

SATCOM For Net-Centric Warfare

January 2015

MilsatMagazine



Weighing Proprietary Vs. Industry Standards for Government Solutions—Karl Fuchs

2014 Was A Very Good Year... For Boeing's GPS IIF Satellites—Dan Hart

Addressing International Defense + Government Needs—An iDirect Solutions Focus

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MEPS Helps Batteries Not To Fade Away—Jonathan Kasper and Greg Semrau

NSR Analysis—COMSATCOM Capacity: DIY... Or?

31st Space Symposium Honors + Preview

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Participants in the 25th Annual Bataan Memorial Death March prepare to start their 26.2-mile trek at White Sands Missile Range, New Mexico. More than 6,200 participants came to honor more than 76,000 Prisoners of War and Missing in Action from Bataan and Corregidor during World War II. The course starts on White Sands Missile Range, enters hilly terrain and finishes through sandy desert trails, with elevation ranging from 4,100 to 5,300 feet. Photo is courtesy of U.S. Air Force photo/Airman 1st Class Aaron Montoya.

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FIRST OF ITS KIND RADIO PROVIDES SECURE COTM NETWORKING



Harris Corporation has received a \$5 million order from the U.S. Marine Corps for additional Harris Falcon III@AN/PRC-117G wideband manpack tactical radios.

The Marines will acquire the equipment to broaden the deployment of secure networking of Communications-On-The-Move (COTM).

The field-proven AN/PRC-117G is a first-of-its-kind radio, delivering unprecedented situational awareness through wideband networking of the battlefield.

The system delivers critical real-time information to warfighters on the move and their field commanders through a man-portable software-defined radio with significantly reduced size and weight.

The AN/PRC-117G radio allows streaming video, collaborative chat and other advanced applications.

The AN/PRC-117G is the first JTRS Software Communications Architecture (SCA)-certified and NSA Type-1 certified wideband manpack radio system.

The radios are mounted into the AN/VRC-114 50-watt vehicular amplifier adapters, also acquired by the Marines as part of the procurement.

The AN/VRC-114 vehicular adapters provide greater power amplification and connectivity with all radios in the network.

"This most recent order expands the Marine Corps' installed base of wideband networking capabilities, supporting deployed forces with the most advanced tactical communications system available," said Brendan O'Connell, president, Department of Defense business, Harris RF Communications.

He continued, "The AN/PRC-117G offers greater flexibility in operational planning and execution and is capable of setting up tactical networks to pass chat, e-mail, ISR feeds and biometrics and other types of data."

The AN/PRC-117G manpack radio was developed following the U.S. Joint Tactical Radio System (JTRS) program's Enterprise Business Model (EBM).

The EBM encourages companies to develop next-generation solutions in tactical communications using their own investment capital. In doing so, the

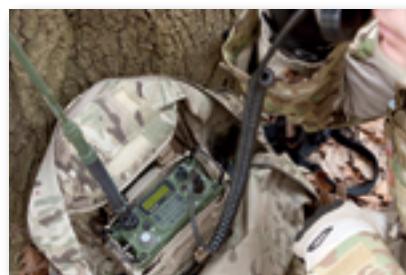
EBM encourages competition, increases innovation, reduces costs and speeds development of important capabilities.

The Falcon III AN/PRC-117G and other Falcon III radios have been adopted by the U.S. Department of Defense, federal agencies and key allies such as the United Kingdom, Canada, Germany, other NATO countries and Australia.

In 2010, *C4ISR Journal* named the AN/PRC-117G as a Big 25 award winner in the category of network systems, recognizing the technology for having "a significant impact in defeating terrorists, preventing attacks, and enabling troops to make the right decisions on the battlefield."

Learn more at the Harris Falcon III AN/PRC-117G infosite:
<http://rf.harris.com/capabilities/tactical-radios-networking/an-prc-117g/default.asp>

A Harris wideband networking solutions video is available for viewing at
http://rf.harris.com/media/Harris%20Wideband%20Networking%20VO_tcm26-23245.webm



DISPATCHES

HERE COMES THE MRGEO TOOLKIT



The National Geospatial-Intelligence Agency (NGA) recently released an application that will allow the public to benefit from the agency's collaboration with DigitalGlobe on a project that simplifies and economizes the storage and processing of large-scale raster data, reducing the time it takes analysts to search, download, preprocess and format data for analysis.

MapReduce Geo, or MrGeo, is a geospatial toolkit designed to provide raster-based geospatial capabilities performable at scale by leveraging the power and functionality of cloud-based architecture.

Releasing MrGeo helps further the agency's goal of increasing and streamlining co-creation efforts in software and unclassified data, said Rasmussen. Sharing the application with the open source community helps accelerate its potential to become the standard for storing, enriching and analyzing massive amounts of raster data in a distributed cloud environment.

"The project demonstrates how public-private partnerships can create innovative solutions," said Tony Frazier, senior vice president of DigitalGlobe U.S. Government Solutions. "DigitalGlobe feels the open source community can drive innovation that helps us better mine our imagery and derived information layers to support emerging defense and intelligence mission requirements."

"Available to the public through NGA's GitHub account, the software can be useful in many situations," said Chris Rasmussen, NGA's public software development lead. "Sharing it with the public gives users at all levels another tool to help solve geospatial problems. For example, first responders could use it to plan the best ways in and out of dangerous areas taking into account terrain, land use, and changes in weather."

MrGeo is available at: <https://github.com/ngageoint/mrgeo>.

DigitalGlobe's infosite may be accessed at
<https://www.digitalglobe.com/>

The NGA infosite is located at
<https://www1.nga.mil/Pages/default.aspx>

DISPATCHES

CRITICAL PROCESSORS FOR SATELLITES BEING DEVELOPED BY U.S.A.F.



The Air Force Research Laboratory (AFRL) and a small business partner are developing technologies that they expect will enable successful use of high-power processors that operate on satellites with funding from the Air Force Small Business Innovation Research (SBIR) program.

A next-generation, micro-chip carrier is currently in development by ThermAvant Technologies LLC, located in Columbia, Missouri, and is already being tested by manufacturers of several major commercial and military satellite and aerospace systems.

This innovative cooling solution will reduce the temperature of high-power satellite components to levels manageable by the spacecraft's thermal control system. This is advantageous, because it improves processor reliability while providing the opportunity to increase on-board processing.

"If successful, this technology solution could be headed for every major DOD (Department of Defense) space system, where it will replace the current, state-of-the-art technology developed during SBIR programs 10 years ago," said Dr. Greg Spanjers, the chief scientist of AFRL's Space Vehicles Directorate.

AFRL and ThermAvant began researching the application of this technology as a result of an Air Force SBIR solicitation. The project called for reliable, high-conductivity heat spreaders; ThermAvant demonstrated the improved heat transfer

properties of different structural materials (including aluminum, titanium, copper and Copper Molybdenum composite) embedded with the Oscillating Heat Pipe (OHP) technology. OHP-embedded chip carriers and heat spreaders will be used to transport heat dissipated by micro-chips to the spacecraft's larger thermal control systems.

This is a critical technology for space-based systems that will enable the deployment of higher temperature and power processors aboard satellite payloads. It can be used in both commercial and military satellite applications, as well as any high-performance land-based electronics. ThermAvant successfully investigated the thermal performance tradeoffs of different fabrication processes for making OHP heat spreaders under a range of simulated real-world operating conditions.

During the testing, Therm-Avant's prototype OHP-embedded heat spreaders provided an 84 percent reduction in the temperature rise across the heat spreader, when compared to current state-of-the-art technologies. This reduction in temperature provides many benefits for the Air Force, but the most striking is the ability to increase the on-board computing power.

Current satellite processors are running at 10 percent of their operating capability as a result of insufficient thermal management. Reducing the junction temperature allows for increased processing capability (up to 10 times more) and increases the expected lifetime of the

on-board chips. Additionally, the advanced manufacturing techniques developed under this effort will allow this higher-performing technology solution to be manufactured at a lower price point than competing technologies.

The company's improved methods for making OHP-based products has already demonstrated commercial promise to both space- and ground-based thermal management applications for electronics. During the first year of this Phase II SBIR, ThermAvant transitioned OHP-based thermal management solutions to four major defense contractors for six applications on platforms ranging from Army tanks to Navy ships and Air Force aircraft and spacecraft. In these applications, the OHP-based thermal management solution performs five to 50 percent better than the status quo and is, on average, approximately 20 percent less expensive.

The Air Force SBIR and Small Business Technology Transfer (STTR) programs are mission-oriented programs that integrate the needs and requirements of the Air Force through research and development topics that have military and commercial potential. The SBIR program was established by Congress in 1982 to fund research and development (R&D) through small businesses of 500 or fewer employees.

The Air Force SBIR and STTR programs provide more than \$300 million in funding for research and development activities by small businesses annually. With this budget, the Air Force funds research from the early stages of concept development until it transitions to military or commercial use.

For more information, please visit
<http://www.afsbirsttr.com/>

The ThermAvant Technologies infosite contains additional company information at
<http://thermavant.com/>

DISPATCHES

MILSAT FOR SES + LUXEMBOURG



SES Satellite Operations Headquarters

SES and the Luxembourg Government have announced plans to launch a dedicated satellite for governmental use in late 2017.

A Luxembourg-based company jointly held by SES and the Luxembourg Government is planned to own and operate the new spacecraft. The Luxembourg Government and SES would each invest 50 million euros into the new company, which, at the same time, would receive a 125 million euros bank loan from a consortium of Luxembourg banks to finance the satellite's procurement and launch.

This investment has been accounted for within SES's existing capital expenditure projections. The spacecraft would be slotted for European, MENA and APAC coverage.

The capacity of the new satellite would satisfy Luxembourg's requirements for satellite communications in military frequencies. Capacity would also be made available to governmental and institutional customers for defence and governmental applications. The multi-mission satellite will use dedicated military frequencies (X-band and Ka-band), providing high-powered and fully steerable spot beams to support multiple operations.

"This new, ambitious public-private partnership demonstrates the importance of Luxembourg in the international space sector and the close and successful ties between SES and Luxembourg. SES fully acknowledges the importance of the Luxembourg Government's participation in this future enterprise," said Karim Michel Sabbagh, President and CEO of SES.

"Emerging from the national space sector, this project is not only an important contribution of Luxembourg to European defense, but it further supports the government's economic diversification policy in a key technology sector," said Etienne Schneider, Deputy Prime Minister, Minister of Defense and Minister of Economy.

SES infosite: <http://www.ses.com/>

DISPATCHES

MILITARY STRATEGY CHANGES WILL BE NEEDED IF SEQUESTRATION REMAINS IN FORCE

Unless Congress changes the Budget Control Act, which now requires a return to sequestration-level spending cuts in 2016, the military will need to change its strategy, the chairman of the Joint Chiefs of Staff said in a recent interview broadcast.

In an appearance on "Fox News Sunday With Chris Wallace," Army Gen. Martin E. Dempsey said the Army is drawing down from 570,000 soldiers to 450,000, but he noted that a Pentagon analysis shows sequestration would drive that number to 420,000, and even lower under some circumstances.

"Under those circumstances of sequestration in the Budget Control Act, we would, in fact, have to change our strategy, and we would be far less able to maintain the kind of global presence and the kind of stability we bring to our allies," the general said.

As it now stands, the chairman said, the Budget Control Act limits the options the military can provide to elected leaders against any given challenge. "We provide options," he added. "Those options really begin to shrink dramatically [under the act]," he added.



Sequestration would leave the military "far less able to do the things that we think the country needs us to do," Dempsey said.

Meanwhile, the United States continues to face threats from both state actors and nonstate actors, the chairman said.

The nexus of those two "make this period in our history so incredibly complex and so incredibly dangerous," Dempsey said. State actors, he explained, carry the risk of miscalculation and being pulled into an escalating conflict.

"With non-state actors, it's kind of a persistent threat," the chairman said. "We know for a fact that there are nonstate radical, violent extremist organizations who today, and for the next generation, will be plotting against Western interests, to include the United States. So we've had to do is adapt our military to address both of those challenges."

Though he's concerned about that, Dempsey said the United States is still the most powerful nation in the world, by any measure, and is likely to remain so "unless we—unless we talk ourselves out of it and legislate ourselves out of it with things like the Budget Control Act."

"What will get us through this is investing in our human capital," the chairman said, "because we're going to have to think our way through the future, not bludgeon our way through it."

*Story by John D. Banusiewicz,
DoD News, Defense Media Activity*

VISLINK HELPS TO ENSURE U.K.'S CONSTABLES ARE SAFER

Vislink's real-time airborne downlink (ADL) equipment is being deployed by law enforcement agencies throughout the U.K. as part of a Home Office project to boost surveillance capabilities and enable accurate and timely decision making.

Vislink has been selected to fit 15 aircraft with new integrated video downlink systems capable of transmitting live images from airborne assets to multiple receive sites. During joint operations, regional forces and national agencies will be able to access ADL images transmitted from aircraft using portable and handheld equipment, and also at regional command

and control centers throughout the UK. Vislink's airborne downlink equipment has been a key part of the Metropolitan Police Service since 2006 and is already in operational use across the U.K. With high quality output and H.264 encoding this new equipment greatly improves transfer speeds compared to traditional analogue systems and will increase situational awareness at all levels.

Inspector Richard Brandon, Executive Officer, Metropolitan Police Air Support Unit. "The ADL project has delivered significant improvements to an already excellent Vislink system used by the Met

for many years. Improvements have been noticeable in terms of picture quality and stability, transmission range and security encryption. The new ADL system also lets us operate throughout the U.K., and we have already demonstrated the benefits of this interoperability during a recent multi-agency operation."

All remaining equipment will be delivered by the end of this year, with the project expected to complete in March 2015.

More info at: <http://www.vislink.com/>

DISPATCHES

U.S.N. PREPPING FOR MUOS LAUNCH

Navy military and civilian engineers are preparing the latest military communications satellite for a planned January 20 launch from Cape Canaveral Air Force Station, Florida.

The satellite is part of MUOS, or Mobile User Objective System, which operates like a smartphone network from space, vastly improving secure satellite communications for mobile U.S. forces. Unlike its predecessor system, MUOS provides users a global, on-demand, beyond-line-of-sight capability to transmit and receive high-quality voice and mission data from a high-speed Internet Protocol-based system.

This third of five MUOS satellites was encapsulated into its payload fairing, Dec. 19, representing one of the final steps in preparation for its upcoming launch. The payload fairing protects the satellite from forces during the early stages of its journey.

"This third MUOS launch is another major step toward achieving a fully operational MUOS end-to-end capability by 2016," said Navy Capt. Joseph Kan, the MUOS program manager. "The Navy, in close collaboration with the Army, Air Force and our industry partners, is bringing the future of worldwide mobile satellite communications into reality for the United States and potentially allied nations."

The Navy plays a key role in national space efforts by providing narrowband satellite communications for the DoD and other government agencies. While MUOS was designed for mobile users who require worldwide, secure voice and mission data at higher data rates, services are also available for ships, aircraft and vehicles.

MUOS is more than just a five-satellite constellation. It additionally comprises four ground stations across the globe, complex software to manage the network and a Wideband Code Division Multiple Access waveform that serves as an interface for end-user radios.

Two MUOS satellites, launched in 2012 and 2013, are already providing legacy communications capability from their geosynchronous orbit locations 22,000 miles above Earth. Ultimately, the satellite constellation and associated network will extend narrowband communications availability well past 2025.

The Navy's Program Executive Office for Space Systems, located at the Space and Naval Warfare Systems Command in San Diego, is responsible for the MUOS program.

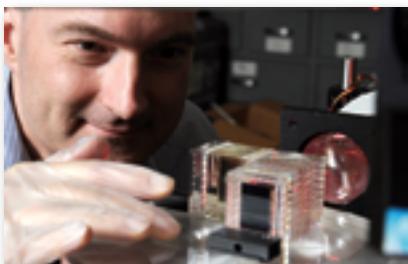
DISPATCHES

A MIGHTI FLIGHT IS BEING PREPARED BY NRL FOR NASA

A U.S. Naval Research Laboratory (NRL) instrument designed to study the Earth's thermosphere is part of a satellite mission that NASA has officially confirmed, with launch expected in 2017.

The NRL Space Science Division (SSD) developed Michelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI) satellite instrument is part of NASA's Ionospheric Connection Explorer (ICON) mission.

This mission, led by Dr. Thomas Immel at the University of California, Berkeley, will fly a suite of instruments designed to explore the mechanisms controlling the environmental conditions in space and how they are modified by weather on the planet. In studying this region where Earth's weather and space weather meet, researchers hope to find answers to their questions about how Earth's upper atmosphere behaves, since this part of the atmosphere is essential for the performance of many systems that use long-distance radio wave propagation.



NRL's Dr. Christoph Englert examines the prototype Michelson interferometer (MIGHTI) being developed at NRL for flight on NASA's ICON mission.
Photo: U.S. Naval Research Laboratory/Jamie Hartman

Ionospheres act as a boundary between planetary atmospheres and space, containing weakly ionized plasmas that are strongly coupled to their neutral atmospheres, but also influenced by the conditions in the space environment. They are mainly influenced by the influx of solar energy and particles but also by dynamical



forcing from the planetary atmosphere below, resulting in a remarkable set of non-linear behaviors, explains NRL's Dr. Christoph Englert.

The unpredictable variability of the Earth's ionosphere interferes with radar, communications and geo-positioning signals—a potential problem for ships, airplanes, and the military—and is a national concern. ICON makes a complete set of measurements of the state of the ionosphere and all of the critical drivers that affect it to explore and understand this variability.

NRL's MIGHTI instrument onboard the ICON satellite will contribute to reaching the mission goals by measuring the neutral winds and temperatures in the Earth's low latitude thermosphere. The MIGHTI instrument uses the DASH (Doppler Asymmetric Spatial Heterodyne spectroscopy) technique, which was co-invented and pioneered by NRL.

The payload consists of two identical units that will observe the Earth's thermosphere with perpendicular viewing directions. As ICON travels eastward and continuously images the thermosphere and ionosphere, MIGHTI will measure the vector components of the vertical wind profile.

NRL's MIGHTI is named for Albert Michelson, a physicist known for his research on the measurement of the speed of light using a related interferometer type. More directly, MIGHTI builds on technology previously used in NRL's SHIMMER (Spatial Heterodyne Imager for Mesospheric Radicals), a payload aboard STPSat-1.

The NRL MIGHTI team is led by Dr. Christoph Englert, head of the Geospace Science and Technology Branch in NRL's Space Science Division. In addition to SSD leading the MIGHTI instrument, NRL scientists Dr. Joe Huba from the Plasma Physics Division and Dr. Andrew Stephan from the Space Science Division will provide ICON scientific data analysis and interpretation.

Now that NASA has confirmed ICON, the next step is the critical design review in 2015. This design review will clear the way for the necessary flight hardware to be built. The ICON launch is planned for the summer of 2017.

ICON is an Explorer-class mission. NASA's Goddard Space Flight Center in Greenbelt, Maryland, manages the Explorer Program for NASA's Science Mission Directorate in Washington. UC Berkeley's Space Sciences Laboratory will develop the ICON mission and the two ultraviolet imaging spectrographs. The Naval Research Laboratory in Washington, DC will develop the MIGHTI instrument. The University of Texas in Dallas will develop the Ion Velocity Meter. The spacecraft is being built by Orbital Sciences Corporation in Dulles, Virginia.

The U.S. Naval Research Laboratory infosite may be viewed at
<http://www.nrl.navy.mil/>

DISPATCHES

RAYTHEON + GENERAL DYNAMICS JV FORMED FOR U.S.A.F. LAUNCH + TEST RANGE CONTRACT

The U.S. Air Force has awarded one of its most important space procurements, potentially a multi-billion-dollar contract to operate, maintain, and sustain launch ranges at Florida's Space Coast and Vandenberg Air Force Base in California, to a joint venture of Raytheon and General Dynamics.

The joint venture, called Range Generation Next (RGNext) is responsible for operations, as well as organizational and depot-level maintenance and sustainment for safe and effective launch, testing, and tracking of Department of Defense, civil, commercial, and international spacelift vehicles. It will also support ballistic missile, guided weapon, and aeronautical tests and evaluations.

The \$1.5 billion, single-award contract has a one-year base period with nine one-year options. Raytheon and General Dynamics formed RGNext to pursue the opportunity, known as the U.S. Air Force Space and Missile Systems Center's Launch and Test Range System (LTRS) Integrated Support (LISC) contract, supporting the U.S. Air Force Space Command. Existing operations and maintenance at the Eastern and Western launch ranges and the engineering and

sustainment work for the entire LTRS are being consolidated into LISC, primarily a fixed-price-incentive firm (target) contract.

The Raytheon RGNext infosite:
<http://www.raytheon.com/capabilities/products/rgnext/>

WEIGHING PROPRIETARY VERSUS INDUSTRY STANDARDS FOR GOVERNMENT SOLUTIONS

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

Should government products adhere to industry standards or rely on proprietary solutions in today's environment? Opinions vary on this subject.

Some in the industry take the viewpoint that all manufacturers should build to industry standards, which will allow for full interoperability. Others believe in proprietary standards which can allow for enhanced features and efficiency. Hardware manufacturers' overall goal is to provide the best possible product for the objectives at hand.

Military missions have a wide range of communications needs based on the Continuity of Operations Plan (COOP). Some missions require only low-speed data transfer with only small numbers of Voice over Internet Protocol (VoIP) streams required. Other missions require real-time, two-way communications such as VoIP but with a limited number of users. Yet other missions require very high bandwidth to support multiple, high-definition video streams.

This means that communications systems must be developed with an open architecture in which any vendor's satellite router can operate with any block upconverter (BUC) and low-noise block down converter (LNB) and with any antenna. Designing modems and antenna control units to adhere to well-defined open standards, such as ARINC 791 OpenAMIP, will ensure the design flexibility needed to meet mission demands.

Although the reasoning above seems self-evident, commercial corporations building COTS equipment have found there is a line to be drawn beyond which proprietary solutions best serve industry. Those with a more conspiratorial nature may assume a proprietary approach is taken simply to "lock" the customer into a one vendor solution. In reality, there are valid reasons—beyond capitalism—to develop proprietary solutions.



Furthermore, missions will operate from anywhere between fixed sites through iterant terminals to high-speed, long-range aircraft. As such, communicators must be able to freely choose the best of breed communications components to design the appropriate solution.

As an example, the best communications solution for an iterant terminal serving to provide VoIP to a small number of users might include a 1.2 meter, auto-point, parabolic antenna. However, this architecture would not serve the airborne community well. The choice of a flat panel or parabolic antenna under a radome will be driven by the type and air speed of a given aircraft as well as the link budget and data rates required.

Industry standards development lags behind state-of-the-art technologies. Vendors must be able to move more quickly and react to the changing demands of the market without hesitation. A less obvious, but more tangible reason for pursuing proprietary solutions, is standards bodies can essentially develop Interface Control Documents (ICDs), but complex systems require much more integrated design and development.

For example, standards for Single Channel per Carrier (SCPC) modems have existed for many years and vendor interoperability in SCPC modems is common place. Well-defined waveform standards exist and can be implemented by any vendor.



iDirect Government's Evolution 8000 Series Airborne Enclosure (e8000 AE) — front and rear views.

Similarly, waveform standards exist for time division multiple access (TDMA) systems. DVB-S2/RCS has been with us for some time now, and RCS2 is now well defined. However, neither RCS nor RCS2 has seen widespread adoption by satellite terminal vendors. Why is that? Why are there so many proprietary TDMA systems when open standards have been so successful in the SCPC market?

TDMA systems derive their efficiencies by allowing users to share network resources in an over-subscribed, contend state while still managing network characteristics, such as jitter, to allow real-time applications, such as voice and video to operate. TDMA systems dynamically reallocate bandwidth across a network very quickly, based on complex quality of service (QoS) rule sets. SCPC modems simply provide data access at a predetermined rate.

Adopting an industry standard waveform and acquisition method for a TDMA system is relatively simple. Developing true vendor interoperability is considerably more difficult if the desire is to preserve the bandwidth efficiencies of the TDMA system.

The true complexity of a TDMA system comes from the integration of a feature rich QoS and de-queuing mechanism with an agile and adaptive bandwidth management system. Adding to the complexity of the system is the requirement that a TDMA system be designed to support regional as well as global networks. This type of complexity goes well beyond the waveform standards such as DVB-S2/RCS2—even beyond terrestrial waveform standards, such as 802.11 or LTE.

Analogy often are made between satellite routers and WiFi cards in laptops or cellular systems and the desire for the seemingly seamless network-to-network interoperability in satellite routers is often expressed. This type of interoperability between TDMA satellite routers is technically feasible.

What would be diminished is the attribute that makes TDMA so attractive—that is, the ability to oversubscribe bandwidth while still maintaining the network characteristics needed to support real-time applications such as voice and video. Although bandwidth considerations are important in the terrestrial market, spectral efficiencies are paramount in satellite communications. To date, no set of standards written for TDMA modems would allow the level of over-subscription and efficiencies that proprietary systems have been able to achieve.

Solid industry standards are critical to system interoperability and successful missions. Industry standards should be seen as the baseline for core features. However, for certain enhanced features, proprietary standards are key to successful implementation of the technology.

Karl Fuchs serves as Vice President of Technology for iDirect Government.



An iDirect Defense + Government Solutions Overview



Fast, efficient and reliable broadband for globally assured access
Militaries not only need secure and mobile communications to connect soldiers in the field with central operations, but also to provide recreation and welfare services for troops deployed far from home.

Governments and Civil Agencies need flexible, secure and reliable solutions for ensuring diplomatic connectivity and public safety. The ability to quickly deploy and manage a network that can easily scale without the restrictions of an existing communications infrastructure is essential to military and government operations. Solutions need to be highly secure and reliable to provide assured access to any need, anywhere.

iDirect offers a highly reliable and extremely scalable satellite network that can be deployed on multiple satellites in C-, Ku-, Ka- or X-band, from a central hub. iDirect's broadband capabilities provide the connectivity for all voice, video and data

MILITARY COMMS ON THE MOVE
ESTABLISHING A COMMON OPERATING PICTURE ACROSS LAND, SEA AND AIR

CONNECTIVITY AT THE TACTICAL EDGE
Specialized Remote Terminal Unit (RTU) to integrate into port facilities
Reprogrammable equipment to withstand extreme conditions

INTELLIGENCE AT SEA
Remotes equipped with defense-grade radios, ports and antennas
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BROADBAND WHILE ON THE MOVE
Fast recovery after blackout from power outages for seamless connectivity
Industrialized components available for communication while on the move

AIRBORNE ISR AND CONNECTIVITY
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Doppler compensation and degrading software mitigates the Doppler effect

ADVANCED FEATURES ENSURE MILITARIES HAVE TOTAL CONTROL

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Automatic Beam Switching to maintain coverage across multiple beams
Beamforming to expand coverage across different satellite networks
- BANDWIDTH EFFICIENCY**
DRS (Dynamic Resource Allocation)
TDRS (Traffic Demand Routing System)
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FEC (Forward Error Correction) enhances robust performance
- TOTAL NETWORK MANAGEMENT**
Single view of all deployed remotes
Software Network Management System
Monitoring modules to ensure peak network performance
- MILITARY-GRADE SECURITY**
Hardware/software to support end-to-end and off-the-shelf interoperable security certifications (NATO, FIPS 140-2, STANAG, etc.)

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communications and specialized applications even in the most remote areas. With built-in AES encryption and optional TRANSEC, along with FIPS 140-2 compliance, security is never compromised.

Industrialized, lightweight and tamper-proof equipment that is easy to carry, maintain and quickly deployable has been designed specifically for use in field operations.

The iDirect Intelligent Platform™ provides true mobility with spread spectrum mobile waveform and high-speed Comms-On-The-Move (COTM) features enabling military vehicles, ships or aircrafts to broadband connectivity via very small antennas.

Solutions @ A Glance

- » Flexible platform supporting multiple satellites and bands: X-, C-, Ku- and Ka-band
- » Quickly deployable, robust and lightweight remotes for field operation
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- » Compliant with TRANSEC, FIPS 140-2 and STANAG security standards

To learn more regarding U.S. Government & Military solutions, contact iDirect's wholly owned subsidiary, iGT, at this direct infosite: <https://www.idirectgt.com/>



2014 WAS A VERY GOOD YEAR... FOR BOEING'S GPS IIF SATELLITES

By Dan Hart, Vice President, Boeing Government Space Systems

Boeing continues its support for the U.S. Air Force Global Positioning System (GPS) program, delivering four GPS IIF satellites into service in 2014.

These achievements mark the most rapid deployment tempo since the early 1990s when the first operational GPS satellites were being carried aloft. With the 8th GPS IIF now on orbit, two-thirds of the Boeing GPS IIF contract order have been launched—and 2015 looks to be almost as busy for Boeing.

The 9th GPS IIF was shipped to Cape Canaveral Air Force Station in December to prepare for the first GPS launch of 2015, expected in March. Current projections anticipate three GPS IIF launches in 2015 and the final mission in early 2016. The remaining three GPS IIFs are being stored and maintained at the Boeing Satellite Development Center in El Segundo, California.

The U.S. Air Force Space Command's Space and Missile Systems Center, located at Los Angeles Air Force Base, California, is the U.S. Air Force's center of acquisition excellence for acquiring and developing military

space systems, including the Global Positioning System (GPS).

The 2014 schedule put the GPS IIF team through its paces, with launches occurring approximately every three months to continue GPS modernization. Typically, two satellites were concurrently being processed at the Cape launch site, requiring strong execution, an unrelenting focus on mission assurance and solid team work among Boeing, the Air Force and United Launch Alliance.

Originally a creation of the U.S. Department of Defense to enhance US military war-fighting capability, GPS is available for use, free of charge, to anyone with a GPS receiver. The system achieved Full Operational Capability in 1995, with the completion of an orbiting network of 24 satellites in six orbital planes.

Today, U.S. and allied military forces rely on GPS devices, in virtually every system, to improve their capabilities and effectiveness while reducing risk to their forces and non-combatants.

The U.S.A.F. GPS IIF launch on May 16, 2014, via a United Launch Alliance Delta IV launch vehicle. Photo is courtesy of United Launch Alliance.





*GPS IIF-8 arrives at
Cape Canaveral Air Force Station, July 16, 2014.
Photo is courtesy of Boeing.*

Civilian community use continues to grow even more rapidly. From finance to farming to tracking packages, new commercial applications are continuously being developed and the estimate is that there are more than one billion GPS users around the world.

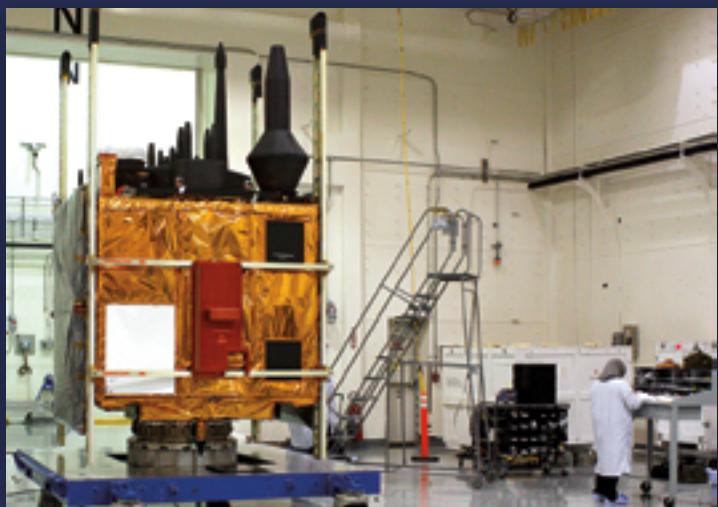
The Boeing GPS IIFs represent the current block of GPS satellites entering service and are one element of a long-term, comprehensive modernization effort by the Air Force.

The increased civil and commercial use of GPS, coupled with lessons learned from years of military operations and specific experiences during Operation Desert Storm, Kosovo, Desert Shield and Iraqi Freedom, drove the desire to modernize GPS and augment its capabilities while sustaining the core mission.

Boeing is under contract to the U.S. Air Force for 12 GPS IIFs, which bring next-generation performance to the constellation. The GPS IIF vehicle is critical to U.S. national security and for sustaining GPS availability for global civil, commercial and defense applications. The GPS IIF features more capability and improved mission performance over earlier GPS spacecraft, delivering:

- **Greater navigational accuracy through improvements in atomic clock technology**
- **A new civilian L5 signal to aid commercial aviation and search and rescue operations**
- **Improved military signal and variable power for better resistance to jamming in hostile environments**
- **A 12-year design life providing long-term service and reduced operating costs**

A GPS IIF satellite weighs about 3,600 pounds at launch, and measures 99x81x71 inches. This is a sharp comparison to the original Block I development satellites built by Boeing legacy company Rockwell, which weighed about 1,600 pounds. The navigation payload on the IIF is equipped with two rubidium clocks and one cesium. As these advanced satellites are entering service, GPS is setting new records for accuracy, with the IIF clocks among the best-performing in the active constellation that is now comprised of 31 satellites.



*GPS IIF-8 being processed, following arrival at
Cape Canaveral Air Force Station, July 17, 2014.
Photo is courtesy of Boeing.*

All GPS IIFs are launched aboard United Launch Alliance evolved expendable launch vehicles, either a Delta IV or an Atlas V. The ability to launch GPS on either rocket enhances scheduling flexibility. The launch schedule in 2014 was as follows:

- **February 20, GPS IIF-5, United Launch Alliance Delta IV—in service**
- **May 16, GPS IIF-6, ULA Delta IV—in service**
- **August 1, GPS IIF-7, ULA Atlas V—in service**
- **October 29, GPS IIF-8, ULA Atlas V—in service**

The first four GPS IIFs were launched in 2010, 2011, 2012 and 2013, respectively.

Boeing has delivered 46 of the 68 GPS satellites launched to date, accruing more than 525 years of on-orbit performance. This is a track record of which Boeing is extremely proud. Looking forward, Boeing is leveraging digital payload innovations, driven by the commercial satellite market and our next-generation commercial bus product line, to meet the government's future GPS needs.

Dan Hart is vice president of Government Space Systems for Boeing's Network & Space Systems division. In this position, he oversees the Wideband Global SATCOM, Global Positioning System, Tracking and Data Relay Satellites, Payload Programs, Experimental Systems Group and Advanced Information Technology programs. He was named to this position in December 2013.

Hart has held a wide variety of leadership roles in Program Management, Engineering and Operations across Boeing's Network and Space Systems unit. He has led teams in all phases of the product life cycle, from R&D through development, production and flight operations, and has supported more than 80 space launch missions across Manned Space, Satellite Development, Launch Vehicle Development and Missile Defense. Prior to his current assignment, Dan served as vice president and chief engineer for Boeing Network and Space Systems. He was responsible for providing functional oversight for all engineering, technology development and mission assurance activities by approximately 10,000 engineers.

NSR ANALYSIS: COMSATCOM CAPACITY—DIY... OR?

By Brad Grady, Senior Analyst, NSR USA



Every homeowner will eventually reach a point where they will ask themselves, "If I was to remodel my kitchen, would I Do-it-Myself or get a Kitchen-as-a-Service?"

With a Swedish kitchen remodel offering organized bliss and respectable prices... the extra labor often gets lost among the endless supply of nuts, bolts and Allen wrenches. Left to wonder how an entire kitchen will fit into a hatch-back, another big-box store promises to not only deliver... but also design, install, and finish the project. While both will support the kitchen sink, homeowners everywhere are left to weigh the merits of Scandinavian design against the 'one-and-done' approach.

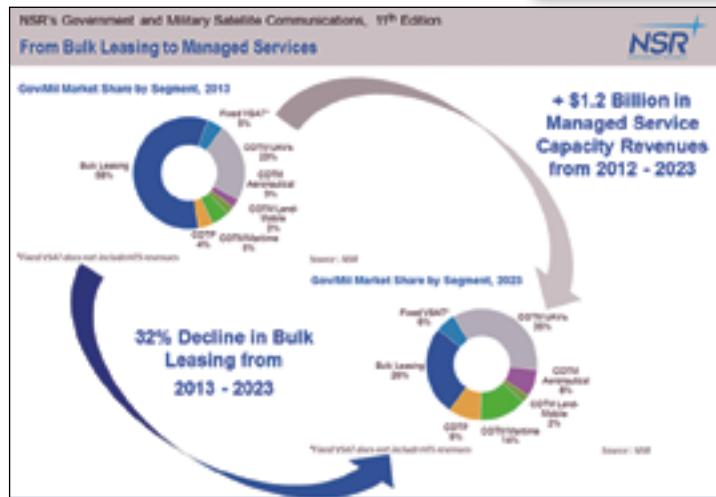
Similarly, Government and Military (MAG) end-users must make a choice when procuring Commercial Satellite Capacity (COMSATCOM), "Do I get the Hertz myself, or Get-it-as-a-Service?" Mainly, do they go the bulk leasing route, which offers cheaper per-MHz pricing and more flexibility at the cost of 'some assembly required', or the Managed Services direction that offers full-service, tailored solutions/applications at a potentially higher cost?

Just as every homeowner will reach that crossroad, the U.S. Government has found that 'DIY' vs. 'As-a-Service' depends on the situation. Specifically, all depends on the demands on the ground, the supply of proprietary capacity available in space, the technical abilities of the organization procuring the capacity (and security requirements), and the timeline over which the capacity will be used... plus the available budget. For the U.S. Government, Bulk Leasing has long been the popular choice when demands exceeded proprietary supply, taking advantage of the flexibility of raw capacity.

NSR's recently released **Government and Military Satellite Communications, 11th Edition** study found that bulk leasing contracts contributed 58 percent of MAG Satellite capacity revenues in 2013. Yet, over the past few years, managed services have become more attractive—both in the U.S. and around the world. Looking forward, that trend will only intensify with bulk leasing expected to contribute only 26 percent of MAG Satellite capacity revenues by 2023. In dollars, it will grow by just over \$50 million, compared to \$1.2 billion for managed services from 2013 to 2023, a clear shift in market direction.

Why, then, if the DIY route has provided value and flexibility for years, are MAG end-users opting for the 'As-a-Service' offering? The drivers of this change are two-fold: cost and capability.

As homeowners seldom include the cost of renting a larger car and the tools/training required to assemble the cabinets, counters, plumbing, and appliances into the cost of their 'DIY' kitchen, government end-users have found that the "Do-it-yourself" aspect of satellite



capacity can strain budgets and complicate operations. By consolidating the many disparate elements of coordinating a networked service into a single external contract, managed services can provide a more cost effective solution than bulk leasing and internal network management.

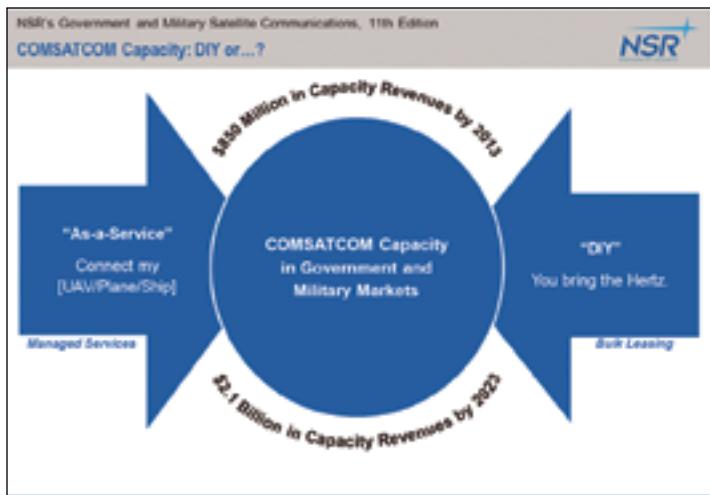
Further, as demands for satellite capacity increase, uses of satellite connectivity become more complicated and greater expertise to establish and manage networks is required, it is increasingly attractive for the entire process to be outsourced through a managed service contract. This contract draws on expertise and solutions already developed and refined through industry experience. The 'As-a-service' solution through managed services procurement can contribute new capabilities to the overall system without requiring development investment by MAG players.

Even when the necessary capabilities in manpower and technology do exist, the reallocation of resources to manage the network in-house is not always justified by the gain in network control and flexibility. The dynamics of MAG SATCOM has now morphed toward application centric thinking. This makes the question, "How many meatballs do I want," rather than, "what size Allen wrench do I need (and then learning about kitchen design theory)?" Managed services that provide integrated solutions with fewer moving parts streamline procurement, and NSR expects new services (such as UAVs) to opt for these solutions as they are rolled out.

The homeowners have already seen the shift—you can now have your Scandinavian kitchen without lifting a single tool.

MAG markets are in the middle of this transition, with providers moving further down the value-chain, consolidating offerings, and similar to kitchens, focusing on how people will use capacity. HTS will only further accelerate this shift. With a greater focus on delivering

maritime mobility, serving UAV platforms, or supporting highly-mobile armed forces, the role of the Managed Services will be a go-to solution across the MAG markets.



However, there will always be users with a love of 'DIY.' For them, this model of Bulk Leasing some X-band, MEO-HTS, and Ka-band capacity (while still, maybe, getting the 'countertop-as-service') will be how they support their requirements.

Changing fiscal and technical landscapes are driving MAG users away from the DIY bulk leasing to the "Kitchen-as-a-Service" Managed Service model. With emerging programs such as U.S.A.F.'s Pathfinder, bulk leasing will not go away. However, an overwhelming share of growth over the next decade will be from Managed Services connecting Aeronautical, UAV, and Maritime SATCOM terminals on C-, Ku-, Ka-, X- and GEO/MEO-HTS networks.

Overall, service providers and satellite operators will need to work on the right mix of "do-it-yourself", and "as-a-service" to capture this market potential.

Mr. Grady has been involved in the Satellite Communications industry since 2005, joining NSR in 2010. He is NSR's Energy market subject matter expert, and a core member of NSR's mobility research practice for both civil and government markets. He regularly provides his insights and analysis to NSR's single-client consulting practice, and is also a regular contributor to leading industry publications and forums.

Before joining NSR, Mr. Grady served as the Sustainable Development Projects Coordinator Intern with the Global VSAT Forum where he worked regularly with the GVF Secretariat and the Regulatory Working Group on many of the forum's initiatives. Working with the Regulatory Working Group, Mr. Grady helped develop and implement various RWG initiatives aimed at protecting satellite spectrum, increasing awareness of satellite services, and working to promote regulatory reforms across the globe. He works in NSR's Washington DC office.

DOING AWAY WITH BATTERY FADE, THANKS TO MEPS

By Jonathan Kasper, Project Engineer + Greg Semrau, Systems Engineer, Moog, Inc.

Asatellite's electrical power system (EPS), typically based in solar cells and batteries, can be taxed with development of new loads and use cases.

While trying to solve an array of unique challenges for launch vehicles, Moog Inc. (Moog) developed (and filed a patent for) a Modular Electric Power System (MEPSTM) that can satisfy the power dense needs of many aerospace applications, including military satellites.

This novel solution is an enabler to the satellite EPS; it packages ultra-capacitors in a unique configuration that allows the direct connection to batteries or can join directly to the vehicle system power bus. This is advantageous because MEPS can join batteries to extend a battery's life in space and at less cost than a traditional battery-only system. The MEPS hybrid system can potentially lower satellite weight, reduce thermal impact, increase power output, boost regenerative energy capture, and, most important for military satellite makers, decrease battery capacity fade.

Conventional battery systems on military satellites, and many other satellites, are potentially oversized in terms of energy. That's because designers must account for the energy capacity reduction as a function of calendar and cycle life. Potential savings in weight comes from reducing this oversize by compensating with MEPS ultra-capacitors.

Reducing Capacity Fade

The claim of capacity fade reduction is substantiated by Dr. Zaher Daboussi et al. in "Li-Ion, Ultra-capacitor Based Hybrid Energy Module," and Clark Hochgraf et al. in "Effect of ultracapacitor-modified PHEV protocol on performance degradation in lithium-ion cells," specifically for an actively hybridized circuit. Further testing is planned to substantiate this claim for passive circuits.

Hochgraf and his colleagues at the Rochester Institute of Technology showed that the reduction in peak load current experienced by a battery, such as that provided by an ultra-capacitor hybridization, reduces capacity fade on the battery by a factor of two for electric vehicle-type loads. This result can be targeted by the MEPS passive hybridization configuration and is a significant advantage over

competing technologies. The discharge capability of the MEPS supplemented power system exhibits the largest benefit for higher peak power discharges when compared to the constant current discharge of the system.

Capacity fade reduction could be an important benefit for any battery system, especially in satellite applications where maintenance isn't easily or economically accomplished. The MEPS ultra-capacitors supplement the battery discharge for short transients; this reduction in transience (i.e., magnitude and rate) in the battery discharge lowers the long-term capacity fade and increases battery life.

Capturing Regenerative Energy

The MEPS hybrid system captures large amounts of regenerative energy without over-taxing the battery portion of the system. The ultra-capacitors are configured via a passive hybridization method to receive a large majority of the regenerative energy. This configuration is advantageous because the batteries have unique challenges when faced with accepting excessive regenerative energy. Typical systems use an oversized "burn-off" resistor to overcome this design obstacle; the resistor's sole purpose is to thermally dissipate regenerative energy. Using MEPS in systems design eliminates the need for this resistor and the supporting circuit to regulate current into said resistor.

The lower internal resistance of the ultra-capacitor can alleviate thermal dissipation concerns. The lower value will decrease the heating caused by power dissipation within the system; this, plus the limited number of ultra-capacitor strings needed in parallel for systems, will lead to significant thermal savings.

Fewer Batteries Mean Less Weight, Cost + Volume

The ultra-capacitors bring low-impedance, high-current discharge capability, which drastically increases the power density of the full system. The MEPS (when compared to a conventional battery system) will inherently be a reduction of system weight and an increase in the power output capability, while still maintaining a high energy density with a lowered thermal impact. There is also the possibility of increasing the life of the supplemented battery in the reduction of capacity fade and peak transient load leveling by the MEPS ultra-capacitors. The



saving of weight, cost and volume that comes from MEPS is the result of a smaller number of required batteries.

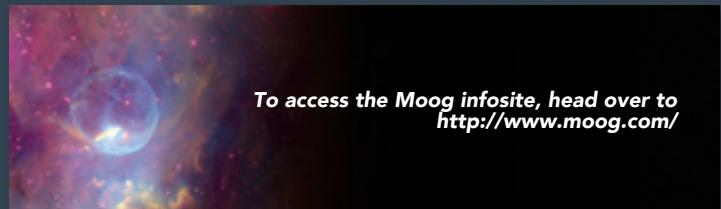
Ultimately, MEPS is a technology enabler; the flexibility it provides to the system architect in relation to what is required out of the battery could lead to optimization at the system level. The MEPS hybrid system is based on modular building blocks; so that, the multiple applications of this system can be based on a limited number of these blocks for an economic mix of specific application optimization and non-recurring investment. In fact, satellite designers can mask some shortfalls of certain battery technologies or newly developed high-energy-density batteries by using MEPS as part of the power system.

MEPS technology can also accommodate large loads or peak-driven loads that are present in satellites. When faced with design constraints, engineers can turn to MEPS and tune the system to maximize the output of a high-energy-density battery or provide relief to an over-stressed power system.

Satellite makers can use the MEPS hybrid system to: create new designs; retrofit current systems with loads that stress the central power bus; or, upgrade the load to something that was unattainable in the past. If reducing weight and cost (or improving performance) are of top concern to a satellite designer, then MEPS can play an important part in achieving those ends.

Jonathan Kasper is the project engineer for the Modular Electric Power System research at Moog Inc. in East Aurora, New York. Since joining Moog in 2007, Jonathan has focused on precision fluid and motion control systems for spacecraft and launch vehicles. These highly engineered systems require unique power management strategies, which are an ideal use for the MEPS technology. Jonathan earned his bachelor's degree in mechanical engineering from Rochester Institute of Technology and his MBA from the State University of New York at Buffalo.

Greg Semrau is a system engineer at Moog Inc. Prior to Moog, he worked at General Motor Hybrid Powertrain on electric motor control and power systems. Power systems are an integral part of Moog's motion control systems platform and require unique solutions to fulfill equally unique customer requirements. Greg Semrau received his bachelor's degree in mechanical engineering from Kettering University (formerly GMI) and his master's in mechanical engineering from Rochester Institute of Technology.



**To access the Moog infosite, head over to
<http://www.moog.com/>**

PROTECTED COMMUNICATIONS: AN INTELSAT GENERAL TECHNOLOGY PERSPECTIVE

By Tim Turk, Director of Engineering, Intelsat General Corporation (IGC)



With the rise of network-centric warfare, the TTPs connectivity and situational awareness delivered by SATCOM has never been more vital. Potential adversaries are experimenting with ways to disrupt the satellite bandwidth that provides our forces with critical ISR superiority in theater.

Protection comes in many differing forms; Threat Identification and Education, Tactics, Techniques and Procedures (TTP's), resilient waveforms, signal cancellation, carrier identification, and the ability to geolocate and identify adversaries. IGC's Protected Communications Team is investigating all these types of protection, so as to provide a defense-in-depth approach to protection and resiliency.

The existing threats vary from repurposed SATCOM systems used as jammers to purpose-built barrage jammers capable of a variety of jamming techniques. Our team has studied these threats and identified a variety of mitigating techniques and material solutions to provide a defense-in-depth approach and tailor our solutions to each customer and their particular mission needs. I discuss some of these solutions in order of effectiveness in the following paragraphs.

TTP's enable our government customers to withstand a certain level of interference, or jamming, and still be able to communicate despite the effects of the offending signal. Some of these TTP's might include planning around the interferer, increasing power, beam shaping, beam steering, and other effective methods to operate in the presence of an interfering signal.

For example, assuming an interferer is transmitting a continuous wave (CW) carrier and causing interference to a fixed frequency, the user could simply be moved away from the CW carrier to plan around (i.e. mask) the interfering carrier so as to maintain effective communications.

Increasing power may work against certain jammers—however, the resultant effect of increasing power may be more detrimental to the satellite and/or other users than it is worth. Beam steering and beam shaping are two techniques, which can be quite effective. Beam shaping or beam steering can effectively remove the jammer from the uplink footprint of the satellite and reduce or eliminate its ability to interfere with users.



Of course, in order for beam shaping or steering to be effective the location of the jammer must be known and the users must not be too close to the geographic location of the jammer. Intelsat's EpicNG class of satellites will enable IGC to employ these techniques for our customers.

The ability to geolocate and identify the source of interferers or jammers is paramount. IGC works closely with our corporate parent, Intelsat, to obtain geolocation of interferers in an effort to minimize the effects of interfering signals from both a time and breadth perspective. Further, IGC can also access other geolocation resources belonging to our customer organizations.

CID

Carrier Identification (CID) is a newer technology, which is being adopted by the commercial industry and will enable accidental interferers to be quickly identified and contacted to resolve interference cases. When fully employed across the SATCOM ecosystem, CID will also help distinguish between legitimate SATCOM users and jammers.

With CID, Satellite operators will now immediately be able to distinguish a legitimate SATCOM user from users who either refuse to adopt the CID technology or nefarious characters bent on disrupting the communications of authorized users.

Some military users are concerned about force protection and anonymity of their ground users, and are conducting their own evaluation of the efficacy and security of CID. Of immediate concern is that not all SATCOM users will adopt CID, which will make identification of the nefarious characters more troublesome. It is expected that users who choose to operate without CID will eventually become a minority.

In order to address security of military, and other government users, identification and location of end user information should only be available to personnel within military or government organizations and maintained at a classified level, so as to protect the identification and/or location of such users.

Commercial satellite operators will only see the CID number associated with an interferer and call the designated organization to report the interference; it will then be incumbent upon the designated organization to contact the end user and resolve the interference event.

PTWs

More complex protection techniques include technical solutions, such as direct sequence spread spectrum (DSSS), frequency hopping, signal cancellation, and other Protected Tactical Waveforms ("PTWs") in development at this time. IGC is actively involved with several organizations to develop and, eventually, offer these technical solutions to our customers.

The IGC Protected Communications Team is working directly with several modem manufacturers to identify and test a variety of new modems under development in the industry. These technologies include terrestrial and space based solutions, which will offer IGC customers the best and most resilient SATCOM available from the

commercial industry. Eventually PTWs are expected to rival that of complex military protection capabilities already on orbit at a fraction of the cost. In addition, solutions will be available to a myriad of tactical users, regardless of platform or frequency band.

In March of 2014, IGC engineers teamed with L-3 Communications Systems West (L-3 CSW) and successfully tested L-3 CSW's new modem, which was designed around the U.S. Air Force's PTW. The test, which was conducted using an Intelsat satellite emulator, measured the modem and PTW performance against various interference and jamming tactics and waveforms. The success of this test is encouraging and helps IGC pave the way toward offering protection, resiliency, and modernization of services for our customers.

The IGC Protected Communications Team is chartered to identify, research, and employ various levels of protection for our customers' bandwidth and services to improve resiliency and reliability in a contested electromagnetic environment. Our efforts in the Protected Communications environment will ensure our customers are operating in the most secure SATCOM environment available from the commercial industry.

IGC is excited about the capabilities we are discovering for our customers and will continue to lead the industry in providing resilient, uninterrupted, protected SATCOM services. Space is getting more and more crowded and competitive—we will continue to work hard to protect our customers.

As the Director of Engineering for Intelsat General, Tim ensures that the engineering team provides support for technical proposals to government customers, including monitoring the integration, installation and testing of equipment and resolution of any technical issues associated with implementation. Tim is leading the Intelsat General team working with Intelsat on development, fleet planning, transitions, and spacecraft design of the new Intelsat EpicNG constellation of satellites. Tim served in the U.S. Navy and completed his career there as an Electronic Warfare Officer and Information Operations Planning Officer for the entire Pacific Fleet. Tim holds a BS in electrical engineering, and a masters in space systems operation as well as an MBA.



A Case In Point

Knight Sky Uses Intelsat Satellite to Provide Disaster Communications



Nags Head, North Carolina, feeling the effects of Hurricane Arthur.

As Hurricane Arthur (The first hurricane of the 2014 hurricane season) roared toward the Outer Banks of North Carolina on the afternoon of July 3, employees at Knight Sky in Frederick, Maryland, were working with officials from the Federal Emergency Management Agency (FEMA), planning for the worst.

Happily, the worst did not happen. The hurricane passed further east, not making landfall "this time." Damage was relatively light, ground-based communications were not destroyed, and Knight Sky's SkyMAX services were not required.

Had Arthur left a national disaster in its wake, Knight Sky was prepared to provide emergency satellite communications to FEMA or the North Carolina National Guard's command vehicles, which would have been deployed to the Outer Banks.

Such is the nature of Knight Sky's business, according to President George Knizewski. The company provides a majority of the emergency communications required by FEMA and Emergency Management Agencies throughout the United States, using Intelsat's Horizons 1 satellite and the company's SkyMAX Emergency Communications Network, managed from its secure Network Operations Center (NOC) located in Frederick. The satellite connection provides FEMA and others with on-site secure communications when a disaster takes out terrestrial communications infrastructure, mobile cell towers and other ground-based services.

For incidents such as hurricanes that provide some advanced warning, Knizewski said the company might have a few days to plan a response. However, other man-made or natural disasters such as the tornadoes during the spring of 2014 in Alabama and Mississippi and the disastrous mudslide in Oso, Washington, that wiped out an entire town, do not provide any advance warning. Yet Knight Sky needs to respond within hours and may be providing connectivity for several weeks.

"It's impossible to meet all the security requirements and regulations of interconnecting to the government's communications network if you start when the disaster strikes," said Knizewski. "All the work needs to be done in advance and all the equipment needs to be configured and tested prior to the disaster. You can't start when the phone rings or you'll never get the job done."



Knight Sky's contract with FEMA requires that satellite connectivity be provided within four hours of a request, but Knizewski said the company often has the connection up within minutes of notification.

"We already have our SkyMAX infrastructure and procedures in place and have coordinated with the customer, so we are always in a state of readiness, 24/7/365," he said.

Knight Sky supports hundreds of emergency response vehicles scattered around the country that can deploy on a moment's notice in the event of an incident. Once a decision is made to deploy a particular vehicle, Knight Sky receives the official government notification and establishes the satellite connection.

At Intelsat General, Kevin Debruycker, the lead Customer Support Engineer, coordinates the connection between Knight Sky and the Horizons 1 satellite or any other spacecraft that might be better suited to the mission.

"It is very much a hurry-up and wait process," said Debruycker. "Fortunately for us, the Knight-sky team has a very good relationship with their customers and understands the challenges of not only finding additional capacity but also the technical coordination required to ensure the customer is able to use the capacity when needed."

Depending on the size of the mobile ground terminal, Knight Sky and Intelsat General can provide between 1 and 155 Mbps of broadband connectivity for voice, video and data that meets the performance, reliability and information assurance requirements of GSA and the security requirements of the Federal Information Security Management Act (FISMA).

In addition to FEMA, Knight Sky provides emergency communication services to U.S. Army North, based in Ft. Sam Houston, Texas, which is responsible for assisting in national disasters. Knight Sky also provides similar connections to about a dozen state Emergency Management Agencies and National Guard Units.

Knizewski said meeting the security requirements when interconnecting with a government network is a particular challenge of his business. FEMA and Army North have their own distinct technologies and procedures, and each individual state has its own particular methods and regulations of establishing and maintaining secure emergency response communications.

"The National Weather Service is predicting a slow hurricane season, but of course there is no guarantee of that, so we are ready," he said. "Summers have become the busy season for us. We are extremely proud to support federal, state and local agencies with emergency communication when disaster strikes right here at home."

31ST SPACE SYMPOSIUM HONORS + EVENT PREVIEW

By Carol Hivey, Director, Public Relations + Team Communications, Space Foundation

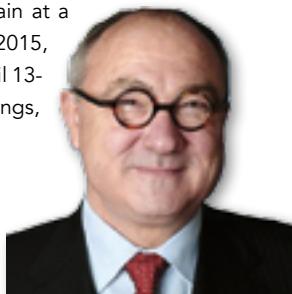
The annual Space Symposium provides an ideal opportunity for the Space Foundation to present its top awards. For 2015, the Board of Directors of the Space Foundation unanimously selected Jean-Jacques Dordain, Director General of the European Space Agency (ESA), as the recipient of its highest honor—the General James E. Hill Lifetime Space Achievement Award.

The award will be presented to Dordain at a special industry luncheon on April 15, 2015, during the 31st Space Symposium, April 13-16, at The Broadmoor in Colorado Springs, Colorado, USA.

"Jean-Jacques Dordain's long, distinguished and globally recognized service in the space sector make him an outstanding selection as the 2015 winner of the Space Foundation's highest award," said Space Foundation Chief Executive Officer Elliot Pulham. "Through his leadership, ESA has achieved remarkable success with programs like Gaia, Rosetta, ATV, the International Space Station and many others. This work has helped to improve global cooperation in space, and since 2003, ESA has added five European Member States and six European Cooperating States."

Dordain has been ESA's Director General since July 2003 and was reappointed twice to the position by the ESA Council. When he joined ESA in 1986, he was appointed Head of the newly set-up Department for the Promotion and Utilization of the International Space Station. In 1993, he became Associate Director for Strategy Planning and International Policy. In 1999, he accepted the position of Director of Strategy and Technical Assessment, and in 2001, he became Director of Launchers.

Dordain graduated in engineering from the Ecole Centrale de Paris in 1969, and began his scientific career in 1970 in the field of propulsion and rocket boosters at the French National Office for Aerospace Studies and Research (ONERA). From 1976 to 1983, he was the Coordinator of Space Activities at ONERA until he was appointed Director of Fundamental Physics. During this period, he was among the first five French astronaut candidates to be selected by CNES for the ESA Spacelab 1 program. Throughout his career, Dordain has taught in several prestigious positions.



Dordain is a Member of the French Académie des Technologies, an Associate Member of the Belgian Académie Royale des Sciences, des Lettres et des Beaux Arts. He is also a Member of the Air and Space Academy (France); the International Academy of Astronautics and the Association Aéronautique et Astronautique de France. He is an honorary Vice President of the International Astronautical Federation and honorary Chancellor of the International Space University.

Dordain is expected to retire from ESA on June 30, 2015, and his participation at the 31st Space Symposium is expected to be one of his last official appearances.

Tickets for the award luncheon should be purchased in advance by Space Symposium attendees at <http://www.spacesymposium.org/register>.

31st Space Symposium At A Glance

The Space Foundation's annual Space Symposium has been firmly established as the single most important event to link government, military and industry on both a national and international basis. For 2015, the Space Symposium will offer more choices, more classified programs, more international and government participation and more networking opportunities than ever.



The 31st Space Symposium will also feature the Ball Aerospace Exhibit Center and Pavilion, with more than 160 displays of the world's latest space technology, products and services.

Returning attendees will find many of the same compelling reasons to attend the Space Symposium as in previous years, such as the Technical Track Program, plus some changes for 2015. The Space Foundation continuously revamps the Symposium to give its customers the conference experience they want. There are now two classified events for 2015—Cyber 1.5 and the Space Classified Program.



Cyber 1.5 Conference Is Classified for 2015

On Monday, April 13, the Space Foundation's Cyber 1.5 Classified conference will focus on the evolving security challenges posed in cyberspace. Discussion will include senior leadership views on Department of Defense and industry cyber activities, with emphasis on hot button issues, human capital development and international dimensions.

U.S. citizenship and a TS/SCI security clearance are required to attend



Cyber 1.5. TS/SCI clearance must be received and verified by the Space Foundation by April 3, 2015.

See details about Cyber 1.5 and registration information at
<http://www.spacesymposium.org/tracks/cyber-15-classified>.

Active Military + Government Attendees

The 31st Space Symposium agenda includes sessions and presentations of special interest to the military, such as featured speaker The Honorable Deborah Lee James, Secretary of the Air Force, on April 16.

The Space Foundation offers reduced pricing for active military and government registrants.

The active military/government rate includes admission to Symposium general sessions, exhibits, receptions, plus one ticket to each Symposium dinner and one ticket to a Symposium luncheon, such as the Space Warfighters Luncheon on April 14. This special rate does not apply to contractors who work for, or with, the government or military.

See military and government registration information at
<http://www.spacesymposium.org/register>.

Register Now

Visit <http://www.spacesymposium.org/register> for secure online registration and complete conference information, or call +1.800.691.4000.

Co-Sponsors

A special thank you to our co-sponsors: Aerojet Rocketdyne; Arianespace, Inc.; Arotel LLC; Ball Aerospace & Technologies Corp.; Colorado Space Coalition; El Pomar Foundation; Inmarsat; Intelsat General Corporation; Lockheed Martin; Northrop Grumman; Orbital; Raytheon; Spincraft; Stellar Solutions; United Launch Alliance (ULA).

About The Space Foundation

Founded in 1983, the Space Foundation is the foremost advocate for all sectors of space, and is a global, nonprofit leader in space awareness activities, educational programs and major industry events, including the annual Space Symposium, in support of its mission "to advance space-related endeavors to inspire, enable and propel humanity." Space Foundation World Headquarters in Colorado Springs, Colorado, USA, has a public Discovery Center, including El Pomar Space Gallery, Northrop Grumman Science Center featuring Science On a Sphere® and the Lockheed Martin Space Education Center.

The Space Foundation has a field office in Houston and conducts government affairs from its Washington, D.C., office. It annually publishes The Space Report: The Authoritative Guide to Global Space Activity, and through its Space Certification™ and Space Technology Hall of Fame® programs, recognizes space-based innovations that have been adapted to improve life on Earth. Visit <http://www.SpaceFoundation.org>, follow us on Facebook, Instagram, LinkedIn, Pinterest, Twitter and YouTube, and read our e-newsletter Space Watch.

DISPATCHES

GATR LIGHTWEIGHT ANTENNA INCREASES ARMY AGILITY

Inflatable ground satellite antennas are aiding in the expeditionary nature of U.S. and coalition forces, enabling them to achieve high-bandwidth network connectivity anywhere in the world from small deployable packages.

"Many of the conventional satellite terminals previously fielded aren't suitable for some of the more agile transportation requirements of today's deployed Joint Forces," said Lt. Col. Leonard Newman, Army product manager for Satellite Communications, which is assigned to Project Manager Warfighter Information Network-Tactical, known as WIN-T. "The inflatable satellite antenna is transforming how Special Operations forces and now airborne and other conventional forces deploy high-bandwidth SATCOM around the world."

Future Joint contingencies and support operations are expected to require rapid deployment of smaller sized elements to a wide variety of austere environments, with Soldiers needing to fight on arrival. The lightweight, easily transportable Ground to Air Transmit and Receive, or GATR, inflatable antenna reduces size, weight and power requirements over current capability, enabling smaller units to quickly deploy anywhere in the world and achieve network connectivity. The antenna can connect Soldiers in remote locations to the Army's tactical communication WIN-T network backbone, as well as support other services and first responders.

For WIN-T users needing at-the-halt access to the tactical communications network backbone, the GATR provides Secure Internet Protocol Router and Non-secure Internet Protocol Router access at the company echelon and small combat outposts. It also uses the same modems, baseband, encryption and networks as traditional terminals so they can leverage the existing network and services.



*Ground to Air Transmit and Receive Inflatable Satellite Antennas are increasing agility and expeditionary nature of U.S. forces.
U.S. Army photo.*

The Marine Corps established contracts to procure and certify the GATR terminal for military Ka- and X-band use. As the Army evaluates its SATCOM terminal portfolio to prepare for future contingencies, it is leveraging the Marine's previous efforts to add these versatile terminals to its own portfolio.

"Gaining access to the full complement of net-centric warfare applications earlier in operations is critical to establishing and maintaining effective command and control," said Jim Sawall, assistant product manager for the Commercial Satellite Terminal Program. "The inflatable antenna technology provides commanders with battalion-strength communications and data links earlier and with significantly reduced logistics burden—and in situations where previously only company-level communications would have been possible."

Fitting in just two transit cases, the GATR antenna provides the same robust data links as conventional, rigid satellite dishes, but weighs up to 80 percent less. Its unique ultra-portable design can provide high-bandwidth communications for transmission of classified and unclassified data, voice and video, all in a compact, highly survivable package. The flexible ball and dish weigh only 25 pounds, making the entire system small and light enough to be transported as checked baggage on commercial aircraft, and once on-site, it can be set-up in less than 30 minutes.

The system features a dynamic inflation mechanism that is easy to turn on and off and provides immediate, automatic adjustment to pressure changes caused by environmental factors. The GATR antenna system also contains a battery back-up system to ensure continuity of operations for at least six hours in the event of power loss. Although satellite acquisition is manual, advanced capability makes it easy to point, and a brief introductory course prepares operators to successfully deploy it anywhere.

The spherical shape greatly reduces the effect of wind, and a unique cable anchoring system assures stability in winds exceeding 40 mph, and survivability up to 60 mph – wind speeds that can interrupt connectivity in all other terminals. Moreover, it is suited to perform in the field, with all elements passing environmental testing requirements, Newman said.

The GATR antenna is designed to support the same networks as traditional 2.4 meter dishes that require a trailer, vehicle and four people to lift the transit cases. The Army is also looking to introduce a larger four meter version of the inflatable antenna for data transport both within and beyond theater. By deploying a four meter antenna in as few as three cases, Soldiers can augment, or in some cases replace, existing vehicle-size infrastructure to enable more nimble operations from the hub level down to the tactical user.

Instead of requiring a cargo pallet or vehicle-sized transport container, Soldiers can move critical, large aperture communications gear to or around the battlefield in a High Mobility Multipurpose Wheeled Vehicle, light tactical vehicle, small helicopter, etc., greatly increasing the expeditionary nature of today's forces, Newman said.

Story by Amy Walker, PEO C3T

DISPATCHES

NAVAL POSTGRADUATE SCHOOL INTERNATIONAL TEAM SOLVES TUBESAT ENIGMA



University of Bundeswehr students, German Navy 2nd Lt. David Ohst, front left, and Ensign Sebastian Stoppe, front right, built an operational TubeSat as part of their exchange program in the Naval Postgraduate School's CENETIX Lab. The inexpensive satellites will further ad-hoc networking research by Department of Information Sciences Professor Alex Bordetsky, back right, and Research Associate Eugene Bourakov, back left.

A pair of Naval Postgraduate School (NPS) international exchange students from the University of Bundeswehr say they are the first to have ever successfully built an operational InterOrbital Systems Tube Satellite (TubeSat).

German Navy 2nd Lt. David Ohst and Germany Navy Ensign Sebastian Stoppe assembled the satellite at NPS' Center for Network Innovation and Experimentation (CENETIX) under the tutelage of CENETIX director, NPS Professor Alex Bordetsky, and NPS Research Associate and Team Lead Eugene Bourakov, in collaboration with the Space Systems Academic Group.

"The big output of this project was a proof-of-concept using immature kits to develop the tube satellites," said Bordetsky.

"This project is a great example of where a craft with limited capabilities can create an unlimited source of research and development tasks that are extremely valuable to our students," added Bourakov.

The kits themselves cost about \$8,000. According to their manufacturer, successful assembly includes a guaranteed launch into LEO on an Interorbital Neptune modular rocket. Designers intend to launch the first

36 TubeSats completed to standard at a date to be determined.

The kits are fairly basic—they include printed circuit boards, a battery pack, solar cells, a power management control system, microcomputer, software, antennas, a power switch and an instruction booklet.

Stoppe and Ohst had to contend with a host of challenges before finally assembling the satellite. They noted a series of design challenges and the need to adjust schematics rewrite files and make adjustments to voltage, circuit board design and solar panels.

But, by applying their previous electrical engineering skills and collaborating with the experts at the CENETIX lab and NPS' Space Systems Academic Group (SSAG), Ohst and Stoppe were able to do everything from recreate circuits boards to recalculate resistor values.

"We had to develop the rings, configuration and layout... We even used a 3-D printer to produce some of the parts that made this possible," added Stoppe.

"Without our background in electrical engineering, we would not have been able to complete this project," said Ohst.

"What made this an actual functional satellite is the injection of their and Eugene [Bourakov's] talent while incorporating 3-D printing technology... You have a seemingly simple thing, but it is actually the product of a highly-educated group of engineers," said Bordetsky.

The completion of the satellite is big news for researchers at CENETIX who now hope to be able to use TubeSats in their continuing ad hoc networking and Maritime Interdiction Operation (MIO) experiments.

"With this completed TubeSat we can now incorporate the TubeSats into our MIO testbed," said Bordetsky. "This satellite, by virtue of being perishable, allows us to study how we bring these new network nodes into orbit without wasting expensive satellites."

As Ohst and Stoppe worked against the clock to complete their satellite, they received input from satellite enthusiasts from around the world. They are part of an online special interest group devoted to the inter-Orbital Company's TubeSat concept.

"We are getting a lot of requests for assistance after posting our results to the group," said Ohst. "They are excited because we were the first to actually put it together."

Despite its surface simplicity, Bordetsky insists that the TubeSat is a functioning satellite and that Ohst and Stoppe's work is a significant engineering achievement. Bordetsky is currently working on weighing the merits of different launch options, including the option of placing the TubeSat into LEO by launching it from a fighter jet.

Bordetsky lauds the efforts of Stoppe and Ohst as illustrative of the advantages of the international collaboration that occurs between students and U.S. service members at NPS.

"This is a perfect example of the success of our collaborative efforts, two German officers building a satellite, built upon the work done by a Greek officer from the Hellenic Navy, achieving a break through at CENETIX," said Bordetsky.

In the future, Stoppe and Ohst hope to see their work continue through testing via stratospheric balloons, radio tests various payloads and the building of a second and third TubeSat.

DISPATCHES

GPS MODERNIZATION OCCURS AS BOEING ACTIVATES GPS IIF-8



*Artistic rendition of a Block IIF satellite.
Image is courtesy of Boeing.*

The eighth Boeing Global Positioning System IIF satellite has completed on-orbit checkout and joined the active 31-satellite constellation, helping the U.S. Air Force continue modernizing the network that millions of people worldwide use.

The U.S. Air Force and Boeing have now placed four GPS IIF satellites into service this year, adding to the modernization effort with advanced atomic clocks,

stronger anti-jamming, and a new third civil signal and longer design life. Since becoming fully operational in 1995, GPS has evolved into a global digital resource.

The Air Force modernization is a long-term initiative to further improve GPS signal accuracy, strength and quality while also adding new military and civil signals to benefit the ever-expanding user community.

Boeing has contributed to GPS since its inception, providing four generations of satellites over a four-decade period. The latest satellite, known as GPS Space Vehicle-69, was launched on October 29 and completed on-orbit checkout and validation December 12.

"We made great progress this year [2014] in the quest to modernize GPS services," said Dan Hart, vice president of Government Space Systems for Boeing Network & Space Systems.

"With two-thirds of the 12 Boeing GPS IIFs now on orbit, the constellation is setting new records for accuracy and the Boeing GPS IIFs are consistently among the best performing."

"We believe that our track record on GPS speaks for itself, with more than 525 years of on-orbit operation," Hart said. "We continue to support today's GPS mission, and are looking forward to delivering the remaining four GPS IIF satellites into service. At the same time, Boeing continues to explore innovative new solutions that will further enhance and improve the next generation of GPS satellites."

The Boeing Defense, Space & Security infosite at
<http://www.boeing.com/boeing/bds/>
offers additional information.

GOT 'EM FOR COTM—EXELIS + IRIDIUM DEMO NEW COMMS CAPABILITIES FOR DISA

Exelis and Iridium Communications Inc. have successfully demonstrated a new global-reach communications capability for the Defense Information Systems Agency's (DISA) Distributed Tactical Communication System (DTCS).

The capability, once deployed, will advance the Department of Defense's critical satellite communications network, bringing secure, reliable and truly global communications services to users in the defense and intelligence community operating anywhere on Earth.

In partnership with DISA's Enhanced Mobile Satellite Services (EMSS) program office, the team demonstrated real-time, push-to-talk voice and data communications that connected users in regions across the globe, including Virginia, Arizona, Hawaii, Alaska,

Australia and locations within the Arctic Circle. Multiple radios deployed within each region demonstrated the ability to simultaneously connect with those nearby as well as with others thousands of miles away.

The global services capability will provide command and control, as well as situational awareness, through inter-theater, on-the-move communications between distributed tactical units and multiple echelons of command around the world. The demonstration was carried out by leveraging currently fielded technology, with some enhancements made to software and DISA communications infrastructure.

Exelis received the DTCS Global Services contract from the EMSS program office in May 2013. Since then, the company

has worked collaboratively with Iridium and DoD representatives to define a capability roadmap for the global satellite communication system.

For additional information, download the Exelis infosheet at <http://www.exelisinc.com/capabilities/Distributed-Tactical-Communication-System/Documents/Exelis-Support-Of-DTCS.pdf>

Iridium's infolink regarding EMSS is located at
<https://www.iridium.com/EMSS.aspx>

The DISA Network Services infosite is accessible at
<http://www.disa.mil/Services/Network-Services/Satellite/DTCS>

DISPATCHES

RAPID RESPONSE SOLUTION DEPLOYED BY LUXEMBOURG, SES TECH COM + HITEC

SES Techcom Services



The Luxembourg Government signed a new agreement with the Joint Undertaking (JU) between HITEC Luxembourg S.A. and SES TechCom S.A.—in partnership with Luxembourg Air Rescue—to extend the emergency.lu rapid response solution for a duration of six years.

emergency.lu is addressing the challenge of worldwide rapid response capacity and preparedness for humanitarian emergencies by providing a solution to fill the communication gap in the first hours and days after a large-scale disaster.

The solution provides communication facilities in remote areas due to chronic humanitarian crises. It is being deployed since January 2012 following the initial contract signature in April 2011.

Since then, emergency.lu has been productively deployed on multiple missions: South Sudan, Mali, Venezuela, Nepal, Philippines and lately in the Ebola prone regions in Africa. The emergency.lu solution is greatly appreciated by the international worldwide humanitarian community and has become an essential element in the disaster relief toolbox.

The success of the emergency.lu system swayed the Directorate for Development Cooperation and Humanitarian Affairs of the Grand Duchy of Luxembourg to continue the service offering and also to extend the system.

As such, the number of rapid deployment kits is being augmented by ten additional terminals. These devices are consisting of an inflatable antenna plus redesigned NoSaCo® Rapid terminals, which are entirely manufactured in the Grand Duchy by HITEC Luxembourg.

These devices are making up the field infrastructure in case of natural or man-made disaster which require immediate intervention. The Grand Duchy is also investing in 30 new transportable or disposable antennas for long-term humanitarian missions to be used with HITEC Luxembourg's new NoSaCo® Rack.

The satellite capacity used in emergency.lu to ensure a worldwide coverage is being extended. "On behalf of SES and as a member of the NSCF-emergency.lu joint undertaking, we are pleased to provide the Luxembourg Government and their development partners, among them the UN World Food Program, with a satellite-based communication infrastructure including satellite capacity and services that will ensure the availability of quick and reliable data and voice communications in disaster relief

theaters," said Gerhard Betschneider, Managing Director of SES TechCom.

"emergency.lu shows the technical expertise of HITEC Luxembourg in both domains of satellite ground segment and of ICT. The extension of the agreement with the Luxembourg Ministry demonstrates the success of the developed solutions and proves that we have met the expectations of our client on reliability, resilience and quality of service demanded by the public safety and humanitarian aid community," said Yves Elsen, Managing Partner and CEO of HITEC Luxembourg.

Both Luxembourg based companies, SES and HITEC Luxembourg continue—together with Luxembourg Air Ambulance—their involvement in humanitarian aid and disaster relief through the refreshed agreement with the Luxembourg Government.

There's additional information regarding SES TechCom at

<http://www.ses.com/techcom>

The HITEC Luxembourg infosite:

<http://www.hitec.lu/>

To learn more about emergency.lu, please visit <http://emergency.lu/>

The Luxembourg Air Rescue infosite may be reached at:

<http://www.lar.lu/index.php/en/>

The Luxembourg Air Ambulance infosite: <http://www.air-ambulance.lu/>

emergency.lu



