SATCOM For Net-Centric Warfare

April 2013

MilsatMagazine

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Spotlight On MUOS
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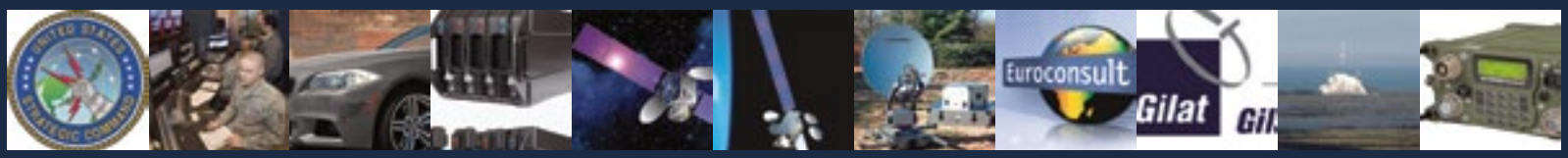

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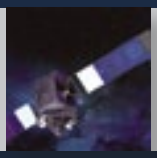

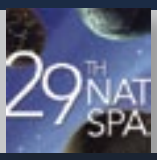

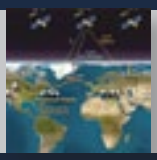

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Fiscal Uncertainty Threatens Readiness

Declaring U.S. Strategic Command mission-ready for its global missions today comes with a warning. According to its commander, who addressed Congress, given the specter of fiscal uncertainty and declining resources, he's concerned he "may not be able to say the same in six months or a year."

Air Force Gen. C. Robert Kehler painted a picture of an uncertain, complex national security landscape during testimony before the Senate Armed Services Committee, even as the United States transitions from more than a decade of conflict.

These factors make the transition "unlike any we have experienced in the past," he said, with increasing volatility in many of the world's regions and the global interconnections that can quickly cause regional issues to go global.

Kehler cited examples over the past year alone: actions by violent extremists, increasing cyber activity, Iran's nuclear ambitions, North Korea's nuclear activities, the civil war in Syria and the rise in Russian and Chinese strategic capabilities among them.

Fiscal uncertainty adds to these challenges, he said, threatening already-overdue modernization efforts and, ultimately, readiness.

Kehler emphasized that this point is not lost on those intent on doing harm to the United States and its interests. "Our enemies and potential enemies are watching," he told the Senate panel.

General C. Robert "Bob" Kehler, Commander, U.S. Strategic Command

Meanwhile, Stratcom remains focused on the missions critical to the nation's core national security interests, he said.

"To do this, our men and women wield a range of complimentary capabilities to create the tailored effects the nation needs," he said. "Our primary objective is to prevent conflict by influencing in advance the perceptions, assessments and decisions of those who would consider threatening our vital national interests."

This, Kehler said, demands continuing credibility of the United States' military capabilities, working in concert with other elements of U.S. national power.

The general emphasized the importance of Stratcom's historic mission—nuclear deterrence—and the need to ensure the readiness of the nuclear triad of strategic bombers, intercontinental ballistic missiles and submarine-launched ballistic missiles into the future for as long as nuclear weapons exist.

He recognized the need to modernize the command-and-control systems that ensure nuclear deterrence, and to replace the current fleet of Ohio-class submarines that is approaching the end of its service life.

Asked about the viability of the U.S. missile defense deterrent in light of North Korean activities, Kehler said he is confident the United States could defeat an attack from North Korea today. But he signaled that additional steps could be necessary in the future if North Korea continues to boost its own capabilities.

Sequestration and other budget uncertainties threaten these and other aspects of deterrence, he said, and ultimately, the command's readiness to defend the United States and assure its allies and partners.

It also puts the brakes on growth in essential areas such as cyber defense, he said, and ultimately could degrade the nuclear deterrent, global strike, missile warning and e-defense and situational awareness in space and cyberspace capabilities.

That will have a direct impact on Stratcom's support to warfighters around the globe, he said.

Kehler said he's also concerned about the impact on Stratcom's workforce, particularly civilians who are "integral to everything we do." They serve in some of the command's senior leadership positions and contribute specialized expertise to the mission, he said.

"There will be impacts across the board," he said, telling the committee the true extent of that impact won't be totally understood while the budget remains in flux. **#**

Story by
Donna Miles,
American Forces Press Services

JABIRU-1

"New" capacity to high demand regions

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A Whole Lot Of Shaking Going On

Data Physics Corporation recently installed a SignalStar Matrix multishaker vibration controller for use in the testing of missiles at a U.S. west coast Navy test and evaluation facility.

The Navy uses the Matrix multishaker vibration controller in several, single and multiple shaker configurations. Some applications use a single Data Physics SignalForce electrodynamic shaker with the Matrix vibration controller and some use two SignalForce electrodynamic shakers to test a missile in a single degree of freedom.

Yet other applications use electrodynamic and hydraulic shakers in combination to test missiles in up to six degrees of freedom. There is even one application that combines two six degree of freedom hydraulic shaker systems to test a missile in its container to produce defined linear or rotational motion.

What is common to all these applications is the ability of the SignalStar Matrix controller to drive these multiple shaker configurations, producing precise motion in specified degrees of freedom.

Shock and vibration testing is used to test products in simulated real world environments. Most vehicles, vehicle components, and consumer electronics undergo some type of vibration testing in the design and validation cycle. Critical components often also undergo shock and vibration screening as part of the manufacturing process.

Vibration testing on missiles and missile canisters is critically important because of the potential for accidental detonation during transportation.

A difficulty with performing multishaker testing has been vibration control of the shaker systems for random, sine and shock test types.

The SignalStar Matrix controller has proven to be capable of operating most multishaker arrangements producing accurate control in many commercial and government aerospace applications.

For instance, when used to control two six degree of freedom actuator systems on a common large test article, the actuators can be controlled to one, two or three directions of translation while constraining the rotational degrees of freedom. Realtime vibration control of this shaker configuration to random, sine, and shock profiles is a unique feat that truly demonstrates the capabilities of SignalStar Matrix.

The U.S. Navy now uses SignalStar Matrix vibration controller and analysis systems at several large test facilities and joins other advanced users, such as NASA. The Matrix is designed to meet the demanding requirements of advanced testing and evaluation, and provides a single solution for both multishaker and single shaker control. #

GaN Is All Amp'd Up

Comtech Xicom Technology, Inc. introduced a compact and highly efficient GaN-based amplifier for X-band MILSATCOM service.

Model XTSLIN-100X-B1 features 100W of WGS linear power in a compact, rugged 32-pound package. Drawing only 750W of prime power while at linear RF output, this amplifier is ideal for transportable applications where robust, high efficiency, lightweight and high-temperature operation is required.

In addition, this unit has demonstrated the ability to support critical multi-carrier X-Band operation with extremely low leakage levels in the receive band, even for the case with the SSPA in view of the antenna and feed.

Model XTSLIN-100X-B1, measuring just 6.8-inches x 10.5-inches x 17-inches, includes an integrated BUC, output isolator and harmonic filter.

This amplifier has been developed and is manufactured in the USA, facilitating military procurement and logistics.

It is the perfect solution for military users who need high power, high-efficiency, compact solid-state amplification for single- or multiple-carrier X-Band tactical SATCOM systems.

"We are extremely proud to introduce this industry-leading X-Band product in support of our military customers who are looking for greater mobility, efficiency and linear power. Our new HPA delivers 100 Watts of WGS linear power in a smaller and lighter package. No other product in the marketplace offers this level of linear power in such a lightweight package," said John Branscum, President of Comtech Xicom Technology, Inc. "As customers demand higher performance, they continuously turn to Comtech Xicom Technology where we are dedicated to rapidly providing solutions to their most challenging problems."

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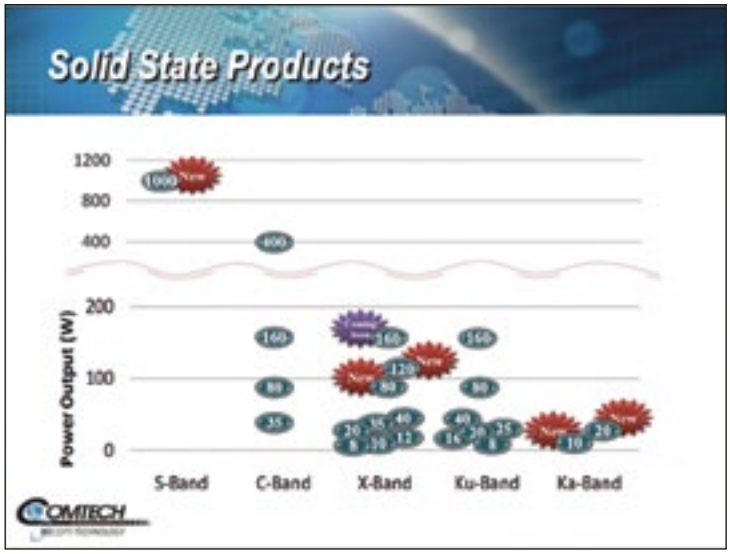

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U.S. Army Builds STEM Interest

In honor of National Engineers Week, U.S. Army Corps of Engineers Europe District employees presented structural engineering, alternative energy and fire-protection concepts to Department of Defense Dependents Schools-Europe students February 19-21, at Wiesbaden Middle School.

Lawrence Carabajal, a district structural engineer, presented a bridge-building lesson to eighth-grade science and math students. Carabajal used a hands-on approach, constructing a Leonardo da Vinci-designed wooden bridge for students to test and re-create.

"What engineers love doing is building things and testing them, so let's do it," Carabajal said as he assembled the self-supporting arch bridge in front of a 46-student audience.

Once the bridge was constructed, students were eager to test the capacity by adding textbooks, two at a time, to determine the applied load the structure could hold. Volunteers loaded the bridge with 20 textbooks until an audible crack replaced the silence in the school foyer.

"Wow! There went something. What just cracked?" asked a member of Elaine Young's eighth-grade science class.

A few seconds later the structure collapsed.

"Our bridge has reached its limit," Carabajal said.

Due to excessive weight, the bridge failed and needed to be rebuilt, he explained. Carabajal asked the class to suggest a method to strengthen the bridge. As a clue, he described the weakness of the previous bridge design.

"On our previous arch bridge, the ends were translating or going outwards. For arch bridges you don't want the ends translating. You want them pinned or fixed," he said.

An engaged student's hand popped up in the air; he said reinforcement was the answer to strengthening the bridge.

"This guy is smart," Carabajal said.

Using their feet, students created abutments to reinforce the new bridge, causing the arch to resist through compression and withstand a greater applied load than the previous bridge. The demonstration provided a real-world lesson on compression versus tension, a concept critical to bridge design and construction.

"This is a practical application of the learning taking place in the classroom," said Millicent Dixon, a Wiesbaden Middle School math and resource management teacher. "We need to use math to do this, to build this structure."

For teachers, it is always a challenge to explain how classroom lessons translate into reality, Dixon said. The bridge-building exercise provided students tangible examples of applied math and science.

David Williams, an eighth-grade student who fancies math, said the structural engineering exercise was a good way to learn about bridges.

"At first, it looked like a jigsaw puzzle and I thought, 'Wow, how do you make it stand?'" he said.

As the presentation progressed, Carabajal explained how the arch bridge transferred the weight of the bridge and its load to the abutments or reinforcements at either end. He also explained that there are four main types of bridges: beam, suspension, truss and arch. During the workshop, Dixon saw interest gleaming in her students' eyes.

"Experiences like this with our community motivate our students to learn. The more hands-on engagement, the more real and accessible engineering seems," Dixon said.

The students enthusiastically raised their hands, asked questions and volunteered to build, load and measure the bridge. The hands-on exercise allowed students to touch, feel and break the structure.

Getting students excited about engineering in middle school or even earlier is advantageous. Frequent exposure to engineering activities and professional engineers is key to attracting students to the field, Dixon said.

"I remember being a student and thinking all engineers went to (Massachusetts Institute of Technology). For me it seemed unattainable," Dixon said. "But the more experience [my students have] with people in this field the better.

"They see their teachers every day so they want to be teachers," he continued. "They see athletes on television, so they want to be athletes. They need to see people in science and technology to get them interested in these fields."

As a sponsor, Europe District works with Wiesbaden Middle School teachers and administrators to engage students throughout the year. In addition to Engineers Week, district volunteers connect with WMS via videoconferencing lessons, Earth Day activities and Take Our Daughters and Sons to Work Day. At USACE, it is a priority to attract students to science, technology, engineering and math, or STEM, through a variety of outreach programs.

"Our country is in dire need of more scientists and engineers," Carabajal said. "The president has this STEM initiative because so much of the work is being sent overseas. We have to educate [students] and keep that work in our country."

STEM jobs are growing at a rate three times as fast as non-STEM jobs, and by 2018 they are projected to grow by 17 percent, according to the U.S. Department of Commerce.

As Carabajal's bridge-building presentation drew to a close, he made a plea to the students, "Please consider engineering as a career field."

Story by
Jennifer Aldridge, USACE

#

Lawrence Carabajal, a U.S. Army Corps of Engineers Europe District structural engineer, presents bridge building concepts to eighth-grade science and math students at Wiesbaden Middle School, Germany. Photo credit: Jennifer Aldrige, USACE

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Three More On The Books

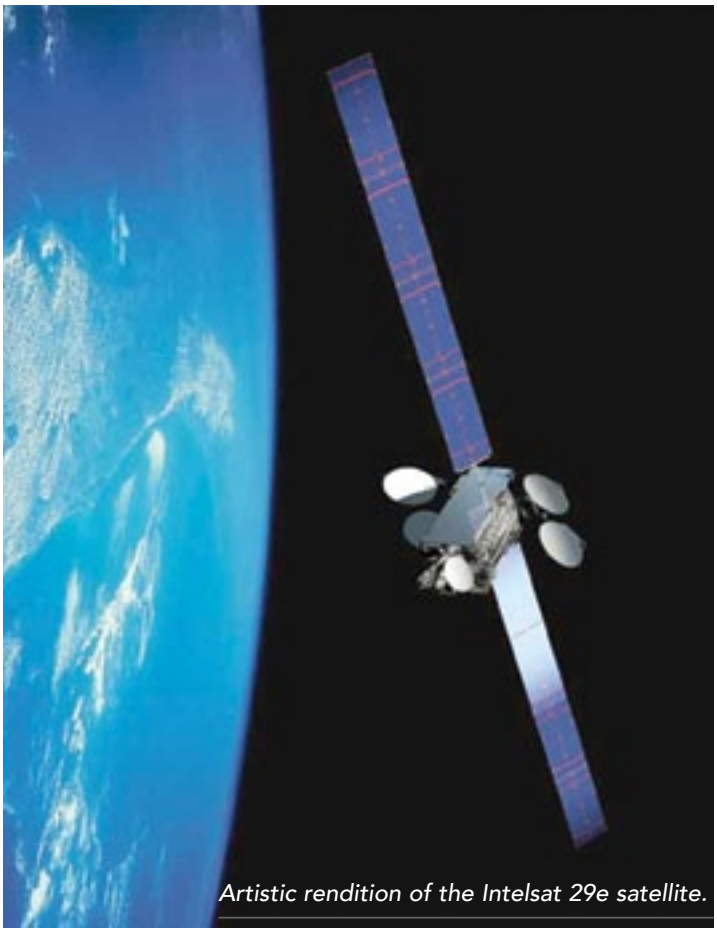
Arianespace has completed a launch services contract with Intelsat S.A. for the launch of three satellites through 2017.

Weighing more than six tons each at launch, the satellites will be placed into GTO by the Ariane 5 ECA from Europe's Space Port in French Guiana.

The three missions will include the launches of Intelsat's previously announced, high throughput EpicNG–class satellites. Intelsat EpicNG is designed to address wireless and fixed telecommunications, enterprise, mobility, video and government applications that require broadband infrastructure.

On this occasion, Jean-Yves Le Gall, Chairman & CEO of Arianespace, said, "We are particularly proud to be able to serve the world's largest satellite operator and we thank Intelsat. It is an honor to continue a partnership that goes back nearly 33 years.

This new contract for three satellites—representing the 52nd, 53rd, and 54th satellites Arianespace will have launched for Intelsat—is for us a confirmation of the quality and the competitiveness of our launch services." #



Artistic rendition of the Intelsat 29e satellite.

Readjusting The Ceiling

Harris Corporation has received a $500 million increase in the ceiling value of its 2011 Indefinite Delivery, Indefinite Quantity (IDIQ) contract with the U.S. Army Communications Electronics Command.

The increased ceiling provides the U.S. government with greater flexibility in acquiring Harris radios, accessories, systems and services to assist international partners with their mission-critical communication needs.

Under the contract, Harris provides military and land mobile radio systems to international partners of the U.S. State Department and U.S. Department of Defense.

The contract is part of the U.S. government's Foreign Military Sales program, which supports coalition building and interoperability through sales of defense equipment, training and services.

The contract allows all of these organizations to acquire product from the entire Harris Falcon radio portfolio. Such includes many advanced wideband solutions—such as the RF-7800H High-

The Harris RF-7700H-MP Multiband Networking radio. Photo courtesy of Harris.

Frequency, RF-7800M Multiband Networking and RF-7800S Secure Personal radios—as well as Harris Unity and other land mobile radios for public safety and first responder communications.

"The increased ceiling expands our ability to support international customers with advanced tactical radios and integrated communications system solutions," said Dana Mehnert, group president, Harris RF Communications. "Backed by 50 years of expertise and world-class customer support, our radios have been proven extensively in missions all around the world. We provide users with mission-critical network communications for applications in command and control, border security, counter-terrorism and other missions.'' #

Roaming Resources

Thuraya Telecommunications Company has just announced a strategic partnership with AT&T Inc., which will provide outbound GSM roaming for voice and data services to Thuraya users across the United States.

The roaming service, which commenced on March 15, 2013, allows Thuraya subscribers to roam seamlessly with their Thuraya XT-Dual handsets on the AT&T network.

Thuraya customers in the United States, including Puerto Rico and the U.S. Virgin Islands can now make and receive calls, and also send and receive text messages (SMS).

The next stage of the roaming service between Thuraya and AT&T will enable AT&T customers to roam and use the Thuraya satellite network which spans more than 140 countries across Africa, Asia, Australia and Europe. #

Expansion of EXPLORERs

The EXPLORER BGAN portfolio is expanding with the addition of four new series of VSAT terminals, all bearing the famous EXPLORER name.

To make this possible, Cobham SATCOM is migrating its established TracStar portfolio of VSAT terminals to become EXPLORER products, creating a most comprehensive range of land-mobile satellite communication products in the market, covering both BGAN and VSAT. The expanded EXPLORER portfolio now includes:

- *EXPLORER 300, 500 & 700 Series: Ultra-portable and easy-deployable Inmarsat BGAN terminals (L-Band)*
- *NEW – EXPLORER 3000 Series: Manual Deploy Fly-Away VSAT Antennas*
- *NEW – EXPLORER 5000 Series: Auto-Acquire Fly-Away VSAT Antennas*
- *NEW – EXPLORER 7000 Series: Auto-Acquire Drive-Away VSAT Antennas – Communication-on-the-Pause (COTP) for vehicles*
- *EXPLORER 325 & 727: Satcom-on-the-Move (SOTM) BGAN terminals for vehicles*
- *NEW – EXPLORER 9000 Series: Satcom-on-the-Move (SOTM) VSAT Antennas for vehicles*

The Cobham SATCOM land portfolio now features a diverse array of turnkey satellite terminals, ensuring that it can fulfil critical communications needs and offer true choice and flexibility for end-users. Regardless of location, when traditional communication infrastructure is unavailable, EXPLORER products keep users connected with reliable voice and data links.

EXPLORER enables high quality IP-based services such as voice communication, radio, data, fax, and live video transmission that work efficiently across the BGAN network and now, on VSAT satellite links.

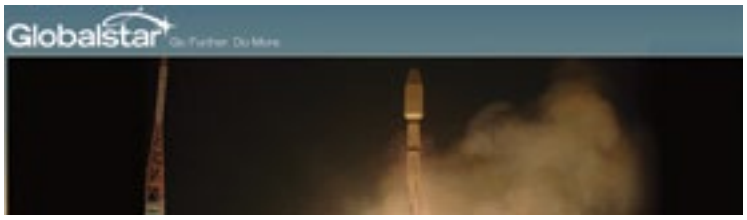
Customers of Cobham SATCOM's TracStar land-mobile product lines will experience no major changes in service as the TracStar products become EXPLORER.

The same sales, engineering, and support staff remains focused on servicing products in the field and developing world-class mobile VSAT solutions under the EXPLORER name.

These efforts are strengthened by the structure of Cobham SATCOM, which benefits from the expertise of the teams behind EXPLORER and TracStar. **#**

Cobham's EXPLORER 5100 Fly-Away Configuration

Monitoring Those Remote Assets



Globalstar Inc. signed a three-year manufacturing, airtime and distribution agreement with Nupoint Systems to expand the Company's M2M data communication service offerings beyond the reach of terrestrial (cellular) communication.

Nupoint products and services integrated with Globalstar satellite data services will be used to provide two-way communications for M2M data collection and monitoring of customer assets.

Companies that work in remote locations such as: Oil and gas wells, mining sites, water management systems, environmental/ weather sites, pollution detection systems, early warning systems and remote security, will benefit from this cost-effective, long-term asset monitoring solution.

Wayne Carlson, President & CEO of Nupoint Systems, said, "Companies can't always choose the location of their assets, but they can choose a reliable and cost effective satellite communications solution to connect to those assets. With Globalstar's recently launched satellites having a design life of 15 years, Nupoint is able to provide reliable two-way connectivity with our customer's data equipment, even in the most remote locations for years to come."

"Globalstar's satellite network will provide reliable solutions to meet the varying needs of Nupoint Systems' many customers. Decision making information will be available in real-time regardless of the asset location," said Frank Bell, President of Global Sales and Marketing for Globalstar.

Globalstar successfully launched its final batch of second-generation satellites on February 6, 2013.

Once placed in service, Globalstar will be positioned as the first mobile satellite services provider to complete the deployment of a second-generation constellation of low-Earth-orbit (LEO) satellites.

Combined with the Company's affordable and award-winning suite of consumer retail SPOT products, Globalstar will be uniquely positioned to offer the world's most extensive lineup of highly reliable and lowest-priced mobile satellite services to the broadest range of customers around the globe. #

Processing Those Payloads

Astrotech Corporation has announced that its Astrotech Space Operations (ASO) subsidiary has been awarded a NASA task order contract to provide payload processing services for the Soil Moisture Active Passive (SMAP) satellite at ASO's Vandenberg Air Force Base, California, facility.

SMAP is the second mission awarded by NASA under the current Not-to-Exceed $16 million Indefinite-Delivery/Indefinite-Quantity (IDIQ) task order contract that runs through December, 2017.

The Jet Propulsion Lab satellite, scheduled to launch in October, 2014, will gather global measurements of soil moisture and its freeze/thaw state from space. The three-year applied science mission will enhance weather forecasts and climate monitoring and prediction capabilities.

In January, NASA awarded a Not-to-Exceed $12.1 million IDIQ task order contract to ASO Florida to provide services for satellites launched at Cape Canaveral Air Force Station, Florida. #

Plenty Of Support

Northrop Grumman Corp. has completed the fabrication of the primary mirror backplane support structure (PMBSS) wing assemblies for NASA's James Webb Space Telescope.

The primary mirror backplane supports the telescope's beryllium mirrors, instruments and other elements during ground test operations and launch. It holds the 18-segment, 21-foot-diameter primary mirror nearly motionless while the telescope is peering into deep space. Their unique folding design permits the telescope to fit in the five-meter fairing of the launch vehicle.

Measuring approximately 24 by 21 feet, and weighing more than 2,000 pounds, the primary mirror backplane support structure—which includes the wing assemblies as well as the center section that ATK completed in February 2012—must meet unprecedented thermal stability requirements. While the telescope is operating at a range of extremely cold temperatures, from -406 to -343 degrees Fahrenheit, the backplane must not vary more than 38 nanometers (approximately 1/1,000 the diameter of a human hair).

The wing assemblies of the Webb Telescope's primary mirror backplane support structure were designed and fabricated and will be tested at ATK facilities in Magna, Utah. ATK designed and built the 900 composite parts of the wing assembly using lightweight graphite materials and advanced fabrication techniques. #

Advantech Wireless

Ultimate Mobility

from a world leader
in satellite communications

Advantech Wireless accredited products and advanced technologies have provided leading-edge innovations for over 20 years. We provide diverse and extensive technologies and products for video and data transmission and proven flexibility for specialized solutions.

Advantech Wireless' S5920M Ruggedized VSAT Terminal is a complete DVB-RCS modem that can be used in very harsh environment as in military and desert operations. The AMT 73L was the World's first deployed modem with certified compliance to the MIL-STD-188-165A standard, designed to fulfill two way satellite communication requirements in Defence Satellite Communications Systems (DSCS).

The Raptor series of transportable hubs are turn-key systems which can be deployed in less than 1 hour, to enable a wide range of public and/or private network topologies with satellite interactive terminals. The RAR9160 Ruggedized Router is designed to provide best in class performance for critical applications under harsh environments. Advantech Wireless' new line of ruggedized products, the KR Series, are perfect for government and military application.

Solid State Pulse Amplifier

AMT 73L Modem DISA CERTIFIED

Ruggedized Router RAR9160

S5920M Ruggedized DVB-RCS VSAT Terminal

Raptor - DVB-RCS Compact Transportable Hub

KR Series - MCU-2000 Mobile Mesh Networking System

KR Series - 3G Router

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Impressive VSAT Efficiency Gains

The newest and highest capacity member of its family of VSAT indoor units builds on the proven VSAT while tripling its throughput.

STM Group, Inc. announced Monday, March 18, at the Satellite 2013 tradeshow, the newest and highest capacity member of its SatLink® family of VSAT indoor units.

The SatLink 2910 builds on the proven SatLink 2900 VSAT while tripling its throughput. Multicast or streaming IP data is supported at rates up to 150 Mbps. Interactive IP traffic and bulk file transfers are handled with exceptionally high throughput as well.

The SatLink 2910, like all current SatLink products, supports the DVB-RCS2 standard for efficiency and link performance with ACM on DVB-S2 carriers and superior performance on TDMA carriers by using ACM per burst. Its capabilities deliver both higher return link throughputs and much higher link availability.

TDMA carriers up to 8 Msps are supported, enabling information rates up to 24 Mbps on return links.

All satellite bands are supported by the SatLink 2910 VSAT indoor unit, including: C-, Ku-, and Ka-bands.

The new 2910 is especially well suited for powerful new High-Throughput Satellites in Ku- and Ka-band. In some maritime and mobile markets the efficiency gains realized can be up to 250 percent, even with conventional Ku-band satellites.

Value-added IP networking features in all SatLink networks and in the SatLink 2910 include: advanced QoS, integration of traffic shaping with ACM controls, integrated link encryption using AES-256, VLAN tagging with private networking extensions, and mesh networking among VSATs. The SatLink 2910 includes a built-in 8-carrier mesh TDMA burst receiver for excellent mesh networking performance.

The SatLink 2910 is a 1U rack-mountable unit targeted primarily into maritime and other professional markets for broadband multimedia services. It will also serve demanding specialized applications for large commercial enterprises, such as oil & gas exploration companies, as well as defense, homeland security, and other government ministries.

In maritime environments and other mobile VSAT markets the SatLink 2910 uses the VSAT Antenna Control Protocol (VACP), an open protocol developed by STM and supported by most manufacturers of stabilized antennas. VACP enables seamless beam and satellite handovers for mobile VSATs when roaming or experiencing blockages.

The SatLink 2910, like other SatLink VSATs, is fully configured and automatically controlled from the Hub, avoiding the download of configuration files or any manual actions during beam handovers.

The DVB-RCS2 standard includes all best-in-class technologies, such as: linear modulation up to 16QAM; 16-state Turbo code FEC; and burst formats with encapsulation optimized for IP communication. This ensures the lowest possible overheads and best bandwidth utilization, while also removing the need to configure return carriers in SCPC mode simply to obtain high throughputs at the best efficiency.

STM is currently the only supplier shipping products with support for the DVB-RCS2 standard.

The SatLink 2910 will be commercially available in Q3, 2013.

STM also announced a development project for a very high-throughput, integrated TDM/TDMA Hub modem, supported by the Norwegian Space Centre and the European Space Agency.

This project will produce a compact 1U rack-mountable unit with 350 Mbps of IP throughput over DVB-S2 forward carriers with symbol rates up to 200 Msps. Also, the new DVB-S2 extensions currently being standardized by DVB, like 64APSK modulation, will be supported.

At the same time this new modem will perform burst demodulation for up to 64 DVB-RCS2 return carriers simultaneously, each using ACM per burst with an IP throughput of 150 Mbps.

The hardware platform for the modem will also contain an integrated Network Control Center (NCC) function handling all TDMA return link burst scheduling and burst performance tracking for up to 10,000 active VSATs. #

SAMS™ Saves

Satellite traffic planners have a host of tasks and solutions usually are costly.

SAMS™ by Glowlink is a NexGen satellite capacity and link planning tool. Satellite traffic planners can use SAMS™ to plan satellite communications traffic, perform link budget analysis and optimize space assets to meet data throughput and link performance objectives—all at a fraction of the price of other planning products on the market.

SAMS™ is designed for both fixed and mobile networks including aeronautical and maritime networks. The product is designed with an emphasis on ease-of-use. Its point-and-click interface gives the user a graphical and intuitive way to plan traffic links and predict their performance on a link-by-link or network-wide basis.

SAMS™ can be used either as a stand-alone link planning tool, or seamlessly integrated with Glowlink's industry-leading carrier monitoring systems for an end-to-end, all inclusive network planning/management operation: real-time carrier measurements can be incorporated into the refinement and assessment of planned traffic. Likewise, spectrum plans can be loaded into the monitoring system with a simple mouse click so the planned traffic can be immediately monitored for performance verification.

SAMS™ comes packaged with a SAMS™ Server and an integrated SAMS™ workstation for a true turn-key, plug-and-play solution.

http://www.glowlink.com

#

The Dilemma Of Decreased Spending

According to Euroconsult's newly released research report *Government Space Markets, World Prospects to 2022*, government spending on space reached a peak in 2012 of $72.9 billion, a non-negligible increase compared to 2011, which followed two consecutive years of minimal growth.

This upswing is attributed to increased activity of countries such as Russia, China, India and new world or regional leaders who compensated for budget uncertainties affecting North America and Europe. Euroconsult expects global government expenditures on space to decrease due to fiscal policies exerting continuous pressure on public finances; improvement is not expected before 2015.

"As forecasted in the previous editions of this research report, global government spending in space has entered a deceleration phase," said Steve Bochinger, COO at Euroconsult. "2013 should mark for the first time in 12 years a global decrease in government funding for space programs."

According to the research report, government space programs should be affected in the short term by an overall flat spending environment and decrease in global funding.

The situation is expected to recover in the second part of the decade, driven by a cleaner public finance environment, a new procurement cycle and R&D in historical leading space nations, and sustained spending from new world/ regional leaders and nascent programs. By 2022 global government funding for space activities is anticipated to pass the $77 billion mark.

The landscape for civil space activities has experienced profound structural changes in the last decade. In 2003, the top three civil space programs (U.S., Europe, Japan) accounted for 90 percent of world's civil expenditures. In 2012, their share accounted for only 64 percent illustrating the "decentralization" of space investment worldwide.

Following a peak launch of 65 satellites in 2011, governments worldwide sustained a dynamic launch rate in 2012 with 58 satellites for civil and defense applications, marking the second highest launch rate over the last decade. #

First Year Celebration

ViaSat Inc. is marking the one-year anniversary this month of the nationwide rollout of its Exede Internet service, which uses the ViaSat-1 satellite, the most advanced and highest capacity satellite in the world.

The consistently speedy performance of the Exede residential broadband service has helped ViaSat reach more than 285,000 subscribers on ViaSat-1 in its first year of operation.

The total subscriber count across all ViaSat satellites has surpassed 500,000 for the first time.

"Our results prove that driving down the cost of bandwidth can make satellite a better choice than slower terrestrial alternatives," said Mark Dankberg, chairman and CEO of ViaSat. "The market success of ViaSat-1 strengthens our commitment to delivering a series of new satellites that push the boundaries of what's possible in satellite broadband across a broad range of opportunities."

The 12Mbps baseline download speed offered by Exede Internet is eight times faster than previous generation satellite services.

While the feasibility and value of such a major technology advance was initially questioned in the industry, the Exede experience has quickly demonstrated that there is a much bigger appetite for satellite broadband in the market than most people anticipated.

Powered by ViaSat-1—now officially recognized as the World's Highest Capacity Communications Satellite with a Guinness World Records title—Exede service has moved into the mainstream of Internet options. A February 2013 FCC report showed Exede Internet outperforming all other ISPs in delivering promised speeds to subscribers, with 90 percent of Exede subscribers receiving 140 percent or better of the advertised 12 Mbps speed during peak periods.

Approximately 40 percent of new Exede subscribers are choosing the satellite service over other alternatives available to them, such as DSL, cable, and mobile wireless for fixed home use—a major shift from the previous generations of satellite Internet service, which were considered to be a "last resort" for those with no other Internet alternative.

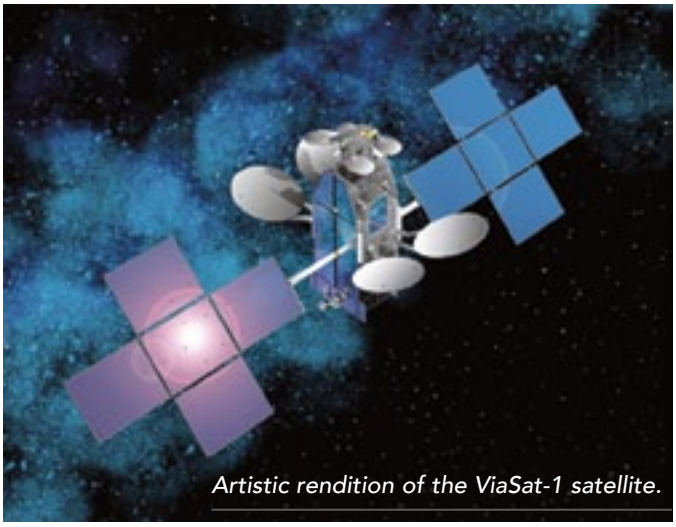
Beyond residential Internet, the ViaSat high-capacity satellite system is poised to re-shape communication services in other industries as well:

Faster, easier-to-use, and more cost-effective communications and video streaming for live events, such as newsgathering, concerts, and sports, as well as emergency response operations

Improved in-flight Internet that can provide enough high-speed bandwidth for every passenger on the plane

Higher-definition, higher-volume mobile video gathering and dissemination for military operations

ViaSat showcased these new services at Satellite 2013 in March, with interactive newsgathering, military ISR, and in-flight broadband demonstrations. Experts from several ViaSat business areas also participated in six conference panel sessions. **#**



Artistic rendition of the ViaSat-1 satellite.

Comms For Rotary

Hughes Network Systems, LLC has successfully demonstrated high-throughput video and data transmission over. SATCOM links on a variety of rotary wing platforms.

Employing an advanced waveform technology developed by Hughes, the new communications-on-the-move (COTM) microsat system achieved zero packet loss on transmission and reception through the rotor blades, over both Ka and Ku-band satellite channels.

Tests were conducted on a variety of military and commercial helicopters in both static and in-flight environments that included numerous pitch, bank and roll maneuvers.

In all cases, the Hughes microsat system successfully transmitted full motion video (FMV) beyond the line-of-sight (BLoS) through the rotor blades over conventional Ku-band global beam and Ka-band global or spot beam satellites.

The system operates with a variety of commercially-available airborne antennas, facilitating integration with various government, military and commercial platforms.

The Hughes microsat rotary wing system is based on the company's advanced HX satellite broadband platform, which meets the Federal Information Processing (FIPS) 140-2, Level 2 encryption standard and employs patented and patent pending waveform technology. #

Thwart Thought For ECM

Allen-Vanguard has released a further application for its software defined, open architecture EQUINOX Electronic Countermeasure system.

This new application will provide remote command and control of EQUINOX units from anywhere in the world. This represents a game changer in the way ECM can be used and maintained. Providing real time diagnostics and sending updated waveforms using secure communication protocols will benefit the logistics chain. Dynamically changing protective profiles will be a real boost to deployed Electronic Warfare Coordination Cells as well as headquarters which could be on the far side of the globe.

"This is a very exciting development and one that shows the true versatility of a software defined system such as EQUINOX" said Allen-Vanguard CEO, Dennis Morris. The server-based application provides users global access via a web-based interface to deployed EQUINOX assets worldwide. This marks the first known real time Machine to Machine (M2M) connectivity of Electronic Countermeasures. Users will get full situational awareness of deployed systems as well as be able to securely provision and get feedback from all their assets on the ground.

Mr. Morris continued. "Using the Short Burst Data of the Iridium network in collaboration with Track24, we are able to provide a cheap COTS communications transport layer that can seamlessly be integrated onto existing platforms to provide an immediate capability". **#**

The Odyssey Shall Continue...

Sea Launch AG and EchoStar Satellite Services, a wholly owned subsidiary of EchoStar Corp. (NASDAQ: SATS), have announced that Sea Launch has been identified as the intended launch services provider for the launch of a satellite from the ocean-based Odyssey launch platform in 2015.

Sea Launch's Zenit-3SL vehicle is suited for launching heavyweight-class spacecraft, with multiple restart capability and heavy-lift performance.

Sea Launch's history with EchoStar dates back to 2003. Most recently it launched the EchoStar XI satellite.

Sergey Gugkaev, chief executive officer of Sea Launch, said, "Sea Launch welcomes the opportunity to support EchoStar's launch requirement in 2015."

Kjell Karlsen, president of Sea Launch, added, "We are pleased to extend our relationship with EchoStar and we look forward to providing the required flexibility, performance and diversity of supply necessary to support their business plan."

"This preliminary agreement with Sea Launch provides EchoStar with the flexibility we require to accommodate our launch requirements as we undertake the expansion of our North American fleet," said Anders Johnson, president of EchoStar Satellite Services.

"We have been pleased with Sea Launch's performance on past missions and look forward to continued success."

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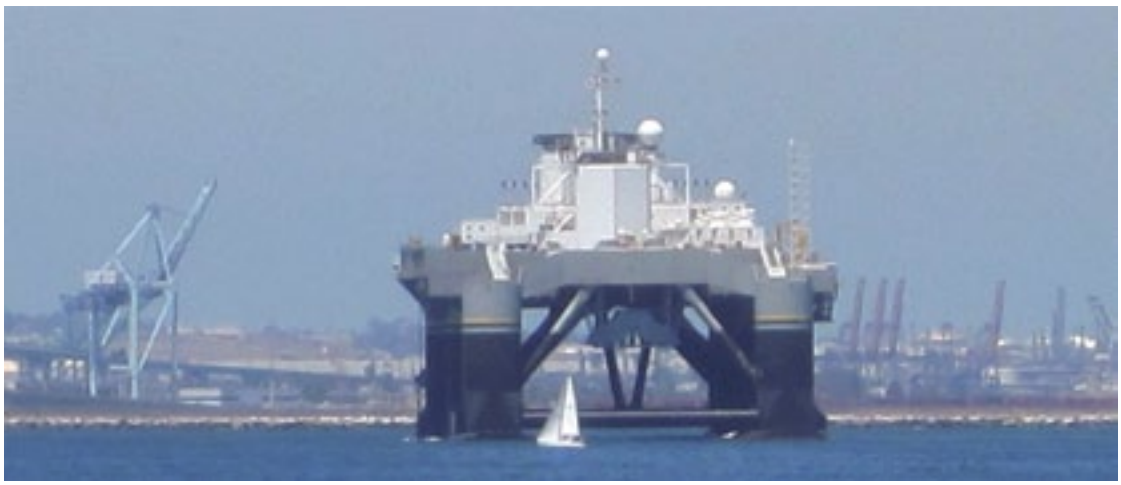


A New Earth Station Equipment Marketplace...

New Era Systems is celebrating its 13th year in business and has created an initiative to foster a more robust and efficient previously-used Earth station equipment marketplace.

The campaign kicks off with a drawing for a free iPad.

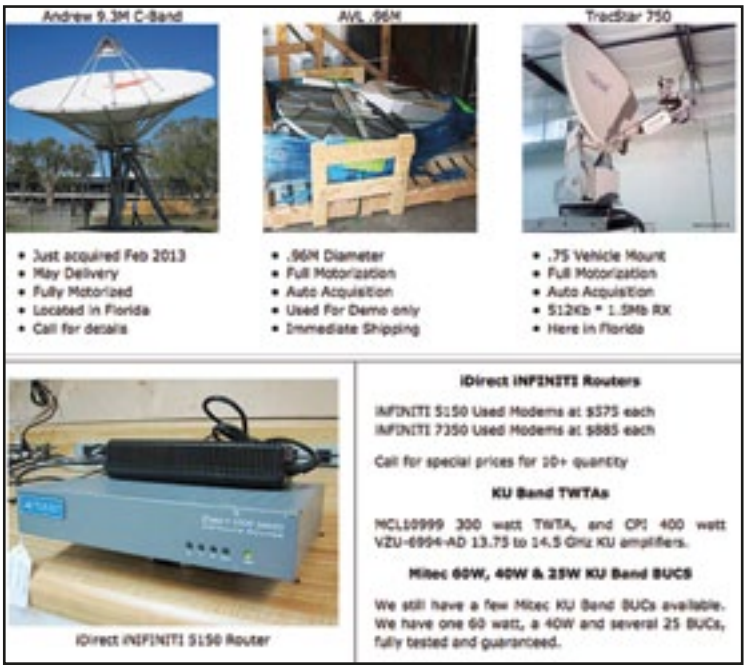
New Era Systems estimates there are hundreds of millions of dollars worth of unused antenna and RF equipment assets in satellite Earth stations around the world that could be profitably re-employed elsewhere.

"Until now, however, there has not been a well-known industry resource for buying and selling used gear, or disposal of large antenna systems," according to Phil Thomas, President of New Era Systems. "Our goal is to raise awareness of the pre-owned equipment market place—where we can help antenna buyers save money, and also help turn surplus antennas and gear into cash."

New Era Systems is inviting World Teleport Association members and teleports, as well as Earth station owners, operators and affiliates, to register interest in creating a more robust after-market and join the discussion, with the chance to win a free iPad at ***http://www.newerasystems.net/ipad-registration.html.***

"We will work with teleports and the industry to create a more efficient and transparent after-market for satellite equipment," Thomas added.

Robert Bell, Executive Director of the World Teleport Association (WTA), commented on the initiative... "We are delighted to welcome New Era Systems to the World Teleport Association. We look forward to adding them to the WTA marketplace, and to working with New Era Systems to educate our members on after-market equipment opportunities."



Hot Fire Tests

Engines fired for the military, Sandia, MELCO and others were 50 percent more in number in 2012 than in 2011, and more than 100 percent from those tested in 2010.

Within the past year, Moog ISP, part of Moog Inc.'s Space and Defense Group, successfully conducted more than 7,900 hot fire tests on 400 engines for at least 14 different customers.

In addition to testing engines and a variety of propellants and propulsion systems, Moog ISP manufactures liquid rocket engines, tanks and propulsion systems for satellites and launch vehicles. Moog ISP conducts hot fire tests at its Niagara Falls, New York facility which includes four vacuum-capable rocket test cells and one sea-level-capable rocket test cell.

In 2012, Moog performed hot fire tests on engines (ranging in thrust levels from approximately 250 lbf to less than 1 lbf) for commercial and military clients, including Sandia and MELCO.

"When selecting spacecraft instruments, performance and reliability are the most important criteria," said Masato Kotani, system engineer at MELCO. "We work with Moog ISP because we have always been completely satisfied with the in-orbit performance of their products."

According to Thomas Donnelly, Propulsion Test Manager for Moog ISP, the number of engines fired in 2012 was approximately 50 percent higher than the mark hit in 2011. And the total number of engines hot fire tested in 2012 exceeded the amount fired in 2010 by more than 100 percent.

"The utilization rate for our five test cells is approximately 90 percent, and we are now building a sixth vacuum-capable rocket test cell in Niagara Falls that we expect to operate by the end of 2013," said Donnelly.

Moog ISP usually assembles all of the engines and propulsion systems it tests at its Niagara Falls facility. Once an engine is tested for pressure, flow and vibration, it is then hot fired to verify performance characteristics such as thrust and chamber temperature prior to delivery to the customer. **#**

Pictured: Tom Donnelly, Moog Propulsion Test Manager, inside one of the rocket test cells at his company's Niagara Falls, New York facility.

An EPOCH™ Satellite Program

EPOCH is used to support more than 50 Space Systems/Loral 1300 satellites around the globe, far more than any other Command & Control system in the world.

Kratos Defense & Security Solutions, Inc. has announced that its Kratos Integral Systems International (Kratos ISI) business unit has been awarded a contract by Asia Satellite Telecommunications Co. Ltd. (AsiaSat) to provide Command & Control systems for the AsiaSat 6 and AsiaSat 8 satellite programs.

AsiaSat will expand its use of Kratos ISI's industry-leading EPOCH™ Integrated Product Suite (IPS) Fleet Management System to support the AsiaSat 6 and AsiaSat 8 satellite programs.

AsiaSat 6 will have 28 high-power C-band transponders, and AsiaSat 8 will have 24 Ku-band transponders and a Ka-band beam.

The high-power transponders on the satellites will enable the use of small antennas on the ground.

The two Space Systems/Loral 1300 satellites are currently under construction and scheduled for launch in the first half of 2014.

EPOCH IPS is used to support more than 50 Space Systems/Loral 1300 satellites around the globe, far more than any other Command & Control system in the world. The contract expands the number of AsiaSat satellites managed by EPOCH IPS to seven, including satellites supplied by three different manufacturers, demonstrating the flexibility and ease of use of EPOCH IPS to manage satellite fleets no matter the configuration or size.

"We are excited to have selected Kratos ISI as the Satellite Control Facility supplier for the two new additions to our expanding fleet—AsiaSat 6 and AsiaSat 8. Following their launches in the first half of 2014, we will be able to offer the highest transponder power ever for a broad range of satellite services in the Asia Pacific. Over the past years, AsiaSat has witnessed the continuous improvement of the EPOCH IPS family products, which reinforces our confidence in ISI's commitment to excellence. We are pleased to work with Kratos ISI again and are confident that Kratos ISI will deliver the project on time to support our upcoming launches," said Fred Ho, Director, Technical Operations of AsiaSat.

Artistic rendition of the AsiaSat-6 satellite. Courtesy of SS/L.

"There is no better testimony to the value of Kratos' products and the quality of our service than repeat awards from long-term customers," said James Kramer, Senior Vice President of Kratos ISI. "We are honored that AsiaSat has again selected Kratos ISI to expand their EPOCH IPS fleet management system to operate AsiaSat 6 and AsiaSat 8."

For 30 years, Kratos ISI has been a leading provider of satellite ground systems supporting approximately 300 satellite missions. Kratos ISI offers turnkey ground segments solutions encompassing Command & Control, RF/IF equipment, satellite and terrestrial communications signal monitoring systems, equipment and network management and payload management solutions.

The company's EPOCH IPS, an all-in-one Fleet Management solution, is the most widely used Command & Control system with successful installations in five continents.

Government clients include the National Space Organization (NSPO) of Taiwan, Vietnam Posts and Telecommunications Group (VNPT), European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), Secretaria de Comunicaciones y Transportes (SCT) of México, NASA, the U.S. Air Force and the National Oceanic and Atmospheric Administration (NOAA).

Commercial clients include AsiaSat, Asia Broadcast Satellite, Broadcasting Satellite System Corporation (B-SAT), Chunghwa Telecom, EchoStar, Hellas Sat, Indovision, Intelsat, KT Corporation, PT Telkom, SatMex, SES, SingTel/Optus, SKY Perfect JSAT, Thaicom, and Telesat. **#**

Contract For Interference...

Kratos Defense & Security Solutions, Inc. announced that its SAT Corporation (SAT) subsidiary has also received a multi-million dollar order to provide satellite interference detection and quality of service monitoring.

The contract includes SAT's satellite monitoring product, Monics®, an enterprise networked advanced spectrum measurement and interference analysis system used by the majority of satellite operators and telecommunications providers around the world. As a complete carrier monitoring system, Monics also provides advanced interference detection and analysis capabilities.

The Monics implementation will combine hardware and software components to provide monitoring for satellite uplink and downlink performance. Monics' native scalability and flexibility enable a fully distributed, autonomous system for monitoring payload traffic and RF interference, including co-channel interference.

This will be the first satellite operator to implement both Monics and SAT's new Monics Enterprise Manager (MEM). MEM will provide greatly enhanced visibility into the customer's satellite payload performance along with centralized control over their monitoring assets. MEM adds an improved user interface that includes custom displays for alarm and data management as well as enhanced system administration. #

SatFinder

Satellite Database & Calculation Software

DATABASE

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

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

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

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

CALCULATION

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

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

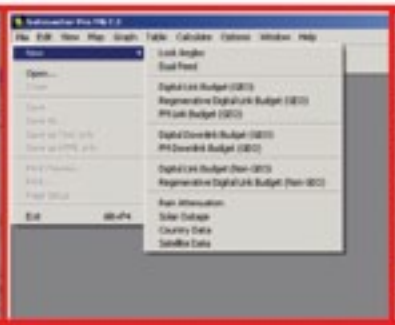
Calculates atmospheric losses and rain fade margins for any desired availability on uplink and downlink.

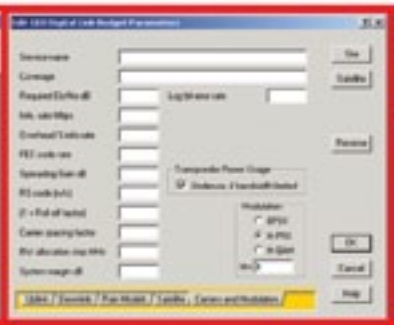
Handles BPSK, QPSK, M-PSK or M-QAM with any FEC code rate.

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

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

UPDATED QUARTERLY!





http://www.satnews.com/satfinder

First Sergeants Find Value In Air Guard's Warrior Network

When Chief Master Sgt. Michael Kennedy wanted to communicate to more than 800 first sergeants across the Air National Guard as their functional manager this week he turned to the I.G. Brown Training and Education Center.

The center told him, no problem.

Its Media Engagement Division and "Warrior Network" were broadcast by Kennedy live from an anchor desk, in high definition. They set him up in a state-of-the-art video broadcast, while at the same time fielded questions to him via email, text and phone.

Subject matter experts and top Total Force leaders were also connected live via high definition video teletraining systems, or telephonically, creating a virtual conference that was pushed out to all of the Air Guard's first sergeants.

If that's not enough the broadcast went out via satellite to the entire Air Guard, nationwide, through base cable networks and directly to some airmen's desktop computers.

Staff Sgt. Michael E. Davis, TEC/TV broadcast journalist at the I. G. Brown Training and Education Center here fields phone calls from callers wanting to speak with Chief Master Sgt. Michael Kennedy, the first sergeant functional manager for the Air National Guard during a live broadcast March 7, 2013. The broadcast, via the Warrior Network, was part of their continuous development training. (National Guard photo by Master Sgt. Kurt Skoglund)

Maybe best of all, it cost Kennedy's department little more than a plane ticket and a hotel stay for one.

"I think we are capturing all the facets here at this jewel and really making it sparkle today," said Kennedy. "It's very cool, and I'm pretty excited about it."

The Warrior Network and its dedicated satellite television system beams out to all of the Air Guard's sites, for a total of 186 downlinks, for the purpose of delivering news, command information and professional training, among other creative uses.

Managers of the advanced television studio network said the recent fiscal constraints are proving the value of having a combined physical and virtual campus with conferencing capabilities.

It's a center of learning that has grown toward its golden age for decades.

"I think the Warrior Network is at the start of a level of usage that has not been seen," said Maj. Gabe Johnson, division chief. "It's cost effective … really the only travel is for you to come to TEC, your audience doesn't have to go anywhere, and that's a huge benefit."

As the physical school house and satellite campus for the Air Guard's enlisted academies, members at the Center are working hard to serve the field with innovation and technology to "be the all-encompassing place for knowledge, comprehension and application levels of learning," said Johnson.

Having been a participant in the Center's satellite Noncommissioned Officer Academy back in the '90s, Kennedy said he knew right away the Air Guard was "bringing a very unique perspective to professional training."

"Working with the crew here and what they bring to the fight every day, it's just quality, bar none," said Kennedy.

The award-winning media team consists of Air Guard and Air Force active duty Airmen on special assignment, as well as civilian studio engineers and technicians.

Every duty day, the studio broadcasts its signature "Minuteman Report"—a news story from the field—to the National Guard as well as to the Department of Defense's Pentagon Channel and American Forces Network, reaching millions of viewers around the world.

The studio is preparing to deliver the next Airman Leadership School via satellite to sites all across the nation on Monday. The Air Guard's Senior Leadership Conference was broadcast live through the studio, and Chief Master Sgt. James W. Hotaling, command chief of the Air Guard, recently recorded and broadcast his introductory message to the field here.

Johnson said the Center and its Warrior Network see endless opportunities for innovative communications for all of the service components and Departments.

"At the very basic level we are willing to work with customers to put out computer-based training or a recorded video, all the way up to producing interactive broadcasts and hosting campus workshops and classrooms with live coverage," said Johnson.

"This is our third time using the Warrior Network," said Kennedy. "It's a low-cost, high impact way to reach 100 percent of our Wings."

Kennedy said he once brought a cadre of instructors here, even the Air Guard's command chief, who was scheduled to broadcast with him that afternoon.

"I can hold a Total Force broadcast here with just a few phone calls and speak to the entire Air Force, worldwide," said Kennedy. "To me, that's just an awesome venue to take advantage of."

Story by
Master Sgt. Michael Smith,
Air National Guard Training,
U.S.A.F.

Chief Master Sgt. Michael Kennedy, the first sergeant functional manager for the Air National Guard speaks interactively with more than 800 First Sergeants from the I. G. Brown Training and Education Center here, March 5, 2013. The live broadcast, via the Warrior Network was part of their continuous development training. Also pictured, Senior Master Sgt. Paul A. Mann, public affairs branch chief at TEC/TV. (National Guard photo by Master Sgt. Kurt Skoglund)

Sicilian Blockade

Italy is blocking completion of a controversial U.S. military satellite station in Sicily pending the results of a health and environmental study.

The satellite system, approved by the Italian Defense Ministry in 2006 for construction near the U.S. naval base at Sigonella, has been for months the catalyst for protests by Italians amid concerns about exposure to radiation.

Italian officials signed an order staying further progress at the satellite station, which is going up in the Sicilian town of Niscemi, and ordered an impact study of the antenna system. Protesters have blocked access to the base, reportedly cut holes in security fences and clashed with police.

Italy's prime minister wrote in a statement that final satellite antennae installation would be blocked until completion of the independent study. Prime Minister Mario Monti's statement said the government's action was in response to "concerns of local people about the impact on the environment and human health as a result of ongoing work to modernize and expand the facilities."

The satellite station, located about 45 minutes from the Navy base at Sigonella, will host part of the global communications network called Mobile User Objective System, or MUOS.

The network eventually will comprise five satellites that will be able to communicate with antenna systems placed on bases around the world. In addition to the site in Italy, there are sites in the U.S. and Australia.

The first satellite was launched from Cape Canaveral, Florida, in February 2012. MUOS-2 is expected to be launched in July. The five-satellite global constellation is expected to be fully operational in 2015, extending UHF narrowband communications to all of the U.S. armed forces past 2025, according to Steven A. Davis, spokesman for the SPAWAR.

"Born from the need for stable, 24/7 ship-to-shore communication that could be successful, regardless of environmental and geographical conditions, the Navy is assigned the responsibility to provide this crucial capability known today as narrowband satellite communication," Davis said.

Other stateside locations include Hawaii and Virginia.

Two health studies were conducted by technicians at the sites in Wahiawa, Hawaii, and Chesapeake, Virginia. They measured levels of the electromagnetic radiation and results showed levels were below applicable permissible exposure limits, or PELs, established by U.S. standards, Davis said. Summaries of the studies have been translated into Italian and posted on the U.S. Consulate's website.

The MUOS antenna will not interfere with any of the 2,409 local or remote communications systems within a 75-kilometer (nearly 50-mile) radius, he said. **#**

Story by Sandra Jontz, Stars and Stripes

New Network For Afghan-Bound Unit

When they deploy to Afghanistan this summer to assist in the drawdown of U.S. forces, the Soldiers of the 4th Brigade Combat Team, 10th Mountain Division, will have a new edge.

The unit will be the first to use an on-the-move communications network that stays connected over vast distances, providing information throughout the brigade down to the lowest echelons.

That capability will be critical as U.S. troops work closely with the Afghan forces, take down fixed infrastructure and become increasingly mobile and dispersed in their operations, leaders said.

"This is much needed in Afghanistan," said Brig. Gen. Walter E. Piatt, deputy commanding general for support, 10th Mountain Division (Light Infantry).

Like their counterparts in the 4th Brigade Combat Team, or BCT, the Division's 3rd BCT will also be deploying as a Security Forces Advise and Assist Team, or SFAAT, with the new network later this year.

"Imagine you're a Soldier and you need information on a given area, or you want to see where units are located to your left and right," Piatt said. "You don't want to have to come back to headquarters; you don't want to have to force a transmission over a radio net just to get that. You want to have that information readily available. (This network) allows us to do that on the move, and

allows us to do it dismounted as well."

Known as Capability Set 13, or CS 13, the package will allow the 10th Mountain units to use advanced satellite-based systems—augmented by data radios, handheld devices and the latest mission command software—to transmit voice/chat communications and situational awareness data throughout the SFAAT.

On patrol inside mine-resistant, ambush-protected vehicles configured with components of CS 13, leaders will be able to exchange information and execute mission command using mobile communications technologies, rather than having to remain in a fixed location to access the network.

The Army targeted the two brigades as the first to receive CS 13 capability because they require advanced communications to carry out their advise-and-assist mission in Operation Enduring Freedom. While the Afghan forces will be taking a lead in operations, the SFAAT units will have the network capabilities to support with situational awareness and needs such as calls for air support, artillery support and other reach-back communications.

After several months of new equipment training to familiarize Soldiers with CS 13, the 4th BCT is now immersed in intensive final preparations for deployment.

The prep includes a several weeks-long Joint Readiness Training Center rotation where they will use the gear in realistic operational scenarios based on the SFAAT mission.

The 10th Mountain brigades are also receiving lessons-learned and recommended tactics, techniques and procedures, known as TTPs, for using the equipment that were developed during the Army's Network Integration Evaluation, or NIE, process.

The semi-annual field exercises involve 3,800 Soldiers of the 2nd Brigade, 1st Armored Division, who use networked equipment as they execute mission threads in the rough terrain of White Sands Missile Range, New Mexico. The NIEs were used to integrate the CS 13 network and validate its performance prior to fielding. They also produced voluminous Soldier feedback that was incorporated into vehicle designs, handheld device configurations, software features and other elements of the capability set.

Capt. Joseph Perry, a company commander with 2/1 AD who has participated in several NIEs, said he looks forward to seeing how the SFAAT teams will ultimately use the network in theater.

"I'm really curious to see what their feedback is," he said. "I'd like to see the circle complete."

The brigades' deployment with CS 13 will be the culmination of a total Army effort to quickly field the capabilities, spanning dozens of commands and locations and requiring constant coordination among network and vehicle project managers, production facilities, brigade staffs and fielding and training professionals.

Along with the sophistication of the equipment, the fielding effort was unique because it marked the first time the Army delivered a complete package of network technologies that was integrated up front, rather than providing each system independently.

"This is the way the Army needs to conduct business for this type of fielding," said Lt. Col. Bill Venable, the Army's system of systems integration "trail boss" assigned to 4/10. "Synchronizing equipment deliveries, vehicle touches, training and other elements makes sense for communications systems that are integrated across the BCT, and helps reduce the burden on the unit operating in a time-constrained environment." **#**

Story by Claire Heininger, U.S. Arny

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Coast-To-Coast Training

The 35th Signal Brigade soldiers continued training to become experts in their field and masters of the fundamentals during a field training exercise from January 28 to February 1 at Fort Gordon, Georgia, Joint Base Lewis-McChord, Washington, and Fort Bragg, North Carolina.

"The training gives the Brigade the opportunity to test communication systems and connectivity between battalions as the operators maintain proficiency on these systems," said Jerry W. Vanlue, the deputy S-3 for the brigade. "The training exercise also provides the leader a chance to enhance and perfect their capabilities."

The 63rd Expeditionary Signal Battalion commander, Lt. Col. Michael P. Martel, echoed Vanlue's statement.

"The exercise allows our communication teams to strengthen their skill set," said Martel. "It helps prepare our communication teams for future missions."

Capt. Ernest B. Jones, the B Company, 63rd ESB commander, ensured that his command post node teams executed battle drills and established communication systems.

His multichannel transmission and information technology operators cross-trained and took advantage of the exercise to enhance their Blue Force Tracker and FM communication systems skills.

"This training is an excellent way to firm up the fundamentals and the skill set of our soldiers," said Jones. According to Spc. Mallory A. Kaleta, a multichannel systems operator assigned to C Company, 63rd ESB, the field environment gave her the optimal time to train her new team member, Pvt. Eric Rodriguez.

"Training in the field is a pretty easy way to teach the new soldiers," said Kaleta.

Safety of brigade soldiers and equipment is paramount, and weather provided some challenges to the training units. Sgt. 1st Class Samuel P. Moore III, a unit controller during the exercise, was the go-between for the 51st ESB at Joint Base Lewis-McChord and the brigade headquarters. However, when high winds and thunderstorms affected Fort Gordon, he became a liaison between range control and the post installation operations center.

"The brigade ensured a plan was in place in case of severe weather and communicated the accountability of personnel to the IOC," said Moore.

The field environment not only allowed the brigade to execute communication skills, but also allowed maintenance Soldiers to troubleshoot any problems with vehicles and generators. Sgt. 1st Class Ronaldo C. Allen's team of air conditioning, vehicle and generator mechanics from B Company, 63rd ESB, was dispatched and on call to support training sites throughout Fort Gordon. His mechanics valued the hands-on experience.

"The field environment allows us to think outside the box," Allen said.

Brigade food service specialists received praises for serving "good hot food" during the training exercise.

"We also try to maintain morale and ensure they have a hot breakfast when they wake up and have a hot meal before they go to bed," said Staff Sgt. Laura I. Weymon, a food service specialist assigned to B Company, 63rd ESB. **#**

Story by Capt. Devon Thomas, 35th Signal Brigade, U.S. Army

U.S. Army Sgt. Leroy Smith Jr., right, a multichannel systems operator assigned to Alpha Company, 67th Expeditionary Signal Battalion, instructs Pvt. Dommonic T. Thigpen, a cable systems installer, on how to set up an antenna at a training site in Fort Gordon, Georgia, January 31, 2013. The 35th Signal Brigade held a field training exercise at Fort Gordon Georgia, Joint Base Lewis-McChord, Washington, and Fort Bragg, North Carolina, for Soldiers to validate and to train on communication systems. (U.S. Army photo by Capt. Devon O. Thomas/Released)

Bringing More Fire To The U.S. Navy

The U.S. Navy has awarded Northrop Grumman Corporation a contract valued at more than $71 million to produce six additional next-generation Fire Scout unmanned helicopters.

The Fire Scout endurance upgrade, designated the MQ-8C and based on Bell Helicopter's 407, will provide ship commanders with increased range, endurance and payload capacity over the current MQ-8B variant.

The Navy plans to purchase a total of 30 aircraft under a rapid development effort. Northrop Grumman is currently under contract to produce 14 Fire Scouts that are scheduled to begin deploying in 2014.

Manufacturing and assembly operations of the new Fire Scout variant are well under way across the country, with airframe modifications being made at Bell's facility in Ozark, Alabama, and final assembly being completed at Northrop Grumman's Unmanned Systems Center in Moss Point, Mississippi. **#**

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Protected MILSATCOM + The Affordable Solution

By Rick Skinner, Business Development Director, Communication Systems, for Northrop Grumman Aerospace Systems

Meeting the communications needs of mobile users is a high priority for the U.S. military. The types and quantity of information passing over mobile communications links has grown rapidly and will likely continue to grow. Demand will further increase as irregular warfare will often drive fighting forces to operate in smaller, more mobile groups that are more widely dispersed. This will lead to additional Communications on the Move (COTM) bandwidth needed for situational awareness and command and control information. Since much of this communication occurs between users without line-of-sight access, military satellite communications (MILSATCOM) are an important part of the solution to the connectivity and capacity demands of a highly networked, mobile force.

While there is little debate that servicing mobile users requires additional MILSATCOM in general, and protected MILSATCOM in particular, there are multiple approaches for achieving this goal.

Addressing those needs and threats means examining all parts of the MILSATCOM eco system—space-based satellite relays; a ground-based satellite control and mission planning capability; user terminals; interfaces to the communications commons like the Department of Defense's Global Information Grid; and life cycle support and sustainment.

It's the combination of these systems—terminals, space and mission control—that define the SATCOM capability.

The Need For MILSATCOM

Experience in combat teaches that connectivity is king. The growth has been huge, and has well outpaced predictions.

Government-owned SATCOM was unable to meet military demands in U.S. Central Command area of responsibility in the Middle East, but fortunately, the commercial SATCOM industry met most of the needs. That part of the world is on the under-served side of the digital divide; in Iraq, because before we sent troops in, we obliterated a relatively modern communications infrastructure. But in the case of Afghanistan, it really never existed.

The U.S. isn't likely to see a much different equation as it rebalance forces to the Pacific. SATCOM may even be more critical to success in that region. Unlike Afghanistan and Iraq, there are potential adversaries in that part of the world that are not only willing but able to negate many of SATCOM capabilities that are not purpose-built to defend against threats.

While the Department of Defense and its industry partners were able to focus available owned and leased commercial assets to provide a strong SATCOM network for operations in Afghanistan, it hasn't been a perfect system. SATCOM support was definitely good at brigade headquarters and above, but pretty sketchy out at the pointy edge of the spear. To the extent SATCOM was available at all to the individual soldier or Marines in small unit operations, it was low-speed data or cell phone voice quality often shared among tens or hundreds of users.

More importantly, SATCOM was largely unprotected against modern-day threats. It was vulnerable to interference. Improper configuration of user terminals frequently brought down a satellite network because improperly configured satellite terminals are jammers, too. The networks relied on satellite hubs where physical damage or electrical power outage could bring down an entire network.

Threats To MILSATCOM

Many people are worried about the jamming threat. But a much easier and longer-lasting effect might be caused by a rocket launched into a SATCOM gateway, a cut cable between a remote terminal and command center, or a cyber attack on the networking gear behind the satellite terminal.

That's why it's important to focus on all the threats—not just jamming alone—and make a thoughtful determination on what threats to address in any SATCOM solution.

The communications network is only as strong as its weakest link. It doesn't make sense to have a great anti-jam system if the ground infrastructure on which the network is dependent is an easy target to deny or degrade.

As military attention pivots from Afghanistan to potential adversaries in the Pacific, there's no reason to pat ourselves on the back about the successes of SATCOM in Operation Enduring Freedom. Adversaries in the Pacific are different. They have different intentions, they have very high-technology capabilities, and they will want to degrade or eliminate our network-centric advantage very early in the game. Targeting the communications links will be a good start, particularly if they are easy targets.

There's a mix of SATCOM capabilities in place today. To be well-connected, users have to access all the satellites in view. They can link SATCOM together on the ground using network routers and other network hardware. But having to span several SATCOM links through space in a series results in a significant time delay that makes some communications applications unsatisfactory.

Voice and video teleconferencing—two significant uses of communications in the national security arena—for example, are pretty unsatisfactory when multiple satellite links (called hops) must be used. That's only made worse when three of the four satellite capabilities will be out of service due to jamming or other attack.

All critical communications—those that are essential for mission accomplishment—should migrate to protected SATCOM whether the user is a sensor, a command and control node, or an air, maritime or ground shooter.

A mixed SATCOM system works well in a benign environment. But it is not necessarily efficient because multiple SATCOM links may be required to form a network. This means that:

- **The service is more expensive and requires more ground equipment to "glue" it together**
- **Performance is reduced when multiple SATCOM links need to be connected end-to-end**
- **Users must deploy and bear the burden of operating and maintaining multiple satellite terminals to avoid those issues**
- **Most of the architecture offers little protection, and while there may be many satellite points of presence in view, tying them all together is complex**
- **While an individual link may not break the bank, having to use four links to get a job done is clearly more expensive than using one that does the whole job.**

Protected SATCOM has been available for more than 30 years. The communication payloads that make it possible were purposefully designed and built to operate through government-specified threats from the low end of technology to the very highest level threats. Northrop Grumman has a "shelf full" of components that are flight-proven and known to mitigate the threat.

These components do a great job of meeting all requirements of the Advanced Extremely High Frequency protected SATCOM system, delivering strategic command and control at all levels of threat. Since the strategic threat exceeds that facing tactical forces, the AEHF system meets the needs of tactical operators as well.

To be sure, tactical troops use the preponderance of Milstar and AEHF capability in terms of capacity and connections. That said, as needs for tactical protected communications grow and needs for strategic communications stay about the same, the military should give more consideration to protected tactical SATCOM that may not have to incur all the features of a strategic system.

An Affordable Solution

This opens the possibility of using a nonstrategic satellite bus available from several U.S. manufacturers; a nonstrategic mission control and planning element; nonstrategic terminals; and commercial launch.

The ability to reconfigure AEHF components to meet other requirements is demonstrated in the Enhanced Polar System (EPS). EPS is a scaled-down version of the AEHF payload specifically designed to be hosted on satellites that provide coverage of the high latitudes. Users there don't need a full AEHF capability. As the prime contractor for two EPS hosted payloads, Northrop Grumman scaled down AEHF digital and radio frequency assemblies and redesigned antennas to meet coverage needs in the high latitudes.

The same reuse and scaling of AEHF components can meet other needs as well. The company is proposing to build, for example, a protected tactical satellite using a commercial satellite bus, commercial launch, and the EPS Control and Planning Segment to augment AEHF with additional capacity and connections.

Once these satellites are in production, their price becomes very close to the price of equivalent unprotected SATCOM. The ground segment, furthermore, is much less complicated if AEHF crosslink assemblies are used to extend the on-orbit network coverage beyond the range of a single satellite. This gives a protected tactical satellite several advantages:

- **It only needs a single U.S.-based ground station and a back-up because satellites that are out of view can be controlled via the crosslinks**
- **It doesn't rely on overseas ground stations to manage the network and to present a lucrative target to adversaries**
- **Users don't have to tolerate performance impacts of relaying communications over multiple satellite hops**
- **Together, this tactical satellite service is about the same price as an equivalent unprotected system**

These components can be reconfigured in other ways, as well...

- **It's possible to build a smaller, strategic satellite on a smaller, strategic bus to eventually replenish the strategic AEHF capability as it reaches its end-of-life**
- **Another interesting configuration would be combining a tactical capability with something called the wideband relay. This would provide platforms like Global Hawk and Reaper with protected command and control links to their respective ground stations while relaying hundreds of megabits of mission data via pin-point uplinks that can be shaped to avoid interference threats.**

The ability to deliver a protected system at prices close to unprotected can change the calculus of what communications the military protects. Rather than rationing out access to protected SATCOM, operators can allocate it to all users that could experience mission failure if their communications links are degraded, disrupted, denied or destroyed.

These options for future EHF capability are known as "evolutionary EHF" because there's no need to invent anything new. Consequently, there would be very little non recurring engineering content, which can be hard to estimate and can impact cost and schedule.

This kind of modularity and ability can be used to craft a new capability from proven components without starting a new development. It allows military leaders to pursue a vision of a unified communications system where all core users can access a single system that is impervious to threats. These payloads can be placed in a variety of orbits that complicates an adversary's ability to bring high-end threat of physical damage to all the platforms in view.

This doesn't do away with other forms of SATCOM, but it does unify essential command, control and communications into a single, threat-proof system that makes it possible for any user—at any point on the globe—to connect with any other user, and via ground interconnection, to all users. If ground services should become impaired, essential communications will be maintained.

Air Force leaders have compared this situation with being at the proverbial fork in the road. In one direction, communications is a force multiplier that operates through anticipated threats. In the other direction, there is a great system of systems but it is vulnerable and may be degraded or denied by a tech-savvy adversary.

So the choice is clear: Satisfy known needs, or let a patchwork of decisions make it by default as each sensor, shooter and command and control capability is fielded. Military services are dependent on communications to tie the key actors in the battlespace together. Leveraging decades of investments in protected SATCOM provides an affordable option well worth considering.

About the author

Rick Skinner is Business Development Director, Communication Systems, for Northrop Grumman Aerospace Systems, where he manages business capture initiatives for protected military satellite communications. He is a 29-year veteran of the U.S. Air Force, where he held senior level positions in communications and space systems policy, program oversight, operations, research and development and acquisition. In his last Air Force position, he served in the Office of the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence), which was the principal Office of the Secretary of Defense staff assistant for the development, oversight and integration of Department of Defense policies and programs relating to the strategy of information superiority for DoD. Previous Air Force assignments included acting Mission Area Director, Space and Nuclear Deterrence at in the Office of the Assistant Secretary of the Air Force - Acquisition. After retiring from the Air Force, Skinner joined Lockheed Martin Space Systems, where he was Vice President, Strategy and Business Development for Global Communications, and prior to that, Vice President, Transformational Communications.

A Short Burst Data Capability

By Giles Peeters, Senior Contributing Editor + Defence Sector Director at Track24 Defence

When it comes to communications, military organizations are increasingly looking to keep it short and sweet.

In the world of communications, data is all important. The ability to easily and cost-effectively send and receive data has completely transformed the way people carry out day-to-day tasks and communicate with one another.

When *Short Message Service* (**SMS**) technology was introduced to cell phones, it was put in as an afterthought and was predominantly used to send network messages and voicemail notifications. Today, 2.2 trillion texts are sent a year in the U.S. alone, with the total global figure estimated to be 8.6 trillion. SMS is a low cost way of sending information, which in many cases is more efficient than making a call.

For military organizations, communication is essential for effective situational command and control—yet many forces still rely solely on radio to keep in contact with units in the field.

Limited By Voice

Unfortunately, radio has struggled in recent conflicts. It is a line-of-sight only method of communication (not ideal for the rugged, mountainous terrain of Afghanistan for example), prone to signal loss due to its limited range. Its channel-based system is also hindered by the fact only one person can be talking at a time, and this must be constantly monitored to make certain messages are not missed. When it comes to disseminating received information, the original message must be copied down and then repeated to the new receiver. In situations where every second counts, this delay is unacceptable and also leaves the message open to misinterpretation through human error.

As a first responder technology in new territories, radio is limited and seems even more antiquated when you consider that, thanks to smartphones, civilians have the ability to find their current locations and then alert others to their whereabouts in real-time through social media—a soldier on the battlefield is left describing locations using landmarks and map grid references. These limitations have resulted in a rise in satellite *short burst data* (**SBD**) usage in recent years.

Data Strengths

The main benefit of SBD is cost-effective *Beyond-Line-of-Sight* (**BLOS**) transmission. However, it also allows for simultaneous broadcast, meaning that information can be sent back and forth between multiple parties at the same time without interference.

If a commander wanted information from multiple units out in the field, this request could be transmitted to all units simultaneously. The responses would automatically be

queued up for the commander to read. Information exchange is instantaneous and accurate, unlike voice communications. Furthermore, there are no combat network radio management issues to contend with. This data can then be forwarded on, verbatim, to other receivers quickly and easily.

Data also allows for delayed receiving: The message does not have to be retrieved immediately once it has been sent—should the receiving party be unavailable, the message will remain accessible. This means that non-critical information can be transmitted without the fear of distracting receivers who may be carrying out tasks requiring their full concentration. This is why chat messaging between in-theatre forward operating bases is so widely used.

BLOS communications is why larger militaries invest millions of dollars in MILSATCOM, but even military satellites offer limited territorial coverage. This has resulted in a rise in commercial satellite network usage, as a provider such as **Iridium** offers total global coverage and this is why the U.S. military relies on commercial satellite services for as much as 80 per cent of its SATCOM capability.

SBD is a more cost efficient way of communicating than a voice call via satellite, as concise information is transmitted. This makes it easier to manipulate, disseminate and encrypt, again bringing the cost down, allowing for more data to be sent, more frequently.

Secure Comms

The obvious concern for many in the military sphere regarding commercial satellite communications is security. This centers on the fact that data is often sent through another nation state; for example, in the case of Iridium, the USA. The worry for, say, Russia or countries in the Middle East, is that regardless of whether data is commercial or defence related, it will flow through a gateway that is based in another country.

It is therefore up to end-to-end service providers that use these commercial networks as their SATCOM backbones to address any potential vulnerability. The answer is to encrypt data at a high level at both the device and system end. This prevents un-encrypted data from travelling through commercial gateways. This ensures only the military force with the encryption key has access to the data.

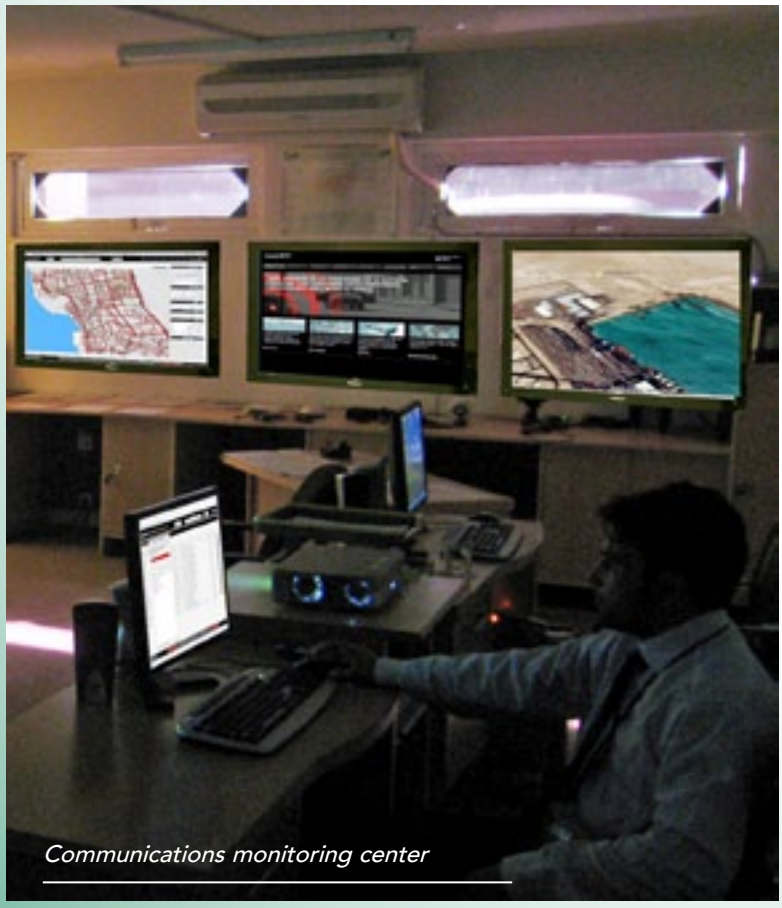
While some may question the level of security that service providers offer when compared to military channels, when considered in detail, it is actually very similar. '**Suite B**' cryptography is part of the U.S.' **NSA** *Cryptographic Interoperability Strategy* (**CIS**) and is used to communicate with coalition partners. **AES256** is a Suite B algorithm and is what is used in many commercial solutions. In fact, sending short burst data via a commercial network means it will be travelling alongside data sent from companies in various other sectors, adding a layer of 'data camouflage'.

Track24 Defence's Whisper

Another commercial satellite advantage now realized by military forces is that provisions are already in place to reduce any disruption to the network. This was the case in 2009 when ***Iridium 33*** collided with a defunct Russian satellite and was destroyed. Within three days, the hole in the network's service had been closed and disruptions dealt with.

Why Now?

The main driver behind the recent increase in SBD popularity however, is latency reduction.



Communications monitoring center

Five years ago, data transfers via satellite could take up to five minutes to complete. This was a problem for militaries wanting to use SBD to transmit location data and resulted in large discrepancies between where HQ was being told an asset was positioned and its actual location. The unit could be five kilometres from that location in any direction by the time the data reached central command.

Advances in data transmission technology have now reduced SBD latency to around 10 seconds, making it suitable for situational command and control. This is now classed as near real-time information. This reduction in latency has been accompanied by a reduction in the size of the hardware used to transmit data.

This means SBD is now also being used extensively for *Machine-to-Machine* (**M2M**) communications. Two recent examples include UAV navigation while still in the air, and counter-threat solution provider **Allen-Vanguard** using SBD to update its ***Electronic Counter Measure*** equipment while in the field and out of radio contact range.

When All Is Sent' + Done

When it comes to close-quarter live comms within an established operational region, radio will remain the primary form of instant communication. However, the battlefield has evolved and conflicts now take place in remote regions hundreds of miles from base. BLOS communication has never been more important and the reduction in round-trip latency has meant a reconsideration of SBD for military forces around the world.

There is robustness to a commercial network with multiple LEO satellites that military organizations struggle to match. Data transmission is the future of command and control and as the technology develops the hardware will become smaller and ruggedized.

We've already seen a spike in creative M2M solutions using SBD and we anticipate this going further still as the potential of SBD transmission is fully explored, understood and exploited.

About the author

Giles Peeters commenced his military communications career at RAF Digby in 1997 before moving on in 1998 to the Engineering Office at 751 Signals Unit on the Falkland Islands. In 1999 Peeters joined the Defence Communications Security Agency (DCSA) Corsham, as the Duty Operations Officer of the Global Operations Security Command Centre (GOSCC), before becoming the Military Liaison Officer for Signal Intelligence at GCHQ Cheltenham in 2001. Peeters then worked with the DCSA Corsham Satellite Integrated Project Team (SAT IPT) as their MOD Commercial Satellite Service Delivery Officer. From 2004 to 2007 Peeters' significant expertise in commercial satellite communications proved invaluable in Iraq and Afghanistan as he provided front line tactical communication and deployment capability for the Joint Helicopter Command (JHC) J6 SO2 from HQ Land Command, Wilton. Peeters' final rank was RAF Squadron Leader. In 2007 Peeters moved to the private sector to consult for organisations such as NATO, on blue force tracking requirements. Now Defence Sector Director at Track24 Defence, Peeters is the driving force behind the launch of the company's new, commercial-off-the-shelf (COTS) blue force tracking solution, situational Command & Control (SCC).

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High Throughput Satellites = A Bright Future For MILSATCOM

By Karl Fuchs, Vice President of Technology, iDirect Government Technologies (iGT)

The military has a voracious appetite for communications. However, shrinking Department of Defense (DoD) budgets threaten to quash the military's development and use of next-generation communications to support the warfighter.

This doesn't have to be the case.

Technology can help to solve the biggest challenges of using satellite communications: Bandwidth and cost. New *High Throughput Satellite* (**HTS**) technology can help advance MILSATCOM while offering DoD users the high quality, consistent reliability and lower costs they need.

Take, for instance, the military's widespread use of *intelligence, surveillance and reconnaissance* (**ISR**) missions and other full-motion, *high-definition* (HD) video feeds. These are the fastest-growing, bandwidth-consuming applications used by the warfighter.

One of the first, real-world applications of ISR missions was the cleanup effort for the Gulf Oil Spill. **iGT** and the industry were able to achieve return channel bandwidths to support HD video feeds. However, the military end-user missions demand more in the way of deliverables. The achievable data rates at the time of the spill were limited by the aperture of the antenna as well as the G/T and EIRP of the hemispherical beam of the satellite.

HTS networks now being launched have performance characteristics that will allow much greater data rate over a given aperture antenna. This provides excellent augmentation to the military's current communications resources in support of ISR and other bandwidth-intensive uses.

A review of the MILSATCOM landscape reveals that budget constraints, the growing use of airborne *Communications-On-The Move* (**COTM**) systems, and the rapidly changing profile of end-users' data, make the new HTS networks well suited for the military's needs to fully support mission coverage.

HTS networks offer ubiquitous, global footprints with an overlapping, spot beam architecture. HTS can deliver dependable SATCOM coverage around the globe, significantly augmenting ***Wideband Global SATCOM*** (**WGS**) coverage by leveraging the commonality of commercial Ka-band.

The overlapping spot beams and the consistent transmission profile make HTS a perfect communications solution for airborne COTM. HTS supports Ka-band, and although Ka-band is in the commercial portion of the band in HTS systems, the band enables the military to leverage some commonality of antenna and transmission equipment used on WGS Ka systems.

Although HTS brings considerable opportunity, it comes with its own set of challenges for the military user. One challenge is how to construct a system that will seamlessly transition between a government-owned and operated network using WGS Ka bandwidth and a commercial HTS spot beam system. Devising a modem that works in both types of networks, and has the all-important government *Information Assurance* (**IA**) and *Transmission Security* (**TRANSEC**) requirements, is essential for HTS operation.

The design of commercial HTS systems relies almost exclusively on proprietary waveforms—the DoD is moving toward a standards-based platform. A modem with sufficient memory would be capable of supporting multiple operational images.

Another significant challenge is supporting both commercial and military ranges of the Ka frequency band. Most commercial modems have an L-band interface which covers approximately 1GHz. The entire Ka range, including military and commercial on a downlink, spans well over 2GHz. The challenge is to address both ends of the band using a single L-band interface.

One proposed solution would be to develop a Ka *Block up Converter* (**BUC**) with two *Local Oscillators* (**LO**). A communication mechanism would be required between the modem and BUC to implement the LO change.

Other considerations that need to be addressed before HTS networks can be used to augment satellite bandwidth include the need for commercial satellite providers to provide a secure enclave within their teleports. Ultimately, the landed traffic will need to be transported to a secure terrestrial network—the commercial satellite provider will have to meet stringent government requirements, such as *Mission Assurance Category* (**MAC**) *II* or even *MAC I*. A commercial provider's teleport infrastructure will be subject to the same stringent IA requirements, including *Security Content Automation Protocol* hardening as government teleports. Finally, a TRANSEC-enabled network may be required for some missions.

The advantages of using the new HTS global networks as either a primary or secondary choice to meet government mission needs cannot be overstated. The architecture of the new satellite constellations provides remarkable amounts of satellite capacity with beam characteristics that make the technology perfectly suited to support the newest high data rate applications.

The global reach and ubiquitous, "always on" coverage can augment any currently deployed government network. In the case of Ka HTS satellites, the rain fade disadvantages are being mitigated with new technologies, such as seamless geographic hub redundancy that addresses hub side rain fade as well as improvements regarding in-route spectral efficacies by incorporating adaptive in-bound channels. Leveraging a shared infrastructure and tapping into such a fast-growing bandwidth pool will make using HTS a most cost-effective method whereby mission requirements can be successfully met in the years to come.

Whether it is access to high-speed Internet, streaming reconnaissance video or other communications needs, the launch of high-performance satellites, and, more specifically, the development of diverse remote terminals that are designed with end-users in mind, will bring these communications capabilities to reality for the DoD.

These advances in the sky will enable our troops on the ground, in the air and at sea to capture mission success, no matter where in the world they may be located.

About the author

Karl Fuchs is vice president of technology for iDirect Government Technologies (iGT). He joined iGT in 2004 as the director of sales engineering, just as the satellite-based IP communications company was expanding its very small aperture satellite (VSAT) market presence into the federal government and international Internet Protocol (IP) networking world. He now works as the vice president of technology. With more than 20 years of experience in technology and with the federal government, Fuchs leads iGT's team of federal systems engineers and serves as chief architect for new product integration.

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

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

Strategies For Comprehensive Link Protection

By Steve Williams, Business Area Manager of Signals Instrumentation, RT Logic

Reliance on satellite communications (SATCOM) for critical communication links has never been higher, making the growing problem of link protection even more critical. Commercial satellite operators estimate that millions of dollars are lost in interference related events each year. Interference is a frequent problem in military operations, not just from unfriendly sources, but from inadvertent activities of friendly ones as well.

To withstand these accidental and intentional interference threats, mission assurance requirements increasingly demand an end-to-end strategy for link protection that spans all phases from equipment R&D and test, to planning to operations and training.

A thorough SATCOM link protection strategy includes...

1. *SATCOM equipment with designed-in, adaptable link protection capabilities to include interference detection and cancellation. Satellite Channel Simulators, Satellite Transponder Simulators and Satellite Signal Emulators can be applied with excellent results during the proof-of-concept, R&D, test and production phases of SATCOM equipment.*

2. *Continuous, automatic monitoring at each SATCOM receive and transmit terminal. Advanced signal interference detection systems sense and warn when accidental or intentional interference is present.*

3. *Fast and automated response mechanisms to restore communications, including sophisticated Signal Geolocation Systems that can locate interference sources, with appropriate agencies using these results to guide resolution steps.*

4. *Ongoing on-site training to enhance the interference recognition and response skills of operators at both ends of a SATCOM link. Geolocation simulation systems are critical to developing and maintaining operator currency on emergent interference types and techniques, as well as the practical problems users and systems experience under interference conditions.*

5. *Thorough and automatic link protection and SATCOM system Self-Testing at each SATCOM terminal. The systems mentioned above assure nominal operation of the terminal, of the link protection gear, and provide early warning as to potential system failures.*

Designed-In Link Protection

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

In the laboratory, Channel Simulators and Transponder Simulators create physics-compliant signals indistinguishable from their real world counterparts. These signals include propagation effects modeling, motion-related *Doppler* shift, atmospheric and multipath fading, path delay, and atmospheric noise profiles. Furthermore, these systems can simulate spacecraft equipment effects, duplicating amplitude and phase response and introducing linear and non-linear signal distortions.

These simulators, coupled with SATCOM Signal Generators, add further realism by supplying anything from perfect signals, to those impacted by advanced static and dynamic interference, both accidental and intentional. These instruments also generate signals perturbed by unexpected flight paths, attitude or antenna pattern issues.

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

These instruments, often used as shown in *Figure 1* on the following page, give SATCOM hardware, firmware and software designers a huge advantage during the design and test process, enabling them to develop and test equipment that will be tolerant of natural signal degradation and resilient to a broad variety of attacks on the signal. Additionally, they support innovative development of interference cancellation capabilities, interference resilient waveforms, and automatic signal parameter negotiation (such as modulation types, power levels and data rates) between transmit and receive devices at each end of the SATCOM link.

Link Protection Through Effective Monitoring

With well-designed and tested SATCOM systems in place that are enhanced for link protection, the first operational line of defense is continuous and advanced monitoring of the received and transmitted signals to assure they match expectations.

Automatic signal monitoring should go beyond simple spectrum analyzer mask analysis of bandwidth, center frequency and power level. In-depth and real-time signal analysis must also include blind determination of modulation

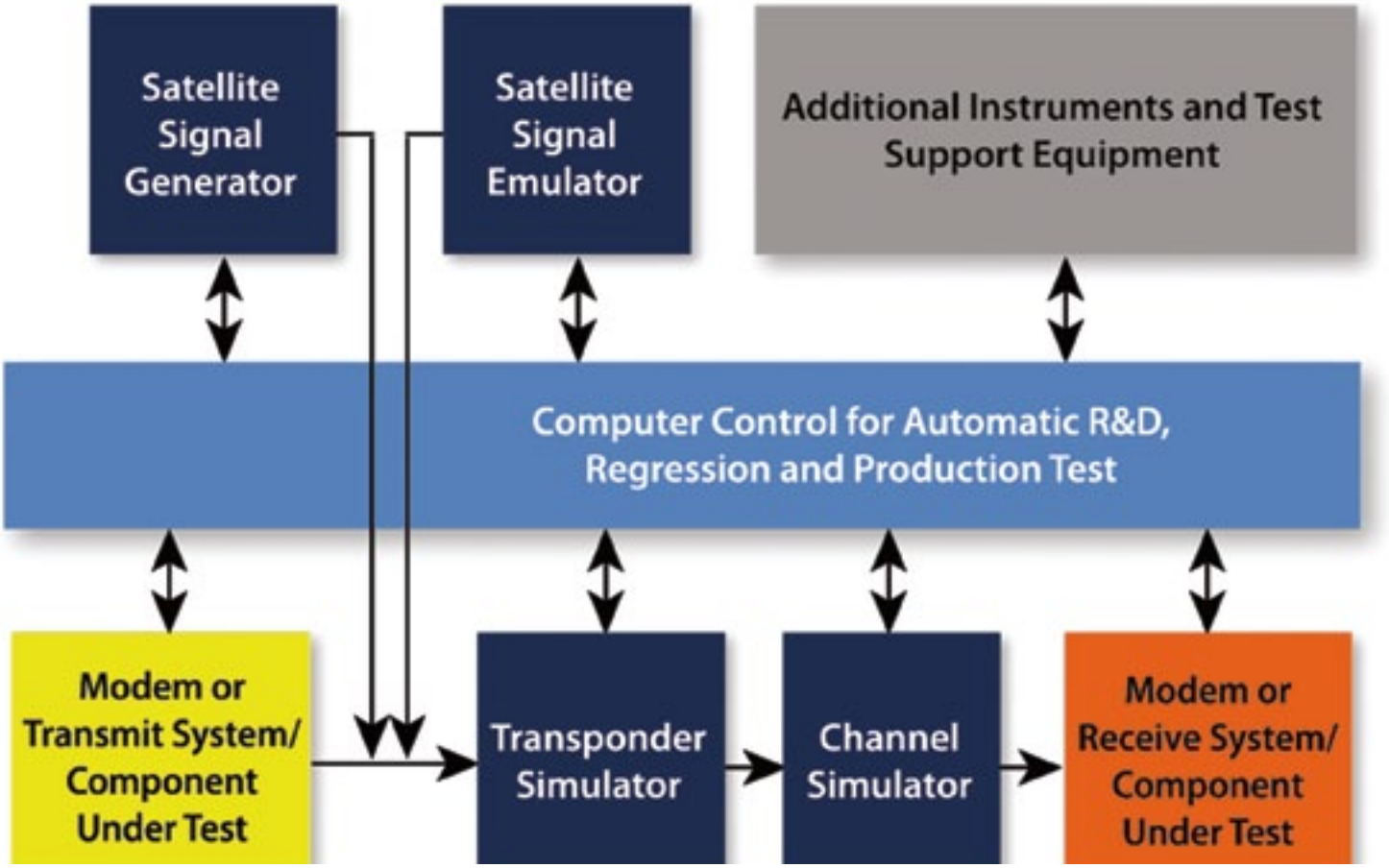

Figure 1: Automated test equipment (ATE) setup for SATCOM device R&D, verification and validation.

type, data rate, coding scheme, modulation error ratio (MER), error vector magnitude (EVM) and bit error rate (BER).

Monitoring tools that support such analysis should mathematically decompose the signal of interest, searching for unauthorized signals within the protected bandwidth that could degrade quality of service (QOS), as shown in Figure 2 on the following page.

Once these real-time measurements are complete, the monitoring system should match the results against expected values for each signal. Modulation type, data rate, center frequency, and power level differences between measured and expected values must be tolerable to the monitoring system within the boundaries of the satellite access authorization (SAA).

All SATCOM modulation types should be supported by the monitoring system over high and low amplitude ranges, and narrow and wide bandwidths. This includes time division multiple access (TDMA), spread spectrum, and others, as well as the usual array of phase-shift keying (e.g. BPSK, QPSK, 8PSK, APSK, etc.) and quadrature amplitude modulation (e.g. 16QAM, 32QAM, etc.) signals.

Ideally, the monitoring system should be field-adaptable to detect and characterize new modulation types, emerging interference types and evolving intentional interference techniques.

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

Effective data logging should store historical, time-tagged measurement data for future trend analysis. Such a repository is useful for predicting equipment failures, communications outages, and impending electronic attack preceded by detectable signal trends. Historical data can also be exploited to differentiate equipment problems or operator error, and between accidental or intentional interference.

Link Protection Through Geolocation

When monitoring systems reveal unexplainable signal interference, the next step is to use *Signal Geolocation* systems to pinpoint the Earth location of the disrupting signal. Once a physical location estimate of the transmitter is available, an assessment of friendly (accidental) or hostile (intentional) interference can proceed. Assisting in this determination, geolocation data can be combined with other location-specific intelligence.

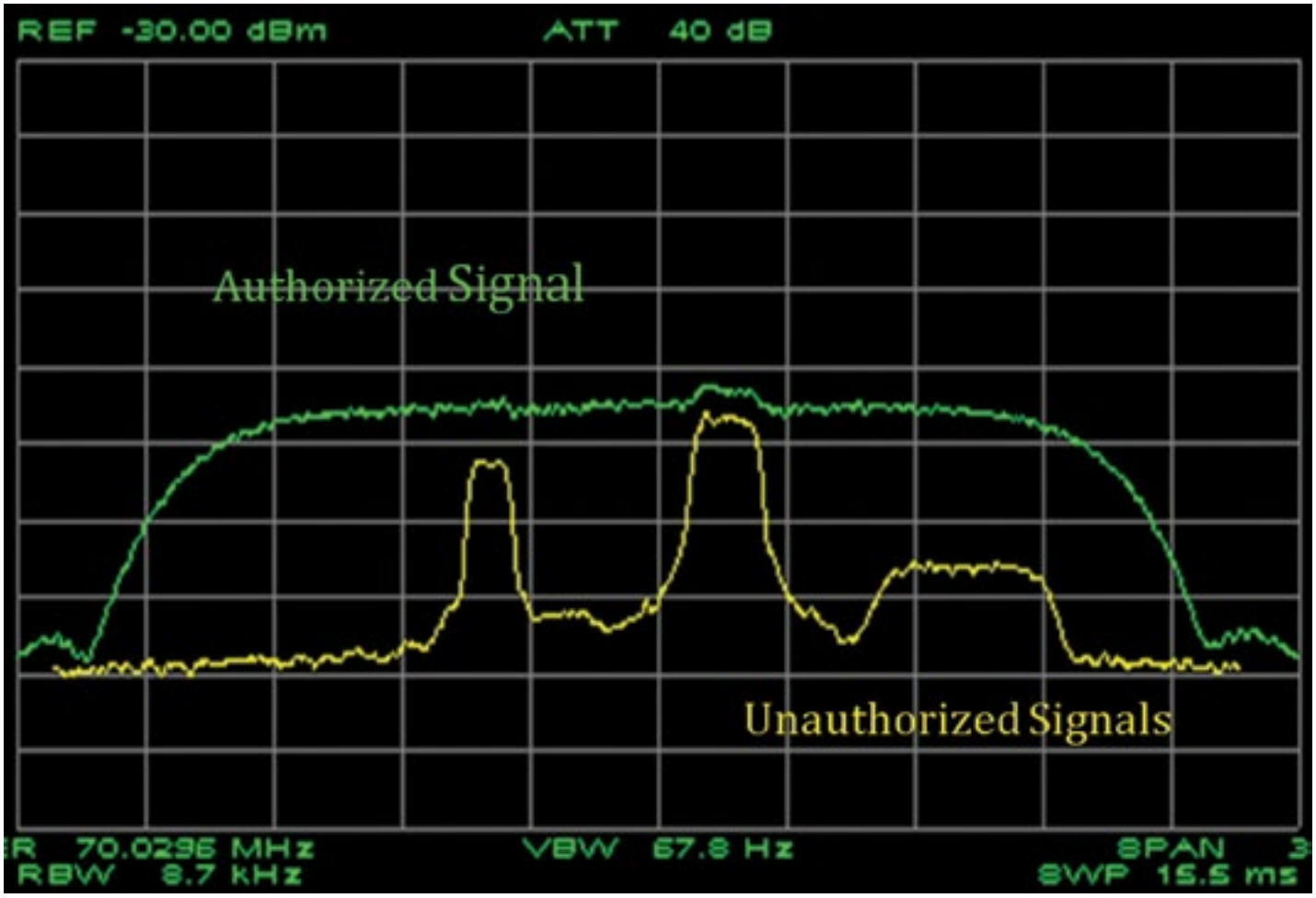

Figure 2: Capable interference detection systems reveal unauthorized signals invisible to standard spectrum analyzers.

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

Geolocation systems analyze time difference, and Doppler shift-induced frequency difference between received signals to derive intersecting time difference of arrival (TDOA) lines and frequency difference of arrival (FDOA) lines. The conjunction of these lines represents the location of the interfering transmission source.

Link Protection Through Training

Unless SATCOM networks someday become fully self-healing, human operators and analysts will remain the ones who interact with link protection systems, interpret their results and take corrective action based on their indications. Operator familiarity with these systems dictates how quickly and correctly they can identify and resolve those problems.

Effective geolocation system operators have achieved a deep understanding of scenario aspects that relate to geolocation accuracy. Satellite orbit characteristics, the distance between primary and secondary satellites, and reference emitter locations are key, although a host of other factors can play in as well.

Training to high levels of geolocation understanding and effectiveness can be facilitated using sophisticated Geolocation Signal Simulators. These devices combine Channel Simulators and Signal Generators to create input signals that precisely represent those received by geolocation systems under any scenario imaginable. They connect to, or are integrated with Geolocation Systems, so training can be conducted 24/7 without need to attend distant and expensive schoolhouse events.

These simulators allow operators to select ground locations for transmission and reception sites, choose satellites, enter antenna pattern information, and generate protected, interference and reference signals. They include simple setup, advanced underlying physics engines and full motion displays.

Similarly, Channel Simulators, Transponder Simulators, Signal Generators and Satellite Signal Emulators can be switched into ground station signal inputs instead of normal antenna/amplifier inputs. This allows the ingest of many nominal and worst case signals, with or without interference, and results in the ground station performing exactly as it would under real world degraded signal conditions, but without consuming vital satellite bandwidth or using live interferers.

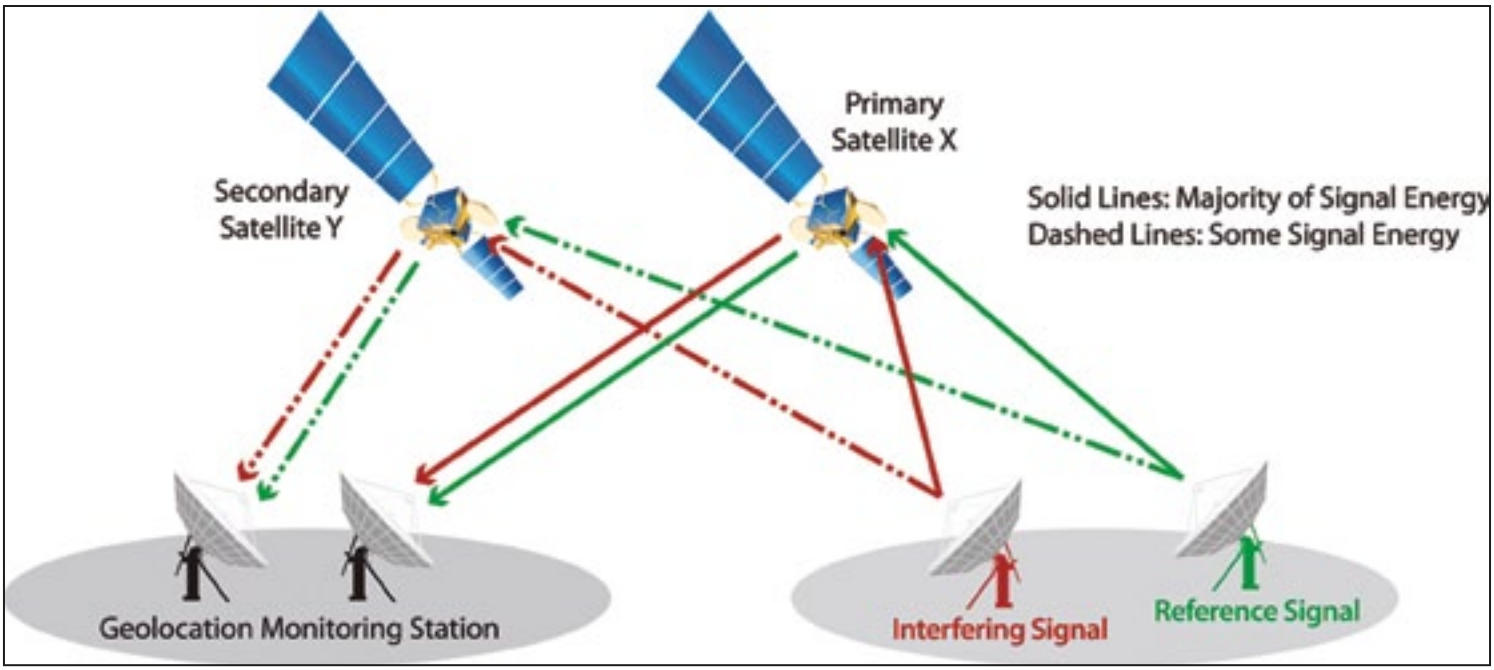

Figure 3. State-of-the-art geolocation systems today use a two-path solution to find interfering signals.

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

Link Protection Through System Self-Test

Just as pilots run automated self-tests and manual checklists before and during flight, SATCOM professionals should periodically do the same to ensure the proper functioning of their link protection systems.

At the command of human operators, and under computer control, Channel Simulators, Transponder Simulators, Signal Generators and SATCOM Signal Emulators can be switched into receiving system inputs where amplified antenna signals normally appear. These simulators can rapidly step through a series of pre-determined normal and degraded signals, adding interference if desired, and presenting these signals to link protection system inputs instead of the usually received SATCOM signals.

As these signals are presented, self-test software can check that each injected anomaly was properly detected and identified by the link protection capabilities. This assures proper functionality of link protection systems and algorithms, and can be an important differentiation step in isolating equipment faults, operator error, or actual link disruption.

Similarly, Geolocation Signal Simulators can be switched into geolocation system inputs in place of their usual antenna feeds. These simulators can then cycle through various combinations of satellites, ground stations, antenna patterns and other conditions to ensure anticipated geolocation results

An End-To-End Protection Strategy

SATCOM links are vital infrastructure elements in commercial, as well as military command and control (C2) and data transport applications. Due to their mission-critical nature, the function and performance of these links must be protected with great attention, constancy and attention to detail.

From a design and test viewpoint, SATCOM equipment designers are applying innovative new ideas to architecting systems that are both aware and tolerant of interference. They must have relevant, application-focused, precision instrumentation to support their crucial RDT&E work.

In deployment, SATCOM operators must be able to access an ever-evolving arsenal of effective interference detection, location and mitigation tools. Equally important, their interpretation skills and SATCOM understanding must be broad, deep and constantly refreshed. Nothing less than full life cycle vigilance will keep our military and commercial SATCOM at peak performance.

About the author

Steve Williams is the Business Area Manager of Signals Instrumentation at RT Logic and may be reached at ***swilliams@rtlogic.com.***

End-To-End Link Assurance Solutions

Kratos Defense & Security Solutions is focused on RF link protection solutions across the spectrum of mitigation touch points. The company's **RT Logic** and **SAT** subsidiaries specialize in developing COTS and tailored products for monitoring, detecting, characterizing and mitigating RF interference and other challenges to protected communications. RT Logic and SAT provide products and solutions to both commercial satellite operators and U.S. defense agencies on programs such as the U.S. Air Force's *Rapid Attack Identification Detection Reporting System* (**RAIDRS**), the *Joint Spectrum Center*'s **SPIRIT**, and the U.S. Army's *Wideband Remote Monitoring Sensor* (**WRMS**). Advanced products for RF link protection include:

Channel Simulators: Building and Testing For Protection
RT Logic's family of Channel Simulators are used by SATCOM hardware, firmware and software designers to create hardware-in-the-loop tests that precisely simulate the punishing RF environments encountered on live missions. They create physics-accurate signals with characteristics such as dynamic time delay and phase offset allowing users to test the resilience of their modems and receivers against an array of natural and manmade disruptions. Armed with these results, engineers can innovate, tune and test their designs to create more robust and reliable communication systems.

Monics: Automated RF Interference Monitoring
Beyond built-in capabilities, reliable monitoring is the cornerstone for link assurance during mission operations. SAT's ***Monics***® is used by the majority of the satellite industry for networked advanced spectrum measurement and interference analysis as well as being the foundation of RT Logic/SAT tailored systems. Monics monitors satellite uplink and downlink performance while performing advanced interference detection and signal analysis. Highly scalable, Monics provides a fully distributed, autonomous solution for monitoring and detecting RF interference, including co-channel interference, as well as payload traffic and quality of service. To support truly comprehensive end-to-end (E2E) situational awareness, Monics is integrated into Kratos' ***Management Suite*** alongside it's ***Compass***™ satellite equipment *Monitoring & Control* **(M&C)** solution and ***NeuralStar***®, its enterprise "manager of managers" used by organizations such as the **Ballistic Missile Defense Agency**, the **U.S. Army**, **DISA** and other agencies.

satID: Integrated Monitoring And Geolocation
SAT's RF interference geolocation product, ***satID*** *(see screenshot below)*, is also integrated with Monics to deliver a seamless, accurate all-in-one solution for locating and identifying sources of interference due to equipment failure, operator error, intentional jamming, or unauthorized users. Employing the world's only global network of dual antenna sites, satID is available either as a product, or in a service-based model that can also include interference monitoring and managed network operations services.

satID GeoSim: Testing and Training
satID GeoSim is the newest product in RT Logic's testing and simulation portfolio, supporting a comprehensive link protection strategy in several ways. Starting at the earliest points in the process, engineers and planners use satID GeoSim to design link protection into their equipment and missions, as well as employing it as part of a comprehensive, automatic geolocation self-test strategy for ongoing peak performance. satID GeoSim also provides a solid foundation for continuous training efforts so that operators gain mission-critical experience and master essential techniques under a variety of conditions and interference scenarios. Because satID GeoSim's output is indistinguishable from the actual signals received from primary and secondary satellites in geolocation events (whether unintentional interference or deliberate jamming), it presents a dramatically more cost effective and repeatable solution over using actual satellites for these purposes.

For more information, please contact
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Techniques For Ensuring The Highest Quality Microwave Measurements

By Theng Theng Quek, Business Development Manager, Agilent Technologies

In the RF and microwave domain, high frequencies and stringent application specifications are the norm. As a result, engineers face a number of critical challenges, not the least of which are making precise measurements with accurate data and obtaining repeatable results.

While measurement instrumentation can play a key role in addressing these challenges, the importance of test accessories (*e.g.*, switches, amplifiers and attenuators) in forming complete test solutions cannot be underestimated. By choosing the wrong accessory, engineers risk creating a weak link in the test system, further complicating its setup and limiting its measurement ability.

With high-performance instrumentation and accessories pushing the envelope of today's advanced high-frequency applications, it is now more crucial than ever for engineers to select the right test accessories. Doing so improves the test system's utility and automation, and eliminates any weak links in the measurement path.

Eliminating The Weak Link

RF and microwave test accessories are an integral part of any test system and can include everything from DC blocks, attenuators and couplers, to switches and system amplifiers. Such accessories complement a system's instrumentation by helping to simplify test setups and maximizing the instrumentation's full potential. For the purposes of this article, only switches, attenuators, power limiters, active probes, and RF detectors will be discussed.

Regardless of the accessory in question, selecting one with the highest quality provides an easy and invaluable means of optimizing RF and microwave measurement systems, while also ensuring a more reliable test setup.

The trick lies in knowing what accessories to use in a given application. Some of the more common test accessories and their key applications are as follows:

Increasing Efficiency Using EM Switches

When used in signal routing schemes, *electromechanical* (**EM**) switches (*e.g., single-pole, double-throw* (**SPDT**), transfer or *double-pole, double-throw* (**DPDT**), multiport, and bypass) enable multiple measurements with a single connection. The ability to test multiple *devices-under-test* (**DUT**s) with a single instrument or to make multiple types of measurements on a DUT maximizes the test system's throughput.

When selecting an EM switch, a few tips are helpful to keep in mind:

1. *Select a switch with good repeatability and a long operating life. Quality switch manufacturers provide a repeatability specification for their switches and specify switch lifetime as the number of cycles it can complete while still meeting performance/repeatability specifications. Other vendors specify life as the point at which the switch experiences mechanical failure; however, in this case, signal degradation can actually occur much earlier. Consequently, choosing a switch specified in this manner may result in a switching price tag over the lifetime of a test system that is quite high. Note that typical switch lifetime specification numbers are in the millions and can go as high as 10 million, depending on the switch's quality.*
2. *Continuous wear and tear in a switch results in debris accumulation, which increases insertion loss and measurement uncertainty. Purchasing a switch that effectively addresses this dilemma ensures better switch repeatability. Agilent's switches, for example, employ a patented design with a curved top center conductor that produces friction between the jumper contact and center conductor during switch closure. The friction mimics a wiping action that removes contact point debris (*Figure 1 above*).*
3. *Coaxial switch datasheets are tricky to read, differing from one manufacturer to another. When reading a datasheet, watch for words like 'typical' or 'guaranteed' following a specification, as this may indicate a need to investigate the specification further. Also, if an important specification to the switch matrix design (e.g., repeatability) is missing from a switch's datasheet, think twice before making a purchase.*

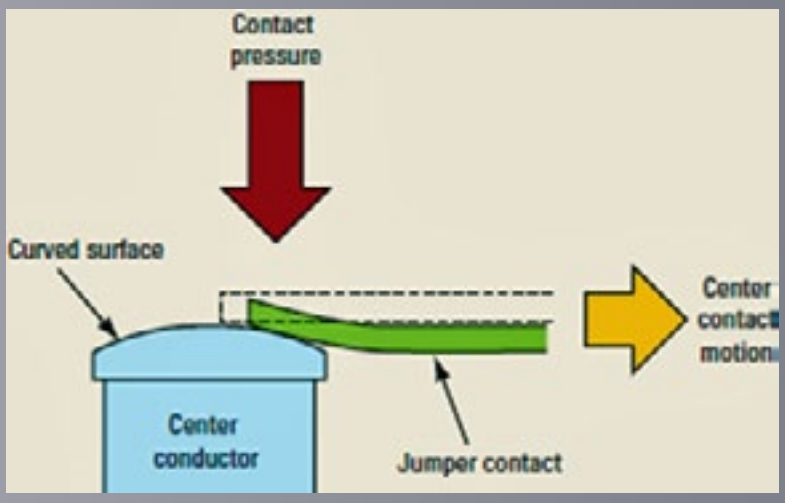

Figure 1. Shown here is the microscopic wiping action that takes place in Agilent's EM switch mating configuration. Because of this "wiping," Agilent is able to specify a switch repeatability of 0.03 dB (variation in insertion loss) over the guaranteed life of the switch.

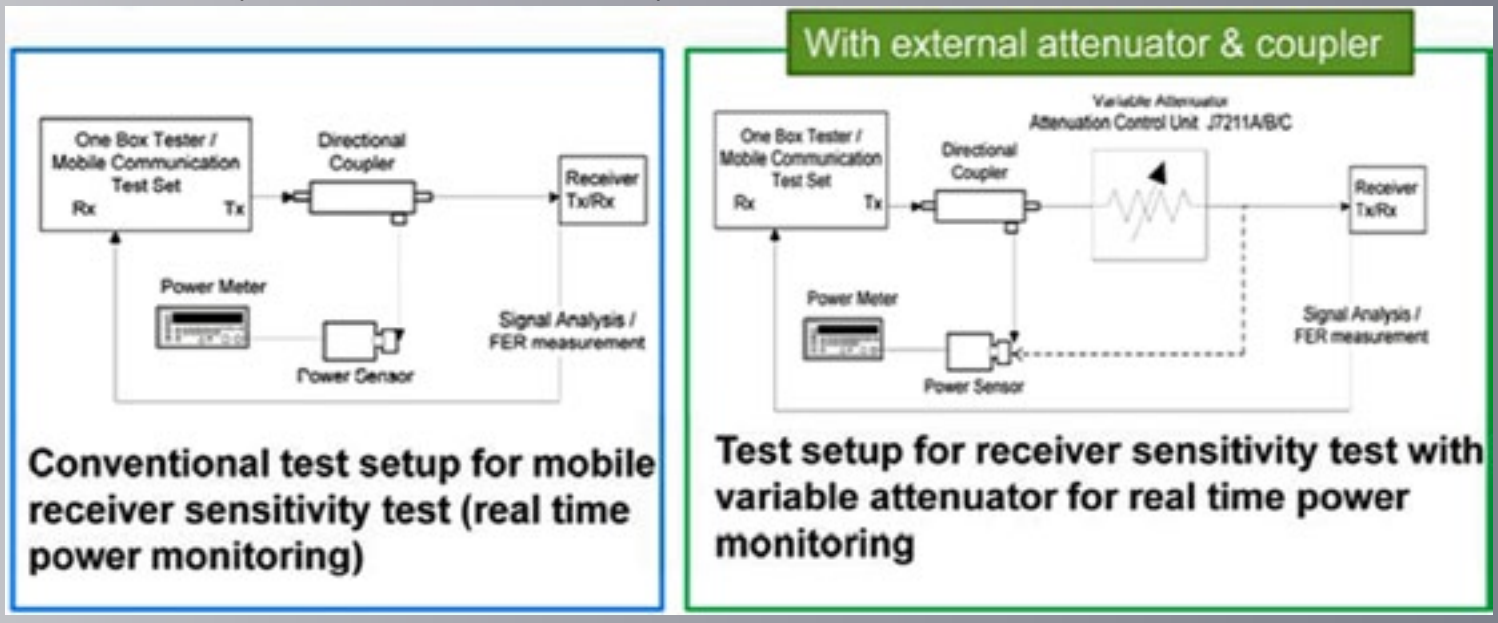

Figure 2. Shown here are two test setups for real-time power monitoring. One setup (left) highlights the more conventional approach, while the other (right) employs an external variable attenuator for fast and accurate power calibration in receiver sensitivity testing.

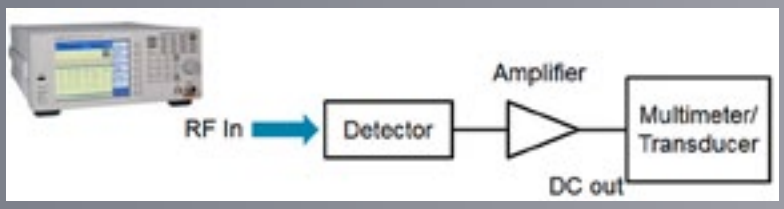

Figure 3. Shown here is a simple block diagram of a power measurement.

4. *Never judge a switch by its price. Instead, verify that all performance specifications fit the design in question. Then, break down the switch price into units based on the switch's lifetime. Remember, having a test system go down to replace a switch can be a costly proposition. Also, note that when working with non-latching switches, it may be worthwhile to break down the switch's cost based on power consumption.*

Enabling Reliable Signal Conditioning

An external variable attenuator can be used to ensure reliable signal conditioning in a range of wireless test applications, such as for fast and accurate power calibration in mobile receiver sensitivity test or for an adjacent channel interference test. In both applications, use of the attenuator eliminates power nonlinearity and inaccuracies from the source.

As an example, *Figure 2 on the previous page* shows two setups for a mobile receiver sensitivity test used to measure real-time power. The conventional test setup on the left offers real-time power monitoring and power-level control straight from the source. However, it is unable to measure and calibrate low power levels. The alternate setup on the right adds an external attenuator and directional coupler. Doing so provides a number of benefits. It enables easy one-time power calibration and allows the source to stay at a single power level. Additionally, the setup frees the user from power-level nonlinearity and accuracy issues from the source, and makes it easier to obtain accurate and calibrated low power levels.

Protecting Investments Using Power Limiters

When expensive instruments (*e.g.*, a network analyzer, spectrum analyzer or signal generator) and components are mishandled or damaged by excessive RF power, DC transients or *electro-static discharge* (**ESD**) to the input port, the result is significant test system downtime and a high repair cost. Power limiters with ESD provide engineers with an inexpensive way to protect their measurement system investments.

Optimizing RF Circuit Design With Active Probing

An active differential probe provides an effective way for RF circuit designers to optimize and troubleshoot their circuit designs. It can be used to measure a design's harmonics, power levels and frequency, as well as its modulation, to identify faulty or problem areas. When used with a high dynamic range signal/spectrum analyzer, the probe's high sensitivity and low distortion levels enable even the smallest signals to be detected, providing engineers with greater insight into the DUT's spurious response. An active differential probe can also be used with a signal source analyzer to measure the phase noise and jitter of a clock in a high-speed digital board design.

Measuring Power With An RF Detector

An RF detector is the ideal accessory for measuring power. As an example, consider the block diagram of a power measurement shown in *Figure 3* on this page. Here, the absolute power is measured by characterizing the detector with a power sensor and meter using a reliable source. The detector is connected to a source, which is swept across the frequency or power level of interest. The output voltage measured from the detector is then collected and plotted. Using the slope of the resulting graph, the power detected is calculated based on the measured voltage. This method can also be used beyond the square-law region, where variations are repeatable and predictable for each diode family. Computer-controlled compensation compensates for any nonlinearity.

A detector can also be used in envelope or video detection, a prime example of which is a radar system. In this application, the detector receives and processes recovered signals, sending them on to test instrumentation where they can be displayed. The detector's output signal serves as an indicator of the target's range.

The Bottom Line

Use of low-quality RF and microwave test accessories can result in inefficient, unreliable test systems. Selecting the right accessories, however, ensures test system optimization and minimizes measurement uncertainty. The best way to achieve this goal is by purchasing accessories from a premium vendor with unmatched reliability and repeatability. The accessories should also have a proven long operating life and require minimal maintenance throughout their lifetime. Additionally, the right accessory must be used for the right application in question, whether it's enabling reliable signal conditioning or protecting the engineer's investment. By following these tips, today's engineers can simplify their test setups and maximize their equipment's full potential to ensure the best possible measurement results.

About the author

Theng Theng Quek is a business development manager in Agilent Technologies' Component Test Division. She joined Agilent as a product marketing engineer in 2006. Prior to that, she was an R&D engineer for Motorola. Theng Theng holds a bachelor's degree in engineering from Multimedia University of Malaysia with a major in microwave and communications.

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Ice Quake System

The Ice Quake system (U.S. patent pending) enhances the reliability of the Snow Shield systems by a factor of 185 percent. The Ice Quake System also acts as a Rain Shield to prevent water from sheeting on the antenna reflective surface causin rain fade on a Ku or Ka band antenna.

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SOTM—A Terminal Case

The Japanese National Institute of Information and Communications Technology (NICT) is the recipient of two, state-of-the-art Ka-band Satellite-On-The-Move (SOTM) terminals from communications engineering company EM Solutions. This delivery represents a key milestone for the firm for a partnership project with Tokyo-based Jepico Corporation.

EM Solutions' Ka-band SOTM terminal, originally built for the **Australian Defence Force** for use on the U.S. ***Wideband Global Satellite*** (**WGS**) military constellation, was extensively upgraded to work with Japan's ***Kizuna*** (***WINDS***) Ka-band experimental satellite. The upgrade increases the terminal's effective data rate up to 20Mbps, with a new 65cm diameter antenna dish and 40W radio transmitter.

Two initial SOTM terminals have been supplied to NICT for mounting on vehicles and a ship. They will be used as experimental equipment to enable a rapid response to emergencies and natural disasters.

The terminals maintain broadband data communications even from a moving vehicle or vessel and will establish a mobile communication 'hub' through the WINDS satellite to deliver high speed voice, data and video traffic from the affected site independent of the terrestrial network .

Founded in 1972, **JEPICO** is one of the best-known distributors and represents foreign suppliers of electronic components in the Defense, Aerospace, and Industrial markets in Japan, JEPICO provides a wide range of services including technical support, system integration, and engineering project services to Japanese clients that include the Government sectors. Headquartered in Tokyo, JEPICO has several offices in Japan, Taiwan and the USA. For more detail, please visit ***www.jepico.co.jp***

Carrying out R&D and promotion for businesses within the ICT industry, the National Institute of Information and Communications Technology (NICT) drives economic growth and development as well as creates the promotion of R&D on network technologies, universal communications technologies, advanced ICT, and applied electromagnetic technologies. Such work helps the company to meet various

Photo courtesy of NICT

challenges that range from daily living and global issues such as the declining birthrate and an aging population, to medical and educational issues as well as global warming. NICT also focuses on projects that produce advances through cross-disciplinary linkups of various technologies, especially in regard to ICT use in disasters.

KIZUNA (WINDS) was jointly developed by **JAXA** and NICT as part of the *e-Japan Priority Policy Program* of the Japanese government's IT strategy headquarters. KIZUNA was launched by a ***H-IIA Launch Vehicle No.14*** on February 23, 2008, from the **Tanegashima Space Center** to establish advanced information and telecommunications for Japan.

In addition to establishing a domestic ultra high speed Internet network, the project also aims to construct ultra high speed international Internet access, especially for Asian Pacific countries and regions that are closely related to Japan.

The KIZUNA project is responsible for the demonstration of the validity and usefulness of technologies related to large-capacity data communications in our space infrastructure project, "i-Space," the purpose of which is to promote the use of satellites in such fields as Internet communications, education, medicine, disaster measures and Intelligent Transport Systems.

About EM Solutions

EM Solutions is recognised for offering technologically advanced microwave modules and systems for next generation broadband communications. EM Solutions' vision is to offer to systems integrators and telcos differentiated microwave products that embed the firm's unique I.P., designed to be available whenever they are needed. EM Solutions' core activities focus on the design, engineering and manufacture of products for satellite and microwave communication applications. One of the world's most experienced active and passive Ka-band SATCOM microwave and RF engineering design teams is incorporated into the company, with capabilities that include in-house digital and signal processing technology, software, and mechanical design. For more than 10 years EM Solutions has been a leading supplier of Mil-Std-188-164 (WGS compliant) Ka-band SATCOM RF Ground equipment, such as BUC's, LNB's and SSPA's, to defence and commercial customers around the world. EM Solutions has developed highly integrated RF subsystems for X-, Ku- and Ka-band SATCOM terminals, all purposefully designed to meet, and exceed, specific customer requirements.

When Bigger Isn't Necessarily Better

By David Leichner, Vice President, Marketing + Business Development, Gilat Satellite Networks

U.S. Defense spending dropped significantly in the last quarter of 2012. According to data compiled by Bloomberg News, military awards dropped 18 percent to $94.8 billion in the quarter ended December 31, 2012 from $115 billion in the previous quarter.

Yet, even with these cuts there are still areas that are experiencing high growth within the defense industry. One of those areas is unmanned aircraft vehicles (UAV) or Unmanned Aircraft Systems (UAS), a term generally used to describe all the operating equipment including the UAV, the control station where the aircraft is operated, and the wireless data link.

This comes as no surprise, given the statement made by outgoing U.S. Secretary of Defense *Leon E. Panetta* in January, 2012, who said, "…as we reduce the overall defense budget, we will protect, and in some cases increase, our investments in special operations forces, in new technologies like ISR and unmanned systems."

U.S. Vice President *Biden* also said it most emphatically during his debate with *Paul Ryan* in October 2012, when he noted, "What we need is more UAVs."

In fact, a 2012 study by consulting firm **Teal Group** estimates that UAV spending will almost double over the next decade from $6.6 billion annually to $11.4 billion annually. *Philip Finnegan*, Teal Group's director of corporate analysis and an author of the study, found, "The UAV market will continue to be strong despite cuts in defense spending. UAVs have proved their value in Iraq, Afghanistan and Pakistan and will continue to be a high priority for militaries in the United States and worldwide."

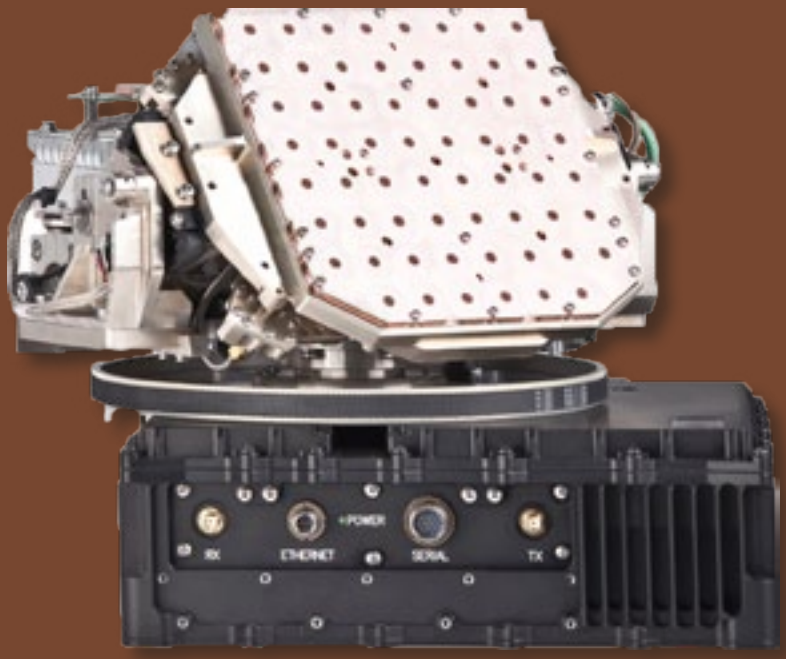
However, as the industry grows larger, such is not necessarily the case for the UAVs themselves. There is a clear demand to develop and deploy smaller UAVs for a variety of reasons. Smaller UAVs generally cost less and are more flexible for takeoff and landing and the ability to "cover" a target with less chance of being discovered. Another advantage of small UAVs is that they can be transported and launched more easily for rapid deployment. Their size also corresponds to a reduced radar cross section and a quieter system, which, in some cases, enables better intelligence gathering.

Information superiority based on the availability of real-time intelligence and facts on the ground is a key requirement of today's defense organization. Assets operating in unfriendly environments require a solution which provides them *Beyond-Line-of-Sight* (**BLoS**) intelligence which can be distributed using secure, communication solutions. Using local communication networks is not an option for obvious reasons of risk and the potential for exposure.

The longer the mission, the longer the distance, the more obscured the terrain, the more important it becomes to command a UAV that can stay in the air longer with the ability to carry an ample payload, while burning less energy.

Smaller UAVs have provided this endurance with the added advantage of being able to fly into more treacherous areas, while being less detectable to an enemy. The challenge then becomes to ensure that the UAVs have the communications capabilities needed to provide sophisticated communications back to the control center. In addition, the communications solution must be small, lightweight, and energy efficient, while providing the capabilities that, up until now, have only been available on larger and more costly UAVs.

Gilat Satellite Networks provides solutions for UAVs that address the defense and military market's critical need to exploit the full capabilities of the aircraft's operational range. These solutions include a small integrated UAV communication terminal that uses geostationary satellite capacity to provide full-duplex satellite communication, linking the UAV to its remote control facility. The forward link provides command and control capabilities while the return link transfers sensor data.



Leveraging in-house satellite communications technologies has enabled Gilat to address our customers' critical need for reduced size and weight, while offering an affordable, tightly integrated solution with fast customization times. For example, the terminal pictured below is a miniature, lightweight integrated terminal specifically designed to provide high data rate video download for small, tactical, long endurance UAVs.

Offering one of the industries smallest and most compact aerial solutions in its category, the Gilat integrated approach can dramatically increase mission effectiveness. Its miniature dimensions allow BLoS operations for even the smallest UAV platforms, while supporting UAV video and data downlink and uplink applications.

Gilat's UAV terminal is a highly integrated, minimal SWaP airborne terminal. It comprises best of breed technologies, tailor made to the customer's end user's specifications. The main subassemblies of the solution include a flat array, mechanically tracking RaySat antenna, a high performance Gilat satellite modem, and a power efficient Wavestream BUC or SSPA.

The system weighs only 10.5Kg / 22lb. but is capable of transmitting more than 1Mbps from the UAV. The terminal provides spectrum efficient IP connectivity adaptive in real time to varying link conditions. Network implementation is straight forward by adding the modem to any Ku-band gateway infrastructure including transportable hubs.

All of the critical technology building blocks are developed, manufactured and integrated by Gilat, providing high end-to-end performance and great design flexibility. Customized solutions are designed to customer specifications in short design cycles. Further information about Gilat's integrated solutions for UAVs can be found at ***www.gilat.com/UAV***.

About the author

David Leichner is Vice President at Gilat Satellite Networks responsible for marketing and U.S. business development. Mr. Leichner has more than 20 years of technical, marketing and management experience in the areas of space and defense, communications and enterprise solutions.

ComSats That Didn't Quite Make The Grade...

By Jos Heyman, Senior Contributing Editor

Communications satellites provide an excellent opportunity to make money but, over the years, many ventures to establish a communications network, especially those that seek to provide novel services, suffered failure. In this article four such ventures will be discussed.

AirTV

AirTV was a proposal to build a satellite system for a global live television broadcasting network for use on commercial airliners. This came in the wake of the great success of live television on JetBlue Airways in the United States. The company was established in 1992 by a John D. Larkin. The company, with headquarters in New York, was based in Jersey Channel Islands.

The plan was to provide 60+ television channels as well as Internet and e-mail services to passengers on board commercial aircraft.

In 2000 the company signed a contract with Alcatel Space's operating arm, Spacecom, to become one of the strategic partners.

Alcatel Space was responsible for the development of the space segment consisting of four high-powered S-band satellites. The satellites would have been based on the Spacebus platform and each satellite would have carried four very high power S-band transponders, for which amplification will have been realized by several travelling wave tube amplifiers (TWTA's) assembled in a parallel configuration, a technique mastered by Alcatel Space for various programs. The satellites, for which the individual launch mass will be approximately 3800 kg, would each have supplied 8 kW of power for an operational lifetime of 12 years.

The initial satellite, which was to be launched in 2007 with an Ariane 5, would have been placed over the Atlantic Ocean serving flights between Europe, the Middle East and the Americas, which represented about one-third of the market. Other areas of the globe would follow after that.

Lack of finance eventually led to the cancellation of the programme and the company ceased to exist.

AssureSat

AssureSat was established in El Segundo, California for the purpose of placing two communications satellites in orbit and leasing those satellites out to operators that suffered launch failures. Whilst insurance companies would pay for the loss of the satellite when there was a launch failure, they would not pay for the loss of potential income as a result of not having the satellite in orbit. The Galaxy-4 failure of 1998, which disabled millions of pagers, brought this issue into sharp focus.

Recognizing a market niche, the AssureSat idea was conceived by Jerry Farrel who, from 1984 to 1997, was responsible for Hughes's Galaxy Satellite System. At that time, the Hughes corporation, through its Hughes Global Services (HGS) subsidiary, had some experience with the acquisition of satellites that failed to achieve their desired orbit, or in some other way did not perform properly and somehow, nursed them into limited service.

In early 1998 Farrel began brainstorming with Mark Fowler, a former chairman of the Federal Communications Commission, and with Bruce Lederman, an attorney who had been an external counsel for Hughes when Farrell was president.

The trio refined the idea for AssureSat, and after garnering some seed capital, they set out to raise $540 million. Farrell identified 40 potential customers and envisaged a company with not more that 25 employees, of which five would have been responsible for the marketing.

The satellites selected were Space Systems/Loral 1300 communications satellites to be fitted with 36 C-band and 36 Ku-band transponders. One of the satellites was to be located over the USA, the other was to be placed over Europe and Asia, and they were to be fitted with steerable antennas and could be moved readily to any location where they were required.

Loral had begun limited production, with full production to begin upon AssureSat's completion of the required additional financing. AssureSat also reached an agreement with Sea Launch in 2000 for launching the satellites on Zenit-3SL boosters in 2002.

Farrel and company managed to secure $420 million—not enough to continue—and the satellite contracts with Loral were cancelled. The company was dissolved in December 2004.

"It has been quite a learning process for me," Farrell was quoted as saying. "We totally missed how long it would take to raise money, even though we had a business plan that was rational, that would earn money, and that was as solid as anything I've done before."

As an aftermath, the Boeing Company, which had acquired Hughes Space and Communications in October 2000, was taken to court in May 2003 for stealing trade secrets from AssureSat. They managed to accomplish this by using confidential information obtained during talks to become AssureSat's manufacturing partner.

HKSat

Hong Kong Satellite Technology Group (HKSTG) was a joint venture between Hong Kong Satellite Technology Holdings, China Aerospace Science & Technology Group, Sino Satellite Communications, and Israel Aircraft Industries formed in 2001 for the establishment of a fleet of 10-15 satellites by 2010 to provide communications services to the Asian market.

The satellites were to be based on the Israel Aircraft Industries (IAI) Amos-HP telecommunication spacecraft bus, carrying 20 Ku-band transponders and providing 5.500 kW of power. The satellites had a design life guarantee to provide a 12 year service life.

On 17 January 2002 HKSat ordered seven satellites from IAI and the first satellite was due to be launched in 2004, followed by HK-SAT-2 around a year later. The two satellites were to be launched from the Xichang Satellite Launch Center in China with CZ 3A launch vehicles. The first satellite would have been placed in a geostationary orbit at 134°- E.

The company also planned to build a Hong Kong-based ground satellite control center, bringing itself closer to the goal of establishing a satellite-based network covering China and other parts of Asia.

HKSTG envisaged providing communication services, particularly direct-to-home television services, to the rapidly growing Asian market. The demand was expected to intensify due to the retirement of other communication satellites that were in service at the time. In addition, it was hoped that the new satellites would be used to support the 2008 Olympic Games in Beijing.

In January 2003 it was evident that this envisaged market would not materialise and the joint effort with Israel was cancelled before the satellites had been completed.

Astrolink

Astrolink LLC was established in 1999 by three equity partners, Lockheed Martin Global Telecommunications, Telespazio (an Italian company) and TRW. They were later joined by Liberty Media Group, as the fourth and largest Astrolink equity partner.

The Astrolink system was envisaged as a global wireless broadband telecommunications network providing high-speed, end-to-end data connections to businesses and individuals around the globe, making it faster and easier for them to use such on-line applications as e-commerce, videoconferencing, distance learning and web browsing.

These services were to be provided as a "dial-up" user access mode as well as secure virtual private networks.

Astrolink had secured licenses from the FCC for five orbital slots: Americas (97°W), Asia (130°E), Atlantic (21.5°W), Europe (2°E), and Oceanic (175.25°West) and had also been working to secure operating licenses in more than a dozen countries around the world. It was estimated that there was an anticipated need for nine satellites in the five geostationary locations.

Four satellites were initially ordered. These would be built by Lockheed Martin using the A2100 space platform whereas TRW would build the Ka band communications payload for the satellites.

The first launch was scheduled for 2003 with an Atlas V launch vehicle and Astrolink-1 was to provide services to customers in the Americas, Europe, Africa and the Middle East. Astrolink-2, to be launched by a Proton M, was to follow later in 2003 whereas Astrolink-3 and -4 were scheduled for 2004 again with an Atlas V and a Proton M launcher.

However, in October 2001 Lockheed Martin and TRW suspended work on the satellites and payloads as the venture failed to gain additional financing. In spite of this, Liberty Media continued to develop the Astrolink concept and came up with a revised operating plan where services would be provided to enterprise customers with private networks, rather than the end-users direct.

In January 2003 Liberty Media's subsidiary Liberty Satellite & Technology acquired the equity held by Telespazio, Lockheed Martin and Northrop Grumman (which earlier had acquired TRW) and signed commercial agreements with these companies for the completion of the satellites. However, the revised operating plan failed and on 29 October 2003 the company announced the termination of the Astrolink project and the satellite contract were cancelled immediately.

Liberty Media Corporation is an American media conglomerate and the Liberty Satellite & Technology, Inc. (LSAT) subsidiary, through a majority owned subsidiary, On Command Corporation, continues to provide in-room movies, broadband access and other entertainment and business services to hotels, motels, and resorts.

About the author

Jos Heyman is the Managing Director of Tiros Space Information, a Western Australian consultancy specializing in the dissemination of information on the scientific exploration and commercial application of space for use by educational as well as commercial organizations. An accountant by profession, Jos is the editor of the TSI News Bulletin and is also a regular contributor to the British Interplanetary Society's Spaceflight journal.

Advancing COTM Technologies To Enhance Warfighter Communications

By Rick Lober, Vice President + General Manager, Hughes Defense and Intelligence Systems Division

Military organizations around the globe need reliable, secure and cost-effective Communications-On-The-Move (COTM) solutions to keep troops connected on the ground, in the air and at sea. Satellite communications (SATCOM) is the ideal technology to provide beyond-line-of-sight (BLoS) broadband communications for the most challenging missions, including special operations, search and rescue, as well as intelligence, surveillance and reconnaissance (ISR).

Although supporting continuous broadband satellite connectivity for COTM presents significant challenges, new technological advances are available to address the critical need for on-the-move solutions that allow the military to successfully complete their missions.

As the U.S. draws down troops in current zones of conflict, the Department of Defense (DoD) faces the challenge of providing secure wideband SATCOM for highly-mobile users in the next contested operating environment. Future adversaries are likely to be more technologically-advanced and will intentionally disrupt military communications. The need is paramount to overcome enemy communication-jamming attempts, even while transferring large amounts of data between tactical warfighters, strategic decision-makers and command and control centers.

The DoD currently uses commercial satellites to fulfill approximately 80 percent of the department's SATCOM needs. Given the current national and global fiscal situation, it is unlikely that the DoD will develop new communication systems that will satisfy the demand for SATCOM in the future. The commercial satellite industry is well-positioned to partner with DoD to drive affordable and proven solutions in existing and future SATCOM systems.

Ultra-Low Profile Antennas

Today's military requires easy-to-use, transportable terminals that can be rapidly deployed and provide secure broadband communications for tactical operations while minimizing detection and interference. They need to be compact, interoperable and ruggedized to support continuous broadband satellite connectivity with mobile terminals, while compensating for shifting transmission paths and blockage by obstacles. The DoD requires ultra-low profile antennas to meet tight volume and height constraints, thereby helping maintain the anonymity of communications vehicles and protect warfighters in conflict zones.

In the past, industry has struggled to address the competing requirements for smaller terminals, higher data rates and secure connectivity through capable solutions which were typically heavy and impractical for tactical mobility applications. However, technology now exists that provides an ultra-low profile antenna and a highly-portable manpack for global COTM missions. Lightweight *Very Small Aperture Terminals* (**VSAT**) and ultra-low profile mobile antennas allow military units to transport a full antenna, quickly install it where needed, transmit/receive securely at broadband speeds, then uninstall and move it to another location.

The latest generation VSAT manpacks and ultra-low profile mobile antennas are economical, practical for tactical mobility platforms and offer high performance in a small profile. This creates a safer environment for military users, making identification

by adversaries difficult. These terminals can be configured to connect worldwide with commercial and government Ka-band satellites, having increased aperture efficiency, high data rates and enhanced control of radiated power spectral density, while remaining compliant with regulatory requirements.

Protected SATCOM Advancements

The military relies on state-of-the-art technology to securely transfer intelligence information for tactical operations. The need for "bandwidth-hungry" airborne ISR applications together with bandwidth used for secure frequency-hopping, spread-spectrum and anti-jamming communication devices is expected to grow. Users require higher rates of data transmission, which can be costly when transmitting critical files, streaming video and enabling video teleconferencing between tactical warfighters and command centers.

Currently, both traditional DoD and commercial SATCOM providers are developing options to reduce acquisition risk for an affordable networking architecture—providing U.S. and allied forces with protected high data rate communications in future contested warfighting environments. The government intends to develop design concepts and demonstrate mature technologies, leveraging capabilities that the commercial SATCOM industry employs for its global, satellite networks

Furthermore, the commercial industry's extensive experience in waveform design and development will be tapped to meet the cost effectiveness goals for a future protected tactical satellite communications system.

Cellular Service & High-Throughput Back Reach

Deploying a combination of wireless 4G/*Long Term Evolution* (**LTE**) technology and high-throughput satellite backhaul offers another option for disseminating large files and real-time video between our warfighters and strategic decision-makers. Integrated designs of these two technologies mitigate latency issues that can disrupt LTE traffic over conventional satellite links, providing the ideal mobile broadband solution for both military and public safety applications. Warfighters and first responders will have the most advanced deployable mobile communications capabilities available in the critical moments of a conflict, or immediately after a disaster.

Defense organizations need continuous connectivity with command and control centers to successfully complete their missions in harsh, challenging communication environments. These three new technology developments result in solutions that provide the most up-to-date information on strategic, operational and tactical situational awareness, offering greater bandwidth efficiency and BLoS capability for all mobile users.

Photo courtesy of DoD

COMMAND CENTER: Dr. John Paffett, SST-US

Since the last National Space Symposium... a look at what was—and what may well be....

Dr. John Paffett is chief executive officer for Surrey Satellite Technology US (SST-US), the United States subsidiary of small satellite manufacturer Surrey Satellite Technology Limited (SSTL). SST-US was created to serve the U.S. market with rapid, cost-effective small satellite systems, applications, and services.

In addition to leading the expansion into the United States, John is also responsible for SSTL's telecommunications, navigation and launch activities, including the development of Surrey's small Geostationary Satellite Platform, capturing and executing the provision of 22 payloads for the European GNSS system Galileo, and in the source and provision of secondary and piggy back small satellite launch opportunities.

MilsatMagazine (MSM)
What successes has SST-US enjoyed since the 2012 National Space Symposium?

Dr. Paffett
We've had a very busy and successful 12 months. Since April 2012 when we announced the spare capacity available for hosting payloads onboard our upcoming ***Orbital Test Bed*** (**OTB**) mission, we've been working with several teams to examine the accommodation of their ancillary payloads and equipment. We've now almost completed the finalization of the OTB payload suite, but based on customer interest, we will almost certainly be looking to provide flight opportunities for third-party payloads on future missions. In fact we're even now considering the possibility of an ***OTB-2***. Surrey's been flying hosted payloads for more than 25 years, during which time we must have flown 50+ payloads across 30 or more missions—these are missions we have strong experience in successfully completing.

We celebrated a **NASA** contract win last year with our inclusion in the **CYGNSS** team, selected for NASA's ***EV2*** program. Led by the **University of Michigan**, and in partnership with the **Southwest Research Institute** and NASA **Ames Research Center**, the mission will use a constellation of eight satellites flying our ***SGR-ReSI*** GPS receivers for the measurement of ocean surface winds to help improve weather prediction and hurricane forecasting.

We're particularly pleased to be involved in NASA's ***EV-2 CYGNSS*** constellation mission, which will fly eight Surrey SGR-ReSI instruments. Again, we're working with another great team, which always helps, but the application is very exciting, and it further demonstrates the important role that small satellite solutions can play in today's world.

This year has also been an important one for moving forward some of our strategic partnerships. Earlier in the year, we announced an agreement with **Aeroflex** of Colorado Springs, Colorado, for the manufacture of spacecraft electronic assemblies; and during the middle of last year, an agreement with **Virgin Galactic,** where we will be teaming with them on their new launch system development.

We are constantly looking at how we can stimulate new markets and applications, and to accelerate the establishment of our U.S. capabilities—our teaming with "kindred spirit" partners is most important to us.

MSM
What challenges will the satellite industry—and specifically SST-US—face this year?

Dr. Paffett
One of the biggest challenges this year, is the same as last year, and that is the current economic climate, which is making business conditions very difficult. Many of the programs we've been pursuing have been delayed significantly, and in some cases, even been cancelled.

Our belief is that budgetary pressure is here to stay. The community will be forced to find new ways of working, to do more, and to accomplish such with less. Unfortunately, what we're seeing at the moment is quite a mixed set of reactions from the customer community. Some appear to be in denial, hoping the environment will return to how such was previously. Others are embracing change and have found new solutions to move forwards. Others are in paralysis, struggling to figure out how they can satisfy their requirements with diminishing funding.

We believe the situation will improve as people accept the need for change. In fact, in the longer term, the increased budgetary pressures are likely to result in growth in the small satellite sector. With advances in electronics, instruments and sensors, there are great number of applications and services ideally suited to our class of mission.

Overcoming procurement and contracting difficulties will also continue to be a challenge. We're seeing positive signs in that respect, with increasing interest in streamlining procurement. **Air Force Space Command**'s **Space & Missile Systems Center** (**SMC**) and NASA, for example, are looking to establish hosted payload IDIQ contracts for the provision of commercial flight opportunities for their payloads. These opportunities would be complementary contracting vehicles to the NASA ***Rapid III*** platform IDIQ contract for free-flyer missions.

Simplifying procurement and providing transparency are essential steps in managing project costs and schedules, which is why our customers like using our e-commerce site. Providing access to information and flight hardware is also one of the reasons why we have our subsystems and professional engineering services in the GSA schedule to enable simpler procurements by government agencies.

The discussion of challenges would not be complete without mentioning launchers. Securing cost-effective launch opportunities for our class of satellites continues to be a challenge, but even here we're seeing positive signs of improvement. There is increasing pressure to utilize excess capacity on government launches, which is beginning to provide flight opportunities for piggy-back payloads. Our friends at **SpaceX** had a phenomenal year last year, and we should witness the number of launches start to increase significantly, which will provide future ride opportunities on the ***Falcon 9*** and ***Falcon Heavy***.

There are also a number of extremely exciting ongoing developments which show significant potential. Vehicles such as ***LauncherOne***, ***Ajax*** and ***ALASA*** will all be targeted at the small satellite end of the market, and once developed and qualified, will have a significant impact on being able to provide timely, cost-effective access to space. We're very much looking forward to these launch systems coming to the market.

MSM

What other projects are in the works?

Dr. Paffett

One of the most significant team events was the move into our new purpose-built facilities in Englewood, Colorado, on March 1st. It has taken a lot of planning and preparation to ensure that we have sufficient capacity to meet our needs and our customers' needs for the coming years.

We'll provide full mission capabilities to our customers through our satellite ground station and mission operations control center; satellite manufacture and payload integration facilities; design, analysis and test equipment and tools; as well as general and secure office areas and systems.

MSM

What can we expect to see from SST-US in the coming three to four quarters?

Dr. Paffett

We're going to be busy delivering our existing customer projects, some of which we've highlighted here, as well as promoting the capabilities of our innovative products, applications and solutions to meet future business needs in the small satellite industry. The institutional and commercial

The completed NigeriaSat-2 spacecraft, based on the SSTL-300 bus. Photo courtesy of SSTL.

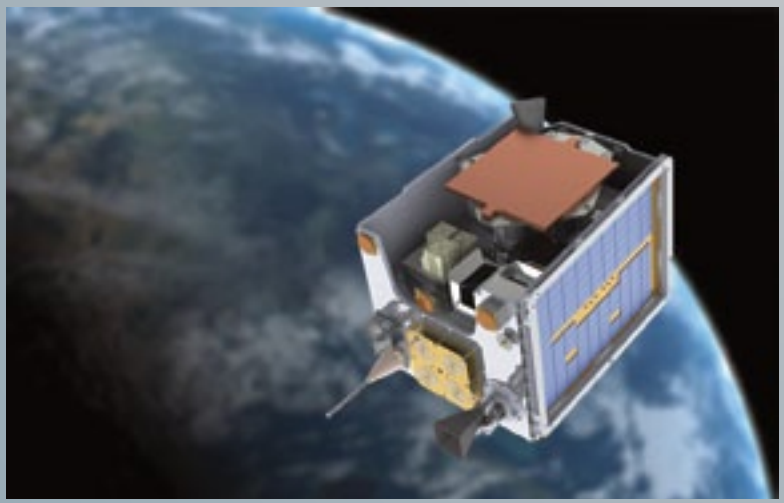
markets are very interested in our geospatial intelligence solutions. Our solutions include a constellation of three ***S-1*** spacecraft delivering sub-meter imagery for a total of $160 million including launch and insurance; the agile ***SSTL-300***-based ***NigeriaSat-2*** providing 2.5-meter imagery for under $30 million; and the wide-area ***SSTL-100***-based "always-on" ***Earthmapper*** satellite providing global land coverage in five days for under $10 million per spacecraft.

Surrey's 6-meter-resolution, all-weather, day-and-night ***NovaSAR*** system offers a market-leading swath-resolution-price solution that outperforms existing SAR systems and is a timely development to meet the growing focus on maritime domain awareness as well as disaster monitoring and land management.

Additionally, the flexibility for payload accommodation and launch vehicle accommodation that we offer with our spacecraft platforms means that we are continuing to see a growing interest for technology demonstration and science missions and for disaggregated operational constellations for Earth observation, Automatic Identification System, GPS, and weather applications.

We've already celebrated the successful launch of two of the four satellites on Surrey's 2013 launch manifest:

- ***Sapphire*, supplied to MacDonald Dettwiler Associates for the Canadian Department of National Defence's first dedicated operational military satellite in support of space situational awareness; and**
- ***STRaND-1*, the world's first "phonesat," an internally-funded "proof-of-concept" nanosatellite mission, which is flying a wide range of new technologies.**
- **Later this year, *TechDemoSat-1*, a U.K.-government-backed hosted payload mission flying a suite of eight technology demonstration payloads in addition to new platform avionics designs, and,**
- ***MRES*, an medium-resolution multispectral Earth observation mission for the Republic of Kazakhstan, will both be ready for launch.**



Artistic rendition of techDemoSat-1, based on the SSTL-150 bus. Image courtesy of SSTL.

We also expect to announce in the second quarter of 2013 the details of future rideshare mission opportunities available to payload providers, including the possibility of an OTB-2 mission.

MSM
Given the state of employment around the globe during these days of difficult economies... is SST-US hiring right now?

Dr. Paffett
We're growing the team across all disciplines and are currently recruiting to find the right people who are able to help create solutions to meet our customers' needs and contribute to our success. Our team members have a wide range of backgrounds, skills, and experiences but we all share a common enthusiasm for the space industry, for Surrey's collaborative "small satellite" approach, and for being flexible in order to meet our commitments.

We consider it essential that future generations of scientists and engineers are encouraged to study **STEM** subjects and have opportunities to develop the specialized skills required to pursue careers in the space industry.

We are looking forward to the completion of the ***TRACSat*** Cubesat research project with the **University of Colorado**'s *Aerospace Department*, which will see the production of a working Cubesat model for testing proximity operations. This is part of an ongoing corporate objective to work with, and support, universities and engineering students, and we look forward to being involved in more interesting projects in the coming years.

MSM
Will SST-US be a participant at many conferences this year?

Dr. Paffett
We have a busy ***conference schedule*** ahead of us. NSS is a key event in our annual calendar and we naturally have a particular interest in several of the panel sessions, including "*Hosted Payloads—Issues and Evolution*", moderated by *Janet Nickloy*, chairman of the **Hosted Payload Alliance**, and "*Mission Assurance in a Budget Constrained Environment*", moderated by *Wanda Austin*, president and CEO of **The Aerospace Corporation**.

Most of all, we're looking forward to meeting with our customers and partners to learn about their requirements and offer ways to solve their business issues and needs.

SST-US at the National Space Symposium
SST-US is exhibiting at ***Stand 122***. Please contact them on 303-790-0653 if you'd like to book a meeting.

For more information about SST-US and to subscribe to SST-US updates and blogs, visit ***www.surreysatellite.com***.

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Commercial X-Band: The Technical + Operational Advantages

By Jim Chambers, Vice President, Engineering, XTAR LLC.

Commercial X-band, a frequency reserved entirely for U.S. and Allied Governments' use, has multiple technical advantages which make it a solid contender in any bandwidth selection process. The benefits of commercial X-band are, in many cases, the same, or better, than those being touted in the Ku- vs. Ka- debates. Hence, it is imperative that government end users and solutions providers alike do not overlook the value of commercial X-band for their bandwidth needs.

Choosing the correct frequency is a process of matching requirements to capabilities: What size antenna do I need? What is the strength of its throughput and will it meet my requirement? Who makes the equipment? At what cost and how quickly can I get the equipment? Will I lose signal when it rains? Is the coverage available where I need it, and when I need it?

There are several technical and operational reasons to justify X-band over other frequencies. Successfully used for military communications for decades, commercial X-band outperforms other frequencies in the most demanding scenarios. Advanced technological capabilities include:

- **Freedom from the clutter of commercial users**: X-band may not completely prevent the chances of interference. However if remedial action is called for, such as requiring users to turn off their transmission to identify the interference source, the process is simpler and faster with the smaller, government-only X-band user pool, compared to the far larger Ku-band user community.

- **Rain-fade resistance**: Rain fade is mainly an issue for frequency bands above 10 GHz. X-band operates at 7-8 GHz. It not only performs better than Ku- and Ka-bands under adverse weather conditions, it also often outperforms C-band, which may suffer from adjacent satellite interference.

Artistic impression of an XTAR X-band satellite. Image courtesy of XTAR LLC.

- **Maximized throughput**: Commercial X-band matches or exceeds all other frequency bands in throughput on same-sized antennas, and with little impact from rain fade regardless of rain zone.
- **Excellent for mobility applications**: Spaced at 4 degrees apart rather than the traditional 2 degree for Ku-band, commercial X-band performs with higher-power and smaller remote antennas (<1m) which are ideally suited for mobile applications.
- **High data rates with existing DoD X-band terminals**: XTAR satellites work with all legacy DoD X-band terminals and can achieve very high data rates through the use of advanced coding techniques together with XTAR's payload amplifiers and spot beam antennas.
- **Existing legacy X-band equipment and experienced users**: Limited cost and training required for most military units which often already have the terminals and experience to use X-band.

As warfighter missions become more mobile, the X-band advantages cited above will come to play a pivotal role in helping achieve mission success. The size, weight and power of the warfighter's equipment is gaining increasing importance, and this includes smaller terminals which provide greater flexibility and agility in all circumstances.

Commercial X-band offers an attractive alternative to commercial Ku- and Ka-bands for transmitting to and from small terminals used for applications such *Airborne ISR* (**AISR**) and manpacks. The main advantages include providing greater spectral efficiency, lower chance for interference, and less rain fade and greater satellite separation.

X-band frequencies (7.9 to 8.4GHz transmit and 7.25 to 7.75GHz receive) operate in a range (below 10GHz) that is not as susceptible to rain-fade signal degradation as are the Ku- and Ka-bands. This can result in significant savings in bandwidth and allow higher throughputs from small terminals.

The XTAR satellites have achieved uplink data rates greater than 3Mbps from a small manpack terminal (0.45m with an uplink EIRP of 41.5dBW) at link availabilities of greater than 99.9 percent. These data rates and link availabilities would be difficult to match from a similar size terminal at Ku-band or Ka-band.

Such bandwidth efficiency is just one advantage to X-band. Satellite interference using X-band occurs less often as X-band satellites are typically spaced at 4 degrees or greater, compared with 2 degrees (or less) at Ku- and Ka-bands. This greater spacing means significantly less chance of adjacent satellite interference. Consequently, X-band is ideal for the small antennas that are generally required for AISR and other mobile missions.

Small antennas have a wide beam width, and, as a result, have a greater chance of interfering with an adjacent satellite or receiving interference from an adjacent satellite than larger antennas do. Spread spectrum technology (deliberately spreading bandwidth in the frequency domain) is often used to decrease the uplink and downlink power spectral densities in Ku- and Ka-bands. The use of spread spectrum greatly increases the satellite bandwidth requirement. Small antennas used with X-band may typically operate without using spread spectrum as the chance of adjacent satellite interference is significantly less. This allows the bandwidth to be used much more efficiently.

These technological advantages assure highly dependable service to government users, enabling greater focus on the value of their X-band satellite solution.

The cost value of commercial X-band for the government user has become more apparent in recent years as the availability of Ku-band continues to shrink. The Ku-band resource limitation has driven up costs and minimized the flexibility of this bandwidth. By comparison, commercial X-band has proven cost effective on a number of levels, including price per MHz, price per Mbps, and the limited capital cost for related equipment. Most importantly, its ability to enable systems and missions which offer the user enormous return on investment by increasing the likelihood of mission success, add significantly to the value of commercial X-band.

Reliability of service is a critical advantage of commercial X-band and extremely valuable to the user. XTAR bandwidth is guaranteed for the term of its lease, unlike the pre-emptibility of MILSATCOM resources. Every MILSATCOM user, outside of President Obama, risks being prioritized off mission-critical space segment because of other users assuming precedence. Warfighters whose missions depend on assured and non-preemptible space segment when they need it, often turn to commercial X-band because of this guaranteed service provision.

Responsible users of commercial X-band can also earn the right to manage their space segment as necessary to meet their mission requirements. They can maintain anonymity by not being forced to disclose operational information such as terminal location. In this respect, they receive a greater freedom from oversight, constraints, and bureaucracy than they might when using MILSATCOM.

In a world which demands ever more bandwidth at maximum value, selecting the right frequency boils down to carefully assessing the specific requirements of an operation, technology or application. At present, commercial X-band is one of the most valuable assets in the warfighters' frequency tool kit.

About the author

As the Vice President of Engineering, Mr. Chambers is responsible for managing XTAR's satellite and terrestrial resources to support government missions as efficiently as possible. Additionally, he helps strategically plan for future capabilities to support XTAR's growth and develops solutions to meet XTAR customers' unique engineering requirements. Mr. Chambers came to XTAR from DRS Technical Services where he lead the engineering team responsible for the full life cycle of satellite, terrestrial and hybrid communication networks for military and other government customers. Previously he held several senior engineering positions with various satellite network providers designing and implementing both satellite and hybrid satellite/terrestrial communications networks. Mr. Chambers graduated from Pennsylvania State University with a Bachelor's degree in Electrical Engineering. He also has a Master's degree in Electrical Engineering from Johns Hopkins University.

A Sell-Out @ The National Space Symposium

The Space Foundation, sponsor of the National Space Symposium, celebrates the greatest global participation in the event's 29-year history.

There are any number of reasons to consider attendance at this highly praised symposium... one of the main drivers is to visit the Lockheed Martin Exhibit Center and Lockheed Martin Exhibit Center Pavilion. Both are sold out and they will feature the latest in space technology, products and services. Additionally, this year, the greatest number of international exhibits in Space Symposium history, plus more than 30 first-time Space Symposium exhibitors.

More than 160 space-related companies, educational institutions, associations and organizations will be on display for Space Symposium registrants, invited guests, uniformed military and select groups of teachers and students. The exhibit center is not open to the general public.

The **Lockheed Martin Exhibit Center** opens Monday evening, April 8, immediately following the Space Symposium's welcoming ceremony, and will be accessible through Thursday, April 11. See the complete list of exhibitors and map of the exhibits at ***www.NationalSpaceSymposium.org/exhibit-center.***

With more than 9,000 anticipated participants over the course of the week, the Space Symposium is the premier annual gathering of the global space community. Scheduled for April 8th through the 11th at **The Broadmoor Hotel** in Colorado Springs, Colorado, the Space Symposium brings together all sectors of the worldwide space community to address opportunities and issues.

Cyber-Centric

The Space Symposium is offered in conjunction with a separate Space Foundation cyber conference for anyone with an interest in, or responsibility for, the cyber domain, whether government policy maker, industry executive or military cyber professional or practitioner at any level.

Cyber 1.3 is a full-day event taking place April 8th at The Broadmoor Hotel, immediately preceding the opening ceremony of the Space Symposium. The Honorable C.A. "*Dutch*" *Ruppersberger* (D-MD), Ranking Member, *U.S. House Permanent Select Committee on Intelligence*, will be a featured speaker at Cyber 1.3.

Space Symposium and Cyber 1.3 speakers and agenda are subject to change, so see the most current details at ***www.NationalSpaceSymposium.org/agenda***.

Secure online registration for both Cyber 1.3 and the Space Symposium is available online now at ***www.NationalSpaceSymposium.org***.

Awards

The Space Foundation's annual Space Symposium provides an ideal opportunity to present its top annual awards. Notable honors to be conferred during the Space Symposium include:

- *General James E. Hill Lifetime Space Achievement Award - posthumously to Neil Armstrong and Sally Ride*
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- *Douglas S. Morrow Public Outreach Award, to Bill Nye, CEO of The Planetary Society*
- *Space Achievement Award, to National Oceanic and Atmospheric Administration (NOAA)*
- *Alan Shepard Technology in Education Award - to Colorado teacher Daniel R. Newmyer, Center High School*
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Learn more about why these recipients were chosen at ***www.SpaceFoundation.org/about/awards***.

Space Technology Hall of Fame's 25th anniversary

"The 2013 Space Technology Hall of Fame inductees will help us mark our 25th year of honoring those who bring space technology 'down to Earth' to benefit our lives in countless ways," said *Kevin Cook*, director, space awareness programs for the Space Foundation. Three events at the Space Symposium will honor the Space Technology Hall of Fame® inductees on April 11:

- *The Space Technology Hall of Fame® Private Induction Ceremony, co-sponsored by Intelsat*
- *The Space Technology Hall of Fame® Cocktail Reception, co-sponsored by Inmarsat*
- *The Space Technology Hall of Fame® Dinner, which features dinner speaker Sigourney Weaver and is co-sponsored by SpaceX*

The Private Induction Ceremony is by invitation only and the reception and dinner are open to all Space Symposium attendees.

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The active government/military rate for ***Cyber 1.3*** is $395, or, when combined with Space Symposium registration, the total for both events is $1,140. See details at ***www.NationalSpaceSymposium.org***.

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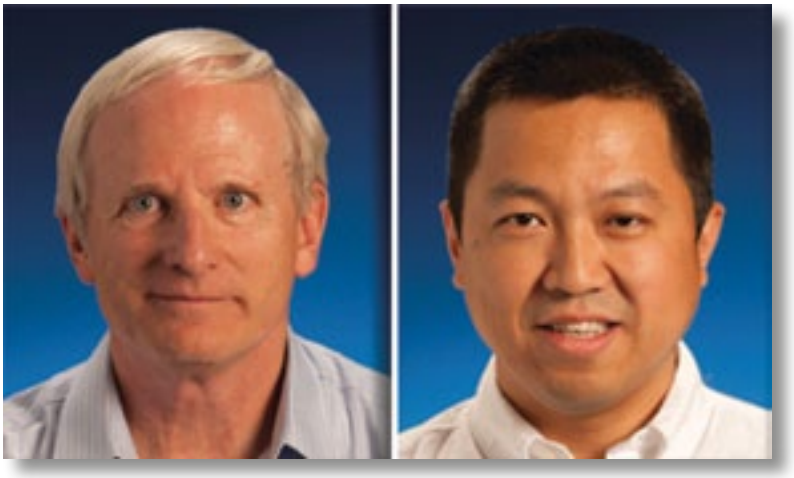
Satellite Spotlight—Understanding + Using MUOS

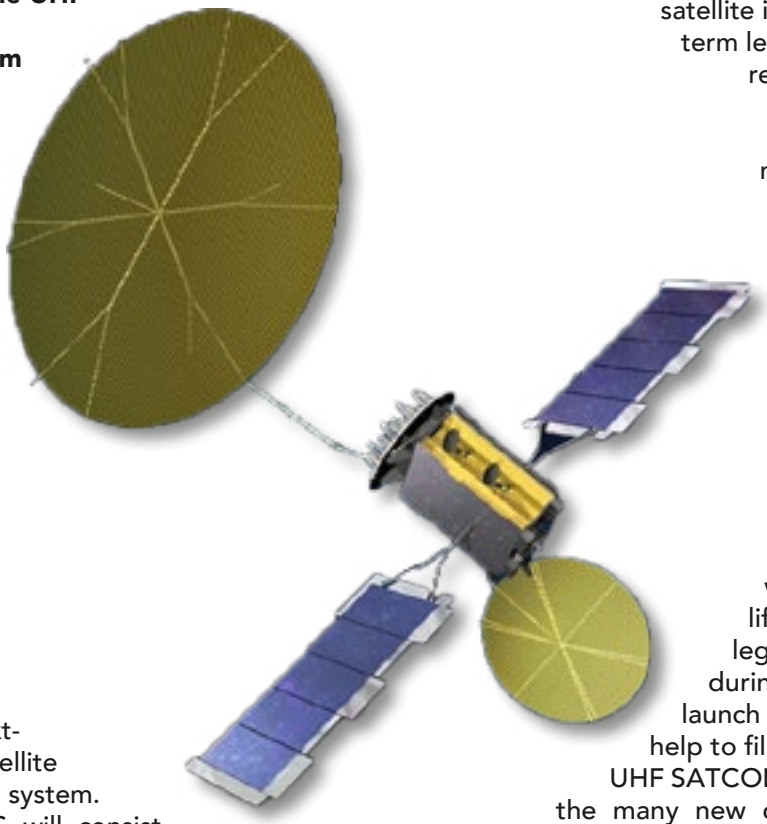
John D. Oetting, Project Manager + Lead Systems Engineer, MUOS Project, APL Principal Professional Staff (l.)

Tao Jen, member of APLs' Prinicpal Professional Staff and Assistant Group Supervisor, Communications + Systems Group (r.)



The Navy has used the military UHF band (300–400 MHz) for satellite communications (SATCOM) since the launch of the first Fleet Satellite Communications (FLTSATCOM) satellite in 1978. In the past 30 years, several replacement constellations have been launched, and UHF satellites have become joint assets used by all the services; however, the communication waveforms and architectures have not changed significantly.

This article from the *John's Hopkins APL Technical Digest* describes the UHF SATCOM system called the Mobile User Objective System (MUOS). The system is based on the identical technology now being widely deployed on terrestrial cellular phone systems and will revolutionize the way the Department of Defense (DoD) uses UHF SATCOM. This article describes the MUOS system architecture, APL's role in the MUOS program, and the impact of our work on programs at APL.



Saying Hello To MUOS

MUOS is the DoD's next-generation UHF satellite communications (SATCOM) system. When fully deployed, MUOS will consist of a constellation of four geosynchronous satellites (plus an on-orbit spare) and the associated ground stations. The MUOS system[1] will provide global connectivity between MUOS users and will also provide MUOS users access to the **Defense Information Systems Agency**'s (**DISA**) terrestrial voice and *Internet Protocol* (**IP**) networks. Point-to-point, broadcast, and netted (push-to-transmit) services will be supported at data rates ranging from 2.4 up to 384Kbps.

The MUOS waveform—Spectrally Adaptive Wideband Code Division Multiple Access (SA-WCDMA)—is based on cellular Third Generation Partnership Project (3GPP) technology. Design features include Rake Receivers, advanced turbo coding, and state-of-the-art interference-mitigation techniques for maximum efficiency on the UHF uplink and downlink.

In addition to providing cellular-like service using WCDMA technology, each MUOS satellite includes a legacy payload (the term legacy or legacy UHF SATCOM refers to the existing DoD UHF SATCOM capability, which is based on frequency division multiple access and dedicated narrowband channels), which will provide bent-pipe communication capabilities essentially identical to those of the UHF payload of a UHF follow-on (UFO) satellite, the space element for the existing legacy constellation.

As most of the UFO satellites are operating well beyond their expected lifetimes, it is likely that the legacy capacity will decline during the next few years. The launch of the MUOS satellites will help to fill any potential gaps in legacy UHF SATCOM capacity, as well as provide the many new capabilities of the WCDMA system, including more than an order of magnitude increase in the worldwide communication capacity.

MUOS Architecture

Figure 1 on the next page illustrates the MUOS architecture. The heart of the MUOS system consists of the four active

The United Launch Alliance's Altas V lofted the first of five U.S. Navy's Mobile User Objective System (MUOS) satellites from SLC-41 at Cape Canaveral Air Force Station (CCAFS) on February 24, 2012. The successful mission also marked the 200th launch of a Centaur upper stage.—NASA, Spaceflight.com

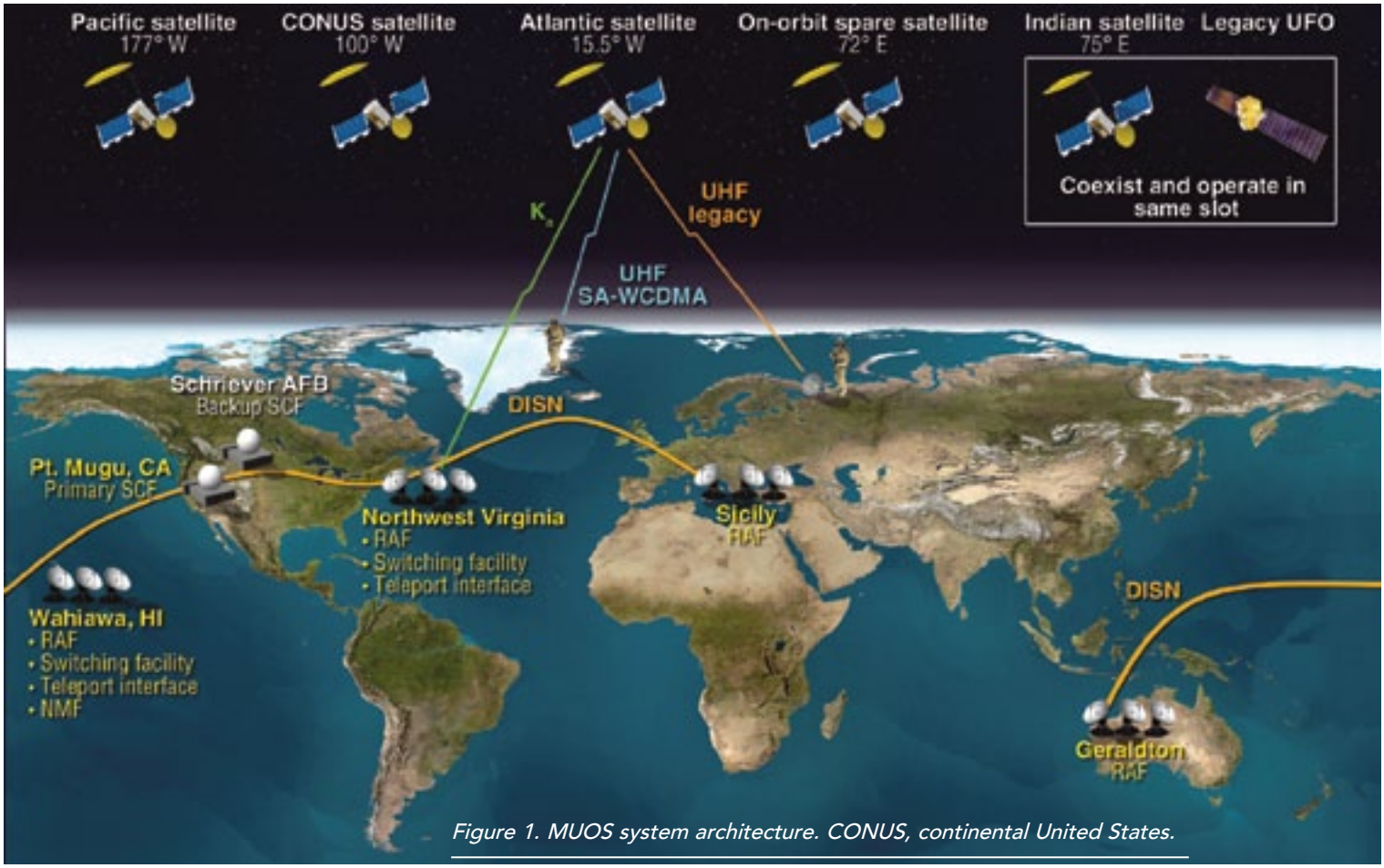


Figure 1. MUOS system architecture. CONUS, continental United States.

satellites in geosynchronous orbit and the four *radio access facilities* (**RAFs**) on the ground. Each satellite is in view of two RAFs, and each RAF has two satellites in view.

MUOS terminals communicate with the satellite via UHF uplinks and downlinks. The satellite converts each UHF uplink to digital format and sends the digitized signals to a RAF via a Ka-band feeder downlink. The combination of the UHF uplink, the satellite, and the Ka-band downlink is called the *user-to-base* (**U2B**) path, in accordance with 3GPP terrestrial terminology. (*In terms of the more familiar terrestrial cellular networks that we use every day, each MUOS satellite corresponds to a cell tower, and each RAF corresponds to a base station. However, the "cell towers" are 23,000 miles high and the "cells" are more than 600 miles in diameter.*)

The RAFs demodulate and decode all of the user traffic they receive from the satellite. All RAFs are interconnected via high-capacity fiber optic terrestrial links, shown in *Figure 1* as thick orange lines. This terrestrial connectivity allows RAFs to send data to the nearest switching facility. The switching facilities route the data to either the *Defense Information Systems Network* (**DISN**) or to an appropriate MUOS RAF (one that is in view of a satellite that has the destination user within its UHF footprint). Each RAF takes all of the data it receives from the two switching facilities and uplinks approximately half of the data to each of the two satellites in view via analog Ka-band feeder links. Each spacecraft amplifies the signals received from its two RAFs, downconverts them to the UHF band, and transmits them to MUOS terminals via the UHF downlink. The combination of the Ka-band uplink, the satellite, and the UHF downlink constitutes the *base-to-user* (**B2U**) path.

Also shown in *Figure 1* are the *network management facility* (**NMF**) and the primary and secondary *satellite control facilities* (**SCFs**). The NMF provides a management system for communications planning, allocating, and prioritizing access to the MUOS communication resources. It provides the MUOS system with the information needed to perform priority-based, real-time communication resource allocation, as well as reallocation of resources and preemption of low-priority traffic, when absolutely necessary. The NMF also provides the tools necessary to manage the MUOS network and provide situational awareness. The SCFs receive status information from the satellites (via the RAFs) and send commands to the satellites via the RAFs using secure telemetry links. Operators at the SCFs configure the satellite and ensure that it stays in the proper orbital location (*stationkeeping*).

The flow of MUOS signals from user to base and base to user is illustrated in *Figure 2*, on the next page, which also shows the frequencies used for the UHF and Ka-band uplinks and downlinks. Each MUOS satellite uses a *multibeam antenna* (**MBA**) with a 14m reflector for transmission and reception of the MUOS UHF WCDMA signals.

Legacy UHF signals are received by the satellite's MBA but are transmitted on the UHF downlink via a separate legacy transmit antenna, which has a 5.4m reflector. Both the MBA and the legacy transmit antenna reflectors are constructed

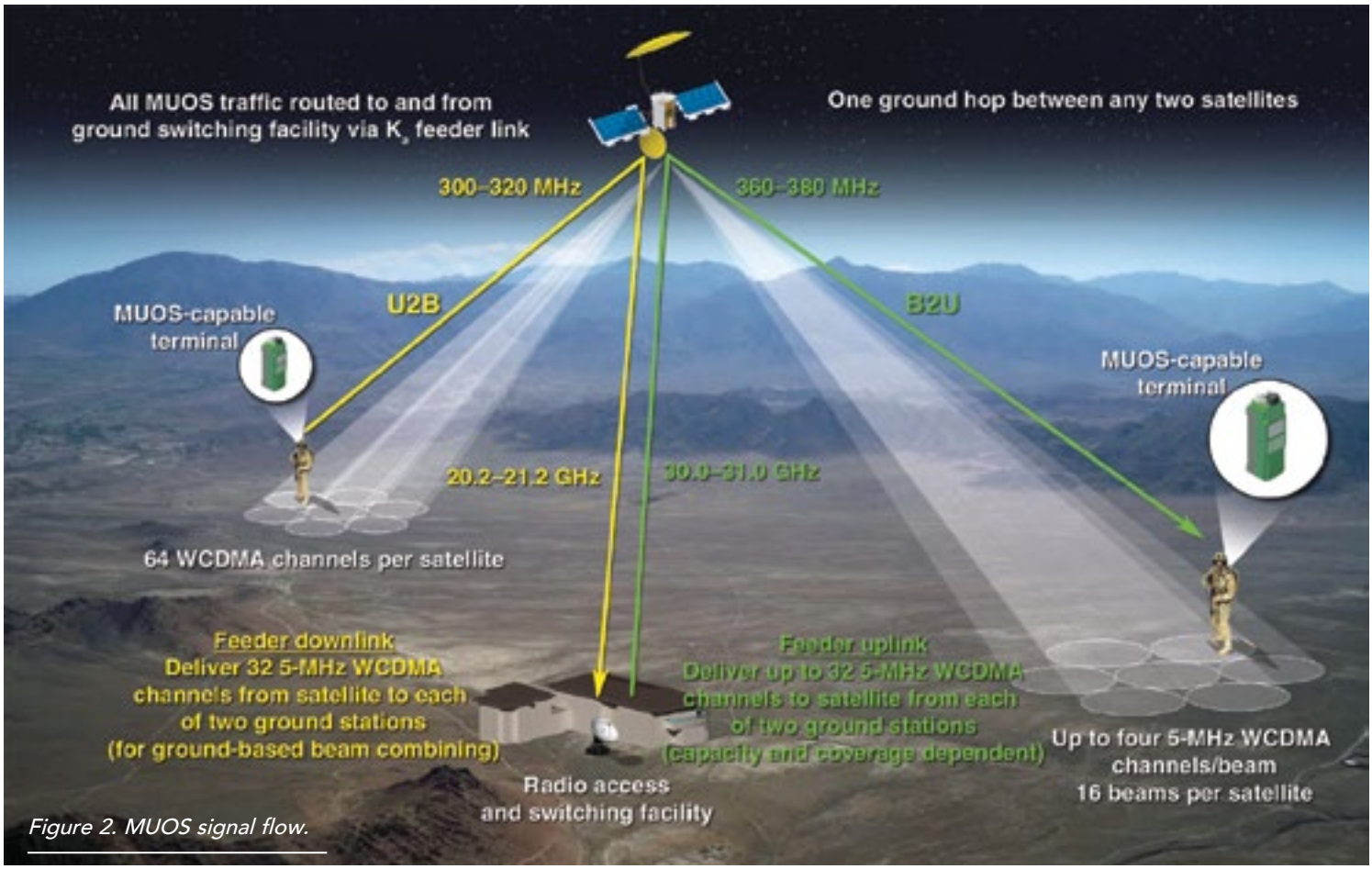


Figure 2. MUOS signal flow.

of gold-plated mesh so that they can be stored in a small volume and then deployed after the satellite is in orbit.

The MBA forms 16 beams that cover the entire footprint of the satellite, enabling much higher antenna gains than the Earth coverage antennas used by the UFO system. The additional antenna gain makes it possible to provide connectivity to handheld terminals (although the MUOS satellites are designed to support handheld terminals, there are currently no handheld terminals under development) and also greatly reduces the required transmit power for all terminals.

Note in *Figure 2* that 20MHz of bandwidth is allocated for both the UHF uplink (300–320MHz) and downlink (360–380MHz). The uplink and downlink bandwidth is divided into four 5MHz WCDMA channels. Each user within a given 5MHz channel is assigned a different spreading code, enabling as many as 500 users to share a single channel, depending on the mix of data rates and terminal types.

The MBA enables all four channels to be reused on each of the 16 beams, resulting in 64 WCDMA channels per satellite (16 beams x 4 channels per beam = 64 channels). On the U2B path, each of the 64 channels is downlinked via the digital Ka-band feeder downlinks to a RAF, with 32 channels sent to each of the two RAFs in view.

On the B2U path, each RAF sends 32 channels via the analog Ka-band feeder uplinks to each of the two satellites in view. The satellite switches each of the 64 channels it receives (32 from each RAF) to the appropriate downlink beam and channel. Each of the 64 channels per satellite is referred to as a satellite beam carrier (SBC). Within the constraints imposed by system loading, the ground facilities attempt to spread the load as uniformly as possible among all of the available SBCs in order to maximize system capacity.

Figure 3 on the following page shows the worldwide coverage provided by the four active MUOS satellites (latitude 65 degrees North to latitude 65 degrees South). The figure also shows the coverage provided by individual MUOS beams, as well as the portion of the Earth's surface covered by two satellites (dual coverage). More than 70 percent of the required coverage area is covered by two satellites. Coverage by two satellites provides more capacity to a region as well as the ability to communicate when one satellite is disabled, obstructed, or jammed.

The MUOS UHF frequency plan is illustrated in *Figure 4*, which also shows the legacy frequencies falling into the MUOS UHF uplink 5MHz channels. The fact that the UHF band is heavily populated with external interferers (external interferers encompass a wide range of signals found in the heavily congested UHF bands used by MUOS, including line-of-sight communication signals, radar signals, radio navigation signals, and commercial television) as well as our own legacy SATCOM signals necessitated the use of a modulation technique that can coexist with many other users sharing the same bandwidth.

The use of power control and spread-spectrum WCDMA enables MUOS to share the band with legacy users without

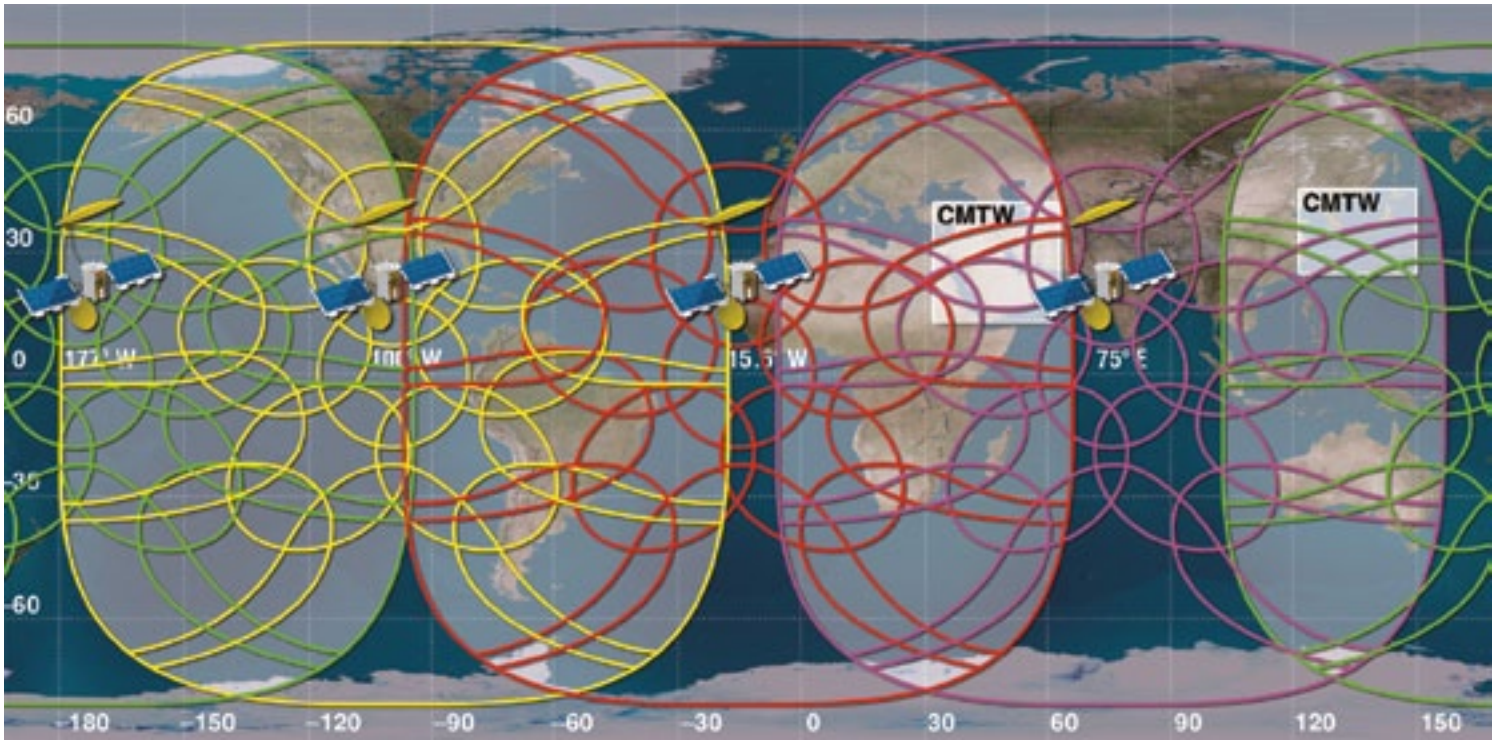


Figure 3. MUOS global coverage. The MUOS terminals within the gray shaded areas are in view of two MUOS satellites. CMTW, combined major theaters of war.

significant performance degradation to the legacy users or to the MUOS WCDMA users. Adaptive signal processing is used to notch out interferers on both the U2B and the B2U paths. Legacy users and external interferers within the 5MHz WCDMA uplink channels are notched out by processing performed at the RAF.

External interferers on the UHF downlink are mitigated through adaptive filtering performed by the MUOS terminals. MUOS terminals can also implement notches in the MUOS WCDMA transmitted signals in order to comply with host nation agreements or to avoid interfering with other nearby communication assets.

Up to several hundred kilohertz of each 5MHz channel can be notched out before significant performance degradation can be measured. Furthermore, the MUOS power control loops automatically increase the transmitted power to compensate for any loss that does occur (see discussion of power control below).

MUOS implements closed-loop power control independently on the U2B and B2U paths so that each terminal transmits just enough power to close its UHF uplink and the satellite transmits just enough power to close all of its UHF downlinks. 3GPP WCDMA-based cell phones have very similar power control loops; however, power control for MUOS is more challenging due to the 640-ms round-trip propagation delay between the terminals and the RAF. Like terrestrial WCDMA systems, MUOS uses two power control loops: an inner loop which attempts to track channel gain variations in order to achieve a target E_b/N_0 (the energy per bit to noise power spectral density ratio) and an outer loop that monitors communications performance and makes adjustments to the target E_b/N_0.

To deal with the long delays, MUOS uses two key techniques not found in terrestrial systems. First, the inner loop uses linear prediction to predict, on the basis of the current and past fade values, the fade state of the channel 640-ms in the future. Second, whereas terrestrial systems rely on cyclic redundancy check failures to estimate performance (so that the outer loop can make appropriate adjustments to the target E_b/N_0), the MUOS outer loop estimates the instantaneous block error rate by applying a polynomial fit to sequences of signal-to-interference ratio measurements made on each 10-ms frame. Details of these algorithms can be found in *Reference 2*.

Another MUOS power control challenge relates to the DoD-unique netted capability, whereby one user's transmission is sent to all other members of a net. Members of the net can be in the same beam, different beams of the same satellite, or different satellite beams. As only one netted user transmits at a time, U2B power control for nets works identically to power control for point-to-point connections. However, on the B2U path, the satellite must provide enough power to each SBC containing net members to ensure that the most disadvantaged terminal is able to achieve the required quality of service.

This goal is achieved in the following manner. If nothing is heard from any user terminal in a given SBC, the ground station reduces the power for each user in the SBC by a specified increment at the beginning of each power control interval. Meanwhile, each user on the net is continuously monitoring its downlink signal-to-interference ratio. When a user determines that the next power control decrement will reduce its signal-to-interference ratio below a designated

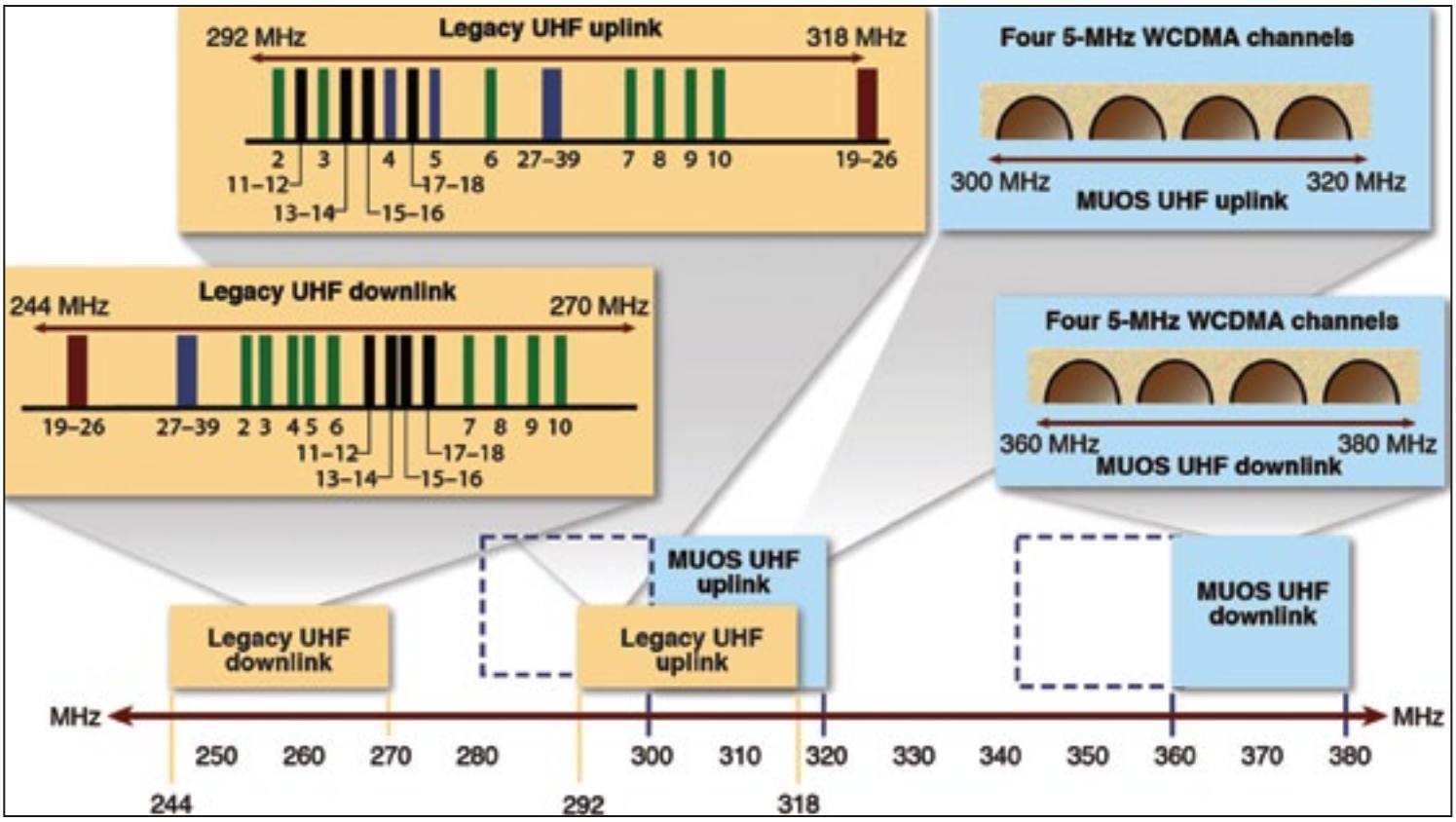


Figure 4. MUOS UHF frequency plan. MUOS uplink carriers are dynamically notched as necessary to comply with host nation agreements. Colors indicate four legacy frequency plans, and dashed boxes indicate frequency bands allocated for future MUOS use.

threshold, it sends a message to the ground facility asking either for no decrease or, if needed, an increase in power for the next power control interval. In this way, all users are allocated the satellite power they need to maintain their required level of performance.

In addition to spread spectrum modulation, MUOS uses state-of-the-art error correction coding with turbo decoding to reduce the required power and increase robustness. Rake receivers (a Rake receiver combats multipath fading by coherently combining the energy received on each path) are used at the RAFs and in the user terminals to combat the effects of fading channels. Extensive simulations and hardware tests have demonstrated that the Rake receivers used on MUOS provide excellent performance over a wide variety of UHF SATCOM channels.

The MUOS waveform also incorporates extensive interleaving, including the option of uplink interleaving over intervals as long as 640ms. The MUOS network features an IP-based core. All data are Type 1 encrypted within the terminal either by a *High Assurance IP Encryptor* (**HAIPE**) or by a *Secure Communication Interoperability Protocol* (**SCIP**) device. SCIP is used for all transmissions between MUOS users and the *Defense Switched Network* (**DSN**), the DoD's terrestrial voice network.

APL'S Role In The MUOS Program

APL has been involved in the MUOS program for more than 10 years, starting with our development of the analysis of alternatives, which was finalized in 2001. APL provided significant technical expertise in analyzing the performance of 18 different candidate architectures and defining the government reference architecture.

APL led the development of the measures of effectiveness and measures of performance for the system. APL was instrumental in the development of the MUOS performance specification and the request for proposals. We led the performance assessments for MUOS source selection and provided technical directions on system capacity, link availability, and quality of service requirements—the most important performance parameters for the system.

Concepts and negotiated requirements for supporting DoD IP-centric requirements were developed that were essential for MUOS to gain approval of its key decision point B acquisition milestone.

In addition, APL provided technical directions that helped MUOS successfully complete the system preliminary design review and the system critical design review, developing an in-depth technical road map that guided the application of IP networking technologies in the MUOS architecture and design. Also developed was an information assurance solution that helped the MUOS program gain approval to use modified commercial-off- the-shelf equipment to provide assured communications. APL guided major architecture and design decisions including the adoption of an all-IP core network design and the connections into DSN, *Unclassified-but-Sensitive IP Router Network* (**NIPRNET**), and *Secret IP Router Network* (*SIPRNET*).

APL is currently providing technical support in the areas of system performance analysis, test and evaluation of the ground hardware and software, network management,

information assurance, and key management. APL also approves all changes to the satellite specification that affect satellite RF performance and has been heavily involved in determining the impact of these design changes on system performance. Some specific examples of APL's contributions to the MUOS program are described in some detail in the following subsections.

MUOS Performance Model

Due to a of a number of factors, assessing the capacity of a WCDMA system is an extremely challenging problem. The fact that quality of service is limited by the interference from other users sharing the same 5MHz channels (multiple access interference), rather than by thermal noise, and the fact that the power levels of every user are constantly being adjusted by the power control loops, make it impossible to assess the performance using the conventional link budget approach. Therefore, it was necessary to assess system capacity by means of simulation.

For this purpose, a tool called the *MUOS Performance Model* (**MPM**) was used. Rather than attempting to simulate the dynamic behavior of 20,000 users, a snapshot of the MUOS system was generated that consists of all users that are transmitting and receiving MUOS data at a particular instant of time. For each link in the snapshot, MPM calculates a link budget every 10ms, taking into account inverse-square propagation loss, fading, interference, multiple access interference, and many other factors. For every user, MPM also implements the actual power control algorithms used by the MUOS system. The primary outputs from an MPM run are the average link availability for every user, the transmitted power versus time for each of the four satellites, and the uplink load factor (a measure of traffic loading) versus time for each of the four satellites.

MPM was developed over the course of many years by an integrated team consisting of contractors and government/APL personnel. APL has developed a number of algorithms used by MPM, some of which will be described in this section. APL's most important contribution to MPM is the suggestion of averaging link availability results over multiple MPM runs.

Figure 5. The first MUOS satellite completing thermal/vacuum testing at the ***Lockheed Martin*** *facility in Sunnyvale, California.*

The most important output of MPM is the average annual link availability for each of the thousands of users included in a simulation run. According to a long-standing agreement between the government and the MUOS contractors, if even one of these users has a link availability less than the required 97 percent link availability, the system does not meet its capacity requirement, which is the most important performance requirement for the MUOS program. Prior to March 2009, link availability was computed on the basis of a single MPM run, which consists of 24 segments spaced 1h apart, with each segment covering 200s of real time. Most of the random variables associated with the simulation are changed for each segment, but the location of each user is kept fixed for all 24 segments.

APL recognized two significant problems with this approach. First, the fact that there are only 24 draws for each random variable means that one or two bad draws for one user can potentially result in that user failing to meet the 97 percent link availability requirement. Second, the fact that the users stay in fixed locations over the course of the simulation run means that a user located in an unfavorable position (*e.g.*, on the edge of a beam or in between multiple beams) can fail to meet link availability.

To alleviate these problems, APL suggested performing approximately 10 runs for the same users and averaging the link availability of each user over all 10 runs (eventually, an agreement was reached to use 12 runs, and this is the number of runs performed to the present day). Users would be randomly repositioned within their area of operations at the beginning of each run.

After this method was introduced in March of 2009, the predicted worldwide throughput increased (literally overnight) from less than 100 percent of the required throughput to greater than 120 percent of the required throughput. This increase in the estimated capacity occurred because of the drastic reduction in the variance of the link availability estimates produced by the averaging procedure.

APL also developed the MPM model for Ka-band reradiated noise. The MUOS B2U path includes an analog Ka-band uplink and a UHF downlink, which is essentially a standard bent-pipe satellite link. The MUOS satellite simply translates each channel from the Ka-band to the appropriate UHF frequency, routs the channel to the appropriate beam carrier, and amplifies each beam carrier prior to transmission to the MUOS users via the UHF downlink.

As a result, any noise on the Ka-band uplink will be amplified and retransmitted on the UHF downlink. MPM must model this additional noise, which is most severe when the Ka-band uplink is in a deep fade. Furthermore, the fading characteristics depend on the climate at the ground station and the elevation angle to the satellite and therefore differ for each of the eight Ka-band uplinks (four RAFs, each with two satellites in view) and vary with time (because of satellite motion).

At the time that the MPM reradiated noise algorithm was developed, APL was conducting only one 24-segment run (rather than 12), so a major concern was that a few bad draws for a particular Ka-band link could cause link availability failures for every user traversing that link.

APL came up with a solution based on the fact that there are 192 random draws in each MPM run (8 links and 24 draws per link). For each MPM run, the algorithm ensures that two of the draws will be assigned a 96 percent fade depth, two will be assigned a 97 percent fade depth, two will be assigned a 98 percent fade depth, two will be assigned a 99 percent fade depth, one will be assigned a 99.5 percent fade depth, and the rest will be assigned a 95 percent fade depth (at the 95 percent fade depth, the reradiated noise has little impact, so there is no need to granulize the fade depths below 95 percent).

For each segment, each of the eight links is assigned a percentile fade depth based on the above distribution, and the fade depth corresponding to that percentile is found in a precomputed look-up table. The look-up table includes fade depths for each of the above percentiles for each link and for each of the 24 hours in a day. Once the fade depth is determined, the reradiated noise can be computed in a straightforward manner.

Another APL contribution to MPM was an algorithm for automatically generating snapshots having the required throughput characteristics. Before we developed this algorithm, a snapshot was generated by going through each of the MUOS point-to-point links and nets and including each link or net with a probability equal to its duty cycle. This method produced loading characteristics with significant variation from one random seed to the next.

To obtain a valid snapshot, it was necessary for someone to manually examine the statistics associated with a large number of snapshots and pick the snapshot that seemed to provide the closest approximation to the specified average loading characteristics. This process was labor intensive and prone to errors.

APL conceived of an alternative approach that would ensure that every snapshot generated by MPM would have the desired throughput values for five mutually exclusive categories of traffic. To achieve this result, the user was allowed to input the five target throughput values corresponding to the five traffic types. As before, the links/nets are gone through one by one, selecting a link or net with a probability equal to its duty cycle. However, instead of going through the entire list exactly once, it is continued until all five throughput targets are met. Once a particular target is met, no more nets/links in that category can be selected. In order to avoid biasing the selection probabilities, the order of the links/nets is randomized prior to each iteration of the algorithm. APL developed and tested a MATLAB implementation of the algorithm and then wrote the design description used by the software coder to implement the algorithm in MPM.

Legacy Interference

APL has performed a significant amount of work pertaining to the effect of legacy interference on MUOS communication performance. Note from *Figure 4* that the MUOS uplink frequency band (300–320MHz) overlaps the uplink bandwidth used by the existing legacy satellites (292–318MHz). As the legacy satellites have greatly exceeded their design life, and because each MUOS satellite includes a legacy payload in addition to the WCDMA payload, significant narrowband legacy interference will be present within the MUOS bandwidth. Although the ground processors have the capability to eliminate most of this interference by means of adaptive filtering, there have been long-standing concerns that the legacy signals, which greatly exceed the power level of the WCDMA signals, could saturate the satellite receiver front end or the analog-to-digital converters on the satellite.

APL performed the analysis that was used to establish the levels of legacy interference that the system must be able to withstand, and these levels were incorporated into the MUOS system specifications. Later, APL developed a simulation to evaluate the effects of legacy interference[3] and was instrumental in planning and conducting legacy interference tests using the MUOS payload emulator.[4]

Specifically, APL convinced the government to spend the money to perform the tests, worked closely with the contractors to formulate the test plan, developed the files used by the arbitrary waveform generator to emulate the legacy interferers, witnessed the tests, and made significant contributions to the test report. To ensure that the first MUOS spacecraft has performance similar to that of the payload emulator, APL convinced the government and the contractors to conduct similar tests using the actual payload during end-to-end testing prior to launch.

Modeling + Simulation

In addition to the legacy interference simulation, APL has developed simulations to estimate the system acquisition time statistics for the worst-case MUOS user, analyze the peak-to-average power ratio statistics of the MUOS waveform,[5] and analyze the dynamic loading statistics on the basis of the specified user duty cycles and data rates. The dynamic traffic model was used to estimate the factor used to convert the average load to the 99th percentile load, which is the agreed-upon loading factor for all MPM runs.

APL developed a simulation of the U2B path that enables the government to evaluate potential improvements to the MUOS system, including improvements in capacity and jam

Figure 6. The three Ka-band antennas being installed at the RAF in Geraldton, Australia.

resistance. To date, the WCDMA transmitter has been simulated, most of the fading channel models, the interference excision algorithm, interleaving, and the turbo decoder. A channel estimation algorithm has also been implemented and tested, used to provide channel information to the Rake receiver.
Eventually, APL will add satellite nonlinearities, beam combining, and various types of jammers to the simulation. Using our simulation, the increase or decrease in required resulting from the use of a new technique or the presence of jammers will be able to be estimated. This information can be input into MPM in order to evaluate the resulting gain or loss in system capacity. This capability will allow the government to evaluate potential improvements to MUOS. Because of the unique architecture of the MUOS system, it will be possible to implement all of these improvements on the ground without launching new satellites.

Network Management
APL has been the lead systems engineer in the MUOS network management area for many years, overseeing the requirements, architecture, and design in many key areas including communications planning, provisioning, and IP address management. APL successfully guided a major engineering change proposal that made significant changes to over-the-air provisioning to simplify the provisioning of MUOS terminals. Technical issues in applying HAIPE dynamic discovery technologies were resolved and investigating ways to reduce the complexity of managing tens of thousands of IP addresses, improve HAIPE dynamic discovery technologies, and streamline communications planning and provisioning for tactical users are also being managed.

Requirements Verification
APL is investing considerable effort in requirements verification and analysis of test data. APL personnel are responsible for verification of 35 of the 128 system-level requirements, including all requirements pertaining to communications quality of service. APL responsibilities include reviewing all test plans and procedures, witnessing key tests, analyzing test data to ensure that performance requirements are met or exceeded, and recommending to the government whether to approve verification of each requirement. APL is also heavily involved in verification of the ground segment requirements.

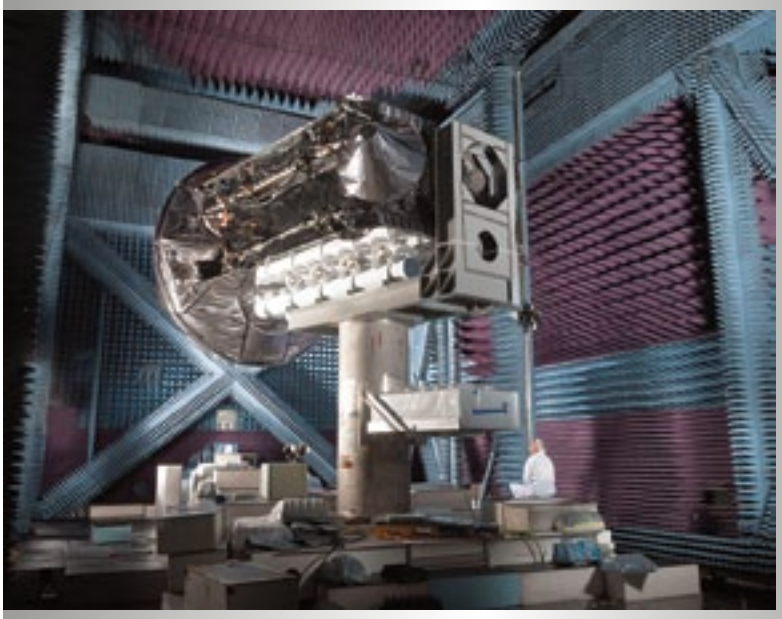
Information Assurance + Key Management
For many years, the APL team has provided support to the **Navy Program Office** and to the **National Security Agency** MUOS team in the areas of information assurance and key management. The APL information assurance team continues to assess MUOS program information assurance risks, propose risk mitigation approaches, and facilitate accreditation efforts. In addition, APL is heavily involved in the development and implementation of cryptographic key management capabilities and procedures.

Future Work
APL is assisting the MUOS Program Office in assessing technology insertion options to provide performance

Lockheed Martin's Crucial Role

In January of this year, **Lockheed Martin** *successfully completed the required system testing on the second satellite in the* ***U.S. Navy's Mobile User Objective System*** *(***MUOS****), designated* ***MUOS-2****, as well as delivered the software waveform for the satellite. The new waveform will enable military satellite communications terminal providers to deploy equipment that takes full advantage of enhanced MUOS capabilities. The satellite has been placed in storage to awaits its scheduled launch date in July of 2013.*

In the spring of 2013, Lockheed Martin will remove the satellite from storage, perform final spacecraft component installations and conduct a final factory confidence test in Sunnyvale, California, prior to shipping MUOS-2 to ***Cape Canaveral Air Force Station****, Florida, for its launch aboard a* **United Launch Alliance** ***Atlas V*** *rocket.*



Prior to entering storage, the U.S. Navy's second Mobile User Objective System (MUOS) was paced through a series of rigorous tests to ensure its performance and health throughout its on orbit life. Here, MUOS SV-2 completes testing in a Lockheed Martin anechoic test chamber to ensure the spacecraft's signals and interfaces work properly. Photo courtesy of Lockheed Martin.

A nexgen narrowband tactical satellite communications system, MUOS provides significantly improved and secure communications capabilities, including simultaneous voice, video and data, for mobile and remote users. MUOS satellites are equipped with a ***Wideband Code Division Multiple Access*** *(***WCDMA****) payload that provides a 16-fold increase in transmission throughput over the current Ultra* ***High Frequency*** *(***UHF****) satellite system.*

improvements and new capabilities for MUOS. As almost all of the signal processing is performed on the ground, it is possible to achieve significant improvements in capabilities without modifying the existing constellation of satellites or launching new satellites. Some potential areas for exploration include time-aligned (synchronous) WCDMA,[6] nulling of strong interferers via multibeam or multisatellite processing, multiuser detection,[7] improved coding/decoding techniques, and application of fourth-generation commercial cellular technologies[8], [9] to MUOS. The U2B simulation tools described in a previous subsection can be used to evaluate the performance improvement provided by each of these techniques, which will enable the government to perform cost/benefit analyses for each proposed enhancement.

APL is also assisting the MUOS Program Office in exploring options for using an additional 20MHz of uplink and downlink bandwidth included in the MUOS frequency filings, which could be used to support a second constellation of MUOS satellites. Still farther into the future, APL will be involved in exploring options and developing requirements for the next generation of UHF satellites.

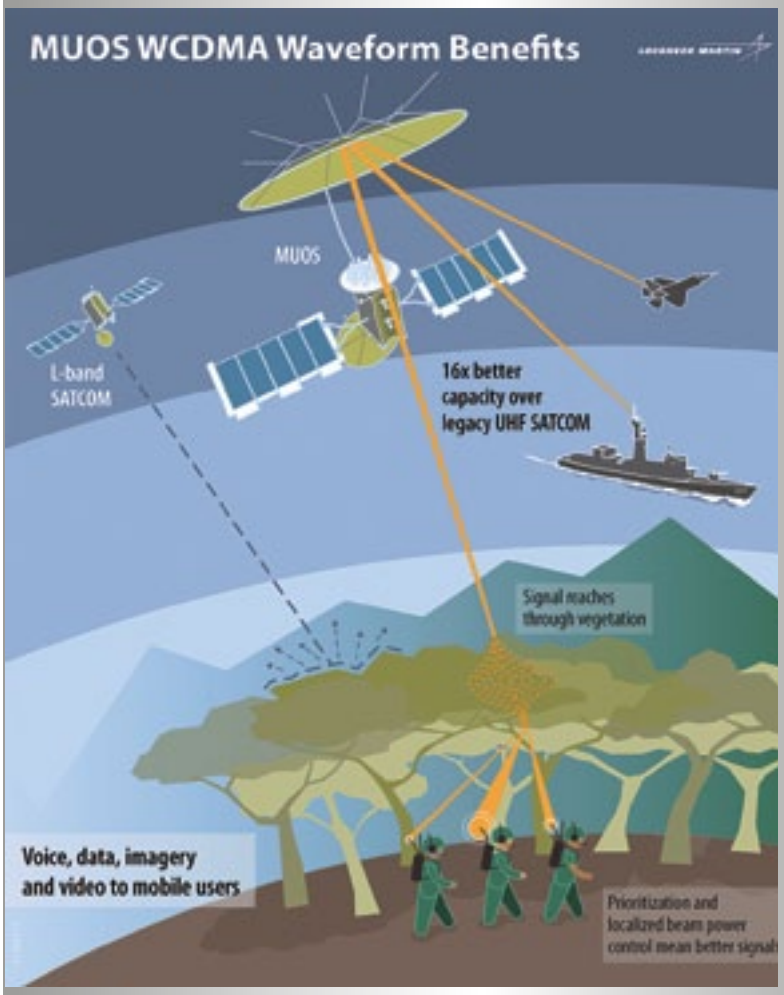
Understanding + Using MUOS

Although the four MUOS satellites will provide more than an order of magnitude increase in capacity compared with the current constellation of eight UFO satellites, this quantum leap in performance is accompanied by a significant increase in complexity. Users who are accustomed to being assigned dedicated circuits will have to adjust to an IP-based, bandwidth- on-demand concept of operations.

Communication planners accustomed to simply assigning a fixed number of available channels to the pool of users will be faced with managing a complex system that requires significant expertise to achieve the maximum capacity that the system can provide. With dozens of staff-years of cumulative experience working on MUOS, APL is well positioned to provide the technical expertise needed to ensure that the maximum system capacity is achieved and that warfighters receive the full benefit of all of the system's unique capabilities.

UHF SATCOM is the primary means of *Beyond-Line-of-Sight* (**BLOS**) communication for tactical users. As such, it is projected that tens of thousands of users from dozens of military programs will use MUOS. Many of these programs rely on APL for technical advice.

Since 2006, we have provided APL staff with information that will help them to transition the ***Tomahawk*** missile in-flight command and control from the legacy UHF SATCOM system to MUOS. In early 2010, we completed a white paper describing the use of MUOS on the ***DDG-1000*** guided missile cruiser, a futuristic warship currently under development by the Navy. For several years, we have provided technical assistance to the **Office of the Secretary of Defense** in the area of UHF SATCOM end-to-end systems engineering. The first tangible result of this work is a new DISA program to implement a bridging capability between MUOS users and legacy UHF SATCOM users.[10] The approach being implemented is based on an idea developed by APL staff as part of our MUOS work.



Lockheed Martin tailored a previously commercial waveform to be used with the new WCDMA payload. The U.S. government has made the waveform available for military satellite communications terminal providers through the ***Joint Tactical Networking Center*** *(***JTNC***) Information Repository, and contractors can now integrate the waveform into their MUOS-compatible terminals to provide WCDMA capabilities for users.*

"With the new WCDMA payload, MUOS is a game changer for the military worldwide," said ***Iris Bombelyn****, vice president of Lockheed Martin's* ***Narrowband Communications*** *mission area. "As our government and industry partners begin deploying new communications terminals, remote and mobile tactical users will be able to quickly and securely share video, data and voice communications critical to their safety and mission success."*

Recently, we performed a quick-reaction analysis which showed that using MUOS instead of legacy UHF SATCOM would enable communications using APL's developmental buoyant cable antenna, potentially allowing submarines to receive a UHF broadcast without surfacing. Using our knowledge of MUOS and taking into account the characteristics of the buoyant cable antenna, we developed link budgets showing that we could close the U2B and B2U links with ample margin. In summary, the work we have done on MUOS has provided significant benefits to many other APL sponsors.

Acknowledgements

We thank *Brian Flemming*, *Jay Yoo*, *Kim Grempler*, *Ania Kacewicz*, *Andy Moor*, *Patrick Hogue*, *Chuck Pitts*, *Charlie Leeper*, *Ryan Hearty*, and *Jonathan Gordon* for their ongoing technical contributions to the MUOS project; *Charlene Williams* for program management contributions; and *Andy Oak*, *Jim Veneziano*, *Frank Mackowick*, and *Anne Gugel* for their many years of technical contributions to the project.

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The fully-integrated MUOS satellite stands vertical in Lockheed Martin's Sunnyvale, California, facility. Photo: Lockheed Martin.

Each MUOS satellite also includes a legacy UHF payload that is fully compatible with the current UHF Follow-on system and legacy terminals. This dual-payload design ensures a smooth transition to the cutting-edge WCDMA technology while the UFO system is phased out.

The system is ready to provide full WCDMA capability to users. Other near-term milestones include the second MUOS satellite launch in July 2013, completion of on-orbit testing and check-out with the MUOS ground system and certification of terminals like HMS Manpack to use the MUOS waveform.

Lockheed Martin is currently under contract to deliver five MUOS satellites and the associated ground system to the U.S. Navy. Lockheed Martin Space Systems, Sunnyvale, California, is the MUOS prime contractor and system

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John D. Oetting is the Project Manager and lead systems engineer for the MUOS project. Dr. Oetting is a member of APL's Principal Professional Staff and leads the DoD Communication Architecture Development section of the Communication and Networking Systems Group. He concentrates his efforts in the areas of system performance, modeling and simulation, system requirements verification, and satellite RF performance requirements.

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Editors note: We wish to thank the Johns Hopkins APL Technical Digest for their permission to republish this article.
Note: The Johns Hopkins APL Technical Digest can be accessed electronically at ***www.jhuapl.edu/techdigest.***

An overview video created by U.S. Navy for the MUOS system is available at ***http://www.public.navy.mil/spawar/Press/Documents/Videos/7.27.11_MUOS_Kit_IV.wmv***.

integrator. The Navy's Program Executive Office for Space Systems, Chantilly, Virginia, and its Communications Satellite Program Office, San Diego, California, are responsible for the MUOS program.

For MUOS, Lockheed Martin is building on its proven record of providing progressively advanced spacecraft for protected, narrowband and wideband military satellite communications. Lockheed Martin built the legacy ***Milstar*** *protected communications satellites, as well as the* ***Defense Satellite Communications Systems*** *(****DSCS****) wideband communications spacecraft for the U.S. Air Force.*

Lockheed Martin engineers prepare the third Mobile User Objective System (MUOS) satellite for acoustic testing, one of several simulated environmental tests to validate the satellite's performance throughout its launch and on orbit mission life. Photo courtesy of Lockheed Martin.

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Smartphone Use For SATCOM

By Tom Cox, President, Coolfire Solutions

Satellites allow billions of people on the ground, in the air, and at sea to communicate in ways that wouldn't be possible without this technology. We use SATCOM for international communications, video and content distribution, as well as access to areas fiber or other terrestrial communications systems cannot go—it's amazing to think just how common SATCOM really is.

In fact, there may be more than a million transmitting terminals in operation around the globe, ranging in size from small handheld satellite phones to 100-foot diameter directional antennas.

Sometimes these terminals are installed and commissioned by highly experienced field engineers who have commissioned hundreds, or even thousands, of terminals. However, frequently, terminals are commissioned by lesser-trained technicians, or even untrained personnel.

When a terminal is incorrectly commissioned, that terminal can wreak havoc on entire satellite networks, causing cascade failures that can be costly—in many ways.

This happens occasionally in military environments as well. A SATCOM technician may be trained in the theory of satellite communications, but many times they'll get to the field and be asked to build and commission a satellite terminal they've never seen before.

It's important to make sure installers have the tools they need to get the job done. There are thousands of things that can go wrong when setting up a link. Sometimes just having the right tools can help, but knowing how to use them to solve a problem is pretty important, too.

In order to effectively align a satellite terminal, a technician needs several things. Specifically, they need a compass, inclinometer, GPS receiver (to find their location), a declination map, a computer to control the satellite terminal equipment, a phone to communicate with the satellite controller, and possibly a user manual with instructions on how to set up the terminal.

All of these elements exist inside today's smartphones. Plus, there are mobile apps available in the app stores that help users setup, acquire, and sustain satellite links. **Coolfire Solutions** has built an app called ***Surveyor*** (part of the ***Reconn*** platform) that does exactly this job. Other apps come from commercial installers of DT) services such as **DirecTV**, **Dish**, and **Exede**.

Especially for the lesser-trained and untrained users, having a smartphone with SATCOM apps loaded on it makes sense. They have all of the sensors they need, and step-by-step instructions. They can even look up information on the Internet and call for help—depending on the mission environment.

Few technicians have these tools available to them, especially in the military, where restrictions on using smartphones can be quite draconian. It's unfortunate as these tools are relatively inexpensive when compared to the cost of improper installations, link downtime, and sending engineers around the world from site to site.

Perhaps this has more to do with the word "*smartphone*" than anything else. Smartphones seem to cause security types to cringe. Historically, in security circles, a phone has been treated quite differently than a laptop computer. What happens when you combine them, and then market them as a powerful phone? You get a lot of confusion about which set of rules to follow.

Smartphones Are "Handtop" Computers

The first computers filled entire rooms with huge racks of electronics. They had a simple keyboard and screen, called a terminal, to interact with these large machines.

In the late 1970s, the personal computer was invented by Apple and made popular in business and military applications by IBM. They were small enough to fit on your "desktop." These desktop computers revolutionized the way in which we interacted with information, and ultimately, with the invention of computer networking, with one another.

In the 1990s, these desktop computers were made even smaller and more portable, effectively becoming small enough to fit on your lap, hence their naming as "laptop" computers. I bet every single person reading this article owns a laptop or uses a company-provided laptop (feel free to email me if I am incorrect).

Coolfire's Surveyor App

In 2007, with the invention of the *iPhone*, **Apple** again changed the world of computing by further shrinking a personal computer down to the size of a phone. Apple markets this computer as a smartphone, but really this is a "handtop" computer.

With the smaller form factor, typical operating systems that work well on mainframe, desktop and laptop computers wouldn't work as well. **General Dynamics** once tried this by creating a handtop computer in the most linear sense of evolution possible. The ***MR-1*** laptop is quite literally a laptop computer with a 5-inch display and a 5-inch keyboard. It runs the ***Microsoft Windows XP*** operating system, so a user needs to maneuver an incredibly small curser on the screen with a tiny trackball to the barely visible "Start" button to launch a software application.

To solve this user interface problem, Apple, and ultimately several other companies, created a mobile operating system with a touch-screen that lets users intuitively interface with the computer in their hand. ***iOS***, ***Android***, ***Blackberry*** and ***Windows Mobile*** are the most popular mobile operating systems.

These handtop computers have several radios embedded in them. They run a mobile app called "Phone" which uses these radios to communicate via voice with other users. This is not how these devices are marketed. They are explained as phones that can do so much more.

What if they were marketed as small computers with a voice communication app? Would the functionality and utility of these devices change one bit?

Interestingly, the phone app is actually not the most used application on these devices. Text, email, web browsing, and sometimes even other applications are more often used than the voice app. European telecom giant **O2** recently released a study on how people use their mobile phones, and found that the "Phone" app ranks about 5th in use for most people. In fact, users use the Phone app only about 12 percent of the total time they use a smartphone.

The point is that these powerful computers have been marketed as phones, but when seen as a portable computer packed with sensors, we begin to get a clear understanding of how they can be used in SATCOM applications.

Mobile Apps Are Just Like Laptop Apps

Our CTO once overheard someone say that "mobile apps aren't the same as regular software applications." This person, who was the program manager in charge of mobility adoption at a specific military organization, completely misunderstood what mobile devices and mobile apps really are.

Mobile apps and desktop apps are identical in more ways than people realize. In fact, mobile apps are sometimes far more powerful than their desktop and laptop cousins. This is because mobile apps work not just on a computer—like desktop and laptop applications—but they take advantage of the dozen or so sensors packed into smartphones and tablets, such as the camera, gyroscope, microphone, GPS receiver, and more.

Developing mobile apps—useful ones that do something important—is actually a bit trickier than regular laptop applications. This is because that processing power, memory, bandwidth, storage are all far more limited on the smart device. Being efficient in code is much more important. Also, the user interface is far more tightly integrated in a smartphone or tablet than on a laptop. A user isn't just looking at the information on the screen, the user is interacting with the screen.

What about Security?

Most everyone in SATCOM can understand the basic value proposition of using mobile devices and mobile software applications. Most everyone can understand that smartphones are powerful computers with an ecosystem of processors, bandwidth, storage, and software apps.

The elephant in the room is that some security still will not allow users to bring smartphones into environments where sensitive or classified information can be accessed.

The biggest concern security has about smartphones is their ability to record and transmit information without being detected. This concern can be mitigated by disabling the radios permanently on smartphones, and, disabling the recording mechanisms of the device (such as cameras, audio recorders, and so on.)

Both of those actions can be accomplished by software. Coolfire Solutions has developed software that can disable the radios and other sensors on an Android or Blackberry device. The software resides in the kernel and in the operating system, effectively bypassing any malware that may or may not be installed on the device.

Additionally, the devices can be configuration managed to disallow certain types of software to run based on policies set by the administrator. For example, a system admin can restrict a device from downloading any unauthorized software. Also, file transferring can be disabled. All communications apps, such as the phone, email, and web-browsing, can be disabled as well.

The goal is to use these devices as handheld computers. We can easily implement system administration and information assurance policies for these devices—just like we do with laptop computers.

At Coolfire Solutions, we've focused on using the smartphones as standalone computers not connected to any type of classified network, and in some case, not connected to any network at all.

At the end of the day, it will take time for administrators and security types to grow comfortable with the devices in their networks. There are plenty of initiatives to get us there, and each will increase the level of general comfort and understanding on how to use mobile devices in secure environments.

The **NSA** has been working on a program called ***Fishbowl*** which would allow the use of smartphones on classified networks. A big part of their initiative is the ability to "sandbox" secure information and capabilities from the rest of the phone. This way, if the phone is compromised in any way, the information is not accessible by malware services.

DISA has also recently produced an RFP that calls for a *Mobile Device Management* and *Mobile App Store* (**MDM/MAS**) solution to allow for an Enterprise-wide rollout of smartphones.

These initiatives are important—they are not the only way smartphones can be used in classified environments. By disabling the radios and locking down what software can run on them, we can treat smartphones just as we do laptops that access classified networks.

Using Smartphones For SATCOM

A SATCOM installer needs several simple tools to actually set up and commission a satellite communications terminal and satellite link. All of these capabilities are available on a commercially-available smartphone. Just about everyone who might be pressed into duty to set up a SATCOM link knows how to use a smartphone, and if the app is built well, stepping through the process should be pretty straightforward.

Once the military resolves the security issues involving smartphones, imagine the power these devices will give to SATCOM technicians. In many ways, the knowledge that experienced engineers have can be shared in the form of workflows and instructions in the mobile app using the smartphone's sensors.

Smartphones have the ability to raise the level of training and experience across the board for SATCOM installers and maintainers. They also have the ability to lower the total cost of ground terminal operations and maintenance as fewer engineers will need to travel to remote sites. They'll be able to work remotely with a technician already at the site.

To see an example of how smartphones can be used in SATCOM, download the **Coolfire Solutions *Surveyor*** app from the **Apple App Store** or the **Google Play** store and try it out.

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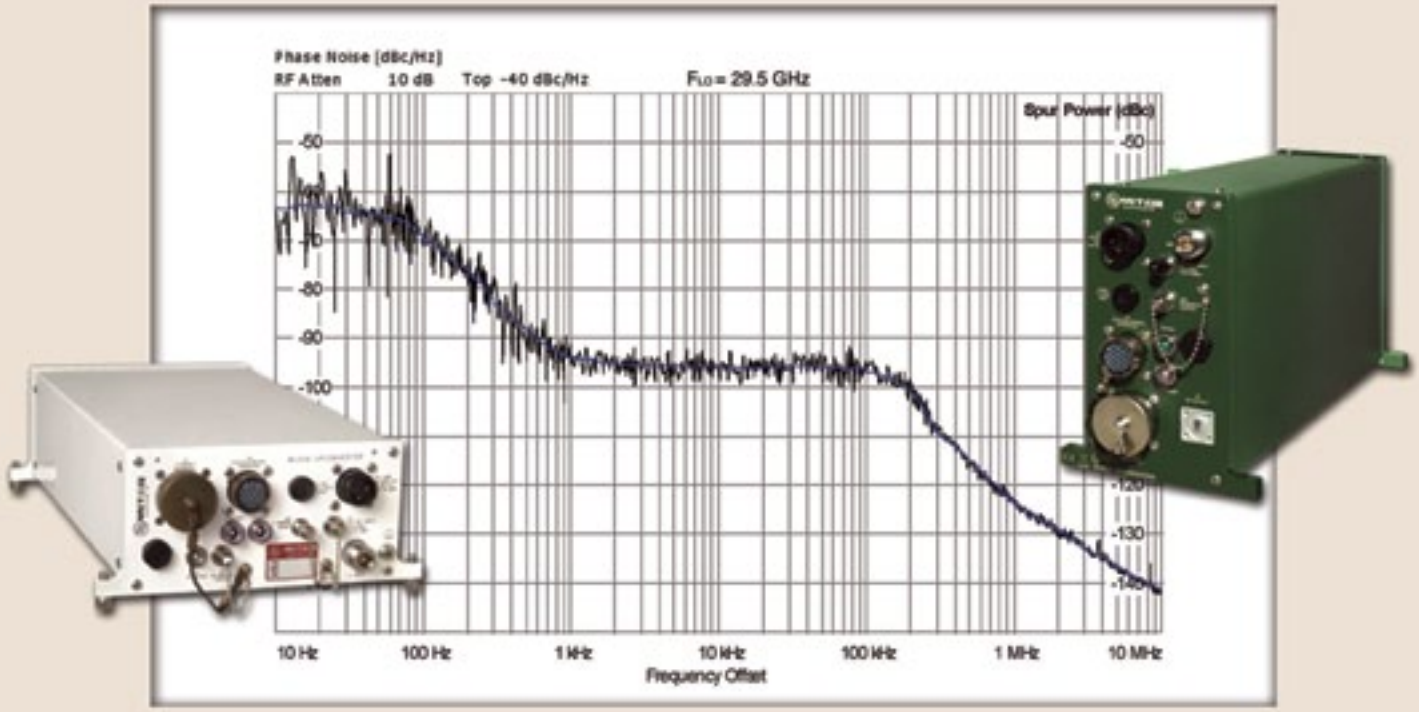

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27 - 27.55	950 - 1500	UPB-WS-29.275
28.0 - 28.5	950 - 1450	UPB-WS-28.25
28.1 - 28.6	950 - 1450	UPB-WS-28.35
28.35 - 28.6	950 - 1200	UPB-WS-28.475
28.5 - 29.0	950 - 1450	UPB-WS-28.75
28.6 - 29.1	950 - 1450	UPB-WS-28.85
28.75 - 29.35	950 - 1550	UPB-WS-29.05
28.8 - 30.0	950 - 2150	UPB-WS-29.4**
29.0 - 29.5	950 - 1450	UPB-WS-29.25
29 - 30	1000 - 2000	UPB-WS-29.5-1*
29.5 - 30.0	950 - 1450	UPB-WS-29.75
30 - 31	950 - 1950	UPB-WS-30.5**
30 - 31	1000 - 2000	UPB-WS-30.5-1**

Note: WS Models listed include MITEQ Low Phase Noise Option.
* Model includes frequency inversion. ** Wide IF: 1-1.5 GHz IF bandwidths.

WS Series Downconverters

RF Frequency (GHz)	IF Frequency (MHz)	Model Number
17.7 - 18.2	950 - 1450	DNB-WS-17.95
18.3 - 18.8	950 - 1450	DNB-WS-18.55
18.8 - 19.3	950 - 1450	DNB-WS-19.05
19.7 - 20.2	950 - 1450	DNB-WS-19.95
20.2 - 21.2	950 - 1950	DNB-WS-20.7**
20.2 - 21.2	1000 - 2000	DNB-WS-20.7-1**
25.5 - 27.0	950 - 2450	DNB-WS-26.25-1.5**
27.5 - 28.0	950 - 1450	DNB-WS-27.75
27.6 - 29.1	950 - 2450	DNB-WS-28.35-1.5**
28.0 - 28.5	950 - 1450	DNB-WS-28.25
28.1 - 28.6	950 - 1450	DNB-WS-28.35
28.35 - 28.6	950 - 1200	DNB-WS-28.475
28.5 - 29.0	950 - 1450	DNB-WS-28.75
28.6 - 29.1	950 - 1450	DNB-WS-28.85
28.8 - 30.0	950 - 2150	DNB-WS-29.4**
29.0 - 29.5	950 - 1450	DNB-WS-29.25
29 - 30	1000 - 2000	DNB-WS-29.5-1*
29.5 - 30.0	950 - 1450	DNB-WS-29.75
30 - 31	950 - 1950	DNB-WS-30.5**
30 - 31	1000 - 2000	DNB-WS-30.5-1**

Custom Models with BW up to 2.5 GHz and Multi-channel Models are also available.

For additional information, please contact our MITEQ SATCOM Sales Team at (631) 439-9108.

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