that is expected to grow by 14 percent through 2019 will lure investors. That growth will be fed by plans for as many as 1,000 nanosats in the next decade.

Business plans for the companies vary and range from selling satellite images to the military and government agencies to assist crucial operational planning and missions, to firms that might like to count cars in competitors' parking lots during a holiday sale, to environmental missions, to education, to humanitarian and disaster relief and scientific research and, yes, even more.

Each new company, each technical advance is a product of an effective imagination and spawns even more thought in developing new uses for nanosats. This is a new space race, driven by entrepreneurialism and the opportunity to gain a foothold in the ever-expanding imagery market sectors.

For additional information regarding TST, please visit
http://www.t-sciences.com/

About the author

AJ Clark is the President of Thermopylae Sciences & Technology (TST), a leading provider of Web-based geospatial capabilities, mobile software framework and applications, situational awareness, and cloud computing solutions for the U.S. military and private sector businesses.

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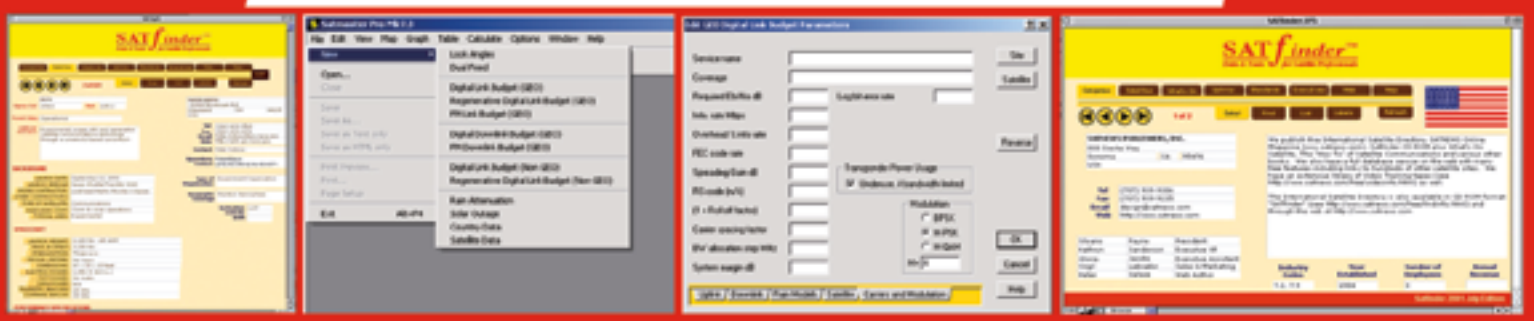

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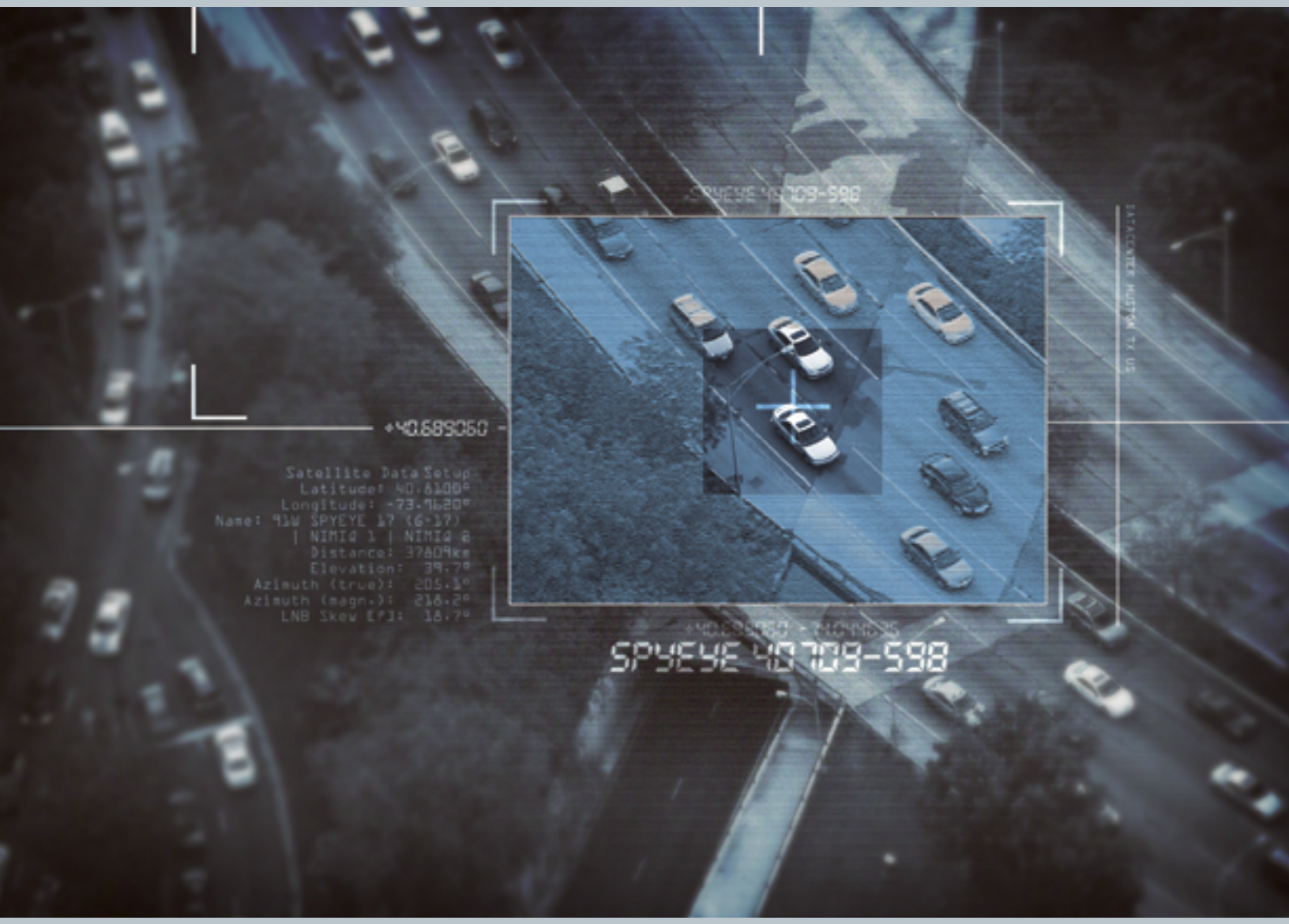
MISSION CRITICAL COMMUNICATIONS DEMAND SATELLITE CONNECTIVITY

By Ali Zarkesh, Product Development Director, Vislink

The face of modern surveillance has changed dramatically in recent years. Today's defence officials expect a constant stream of information live from the scene as it unfolds, and they rely on a combination of video, audio, and data to provide the necessary input for making critical decisions.

Traditionally, this need has required a sizable and often expensive investment in military grade hardware. Given the personnel and budget restraints currently faced by governments all around the world, however, investing in bespoke equipment is no longer always possible to accomplish. These groups are, therefore, turning to commercial off-the-shelf (COTS) equipment out of necessity. However, contrary to popular belief, this is no longer a compromise on performance.

Effective communication among disparate teams has always been the most powerful tool in any military's arsenal and is also critical when it comes to surveillance, as operational success largely depends on the quick and reliable transfer of information. Now, thanks to the latest developments in satellite technology, there is no longer a need to rely on expensive and bespoke equipment. Identical results can be achieved with hardware that, although initially intended for the broadcast market, is capable of meeting the expectations of defence officials in terms of speed, reliability and security. Rugged, portable and boasting high data throughputs, modern satellite data terminals are a cost effective alternative for military personnel looking to handle HD video, voice and data simultaneously, and can provide a much more effective communications network than traditional radio or cellular.



That's not to say there isn't room for cellular technology. After all, Mobile Network Operators have invested heavily in their 4G LTE networks to improve bandwidth and coverage, and with 5G on the horizon, it is no surprise they are looking to cash in on their investment by offering premium network services tailored specifically to the defence sector. However, 4G LTE was never intended for mission-critical communications where there is absolutely no margin for error.

Surveillance personnel have come to expect a reliable line of communication with HQ at all times, which cellular cannot provide. These networks are prone to being overloaded in a crisis, resulting in a delay in transmission. Given the nationwide coverage offered by cellular networks, they are well suited for initial surveillance and data gathering purposes. However, during heavy usage they are subject to high latency, delay and glitches, which can ultimately result in a failed operation. This is a risk that military personnel cannot afford to take—satellite communications offer a much safer alternative.

Combine the advent of Unmanned Aerial Vehicles with the need for reliable backhaul services on land, sea and air, and it's no surprise there has been such a large surge in the use of non-traditional satellite communications equipment. As this technology advances, however, providing greater throughput rates and higher quality video also increases the amount of created data. The availability of fast, portable and robust SATCOMs equipment has always been of paramount importance. As satellite bandwidth is also a prized commodity, that same equipment must compress the data feed as much as possible.

Fortunately, new modems included in satellite hardware are capable of achieving significant data rates and high efficiency gains. Paired with portable equipment housing, such as Vislink's MSAT range, which weighs only 12.5kgs and is designed for one-man operation, COTS equipment can provide military personnel with all the benefits of a fully integrated satellite terminal yet on a much smaller scale, suitable for use in any environment.

This represents a marked change in how satellite technology is viewed by the defence sector. Historically, satellite communication has been seen as an expensive and complicated network. With steadily increasing capacity, reduced costs, and modular functionality and the higher data transfer rates now available, satellite communications can exceed even the most stringent requirements, all delivered through a far more robust network than 4G LTE. As a result, SATCOMs now play a more important role than ever before in keeping disparate teams of military personnel connected at all times.

As military budgets continue to be squeezed, yet governments continue to expect high returns for their restricted investments, the global reliance on COTS equipment for mission-critical communications is set to grow exponentially. COTS equipment is more than suitable for surveillance operations and this technology also has applications for domestic training, data distribution and backhaul purposes.

No matter what the requirement, satellite technology has the ability to deliver video, voice and data from a variety of deployed assets to enable swift, accurate and intelligent decision-making.

Information regarding Vislink is available at their infosite:
http://www.vislink.com

About the author
Ali Zarkesh is the Product Development Director at Vislink.

EVENT: TAKING STOCK OF MILSATCOM EFFECTIVENESS... MILCOM 2014

MILCOM, the premier international conference and exposition for military communications, returns to Baltimore October 6-8, 2014.

Gathering the leading minds of government, military, industry and academia, MILCOM offers an interactive forum to further explore, define and leverage commercial and defense technologies.

Focusing on this year's theme, ***Affordable Mission Success: Meeting the Challenge***, MILCOM 2014 will feature five tracks of technical expertise and a line-up of top military, government, and industry speakers for the estimated 3,000 communicators who will travel from more than 25 countries who are expected to attend the conference.

Senior military, government and industry leaders will dialogue with attendees on the latest in military and commercial communications. Among those confirmed to speak at MILCOM 2014 are General Dennis Via, USA, Commander, U.S. Army Materiel Command, and General James Cartwright, USMC (Ret.), Harold Brown Chair in Defense Policy Studies, Center for Strategic & International Studies.

In addition to keynote addresses, decision-makers will share their perspectives during daily plenary panels. Topics include...

- *Affordable Mission Success: Insights for Industry, Mission, Money, Trust*
- *The Roadmap to the Enterprise, Affordable Mission Success*
- *Perspectives in Acquisition*
- *Fielding the Army Tactical Network*

The cornerstone of MILCOM is the strong technical program that includes a broad array of topics covering current communications issues. More than 275 papers will be presented in the technical program based on five technical tracks:

- *Cyber Security and Trusted Computing*
- *Waveforms and Signal Processing*
- *Networking: Architectures, Management, Protocols and Performance*
- *System Perspectives*
- *Selected Topics in Communications*

This technical program will also offer panels and tutorials for attendees. Many of the sessions are eligible for continuing education units (CEUs).

Complementing the technical program are more than 200 exhibitor booths to visit throughout the three-day conference—many of the world's leading providers of information, communications and defense technology companies will be on hand to demonstrate and discuss their products.

The technical program registration is free for military, government, and student participants; breakfasts and lunches are all available for a nominal fee.

MILCOM, now in its 33rd year, is co-sponsored by the Armed Forces Communications and Electronics Association (AFCEA) International and the Institute of Electrical and Electronics Engineers (IEEE) Communications Society. Raytheon is serving as the conference's 2014 corporate host.

MILCOM 2014 is held at the Baltimore Convention Center, located at One West Pratt Street in Baltimore, Maryland, and runs from October 6th through the 8th, 2014.

Visit ***http://milcom.org*** for a full conference agenda and information on registration.

Attendees can see, touch and try out products and solutions from more than 200 exhibitor booths in the MILCOM exhibition.

MILCOM 2014
Affordable Mission Success: Meeting the Challenge

MILCOM 2014
AFFORDABLE MISSION SUCCESS: MEETING THE CHALLENGE

Oct. 6–8, 2014

Baltimore Convention Center

www.milcom.org

The premier international conference and exposition for military communications, MILCOM 2014 showcases the technical innovations and creative talents of military, academic and industry leaders. Attendees will experience an in-depth technical program with industry exhibits, panel discussions and tutorials, which are eligible for continuing education units.

Technical tracks and topics include:

Cyber Security and Trusted Computing

Waveforms and Signal Processing

Networking: Architectures, Management, Protocols and Performance

System Perspectives

Selected Topics in Communications

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A SHIFT TO THE SUN FOR UAV INNOVATION: A BYE AEROSPACE PERSPECTIVE

By George E. Bye, CEO + Chairman, Bye Aerospace

Much like the race to the moon in the 1960s, history shows that the transformation of aerospace has helped the United States remain competitive around the globe. Given the sensitivities in today's world as well as the limitations of any ongoing U.S. government support, it is imperative that the private sector continues to ensure the momentum of aerospace transformation proceeds to move forward.

Time and again, the U.S. has proven that when the country puts its weight behind the development of aerospace technologies—particularly during a crisis—the benefits to the nation are immense.

In 1915, as the world engaged in World War I, President Woodrow Wilson created the National Advisory Committee for Aeronautics (NACA) to promote a coordinated effort between industry, academia and government in anticipation of a future entrance into the war. The Congressional decree that created NACA stated, "It shall be the duty of the advisory committee for aeronautics to supervise and direct the scientific study of the problems of flight with a view to their practical solution."

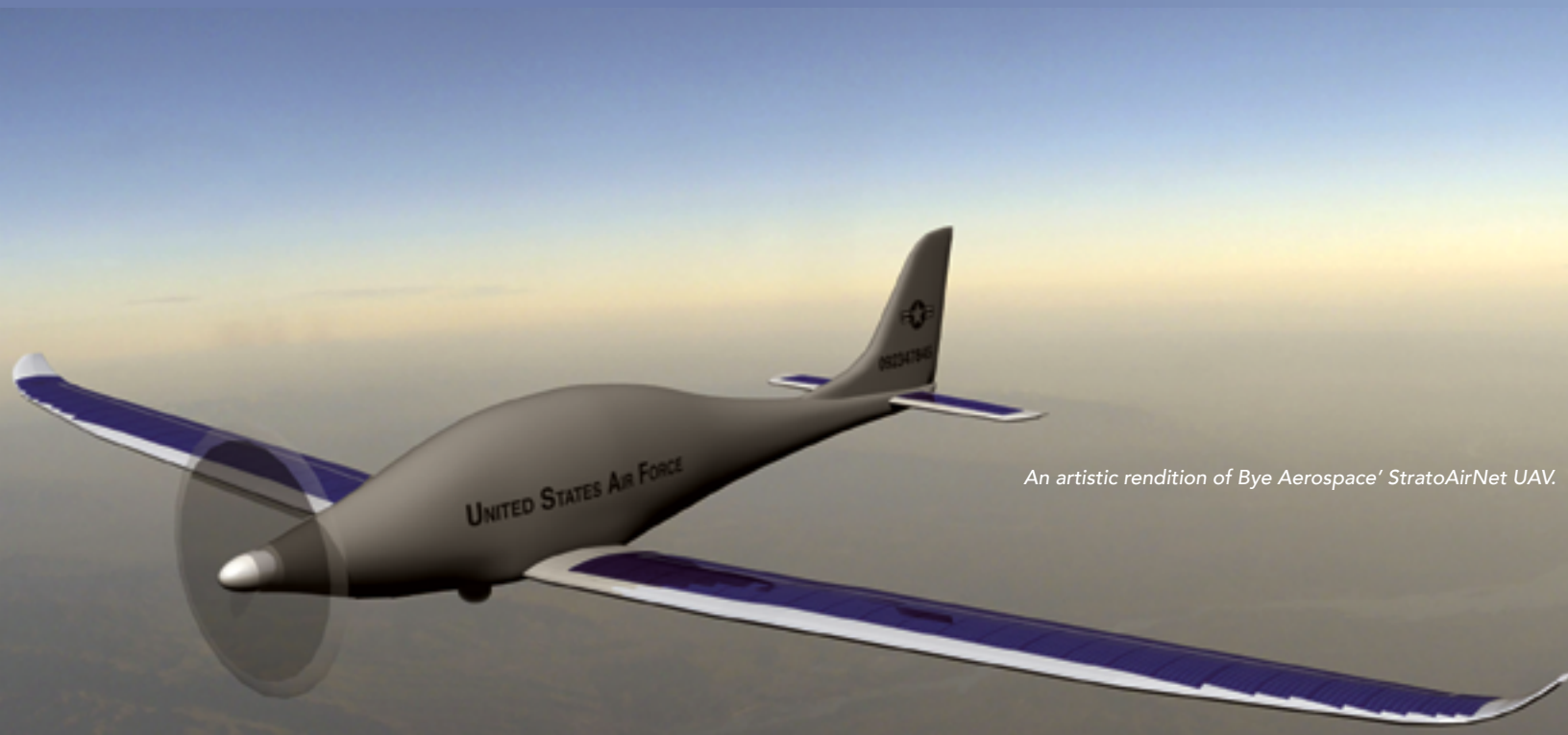
Perhaps most stunning about the creation of NACA is that the committee consisted of 12 individuals, all unpaid volunteers, who were given a budget of $5,000 for that first year.

In the years that followed World War I, NACA shifted its mission to promote military and civilian aviation through applied research that considered the future needs of aerospace and the country. Over the next four decades, NACA contributed to great achievements in thin airfoil theory, drag reduction, airfoil shapes and the transonic area rule.

The investments in NACA became critically important contributions to aircraft during World War II, for post-war research and the subsequent boom in civil general aviation as well as the jet age and included the work of government laboratories. The stage was then set for NACA's eventual successor—the National Aeronautics and Space Administration (NASA), which was created in 1958, and the launch of the U.S. race into space and the moon.

This remarkable aerospace legacy is a vital component of U.S.' identity. Today we find ourselves at an identical critical juncture, just as we were 100 years ago at the start of World War I.

With the retirement of much of the U.S.' space program, and little vision or budget for the future of aerospace, the genuine concern is that the great days of NASA are now behind us. The size and scope of the challenges facing all sectors of aerospace are enormous, necessitating an efficient process to expedite deployment of new technologies.



An artistic rendition of Bye Aerospace' StratoAirNet UAV.

To get to market, however, emerging technology must move through an innovation pipeline that is comprised of four critical phases: research, development, demonstration and deployment. Each phase represents an opportunity for great achievement or a chance for failure. With the volatile economy of the past five years, many in the industry and government are highly risk averse and fewer risks are acceptable in a push forward to nexgen technologies.

Unfortunate, to say the least. Especially critical is the transition from product demonstration to actual deployment—often called the "Valley of Death." Testing of prototypes often requires large-scale, complex, development capabilities. The U.S. Air Force and certain elements of the aerospace industry possess such wherewithals, as well as extensive experience, but they have no actionable budget to complete such programs.

With proper leadership and financing from non-government sources, an innovative aerospace industry is starting to offer accelerated development cycles. Bye Aerospace, for example, is developing a remotely piloted aircraft called the "StratoAirNet" unmanned aerial vehicle (UAV), a nexgen, high altitude, long endurance network-capable, commercial communications platform. Unprecedented performance and reliability will be achieved by using new, ground-breaking solar electric hybrid energy technology, while exploiting proven engineering design and manufacturing concepts.

StratoAirNet UAVs are intended to be part of a multiple, UAV-linked capability called the StratoAirNet Airbridge System (SANS), which will supplement other ground, air and space platforms. It is expected to be part of a large and ever growing communications market and will demonstrate economic and performance superiority in satellite comparable data, voice, Internet communication, Earth Observation (EO) and mapping.

StratoAirNet will use long, 25 meter span, glider-like, low drag laminar flow wings and highly efficient solar electric technology. These technologies are combined to provide utmost flight endurance, which will be accomplished through the use of new technology that includes electric propulsion systems for flight thrust via the efficient energy collection of sunlight.

Lightweight, thin film solar photovoltaics (TFPV) are placed on the wings' surface. The daylight excess energy is stored in batteries for operations at night—providing sufficient energy for flight operations around the clock. This day and night capability provides highly desirable and unprecedented mission flexibility, all at a unit and operating cost that is dramatically less than typical UAV systems of this size and weight category.

The glider wing area is sized against solar energy collection, aerodynamics, and thrust requirements analysis. Lightweight carbon composite structure, modern Li-ion battery, highly advanced TFPV, and electric motor technology and payload weights, are carefully balanced against the mission duration requirements.

George Bye with the Electra One technology demonstrator.

While sized similar to the Predator UAV, StratoAirNet is priced at a small fraction of that unit cost. However, StratoAirNet is projected to outperform in global range and persistence by a wide margin. With modern sensor packages, the modular payload bay is "sized right," relatively light compared to the older systems on competing UAVs.

Aerospace projects such as StratoAirNet are highly complex, requiring technology from a number of different sectors. Bye Aerospace gained experience with advanced technologies when the company recently collaborated with another Colorado company, Global Near Space Services (GNSS), on design and research for the development of a unique solar-electric powered airship named "Starlight."

The Starlight is a lighter-than-air UAV that uses solar electric energy stored in batteries to run propellers to support the drone at a specified location. A special combination of technologies and design enables the vehicle to maintain station for four months at a time. Starlight is intended to be a high-altitude, long-endurance UAV system with military applications for border patrol, visual and thermal reconnaissance and forward air control. Civilian applications include traffic control, pipeline and power line inspection, aerial law enforcement, forest fire detection and aerial photography.

Another technology experiencing rapid improvement are TFPVs themselves, which have seen an operational conversion efficiency increase rapidly. This high conversion efficiency of sunlight energy

Bye Aerospace's single seat technology demonstrator prototype lifts off at Centennial Airport near Denver. Photo courtesy of Deborah Smith/Centennial Airport.

to electric energy appears to allow for a meaningful supplement to some long-endurance flight aircraft. Ascent Solar Technologies, Inc. (Ascent), a developer of flexible copper indium gallium (di)selenide (CIGS) solar panels, has been named a development partner for Bye Aerospace's aircraft programs for the aerospace and defense markets.

Ascent's panels employ CIGS photovoltaic technology on flexible, plastic substrate—a technology that has the potential to transform the way solar power can be used in everyday life. The technology was founded decades ago to enable aerospace and high-altitude applications due to their lightweight, flexible characteristics and the ability for seamless integration with a number of substrates.

As a company, Ascent plays on its strength and thinks differently than traditional solar organizations. Their business model is not to compete with glass crystalline modules but to look for any other surface for power generation. As the panels integrate seamlessly with any number of substrates, the applications for the technology are limited only by one's imagination and access to the sun.

Panel features can vary by applications. For example, for more robust applications, the panel can be attached to a thicker backsheet and protected by a finish. The panels can be integrated into fabrics used in forward operating bases and as portable solar chargers for soldiers without weight burden.

In example, Ascent is testing multi-kW scale tent flies designed as charging stations that can be quickly deployed and folded after use with minimal weight impact to a soldier's backpack. These products have the capability of directly reducing the military's dependence on conventional, fossil-fuel based power systems, while simultaneously reducing the physical burden and security risks to soldiers. Additionally, Ascent has already demonstrated commercial applicability in the electronics, building and transportation sectors.

Advances such as Ascent's technology can also open a range of opportunities to address poverty reduction in underdeveloped areas of the world. The introduction of the cellphone introduced opportunity to these areas but users must walk for hours to access diesel generators to charge their cellphones. Deployment of flexible, solar charging stations certainly will provide an inexpensive and time-saving solution for the poorer areas of the world and their communications needs. These panels could further be applied to lanterns to replace those that are currently powered by kerosene.

As these examples illustrate, striving for innovative achievements in aerospace is not only possible, it is imperative. Many in the military industry are proclaiming that the U.S. has become complacent in regard to new technology innovation—I wholeheartedly agree.

Our would-be adversaries have access to many of our same resources, but often lack the funds or sophistication to take advantage of the situation. Key to the equation of achieving and maintaining technology superiority in aerospace is private sector funding, aided by incentives from government military programs to increase the speed and momentum of innovation.

By the same token, the U.S. must be willing to take on risk or innovation loss will be the result. All too often, innovative efforts are governed by schedule, risk and budget, but that approach is flawed. Some of the greatest aerospace programs in history achieved success because private industry made the initial investment, proved the capability and brought the technology to market.

With the combination of innovation, incentives and collaboration, the greatest achievements in aerospace are not behind us, but are positioned directly at our doorstop.

About the author

Mr. Bye is the Founder of Bye Aerospace, Inc., and the creative innovator behind the company with two decades of experience as an aerospace entrepreneur and executive. In early 2007, he founded Bye Aerospace, with a business plan to balance engineering services and internal research of advanced concepts. Among the designs, which use advanced aerodynamics, composite structures and alternative propulsion systems are two new solar-electric whybrid UAV concepts.

Previously, Mr. Bye launched and developed Aviation Technology Group, Inc., where he led the team designing the Javelin, a transonic two-seat advanced jet for military and civil utility. Mr. Bye holds the design patent for the Javelin jet, U.S. patent D500,730 S, January 11, 2005. The Javelin first flew in September 2005 with further tests in 2006 and 2007.

Following his service in the U.S. Air Force he was an instructor pilot subject matter expert in the analog avionics to digital avionics modernization program (AMP) for the Lockheed C-141 Starlifter in the mid-1990's. Mr. Bye holds a B.S. in Engineering from the University of Washington, and an Airline Transport Pilot rating with more than 4,000 flying hours. His varied flight experience includes the supersonic Northrop USAF T-38 where Mr. Bye flew as an instructor pilot in the Euro-NATO Joint Jet Pilot Training program at Sheppard AFB and the C-141B strategic cargo transport as a USAF and Aircraft Commander IP, including service in Desert Storm.

MORE LIVES WILL BE SAVED—THE FUTURE OF SATELLITE-BASED SEARCH AND RESCUE (SAR)

By Randel Maestre, Vice President, Global Strategic Marketing and Americas Sales, McMurdo Group

The year 2014 has, so far, seen Search and Rescue (SAR) receive global attention with several high-profile incidents in the air, on land and at sea. These include the Malaysia Airlines disappearance, the South Korea Ferry accident, a dramatic man-overboard emergency in the Clipper Around the World Yacht Race, four lost British sailors on the Cheeki Rafiki yacht and, more recently, six missing climbers on Washington's iconic Mt. Rainier. This list, however, represents a mere faction of the SAR incidents that occur daily around the world.

On average each year, 400,000 people drown, 24,000 fishermen die and more than 700 people lose their lives in airline crashes. In the U.S. alone, nearly 5,000 deaths annually are related to maritime or boating accidents. These industry statistics, coupled with 2014's high-profile incidents, illustrate the need for a more efficient and effective SAR solution—one that can locate distress beacon signals quicker, mobilize rescue authorities sooner and, ultimately save more lives.

Satellite-Based SAR Today

Search and rescue is a term often used to describe the "search" for people in distress or imminent danger via associated "rescue" by emergency response agencies. There are several categories of SAR, depending primarily on geography or terrain (e.g., mountain rescue, air-sea rescue over water), but the general concept is the same—emergency personnel are dispatched to locate, assist and rescue people in crisis situations.

A critical component in all SAR efforts is the international satellite system for search and rescue, COSPAS-SARSAT, which has helped teams rescue nearly 37,000 people since 1982. Used by military and civilian SAR organizations around the world, the system operates on a specialized frequency band (406MHz) to communicate with various distress beacons, transmitters and other location devices that are activated during an emergency.

Figure 1. The Cospas-Sarsat Ecosystem.

How does this SAR ecosystem work? As shown in *Figure 1* above, after an emergency or incident, a distress beacon is activated and the signal from the beacon is sent via orbiting satellites to satellite ground stations (or Local User Terminals—LUTs) then on to Mission Control Centers (MCCs) and, eventually, to Rescue Coordination Centers (RCCs) who manage the actual rescue on land or on sea.

COSPAS-SARSAT has established itself as the foremost global search and rescue system due to the wide adoption internationally (over 40 countries) of the technology, expansive satellite coverage (no mobile phone dead spots) as well as the system's proven alert detection and information distribution process (nearly six people saved per day, on average).

Despite these successes, there is always room for improvement, as with any technology. What can be done to reduce distress beacon detection times? What if emergency transmitters on commercial aircraft could be automatically activated based on rapid changes in altitude or pitch? What new hardware and software are on the horizon to further streamline the rescue process?

These questions will be answered in the following categories: Next-Generation Emergency Distress Beacons, Next-Generation Satellite-Based SAR (MEOSAR) and Next-Generation SAR Applications.

Next-Generation Emergency Distress Beacons

The distress beacon triggers the SAR process. Today's beacons vary in size and shape depending, on use case, but their purpose is universal—to help remove the search element from "search and rescue." They can pinpoint areas up to a 5km range 95 percent of the time within 10 minutes of their activation.

Tomorrow's distress beacons are being refined to significantly reduce time for a satellite to locate a beacon, and the will ultimately have an accuracy of within 30 meters 95 percent of the time within five minutes.

For aviation, future technology advancements are a quantum leap forward. Next-generation Emergency Locator Transmitters (ELTs) installed in aircraft will activate automatically when emergency indicators triggered by an aircraft's angle of descent, speed and other variables, are detected. Current ELTs are designed to activate upon impact with the ground and, as a result, are often damaged beyond use in the crash.

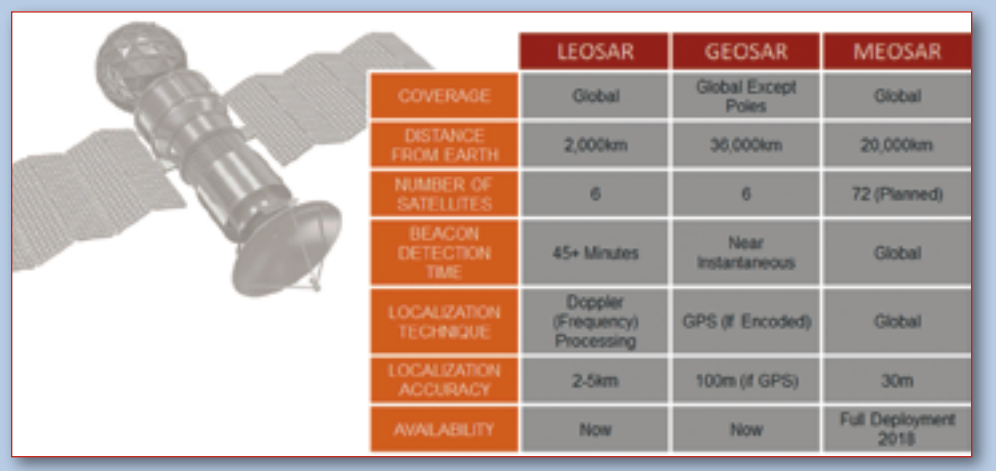
A unique feature built into next-generation beacons will be the ability to send a "return link signal" via the SAR satellite infrastructure. With this functionality, confirmation messages can be sent to the beacon acknowledging that the emergency signal was received, thereby providing an increased comfort level for distressed individuals. Beacons could be activated remotely in situations where human intervention is not available, or when vessels are stolen or lost. Or, beacons can be turned off remotely in instances of false alerts due to accidental beacon activation. This return link capability/functionality will require both next-generation emergency beacons and the next-generation satellite infrastructure, which are addressed in the next section.

Next-Generation SAR Satellite System

MEOSAR (Medium Earth Orbit Search and Rescue), the next-generation COSPAS-SARSAT satellite system, is expected to bring a number of improvements to the SAR process. While the SAR process flow will remain relatively the same, the performance of that flow will be greatly improved.

Scheduled for full deployment by 2018, MEOSAR will consist of 72 MEOSAR satellites, versus the 12 satellites in place today for COSPAS-SARSAT. This will increase global satellite coverage and provide near-instantaneous detection, identification and location of next-generation and existing 406MHz distress beacons. *Figure 2* identifies several of the MEOSAR advantages versus existing COSPAS-SARSAT satellite systems today.

MEOSAR requires that beacon distress information be relayed through three separate satellites to triangulate and accurately calculate a beacon's location (latitude, longitude, altitude). With the planned 72 MEOSAR satellites in orbit, capturing those three signals will be nearly instantaneous, compared to the current LEOSAR (Low Earth Orbit Search and Rescue) systems that can require from 46 minutes to 100 minutes due to the inherent gaps in satellite coverage.



	LEOSAR	GEOSAR	MEOSAR
COVERAGE	Global	Global Except Poles	Global
DISTANCE FROM EARTH	2,000km	36,000km	20,000km
NUMBER OF SATELLITES	6	6	72 (Planned)
BEACON DETECTION TIME	45+ Minutes	Near Instantaneous	Global
LOCALIZATION TECHNIQUE	Doppler (Frequency) Processing	GPS (if Encoded)	Global
LOCALIZATION ACCURACY	2-5km	100m (if GPS)	30m
AVAILABILITY	Now	Now	Full Deployment 2018

Figure 2. Satellite comparisons.

Most MEOSAR ground station systems (also known as MEOSAR Local User Terminals or MEOLUTs) consist of four to six antennas whose purpose is to capture at least three of these signal bursts to determine a beacon's location. Furthermore, with a multiple antenna system, if one antenna is being repaired, there will still be a sufficient number of remaining operational antennas to process incoming signals, increasing overall system availability.

A unique feature known as "MEOLUT networking" will also increase global, real-time coverage. For example, if a beacon is activated in the middle of the Atlantic Ocean, but a U.S.-based MEOLUT only has two antennas covering that area, how is the beacon location determined if the three triangulation data points are not identified? In this case, the data collected from the two U.S. MEOLUTs can be combined with data collected from a European MEOLUT also covering the area via a networking process to provide that third data point that is needed to calculate an accurate position.

Next-Generation SAR Applications

"Convergence" is a key word when it comes to next-generation SAR applications. The convergence of SAR products, technologies and processes into related applications such as fleet management, vessel traffic management and vehicle monitoring is already evident across a number of industries and is becoming a catalyst for joint integration and development partnerships.

In the commercial maritime industry, for example, the convergence of search and rescue into current Maritime Domain Awareness (MDA) applications is creating a new generation of e-Maritime solutions. Fleet management software that can identify emergencies based on 406MHz distress beacon technologies and alternative SAR options, such as Automatic Identification System (AIS), will allow workboat operators, commercial fishing fleets and inland waterway transportation companies to streamline operations as well as save lives.

Maritime operational courses and simulation systems are including a variety of COSPAS-SARSAT search and rescue procedures—emergency preparedness, risk detection, crisis response and emergency operations—as part of vessel operator's certification training, resulting in higher levels of navigational and safety proficiency.

In the wake of Malaysia Airlines Flight 370's disappearance earlier this year, the aviation industry is also expected to increase its focus on SAR-related applications. Later this year, the United Nation's International Civil Aviation Organization (ICAO) is expected to unveil a plan to create a global flight tracking system that will, in part, decrease search and rescue response times. Several air traffic management and air traffic control applications are also using variations of COSPAS-SARSAT software to track, identify and manage emergency situations.

A New Era of Search and Rescue

In the world of search and rescue, there is one primary mission: saving lives. Today's SAR systems are highly effective, as evidenced by the number of people saved by COSPAS-SARSAT. Technology improvement across the entire SAR ecosystem over the next few years, especially to the network of satellites orbiting Earth, will dramatically improve the safety of maritime personnel, aviators and recreationists around the globe.

As the awareness and understanding of search and rescue increases, a number of breakthrough applications, innovations and procedures will emerge that will save even more time, more costs and, most importantly, more lives.

Additional information is available at the McMurdo Group infosite:
http://www.mcmurdogroup.com/

About the author

Randel Maestre is Vice President, Global Strategic Marketing, of McMurdo Group. He previously was Vice President, Worldwide Industry, Field and Channel Marketing at Polycom, which included a two-year assignment in Singapore. Randel has held management positions in marketing, product management, sales and business development for Fortune 500 companies (AT&T/Lucent) and startups. He has lived in Asia, Europe (Netherlands) and Latin America (Mexico). Randel has a BS in Aerospace Engineering from the University of Southern California and an MBA in Marketing / Finance from Columbia University.

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