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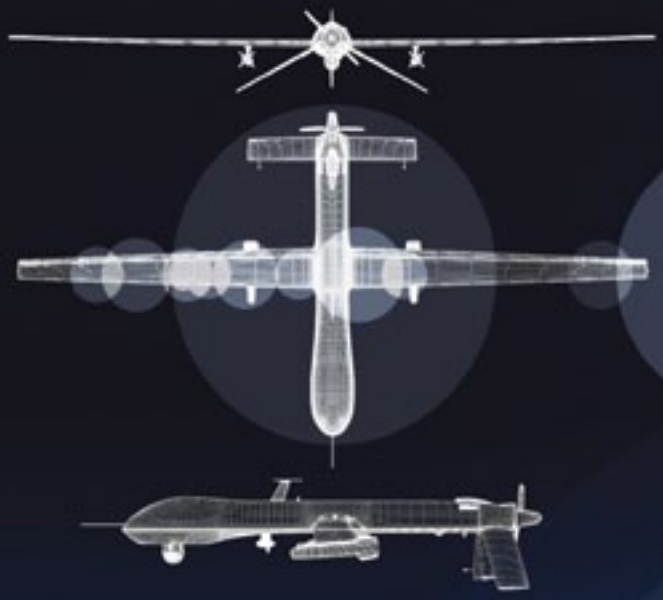
MilsatMagazine



UAVs + UAS

Naval Research Lab
SATCOM Lifelines
Military Bandwidth
SDR Standards

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When It Matters Most
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OS/COMET® is a critical element in providing ground-based command, telemetry, and decommutation capabilities in testing the Orion/MPCV vehicle for Lockheed Martin in multiple labs and test facilities. OS/COMET was chosen for its flexibility and adaptability to meet the stringent requirements for the Orion/MPCV vehicle.

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Right On Target

AeroVironment, Inc. (NASDAQ: AVAV) and Australia-based Sentient have signed an exclusive global license agreement that allows AeroVironment to distribute Sentient's automatic target detection software for full motion video for use with small unmanned aircraft systems (UAS).

AV's Unmanned Aircraft Systems have supported U.S. and allied Armed Forces with reconnaissance data to enable automated detection of targets.

Sentient's Kestrel Land MTI Tier I is specifically designed to enable automated detection of targets, in real time, from small UAS. Over the past 18 months Sentient and AeroVironment have optimized and integrated the software with AeroVironment's existing common Ground Control System (GCS), which serves the Puma™, Raven® and Wasp™ small UAS.

"The Kestrel software adds capability to our existing small UAS by automatically detecting moving objects on the video screen and presenting that information visually to the operator," said Tom Herring, AeroVironment senior vice president and general manager of Unmanned Aircraft Systems. "This software makes it much easier to detect and track multiple moving objects in the battle space, thus delivering improved situational awareness to the system operator and tactical commander."

Military forces frequently deploy AeroVironment's small UAS in dynamic and complex operating environments. Kestrel has the ability to give operators an immediate cue to potential threats. This capability enhances situational awareness on the ground, which can help save lives.

"Kestrel Land MTI is deployed in a variety of theaters all over the world," said Simon Olsen, sales and marketing manager at Sentient. "The automated cueing capability has proven to be a decisive edge in a number of operational missions. This extensive operational experience was a key prerequisite for this relationship to proceed."

The license agreement between AeroVironment and Sentient does not include Sentient's automated target detection software solutions Kestrel Land MTI Tier II, Kestrel Land MTI Tier III and Kestrel Maritime.

Strategic Alliance Combo Brings UAS + SATCOM Together

AAI Unmanned Aircraft Systems (UAS), an operating unit of Textron Systems, a Textron Inc. (NYSE: TXT) company, and ViaSat Inc. (Nasdaq:VSAT) now have a strategic alliance that will align AAI's advanced unmanned aircraft and command and control technologies with ViaSat integrated airborne and terrestrial satellite communications, as well as its Internet Protocol-based networking and security technology.

Under the agreement, the organizations intend to develop and mature beyond-line-of-sight satellite communications capabilities for current and next-generation AAI Unmanned Aircraft Systems aircraft. Along with fellow Textron Systems business Overwatch, AAI Unmanned Aircraft Systems and ViaSat collaborate on the Forward Airborne Secure Transmission and Communication, or FASTCOM™, system. FASTCOM is an end-to-end, mobile cellular network that accommodates Top Secret smartphone communications. Through this strategic alliance, the two companies can build on the FASTCOM system's maturity with additional third- and fourth-generation, or 3G and 4G, capability to further enhance battlefield communications.

"The performance and affordability of tactical UAS like our Shadow® system make them an invaluable battlefield asset with a growing mission spectrum," says Senior Vice President and General Manager Steven Reid of AAI Unmanned Aircraft Systems. "Our customers' unmanned assets need to be as flexible and capable as the troops who utilize them, and this new strategic alliance with ViaSat is one way that we're staying on the leading edge of system development and integration."

"This new phase of the AAI Unmanned Aircraft Systems relationship is completely in-sync with our intent to continue delivering industry-leading broadband performance over ultra-small-aperture airborne satellite communication systems," said Vice President and General Manager for ViaSat Global Mobile Broadband Paul Baca. "And our private satellite network services can deliver the dedicated bandwidth needed to distribute tactical UAS video throughout the battlespace."

FASTCOM, artistic rendition, courtesy of Overwatch, TEXTRON Systems.

A Total Fabrication

Aurora Flight Sciences has been awarded a contract by Boeing Defense, Space & Security to design and fabricate structural components for the revolutionary Boeing SolarEagle unmanned aircraft.

The Company will design and fabricate the ribs and skins for the 400 foot long wing and the solar collection panels. The work includes components for both a subscale test article and a flight demonstrator.

"Aurora will have to push the limits of materials and the imagination to create answers to the demanding requirements of this very large yet gossamer aircraft," said Tom Clancy, Aurora's Vice President and Chief Technology Officer. "We are delighted to have been chosen for such an important role. Boeing recognized the value that Aurora brings to the program through our combination of experience in rapid prototyping and our expertise in composite structures."

During testing, the SolarEagle demonstrator will fly at high altitudes above 60,000 feet for 30 days.

SolarEagle is being developed under the Defense Advanced Research Projects Agency (DARPA) Vulture program. During testing, the SolarEagle demonstrator will fly at high altitudes above 60,000 feet for 30 days, harvesting solar energy during the day that will be stored in fuel cells and used to provide power through the night.

Aircraft that can stay aloft for extended periods can function as pseudo-satellites for intelligence, surveillance, reconnaissance (ISR) and communication applications.

Aurora has more than 20 years of experience with gossamer aircraft. The company's background in human powered aircraft directly translates to the current lightly-loaded, low Reynolds number solar powered airplanes. Aurora recently converted one of its early human powered aircraft into a solar powered UAV.

Awarding + Rewarding

Avwatch Inc. has been awarded the U.S. General Services Administration Schedule 66 contract for scientific equipment and services.

The contract, a product of a detailed application process, signifies Avwatch's dedication to putting its innovative technology into the hands of national law enforcement, homeland security, and military responders in a cost effective way. Avwatch has already forged a rich portfolio of operational successes with the U.S. military, Department of Homeland Security, and other state and local responders.

Avwatch streams high-quality video and real-time data to operational commanders on the ground.

During the Mississippi River flooding in April and May 2011, Avwatch provided real-time, full-motion video of 150 miles of the river to the Federal Emergency Management Agency, the Mississippi Emergency Management Agency, the National Guard, and the Pentagon, delivering vital situational awareness to each. During Hurricane Irene in August 2011, Avwatch flew over affected areas from New York to New Hampshire. A team of federal, state, and local responders linked by Avwatch's signature network detected a person in distress aboard a sailboat. Coordination by Avwatch ensured the operator and sailboat were safely and quickly recovered. Following the Deepwater Horizon oil spill in 2010, response leaders tapped Avwatch to assist with recovery operations. Rapidly installing an extensive data network, and canvassing more than 10,000 square miles by air,

Avwatch streamed high-quality video and real-time data to operational commanders on the ground who remotely controlled the onboard imaging system while identifying oiled areas and prime booming locations.

Avwatch also flew before and after several tropical storms in the cleanup zone, allowing commanders to complete comprehensive pre and post-storm assessments. Further, Avwatch was first on scene during multiple search-and-rescue cases in the response area and delivered real-time video to responders.

Working with MIT Lincoln Labs in 2009, Avwatch provided breakthrough advances in battling forest fires by equipping a California Department of Forestry and Fire Protection aircraft with Avwatch technology. Using infrared to see heat concentrations and burn patterns through smoke plumes, the team provided aerial video to surface responders, which served as an indispensable tool for coordinating mission-critical airdrops and a valuable record for prosecution and training.

Looking ahead, Avwatch aims to further enhance the government's ability to respond in areas where the company has proven most effective, namely search and rescue, disaster reconnaissance, and homeland security missions.

"Historically in all of these, the speed and efficiency that tactical information is gathered, disseminated and processed ultimately determines the overall effectiveness of the response," said Avwatch president Chris Kluckhuhn. He said the GSA contract, something he has envisioned from the very beginning of Avwatch, makes it considerably easier for decision makers in government to take advantage of the company's technology and expertise.

BACN Bits

Northrop Grumman Corporation has been awarded $47.2 million by the U.S. Air Force for the acquisition of two additional Battlefield Airborne Communications Node (BACN) payloads to be integrated on existing Block 20 Global Hawk aircraft.

The U.S.A.F. currently operates the Bombardier Global Express E-11 platform fitted with BACN payloads, to provide an airborne communications and information gateway system in support of operations in Afghanistan. After the BACN payloads have been integrated on the Block 20 Global Hawks, the aircraft will be designated as USAF EQ-4B unmanned systems.

Deployed on the high altitude Global Hawk unmanned platform, BACN maintains continuous operational communications support. The persistent connectivity that BACN provides improves situational awareness and enables better coordination between forward-edge warfighters and commanders. BACN bridges and extends voice communications and battlespace awareness information from numerous sources using a suite of computers and radio systems.

The BACN payload carried by the aircraft bridges between different radio frequencies and "translates" among incompatible communications systems to enable information sharing and enhanced situational awareness. The system employs gateway manager algorithms and Internet protocols to support ground elements a consistent and reliable communications in all types of terrain, using different radio waveforms.

Block 20 Global Hawks will be designated as USAF EQ-4B unmanned systems. Concept illustration: Northrop Grumman.

After the BACN payloads have been integrated on the Block 20 Global Hawks, the aircraft will be designated as USAF EQ-4B unmanned systems, providing long endurance and high persistence gateway capabilities.

Northrop Grumman is the prime contractor for the development, fielding and maintenance of the BACN system and the RQ-4 Global Hawk aircraft. Northrop Grumman developed BACN under a $276 million Defense Microelectronics Activity contract as part of the Interim Gateway program, meeting urgent requirements operational need.

The company was awarded the first BACN contract in April 2005 by the Air Force Electronic Systems Center, Hanscom Air Force Base, Massachusetts. The Global Hawk program is managed by the Air Force Aerospace Systems Center, Wright-Patterson Air Force Base, Ohio.

Stabilized Imaging Payload for MicroUAVs

Aeryon Labs has debuted their Photo3S™—the industry's only integrated 3-axis stabilized high resolution camera for micro Unmanned Aerial Vehicles (UAVs).

Combined with the Aeryon Scout's automated control system, active 3-axis payload stabilization ensures that the Photo3S™ remains on-target to capture precise imagery in the most demanding conditions.

"Three-axis stabilization in the new Photo3S™ marks yet another industry-first for Aeryon Labs" said Dave Kroetsch, President of Aeryon Labs. "Designed as a software and payload platform, we continue to enhance the Aeryon Scout system with advanced capabilities previously only available to large manned and unmanned aircraft, and make these innovations available to our customers at a fraction of the cost."

The stable imagery and precise tracking of the Photo3S™ high resolution camera is achieved through independent adjustment of both the Scout's position and camera orientation through 3-axis of rotation (yaw, pitch, and roll). The Aeryon Scout's automated control system makes these adjustments dynamically, hundreds of times per second, enabling the operator to consistently capture the desired imagery.

Like the Aeryon Scout, the Photo3S™ is weather-sealed and ruggedized to operate reliably in any weather or environment with high-performance capabilities that are incredibly easy-to-use. Advanced imaging features include precise Click-to-Aim™ camera control, as well as the ability to easily adjust camera settings on-the-fly, automatically georeference images and video, and encrypt transmissions.

Using the Photo3S™ with the Scout's AutoGrid™ flight planning software allows fast collection of imagery over large geographic areas and automatically geotags images to facilitate seamless processing by industry standard tools into stitched image mosaics, map overlays, and 3D models.

"Our mission continues to be to deliver state-of-the-art aerial intelligence," says Ian McDonald, VP of Product Marketing. "Developed with end-user in mind and with the most capable environmental performance of any vehicle in its class, the Scout system and the new Photo3S™ are designed to get the job done where other small UAVs simply cannot operate."

Photo3S™ High Resolution Camera

Aeryon's full line of integrated all-digital, weather-sealed, mechanically stabilized imaging payloads are hot-swappable to allow fast switching for specialized applications. Aeryon also develops custom payloads for a wide range of commercial and military uses including communications, gas and chemical sensing, sound and signal detection, and more. For more information, please visit:

http://www.aeryon.com

SHOUT To Be Heard

Enhanced Mobile Satellite Services (EMSS) provides secure global satellite communication services under the Commercial Satellite Communications (COMSATCOM) Center.

EMSS offers a breadth of services to include voice, secure voice, Distributed Tactical Communications System (DTCS), messaging, and data to Department of Defense (DoD), other Federal departments, agencies, state and local governments, and approved foreign and allied Government users.

EMSS offers Short Burst Data (SBD) with automatic billing using the "usage based tiered" pricing structure. The pre-negotiated SBD service and Iridium SHOUT Nano device pricing are exceptionally competitive with the commercial sector and also offers two key advantages—users have the flexibility of tiered data usage, to include UNLIMITED data, and the added assurance of secure communications through the EMSS Gateway.

The SHOUT Nano is a portable, handheld two-way outdoor satellite messaging and GPS device for emergency/rescue, text-messaging applications, and location-based services. The SHOUT Nano's SBD service is enabled by the Iridium satellite constellation which offers global pole to pole coverage.

The Nano has a high resolution color LCD with menu options displayed as icons. The device is designed with ultra-low power consumption electronics drawing less than 35µA during sleep. With an internal 1.95 A-Hr rechargeable Lithium Ion battery, it can send a position report every hour for up to two months (about 1,200 reports) on one charge. The SHOUT Nano offers a variety of other features including:

- *Normal Tracking—programmed to automatically wake up and send a position report at a set interval ranging from continuous to once every seven days*
- *Emergency Alert—sends alerts using a 911 button and also allows messaging to communicate emergency specifics*
- *Free-Text Messaging—sends free-text via three different sets of on-screen keyboards*
- *Canned Text Messaging—sends canned (pre-defined) messages in short codes to save bandwidth instead of the entire message body*
- *Waypoint Tracking—sends and/or saves waypoints (that are interested landmarks) for later retrieval*

SHOUT—a handheld, global, two-way satellite messaging and personal tracking device.

- *Check-In—allows a quick check-in message to be sent using a single soft key*

EMSS devices and services can be purchased through the DISA Direct Order Entry (DDOE) website.

An International Audience

Israel has pioneered the field of unmanned aerial vehicles since the mid 1970s.

The country's aerospace industries have maintained their world leading position for four decades, developing a broad range of systems, platforms, mission payloads, subsystems and services centered around unmanned systems applications.

The International Conference on Unmanned Systems, taking place at the David Intercontinental Hotel in Tel Aviv, March 20-22, is promising to be a groundbreaking event in this field, endorsed by the countries' most prominent academic, research and development centers, and defense companies. Organized by AUVSI's Israel chapter the event will be an exceptional opportunity for reviewing, assessing and discussing the current state of unmanned systems in Israel, and provide a unique insight to the development and future directions of Israel's unmanned systems technologies development and operational use.

Among the prominent speakers presenting at the conference are senior officers from the Israel Ministry of Defense Department of defense research and Development (DDR&D), including Brigadier General Ofir Shoham, Head of DDR&D and Colonel (ret) Dubi Lavi, Director UAV-PEO in the Israel MOD DDR&D;

International guest speakers include Mr. Chuck Thorpe, Assistant Director for Advanced Manufacturing and Robotics, The White House Office of Science and Technology Policy, USA. Major Mark Whittel, 2IC 32 Regt RA, United Kingdom. Dr. Ron Diftler, Robonaut Project Manager, Robotics Systems Technology Branch – NASA, USA. Prof. Johann Borenstein, The University of Michigan, USA. The sessions will focus on the following topics:

- *Unmanned Ground Vehicles*
- *Unmanned Airborne Systems*
- *Unmanned Marine Surface Vehicles*
- *Autonomous Underwater Vehicles*
- *UAS Regulation and Certification*
- *Unmanned Vehicle Systems and UVS Sub-Systems*
- *Propulsion and Operational Missions*
- *UVS Civil Applications, Homeland Security*
- *Simulation and Training*
- *European R&D Project: PPLANE*
- *Unmanned Hovering Platforms, Operational Lessons Learned*
- *Unmanned Airborne Systems—Design Considerations*
- *Human Machine Interface.*

At the adjacent exhibition, 30 Israeli companies are expected to show, demonstrate and discuss Unmanned Vehicles and related technologies.

The organizers have also dedicated a day for a tour of some of Israel's leading UVS industries. Reserve your place at the conference now.

https://event.pwizard.com/auvsi2012/register.py

First Flight Experience

Marines witnessed the first flight of the service's newest small unmanned aircraft January 22nd at the Marine Corps Air Ground Combat Center in Twentynine Palms, California.

As part of the RQ-21A Small Tactical Unmanned Aircraft System (STUAS) Early Operational Capability (EOC), personnel from Marine Unmanned Aerial Vehicle Squadron (VMU) 2 and 3 and Insitu operators exercised the current configuration of Insitu's Integrator for the two-hour maiden flight.

"The lessons learned from this flight and all operations that will be conducted at Twentynine Palms are invaluable," said Lt. Col. John Allee, STUAS integrated product team co-lead at Pax River. "It will help our Marines fully understand how to operate the system when in theater."

Insitu delivered one EOC system, which is the current configuration of the company's Integrator, to Twentynine Palms early in January. The EOC contract option allows for up to 30 months of contractor-provided training and logistics services for the Integrator system. The team at Pax River received the second EOC system January 12th.

"This is a substantial achievement for the team" said Heather Bromley, STUAS IPT co-lead. "To go from contract award to an operable system in 16 months is a testament to the responsiveness of both the government and contractor personnel."

Small Tactical Unmanned Air System Executes Early Operational Capability. A CONUS-based deployment for EOC allows the Navy and Marine Corps to train operators, collect additional performance data and support development for Initial Operational Capability (IOC). The government-industry team will continue to develop the RQ-21A configuration for initial and full operational capability while the EOC system is deployed with VMU-3.

RQ-21A will have payload capacity to support multi missions in a single sortie. Its sensor package will include Electro-Optic, mid-wave infrared cameras with an infrared marker and laser rangefinder.

"We are very excited to deploy an asset that has a greater performance capability with a significantly larger payload, mass, volume and power than intelligence, surveillance and reconnaissance services available in theater today," said Marine

RQ-21A

Col. Jim Rector, Navy and Marine Corps Small Tactical UAS program manager.

RQ-21A will eventually replace the Navy and Marine ISR services contract in which current ISR missions are conducted in Iraq, Afghanistan and shipboard. The system will provide battlefield commanders with an organic capability 24/7, for real-time, actionable intelligence, surveillance and reconnaissance.

"The appetite for ISR has been insatiable," Rector said. "There is an increased demand for ISR capability in theater; and with fewer boots on the ground, we need this asset more than ever."

Scouting With Skylark

A combat team of the Israel Defense Forces (IDF) opens the bag and takes out the first plane. Then a second, and then a third.

Another soldier procures the ground antenna and the computer display from his bag, which will control the unmanned aerial vehicle (UAV) and display reconnaissance on the hostile village. Four soldiers have just deployed a miniature intelligence aircraft in enemy territory.

Ten minutes after reaching their position, the squad already has a UAV hovering silently between the green hills of Ramot Menashe, simulating Lebanese territory, under January's heavy grey skies. The soldiers are at the end of their training, and already stand far beyond the imaginary border. In the nearby village of Elyakim, other soldiers pretend to be the Hezbollah operatives they are keeping an eye on via their UAV. This is the final exercise before becoming an operational squad.

"Our goal and "Skylark's" goal, is to provide tactical information and photographs of the field to infantry commanders. Our tools fill the intelligence gap between reconnaissance efforts of larger planes. Skylark can fly beneath clouds, even in this weather," explains the company commander of the course, Capt. Aviv, against the howling wind. "We can see what no one else can see. Skylark can see over the next hill for the fighters."

When the soldiers finish their course, their squad will join different units for various tasks. "One day it's the 13th battalion, the next it's tanks, then paratroopers. Our team is a brother in arms to every battalion, going in with them and fighting with them without distinction. You have to constantly adapt yourself to new tasks, each with a different character. You have to accompany a force and make sure their path is clear, guarantee that there is no one around the corner, track the movement of terrorists who can plant explosives in the road and get a photo ID on them. The tactical intelligence we have delivered has thwarted a lot of terrorist activity, from stone-throwing to attacks.

After the first couple minutes of testing the wind in the air, the squad begins navigating the complex coded maps and leading the UAV towards its next goal, the village. Each soldier knows how to take on every role in the team—the person who launches could be manning the computer next time, it's all up to the officer. The battalion commander responsible for the squad follows the entire training exercise with a high-tech watch that delivers the images from the plane, giving him all the information he needs. He knows what's over the next ridge and what lies two or three miles down the road.

Despite the heavy winds, the UAV performs reconnaissance for more than half an hour. When the team decides to land the craft, it moves in wide circles and flies over the hill to the soldiers' location. After a few minutes you can hear the buzz of the UAV in the air, and shortly afterwards the craft lands in the wet grass with the assistance of an airbag. Shortly after, they will be able to insert a new battery in the plane and start a whole new mission (during the course, the soldiers are trained to carry half of their body weight). However, now the soldiers store all the equipment within minutes and begin moving again.

A video of the Skylark in action can be viewed at the IDF Youtube channel at:

http://goo.gl/f2HKS

A soldier deploys a miniature intelligence aircraft.

Marketing Moves

World Surveillance Group Inc., a developer of lighter-than-air unmanned aerial vehicles ("UAVs") and related technologies, has closed on a Securities Purchase Agreement with a California-based institutional investor (the "Investor") for an aggregate of $5.5 million (the "Financing").

The $500,000 initial tranche of the Financing, which was funded at the closing, was issued in connection with a Convertible Debenture due in January 2015 and an Equity Investment Agreement (the "EIA").

Pursuant to the EIA, the Investor agreed to invest an additional $5.0 million in monthly tranches beginning on the effectiveness of a registration statement the Company will file with the Securities and Exchange Commission, but not prior to 91 days following the closing. The Investor also has the right to purchase an additional $5.0 million of our common stock at an exercise price of $0.21 per share for a period of three years, for a total potential investment of $10.5 million.

The Company plans on using the proceeds of the Financing to expand the operations of both WSGI and its subsidiary, Global Telesat Corp. ("GTC"), as well as to commercialize and further market our Argus One line of UAVs. The Company expects to deploy resources to continue the Government sponsored flight testing and demonstration of our Argus One UAV in Nevada where the aircraft currently resides, inflated in a hangar.

A portion of the proceeds from the Financing will also pursue GTC contracts for the construction of satellite ground stations, as well as to expand GTC's sales and

WSV's Argues One LTA UAV

marketing efforts to both potential Government and commercial customers.

The Company also expects to advance its partnership with Oklahoma State University—University Multispectral Laboratories, LLC ("UML"), to support additional technical development of our airships as well as flight testing and demonstrations at UML's Oklahoma Training Center-Unmanned Systems ("OTC-US") within the U.S. Army's Fort Sill restricted airspace. WSGI and UML recently completed certain required flight safety procedures and are in the process of finalizing a series of flight exercises in Oklahoma following the Argus One UAV flight exercises in Nevada. For further information on the Financing, current events and technical updates, visit:

http://www.wsgi.com

NRL's Spacecraft Research Challenges

It takes a team to get to space, and John Schaub knows that.

As superintendent of the Spacecraft Engineering Department in the Naval Research Laboratory's Naval Center for Space Technology, Schaub leads a highly skilled team of engineers, scientists, and technicians in the execution of cutting-edge spacecraft research and development programs relevant to the needs of the Department of the Navy and Department of Defense.

John Schaub and two colleagues working on the LACE spacecraft in NRL John Schaub (lower left) working on the LACE spacecraft in NRL's thermal vacuum test facility in 1989. (Photo: U.S. Naval Research Laboratory)

Schaub has more than 26 years of federal service, all of it at NRL. During these years, Schaub has contributed to the successful launch of 19 satellites or space instruments, with several more under development. He has seen the changes in the ways that systems are built.

"When I started in the mid 80s, the nation was producing very large and very capable space systems. Unfortunately these systems were also massive and therefore very costly to launch."

Schaub describes how NRL has made a concerted effort to drive down the size and cost of these systems.

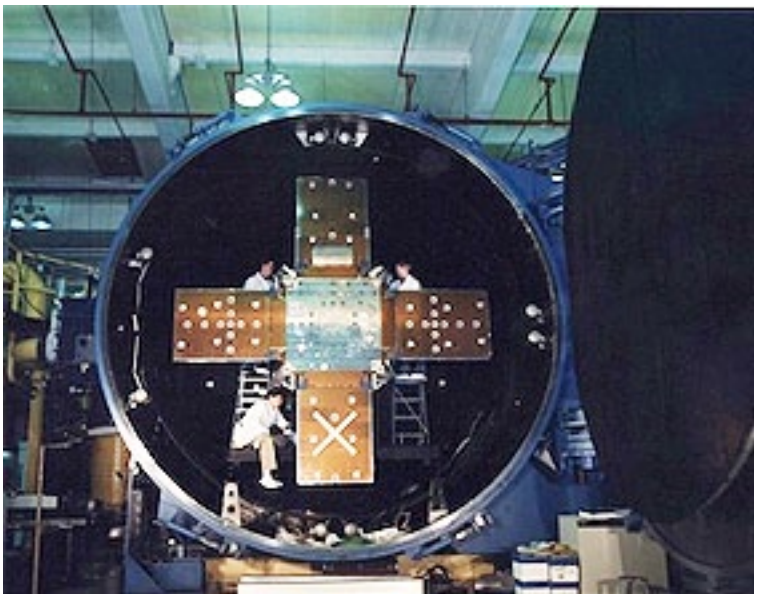
"By applying strong systems engineering principles, exploiting the commercial miniaturization of electronics, and entrusting the quality of the product that we are producing to each individual team member, we are producing today very capable systems in much smaller packages, much faster and less costly."

Before being appointed to his current position, Schaub served as associate superintendent and then acting superintendent of the Spacecraft Engineering Department from November 1998 to December 2006. On a detail to the National Reconnaissance Office, he directed the Space Technology Experiment Satellite Program Office from May 1994 to November 1998. There, he led a multi-million dollar, "first of a kind" advanced technology demonstration space mission to accomplish challenging program objectives of national significance within severe cost and schedule constraints.

Schaub likes to make the case for NRL being a good place to work.

"NRL's retention statistics make the case that when folks come to NRL, they stay... My theory is it is because of the work. NRL offers exciting opportunities to materially contribute towards solving 'real' problems. The personal satisfaction that comes from knowing that the work that you do 'makes a difference' is underrated. I promise recruits that they will be challenged every day they come to work."

*Editor's Note: This article was originally published in the September 2011 Limited Edition issue of **SPECTRA**, the magazine of the Navy's Corporate Laboratory.*



John Schaub (lower left) working on the LACE spacecraft in NRL's thermal vacuum test facility. Photo courtesy of U.S. Naval Research Laboratory.

Second Avenger Iteration

General Atomics Aeronautical Systems, Inc. marked the first flight of a larger, heavier Avenger jet powered 'Predator C' unmanned aerial vehicle.

"The first flight of our second Avenger aircraft is a significant achievement as it refines the first prototype design to an operational capability," said Frank Pace, president, Aircraft Systems Group, GA-ASI. "Avenger provides the right capabilities for the right cost at the right time and is operationally ready today. This aircraft offers unique advantages in terms of performance, cost, timescale, and adaptability that are unmatched by any other UAS in its class."

The first flight of the second aircraft in the Avenger fleet occurred on January 12 at the company's Gray Butte Flight Operations Facility in Palmdale, California. Tail 2 met all performance objectives in its first flight. The aircraft features a longer fuselage than the first Avenger aircraft—increased by four feet to accommodate larger payloads and fuel. The aircraft is equipped with avionics based upon the battle-proven Predator B/MQ-9 Reaper.

Avenger is designed to perform high-speed, long-endurance, multi-mission Intelligence, Surveillance, and Reconnaissance (ISR) and precision-strike missions over land or sea. Powered by a single Pratt & Whitney Canada PW545 jet, the aircraft has a 13.41 m' (44-foot) long fuselage, a 20.11 m' (66-foot) wingspan, is capable of flying at airspeed of over 740 km/h (400 KTAS), and has an endur-

The second prototype General Atomics Predator C Avenger.

ance of over 16 hours. The aircraft can support a wide array of sensors and weapons loads and has been designed to carry an all-weather GA-ASI Lynx Multi-mode Radar, an Electro-optical/ Infrared (EO/ IR) sensor.

Avenger can carry up to 3,500 lb. internally and its wing hard points are capable of carrying weapons ranging from the 500 lb. class to the 2,000 lb. class. For example, with the 2,000 lb. Joint Direct Attack Munition (JDAM) the Avenger will be able to deliver an optimal balance of long loiter ISR and precision-strike capability.

Production of a third and fourth UAS in the Avenger series is also underway, with Tail 3 expected to fly by late summer. One of these aircraft will be delivered to the U.S. Air Force for flight testing and evaluation by the U.S. Air Force. Tail 4 is expected to fly by early next year.

Counterfeit Ops

Reports of counterfeit parts have soared dramatically in the last two years, presenting huge challenges for electronics manufacturing and especially the military and aerospace industry at a time when the U.S. government is tightening regulations covering fake components, according to information and analysis provider IHS.

From original equipment manufacturers (OEMs) to contract manufacturers and from component suppliers to component buyers, supply chain participants in 2011 reported 1,363 separate verified counterfeit-part incidents worldwide, a fourfold increase from 324 in 2009, according to IHS.

This marked the first time the reported number of incidents in a single year exceeded 1,000, a total that could encompass millions of purchased parts. This was according to IHS data, which includes information from the industry's two recognized reporting entities—ERAI Inc., a privately held global information services organization and exclusive partner to IHS; and the Government-Industry Data Exchange Program (GIDEP).

The surge over the past two years is the latest development in a rapidly escalating global supply chain trend toward increased counterfeiting and piracy of global products, with counterfeit part reports having risen by nearly a factor of 700 over the last decade. The figure attached presents total counterfeit-part reports compiled by IHS showing suspect counterfeit or high-risk electronics for the period of 2001 to 2011.

The bulk of these incidents were reported by U.S.-based military and aerospace electronics firms. However, the parts themselves may impact any worldwide company using the same electronics within their products. With each report possibly encompassing thousands of parts and millions of dollars in revenue, the use of potential counterfeits represents a major liability with grave financial downside for these companies. Even more ominously, this phenomenon could pose a

serious threat to human life or national security.

"The counterfeit issue is serious, it's growing and it's a major problem for electronics makers—especially military and aerospace companies," said Rory King, director, supply chain product marketing at IHS. "The problem has grown increasingly hard to ignore, as reports of counterfeits have risen exponentially and most companies lack the awareness and capability to effectively detect and mitigate the growing problem.

The reporting done by the industry can help other organizations pinpoint risky parts or suppliers. And now that United States legislation will hold defense suppliers accountable for counterfeit issues, access to these incident data becomes a critical decision-support capability for business systems."

Counterfeit parts often are cheap substitutes or salvaged waste components that fail to meet strict military and aerospace specifications, leading to potential failures. Even more concerning, these failures put lives at stake. Furthermore, there are fears that some counterfeit devices like integrated circuits have the potential to act as malicious Trojan horses that could be disabled remotely, compromising defense capability at critical times.

The expense to resolve a single counterfeit incident can be massive. For example, the government reported how the U.S. Missile Defense Agency learned that mission computers for Terminal High Altitude Area Defense (THAAD) missiles contained suspect counterfeit devices that could have led to an entire system failure. The cost of that fix was nearly $2.7 million.

To help combat the problem, President Obama on December 31, 2011, signed the fiscal year 2012 U.S. National Defense Authorization Act (NDAA), which adds regulations for counterfeit part detection and avoidance. Members at all tiers of the defense supply chain must put counterfeit risk mitigation procedures in place and certain steps must be completed within 270 days of the president's signature. New defense regulations include:

- *Contractors are now responsible for detecting and avoiding the use or inclusion of counterfeit electronic parts or suspect counterfeit parts*
- *Contractors are also responsible for any rework or corrective action that may be required to remedy the use or inclusion of such parts*
- *Defense contracts will no longer allow the cost of counterfeit electronic parts and suspect counterfeit electronic parts or the cost associated with rework or corrective action to resolve the use or inclusion of such parts*
- *Qualification procedures and processes must be established to use trusted suppliers and procure electronics from authorized suppliers*

The counterfeit problems are more widespread than a single incident report might suggest. According to IHS, a typical bill of materials (BOM) or parts list for a military/defense program can have anywhere from a few hundred to over tens of thousands of purchased parts, of which between 0.5 to 5 percent typically match incidents of counterfeit parts reported to ERAI.

The same is true for medical equipment—products known for sharing high-reliability electronics needs with the military. When just one counterfeit poses major risk, the fact that a typical company has hundreds or thousands of matches to known problematic parts in circulation should be a major cause for concern.

To achieve compliance with the new NDAA requirements and avoid the significant cost they may now incur for counterfeit incidents, companies in the military/aerospace electronics industry must obtain systems and data to analyze, assess, and act on counterfeit and suspect counterfeit electronic parts. They also need to know qualified and authorized government suppliers in order to use trusted suppliers and avoid those that are risky.

With thousands of parts and suppliers scattered across programs and throughout the supply chain, this will not be easy. By making use of available tools and ongoing reports for counterfeit, substandard and high-risk parts, electronics makers can cut costs, avoid risk, and expedite NDAA compliance.

IHS provides content, software and expert analysis about worldwide electronics for component selection, sourcing, and logistics as well as integrated obsolescence management, BOM management, environmental compliance, and counterfeit risk mitigation. IHS offers 100 percent of the verified counterfeit-incident report information, of which more than 90 percent is availed only though the exclusive IHS and ERAI partnership. To learn more, visit:

http://www.ihs.com/info/sc/a/combating-counterfeits/index.aspx

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Commander's Cyberspace Considerations

The Air Force Space Command commander highlighted space and cyberspace superiority, acquisition strategies and industry partnerships, and the need for science, technology, engineering, and mathematics education during a speech February 7th in Colorado Springs, Colorado.

Gen. William Shelton kicked off the Armed Forces Communications and Electronics Association Cyberspace 2012 Symposium, addressing government and industry professionals in the cyber domain.

Shelton spoke to updates on AFSPC's cyber mission and shared some of the challenges associated with a growing cyberspace domain.

"Some of these challenges include establishing some much needed lanes in the road, adjusting the acquisitions process to reflect the nature of cyber products, and expediting a fundamental culture shift across the Air Force from a cyberspace support mindset to one of cyberspace operations," the AFSPC commander said.

"Our military's reliance on cyberspace is hard to fully comprehend because our reliance on networked capabilities is so ubiquitous it's taken for granted," the general said, comparing the ease of networked capabilities to plugging in a utility. "It shouldn't be hard, and in this age of information-enabled warfare, that utility mindset is the way it should be for our warfighters."

Still, he acknowledged with the significant revision to the Air Force's basic cyber doctrine, the cyber business is in its formative stages with rules still being written and skill sets yet defined.

"We've moved on from the term computer network operations to a much more active description of what our service is tasked to provide: cyberspace superiority," Shelton said. "Cyberspace superiority describes our mission to gain advantage in, from and through cyberspace at the times and places of our choosing, even when faced with opposition. We have defined three sub-disciplines of cyberspace superiority: cyberspace force application, cyberspace defense and cyberspace support." Operating within the cyber domain calls for a unique type of thinking with regard to definitions of offensive and defensive cyberspace capabilities, the general said.

"Our new Air Force doctrine document thoroughly discusses cyberspace operations, and it goes into great detail on how the basic principles of war such as mass, maneuver, surprise and others apply in cyberspace," he said. "But the document does not fully define exactly what is offense, what is defense, or things like 'show of force' and 'effects-based operations.'"

Shelton discussed his goal of seamless integration from terrestrial networks to airborne networks to space-based networks.

"If we're going to be successful with cross-domain solutions, it's clear to me our networks must move data without regard to which physical layer is being used," he said.

The general also acknowledged budgetary constraints and highlighted cyberspace priorities in light of fiscal responsibilities.

"We'll focus first on passive defense, then defensive counter cyberspace; cyberspace ISR and situational awareness; persistent network operations; data confidentiality and integrity systems; and the cyberspace air and space operations center," Shelton said. "We round out our priorities with offensive counter cyberspace, contingency extension and influence operations."

Shelton also emphasized cyberspace acquisition and sustainment should produce agile programs of record while addressing the challenges associated with keeping pace with a domain that changes rapidly.

"The Joint Space Operations Center Mission System, or JMS, program will have a huge impact on just about everything we do in space," the general said.

Acting as the hub, JMS will revolutionize space situational awareness capabilities, taking inputs from a huge variety of radar and optical, ground- and space-based, space weather, and many other types of sensors, Shelton said.

"JMS is a great example of how an industrial-age acquisition system just isn't agile enough for an information age program," the general said. "The system is too slow, too stodgy, and the requirements it places on program developers are too cumbersome."

Streamlined acquisition requires everyone to streamline their expectations and process, he said, and is especially important to cyber acquisition process. "In cyber, state of the art hardware can become antiquated before the ink is dry on the check that paid for it—and software is even worse," the general said. Cyber systems change on a timescale of days or months versus the timescales of an aircraft that change over years, Shelton said.

"Success will require agreement and commitment by all organizations up front to make streamlined acquisition a priority," the general said.

"History has shown that industry advances in information technology develop much more quickly than (the Department of Defense) can purchase and apply them," he said, emphasizing the need for industry's ideas to move forward since they are not bound by the government acquisition process.

The general recognized the underlying support for industrial advances is through education. Technical education includes science, technology, engineering and mathematics and is often referred to as STEM. Shelton said the lack of

Gen. William Shelton

graduates in America within these skill sets could constitute a national security issue in the broadest sense. He emphasized the need for an exciting STEM curriculum and financial incentives to keep students interested in STEM-based subjects throughout high school and college.

Shelton also called for partnership between industry, non-profit educational institutions, and educators in school districts, colleges and universities to encourage STEM education and careers.

"Hands-on participation in real science and engineering projects would go a long way toward exciting these students enough to pursue STEM education and a career in a STEM-related field," the general said.

"We'll lean heavily on our partners in the cyber industry to continue to push the envelope in cyberspace innovation and help us overcome the challenges ahead as we work toward our goal of resilient, assured cyberspace operations," Shelton said.

Article by
Capt. Tamara Fischer-Carter
Air Force Space Command

Army Aviation Faces Challenges

Probably by this summer, the Army will be floating a new idea past the troops for intelligence, surveillance and reconnaissance (ISR).

Not a program of record, but something the Army expects to test in Afghanistan this summer, the Long Endurance Multi-Intelligence Vehicle. It's a hybrid air vehicle—like a blimp—that can carry multiple ISR payloads for more than 21 days at altitudes greater than 22,000 feet.

While discussing efforts to resource and transform Army aviation during the Association of the United States Army Aviation Symposium and Exposition just outside Washington, D.C., January 12th, Lt. Gen. Robert P. Lennox, deputy chief of staff, Army G-8, touched on the future of vertical take-off and landing unmanned aerial systems. The general said Army aviation has a "good path" for vertical UAS. "We are using overseas contingency operations dollars and we are hustling systems to theater and we hope to learn from that."

The LEMV, developed by Northrop Grumman, "has got some real promise," the general said. "We will see the value of the persistent stare that that gives us."

Other VTOL capabilities the Army is looking at include the Boeing A160 Hummingbird. "It's wonderful not being tied to a long runway," Lennox said. And the platform's long endurance and "pretty good stare capability when teamed with some of the latest sensors ... I think it can give us some powerful capabilities."

Where such pieces of equipment can go in the Army, or if the Army can even afford them, remains to be seen, he said. "We think it'll help in Afghan significantly."

Lt. Gen. William N. Phillips, with the Army Acquisition Corps and the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology, said the Army must consider vertical UAS "through an affordability lens. What does this provide to the Army, what capability could it provide and then again how much does it cost?"

Lennox said the Kiowa Warrior fleet is now about 35 years old, on average. The rest of the helicopters in Army aviation are about 15-20 years old, and have been "used at incredible rates over the last 10 years," he said.

The general said Congress and industry have helped reset the fleet. "But we haven't fixed the age of the fleet, and the one that stands out like a sore thumb is the Kiowa Warrior; we have to figure out something to do with that."

Two options for that aircraft include continuation of the Cockpit And Sensor Upgrade Program along with the Service Life Extension Program. "We can do that now," he said and "relatively cheaply." That option, he said, comes to between $2.9 and $4.1 billion. Another option—developing a replacement—might run as much as $12 billion. "My challenge for the Army is how do you afford that?" Lennox said.

Challenges for Army aviation, Lennox said, also include modernizing an Army fleet that continues to be used at historical rates and will likely continue to be used that way.

It will be a challenge to fix existing shortages, Lennox said, like the Kiowa Warrior. One solution might be to develop an Armed Aerial Scout to replace the Kiowa Warrior, he said.

Other challenges included: multi-year contracts, modernization of unmanned aerial systems, incrementally improving aircraft, and developing the right aviation force structure.

Right now, said Col. Patrick Tierney, director of Army Aviation, the Army's aviation portfolio is in "good health." About seven percent of the Army force is aviation—though it is an expensive part. There are currently 12 active-component combat aviation brigades, with a 13th coming. There are also eight reserve-component CABs. The Army has about 3,850 rotary aircraft, about 350 fixed-wing aircraft and more than 5,000 vehicles total of all sizes among its unmanned aerial systems.

Phillips said the Army has experienced "exponential growth in UAVs," and the growth, he said, has been successful. "The ground brigade commanders, battalion commanders, company commanders—have learned how to use UAVs in the most extraordinary ways, to extend their ability to achieve a situational awareness on the battlefield."

The Army's fiscal year 2012 investment portfolio includes $2 billion for utility helicopters, including variants of the UH-60 Black Hawk; about $700 million for UAS; over $1 billion for attack helicopters and about $1.5 billion for the CH-47 Chinook. The Army expects to buy

The Long Endurance Multi-Intelligence Vehicle is a hybrid air vehicle—like a blimp—that can carry multiple ISR payloads for more than 21 days at altitudes greater than 22,000 feet.

about 68 UH-60 Black Hawk variants in the next year, 47 CH-47 Chinooks, 19 Block III Apaches, and 39 of the light utility helicopters.

There's "considerable investment in FY12, and it's going to pay off for us," Lennox said.

Border Control Via UAV

Thales and Aerovisión have given a real flight demonstration of the UAV Fulmar (Unmanned Aerial Vehicle) for the European Agency Frontex, the organization in charge of coordinating the border control operations of the European Union member states.

The UAV Fulmar was the only fully Spanish model presented to the European agency for border control purposes. It is fitted with surveillance systems that supply real-time images and video and other types of information for the efficient control of maritime areas.

Fulmar is a wholly Spanish project that is a global solution that uses the Maritime Surveillance Systems of Thales Group. These systems supply images and video in real time and integrate the information in a security system, as is the case with border control. Such systems facilitate surveillance and control of maritime and border traffic and can provide inestimable support to rescue operations. The UAV Fulmar is a small-size model (3.1 metres) weighing only 19 kilos that can fly at a height of 3,000 metres and achieve 150 kilometres per hour, with an eight-hour flight range that would allow it to fly up to 800 kilometres without having to refuel.

The Fulmar UAV in flight

The demonstration for border authorities organized by Frontex was held at the Aktio Air Base in the Greek locality of Preveza.

For three days, several international UAV manufacturers performed test flights patrolling the west coast of Greece, with Fulmar being the only Spanish product to demonstrate its capacities in a market dominated by unmanned aerial vehicles from the United States and Israel.

The demonstration confirmed the ease of installation and flying of the UAV Fulmar, as it does not require a runway for takeoff and landing, given that it is launched from a catapult and is recovered by means of an impact-absorbing net.

Both elements are simple to install in a short time and in different places. This facilitates the assembly and handling of the system and differentiates it from other models on the market.

In the demonstration for border authorities organized by Frontex, the UAV Fulmar flew for two hours, detecting the information sent in from the different points established for the flight and sending images and video in real time for viewing by the attendants at the ground base.

The Fulmar displayed its capacity to integrate with maritime surveillance systems such as radars, a crucial aspect required by this type of unmanned aerial surveillance system.

At this event, Thales and Aerovisión demonstrated that the Fulmar is a competitive solution that can be adapted to different needs and can integrate with other systems to provide a global solution. Fulmar is currently operative in Malaysia, where it performs border surveillance tasks in the Strait of Malacca.

Raven Aerostar Is The Star In The Night Sky

Illegal activity on the U.S. border is old news, but the newest news is how the bad guys are being caught.

Raven Aerostar was part of a three-member team deployed by the Department of Homeland Security's (DHS) Customs and Border Protection component to help detect, identify, and track and individuals suspected of illegal activity along the U.S. border. The event, which was funded by the DHS Science and Technology Directorate, was formulated to allow the CBP to evaluate a new surveillance system for use on the border.

Raven Aerostar helps to secure the U.S. Border in Nogales, Arizona

Raven Aerostar provided a tethered aerostat system that is part of its Flexible Area Surveillance Technology (FAST), a joint persistent situational awareness product with partner L-3 Communications. FAST systems rely on Raven Aerostar's tethered aerostat to carry the L-3 Wescam sensor as part of its payload.

This device operates similar to a camera, and when integrated with the aerostat system, provides commercial, off-the-shelf surveillance capability in any number of applications, including military and homeland security missions.

During the demonstration, a third partner, Logos Technologies, supplied its new Kestrel sensor to operate in conjunction with the L-3 sensor. The Kestrel sensor is capable of scanning a wide area at once, significantly improving the likelihood of detecting small targets within the search area.

"Tethered aerostats are the most cost-effective and adaptable persistent surveillance platform on the market," said Lon Stroschein, vice president and general manager at Raven Aerostar. "Our aerostats and sensors have many thousands of hours of persistent flight time throughout Afghanistan providing military intelligence in order to defend our troops from IEDs and other insurgent activity around our forward bases.

That mission has proven modern aerostats to be one of the most reliable and cost-efficient platforms in the world for persistent surveillance." Stroschein concluded, "The team couldn't be happier with the results that U.S. Border Agents are demonstrating by adapting this proven technology to our borders."

For the Nogales demonstration, Border Patrol spokesman Lloyd Easterling explained, "We will be testing this new surveillance system and evaluating the capacity it will offer in the border environment." The success of the test run will determine whether DHS and CPB decide to procure systems for use along the border in the future.

Early reviews of the system's performance at Nogales have been exceedingly positive—especially at night—as the system sensors, operated by Border Patrol Agents, successfully detected numerous individuals suspected of illegal activity and led to their apprehension.

Sat3Play's Stimulating Success

Newtec has successfully tested their new, high speed Ka-band technology for SES Broadband (previously called ASTRA2Connect), Europe's most successful satellite broadband service.

Newtec has shipped well over 100,000 Ku-band Sat3Play® terminals for SES Broadband and is now providing the next generation Ka-band terminals for SES Broadband evolution, featuring download speeds above 10 Mbps. The test was completed with next generation Ka-band Sat3Play terminals and related hub infrastructure.

The new technology was tested with the ASTRA 1L Ka-band capacity at 19.2 degrees East.

"We have jointly tested and validated the Sat3Play Ka-band platform from Newtec with the objective of proving operational readiness for a rollout of SES Broadband Ka-band services later this year. The upgrade of existing end-user terminals and the next generation Ka-band terminals are part of SES strategy to bring its successful broadband service to the next level. The test was very successful and we are pleased with the performance of the equipment. We look forward to the launch of our Ka-band services," said Patrick Biewer, Managing Director, SES Broadband Services.

During testing, Newtec installed a Sat3Play hub at SES Broadband Services' premises in Luxembourg, provided several Ka-band terminals working on Astra-1L Ka-band frequencies, and also provided the ability to remotely operate the Hub. Serge Van Herck, CEO of Newtec, said, "The testing has been a clear success. We have now completed the tests and look forward to the operational start of the SES Broadband Ka-band services later this year." SES Broadband currently offers download speeds up to 10 Mbps and delivers broadband Internet and Voice Over IP (VOIP) services to private households and small businesses. SES will further increase the performance of its service by using additional multiple spot beam Ka-band capacity that will become available onboard its ASTRA 2F, 2E and 2G spacecraft, with the first spacecraft, ASTRA 2F, scheduled for launch later in 2012. At SATELLITE 2012, Newtec is presenting this new High Speed Ku/Ka-band Sat3Play terminal, including a new modem and a new Ka-band interactive LNB unit.

The terminal features higher broadband forward and return speeds, the lowest power consumption available on the market and an easy installation tool based on Newtec's Point&Play® technology. Newtec company information link.

Cyber Alert

Kratos Defense & Security Solutions, Inc. has announced that its RT Logic subsidiary released CyberC4-Alert, the first Security Information Event Manager (SIEM) designed specifically for satellite networks and operations.

CyberC4-Alert provides network administrators and information security officers with real-time situational awareness and incident response for cyber security situational awareness and mission assurance.

The continued integration of IP-enabled equipment throughout satellite and ground control environments is introducing more attack points and vulnerabilities to mission operations and sensitive information. CyberC4-Alert constantly monitors for cyber security threats by gathering security event data from across the satellite network to provide situational awareness. A correlation engine with user-defined rules and policies prioritizes events by their severity, alerting users of system threats, performance issues, and compliance violations through a flexible drill-down dashboard.

This all-in-one DIACAP

(Department of Defense Information Assurance Certification and Accreditation Process) compliant application is designed for use on military, government and commercial SATCOM environments. Currently more than 80 percent of military satellite communications engage commercial satellite infrastructure, making DIACAP compliance a critical necessity

CyberC4-Alert is composed of three software modules including Dashboard, Sensor, and Logger, which together collect, analyze and report on security event data for immediate internal and external threat management, DIACAP compliance and forensics. Sensor acts as the "eye" of the network by detecting intrusions, anomalies, vulnerabilities, and unauthorized activity. Events are sent to the Dashboard screen display for user action and resolution, and to the Logger, where they are digitally signed and stored to ensure chain-of-custody.

"CyberC4-Alert is a force multiplier for network and security personnel who otherwise face the near impossible task of manually sifting through what may be thousands of log files generated per second to find out if something is threatening the network," said Jerry Meleski, Vice President of RT Logic. CyberC4-Alert automates DIACAP compliance reporting, where otherwise such event violations may not be discovered until long after they've occurred, if at all.

CyberC4-Alert comes complete with plug-ins for RT Logic products and other SATCOM mission unique equipment, eliminating the need for costly software development.

CyberC4-Alert is the first product to be released in RT Logic's CyberC4 line of cyber security and mission assurance solutions.

SATCOM FOR UAV & MANNED AIRCRAFT

Unmanned aerial vehicles and manned aircraft are increasingly being used as vehicles to capture intelligence data for defense, state and civil applications. The aerial vehicles are equipped with technology for both video and data collection that are communicated to a command centre for further processing. When outside the reach of direct data relays due to distance or environment (e.g. mountainous regions) satellite communications will be used for beyond-line-of-sight (BLoS) communication.

Key in the satellite link for BLoS is to get as much data and video as possible through the available bandwidth. Only through the highest possible efficiency can increasing data and traffic demands be attained whilst still taking OPEX costs into consideration. During operations the satellite link needs to be available at all times to assure mission critical communications and not endanger ground operations.

SHAPING THE FUTURE OF SATELLITE COMMUNICATIONS

Defense, Civil and State Applications

The unmanned and manned aerial vehicles are deployed for a wide range of operations within government applications and are key enablers for achieving full situational awareness. The more data that can be collected the better the assessment of any given situation. This leads to the most appropriate actions being taken. Applications for the manned and unmanned systems are:

- Intelligence, Surveillance and Reconnaissance (ISR)
- Border Control (smuggling, illegal immigration…)
- Maritime Surveillance (ship tracking, anti-piracy…)
- Emergency Response Support
- Disaster Relief
- Search and Rescue
- Environmental Monitoring (forest fire, oil spillage)
- Weather Monitoring (ash cloud)
- Infrastructure Monitoring (pipelines, power grids, oil rigs)
- Event Monitoring
- Convoy Protection

The average data and video relay for BLoS will grow to 40-100 Mbps and beyond in a couple of years.

How it Works

FlexACM® technology for UAV and manned aircraft ensures more efficient beyond-line-of-sight communications. At the same time optimal availability can be achieved in any fading condition (inclined orbit, weather, dust, interference) to keep mission critical communications running at all times.

Data and video are relayed over the satellite link between the command centre and the aerial vehicle in a point-to-point or star (Point-to-MultiPoint) configuration. Newtec satellite modems, hubs or modulation boards are installed in the command centre, as well as in the aerial vehicles, and run the FlexACM technology.

FlexACM combines the DVB-S2 standard with a set of technologies in order to double the throughput in the same bandwidth for both video and data. The command centre receives even more data and video info from the aerial vehicle than before to get a better assessment of the situation.

Best-of-Trade COTS Equipment

Newtec has a track record of installations in both unmanned and manned aerial vehicles and can reflect on an installed base of thousands of units in both video broadcasting and IP data communications over satellite. These are for both civil and government applications. Over the years Newtec has built an outstanding reputation for its quality and reliability.

The Newtec modulation units (modems) and boards are based on DVB-S2, the adopted standard for communication over satellite for both video and data allowing full interoperability.

Easy Integration

Newtec modem units and (de)modulation boards have successfully been integrated in UAV and piloted planes providing solutions over satellites worldwide.

Newtec modulators, modems and demodulators fit perfectly into rack space at the command centre or in manned aeroplanes. Both video and data can be transmitted through one modem in the same satellite carrier in the most efficient way.

Newtec Modulation and Demodulation boards can be integrated in aerial systems and terminals where payload and form factor are critical. The boards have the smallest form factor in the COTS market. Their light weight and low power consumption extends the aerial vehicle reach significantly.

Figure 1. Aerial picture over Fukushima after nuclear disaster

Figure 2. Aerial picture over Haiti after earthquake

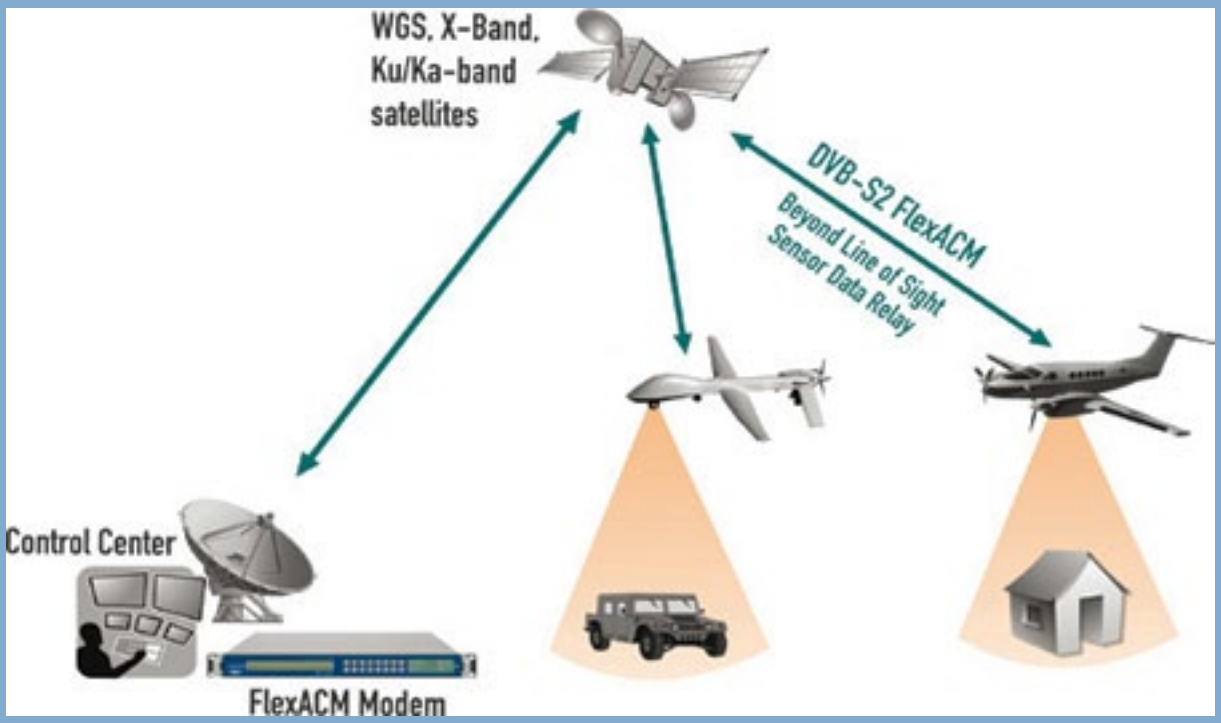


Figure 3. Newtec's FlexACM for efficient data and video relay over satellite.

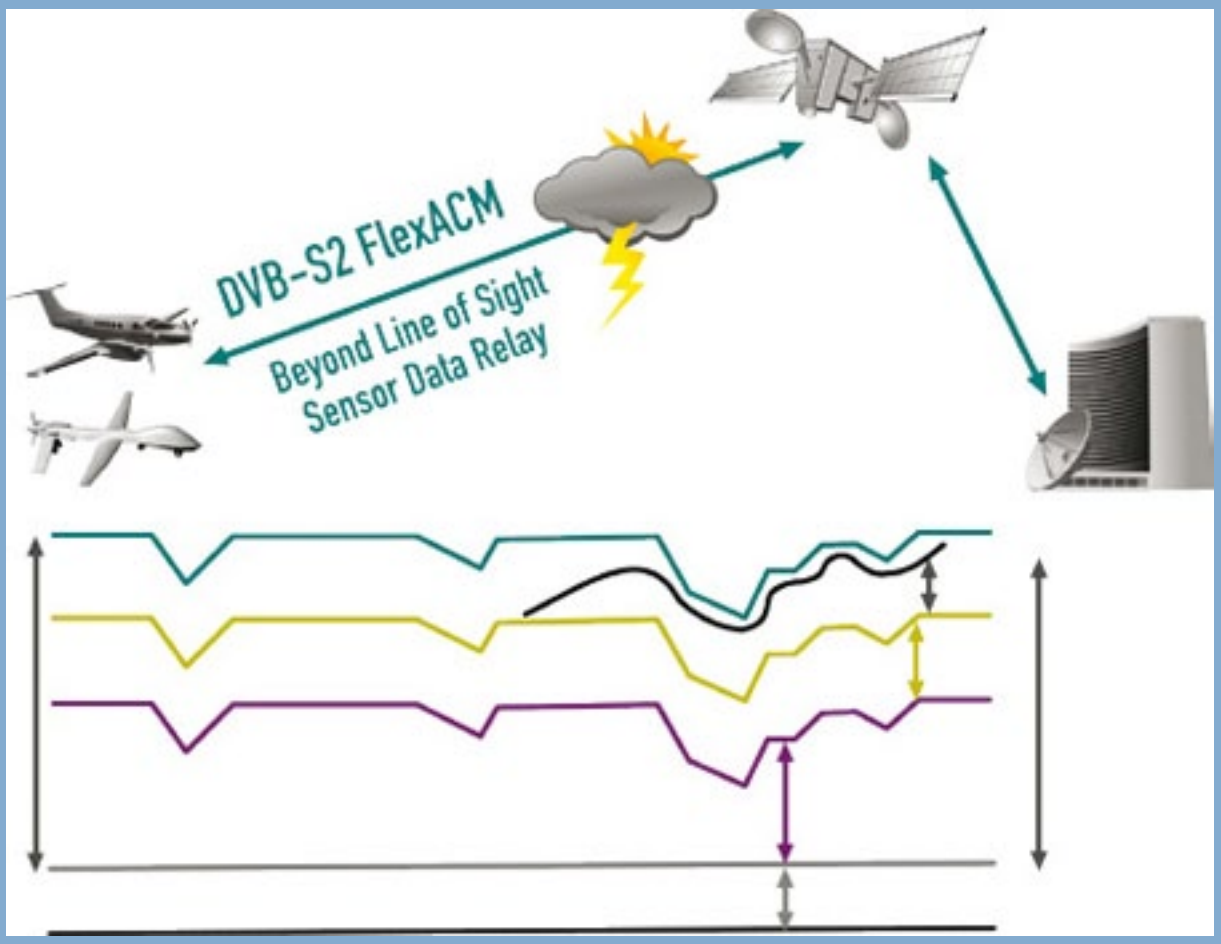


Figure 4. Double the data and video throughput without acquiring extra satellite bandwidth.

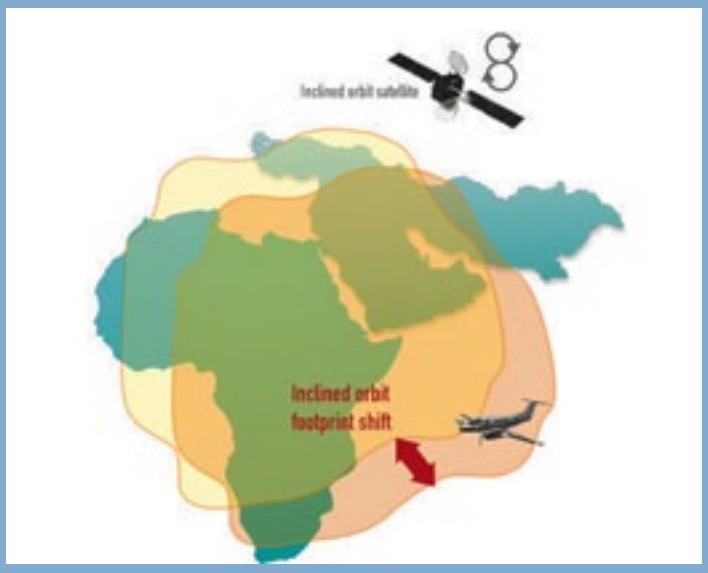
Double Throughput in Same Bandwidth

Experts in the operation of UAV and piloted planes indicate a growing demand in data and video rates over satellite due to new technologies (3D, HD, Gorgon stare, etc.) and the growing number of missions. The increase in rates is matched by a lack of satellite capacity in some areas of operation.

In order to overcome these constraints Newtec deploys FlexACM technology in its equipment. FlexACM uses the full capability of DVB-S2 and combines it with different technologies to get as much data through the same satellite bandwidth as possible.

FlexACM will auto-adaptively set modulation parameters to the optimal point and overcomes distortion, noise and variation in the satellite link. Newtec gets as close to the zero margin limit as possible allowing the full use of the satelite link.

With FlexACM video and data rates can be doubled in the same bandwidth without the need to acquire extra satellite capacity.



FlexACM® gets best possible throughput out of satellites suffering from fading (X-, Ku- and Ka-band) but also out of Inclined Orbit Satellites.

Optimal Availability

During missions in-flight unmanned and manned aircraft regularly encounter fading conditions which disturbs the transmission of video and data over satellite. Fading conditions can be caused by many different circumstances: the choice of satellite (inclined orbit, rain fade in Ku-, Ka- and X-band), interference (between two adjacent satellites) or blocking of antenna (wing, tail, mountain, tracking loss).

Thanks to the auto-adaptive technology incorporated in Newtec's FlexACM, fading conditions will no longer interrupt the transmission nor will such result in the loss of video or data. In fading conditions, FlexACM will switch to more robust modulation and provide optimal availability.

As soon as the fading conditions are over, FlexACM technology automatically switches back to maximum efficiency. During the entire operation, it is possible to sustain *Committed Information Rates* (**CIR**).

Data and Video Relay Optimization

Optimizing the data and video link between the aircraft and the ground station is a continuous process that needs to take changing conditions into consideration at all time.

Newtec was the first in the market to introduce ***Cross-Layer-Optimization***™ technology. This technology is available as software, ***TelliTec*** (which can smoothly be integrated into existing infrastructures) or as part of the Newtec equipment portfolio.

Through Cross-Layer-Optimization, the satellite modulation equipment is in continuous interaction with Acceleration, Compression, Bandwidth Management and IP Shaping Technology. As soon as a satellite link condition changes the link will be auto-optimized following Quality-of-Service and Priority Settings without the loss of data or link.

Cross-Layer-Optimization is available for both *Beyond-Line-of-Sight* (over satellite) and *Line-of-Sight* (direct) Data Relays.

For further in depth information visit the Newtec website:
www.newtec.eu

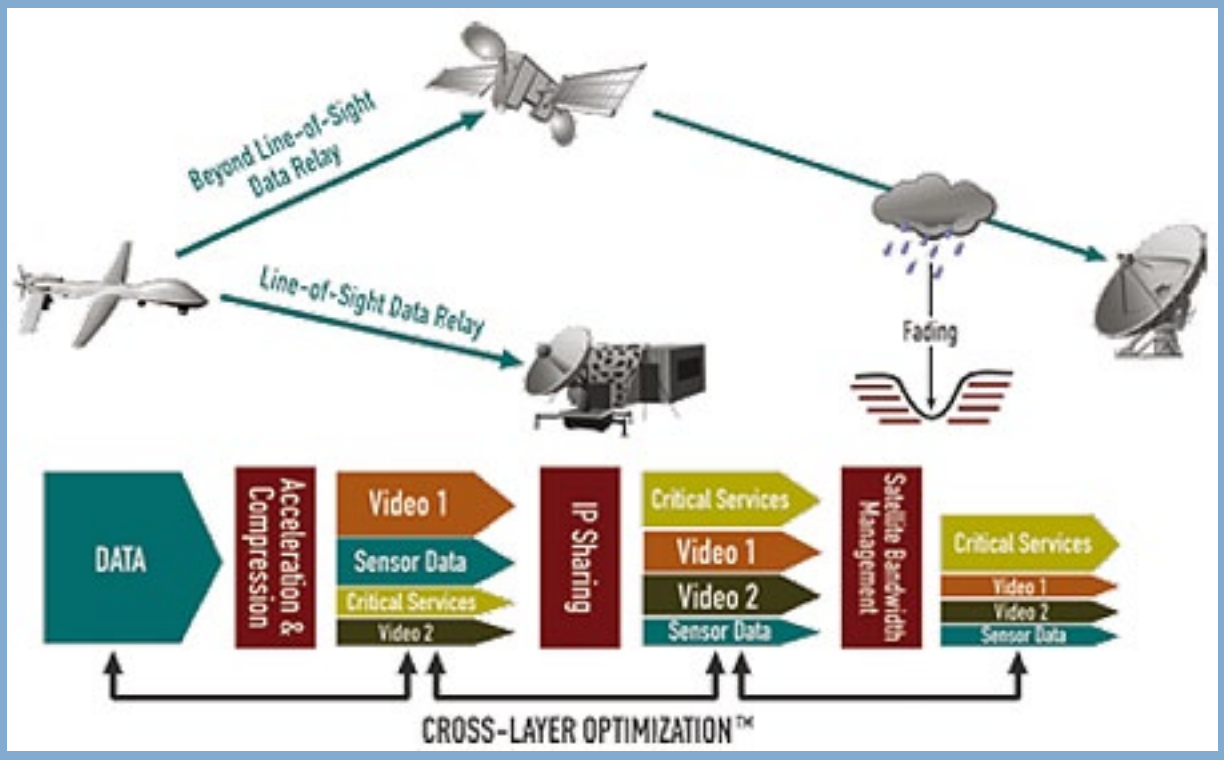


Figure 5. Cross-Layer-Optimization™ auto-optimizes the data link by continuous interaction between satellite equipment, bandwidth management, shaping and acceleration technologies.

WHAT CAN FLEXACM® DO FOR YOU?

Whether you're active in IP Trunking, Government or Defence applications, in today's data transmission business, you may encounter many different challenges.

- ***OPEX reductions***
- ***Ways to do more business within the same bandwidth***
- ***Fixed rate or variable rate SLA requirement***
- ***Migration from Ku- to Ka-band***
- ***Get the highest efficiency out of Inclined Orbit Satellites***
- ***Serving areas suffering from rain fade***

FlexACM® is the unique and market-proven end-to-end solution combining a range of technologies to optimize IP Trunking and IP Backbone satellite links in the most efficient way.

FlexACM can be used in point-to-point and point-to-multipoint systems, in one way (with terrestrial return channel) as well as in two-way configurations (with the return channel also over satellite).

With numerous customers around the world having implemented FlexACM, Newtec understands the business value it is bringing to its users.

"Newtec's FlexACM solution offers higher quality, lower operational costs and significant bandwidth gains" — Chris Young, CTO at Gateway

How Does FlexACM Work?

Compare FlexACM to a jigsaw puzzle. All pieces of technologies fit nicely into a total picture. The pieces of the FlexACM puzzle are advanced technologies such as DVB-S2 ACM, Cross-Layer Optimization™, the patent pending NoDE (Noise and Distortion Estimator) and ThiMM (Thin Margin Manager).

All of the pieces individually contribute to optimizing the satellite IP link. But once put together these pieces bring the satellite link to full efficiency. End-to-End.

FlexACM Advantages:

- ***Double Throughput***
- ***Optimal Availability***
- ***Cuts Down OPEX Costs***
- ***Fit for Inclined Orbit Satellite Operations***
- ***End-to-End Efficiency***
- ***Proven Return-on-Investment***
- ***Flexible Business Models***
- ***Best-of-Trade SATCOM Equipment with Large Install Base***

Inclined Orbit Satellites, An Opportunity To Drive Down OPEX Costs

Using inclined orbit satellites not only provides a good alternative in terms of cutting bandwidth costs by half; they also deliver bandwidth over regions where satellite capacity is scarce. The switch towards inclined orbit operation has repercussions on the availability of the services as the satellite footprint shifts in a predictable and continuous pattern. Therefore, it is more essential than ever to implement technology optimizing both throughput and availability.

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AERYON SCOUT HELPS GUIDE RUSSIAN TANKER RENDA INTO NOME ALASKA

Image courtesy of United States Coast Guard

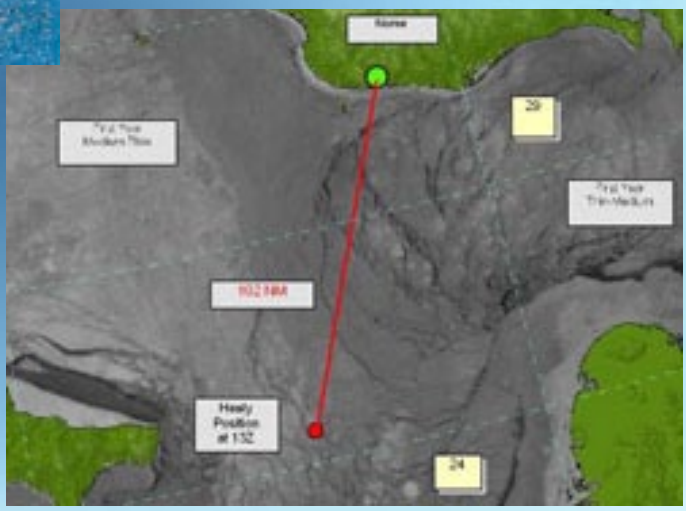


Image courtesy of NOAA National Ice Center

Operating under an Emergency Certificate of Authorization (COA) from the Federal Aviation Association, University of Alaska Fairbanks Geophysical Institute researchers are using the Scout to prepare for the arrival of Russian tanker, Renda, carrying vital fuel supplies to the remote community of Nome Alaska.

As the community of Nome Alaska anxiously awaits critical fuel supplies, the Aeryon Scout is being used by researchers at the University of Alaska Fairbanks to assess safety and environmental impact in and around Nome's harbor ahead of the arrival of the U.S. Coast Guard icebreaker Healy, and the fuel tanker Renda. Researchers are using aerial images and video from the Scout to determine daily ice conditions including the formation of pressure ridges, potentially dangerous obstacles formed when two ice surfaces push together. These images are being used by the research team on the ice, and are being sent to the ships as they advance towards Nome.

Aeryon Scout at the Nome causeway January 10, 2012. Image courtesy of U.S. Coast Guard.

The nature of the mission, remote location, and harsh environmental conditions called for use of an Unmanned Aerial Vehicle (UAV) rather than manned aircraft. The fuel delivery mission is occurring as the region is experiencing extreme winter weather and many local communities have already received more snowfall than is typical for the entire winter. The Alaska coast has been slammed with a series of storms with high winds and temperatures below -20F. Use of the Scout removes the human element and allows researchers to perform their important task from a safe distance. Greg Walker, manager at the Geophysical Institute's Poker Flat Research Range and his team are using two Aeryon Scouts on loan from BP Alaska, who also recently demonstrated use of the Scout for oil spill response in Alaska in July 2011. The University of Alaska Fairbanks responded to an urgent request from the Alaska Department of Environmental Conservation whose representatives had attended the oil spill demonstration and requested the Scout for use in the Nome operation.

"The Aeryon Scout is designed for exactly this type of role and environment —deploying quickly to provide an aerial perspective in any location and in any weather," said Dave Kroetsch, President of Aeryon Labs. "The fact is the Scout operates reliably in wind and weather conditions when many other small UAVs simply cannot fly."

Currently the U.S. Coast Guard icebreaker Healy and the Russian fuel tanker Renda are continuing their journey to Nome. However, when the Renda arrives it will have to enter the harbor to unload fuel without any assistance, as it is too shallow for the Healy. The Aeryon Scout is expected to stay on-station relaying images to coordinators on the ground and on the Renda.

The Scout is currently operating in Nome under an emergency Unmanned Aircraft System (UAS) Certificate of Authorization (COA) granted to the University of Alaska Fairbanks by the Federal Aviation Administration (FAA)—one of only a handful of emergency COAs issued for civilian use. An emergency COA grants clearance for immediate use of UAS in conditions of distress or urgency when there is or has the extreme possibility of loss of life, safe manned flight is not possible, and whereby the UAS is already operating under an existing COA. The FAA is expected to publish updated UAS regulations imminently, broadening use of UAS over U.S. skies under its UAS initiative.

Weighing under 3 lbs., the Aeryon Scout micro-UAV is designed to be flown by anyone with only a few minutes of training, through simple point-and-click map-based navigation and automated flight safety features. From a small case or backpack, the Scout can be assembled in seconds without tools and operates in extreme weather and environments due to its sturdy construction, weather sealing, and unmatched flight performance.

Additional photos are available in our media gallery and the U.S. Coast Guard continues to provide updates and photos from the Healy on their Renda/Nome Fuel Delivery site.

About Aeryon Labs, Inc.

Aeryon Labs provides robotic solutions to real-world problems through the design and manufacture of best-in-class small unmanned aerial vehicles (UAVs) and related systems. Recently proven in several military trials, including the 2011 U.S. DoD Empire Challenge, the Scout allows police, military and civil users to easily collect real-time aerial intelligence, with a system small enough to fit in a backpack or car trunk. With expertise in robotics, control systems, and digital imaging, Aeryon Labs develops state-of-the-art products while remaining focused on end-user ease of use. For more information, visit: ***http://www.aeryon.com***

TOWARD SDR STANDARDIZATION

by Carlo Zammeriello, EDA Software Defined Radio Principal Officer, and Andrea Lorelli, ETSI TC RRS Technical Officer

Software Defined Radio (SDR) is a well-established concept in the military domain where the radio is no longer the physical manufacturing of a single waveform but becomes a computer host onto which different waveforms can be loaded. The military have been studying SDR for a long time and has adopted the Software Communication Architecture (SCA) as the "de-facto" standard upon which different solutions can be developed.

SCA is published by the Joint Program Executive Office (JPEO, under the umbrella of the US Department of Defence - DoD) of the Joint Tactical Radio System (JTRS). This architecture has been developed to assist in the development of SDR communication systems and captures the benefits of most recent technology advances to greatly enhance the interoperability of communication systems and reduce development and deployment costs. Together with the SCA architecture (v 2.2.2 now evolving to the so-called "SCA Next"), the JPEO has also published a number of APIs (Application Programming Interfaces), to allow software components to communicate with each other, but some have a restricted access (basically security and crypto APIs).

Two Programs, Same Topic

ESSOR (European Secure Software Radio Program) is a program realized as a joint effort between six nations: Finland, France, Italy, Poland, Spain and Sweden and managed by OCCAR (Organization for Joint Armament Cooperation). ESSOR is based on the (public) SCA architecture (SCA 2.2.2 and JTRS 1.0.3 APIs) and aims at developing an architecture of Software Defined Radio (SDR) for military purposes and a military High Data Rate Waveform (HDR WF) compliant with such an architecture.

SVFuA is the German national program aiming at developing an architecture of SDR to be used by the Bundeswehr, the German Federal Armed Forces. Also, in this case the starting point is the public SCA architecture (SCA 2.2.2 and JTRS 1.0.3 APIs). With respect to the ESSOR program, Germany doesn't currently have any national military High Data Rate Waveform (HDR WF) initiatives, but rely on another program, COALWNW (Coalition Wideband Networking Waveform), to satisfy their operational requirements.

The COALWNW objective is to realize a wideband, networking High Data Rate Waveform (similar to the one under development in ESSOR) to pass secure voice, video, and data among Coalition Partners. Partners of this program are: the United States, the United Kingdom, France, Italy, Germany, Australia, Sweden, Finland and Spain.

The coexistence of a U.S. program (JTRS) and two European programs (ESSOR and SVFuA) for the SCA-based SDR architecture plus one transatlantic program for an HDR waveform translates into two risks that need to be managed: duplication of effort; and the loss of interoperability, both at the European level and transatlantic level.

EDA + SDR

Software Defined Radio is a key issue in the European Defence Agency's agenda as it is seen as a means to maximize interoperability amongst coalition forces. The approach favored by EDA is to push for an "international SDR standard". In November 2009, with the help of the Finnish armed forces, the EDA organized a conference in Helsinki to address this topic.

The conference brought together international key stakeholders and speakers from **EDA**, **ESSOR**, **U.S. JPEO**, **NATO**, the **European Telecommunications Standards Institute** (**ETSI**) and the *Wireless Innovations Forum* (**WINNF**).

The main achievements of the conference was the initial consensus on the principle to approach standardization with what was then known as the "three basket model" and that ETSI, together with the Wireless Innovation Forum, were possible candidates for the custodianship of some international SDR standards. All this, then, depended on final agreements with the involved governmental stakeholders. The model sees SDR architecture standardization falling into three different baskets.

The first basket is related to market driven technologies that are available to everyone, where the Governmental Stakeholder Group, *i.e.*, contributing nations, would control the content and release of defence related product specifications in order to guarantee compatibility with non-public API specifications as well as backward compatibility.

The second basket includes more sensitive issues, such as security and crypto APIs, where the governments, as trusted partners, would remain in charge of custodianship.

There may also be need for a third basket which deals specifically with Nation sensitive information.

Since the first time the three basket model was presented, many discussions were started on how to make it happen. One point of common agreement is that it would be beneficial for the military SDR community to transfer control of the standardization activities to a *Standard Developing Organization* (**SDO**), at least for that part of the standard not containing sensitive information (and so not restricted). Some advantages of such an approach would be the following:

- Avoiding duplication of work and divergences, which could hamper interoperability
- The reduction of costs
- The fostering of harmonization and help with speeding up the convergence process

During the workshop on SDR and *Cognitive Radio* (**CR**) standardization that took place on the November 17 and 18, 2011, in **Ispra** (organized by the **Joint Research Centre**—JRC—and co-hosted by the *Directorate General Enterprise and Industry*—DG ENTR—and EDA), ETSI, in cooperation with the EDA and the JRC, presented a model aiming at reaching a European standard in the short/medium term and a converged standard allowing transatlantic interoperability in the mid/long term (*i.e.*, between Europe and the U.S.), which is of paramount importance for joint operations. It is important to remark that this mode, as of this writing,

1. Has not been endorsed yet by EU stakeholders, but all are showing great interest
2. Is perfectly aligned with the objectives of the EU government standardization strategies (mainly ESSOR);

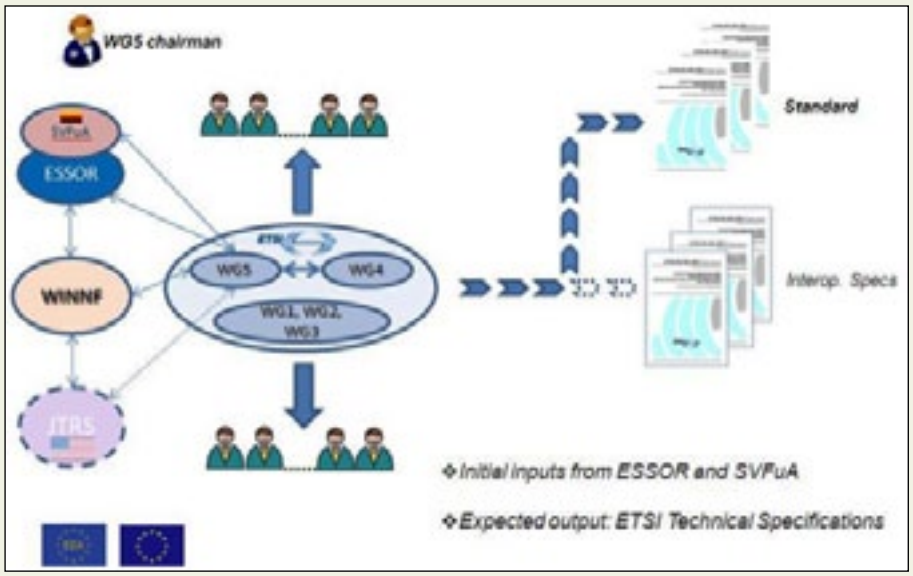


Figure 1. SCA-based SDR European Standard

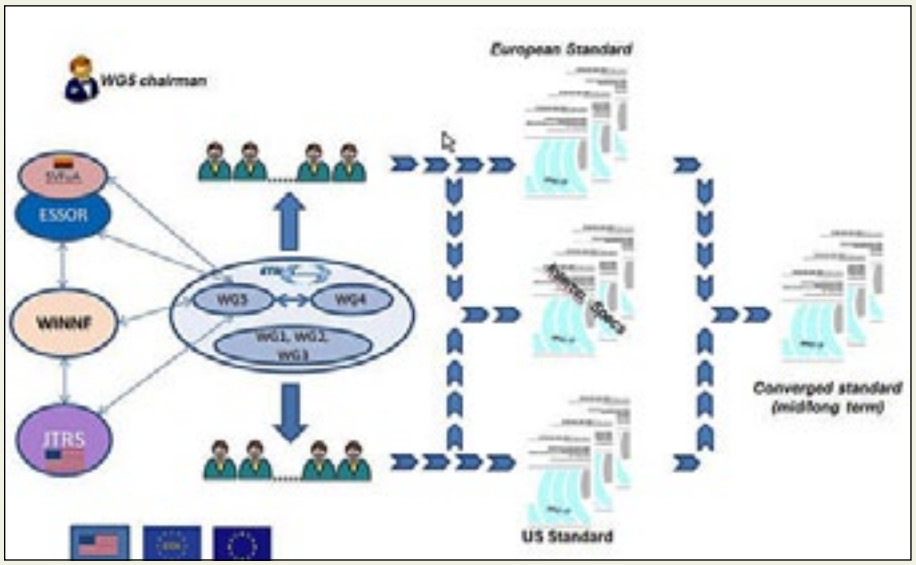


Figure 2. Model for a converged standard–one dedicated WG

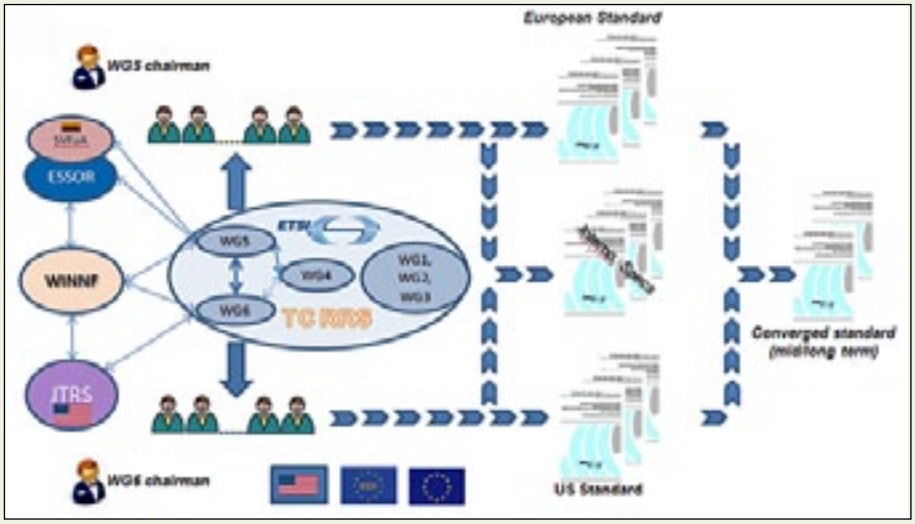


Figure 3. Model for a converged standard–two dedicated WGs

3. Foresees since the beginning, the presence of both WINNF and the U.S. government and industries (if available to participate).

4. Is also aligned with the three basket model as it involves an officially recognized European Standard Organization (ETSI) for all those standardization activities not requiring any restriction, which corresponds to basket one of the three basket model.

The ETSI-EDA Model

The model is based on the assumption that, while a "transatlantic" SDR standard for a military application is certainly the ultimate aim, in the short term at least, a U.S. program and a European program will continue to exist separately. This is also due to the fact the U.S. program is more advanced than the European ones (**ESSOR** and **SFVuA**) and, therefore, a convergence and harmonization can best take place in the medium/long term.

The model takes into account these considerations and allows for a seamless transition within the same standardization body from "regional standards" to an "international standard" without hampering, in the short term, the developments of existing programs. It is assumed here that the European standardization activities will take place in a dedicated *Working Group* (**WG5**) of the *Technical Committee Reconfigurable Radio System* (**TC RRS**).

TC RRS is responsible within ETSI for SDR and CR standardization and, therefore, is the natural host for SDR standardization for military applications. Two options are possible...

- In the first case, TC RRS will host the standardization activities related to a European standard

- In the second case, an ideal model is drawn where the two short-term regional standards are developed in the same committee, i.e., ETSI TC RRS. In both cases interoperability, *i.e.,* a converged standard for joint operations, is considered essential for the mid/long term achievement

The Model For The EC Standard

The starting point is the ongoing regional European programs, *i.e.*, ESSOR and SVFuA. A set of interoperability specifications (to be developed in cooperation with the U.S.) would speed up the "migration" towards a converged standard, which is supposed to take place in the medium/long term.

The WINNF, with its technical expertise in SCA, could provide support to the standard development and help coordinate the technical and market requirements with respect to the U.S. program. This will assure a gradual convergence towards the "international standard", which remains the final target for the mid/long term. The Interoperability Specifications produced are therefore expected to provide the baselines for such a convergence.

The Model For The Converged Standard

The following section describes the model for achieving an international standard in the mid/long term. Although ETSI has had preliminary discussions with the U.S. on this topic and a positive feedback has been received, the final model to be applied has not yet been agreed.

As shown in *Figure 2*, in the short term it is envisaged to have two different regional standards as well as a set of interoperability specifications for instance, under the form of ETSI Technical Specifications and/or feasibility studies (ETSI Technical Reports) that would "complement" the regional standard themselves. It is assumed that the starting points are the ongoing regional programs, *i.e.*:

- ESSOR/SVFuA for the "regional standard 1", i.e. for the European Standard
- JTRS specification for the "regional standard 2", i.e. for the U.S. Standard

The set of inter-operability specifications complementing the regional standards would speed up the "migration" towards a converged standard, which is supposed to take place in the medium/long term.

The two regional standards would be developed independently of each other in the same committee without forgetting the interoperability element which is essential for the development of a single standard in the mid/long term. In this regard, it is clearly an advantage to have all these activities within the same committee as it will optimize resources (some stakeholders might be interested in participating actively in the development of both regional standards).

At the same time, the WINNF, with its technical expertise in SCA, would provide support to the standard development and would help in the coordination of technical and market requirements. In *Figure 2*, it is assumed that these activities will take place in a single Working Group (WG5) but it would be also possible to create two separate Working Groups for the two regional standards (WG5 and WG6). In this case, the two working groups are supposed to coordinate their activities in order to minimize the duplication of work and maximize interoperability in the short term. The model is shown in *Figure 3*.

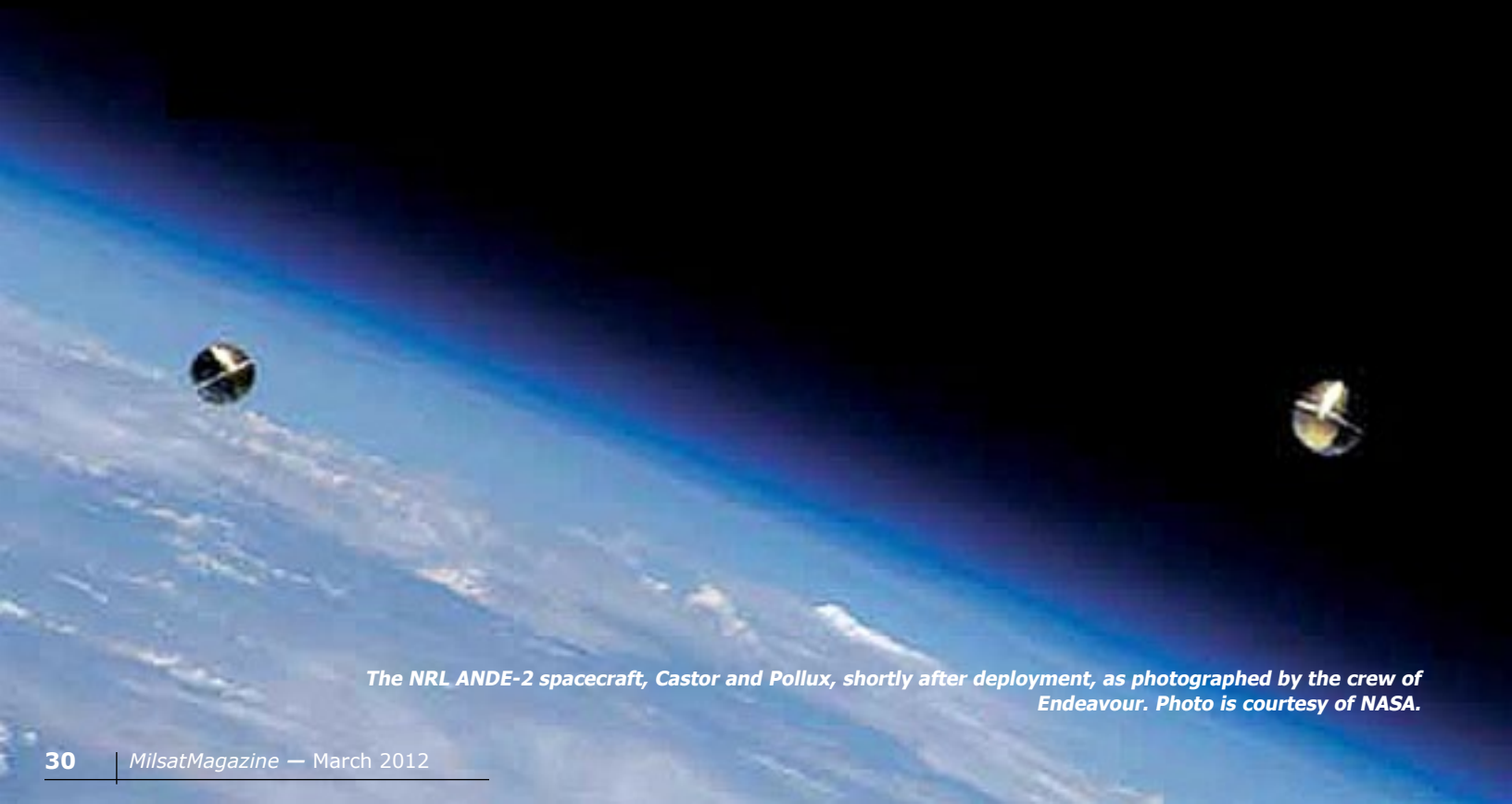
Conclusion

This article has presented the EDA-ETSI model for starting military SDR standardization in the most efficient way. ETSI is an officially recognized **European Standard Organization** (**ESO**) and a **Global Standard Producer** (**GSP**) and can thus offer a single "forum" where standardization activities can start and evolve in the medium/long term towards a true transatlantic and globally recognized standard.

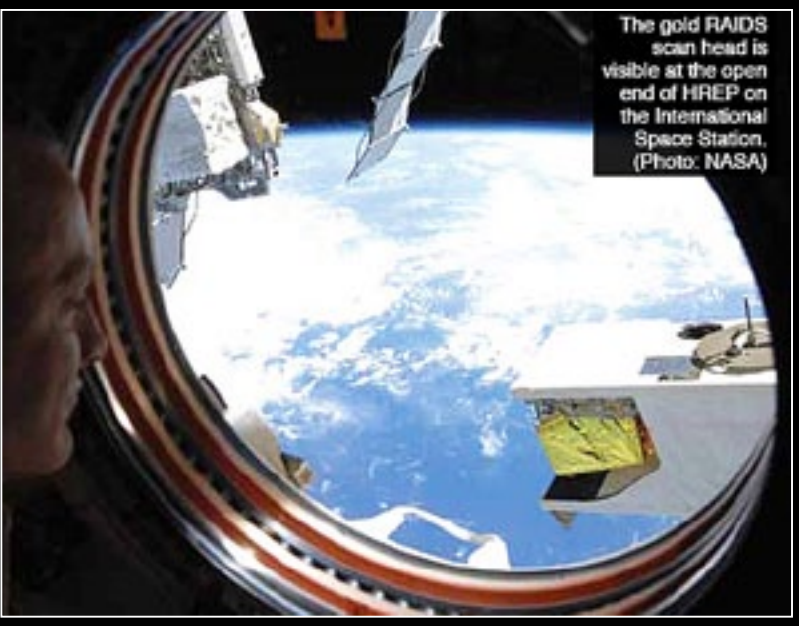
VERY GOOD YEARS FOR THE NRL

by the editors of the NRL's SPECTRA publication

Each year, the Naval Research Laboratory leads or participates in numerous space projects in various stages of development. Normally, these culminate in a launch every few years, or perhaps a launch or two in a single year. This year, for example, the TacSat-4 satellite is ready for launch and two NRL experiments were transported to the International Space Station on Space Shuttle Endeavour.



The NRL ANDE-2 spacecraft, Castor and Pollux, shortly after deployment, as photographed by the crew of Endeavour. Photo is courtesy of NASA.



However, two years ago, 2009 saw the successful launch and deployment of 10 space projects spearheaded by **NRL** researchers. Dr. *Jill Dahlburg*, superintendent of NRL's *Space Science Division*, noted, "2009 was a banner year for NRL space science and technology. The creativity, dedication, and perseverance of our space researchers throughout the Laboratory made this remarkable multitude of achievements possible."

Between March and November 2009, eight militarily relevant experiments of high technical value were integrated, launched, deployed, and operated by the **Department of Defense** (**DoD**) ***Space Test Program*** (**STP**); one cutting-edge instrument suite (***HERSCHEL***) was launched by **NASA**; and one transitioning operational capability (**SSULI**) was launched by the ***Defense Meteorological Satellite Program*** (**DMSP**).

Six of these missions are detailed in this feature. These six space activities scientifically encompass a wide range of investigations and applications typical of the breadth of NRL's space program: hyperspectral spaceborne remote sensing of the Earth's coastal regions, in situ monitoring of materials and components exposed to the extreme space environment, measurements of the Earth's thermosphere and ionosphere for validating and improving space weather models, and imaging of the Sun's corona for increased predictive understanding of the solar wind and space weather.

Operational Sensor SSULI

NRL's Special Sensor Ultraviolet Limb Imager (**SSULI**) was launched October 18, 2009, on the ***DMSP F18*** satellite. SSULI cleanly measures vertical profiles of natural airglow radiation from atoms, molecules, and ions in the upper atmosphere and ionosphere by passively scanning the Earth's limb in the *extreme ultraviolet* (**EUV**) to *far ultraviolet* (**FUV**) wavelength ranges, to provide space environmental data in support of military and civilian systems. SSULI is the first operational atmospheric sensor to exploit the EUV spectrum. DMSP F18 SSULI data products, once calibrated and validated, will be used operationally at the **Air Force Weather Agency** to support the warfighter. The DMSP is a DoD environmental monitoring spacecraft program led by the **U.S. Air Force Space and Missile Systems Center**.

HREP, HICO, and RAIDS

Launched aboard the Japanese H-II Transfer Vehicle

The ***HICO/RAIDS Experiment Payload*** (**HREP**) launched September 10, 2009, from **Tanegashima Launch Center** aboard the inaugural flight of the **Japanese Aerospace Exploration Agency** (**JAXA**) ***H-II Transfer Vehicle***. HREP is the first U.S. payload on the *Japanese Experiment Module–Exposed Facility* (**JEM-EF**), a component of the **International Space Station** (***ISS***). HREP provides all structural support and attitude knowledge to the HICO and RAIDS hyperspectral sensors, and serves as the control interface to the JEM-EF for HICO and RAIDS communication, data handling, monitoring, and power.

From its vantage point on the ISS, NRL's *Hyperspectral Imager for the Coastal Ocean* (**HICO**) is collecting high-fidelity hyperspectral images of land and coastal scenes and is using this information to derive important environmental data products such as bathymetry and water clarity. Under the *Office of Naval Research Innovative Naval Prototype* program, HICO is successfully demonstrating the viability of operating a commercial off-the-shelf (COTS)-based system in space for littoral environmental imaging relevant to Navy and Marine Corps operations.

This HICO image over a coastal region of the South China Sea near Hong Kong, China, was taken October 2, 2009. The images approximately 43km wide and 180km long, centered upon 22°5′N, 114°18′E, oriented from SW at the bottom to NE at the top.

The Remote Atmospheric and Ionospheric Detection System (RAIDS) is a hyperspectral sensor suite studying the upper atmosphere with eight optical limb-scanning sensors that range from EUV to near-infrared wavelengths. RAIDS collects the temperature and composition of the lower thermosphere and retrieves ionospheric electron densities. The new high-resolution results are being compared with predictions from global assimilative models for improved forecasting of satellite drag, specification of the ionosphere, and investigation of the surprisingly strong relationship between atmospheric dynamic processes and global-scale ionospheric morphology. RAIDS was built and is operating in a collaboration between NRL and The Aerospace Corporation. HICO/ RAIDS was integrated and flown under the auspices of the DoD STP.

MISSE-7

Launched by Space Shuttle Atlantis To The ISS

The 7th Materials on the International Space Station Experiment (MISSE-7) was transported to the ISS by ***Space Shuttle Atlantis***, launched November 16, 2009. The numerous individual experiments on MISSE-7 include in situ monitoring of materials sensitivities to the harsh space environment. These experiments provide a better understanding of the durability of advanced materials and electronics exposed to vacuum, solar radiation, atomic oxygen, and extremes of heat and cold. MISSE-7 returned to Earth on NASA's ***STS-134*** mission (the final flight of Space Shuttle Endeavour, launched May 2011) and was replaced by ***MISSE-8***, which will remain in orbit until at least 2013. After MISSE-7 components are evaluated, the technology readiness of successful experimental components will increase to the operational prototype level. MISSE-7 and MISSE-8 were integrated and flown under the auspices of the DoD STP.

ANDE-2 Microsatellites

Launched by Space Shuttle Endeavour

The NRL ***ANDE-2*** twin experimental microsatellites deployed on July 30, 2009, from Space Shuttle Endeavour under the auspices of the DoD STP. The two spherical microsatellites have the same size and drag coefficient but different masses, and are slowly separating into lead-trail orbits. ANDE-2 is providing a direct opportunity to study small-scale spatial and temporal variations in drag associated with geomagnetic activity. The ANDE research products are being used to improve methods for the precision orbit determination of space objects and to calibrate the ***Space Fence***, a radar system of the **U.S. Air Force 20th Space Control Squadron** that tracks low-Earth-orbiting space objects. The ANDE project is also advancing miniaturization of sensor technologies that are pivotal for multi-point, in situ space weather sensing.

CARE-I

Launched By DoD STP Sounding Rocket

The ***Charged Aerosol Release Experiment I*** (**CARE-I**) was launched by the DoD STP from the **NASA Wallops Flight Facility** at dusk on September 19, 2009, to investigate properties of charged dust in the ionosphere. The bright optical CARE-I upper atmospheric display, easily seen from the ground along the East Coast of the United States, was produced by sunlight scattered by concentrated rocket exhaust that was released at 290km altitude by a delayed firing of the sounding rocket fourth stage. The exhaust material, composed of one-third aluminum oxide particles and two-thirds combustion product molecules, interacted with the ionosphere to create a dusty plasma with high-speed pick-up ions.

Ground-based radars tracked the effects of CARE-I on the ionosphere for more than four hours, producing valuable data about how rocket motors affect ionospheric densities. CARE-I also provided a simulation of natural disturbances in the Earth's upper atmosphere.

HERSCHEL

Launched By NASA Sounding Rocket

The NASA-sponsored ***Helium Resonance Scattering in the Corona and Heliosphere*** (**HERSCHEL**) suborbital sounding rocket launched successfully on September 14, 2009, from the **White Sands Missile Range**. This joint mission with the NASA *Living With a Star* program, NRL, and multiple institutions in Italy, France, and the United Kingdom, provided the first global images for the two most abundant elements of the solar corona, hydrogen and helium. HERSCHEL achieved three first-time measurements: simultaneous global imaging of the extended corona in EUV, ultraviolet, and visible light; global measurement of the ratio of helium to hydrogen in the corona; and global maps of solar wind outflow. Determination of the processes that generate and drive the solar wind will provide a fundamental advance in our understanding and forecasting of space weather effects at Earth.

Editors Note

This article is courtesy of the Naval Research Laboratory and the ***SPECTRA*** publication and editors.

NANOSAT DEMOS FOR THE TACTICAL LAND WARFIGHTER

by John R. London III, USASMDC/ARSTRAT, A. Brent Marley, SMDC-RDT-SR, and David J. Weeks, SMDC-RDT-SR

Our nation has a truly impressive array of space-based capabilities supporting our armed forces. However, much of this support is focused at the strategic and operational levels of war. There are several areas of desired improvement in the space force enhancement mission area at the tactical level of war that could be addressed by small, very inexpensive satellites dedicated for use by tactical land warfighters. New trends in the miniaturization of electronic components are leading to smaller satellites with significant capabilities in the nanosatellite (1-10 kg) and microsatellite (10-100 kg) classes.

U.S. Army Space and Missile Defense Command/Army Forces Strategic Command is pursuing a number of technology demonstrations to validate the concept of nanosatellite/microsatellite constellations that could be tasked by the tactical land warfighters at and below the Brigade Combat Team echelon. Current projects include several very small satellites, namely the Space and Missile Defense Command—Operational Nanosatellite Effect (SMDC-ONE), Kestrel Eye, NanoEye, and Small Agile Tactical Spacecraft (SATS). Related enabling capabilities include a user-friendly ground segment and the dedicated launch capability provided by the Multipurpose NanoMissile System (MNMS). These demonstrations can help establish the case for inexpensive space force enhancement for the tactical land warfighter through low-cost, rapidly developed nanosatellite/microsatellite constellations.

The first Army-built satellite in more than 50 years, SMDC-ONE nanosatellite, is onboard the second stage of the launching SpaceX Falcon 9.

The United States Army is the largest user of space systems within the Department of Defense. Despite this heavy dependence on data from space, the Army has historically elected to leverage space systems. The last Army-developed satellite, until now, was the Courier 1B, a communications satellite developed by the Signal Corps and launched on 4 October 1960. The Army has and will continue to depend on existing and future—big space systems to conduct the full spectrum of combat operations.

As the Army combat regime evolves from a Cold War set piece engagement modality to today's environment of asymmetric warfare and continuous multi-theater operations, a number of single requirement niche operations in localized areas have emerged that are either underserved or not supported at all by current satellites. Unmanned Aerial Vehicles (UAVs) have become ubiquitous in addressing some of these operational gaps, and the Operationally Responsive Space (ORS) Office was formed to focus technologies to meet warfighter needs more responsively with lower cost and more rapidly fielded space systems.

Concurrent with the changing nature of Army combat operations is the rapid advancement of many technologies, particularly in the field of electronics miniaturization, that have opened the door for small, highly affordable satellites designed to perform limited

niche missions. These tremendous technical advances were first exploited in this country by universities seeking to rapidly develop satellites at very low-cost for educational purposes. The CubeSat emerged as the standard for many academic institutions seeking to place student projects into space quickly and inexpensively. Although valued greatly by the academic community, CubeSat-class satellites were initially viewed by most traditional satellite developers and users as having little practical value.

One of the major shortcomings of LEO satellites is that individually they do not provide a persistent presence over a specific geographic area of the Earth—**Keplerian** physics demands otherwise. From a systems standpoint, global persistence can only be achieved by the use of multiple satellites in a constellation. The best example of this kind of persistence is the ***Global Positioning System*** (**GPS**) that is always available to any user worldwide.

Taking all of these realities into account, the CubeSat class satellite today offers a unique opportunity to address certain mission requirements for the Army. New trends in the miniaturization of electronic components driven to a large degree by advances in cell phone and *Personal Digital Assistant* (**PDA**) technologies are leading to smaller satellites with significant capabilities in the nanosatellite (1-10kg) and microsatellite (10-100kg) classes.

From an individual satellite standpoint, these small classes of space vehicles can be developed rapidly within the ***ORS Tier 3*** timeline (one year) at very low unit cost. From a systems standpoint, nanosatellites/ microsatellites can be proliferated inexpensively into constellations that would achieve useful and affordable persistence over multiple regions of interest to the Army. It is important to recognize that a number of possible constellations may not be required by the Army to provide global coverage. As the Army's geographic focus may not stretch to the Earth's poles for many missions, constellations of nanosatellites/microsatellites can be limited in number to provide coverage in latitudinal swaths that address specific regions of interest at greatly reduced cost.

Constellations of nanosatellites/microsatellites could be sufficiently affordable to allow application against a specific mission need in a limited geographical area. Such constellations would have additional benefits such as being highly survivable, amenable to being frequently refreshed with technology advances due to shorter on-orbit life expectancy, low detection probability, able to leverage manufacturing economies of scale, having good signal strength in LEO, and having the potential for being rapidly reconstituted on a per-unit basis.

Based on the promise that nanosatellites/microsatellites potentially hold for the Army, and because of urgent requirements gaps that this class of satellite could address, the Army's **Space and Missile Defense Command** decided in the Spring of 2008 to once again move the Army into the satellite development arena.

The U.S. Army Space and Missile Defense Command/Army Forces Strategic Command (**USASMDC/ARSTRAT**) is investigating a number of nanosatellite/microsatellite technologies. These technology demonstrations include ***SMDC-ONE***, ***Kestrel Eye***, ***NanoEye***, and ***SATS***, together with a user-friendly ground segment and a dedicated launch capability provided by the Multipurpose NanoMissile System. Through these demonstrations, the command hopes to validate the utility of the emerging trend in satellite miniaturization for the tactical land warfighter.

The U.S. Army logo is prominently positioned on the SpaceX Falcon 9 rocket the night before launch. The first Army-built satellite in more than 50 years, SMDC-ONE nanosatellite, is onboard the second stage directly behind the Army logo.

SMDC-ONE technology demonstrator.
Credit: U.S. Army SMDC
photo by John Cum

Nanos For BLOS Comms

This section will describe the nanosatellites/microsatellite efforts that took a government organization and its industry partner, neither of which had ever developed a satellite, from a standing start to the delivery within 12 months of eight flight-qualified nanosatellites designed to address a specific warfighter mission need.

The Need For Beyond-Line-of-Sight Communications

On today's battlefield, the tactical land warfighter does not always get the exact communications support he or she desires from the existing constellations of large, expensive military and commercial communications satellites in geosynchronous orbits. Constellations of satellites dedicated to tactical warfighters would greatly benefit command, control and communications as well as intelligence data dissemination to tactical land forces.

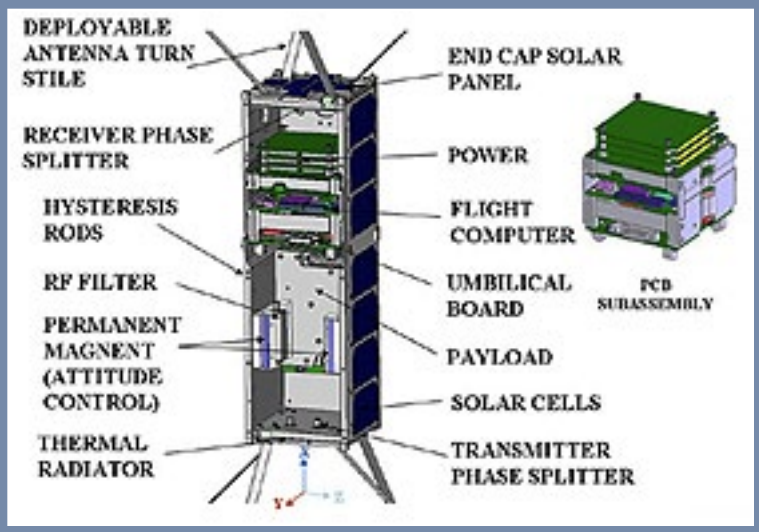
There is an emerging niche for satellites focused on tactical missions such as data exfiltration from ground sensors, text message relay, voice communications and image and video transmission. Data exfiltration and text messaging are both fairly low data rate satellite communications applications and are relatively straightforward, technologically.

To be practical in terms of utility to the tactical warfighter, satellites used for beyond-line-of-sight communications must have an intuitive user segment that is simple to employ. Ideally any new satellites should simply be interoperable with existing hand-held or mobile communications equipment. The satellites should also be available 24/7 to be truly of use everywhere within a given area. As a large constellation would be needed, individual satellite unit cost would need to be very low, in the range of a few hundreds of thousands of dollars. Finally, the satellites should be responsively deployable and easily replenishable on-orbit in accordance with the rapid deployment principles put forth by the Department of Defense's Operationally Responsive Space Office.

SMDC-ONE Technical Approach

To investigate the feasibility of a BLOS communications nanosatellite constellation, the USASMDC/ARSTRAT is executing the Space and Missile Defense Command – Operational Nanosatellite Effect, or SMDC-ONE, technology demonstration. The SMDC-ONE initiative succeeded in designing, developing, building and qualification testing two nanosatellite engineering qualification units as well as acceptance testing eight flight units within a one-year timeframe. Delivery was in April 2009. Three of the flight units are manifested on launch vehicles bound for low Earth orbit. A custom communications payload will provide a capability to support simulated ground sensors and text message relay. More complex communications applications are under consideration.

USASMDC/ARSTRAT's initial focus for SMDC-ONE was on communications with emphasis on data exfiltration; that is, to uplink data of interest from unattended ground sensors and then downlink that data to a site beyond the line-of-sight from the originating sensor location. While there are military and commercial assets that can and do routinely provide communications from warfighters in one area to another location within, or outside that theater, the challenge for the soldier in the field is to obtain the critical data that he or she needs in a timely manner. It would be strongly advantageous for land warfighters to have their own space assets to provide beyond-line-of-sight (BLOS) communications. This is especially the case in areas of mountainous terrain where line-of-site access to satellites or airborne communications is limited or non-existent. A constellation of small satellites in low Earth orbit could provide communications access that heretofore has not existed.



SMDC-ONE subsystem layout

The approach that USASMDC/ ARSTRAT took for its first indigenous satellite program is to explore the nanosat (0-10 kg) class while using the **Cal Poly** CubeSat form. In early 2009, the SMDC-ONE program completed the construction and testing of two qualification nanosats followed by eight flight nanosats. Each is designed to be deployed from a *Poly-Picosatellite Orbital Dispenser* (**P-POD**). One of the qualification units underwent rigorous shock, random vibration and thermal-vacuum testing at the primary contractor and NASA locations. Thermal balancing and antenna deployment tests were conducted during thermal-vacuum testing at the prime contractor's location. Radio frequency characterization testing was conducted at U.S. Army facilities on Redstone Arsenal. Careful coordination was conducted with **Cal Poly**, **Stanford University** and **SRI International** representatives to ensure conformity with the Cal Poly standards and leveraging of their experiences with CubeSats.

SMDC-ONE
Concept of Operations

The objective of the first flight demonstration involved a single SMDC-ONE satellite that received its tasking from the Forward Operating Base (FOB) or Command and Control (C2) station as shown in Figure 4. The initial SMDC-ONE satellites did not have on-board GPS, so the tasking and timing information was provided from the C2 station after the preliminary on-orbit checkout of the satellite occurs.

The program had two C2 stations, one at USASMDC/ ARSTRAT Headquarters in Huntsville, Alabama, and the other at USASMDC/ARSTRAT's Battle Lab in Colorado Springs. The first demonstration consisted of simulated sensor data transmitted from one or both of the C2 stations. The tasking data and other data files were received by the satellite (as its ground track accesses Huntsville and/ or Colorado Springs), stored on-board, and then transmitted to the C2 station(s) as directed.

On some orbits, the ground track covered both C2 stations, which are separated by 1,200 miles. A text message was transmitted from the first station in the ground track and quickly relayed to the second station. In some cases the ground track was first covered by Huntsville while, in others, Colorado Springs when the nanosat came into view first.

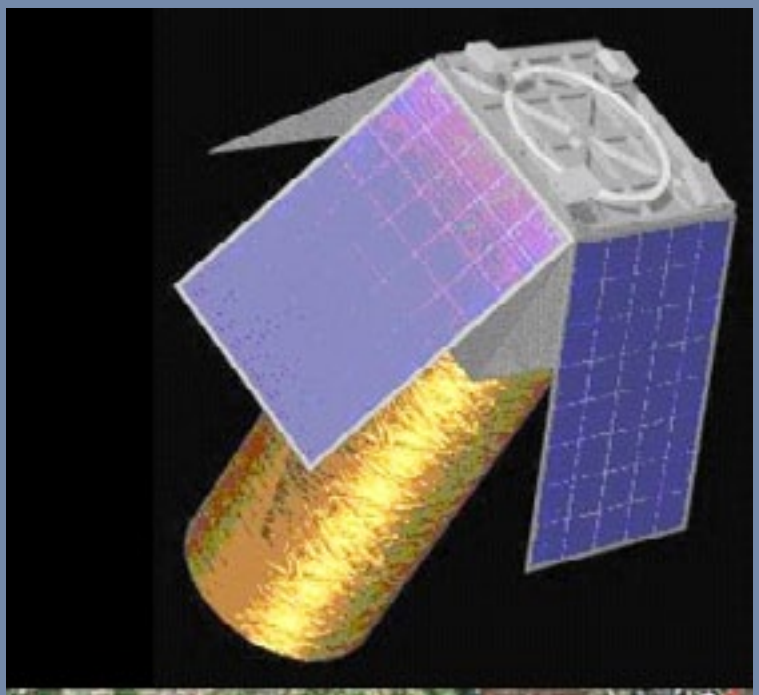
After the initial on-orbit checkout of the satellite by prime contractor (Miltec) and USASMDC/ARSTRAT personnel was completed, testing and experiments were conducted by the Space and Missile Defense Command Future Warfare Center's Battle Lab. Both ground segments (Huntsville and Colorado Springs) were used in the checkout and experimentation phases.

SMDC-ONE was the first Army-developed satellite since Courier 1B in 1960. It has taught a new generation of Army engineers much about developing on-orbit technology for the tactical land warfighter, and is just the first in what will likely be a long line of new Army-developed nanos and microsatellites.

SMALL MICROSATELLITES FOR ELECTRO-OPTICAL IMAGERY

The unmanned aerial vehicle revolution is putting on-demand imagery into the hands of tactical land warfighters. Warfighter-tasked electro-optical imagery from orbiting small microsatellites could complement unmanned aerial vehicles and even substitute for them in denied areas. USASMDC/ARSTRAT is developing the 14-kilogram ***Kestrel Eye*** electro-optical imagery satellite as a technology demonstration to show how the tactical land warfighter can task a dedicated small microsatellite to take and download multiple 1.5 meter resolution images within the single-digit-minute time span of a single overhead pass.

USASMDC/ARSTRAT is also developing the NanoEye imagery microsatellite, which will have a propulsion system enabling it to lower its orbit to enhance image resolution and then fly back up to its normal orbital altitude. Another Army microsatellite effort is the Small Agile Tactical Satellite study, which is investigating the possibility of frame-based video from space.



Kestrel Eye

The USASMDC/ARSTRAT is developing the Kestrel Eye technology demonstration as an electro-optical near nanosatellite-class imagery satellite that will be tasked by the tactical ground component warfighter. Weighing only about 14 kilograms, and capable of producing 1.5 meter resolution imagery, Kestrel Eye's data will be downlinked directly to the same warfighter via a data relay network that is also accessible by other warfighters in theater without any continental United States (CONUS) relay or data filtering. At the low-cost of only about $1M per spacecraft in a production mode, the intent is to demonstrate a tactical space-based imagery small microsatellite that could be proliferated in large numbers to provide a persistent capability to ground forces. Each satellite would have an operational life of greater than one year in low Earth orbit.

The primary objective of the demonstration will be to task the satellite to take a picture of a designated ground object of interest and have that image relayed back to the ground Warfighter during the same satellite pass (i.e., within an approximately 10-minute tasking-to-product cycle). This tactical responsiveness, coupled with the potential persistence enabled by large numbers of these low-cost satellites in orbit, make up the key advantages Kestrel Eye would have over existing orbital imagery assets today.

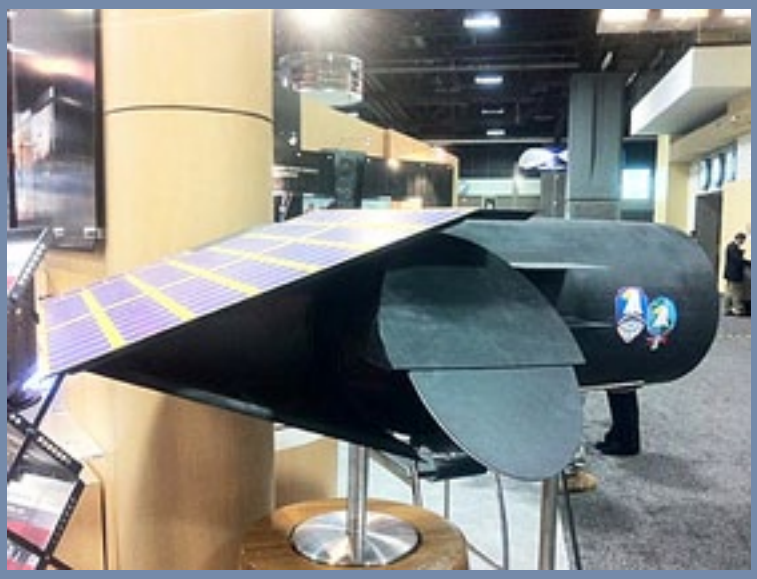
The Kestrel Eye program will extend the Unmanned Aerial Vehicle (UAV) paradigm into space: a dramatically lower unit cost and proliferated numbers of satellites enabling the system to be dedicated to, and operated by, Warfighters who today receive only parceled-out service from more powerful, expensive and far less numerous orbital assets. The eventual goal is persistent coverage available to every Soldier on a handheld device, as GPS is today. The CONOPS for this experiment involves very small satellites, laptops and S-band receiver antennae. Kestrel Eye advantages include:

- Higher altitude than UAVs: coverage above denied areas and invulnerable to surface-to-air missile threats
- Smaller size and greater number: affordable, persistent presence, lower probability of detection, less vulnerable to anti-satellite weapons
- Graceful degradation: no single-shot, launch failure or anomaly causes complete loss of service

Kestrel Eye could provide in-theater tactical land warfighters with the ability to directly task an orbital asset and receive tactically relevant imagery within minutes. It could complement unmanned aerial vehicle (UAV) imagery or even substitute for UAV imagery if necessary. The Kestrel Eye technology demonstration could prove out the utility of on-orbit imagery assets dedicated for use by Soldiers in the field. (*For further information on the Kestral Eye project, see the sidebar*.)

NanoEye

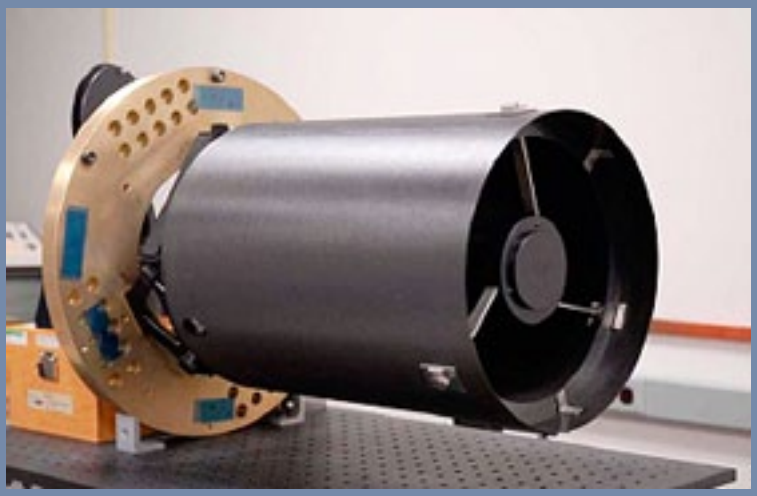
USASMDC/ARSTRAT is developing another small, low-cost imagery microsatellite called ***NanoEye***. Under development through the DoD's *Small Business Innovative Research* (**SBIR**) program, NanoEye cost estimates at $1.4M or less per satellite are 100 to 1,000 times lower than would be the case in a traditional NASA or DoD program. The program's development timeline is close to an order of magnitude shorter as well. Several factors make these cost and schedule reductions possible. One is a new, dramatically lightweight, lower cost telescope. Another is that NanoEye's unibody spacecraft structural design developed by **Microcosm** allows the possibility of an integrated spacecraft/payload. (*The Company is also part of the Reinvent Space Conference 2012 that will be held from May 7th through 11th in Los Angeles, California. Please see the RSC 2012 sidebar for additional information.*) The use of CubeSat components developed by many universities and small companies also contributes to lower cost and rapid development. Finally, SBIR contracting can eliminate many of the typical roadblocks to getting things done rapidly and at low-cost.



NanoEye mock-up on display at a U.S. Army conference.

A key feature of the NanoEye design is the ability to lower its orbital altitude for close up shots of the Earth's surface. The major benefit of low altitude is high resolution with a small payload and spacecraft. Low altitude also means doing without deployable solar arrays that have excessive aerodynamic drag. NanoEye's solar arrays are symmetrically arranged about the spacecraft's velocity vector to minimize any aerodynamic torque and drag when at low orbital altitudes. Solar arrays are also becoming far more efficient, and responsive mission duty cycles tend to be low, allowing body mounted solar arrays to adequately power the spacecraft. The bottom line is that operating at low altitude is dramatically cheaper than incorporating larger aperture. So long as we are willing to give up exquisite resolution and 10 to 15 year orbital lifetimes, we can achieve dramatic benefits in terms of cost.

Similar to Kestrel Eye, the NanoEye technology demonstration has a great potential to prove the utility of space-derived near-real-time imagery to tactical land warfighters at a low-cost. It represents an alternative low-cost design with a unique maneuvering capability to tailor its orbit to meet the needs of the user.



The NanoEye Telescope, which was also used for Kestrel Eye)

Small Agile Tactical Spacecraft (SATS)

A third imagery microsatellite under development by USASMDC/ARSTRAT is the ***Small Agile Tactical Spacecraft*** (**SATS**). Similar in performance to Kestrel Eye and NanoEye, SATS would have a ground sample distance resolution of 1.5-2.0 m (~4-6 feet) at a cost of around $3M per microsatellite. The satellite will weigh about 32 kg (70 lbs) and have an on-orbit life of 36 months.

What sets SATS apart is its ability to switch between three modes of operation. In point-and-shoot mode, SATS would have the ability to capture multiple images within a theater on a single pass, similar to the other Army imagery microsatellites. A unique feature of SATS is its scene mode, which captures still images or video along a pre-planned path defined by a series of latitude and longitude coordinates. It can capture 5 megapixel images at 4 frames per second with 50 percent image overlap. In real-time video mode, SATS will have the ability to track user defined targets with real-time, human-in-the-loop targeting. It will provide monochrome 1 megapixel video at 1-2 frames per second streamed "live" to a user or store and forward in a replay mode for higher resolution post pass data analysis.

The potential for video from a space-based asset represents a new benchmark in capability for situational awareness. SATS represents leading edge technology in this new field at an affordable cost.

Inexpensive, Responsive Launch For Nanosatellies + Microsatellites

Tactical nanosatellite and microsatellite launch needs cannot be met by strategic launch vehicles. Currently, these spacecraft are launched as secondary payloads on large launch vehicles. While these launches are adequate for test demonstrations, the nanosatellite/microsatellite's orbital location is confined to the primary payload's orbital destination. More importantly, these launches

Suborbital, Single Stick, 2-Stage	$277K
Suborbital, Single Stick, 2-Stage, with ATACMS Booster	$153K
Suborbital, Single Stick, 3-Stage, with ATACMS Booster	$306K
Suborbital/Orbital*, Core & 4 Strap-ons, 4-Stage	$1M

**1-10 kg to 250 nmi circular; incl=43°*

Pricing options for various Multipurpose NanoMissile Systems.

are scheduled years in advance, and are not able to meet the immediate needs of users. In order to maximize the benefit of the next generation of nanosatellites and microsatellites, SMDC initiated a program to enable a dedicated, low-cost, small payload launch system to ensure rapid deployment and precise placement of nanosatellites and microsatellites to meet user requirements.

Multipurpose NanoMissile System (MNMS)

Concurrent with the shrinking size and cost of militarily useful satellites is a need for an appropriately sized and priced launch vehicle. USASMDC/ARSTRAT is developing a very low-cost launch vehicle called the Multipurpose NanoMissile System. This innovative rocket is designed to take advantage of low-cost yet modern technologies and non-exotic materials to provide launch for a 10 kilogram (25 lb.) payload to low Earth orbit for about $1 million per launch vehicle.

MNMS Design Philosophy

The Multipurpose NanoMissile System is low-cost because it is simple: it is an integrated tank/booster/engine design, it has a benign bi-propellant liquid propulsion system (ethane and nitrous oxide), and it uses existing launch support and launch site hardware. It can also accommodate existing Army Tactical Missile System (ATACMS) and Multiple Launch Rocket System (MLRS) motors to augment performance as well as provide an important application for these surplus Army assets. The configurable boosters can be tailored to many specific missions: missile defense target vehicle, infrared and radar sensor exerciser, hypersonic test vehicle for aerospace components, pop-up reconnaissance system, and highly responsive orbital launch vehicle for very small payloads (10 kg to LEO). Perhaps the most significant feature of MNMS is that it is designed for minimum cost. Even the orbital configuration unit cost is only projected to be around $1M.

MNMS Operational Capabilities

To achieve enhanced capabilities for the warfighter from space, a necessary requirement is to have the ability to fly into and through space to include both sub-orbital and orbital missions. To test and exercise key space and missile defense technologies, a dedicated missile is required to boost these technologies into their required trajectories or orbits. Currently, the U.S. Army has no such capability despite being the largest user of missile defense and space technologies. The Army also has the largest inventory of missiles and rockets, yet they have been designed primarily as weapons and not platforms to test missile defense and space technologies.

Artistic rendition of the MNMS

The Multipurpose NanoMissile System will combine the Army's great requirement for these technologies with an enormous surplus of ATACMS and MLRS motors to produce a low-cost, simple missile dedicated to bringing enhanced capabilities from space to the U.S. Army ground component warfighter. The design will enable the MNMS to be operationally responsive enough to meet a 24-hour requirement from garrison storage call up to launch ready, a timeline that is unheard of among current launch vehicle capabilities.

For suborbital performance and capabilities, the graph above depicts the expected performance for three different MNMS configurations. The nomenclature in the legend, e.g., "R310" refers to the configuration of booster modules that make up the first, second and third stages. R310 means there are three identical booster modules in the first stage, one in the second stage and none in the third stage; thus it is a two-stage rocket. The "R" stands for "Responder", the missile's nickname. This data assumes a 9 deg azimuth (due east) launch from Reagan Test Site at the Army's Kwajalein Atoll complex in the Marshall Islands in the Pacific Ocean.

In Closing

Appropriate constellations of nanosatellites and microsatellites in low Earth orbit can provide a high degree of persistence for the warfighter which he or she can depend upon, much like the GPS is today. The presence of a proliferated constellation of relatively short life nano- or microsatellites allow for technology refresh opportunities and are problematic to adversaries who might want to eliminate space-based support to the warfighter. Technology demonstrations such as ***SMDC-ONE***, ***Kestrel Eye***, ***NanoEye***, and ***SATS***, together with the dedicated launch capability provided by the ***Multipurpose NanoMissile System***, can help establish the case for inexpensive space force enhancement for the tactical warfighter through low-cost, rapidly developed nanosatellite constellations.

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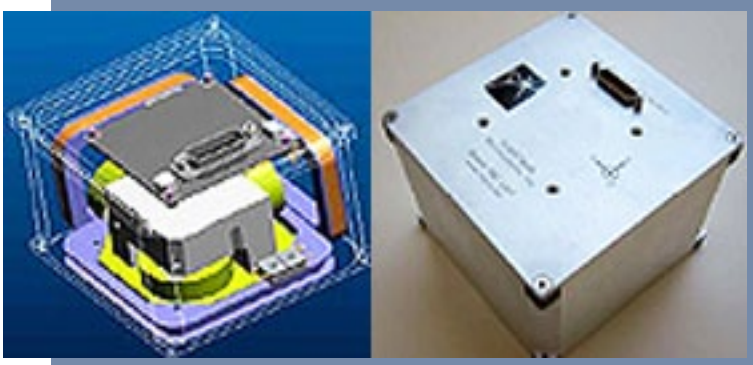
Kestrel Eye: A View To Tactical Real-Time Imagery

The U.S. Army Space & Missile Defense Command/Army Forces Strategic Command, better known as USASMDC/ARSTRAT, Technology Center is developing Kestrel Eye as an electro-optical nanosatellite-class imagery satellite that will be tasked by the tactical ground component Warfighter. This is a revolutionary concept for MILSATCOM, which has always relied upon far larger satellites for their operational projects.

Capable of producing 1.5-meter resolution imagery, Kestrel Eye's data will be downlinked directly to the same warfighter via a data relay network that is also accessible by other warfighters in theater and there is no continental United States (CONUS) relay or data filtering. The intent is to demonstrate a tactical space-based imagery nanosat that could be produced in large numbers to provide a persistent capability to ground forces. The primary objective of the demonstration will be to task the satellite to take a picture of a designated ground object of interest and have that image relayed back to the ground Warfighter during the same satellite pass (i.e., within an approximately 10-minute tasking-to-product cycle).

This specialized Army satellite payload consists of four solar arrays that are attached to the base of the instrument bus box-shaped support instrument unit with a 10-inch tested telescope mounted above. The on-board camera has the integral systems, making it possible for real-time delivery via its S-band downlink system antenna to send two images per second of a 64 kilometer square area on Earth. The prototype brings into play four solar arrays complete with their deployment systems, and commercial based instrumentation flight avionics as well as an attitude control system based on the Commercial-Off-The-Shelf (COTS) approved equipment IMI-200. The 1M1-200 unit contains the 3-axis gyro dynes (the centimeter-gram-second unit of force) mass momentum wheel system to maintain the correct required satellite imaging target pointing attitude.



Left: The IMI-200 — images courtesy of U.S. Army

Similarly the camera, communications systems are based on commercially available systems. The system is designed to be directly taskable from the ground by the war fighters through the back-pack "portable ground station" setup, with sending and receiving capability for tasking and date image return on the same orbital pass. The Kestrel Eye program will extend the Unmanned Aerial Vehicle (UAV) paradigm into space: a dramatically lower unit cost and proliferated numbers of satellites enabling the system to be dedicated to, and operated by, warfighters who receive only parceled-out service today from more powerful, expensive and far less numerous assets. The eventual goal is persistent coverage (24x7x365) available to every soldier on a handheld device, as GPS is today. The CONOPS for this experiment involves very small satellites, laptops and S-band receiver antennae.

Ops Concept

1) The operator will select any pint of the ground trace that is displayed on the world map and calls up the enlarged local map.

2) Objects/areas of local interest by designating with mouse clicks. The positions can be adjusted by dragging and dropping. The approximate photo footprints are shown by white rectangles.

3) The object track, which is shown in red, is automatically updated as additional objects and/or areas of interest are added, and if they are beyond the maneuvering capability of the spacecraft, the operator is warned of such by a pop-up display.

4) When satisfied, the operator selects "Send to Spacecraft" and the requested trajectory is transmitted.

5) Kestrel Eye executes the planned track and snaps pictures at the designated times.

6) Kestrel Eye immediately downlinks the requested images to a data relay network that is accessible by the Warfighter who tasked the satellite, as well as any other Warfighter on the network who needs this information.

If a viable conclusion is achieved with this nanosatellite, as many as 30 Kestral Eyes could be launched to form a constellation. Given that number, the cost range per satellite could not, and would not, be much more than $1 million per satellite if any worthwhile consideration is given to this project. With the current budget cutting being undertaken by the current administration, when compared to the cost of a single satellite at tens of millions of dollars, a complete constellation cost in the area of $30 million would definitely curry favor.

Lower cost factors are assisted by the fact that many of the components of the Kestral Eye are, as mentioned earlier, the COTS products that comprise the nanosallite. The IMI-200 is an extremely precise 3-axis Miniature Attitude Determination and Control System (mADACS), developed by IntelliTech Microsystems, Inc., of Bowie, Maryland. This unit can be used in nanosatellites of up to about 40 pounds in weight. The IMI-200 is hermetically sealed within a 3x3x2.75-inch enclosure (insert kestral_msm0312_imi-200.jpg) and provides turnkey ADACS capability for nanosatellites, including cubesats.

Initially scheduled for a November 2011 launch, the unfortunate cuts to the NASA budget required a rescheduling to the fourth quarter of this year. The launch will be handled by Maryland Aerospace, who started working on the Kestral Eye program in 2006 with assistance from the U.S. Army.

Summary
Nanosatellite technology demonstrator weighing about 10 kilograms

- ***Electro-optical imaging satellite with 1.5-meter ground resolution***
- ***Low-cost: $1M per spacecraft in production mode***
- ***Operational life of greater than one year in Low Earth Orbit***
- ***Tactically responsive: Ability to task and receive data from the satellite during the same pass overhead***
- ***Persistent availability down to the individual Soldier***

Reinventing Space Conference 2012

The New Budget Reality—*Space Budgets* ***WILL*** *get tighter. Last year, the* ***Responsive Space Conference*** *became the* ***Reinventing Space Conference*** *in order to place greater emphasis on the importance of reducing cost. It was critical last year, and even more so this year. The new budget reality is that there is less money available to fund new programs, cost overruns in ongoing programs, or anything else that must be done in space, civil or military. This community has to demonstrate that less can be sent to attain more—that current and future needs can be met more responsively and at dramatically less cost.*

RS2012 will accept papers on all aspects of Low-Cost Space, but particularly solicits papers that emphasize changes in technology or new ways of doing business that allow the nation to drive down space mission cost and schedule in the near term and create affordable and responsive space missions, both military and civilian. Such topics include:

Launch—The single biggest impediment to dramatically lower cost, more rapid missions is low-cost, responsive access to space, particularly for smaller satellites.

Mission and Systems Engineering—What is the status of low-cost mission design, measures of effectiveness, orbits, and getting information to the end user within hours of an unexpected event?

Applications—What are the civil, military, and educational applications for low-cost, quick-turn-around missions? What can we do with collections of small sats?

Business—How do we make money on lower cost space missions? Is there a business case for "low-cost, instant gratification"? What does "low-cost" mean to the builder and to the user? Can small businesses help?

Civil Missions—Can we create good science and civil applications at dramatically lower cost? Can we drive down the cost of all space missions?

Technology—Where are we in plug-and-play, miniaturization, and low-cost, rad-hard components?

Education and Motivation—How do we educate and motivate the coming generation of space technologists? How do we convince young professionals that space is still the place to build a career?

For conference registration, access the graphic.

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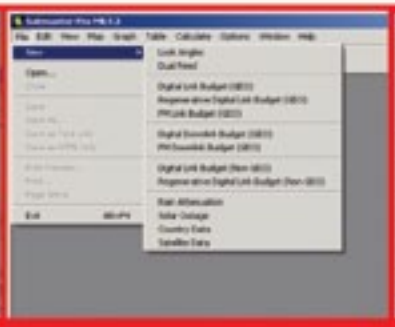
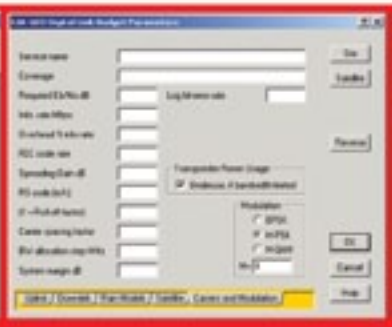


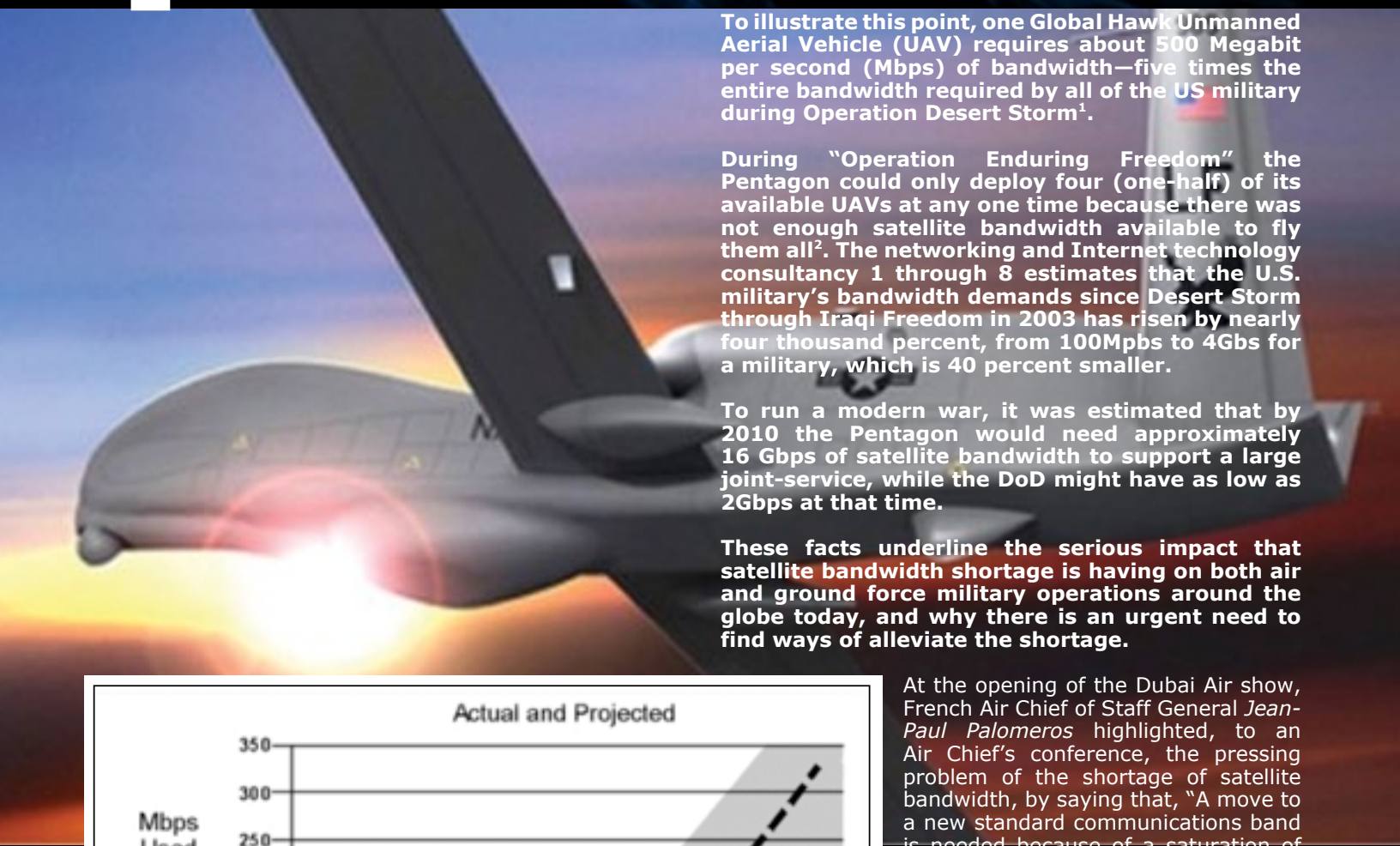


http://www.satnews.com/satfinder

Meeting The Growing Bandwidth Demands Of A Modern Military

by David Furstenberg, Chairman, NovelSat

The unprecedented budgetary pressure imposed on the military and the Department of Defence, combined with the increasing need for additional satellite bandwidth, creates a growing gap between demand and availability. Bridging this gap is a major and pressing challenge for the defence sector.

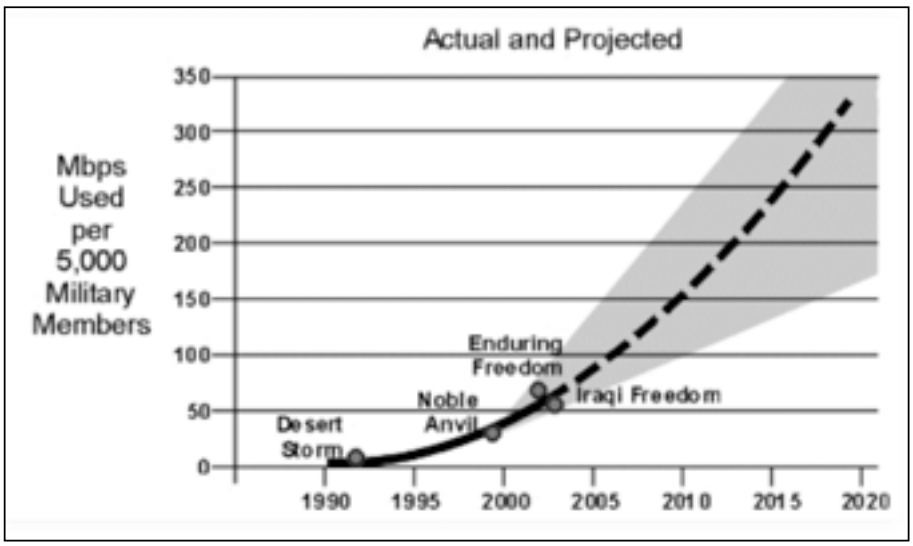


To illustrate this point, one Global Hawk Unmanned Aerial Vehicle (UAV) requires about 500 Megabit per second (Mbps) of bandwidth—five times the entire bandwidth required by all of the US military during Operation Desert Storm[1].

During "Operation Enduring Freedom" the Pentagon could only deploy four (one-half) of its available UAVs at any one time because there was not enough satellite bandwidth available to fly them all[2]. The networking and Internet technology consultancy 1 through 8 estimates that the U.S. military's bandwidth demands since Desert Storm through Iraqi Freedom in 2003 has risen by nearly four thousand percent, from 100Mpbs to 4Gbs for a military, which is 40 percent smaller.

To run a modern war, it was estimated that by 2010 the Pentagon would need approximately 16 Gbps of satellite bandwidth to support a large joint-service, while the DoD might have as low as 2Gbps at that time.

These facts underline the serious impact that satellite bandwidth shortage is having on both air and ground force military operations around the globe today, and why there is an urgent need to find ways of alleviate the shortage.



The U.S. military's bandwidth demands since Desert Storm through Iraqi Freedom in 2003 have risen by nearly four thousand percent, with 100Mpbs to 4Gbs for the military.

At the opening of the Dubai Air show, French Air Chief of Staff General *Jean-Paul Palomeros* highlighted, to an Air Chief's conference, the pressing problem of the shortage of satellite bandwidth, by saying that, "A move to a new standard communications band is needed because of a saturation of current bandwidth. Increasingly relied-upon unmanned aerial vehicles such as Predators, Reapers and the French Harfang generate huge amounts of data, including full-motion video, and complex sensors such as high definition video, laser designators, imaging radar, ground moving target indicators and multispectral images demand high bandwidth for transmission.

Planners estimate a large bandwidth is needed because of a "multitasking of UAVs," with many remote piloted vehicles being operated simultaneously. According to a report in 'Defense News' some 20 gigabits per second is needed to cope with the growing number of UAVs, which are swamping the current Ku- bandwidth available on satellite communications links."

UAV Deployments Gain Momentum

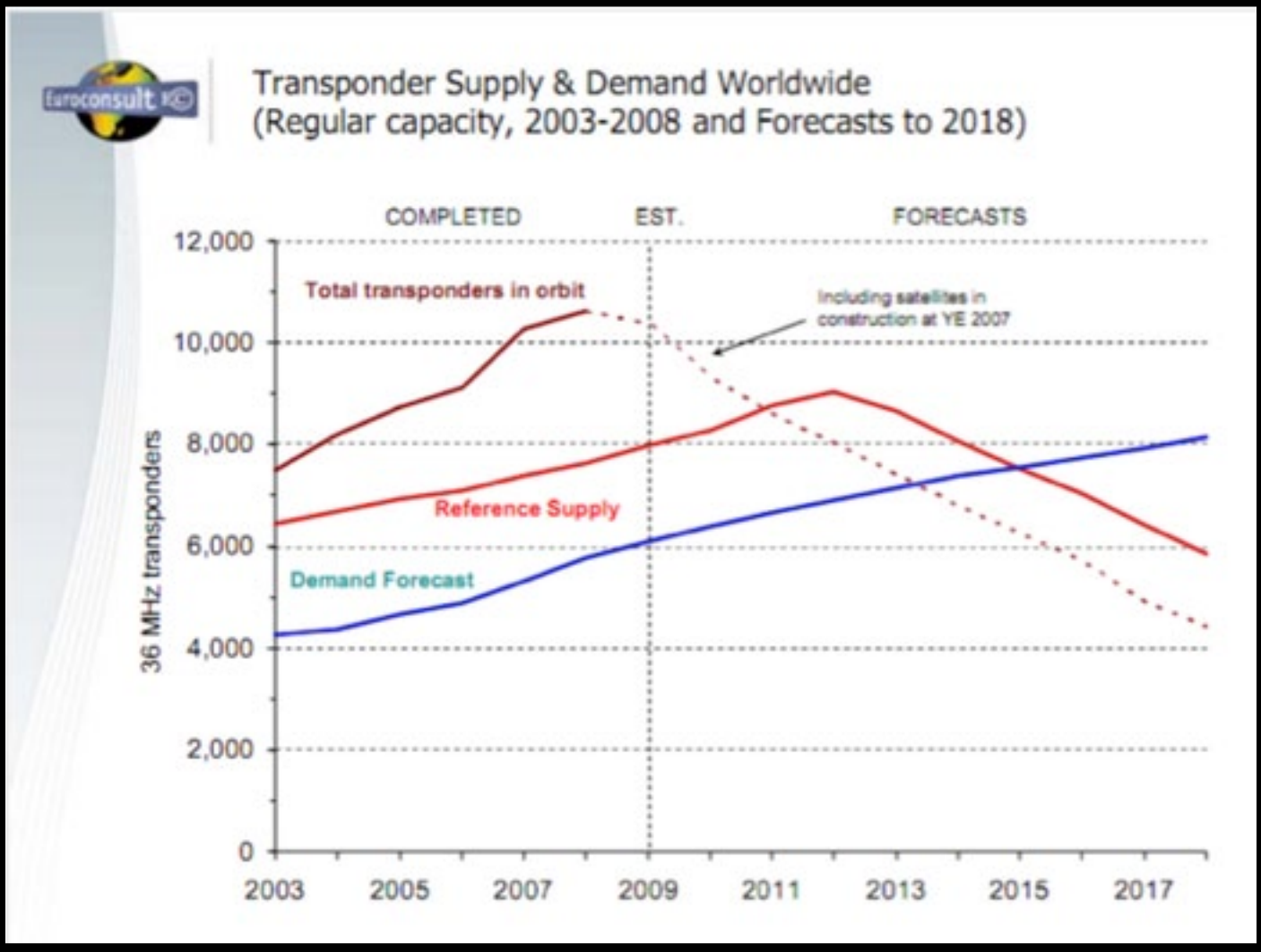
The problem of bandwidth shortage is likely to be further compounded by the increasing move towards a greater use of UAVs on a global scale. Over the past 10 years the U.S. UAV fleet has jumped from four drones to roughly 700. The Pentagon has recently announced its intentions of buying at least 50 more UAVs of the extended range category, signaling its focus shift towards more Communications-On-The-Move (COTM) for UAVs in the coming years. The inevitable outcome of this focus shift is that the numbers of concurrent UAV flights will more than double, leading to an even greater satellite bandwidth problem.

Source:
http://carlisle-www.army.mil/usawc/Parameters/03wInter/rayerman.htm

If further evidence was needed the graph below depicts the satellite bandwidth demand in Mbps against the growth of U.S. military personnel. To make matters worse the chronic shortage of bandwidth is compounded by the sweeping defence budgetary cuts and a growing political unrest alongside mushrooming terrorist threats on a global level. In Britain this amounts to the slashing of defence spending by about eight percent in real terms over the next four years; and in the U.S. President Obama has asked congress to scale back defence spending by a massive $450 billion over the next decade.

Light At The End Of The Tunnel

What can be done to alleviate the problem? Fortunately there is cause for optimism as a new, third generation, breakthrough satellite modulation technology NS3™. According to tests conducted independently by 49 different users, this improved spectral efficiency technology is capable of boosting satellite capacity by 20 percent, and 78 percent over the second generation DVB-S2 under identical conditions. Furthermore, the NS3™ technology is much more robust than the previous generation, especially under extreme, unfavorable conditions such as strong phase noise or power-limited satellite. Satellite bandwidth shortage is caused by two factors: first the increased demand for extra capacity caused by the growing deployment of bandwidth-hungry UAVs, which is competing for supply with other market sectors like the broadcast industry where demand has also been



Over the past 10 years the U.S. UAV fleet has jumped from four drones to roughly 700.

skyrocketing due to the increasing adoption of other bandwidth-hungry technologies such as HD and 3D TV programmes. This is set against a backdrop of a shortage of 'space in space' where the demand for satellite bandwidth is outstripping supply—a situation that some industry analysts estimate will reach a critical juncture in 2015 when supply will exceed demand.

To understand the significance of the new satellite modulation technology it's important to look at the evolution of the marketplace.

In 1995, the first satellite Digital Video Broadcasting standard DVB-S was developed. This offered a maximum speed of 45Mbps and represented a major landmark in the evolution of the satellite industry that was globally adopted as the de-facto standard. In 2005 however, a new technology breakthrough created a second generation standard, aptly named DVB-S2, which represented a dramatic improvement of around 25-30 percent on its predecessor.

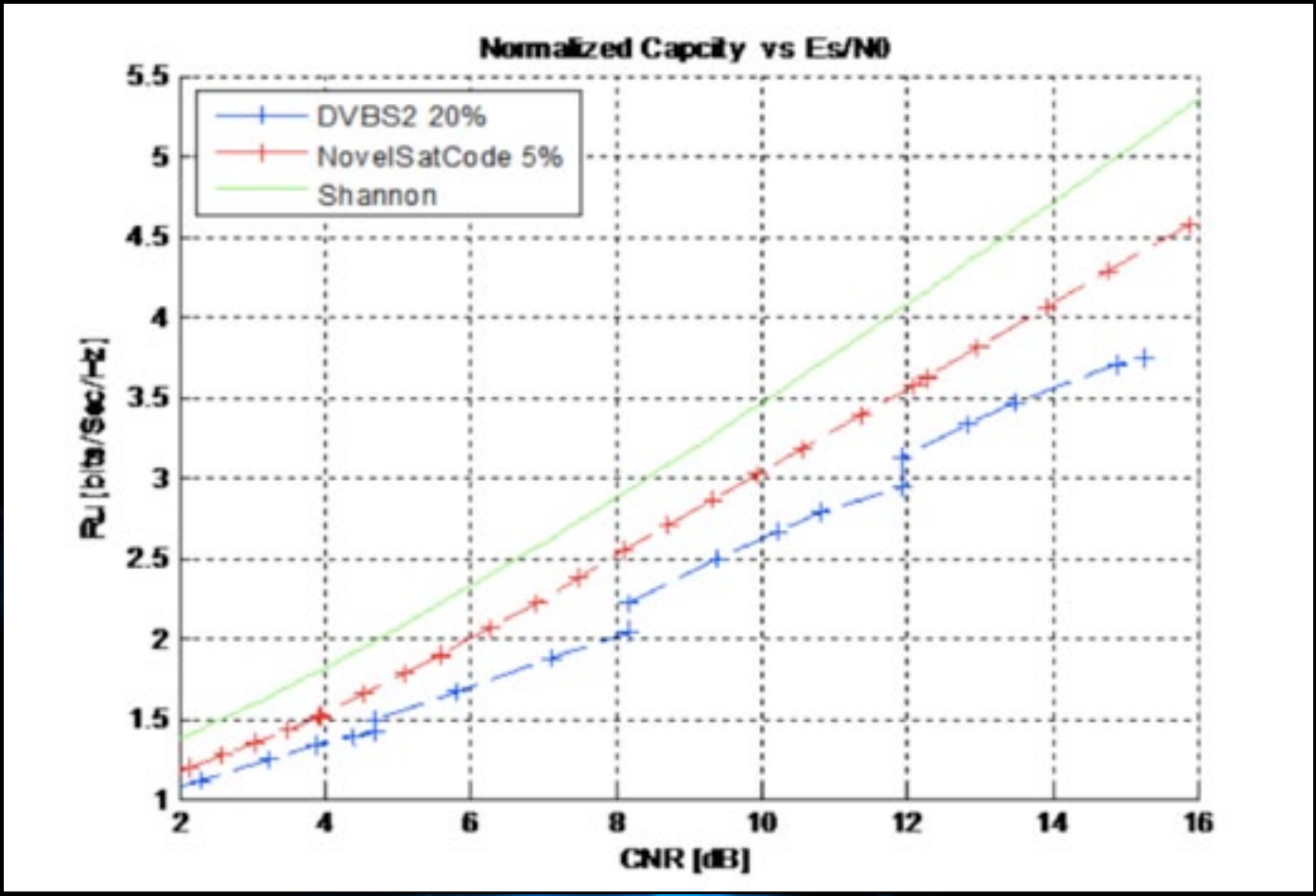
Until the appearance and acceptance of the NS3™, during the spring of 2011, many believed that a full generation improvement over the DVB-S2 was not possible.

The Next Generation Of Satellite Communication

However most recently a new technology has emerged, NS3™ which has been tested in 49 independent trials by Tier One operators worldwide. Despite the initial modest claims of up to 20 percent capacity boost, many of these tests conducted on different satellites around the globe typically showed a much better result in the range of 28 percent and 78 percent increase over DVB-S2 standards and data rates of up to 358 Mbps. Such dramatic improvements have been brought about by improved spectral efficiency which enables more traffic to be transmitted over the same sized pipe.

The ramifications of this are widespread in offering either a 28 percent cost reduction to transmit the same amount of traffic over the previous best case scenario (DVB-S2) or a 28 percent and above percentage increase of available capacity in acute bandwidth shortage territories like Western Europe and parts of Asia, or a 35 percent reduction in antenna size to achieve the same throughput. Whilst taken in isolation these figures may not seem huge but set against the escalating cost of satellite transponder leasing costs they represent a huge sum of money.

However on a 72 MHz wideband transponders the savings are dramatically increased, as NS3™ has the capability to support the full transponder with a single carrier. Previously ground equipment was limited to handling no more than 36 MHz transponders on a single carrier and had to break up the 72 MHz transponder into two carriers. With the advent of the new third generation of satellite technology the full wideband transponder can be accommodated on a single carrier, which means that you can saturate the transponder, and utilise its full potential. Unsurprisingly, therefore, some trials over wide transponders have shown a dramatic surge that ranges between 50-78 percent capacity boost over the current best equipments. This superior and unprecedented performance of 358 Mbps data rate over a 72



Improved spectral efficiency technology is capable of boosting satellite capacity by 20 percent, and 78 percent over the second generation DVB-S2 under identical conditions.

MHz transponder is significantly higher than the next best data rate of 168Mbps by best performing current modems.

To illustrate this point let's examine the average costs of leasing space segments on a satellite transponder. An average transponder costs $3-7K per MHz per month which equates to $36-84K per year. If we assume the new NS3™ standard offers 28 percent typical savings on a 36 MHz transponder, this equates to a saving per 36 MHz transponder of $360-$840K per year on the leasing costs. Contrast this with the savings on an average 72 MHz transponder using a conservative figure of 62 percent in bandwidth savings, then the savings per year per transponder are of the order of $1.6M—3.7M.

However, the importance of this new technological innovation in the satellite market extends beyond its benefits for UAVs alone, to also encompass ground warfare. Often ground campaigns are conducted in areas where satellite signals are poor due to limited spectral availability or difficult terrain or meteorological challenges. Another advantage of this new satellite modulation technology is its ability to enlarge the satellite footprint coverage, or to operate with the same throughput while using 2.5dB lower reception quality, or providing 28 percent more capacity at an identical link budget[3], fade margins and power.

Another issue for ground forces and UAVs alike is the weight and size of the antenna required to transmit the satellite signal. For ground forces this ability to reduce the antenna size by 35 percent means that the size and weight of antenna in a soldier's individual backpack is in turn reduced. For a UAV this reduction in aerial size has significant benefits in the possibility of improving the aerodynamics of the aircraft, reduce air drag and fuel consumption and increase flight range and duration. No less important is the potential to reduce the aircraft size (which is often limited by the minimum antenna size) in order to render it less easy to detect.

Earth Observation satellites, which are orbiting the Earth every 90 minutes at around 400Km altitude, represent another frontier that can be dramatically improved by the introduction of NS3™ technology by enabling 37-50 percent faster download of video and data, as the satellite is passing for only a few minutes by their friendly ground station during each revolution of the Earth. The inherent problems regarding the cost and availability of bandwidth are equally present in this sphere of operation and here, too, the issue of performance is particularly important. Geostationary communication satellites are orbiting at around 35,786Km (22,236Mi) altitude, synchronised with the Earth's rotation. They need to transmit ever increasing volumes of video (HDTV, 3DTV, with an ever increasing number of channels) and data.

From a Homeland security point of view, the importance of the robustness of satellite communication should not be underestimated during disaster recovery. During this past March earthquake and tsunami in Japan it was reported that more than 15,000 businesses and million and a half homes have been left without communication for a very long period of time. Out of the four submarine cables and four additional spare submarine cables that connect Japan to the United States, six of them were damaged and have become useless. One cannot under estimate the huge financial benefit, and mandatory need to build such a backup network for Japan based on this type of third-generation satellite transmission technology.

In conclusion, as 2012 beckons and defence budget cuts loom and governments grapple with the challenges of deploying more digital weapons around the globe, new technological innovation has successfully improved—despite what was previously considered impossible to better. This technological breakthrough offers fresh cause for optimism as it tackles the overwhelming shortage of satellite bandwidth to free up sufficient space in space to accommodate the brave new world of digital weapons that can help defend our planet.

References

[1] Taken from a paper, titled "On the Definition of a Space Weapon" written by David Webb from the Praxis Centre, Leeds Metropolitan University.

[2] According to a report by Greg Jaffe on October 4, 2002 appearing in the Wall Street Journal.

[3] A link budget is the accounting of all of the gains and losses from the transmitter, through the medium (free space, cable, waveguide, fiber, etc.) to the receiver in a telecommunication system

Author's Bio

David Furstenberg has served as CEO at various telecom companies, as well as VP Sales Global at Audiocodes and VP Global Strategic Relationships at Comverse. David has launched several start-up firms in home networking, automated PC fixing, and image processing.

Currently, David is Chairman of the Board for NovelSat, a high-end manufacturer of the world's most innovative, 3G-Sat ground equipment for satellite transmission, NS3™. David's passion for the real world global bandwidth issues that NS3™ can significantly alleviate has him personally committed to the success of NovelSat's robust, versatile, and elite family of products featuring NS3™ that include the World's highest quality Modulators, Demodulators, Modems, and ASIC. NS3™ is capable of boosting capacity by up to 78 percent in a wide range of satellite applications including Video broadcasting, Data, cellular backhaul, VSAT, Government, and ASIC. NS3™ removes the tuner limitation on support of 72MHz wide transponders while providing the highest data rate in the industry.

SATCOM LIFELINES

by Zahed Zaheer, Director of GMPCS Affairs, Thuraya

NGOs (Non-Governmental Organization), also known as the "third sector", are playing a pivotal and catalytic role around the world in empowering and spurring communities to achieve sustainable development. According to analyst reports, NGOs are significant economic players that account heavily in some countries for GDP figures.

As a growing sector globally, NGOs contribute greatly in relief, humanitarian aid, development assistance, reconstruction, basic infrastructure development, health and emergency projects. With many of these activities based in remote regions, NGOs often need advanced communication facilities that can operate beyond the terrestrial reach in order to activate their vital field operations. For this particular sector, the answer lies in satellite communications—the most reliable communication means available outside of connected urban centers.

Sharing of information and coordination of activities with many locations around the world are vital for NGOs, and paramount to conducting business professionally and effectively. They demand tools that allow them to send and receive practical and up-to-date information to support planning and the deployment of projects, coordination of supplies, emergency communications, as well as to safeguard their staff in the field. Hence, both satellite high-speed data and voice services that are easy to deploy are of utmost importance to NGOs. That is because logistical support, welfare and business continuity are contingent on the efficiency of their communications systems. For that very reason, NGOs are highly selective when it comes to the capabilities and features they require from SATCOM solutions offered by *mobile satellite services* (**MSS**) operators.

To conduct their business in various countries and in areas that are often impoverished and under-developed, NGOs generally require rapidly deployable mobile solutions, a reliable service, compact units and, most importantly, offered at a cost-effective price. They need a solution that is easily portable and can be set up in seconds, and one that flexibly integrates with other existing systems—all of these are features for the emergency response apparatus.

Due to the nature of locations where they operate, war-hit or disaster-stricken hotspots, the communication solutions deployed by an NGO literally become a life support function. Hence, it is vital that they are resilient enough, and that they work every time.

Thuraya, an international mobile satellite operator has always been a communication partner of choice for several large NGO organizations. With ubiquitous coverage in more than 140 countries in Europe, Africa, Middle East, Asia and Australia, their solutions can be deployed in almost all of the countries and areas where NGOs are actively present. A large number of NGOs are located within the Company's footprint, which conveniently positions them as the facilitator of the communication requirements and needs for NGO sites and campaigns. Specifically, when there is a need to exchange critical information between head offices and the field, their fast, powerful and reliable network ensures reports and videos are received efficiently, and on time.

Regulations when selecting communication tools are not something that NGOs want, or need, to worry about. Encountering lengthy bureaucratic systems can cause delays in field operations. Thuraya has conscientiously ensured that in the vast majority of countries within its coverage, it provides licensed operations that are compliant with national as well as international regulations. In addition, their consumer terminals comply with international standards and specifications, and have been certified by International Test Houses accordingly. Moreover, the Company has a robust distribution network of partners that include several national telecom operators; all of whom are commercially licensed to offer their services. Hence, NGOs are alleviated from the burden of being bothered about regulated services when they select them.

To ensure consistent and unfailing service, Thuraya provides a network that intelligently and dynamically allocates resources

in high usage areas. Even when there are many simultaneous users in a hotspot or conflict zone, connectivity is ensured via this powerful, robust network, which assures NGO consumers of congestion-free and uninterrupted communications. The Company's satellites have the capability to immediately divert 20 percent of its power to a single spot beam to meet any increased communication requirement resulting from any sudden development, *e.g.*, a natural disaster or a human crisis.

Thuraya's solutions and service packages are designed in such a way that enables this sector to perform its mission efficiently and resourcefully. This is very important for emergency situations following natural disasters or during peace-keeping and humanitarian efforts where NGOs play a major role. During such missions, NGOs tend to set up their own communication systems if terrestrial networks are unavailable or have been destroyed. For those circumstances, they need to know that their alternative means of communications functions at all times, or can serve as an unfailing backup.

When crises strike, NGOs need to react very quickly, sometimes in a matter of hours, which makes reliable and rapidly deployable SATCOM solutions a must. Devices that need sophisticated programming or are bulky to carry and move with will simply be inappropriate for NGOs. When it comes to product size and portability, Thuraya has always been recognized for innovating and offering compact satellite telecom solutions. The Company pioneered the smallest satellite phone, SO-2510, and the smallest satellite broadband solution Thuraya IP to support 384 Kbps streaming.

Designed for powerful high-speed data services, Thuraya IP is compact and rapidly deployable. A-5 sized, it is unmatched in the market in terms of compactness, making it smaller than a regular notebook, and weighs only 1.3 kilograms. The NGO staff can carry it easily while traveling, and most importantly, it is a plug-and-play system, requiring no additional software to operate. It offers speeds of up to 444Kbps standard IP in addition to the guaranteed rate of 384Kbps streaming IP, making email, Internet browsing and video-conferencing available instantly to NGOs.

NGOs also expect versatile communications' solutions to be at hand for the various tasks ahead of them. During emergency situations, NGOs need to communicate with several parties to facilitate search and rescue operations, to coordinate refugee movements, supply management and more. To assist them during such critical tasks, Thuraya offers a netted communications solution based on Thuraya IP, which is a leading-edge solution that integrates different communication technologies into a single closed user group. This service merges Thuraya IP, Thuraya handhelds, public switch telephone networks, GSM and radio systems to provide the NGO with a powerful netted communications solution for emergency communications. With this offering, NGOs can communicate with various parties using different technologies reliably to expedite smooth operations.

In many cases, the area where NGOs manage their projects is vast, with many remote regions. This means the NGO staff should have access to *communications-on-the-move* (**COTM**) in a car or truck. For this purpose, Thuraya provides a Comms-on-the-Move vehicular antenna. Similar to Thuraya IP, this antenna is the smallest and allows consumers to access high-speed data in vehicles moving at very high speeds due to its two axis antenna.

Wireless communications capabilities are also required by NGOs so as not to inhibit their movement. With Thuraya IP, NGOs can create a Wi-Fi hub, allowing more than one consumer to connect to data services.

Managing cost is an extremely important aspect for NGOs who often operate with limited budgets. That factor increases the appeal of Thuraya IP, which is a satellite broadband solution to provide asymmetric streaming, allowing NGO consumers to select upload and download data speeds per their requirements, thus paying only for the bandwidth they consume. Concurrently, there are flexible pricing packages that suit budget-conscious consumers. From unlimited to a zero-monthly fee to on-demand plans, they provide an affordable service without any compromise on quality. The Company also offers a *Shareplan* whereby consumers can share airtime allocation across all Thuraya solutions, voice and data, allowing even greater savings.

As an industry leader in satellite handhelds with 65 percent market share within its coverage area, Thuraya's voice services have been a prime choice for NGO consumers. They select Thuraya due to the service quality and availability of dual-mode handhelds, such as the Thuraya SG-2520. The most recent handheld developed by Thuraya, the XT, has also gained strong momentum with NGOs. It is one of the smallest phones to offer **IP54/IK03** certification, making it splash water, dust and shock-proof. In essence, it is highly durable in rugged environments. NGO staff can drop it, the phone can be covered in dust or sprayed with water whilst working, and it will still remain functional.

Most importantly, the phone offers full walk-and-talk capabilities, allowing NGO consumers to move freely without worrying about gaining the satellite signal. This is essential during crisis situations. The phone allows superior voice clarity due to its high codec rate, meaning there is no sound distortion. That is an important feature because speed and clarity of information exchange is critical to the success of NGO assignments.

Thuraya XT is also the only handheld to offer optional GPS waypoint navigation that allows users to navigate their way to a selected location with the phone providing distance and directional assistance through an electronic compass. As NGO staff are normally based in outdoor and remote locations, they inevitably require GPS services to reach certain locations, and to be reached in the event of an emergency. The phone also offers the highest data rate on any satellite handheld for broadband mobility.

NGOs are increasingly becoming a welcome force to be reckoned with for humanitarian, community services, emergencies and relief missions. As a leading international mobile satellite operator with a vast experience of handling NGOs' telecom requirements, Thuraya will continue to innovate, design and offer telecom solutions that are unique, add value and further facilitate work and mobility for the NGO staff—all of which is enabled by the versatility and robustness of Thuraya's satellite network.

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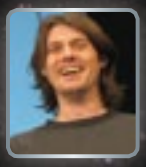

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