SATCOM For Net-Centric Warfare — December 2016

MilsatMagazine

YEAR IN REVIEW: 2016
TARGET: 2017

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Connectivity For Afghanistan'sGovernment

The USAF's WGS-8 payload aboard a United Launch Alliance Delta IV rocket awaiting launch at Cape Canaveral AFS. Photo courtesy of ULA.

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DISPATCHES

The Passing Of A True American Hero

The Space Foundation has commented on the death of Col. John H. Glenn, Jr., USMC (Ret.), 95, the last of the Mercury Seven astronauts, military test pilots selected by NASA in 1959 to become America's first astronauts.

"*US success in space was built on the courage and determination of men like John Glenn, who dedicated his life to serving his country and proving what humans could accomplish in space*," said Kevin Cook, Space Foundation, the Vice President of Marketing & Communications.

In 1962, Glenn was the first American to orbit the Earth and the fifth human in space. He was also the oldest person to go into space when, in 1998 at the age of 77, he returned to space as a Payload Specialist on Discovery's STS-95 mission. An Ohio native, Glenn was a US Marine Corps aviator, engineer and United States Senator. He was inducted into the US Astronaut Hall of Fame in 1990. *Satnews Publishers* adds, *Godspeed, and thank you, Astronaut Glenn.*

(Photo of John Glenn is courtesy of NASA.)

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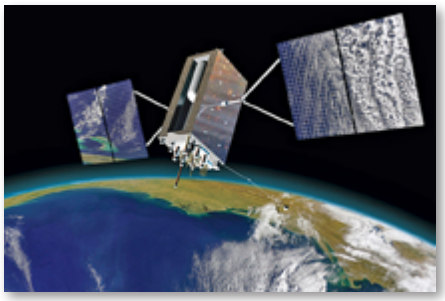
DISPATCHES

Improved GPS Ground System For USAF

They were given the green light, the go, the high five.



The US Air Force has approved Lockheed Martin's Critical Design Review (CDR) for the Contingency Operations (COps) contract that was completed on November 17th. The agreement is designed to upgrade the current GPS satellite ground control system that offers new capabilities in which the GPS III satellites will operate more powerfully and accurately. COps is envisioned as a temporary gap filler prior to the entire GPS constellation's transition to operations onto the next generation Operational Control System (OCX) Block 1, currently in development.

Lockheed Martin will now proceed with software development and systems engineering to modify the existing GPS ground control system, called the Architecture Evolution Plan (AEP) Operational Control Segment. The AEP is currently maintained by Lockheed Martin and controls the 31 GPS IIR, IIR-M and IIF satellites in orbit today.

Once they are launched, the COps modifications will allow the AEP to support the more powerful, next generation GPS Block III satellites, enabling them to perform their positioning, navigation and timing mission.

On October 15, under a separate contract, Lockheed Martin completed the Commercial Off-the-Shelf (COTS) Upgrade #2 (CUP2) project, part of a multi-year plan to refresh the AEP's technology and enhance the system's ability to protect data and infrastructure from internal and external cyber threats, as well as improve its overall sustainability and operability. CUP2 is now fully operational and managing the current GPS constellation.

Lockheed Martin also is under contract to develop and build the Air Force's first ten GPS III satellites, which will deliver three times better accuracy, provide up to eight times improved anti-jamming capabilities and extend spacecraft life to 15 years, 25 percent longer than the newest GPS satellites on-orbit today. GPS III's new L1C civil signal also will make it the first GPS satellite to be interoperable with other international global navigation satellite systems.

lockheedmartin.com

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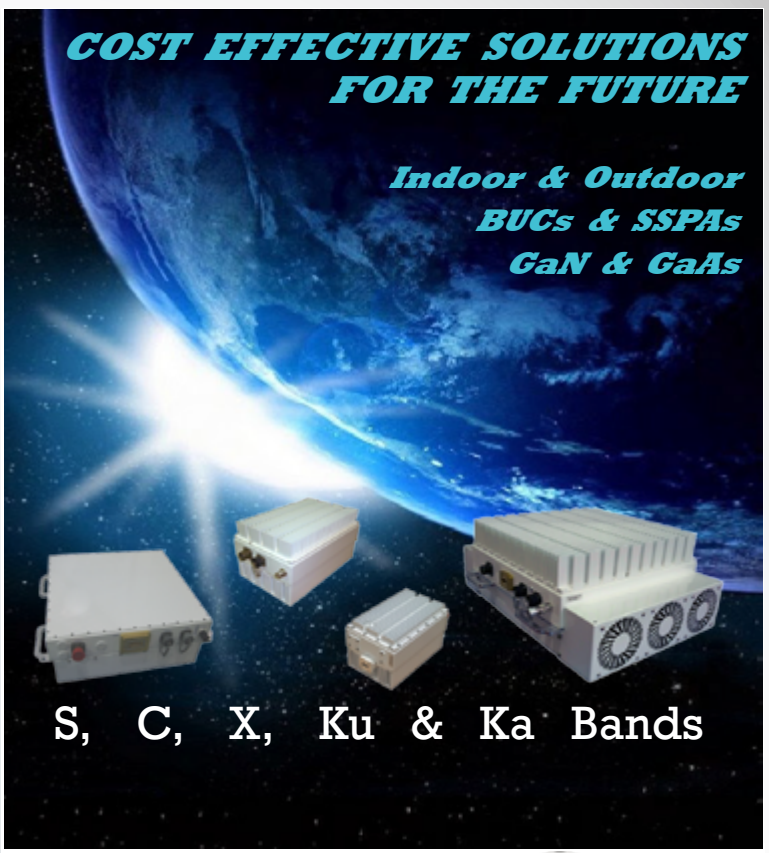

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DISPATCHES

Minotaur Makes The Day For Orbital ATK

The US Air Force's Rocket Systems Launch Program, part of the Launch Enterprise Directorate at Space and Missile Systems Center (SMC), awarded the National Reconnaissance Office Launch-111 to Orbital ATK.

The contract is a firm-fixed-price contract valued at $29.2 million for a Minotaur I launch vehicle. This was the first such award under the Orbital/Suborbital Program 3 (OSP-3) Lane 1 capability.

The OSP-3 contract Lane 1 capability is for 400-4,000 lbs. (181-1,810 kg) to Low-Earth Orbit (LEO) and long-range, sub-orbital missions. The specific launch date of NROL-111 will be determined by the schedule of the contractor but will be no later than 24 months from the date of contract award.

Lt. Gen. Samuel Greaves, Air Force program executive officer for Space and SMC commander, said, "*Continued reliability of space vehicle delivery methods and affordable access to space for the National Reconnaissance Office is an essential forefront for space superiority. Utilizing the capability of the OSP-3 contract Lane 1 capability, immediately benefits our Department of Defense mission partners. The OSP-3 capability also holds great potential for SMC to provide assured access to space for future DoD missions.*"

The Air Force Space Command's Space and Missile Systems Center, located at Los Angeles Air Force Base, California, is the U.S. Air Force's center of excellence for acquiring and developing military space systems. Its portfolio includes space launch, global positioning, military space vehicle communications, defense meteorological space vehicles, range systems, space vehicle control networks, space-based infrared systems, and space situational awareness capabilities.

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DISPATCHES

Delivery Of Enhanced Comms For USAF & Troops With Successful WGS-8 Launch

Success can be claimed by United Launch Alliance and the US Air Force as the WGS-8 launch occurred without a hiccup to provide improved and extremely crucial communications for the armed forces.

A United Launch Alliance (ULA) Delta IV rocket, carrying the eighth installment of the Wideband Global SATCOM (WGS) satellite for the United States Air Force, lifted off from Space Launch Complex-37 at Cape Canaveral Air Force Station on December 7th at 6:53 p.m. EDT.

This is ULA's 11th launch in 2016 and the 114th successful launch since the company was formed in December 2006.

"Thank you to the US Air Force and industry team whose flawless execution enabled today's successful launch of the WGS-8 mission," said Laura Maginnis, ULA vice president of Custom Services. Last week, ULA celebrated our anniversary and 10 years of 100 percent mission success. This evening's launch epitomizes why our customers continue to entrust ULA to deliver our nation's most crucial space capabilities."

This mission was launched aboard a Delta IV Medium+ (5, 4) configuration Evolved Expendable Launch Vehicle (EELV) powered by one common booster core and four solid rocket motors built by Orbital ATK. The common booster core was powered by an RS-68A liquid hydrogen/liquid oxygen engine producing 705,250 pounds of thrust at sea level. A single RL10B-2 liquid hydrogen/liquid oxygen engine powered the second stage.

The booster and upper stage engines are both built by Aerojet Rocketdyne. ULA constructed the Delta IV Medium+ (5,4) launch vehicle in Decatur, Alabama. WGS-8 marks the sixth flight in the Medium+ (5,4) configuration; all launches in this configuration were WGS missions.

At Cape Canaveral Air Force Station, Florida, on December 7, 2016, the United Launch Alliance (ULA) Delta IV rocket carrying the WGS-8 mission for the US Air Force is readied for launch.

Photo is courtesy of United Launch Alliance.

WGS-8 supports communications links in the X-and Ka-band spectra. While Block I and II satellites can instantaneously filter and downlink up to 4.410 GHz, WGS-8 can filter and downlink up to 8.088 GHz of bandwidth.

Depending on the mix of ground terminals, data rates, and modulation and coding schemes employed, a single WGS satellite can support data transmission rates of more than 6 Gbps.

WGS-8 with its advanced digital channelizer may support more than 11 Gbps. The current fleet is providing more than 16 Gbps globally and the most heavily loaded WGS vehicle is now locally providing more than 4 Gbps.

WGS has 19 independent coverage areas, 18 of which can be positioned throughout its field-of-view. This includes eight steerable/shapeable X-band beams formed by separate transmit/receive phased arrays; 10 Ka-band beams served by independently steerable diplexed antennas; and one transmit/receive X-band Earth-coverage beam.

WGS can tailor coverage areas and connect X-band and Ka-band users anywhere within its field-of-view. The X-band phased array antenna enables anti-jam functionality without sacrificing performance.

WGS enables more robust and flexible execution of Command and Control, Communications Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR), as well as battle management and combat support information functions. The WGS constellation augments the existing service available through the UHF Follow-on satellite by providing enhanced information broadcast capabilities.

Five globally-located Army Wideband SATCOM Operations Centers provide 24/7 payload monitoring and command and control of the WGS constellation. In coordination with the WGS-8

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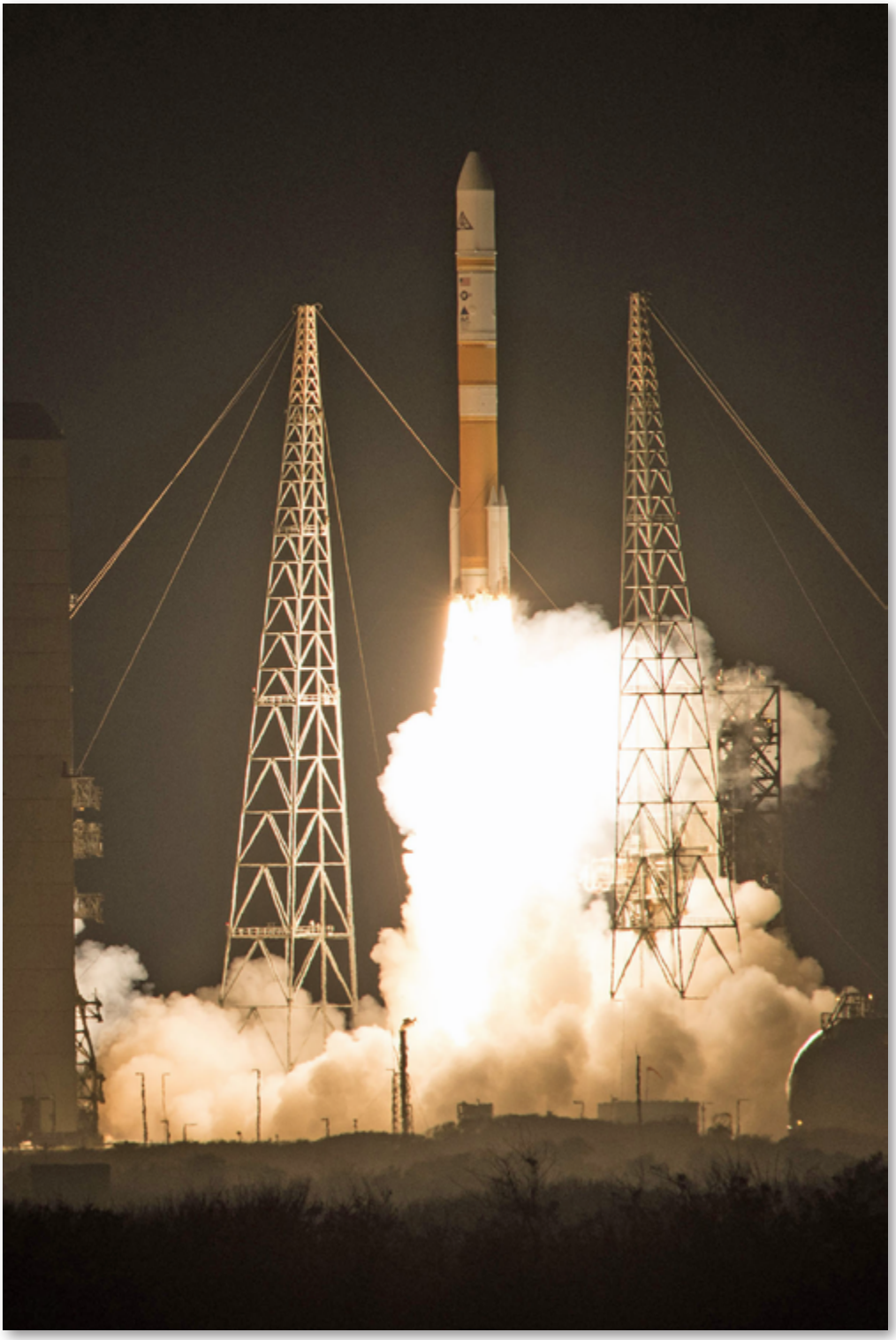

A United Launch Alliance (ULA) Delta IV rocket carrying WGS-8 mission lifts off from Space Launch Complex-37 at 6:53 p.m. EDT on December 7th.

Photo is courtesy of United Launch Alliance.

launch, the US Army has modernized the Global SATCOM Configuration and Control Element to a new service-oriented virtualized software system residing on a new ground hardware platform.

Each Global Satellite Configuration and Control Element has the capability to control up to 10 WGS satellites at a time.

Spacecraft platform control and anomaly resolution is accomplished by the 3rd Space Operations Squadron at Schriever Air Force Base in Colorado Springs, Colorado.

The EELV program was established by the US Air Force to provide assured access to space for Department of Defense (DoD) and other government payloads. The commercially developed EELV program supports the full range of government mission requirements, while delivering on schedule and providing significant cost savings over the heritage launch systems.

WGS satellites are an important element of a new high-capacity satellite communications system providing enhanced communications capability to our troops in the field.

ULA has successfully delivered more than 110 satellites to orbit that provide critical capabilities for troops in the field, aid meteorologists in tracking severe weather, enable personal device-based GPS navigation and unlock the mysteries of the solar system.

Payload Fairing (PLF)
The PLF is a composite bisector (two-piece shell), 5 meter diameter fairing. The PLF encapsulates the spacecraft to protect it from the launch environment on ascent. The vehicle's height, with the 47 ft. tall PLF, is approximately 217 ft.

Delta Cryogenic Second Stage (DCSS)
The DCSS propellant tanks are structurally rigid and constructed of formed aluminum plate, spun-formed aluminum domes and aluminum ring forgings. It is a cryogenic liquid hydrogen/liquid oxygen-fueled vehicle, powered by a single RL10B-2 engine that produces 24,750 lbf of thrust.

The DCSS cryogenic tanks are insulated with a spray-on insulation and helium-purged insulation blankets. An equipment shelf attached to the aft dome of the DCSS liquid oxygen tank provides the structural mountings for vehicle electronics.

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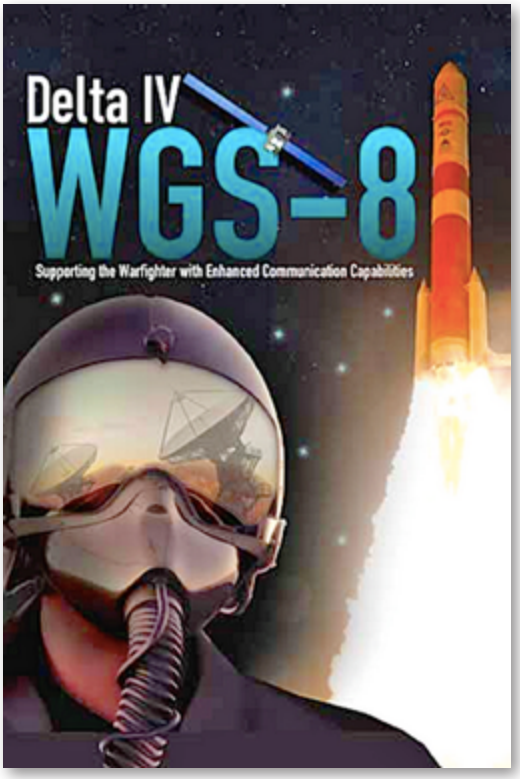


Booster
The Delta IV common booster core (CBC) tanks are structurally rigid and constructed of isogrid aluminum barrels, spun-formed aluminum domes and machined aluminum tank skirts.

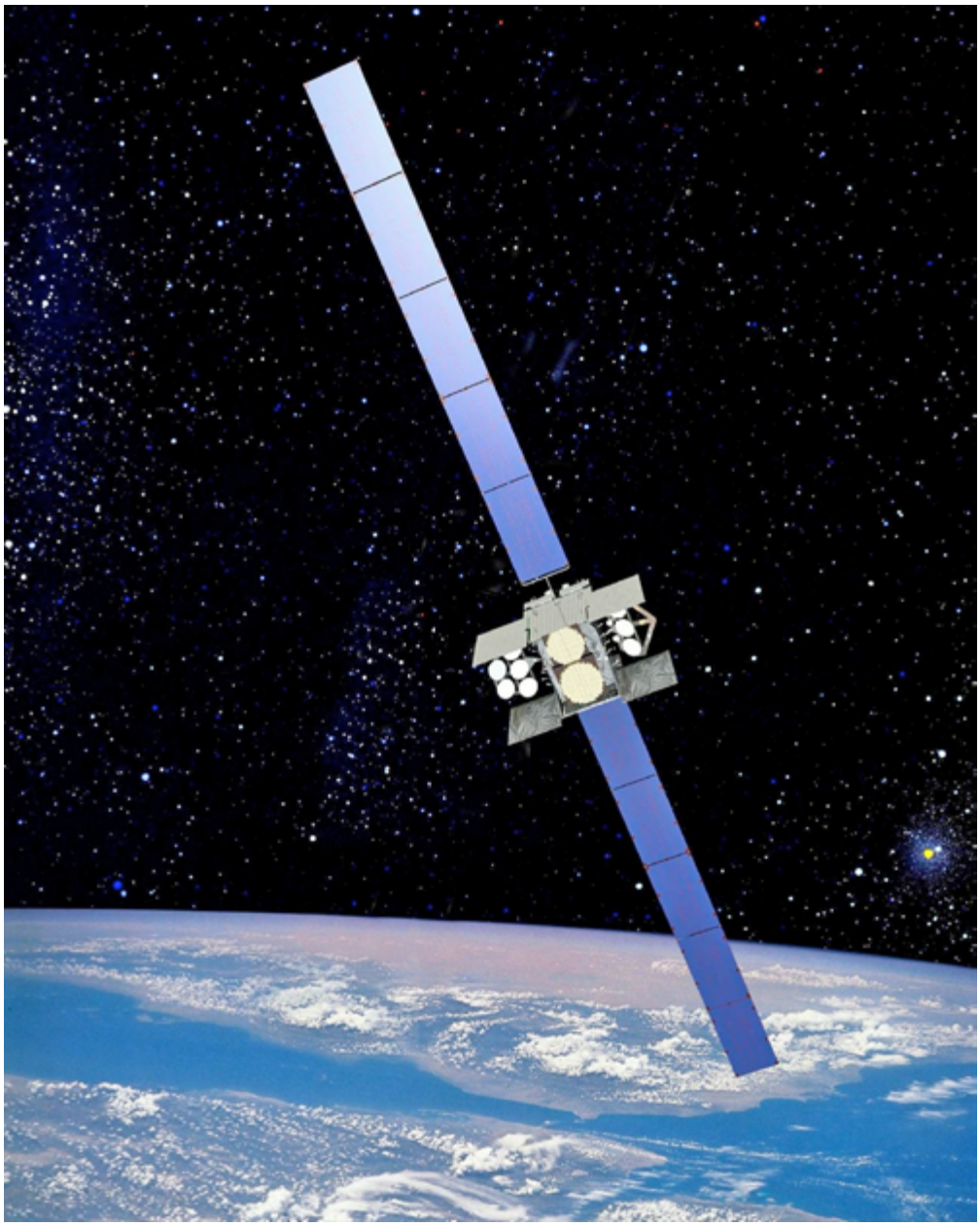
Delta IV booster propulsion is provided by the throttleable RS-68A engine system which burns cryogenic liquid hydrogen and liquid oxygen and delivers 705,250 lbf of thrust at sea level.

The booster's cryogenic tanks are insulated with a combination of spray-on and bond-on insulation and helium-purged insulation blankets. The booster is controlled by the DCSS avionics system, which provides guidance, flight control.

Solid Rocket Motors (SRM)
Four SRMs generate the additional thrust required for liftoff and attain a combined maximum thrust of 1,124,000 lbs in flight.

The SRMs are 5 ft in diameter and 53 ft long and constructed of a graphite-epoxy composite. The SRMs are connected to the booster by two ball-and-socket joints and structural thrusters.

ulalaunch.com



The Orbital ATK Role
From GEMs To Pipes To Tanks

A number of technologies that were provided in support of the United Launch Alliance (ULA) Delta IV rocket launch of the eighth Wideband Global SATCOM (WGS-8) satellite were manufactured by Orbital ATK.

The December 7th launch from Cape Canaveral Air Force Station in Florida noted that both the launch vehicle and the satellite incorporated Orbital ATK technologies.

For the satellite itself, the company produced the loop heat pipes and standard heat pipes, which provide payload, spacecraft bus and battery thermal management which were manufactured at the firm's Beltsville, Maryland, facility.

Additionally, Orbital ATK manufactured the payload pallet boom tubes at their Magna, Utah, location, and the payload module at their San Diego, California, site.

For the Delta IV rocket, Orbital ATK provided four, 60 inch diameter Graphite Epoxy Motors (GEM-60). The 53-foot-long solid rocket boosters

burned for 90 seconds and provided more than 1.1 million pounds of thrust, or the equivalent of 17, 747 jet engines running at full throttle.

Orbital ATK produced the solid rocket motors at their Magna, Utah, facility, where the company has manufactured 82 GEM-60s in support of the 34 Delta IV launches since their initial flight in 2002.

In addition to the GEM-60 propulsion, Orbital ATK supplied a combined thirteen Delta IV and GEM-60 key composite structures, which provide lower weight and higher performance.

The largest composite structures are four to five meters in diameter, range from one to fourteen meters in length, and are produced using either advanced wet winding or hand layup, machining and inspection techniques at Orbital ATK's manufacturing facilities in Iuka, Mississippi, and Clearfield, Utah.

Orbital ATK also manufactured the propellant tank for the Delta IV upper stage roll control system at the company's Commerce, California, facility, and it designed and manufactured the nozzles for Delta IV's RS-68A liquid engine and GEM-60 solid motors at its Promontory, Utah, facility.

Orbital ATK also designed and produced the nozzle's thermal protection material, which is capable of shielding the nozzle from the extreme heat of launch, when external temperatures can exceed 4,000 degrees Fahrenheit.

Orbital ATK's GEM 60 motor.

The WGS-8 satellite is part of a larger system that increases military communications capabilities for US and allied forces deployed worldwide.

orbitalatk.com/

Something To Celebrate For The US Air Force

The US Air Force successfully launched the 8th Boeing-built Wideband Global SATCOM satellite aboard a United Launch Alliance Delta IV Evolved Expendable Launch Vehicle from Space Launch Complex 37B, Cape Canaveral Air Force Station, Florida at 6:53 p.m. EST.

"*Today's launch is a momentous achievement in WGS, as we launch the eighth WGS satellite*," said Lt. Gen. Samuel Greaves, Space and Missile Systems commander and Air Force program executive officer for Space. "*This accomplishment is the result of the remarkable relationship between the 45th Space Wing, 50th Space Wing, our SMC partners and industry. The tenacity and dedication to mission assurance ensures we continue to maintain a robust satellite constellation with modernized, more resilient MILSATCOM capabilities. Thanks to the astounding commitment, focus on the mission, and team work, we successfully launched the next satellite in the WGS satellite constellation.*"

This mission demonstrated the Air Force's commitment to deliver secure and reliable satellite communications around the globe to US forces and her allies. With this launch, WGS 8 will significantly enhance the current WGS constellation by providing increased communication capacity and coverage.

Improving on previous WGS satellites, WGS-8 utilizes a state-of the-art channelizer, which increases the communication capacity by approximately 45 percent compared to its predecessors.

The 45th Space Wing supported a United Launch Alliance's successful launch of a Delta IV rocket carrying WGS-8 mission from Space Launch Complex 37 December 7, 2016 at 6:53 p.m.

Photo is courtesy of ULA.

Over the next few months, Boeing will begin on orbit testing of WGS-8 to verify performance and prepare the satellite for operational use.

Ultimately, WGS-8 will be controlled by the US Air Force's 3rd Space Operations Squadron at Schriever Air Force Base.

The WGS-8 satellite will enter operations in early 2017. With two more satellites in production, the WGS constellation is planned to have a total of 10 satellites on orbit by 2019.

Aerojet Rocketdyne's Mighty Muscle

Aerojet Rocketdyne's RS-68A engine is the world's most powerful liquid-hydrogen/liquid oxygen booster engine, providing 702,000 pounds of liftoff thrust to send a rocket skyward... and this was quite evident with the launch of the USAF's WGS-8 satellite.

Aerojet Rocketdyne's propulsion technologies included an RS-68A booster engine, an RL10B-2 upper-stage engine, 12 MR-106H 9-lbf hydrazine rocket engines on the upper stage, and a 100-lbf bipropellant apogee-raising engine aboard the WGS spacecraft.

"*It is absolutely imperative that US troops and allied forces deployed worldwide receive information in the fastest way possible*," said Aerojet Rocketdyne CEO and President Eileen Drake. "*We are honored to provide the launch and spacecraft propulsion capabilities to help place these critical satellites into orbit.*"

During launch, the RS-68A ignited to boost the Delta IV medium rocket off the pad with that 702,000 pounds of liftoff thrust. After the upper stage separated from the launch vehicle, a single RL10B-2 engine ignited to provide 24,750 pounds of thrust to power the upper stage into orbit.

For more than five decades, the RL10 has been the United States' most reliable upper-stage engine, accumulating one of the most impressive lists of accomplishments in the history of space propulsion.

This engine has played an integral role in placing numerous military, government and commercial satellites into orbit, and powering space-probe missions to every other planet in the solar system.

The 12 Aerojet Rocketdyne MR-106H monopropellant (hydrazine) thrusters packaged in four modules on the Delta IV upper stage provided roll, pitch and yaw control as well as settling burns for the upper stage. ARDÉ, a subsidiary for Aerojet Rocketdyne based in New Jersey, furnished 14 pressurant tanks for the vehicle.

Once separated from the launch vehicle, WGS-8 will perform multiple burns on Aerojet Rocketdyne's High Performance Apogee Thruster (HiPAT™) rocket engine to complete the orbit-raising from Geosynchronous Transfer Orbit (GTO) to its final geosynchronous orbital position.

The HiPAT™ rocket engine has a 100 percent mission success track record spanning over 115 missions, including all WGS spacecraft.

Rocket.com

AerojetRocketdyne.com

Built For Nearly Twice The Bandwidth

Boeing's eighth Wideband Global SATCOM (WGS) satellite will provide nearly twice as much communications bandwidth as previous WGS satellites due to an upgraded digital payload.

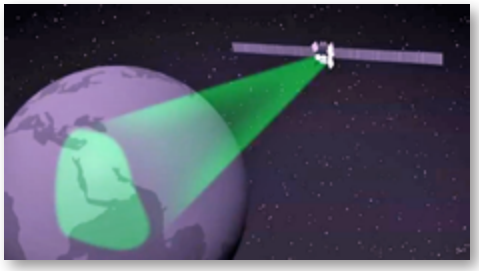
Using leading commercial digital circuit technology, the newly upgraded satellite will aid in fulfilling the increasing demand for high-data rate communications of warfighters around the globe.

"*Not only does WGS-8's cutting edge digital payload nearly double the satellite's bandwidth, but the US government was able to realize more than $150 million in savings for WGS-7 through WGS-10 through fixed-price block purchases and commercial operating practices,*" said Dan Hart, Boeing vice president, Government Satellite Systems.

"*We've been able to both increase the capability and reduce the per-unit cost with each new WGS satellite we've delivered, making WGS, by far, the most cost-effective asset for military communications.*"

During the past two years Boeing has made many improvements to its satellite products.

Those improvements include increasing bandwidth and capacity, incorporating independently steerable and shapeable beams that can point bandwidth to where it's most needed, deploying the world's first all-electric propulsion satellites, and stacking and launching together two satellites.



*A Boeing short video entitled "The Military Satellite That Avoids Jams and Secures Comms" **is available for viewing at this direct link...***

The WGS-9 satellite, funded through an international partnership between the United States and Canada, Denmark, Luxembourg, The Netherlands and New Zealand, will be launched early next year. Boeing is on contract for a total of 10 WGS satellites.

boeing.com

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Image courtesy of DoD

DISPATCHES

4 SOPS Mobile Team Takes Flight

Senior Airman Hans Houser was just finishing laundry and getting ready for bed when he received a late-night call.

"*Exercise, exercise, exercise, this is a recall for all mobile members, report to the DOM Bay*," the person on the other line said.

Houser instinctively hopped up to quickly ready his uniform and bags. Three years of training with the 4th Space Operations Squadron mobile team prepared him for this moment. He entered the 4 SOPS mobile loading bay together with dozens of space operators, engineers, maintainers, security and support augmentees where they awaited a briefing to fully understand what was about to happen. After the security doors clicked, the chatter died down—it was time. The team was to execute a mobile space operating contingency mission in a peacetime environment outside the continental United States. Their destination—an undisclosed location in Hawaii.

"*We chose Hawaii because we were looking for a site we haven't really pre-surveyed to prove we can operate anywhere in the world at any given time. It's a proof of concept (for) us*," said Lt. Col. Sherman Johns, 4 SOPS commander.

This does not happen every day, nor every year for that matter. The last time the mobile team executed a contingency mission was more than eight years ago.

"*We have a new mission platform here that has never done anything like this*," explained Capt. Paul Karsten, 4 SOPS Mobile Operations Flight commander. The squadron controls Milstar and Advanced Extremely High Frequency satellite constellations, a highly protected military satellite communications network.

Most of 4 SOPS's operations support tactical users, such as Army and Marine Corps forces operating down range in need of secure communications. In the event of a nuclear war, the mobile team must be ready to transport their Advanced Ground Mobile satellite operations center and Low Profile Antenna assets to another location to continue running military satellite communication operations. This means they must be able to continue operations anytime, anywhere around the world. During this mission however, the exercise scenario depicted a satellite not operating in accordance with the rest of the constellation. The mobile team was responsible for reeling it back into the fold.

"*In the event of a crosslink breaking and a satellite being all by itself, we will deploy out and provide cryptographic rekeys for (users) to be able to log on to the satellite to use it as needed*," explained Karsten.

After learning their mission, team members dispersed to begin transport. According to Senior Airman Zane Balcer, 4 SOPS DOM technician, daily preparation for deployment is a crucial component for the 4 SOPS Mobile Flight.

"*We make sure everyone has the right paperwork, everyone's up to date with their training. In the event that we do need to deploy, we are all ready to go and not scrambling at the last minute*," said Balcer.

That preparation was evident, as teammates coordinated and prepared equipment and vehicles for convoy. Others reported to the armory to retrieve weapons and protective gear for the assets. Houser, dual-hatted as a mobile EHF operator as well as the weapons manager, ensured his team was fully equipped. He makes sure the needed weapons are issued as well as looks after the maintenance. With go-bags and all equipment prepared, the crew set out on a tightly coordinated convoy to the flight line.

To say this was a big project is an understatement. The AGM is a full-sized semitrailer that contains the AEHF Satellite Mission Control Subsystem and Advanced Antenna Calibration Facilities Interim Command and Control terminals. The LPA fully functions with all the capabilities of a traditional large-scale antenna.

Both of these assets needed to be loaded onto a C-17 Globemaster III. Skilled drivers maneuver the AGM within an accuracy area of just a few inches. The clockwork process of loading immense assets onto the colossal aircraft required all hands on-deck. Once all equipment was ratcheted and chained down, the mobile team took flight.

During the journey, team members rested on mesh seating and make-shift cots along the edges of walls and floors while the trailer took up most of the open floor. After landing, the crews again worked together to off-load in the tropical humidity of an island more than 3,000 miles away from home station.

Armed 4 SOPS security augmentees guarded the assets while transporting them to the operating location. From this point until the end of the exercise, the mobile space operating machinery would not be left without the protection of several weapons qualified 4 SOPS mobile members, day or night.

Senior Master Sgt. Charles Shurchay, 4 SOPS superintendent, explained the big picture of why it's vital for mobile space operators to have advanced security training to protect the assets.

"*We have adversaries who want to weaken space assets and weaken our ability to project global power. For us to be able to do this enables our operators and the national command authorities to take action against those adversaries regardless of whether or not they limit our capabilities to command on the Milstar satellites*," said Shurchay.

The mobile team was called to be "*Semper Gumby*" because of their flexibility during all aspects of the exercise. Security augmentees stayed vigilant throughout damp, sweltering days to warm, rainy nights. Space operators constantly monitored and responded to events within the control center.

On the last day of the exercise, the mobile team left the same way they arrived, returning to Colorado carrying precious cargo.

"*It feels like we have the readiness. Additional training may be needed to get everyone up to speed, but I feel like everything we've been training for, this has paid off tremendously*," said Balcer.

Team Schriever members may not fully understand why 4 SOPS has a flight that needs to be able to deploy in a minute's notice.

"*We do have good support, but (the mission) is not very well-known. If others knew what we were doing, they would see the big picture of what 4 SOPS and the mobile mission is in of itself, and how it integrates to the rest of the warfighting capability*," said Karsten.

Houser is one of several young mobile team Airmen, averaging 22 years old, who are responsible for the maintenance, operations and protection of the mobile assets.

"*It's a truly exciting mission and you always learn something new because of the many moving parts of the mobile mission*," said Houser. "*There's a sense of pride in what you do, and for me, it's all about seeing the end results. Being in mobiles, you get to see the end of your work.*"

Story by 2nd Lt. Darren Domingo
50th Space Wing, USAF

DISPATCHES

A Tactical Debut From iDirect Government

The Series 11000 Tactical Hub has now been released by iDirect Government (iDirectGov), who provide MILSATCOM products and services to military and government concerns—this new hub brings flexibility, agility and efficiency to warfighters, first responders, disaster recovery personnel and field operators.

The new Tactical Hub is powered by Evolution software and works with the Evolution Series remotes. The Tactical Hub comes bundled with a small form factor network management system (NMS), protocol processor and layer-3 switch.

The complete bundle occupies 5RU of network rack space with a depth of 20 inches. The bundle includes a four-channel TDMA license to enable operators to take advantage of the DLC-R's multi-channel capabilities. The Tactical Hub features:

The iDirect Series Tactical Hub is a ruggedized, compact, durable and deployable solution that is easy to set up due to its reduced size, weight and power (SWaP). Weighing approximately 20 pounds in a 2RU chassis, the Tactical Hub comes embedded with the nexgen of defense line cards—the DLC-T and DLC-R.

The DLC-T supports as much as 45 mega-symbols per second (Msps) downstream and is capable of providing one-way transmission security (TRANSEC) to secure broadcast traffic.

The DLC-R supports upstream traffic as much as 15 Msps in single time division multiple access (TDMA) carrier mode and as much as 29 Msps composite in multi-channel mode—nearly four times the increase in aggregate throughput compared to previous line cards.

- *Federal Information Processing Standards (FIPS) 140-2 Level 3 (certification pending), with TRANSEC*
- *Embedded RCM-PPS module*
- *Variable temperature-controlled fans*
- *Field-replaceable power supply*

The hub is secure and can work anytime and anywhere—from remote locations to urban dwellings.

idirectgov.com

SBIRS Sign-Off

Lockheed Martin's newly upgraded Space Based Infrared System (SBIRS) ground system received sign-off from the US Air Force, enhancing the constellation's ability to deliver infrared data that is critical to early missile warning and defense.

The new SBIRS ground system at Buckley AFB in Colorado serves as the nerve center for the constellation, collecting large amounts of data from the satellite's powerful sensors and converting it into actionable reports for defense, intelligence and civil applications. The Block 10 system includes upgrades like faster collection times, improved threat detections and improved target tracking and infrared information to see dimmer events faster.

Operational Acceptance of the SBIRS ground system consolidates the Air Force's command and control of legacy Defense Support Program satellites, SBIRS geosynchronous Earth orbit satellites and highly elliptical orbit payloads into the same ground system. SBIRS Block 10 also improves cueing data for missile defense systems and allows for command, control and mission planning of taskable sensors, as well as real-time and offline raw sensor data processing for technical intelligence used by the intelligence community.

Already, the multi-mission system supports missile warning, missile defense, battlespace awareness, and technical intelligence and also distributes raw and processed data in order to support civil and emerging applications. With the deployment of the ground system, Lockheed Martin will provide ongoing operations and sustainment support, while continuing to enhance the system through additional cyber security capabilities, automation features and continued evolutions to support Air Force requirements.

lockheedmartin.com

DISPATCHES

Inflatable SATCOM Is An Award Winner

GATR Technologies (GATR), a subsidy of the Cubic Corporation, has received the Most Innovative New Product (MIP) Award in the Defense, Transportation and Cybersecurity category at the 2016 CONNECT MIP Awards that took place at an awards ceremony on December 1, in San Diego. Due to the inflatable antenna technology, there are operational and affordability advantages as the antennas are designed for extreme portability, reliability and ease of setup, even in extreme environments.

The antennas can be air dropped to a military unit or transported as commercial baggage, which is a competitive edge that supports the effectiveness of expeditionary missions. With GATR's portable antennas, customers can now set up communication in less than 60 minutes, without the need of special tools.

This is the 29th year of the annual awards program that honors San Diego's leaders of innovation and groundbreaking new products launched in the last year.

Bradley H. Feldmann, President and Chief Executive Officer, Cubic Corporation, said, "*Innovation is the backbone of Cubic and we will continue to focus on technologies to increase competitive advantage and offer best solutions to our customers worldwide.*"

The annual MIP Awards is CONNECT's largest and most prestigious event, attracting more than 700 of the region's top business leaders, researchers and capital providers. More than 110 companies competed in the rigorous, four-month judging process, with a total of only ten winners awarded in the various categories.

The complete list of MIP Awards: ***connect.org/***

cubic.com

• On the Go
• On the Fly
• On the Move
• On the Pause
• On the Ground
• On the Spot
• On the Comm

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COMMAND CENTER: REBECCA M. COWEN-HIRSCH

SENIOR VICE PRESIDENT, GOVERNMENT STRATEGY AND POLICY, US GOVERNMENT BUSINESS UNIT, INMARSAT

As an entry-level engineer with the Air Force's Advanced Range Instrumentation Aircraft (ARIA) mission, Rebecca M. Cowen-Hirsch developed technologies for ARIA planes to support some of the most critical space missions in the U.S. National Security enterprise. These programs opened her eyes to even greater opportunities and engendered a passion to explore innovative ways to support the missions, becoming an experimental flight test engineer.

Following this passion and after a year of intensive training, Ms. Cowen-Hirsch became the first-ever female civilian Mission Commander for ARIA, leading aircrews in support of shuttle missions and satellite launches – including the positioning of the initial GPS installments. "I felt the best way to contribute," she says, "was to take our technology from concept to integration to in-flight deployment. It was an incredibly exciting job, and the flight test experiences made me a better engineer."

Today, Ms. Cowen-Hirsch brings this sense of internal drive and mission-focused passion to her current position as Inmarsat's Senior Vice President for Government Strategy and Policy in the United States Government Business Unit. Previously, as a decorated member of the Senior Executive Service (SES) in the U.S. Department of Defense (DoD), she served as the Program Executive Officer for SATCOM, Teleport and Services at the Defense Information Systems Agency (DISA). This was one of several key SES executive posts, including the first-

ever Vice Component Acquisition Executive for DISA, with executive management responsibility for the acquisition oversight and horizontal integration of DISA's products, services and programs.

Among her notable achievements, Ms. Cowen-Hirsch established the Defense Spectrum Office as its first Director, where her responsibilities included the development of national security spectrum strategic plans and policies, and the national and international negotiation of defense spectrum issues. Her broad defense career ranged from systems engineering, experimental flight test, program management, spectrum management and a wide range of executive leadership positions. After years of selfless dedication to the DoD, Ms. Cowen-Hirsch received an Exemplary Service Medal.

Academically, she earned a Bachelor of Science Degree in Electrical Engineering at the University of Kentucky, and conducted post-graduate studies in Engineering Management. She is a graduate of the University of Tennessee Space Institute Experimental Flight Test Program, the DoD's Acquisition Management Program and the Cambridge Senior Executive Leadership Program. Mrs. Cowen-Hirsch was inducted into the University of Kentucky College of Engineering's Alumni Hall of Distinction, which recognizes alumni who have demonstrated distinguished engineering professional accomplishments, outstanding character and commitment to community service.

MILSATMAGAZINE (MSM)

Good day, Ms. Cowen-Hirsch. Would you afford our readers some insight into your background and expertise, and why you eventually decided to leave the DoD to pursue your career at Inmarsat and its U.S. Government Business Unit?

REBECCA M. COWEN-HIRSCH (RMCH)

I was familiar with Inmarsat during my time in the DoD and was impressed with the company's technology and approach to their government business. The leadership team and the exceptional professional ethos of the company was compelling as well, so it was a natural fit for me.

In joining Inmarsat, I was intrigued by the opportunity to act as what I call a "chief translator" between industry and government. The experience and insights I bring to the company on how the U.S. government operates -- its strategic imperatives, governing statues and policies as well as restrictions, advantages and opportunities – allow me to help shape our company's thinking and direction for the government market.

I am able to translate national security requirements and operational scenarios and deficiencies into viable business cases and commercial solutions that improve the effectiveness of government operations and successful mission outcomes.

My background also allows me to communicate with the government in a language and manner that they understand within their own policy framework. I can champion new innovative methodologies for both operational and acquisition functions.

It was a privilege to serve within the DoD for more than 20 years working on a number of different programs and across several disciplines and with a great variety of responsibilities. Now, I am able to continue to support that customer from an industry perspective, identifying and solving missionimperative challenges. Serving our nation remains a core component of my career. This is a driving motivation for me, and it compels me to do my best for government customers every day.

MSM

What are your responsibilities as a Senior Vice President for your company?

RMCH

It all comes back to customers—how can we best support their missions affordably and with agility? With my engineering background, fundamentally my overarching aim is to solve problems. This certainly is exemplified in my work with Global Xpress. From as early as the concept phase, I was involved in shaping the direction of the program as it relates to our government customers.

Anticipating the growing demand for secure globally portable and flexible wideband SATCOM to interoperate and augment legacy MILSATCOM, I translated these demand signals into the purpose built government focused capabilities within the core program. Those early efforts supported the business case that allowed Inmarsat to invest $1.8B into Global Xpress, which is now fully globally deployed and is the first and only commercial Ka-band satellite communication system built for worldwide mobility, which was also designed in part to satisfy military users' persistent demand for diverse and robust SATCOM.

Inmarsat is also about trust. We are here in Washington. We routinely share insights and ideas with federal leaders and users. We relentlessly strive to come up with new satellite advancements that will best serve the military community – to help to position them for mission success by enabling seamless, reliable, interoperable and costeffective connectivity. This is what the Inmarsat culture is all about, and we make sure our distribution and manufacturer partners reflect our culture as well.

MSM

To elaborate on what you said earlier, we'd like to know how your experience at the DoD brought new methodologies into play for Inmarsat's U.S. Government Business Unit to confer with the federal government and military agencies in regard to their acknowledgement and acquisition of commercial satellite communications (SATCOM)?

RMCH

Because I have a generation of experience within the DoD, I understand the government's challenges, philosophies and operational imperatives. Since I came out of the acquisition arena, I am able to inform our company and channel partners on the federal acquisition strategy, governance and policy so that we can understand their considerations and reflect our capabilities in a manner that will resonate to the government.

My spectrum expertise allows me to understand the imperatives and challenges in the government's utilization of space and how that enables coordination with industry. All of this contributes to our company's advocacy for a strong partnership with the government that hopefully will lead to an integrated, robust SATCOM architecture where commercial SATCOM is fully interoperable with military satellite systems and which empowers users with the most flexible and immediate of trusted and secure technologies.

I seek to build a bridge that enables improved connections between industry and government, in a more relevant manner than both sides have seen in the past. It is all a matter of understanding the critical requirement and syncing the availability of our services so agencies can actually acquire them flexibly and affordably and within a timeframe which best fulfills their needs.

MSM

What do you believe are some of the biggest challenges and opportunities facing the U.S. government today regarding satellite operations? How can the government and satellite industry overcome those challenges and best serve the needs of today's servicemen and women?

RMCH

There has to be a cultural paradigm shift, one which transforms how we think about space challenges and opportunities moving forward. Specifically, we have to commit to the recapitalization of federal SATCOM capabilities. Our military leaders face intense competition for capital to fulfill modernization strategies while still dealing with the limitations of the Budget Control Act (BCA) of 2011. This has become increasingly difficult for initiatives in space which are critical and where new threats are driving changes in the US operating posture.

The good news is that, with advancements made in commercial satellite communications (COMSATCOM), we can incorporate innovation from the private sector into the baseline of DoD architectures to 'ease the pain' of an overstretched budget. This will enhance our relationship with government, elevating it to that of a fully realized partnership. Such a public-private partnership will enable the military community to augment their legacy SATCOM capabilities while ensuring resilience in space through diversity, distribution, and disaggregated protected tactical SATCOM. It will support seamless connectivity and functionality, allowing users to operate anywhere the mission takes them.

However, the current procurement model has become too fragmented and dysfunctional to meet current demands, which are more complex than ever. In an era of globalized and an agile threat environment, key acquisition responsibilities are still assigned in a disjointed pattern across military services and some agencies without a cohesive advocate to harmonize and provide overarching strategic direction for the space enterprise.

Subsequently, agencies acquire terminals through military services and embed them into programs of record with no direct correlation to space system timelines. Furthermore, these programs of record have frequently suffered from delays and/or budget overruns, which occasionally qualify as Nunn-McCurdy cost

breaches, resulting in the re-baselining of spending estimates. How did we reach this level of piecemeal procurement that is in the way of effectiveness and space resilience? A justification that 'it is the way we have always done it' will not hold to the needs of the modern-day military environment. It is clear that this status quo is shortchanging missions, creating inefficiencies and introducing unnecessary risk. With world conflicts now driving a military response that depends upon mobile, asymmetrical engagement, we must do better.

The government should no longer follow a procurement model in which lowest price, rather than best operational value, is the winning element. This creates an abundance of ad hoc networks and solutions – with little thought given to affordability or efficiency and, even more important, interoperability and sustainability. In light of many of these challenges, one of my key roles with Inmarsat is to act as a strong advocate for a longer-term strategic vision of integration and full life-cycle management, in the interest of delivering a sustainable SATCOM architecture that contributes to mission success.

MSM

As you've discussed, Inmarsat has been an advocate for a strong, forward-looking partnership between the government and satellite industry for quite some time. We have seen a number of examples of the government and industry strengthening their partnerships. What would you say are some of the biggest successes of these partnerships? Where is additional work needed?

RMCH

The permanent creation of a private sector presence within the Joint Space Operations Center (JSpOC) under the Commercial Integration Cell construct stands out as a tremendous example of a successful partnership. Inmarsat is proud to take part in this Commercial Integration Cell (CIC) program with five other satellite services companies working under the governance of Cooperative Research and Development Agreements managed by the Air Force Research Laboratory.

We have liaison personnel representing the six companies working on the JSpOC floor every day. We are sharing technology and information on a no-cost basis within proprietary constraints. We are helping the government obtain greater space situational awareness while enhancing the command and control capacity of the Joint Functional Component Command for Space (JFCC Space).

MSM

What are some of the current challenges facing today's servicemen and women that are pushing the limits of the current military satellite communications (MILSATCOM) capabilities? RMCH Troops depend upon mobile, data-intensive applications. They must be able to prosecute their mission "anytime, anywhere". At the mission execution level, military members are focused on results, and their ability to leverage SATCOM capability flexibly and reliably even in a contested environment is essential. Resilience is far more important in operations than who "owns" what part of the SATCOM solution. Unfortunately, the current budget and procurement approaches sub-optimize SATCOM provisioning and perpetuate stove-piped solutions.

This is an area that demands a new approach, as military leadership is starting to acknowledge. Our hope is that through the Analysis of Alternatives process the leadership in the Air Force and the DoD will leverage modern commercial satellite systems and technology flexibility to meet mission requirements and will explore how the satellite communication industry provides innovative solutions to real-world operational challenges.

MSM

We are starting to hear the term "SATCOM as a Service" more frequently. Can you explain what SATCOM as a Service is and the benefits it offers?

RMCH

Much like the information technology sector has been revolutionized by the "as a Service" model, SATCOM also is now also available "as a Service". This capability enables the user, in the case the military, to benefit from a fully integrated, complex commercial solution designed within an end-to-end managed service architecture.

Our approach to SATCOM as a Service is to provide consistent uniform Ka-band service at a committed information rate with an assured service level agreement on a worldwide basis. If you draw a comparison with Uber, SATCOM as a Service allows military units to have access to satellite on-demand with round-the-clock availability of reliable global Ka-band SATCOM capability that "follows" users wherever they go. And, contrary to what they currently deal with through other frequencies, they do not have to guestimate and pre-order bandwidth in advance of a pending mission. This practice has turned to be unnecessarily costly and time-consuming way to do business.

Through SATCOM as a Service, users travel from one part of the world to another, and just "plug in" to get what they need, when they need it. What is more, they benefit from the continued investment and innovation of the commercial operator network.

This approach allows the military to focus on critical mission-essential functions rather than network management and tech refresh. Thus the risk is transferred from the government to industry allowing the military to benefit from the best that commercial SATCOM has to offer to enhance their resiliency profile. We see this as the proverbial "win-win."

MSM

Over the past year, we have witnessed Inmarsat launch the first and only end-to-end high-throughput commercial Ka-band network, Global Xpress. We have also noted the company's continuous investments in their worldwide constellation and services. What is next on the horizon for Inmarsat? What can Inmarsat's current and future government users expect from the company over the next few months and years?

RMCH

Inmarsat's history of commitment to safety services and highly reliable and available networks drives our global mobility-centric strategy, unique in the market. Users can benefit from uniform, global coverage using Inmarsat's systems. This is our core now and in the future.

Global Xpress represents a crowning achievement. It is the first-ever worldwide end-to-end commercial Ka-band satellite system, from a single operator. Soon, we will launch our fourth I-5 satellite for Global Xpress, to complement its seamless, global capabilities to maritime, land and aero users, with complete military Ka-band interoperability.

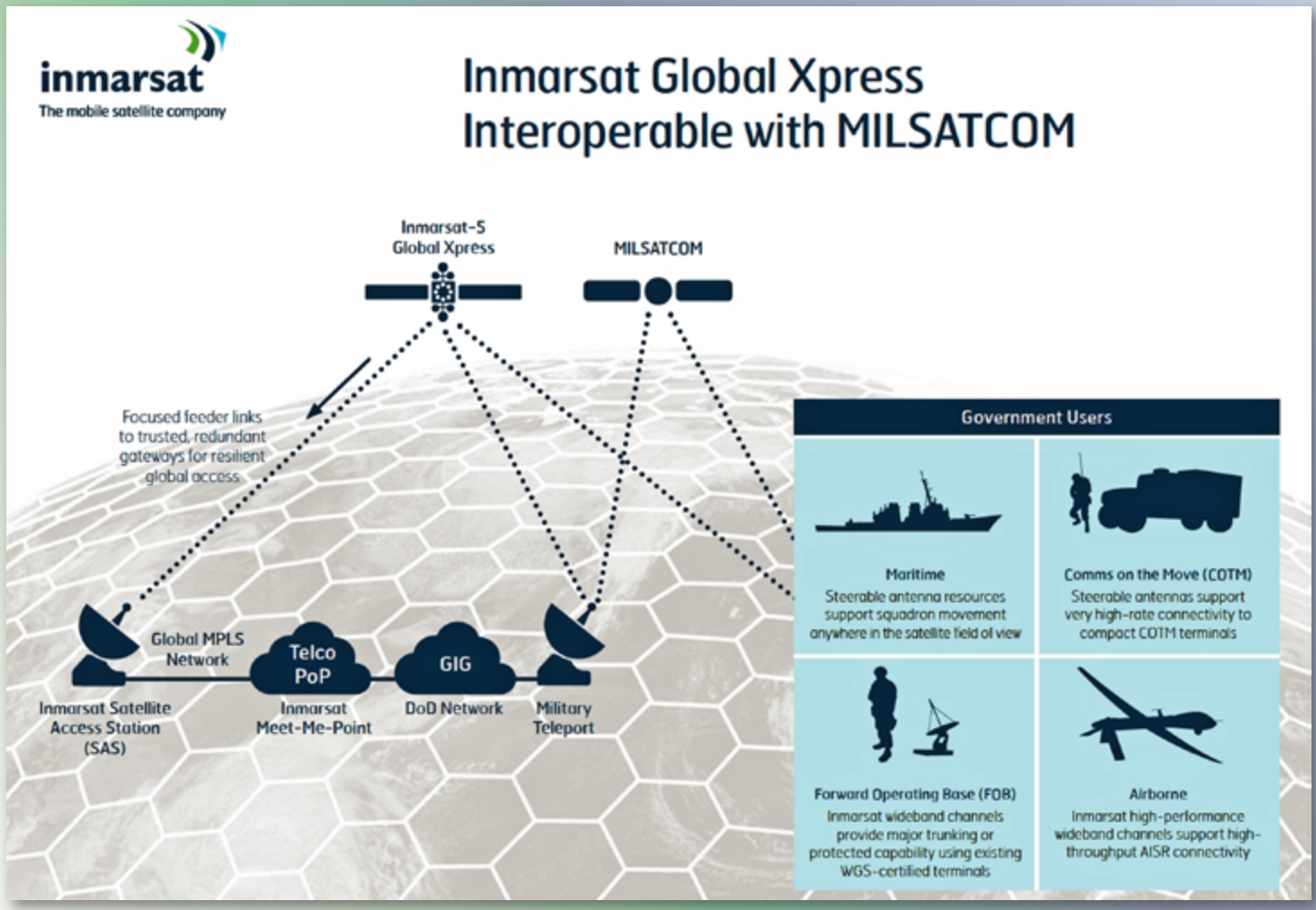
Additionally we continue to innovate on our core competencies in L-band leveraging our existing Inmarsat-4 constellation and further enhancing military satellite systems. Example of such innovation is L-TAC (L-band Tactical Satellite)—a highly resilient communication capability that provides robust, low-cost, beyond-line-of-sight mobile capability in the L-band using in-service UHF and Very High Frequency (VHF) tactical radios. Just recently, we announced a record-breaking data rates as high as 10 Mbps x 10 Mbps using the Inmarsat-4 satellite constellation, supporting small-aperture aero capability for global C4ISR.

MSM

What are some of the other forward-looking investments that Inmarsat is making to address the current and future needs of its U.S. government and military customers?

RMCH

Currently, we are working on the development of our Inmarsat-6 (I-6)— the sixth-generation constellation—as our next significant investment. We are committed to the pioneering of more advanced L-band and Ka-band services,



and we are fully funding I-6 as our first dualfrequency satellites. A single I-6 will carry more processing power than the entire Inmarsat-4 fleet (excluding Alphasat), and the Ka-band payload on each I-6 will deliverer per beam speeds up to three times that of the current Global Xpress fleet. The I-6's will fully integrate into our existing constellations, providing full-backwards compatibility and the most technologically advanced capabilities to enhance our support to the military and our commercial customers well into the next decades.

As always, we continue to explore how to expand interoperability with our terminals and ground segment. We innovate to capitalize on the long lifespan of our satellites in orbit, while offering a great operational advantage of maximum flexibility for the military and well as commercial community.

MSM

Areas that are currently under concentrated examination by the military include the partnerships with the commercial community in regard to satellite manufacture and launch, the use of smallsats to expand support C4ISR, laser communications, hosted payloads and more. How viable are these areas for Inmarsat's U.S. Government Business Unit, in your opinion, and is the company engaged in assisting the military in any of these areas of SATCOM endeavor? Can you tell us more regarding such efforts?

RMCH

We are always supportive of innovative solutions, which solve our customers' challenges. As such, we constantly look for solutions with payloads and capabilities that are relevant and specific to this market, that are reliable and accessible in addressing operational needs. Smallsats and other orbital regimes are in this mix, where the business case makes sense and is consistent with our approach to complement and enhance military satellite communications.

We are an established and strong business with a solid financial record, so we can invest in new technologies and capabilities that are relevant and future proof our networks. Yet, we do so only when the business case makes sense. We view new endeavors in our industry as exciting opportunities that warrant investigation to determine viability for our market. As a technology company, we maintain the flexibility to experiment, and bring the results into the operational fleet when they are mature and relevant to our customers.

MSM

There are many industry concerns regarding the lack of STEM educated students who can fill the technical areas of need. Is Inmarsat involved in promoting STEM-based training and, even more specifically, assisting in the development of excitement for SATCOM and MILSATCOM careers?

RMCH

We are absolutely committed to filling the STEM gap. We want to ensure that there is a strong "next generation" of science and technical leaders who are even more excited and knowledgeable about space than we are. Inmarsat supports the United Nations-backed World Space Week, which is an annual celebration of science and technology for schools, museums and astronomy clubs. In addition, during the summer, students attend six-week workshops led by our internal experts to learn about topics such as satellite data and fuel efficiency engineering.

On a personal level, I am highly active in promoting STEM careers as an option for young women. Toward this end, I founded WIN-Women in NOVA, a standing committee of The Armed Forces Communications and Electronics Association (AFCEA), which helps IT/communications women professionals expand their networks and professional development. All of its profits directly fund STEM scholarships. I also support STEM education by connecting women mentors to participate in NOVA's Adopt-a-School program, providing role models for girls from elementary to high school levels.

MSM

With your experience in this industry on both the federal government agency and commercial sides, what projects truly bring a smile of satisfaction to you as you review your career?

RMCH

I cannot help but cheer when thinking about our Global Xpress program. Although I have had the privilege to work on a wide variety of exciting and innovative programs while in the government, with Global Xpress, for the first time in my career, I have been able to work on the program from the initial concept all the way through to global deployment and also to see the impact of its use on critical missions.

This has been immensely exciting and rewarding. To witness the sheer speed involved in reaching this point in the program is extremely gratifying too. It is thrilling to see how much more we can do—faster and more affordably—to solve real operational and technological challenges. I am looking forward to doing more of the same, for many years to come.

inmarsat.com

THE HPA CORNER: INSIGHTS FROM A HOSTED PAYLOAD PRACTITIONER

By Sid Stewart, Portfolio Manager, Satellite Solutions Group, Space and Intelligence Systems, Harris Corporation

Hosted payloads have long offered the potential to increase the tempo of government and commercial innovation through lower cost access to space.

With the Iridium NEXT constellation being the world's largest instantiation of commercially hosted payloads, a great opportunity to demonstrate the promise of the hosted payloads approach is presented.

Leveraging excess capacity on the commercial Iridium NEXT satellite constellation, Harris has partnered with Aireon[SM], exactEarth and Iridium to provide reconfigurable hosted payloads that enable real time global air and maritime traffic surveillance.

In addition to these commercial mission solutions which have been enabled by the hosted payload approach on Iridium NEXT, Harris Corporation has also successfully integrated a government payload that supports the space weather project called REACH (Responsive Environmental Assessment Commercially Hosted).

REACH also demonstrates how a more "commercial" pace can be implemented for government payloads as REACH will provide global situational awareness of space weather events within three years for a fraction of the cost of a standalone capability.

Harris Corporation recently completed production of more than 150 payloads. The integration of these payloads on Iridium NEXT satellites is ongoing, with seventeen integrated payloads now at Vandenberg Air Force Base, awaiting the first Iridium NEXT launch.

As all anticipate the upcoming launch of the first Iridium NEXT satellites, Harris Corporation is excited and proud to have partnered with Iridium to use hosted payload technology to bring new and innovative capabilities to market that provide insights for a better world.

This column's question for HPA Members is…

What can industry do to align with government procurement processes to help improve hosting opportunity utilization?

"As the budget forecast for the foreseeable future does not cover the replacement or addition of military satellite systems other than those for existing programs of record, US commanders would find it unthinkable to proceed into combat without the very latest, most advanced satellite capabilities.

"Industry officials have long said that hosted payloads are one part of the unified solution that should bring forward-looking capabilities and new thinking around how SATCOM capacity is procured, launched and managed to ensure the needed capability for mission success and fiscal responsibility.

"Through a productive partnership, military users will benefit multi-fold from industry's innovative approaches to integrated architecture, such as SATCOM as a Service. This robust model integrates complex solutions within an end-to-end managed service architecture, and allows for reliable and easy-to-use access to wideband capability worldwide.

"We must collaborate together so private industry complements existing government strengths by filling in gaps and enhancing the robustness of the architecture, therefore, improving protection, resilience and global portability, alongside efficiencies and cost effectiveness."—**Rebecca M. Cowen-Hirsch**, Senior Vice President, Government Strategy and Policy, US Government Business Unit, ***Inmarsat, Inc***.

"In order to better align with government procurement processes and encourage the adoption of hosted payload solutions, industry must continue to work collaboratively with the government to ensure ease of access to hosted payloads and increased awareness of the value that hosting payloads on commercial satellite brings.

"This includes industry's continued support of the hosted payload interface guidelines, quick responses to the frequent requests for information (RFI's), and continued work on Hosted Payload Solutions (HOPS) contract studies.

"To address other governmental space-based needs, industry can provide additional offerings like data services and communications services for a variety of missions, including protected tactical communications, weather data, and space situational awareness data.

"Industry also has the capability to incorporate Government Furnished Equipment (GFE) as hosted payloads on commercial satellite, provide mission operation and management, and then deliver the end product to data users.

"As commercial GEO ComSats are expected to continue launching at a consistent rate with a wide range of accommodation and longitude offerings, government should remain flexible with industry by budgeting and building payloads in advance of host mission identification.

"This will lead to the increased utilization of hosted payload solutions and will ultimately help to ensure a more robust space architecture and greater value to taxpayers."—**Al Tadros**, HPA Chair and Vice President of Business Development, ***SSL***

hostedpayloadalliance.org/

Established in 2011, The Hosted Payload Alliance (HPA) is a satellite industry alliance whose purpose is to increase awareness of the benefits of hosted government payloads on commercial satellites. The HPA seeks to bring together government and industry in an open dialogue to identify and promote the benefits of hosted payloads. The HPA:

- *Serves as a bridge between government and private industry to foster open communication between potential users and providers of hosted payload capabilities*
- *Builds awareness of the benefits to be realized from hosted payloads on commercial satellites*
- *Provides a forum for discussions, ranging from policy to specific missions, related to acquisition and operation of hosted payloads*
- *Acts as a source of subject-matter expertise to educate stakeholders in industry and government.*

AN "END OF YEAR" MESSAGE FROM HPA CHAIR AL TADROS

As the year comes to a close, I'd like to reflect on the progress we've made on the Hosted Payload Alliance's goals, as well as provide some insight on the current state of hosted payloads in today's satellite industry.

The satellite communications industry remains vibrant, with ample opportunities for LEO, MEO and GEO satellite hosted payloads. The cadence of satellite launches continues to increase, and there were more than 65 commercially procured satellite launches in 2015[1].

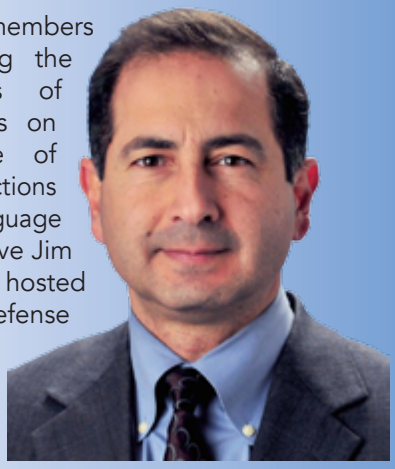
This heavy activity is driving down launch costs and providing more opportunities for hosted payloads to share a ride into space. Additionally, the average number of start-up space investors per year has grown from 19 to 55 over the last 5 years[2], encouraging growth in satellite and fueling the proliferation of Low Earth Orbit (LEO) satellites.

As opportunities for hosted payloads continue to build, our efforts to inform and bridge communications for the benefits to all parties becomes increasingly important. Partly enabled by the HoPS IDIQ contract, which is meant to help normalize hosted payload use, government organizations have committed to a number of hosted payloads, including the TEMPO air pollutants monitoring payload and NOAA's SARSat (Search And Rescue Satellite Aided Tracking) payload.

Over the last year, we believe that there have also been some missed opportunities for public-private collaboration, including the STPSat-6 multipurpose experimental satellite whose payloads were strong candidates for hosting on commercial communications satellite.

The cost, schedule and risk are less favorable with this chosen approach as compared to hosting the payloads on commercial GEO satellite. Furthermore, the opportunity to demonstrate the sustainable approach of hosting payloads on commercial satellites, which can proliferate these payloads in an operational constellation, has been passed up.

Finally, the opportunity to host the communications related payloads on a commercial GEO satellite could have benefited from a transition path for commercial SatCom industry to invest and continue to develop and perpetuate these technologies for the ultimate benefit of the USAF. We must ensure that awareness of these capabilities doesn't go unnoticed.



Hosted Payload Alliance members are constantly communicating the benefits and opportunities of hosting government payloads on commercial satellites. Some of our recent government interactions include providing language suggestions to US Representative Jim Bridenstine (R-OK) regarding hosted payloads in the National Defense Authorization Act (NDAA).

Additionally, Bridenstine's American Space Renaissance Act (ASRA), which was introduced in the House of Representatives this year, also includes language that specifically encourages the use of hosted payloads, requiring the Secretary of Defense to leverage hosted payloads to the maximum extent practicable. ASRA is a tremendous milestone for government access to commercially leveraged solutions.

Over the year, the HPA has also participated in a number of public forums including a panel at SATELLITE 2016 in Washington DC, and most recently, I represented the HPA at the Hosted Payload and Smallsat Summit in Washington DC, where I provided an update on hosted payloads called the "*Hosted Payload State of the Union*."

In this presentation, I emphasized that our continued engagement with both government and industry is critically important. This remains true today, and our recent successes, such as the ASRA and the NDAA amendment, are proof that our efforts to highlight the opportunities that hosted payloads can offer the government and public sectors have been successful.

It is important to now leverage these successes for our continued promotion of hosted payloads and commercial acquisition strategies—which will ultimately result in a more robust space architecture and greater value to taxpayers.

I look forward to participating in and advocating for the continued evolution of hosted payload solutions as we move onwards into the New Year.

hostedpayloadalliance.org

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GovSat Insights #1

Hosted Payloads for the FAA?

By Ryan Schradin, Executive Editor, GovSat Report, and Senior Contributor

In a previous *GovSat Report*, offered was a report from a conference held in October that focused on the uses of hosted payloads and small satellites (smallsats) to accomplish government missions.

Heard repeatedly during the conference was that the government and military understood the benefits of hosted payloads to their missions and budgets, but were concerned about the risks associated with using them.

This sentiment was shared by almost all of the government speakers at the event, and was echoed in this statement by Major James Crane, the Deputy Branch Chief of the Air Force's Hosted Payload Office, within the Space and Missile Systems Center (SMC):

"I would like to acknowledge the frustration that you all have with how quickly the government has adopted hosted payloads. It's not really a technical issue. It really comes down to how the government deals with risk. We also have frustration from the side of the government with our inability to adopt hosted payloads."

However, not all agencies are finding hosted payloads too risky to implement. Recently discussed was a successful NASA hosted payload program on the GovSat Report called *Global scale Observation of the Limb and Disk*—or GOLD, for short.

Additionally, Raytheon and the Federal Aviation Administration (FAA) are currently working with SES GS on their own hosted payload program that—when complete—will deliver some essential and mission-critical information for the federal agency.

The FAA's hosted payload program is called the ***Wide Area Augmentation Service*** (WAAS) and is designed to provide real time GPS corrections from geosynchronous orbit (GEO) to augment the GPS signals being provided by the Air Force's GPS fleet at Medium Earth Orbit (MEO).

The WAAS signal adjusts the measured GPS positions to account for fluctuations in signal delays through the atmosphere due to ionization—providing enhanced safety of flight, more-direct routing for air traffic and eventually allowing GPS-guided precision approaches and landings.

A WAAS payload is hosted on the SES-15 spacecraft that is currently undergoing spacecraft level system test at Boeing.

The new service shelter being installed next to the WAAS Uplink Antenna at Brewster, Washington.

WHERE DOES THE WAAS PROGRAM STAND?

On schedule to launch from Kourou in the second quarter of 2017, the WAAS payload will transmit in the same L-band frequencies as the GPS fleet. C-band uplink of the WAAS signals relayed through SES-15 will come from two redundant Earth stations; South Mountain, California, and Brewster, Washington.

South Mountain has been preparing for installation of a Raytheon-provided C-band uplink antenna and has received a new optical fiber connection to meet a requirement for physical diversity of communications.

The FCC licensing for the site is expected to be granted shortly. Meanwhile, an existing antenna at Brewster has been retrofitted with a modified circular feed and similar L-band receive Phased Array Antenna (PAA). USEI, the Brewster site owner, had also made upgrades to the generators and UPS to ensure resiliency.

On orbit operations are expected to commence in the first quarter of 2018. Signals from the WAAS payload on SES-15 will start transmitting through to GPS receivers over the US later in 2018, following a trial and testing period.

The WAAS program continues to be an excellent example of a recurring operational hosted payload success for the USG.

GovSat Insights #2

Senior Leader Comms

By Ryan Schradin, Executive Editor, GovSat Report

Command and control en route is something that you hear discussed frequently by military leaders and decision makers—and with good reason.

In our personal lives, mobile connectivity is ubiquitous. Using laptops and mobile devices, we can access applications for communication, such as email, phone and video teleconference. That high-quality, remote connectivity we are accustomed to in our personal lives is possible on airplanes and cruise ships thanks to SATCOM.

The government and military's senior leadership expects the same capabilities and conveniences as your average consumer. They want to be connected all of the time. They want to have access to all of the services and applications available to them on the go as they have access in their office.

Most importantly, they don't want major decisions to have to wait until they're reconnected on the other end of a long flight, and they don't want to have to make important decisions without all necessary information because it's simply not available to them. This is why the Department of Defense (DoD) and Air Force operate the Senior Leader Command, Control, and Communications System—Airborne (SLC3S-A) network.

According to the Air Force, the SLC3S-A, "…*Provides executive airborne communications supporting world-wide command and control capabilities to US government senior leaders (i.e., the President of the United States (POTUS); Vice President of the United States (VPOTUS); Secretary of Defense (SECDEF); Secretary of State (SECSTATE); Chairman, Joint Chiefs of Staff (CJCS); Unified Combatant Commanders (COCOMs); and their staff as well as other government senior leaders).*"

Effectively, the SLC3S-A delivers secure and non-secure voice, data, and video connectivity to senior leaders en route so that they can carry out their duties and responsibilities.

As with most similar inflight and nautical networks, the SLC3S-A relies heavily on SATCOM to connect these senior leaders to the capabilities and information they require. But the existing SLC3S-A infrastructure is relatively proprietary and built on older technology that not only gives the government less flexibility, but also makes the system very expensive to operate. For this reason, the Air Force is looking to modernize SLC3S-A in the coming year.

In the coming year, the Air Force will be releasing an RFP for a new SLC3S-A. Although the RFP is not yet public, the general understanding across the satellite industry is that this version of the SLC3S-A is to be built on open standards that will allow the Air Force to utilize a range of different modems and bandwidth providers. This new, more open, SLC3S-A will utilize a modern satellite modem that gives the Air Force the ability to utilize both wideband satellite signals and HTS signals. This is key, since—as we've discussed in previous articles—HTS is truly the future of satellite.

Today's advanced HTS uses smaller spot beams instead of the wider beams found on traditional geosynchronous satellites. These spot beams offer higher bandwidths and throughputs, making it possible to transmit more data, faster, and at lower cost to the end-user.

By enabling the SLC3S-A to use HTS signals, the Air Force will enable even more high bandwidth capabilities to senior leaders on the move, and also cut costs for the military in the long run. To accomplish this, the new modems used in the SLC3S-A will need to be able to transition from beam to beam, since the circumference of each beam will be smaller in HTS environments than in wideband use. However, an open source modem capable of accomplishing this is currently in the works, and is expected to be a vital part of SLC3S-A in the future.

Building a More Open, Better SLC3S-A

By reevaluating SLC3S-A, embracing open standards and working to ensure that SLC3S-A can work with tomorrow's advanced HTS signals, the Air Force is taking huge strides to ensure that senior leaders can have command and control en route. But there are some decisions that are still to be made that could drastically impact just how flexible and powerful the SLC3S-A network is in the future.

Here are a few considerations for the Air Force to keep in mind if they're going to ensure that the SLC3S-A is everything that it can be, and more:

1. Evaluate COMSATCOM providers on bandwidth and throughput—Not all COMSATCOM providers are built the same. In fact, some satellite constellations are capable of

delivering more bandwidth and higher throughputs per HTS spot beam than others. If the purpose of refreshing the SLC3S-A to be more open and feature higher bandwidth for more demanding applications, it would be counterproductive to embrace a COMSATCOM provider that offers lower bandwidth and lower throughputs via its satellites. This becomes even more important if senior leaders are traveling in areas with high satellite use. These lower bandwidth and lower throughput satellite beams will become stressed more easily, and both accessibility and performance will be hindered—leaving senior leaders with lower than optimal performance, or no service when needed.

2. Stay flexible with satellite bands—Aside from decreasing cost and increasing bandwidth, the SLC3S-A is being reevaluated to increase flexibility. That means it would once again be counterproductive to tie the SLC3S-A to one satellite band. It's essential that the SLC3S-A work with both Ka- and Ku-band if the Air Force wants the most flexibility, as well as the best return on their investment. There isn't anything significantly different or special about Ka-band. In fact, it was mostly utilized because providers didn't have access to Ku-. What is different about Ka- is its relatively higher cost equipment, and other engineering challenges that it creates—including a need to worry about and handle higher heat dissipation. If flexibility really is a driving force for reevaluating SLC3S-A, then it is not recommended for the Air Force simply stick to just using Ka-band.

SLC3S-A is essential for keeping senior government and military leaders connected regardless of their location. Reevaluating and reworking SLC3S-A to make it more open and enable it to work with advanced HTS signals is essential for enabling senior leaders to use the most bandwidth-hungry capabilities and applications enroute. By ensuring that the COMSATCOM provider they choose offers the most bandwidth per beam and by not tying their hands with just Ka-band, the Air Force can ensure they get the most flexibility, bandwidth and cost savings from the new SLC3S-A.

*These articles are republished, courtesy of GovSat Report (**ses-gs.com/govsat**), and Executive Editor **Ryan Schradin**. He is a communications expert and journalist with more than a decade of experience and has edited and contributed to multiple, popular, online trade publications that are focused on government technology, satellite, unified communications and network infrastructure. His work includes editing and writing for the GovSat Report, The Modern Network, Public Sector View, and Cloud Sprawl.*

His work for the GovSat Report includes editing content, establishing editorial direction, contributing articles about satellite news and trends, and conducting written and podcast interviews. Ryan also contributes to the publication's industry events and conference coverage, providing in-depth reporting from leading satellite shows.

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IMPROVING CUBESAT/SMALLSAT RELIABILITY

By Christopher Alfenito, Director of Sales and Marketing, Modular Devices, Inc.

The trend toward cubesat use for defense and commercial applications is expected to dramatically grow over the next several years.

Going forward, cubesat mission successes are a must for the industry. Original cubesats were either university or science based projects. As this market grows and matures, the reliability of operation will become critical, whether evaluated from NatSec Task or commercial revenue aspects.

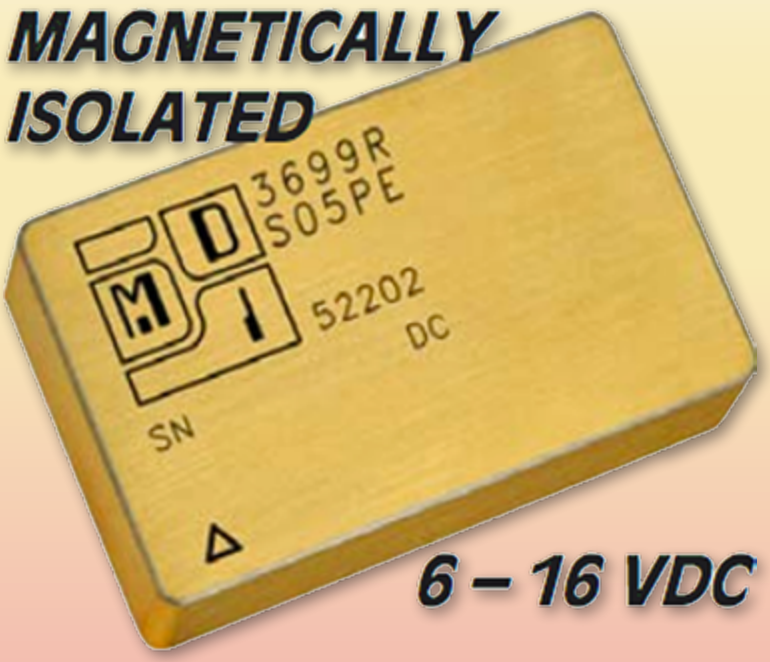
Current and future cubesats will rely on full mission achievement and improved reliability. According to a recent paper (1), an average of 36 percent (28-44 percent) of cubesat failures, including DOA failures and on orbit failures within the first 90 days of operation, were due to faults within the smallsat's electrical power system (EPS). During the first 90 days of operation, EPS failures are the single largest contributor to mission failure.

Many cubesats are derived from "kits" that include power bus components. This can include electrical power systems components such as solar panels, battery and battery charger and a regulator for the satellite bus.

However, what occurs is that most cubesats are user "customized" with various payload requirements that make each cubesat design unique. Often the bolt on function needs a DC voltage that is not provided by the standard bus. This means adding one or more DC-DC converters to convert the cubesat bus to the unique user voltages.

WHAT COULD GO WRONG ?

Having paid a relative bargain price for the cubesat kit and its power bus, some cubesat designers may be tempted to use low cost commercial DC-DC converters, some in the $10 to $20 range, to power the added on circuitry—here are some pitfalls attendant to such inclusions on the bus:



MDI DC - DC Converters: Proton Radf Hard 100K+™, Series 3699.

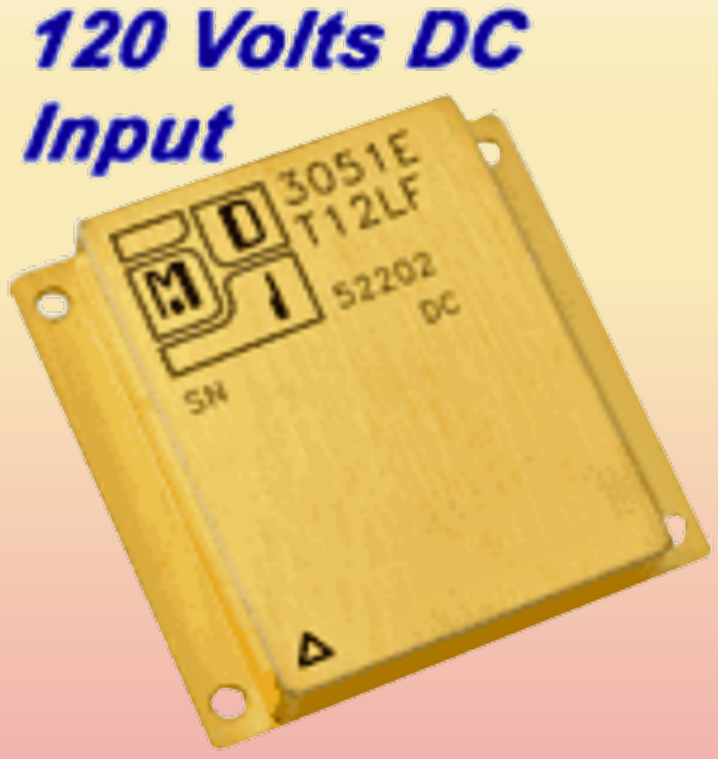
- *Can't operate at hot or cold: Some have a range as limited as 0C to 50C*
- *Fail after temperature cycling: The construction and connections may fail after a low number of temperature cycles as experienced in orbit*
- *Not designed for conduction cooling; need air flow for cooling. There are absolutely no cool breezes in space*
- *Are electrically noisy, input and output: they are noisy neighbors who may interfere with the bus or with sensitive circuits nearby*
- *Can't tolerate even modest radiation: Some CMOS control circuits can only tolerate a few kRad before failing. Or, a low energy heavy ion can zap them, causing failure*
- *Sensitive to shock and vibration: can cause failure during launch or deployment*

Budget constraints are always a factor in successfully designing, building, launching and executing a cubesat mission. At the present time, the appearance is that—excluding labor—actual launch costs remain the largest share of the expense.

The average deployed 1U Cubesat is estimated to cost $100,000, and the average deployed 3U Cubesat is said to cost $300,000. (2).

The CAPEX costs are actually a minor part of the total investment, especially when mission success is taken into consideration. Furthermore if the cubesat design requirement is in the 3 to 6U+ range, the incremental cost of qualified power bus components is negligible.

The obvious immediate solution to improve Cubesat reliability by 30 to 40 percent is to design the Electronic



MDI 32.5 – 80 Watt Hybrid Rad Hard DC-DC Converters, Model 3051.

Power System (EPS), using qualified DC-DC converters specifically designed for the market segment.

Benefiting from careful design, volume production and the gradual elimination of design problems from feedback over many applications, space qualified electrical power systems components can greatly increase reliability.

For more than 30 years, Modular Devices, Inc., has designed and manufactured DC-DC converters for specific requirements of the satellite and cubesat/smallsat markets.

Compact, Rad Hard, hermetically sealed, standard 28V input bus with single, dual and triple outputs, including: +5, +3.3, +2, and -5V for powering digital, RF, and FPGA Cubesat subsystems.

mdipower.com

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Christopher Alfenito is a business professional with three decades of experience that encompasses engineering, technical, product development and management, sales, business development, operations, manufacturing, marketing, training, customer service and staff management functions in multinational environments. He is experienced with all phase of technical, commercial, cultural and regulatory issues at any organization level.

PERSPECTIVES: INTELSAT GENERAL

RAYMOND RETURNS TO SPACE COMMAND

CHARYK CHARTED SATCOM

By SatCom Frontier Editors

When General John Raymond left Air Force Space Command for a new assignment in 2010, he was a one-star general leaving behind a relatively stable strategic environment.

General John Raymond.

Space capabilities at that time were focused on technologies that could support the warfighter on Earth. Space itself was not viewed as a potential battlefield in its own right.

On October 26th, the day after earning his fourth star, Gen. Raymond returned to head a Space Command involved in a "crowded and contested environment," with many new challenges.

"*As we move into our 35th year as a Command, we can't do business the way we have in the past... We don't have that luxury*," he wrote in his Initial Commander's Guidance and Intent, according to a November 1st article in *Space News*. "*Space and cyberspace are no longer benign environments.*"

These two areas are only part of a multi-domain responsibility in which the Air Force must work with other services in conducting today's warfare. Such a responsibility means Space Command needs help, Raymond wrote. It must work more closely with "*the intelligence community and other government agencies, our allies and foreign partners, and the civil and commercial sectors. When we operated in benign environments, these partnerships were important; in contested domains, they are critical.*"

Just how critical was a subject addressed at length in the "*Space Enterprise Vision (SEV),*" announced in April by Raymond's predecessor at Space Command, Gen. John Hyten, who replaced Adm. Cecil Haney as the head of Strategic Command on November 3rd. Raymond is expected to continue pursuing the goals of the SEV.

Since the April SEV announcement, Hyten and Space Command staff have had meetings—many of them classified—with about 700 industry officials, each side seeking to define their respective roles.

While specifics remain unclear, a September 12 article in *Space News* indicated that part of SEV involves Space Command

Skeptics abounded in 1963 when Joseph Charyk went looking for investors and customers for the new, quasi-private Communications Satellite Corporation (COMSAT).

The company came into being when President Kennedy signed legislation designating COMSAT to represent the United States in the nascent international satellite realm.

With Sputnik having launched just six years earlier, satellite technology was in its infancy. U.S. military and communications industry leaders thought low- or medium earth-orbit constellations could meet their needs.

But Charyk advocated placing a few platforms in geosynchronous orbit that could relay signals over wider areas and provide global service.

In August of 1964, with Charyk as its founding president, COMSAT helped create, and was the majority owner of, the International Telecommunications Satellite Consortium, known as Intelsat.

Eight months later, Intelsat launched its first satellite, Intelsat I, colloquially known as Early Bird. This first satellite communications platform relaying signals from 22,300 miles up verified Charyk's belief in geosynchronous orbit for SATCOM.

Designers and engineers made many leaps in technology over a half century to get from Intelsat I, with either 240 voice circuits or one TV circuit—Early Bird could not do both at the same time—to today's Intelsat fleet of more than 50 satellites.

The advances from Early Bird's capability to that of today's growing Intelsat Epic^{NG} high-throughput satellite constellation took more than a few innovators and dreamers.

Charyk, who died in Delray Beach, Flordia, on September 28th at the age of 96 was one of those dreamers.

Born in 1920 to Ukranian immigrant parents in Alberta, Canada, Charyk moved to the United States to earn a doctorate at CalTech.

giving private industry such routine tasks as telemetry, tracking, command and control or space traffic management.

Doing so would "*free up our airmen to do what we think they're going to be called to do in the future, which is understand a thinking enemy and be able to react and defend our constellations,*" said Maj. Gen. Nina Armagno, who oversees strategic plans and programs at Space Command. "*These partnership opportunities are exciting because they offer the chance for cost sharing as well as expanding capabilities.*"

Bringing industry into Space Command operations has been talked about for more than a year. The job becomes even more important with another SEV element: joining currently disparate control systems into one, called Enterprise Ground Services.

Other SEV elements include increasing satellite resilience, in part through disaggregation; cheaper rockets and more agile launch operations; and improved space situational awareness. Industry has potential roles in all of these areas.

At the recent Global MilSatCom conference in London, Deanna Ryals, chief of Air Force MilSatCom Systems Directorate's international military satellite communication division, outlined a formula: **Military plus commercial plus allies equals improved resilience**.

Launch operations can be sped up. Integrating satellites with military launch vehicles takes from 60 to 90 days, Armagno said. The Air Force wants to trim that time to weeks to be ready to replace satellites damaged or destroyed in orbit.

In contrast, the Intelsat Epic 33e and Intelsat 36 satellites were integrated with their Arianspace launcher in about a week for their August launch.

Ahead for the SEV under Gen. Raymond's watch is clarity on timing as well as specific tasks before industry can invest in the plan's future. Satellite companies have asked to be involved at the front end of satellite system architecture, as well as gain greater insight into plans so as to plot a course to greater involvement and support.

It's clear that Gen. Raymond has to look ahead, and that his view from the commander's office is different than it was during his 2009-2010 stay at Space Command.

"*Our adversaries have noticed [U.S. advantages in space and cyberspace], and we are now facing new challenges that could disrupt our warfighting capabilities and threaten our national interests,*" he wrote. "*How we respond to the growing challenges in these domains will shape our ability to protect vital national interests well into the future.*"

After teaching at Princeton, then heading Ford Motor Company's non-automotive business, Charyk was named the Air Force's chief scientist, then held other government positions that included being the first head of the National Reconnaissance Office—all while trying to get back to industry. Upon being named to head COMSAT, he worked to raise capital and customers for a company still seeking an identity.

His chief problem involved beliefs that geostationary satellites would be too heavy to be launched with the propulsion means of the day; that they were limited to a lifespan of about 18 months; and that a half-second delay in transmitting voice communications would be unacceptable to users.

Intelsat I weighed 76 pounds and was in service for four years—that it got to space at all was a saga. In an oral history of COMSAT in 1985, Charyk recalled an early meeting with Gen. David Sarnoff, head of RCA. Charyk believed RCA would be an ideal customer and investor, and so made his pitch for support.

Sarnoff replied, "*Well, you're talking about doing things that may or may not work, that may or not make economic sense.*" RCA had invested heavily in equipment for high frequency radio stations.

Said Charyk, "*Regardless of how it evolves, satellite communications are going to be the way of the future, and your high frequency radio stations are going to become obsolete.*"

Charyk recalled that Sarnoff's staff chimed in objections, then stopped when Sarnoff raised his hand and said, "*You know, I think he's right.*"

Sarnoff became a customer and on October 26, 1965, six months after the first satellite's launch, RCA broadcast the "*Town Meeting of the World*" on CBS, with students from London, Belgrade, Paris and Mexico City talking via Intelsat I with former President Dwight D. Eisenhower, UN Ambassador Arthur Goldberg and then-Solicitor General Thurgood Marshall. This was the first two-way commercial television program transmitted by satellite and the first time multiple points on both sides of the Atlantic were linked by television.

The trip from there to today was charted by Charyk, who ran COMSAT for 22 years until his retirement in 1985, and others who pioneered satellite communications.

"*The thing that impresses me about the old stuff is that what used to be a remarkable thing is just accepted as routine,*" Charyk said in a Washington Post story in 1981. "*...The idea that I can see an event or talk to anyone in the world is now accepted as a routine thing.*"

The two preceding articles are courtesy of Intelsat General's SatCom Frontier infosite and editorial team: intelsatgeneral.com/

TAC OPS: CONNECTIVITY FOR AFGHANISTAN'S GOVERNMENT

By Fysal Gill, Senior Director, Sales

SpeedCast recently partnered with NEDA Telecommunications to provide connectivity to the Government of Afghanistan.

NEDA Telecommunications (NEDA) was founded in 2003 as the first licensed Internet Service Provider (ISP) in Afghanistan. The firm started with dial-up services and quickly moved into wireless broadband services. NEDA quickly established itself as the leading ISP in Afghanistan with a presence in most major cities and with additional plans to roll out even further in the communications services arena within Afghanistan in the not-too-distant future.

As the preferred ISP for most of the banks and ministries in Afghanistan's Capital City of Kabul, NEDA was approached by the Government of Afghanistan to provide them with an upgraded, private communications network for its ministries.

The Government of Afghanistan was running on a SCPC-based network which provided connectivity but was ultimately too expensive and outside of the government's budget.

The Government of Afghanistan is funded by donor agencies such as The World Bank and the United Nations Organization. As such, a cost effective network solution was required that would also provide top-quality security.

Due to the cultural challenges in the region, NEDA also required a satellite service provider partner with a recognized successful track record of experience in the Middle East and Asia.

SOLUTION

NEDA selected SpeedCast as their partner, as SpeedCast has been serving Internet Service Providers (ISPs) and the private sectors in the Middle East for the last decade, providing

connectivity and value added services to the region. SpeedCast installed a new satellite network which provides a secure, private network for one of the ministries of the Government.

The new satellite network provided by SpeedCast has more than 50 sites which deliver the required connectivity and service levels to all of the government's sub-ministries, including the different departments and banks that need to be connected to the main Ministry of Finance.

SpeedCast designed the new private network to aim at providing reliable and secured connection that allows improved efficiency and productivity by extending connection coverage for the government. The network is also cost-effective and scalable, allowing for upgrades to be easily made for future technological developments.

IMPACT

As the relationship has developed, SpeedCast is continuing to work with NEDA to develop the Government of Afghanistan's communications network. SpeedCast is working with NEDA to ensure that the Government always has the most cost effective and secure network to help facilitate the smooth running of the country.

RESULT

Through providing their excellent VSAT satellite solutions and leveraging decades of experience, SpeedCast has successfully helped the Government of Afghanistan install their first iDirect base private network in Kabul.

This is a major achievement for the Government of Afghanistan, as it is the first private communications network that the government has owned.

Through SpeedCast's partnership with NEDA, the Government of Afghanistan has a state-of-the-art, secure network to transfer data, using the latest VSAT satellite services. This deployment demonstrates SpeedCast's commitment to enable its partners to provide high-quality VSAT services to connect users in the Middle East and the rest of the world.

speedcast.com

SpeedCast International Limited (ASX: SDA) is a leading global satellite communications and network service provider, offering high-quality managed network services in over 90 countries and a global maritime network serving customers worldwide. With a worldwide network of 33 sales and support offices and 31 teleport operations, SpeedCast has a unique infrastructure to serve the requirements of customers globally. With over 5,000 links on land and at sea supporting mission critical applications, SpeedCast has distinguished itself with a strong operational expertise and a highly efficient support organization. For more information, visit www.speedcast.com.

Fysal Gill has 11 years of association with SpeedCast Group and currently heads sales for Central and South Asia. By profession, he is an expert business developer for Emerging Markets in key verticals related to the fields of IT and satellite communications and holds a Master Degree in IT and Communications along with 20 years of professional industry experience.

Fysal is a Certified Private Equity Specialist and a member of the International Academy of Business and Financial Management (IABFM). He has participated in the launch of renowned startups, multinational companies and has contributed in driving these entities to become billion-dollar businesses within a few years.

YEAR IN REVIEW: AGILIS

By Rajanik Mark Jayuasuriya, Vice President, Satellite Networks Group (SNG) of ST Electronics

2016 was a critical transformation year for Agilis—after more than 20 years in the satellite industry, deeply focused on the development of RF products, Agilis introduced a comprehensive, end-to-end, solutions model.

Current communication networks are diversifying with more and more pieces of equipment being connected to them. Today, these various technologies all must seamlessly work together to provide the service levels that are required by end customers.

To address this reality, Agilis' global customers have told the company they need an agile partner who understands what is happening in the market, and who can integrate new technologies and provide the intelligence to manage them.

End-To-End Solutions Model

Agilis developed an end-to-end model that brings all aspects of communication networks together through an expanded set of integrated offerings.

The goal is to help customers form a complete communication solution backbone—one that is highly engineered to meet all of the requirements that are based upon deep systems intelligence.

Agilis will continue to develop in-house RF equipment and offer best-of-breed integrated products to create complete solutions, fully optimized for the business. Yet, with networks becoming more complicated, there are more applications to run, more access technologies to support, more equipment to monitor and more data to manage.

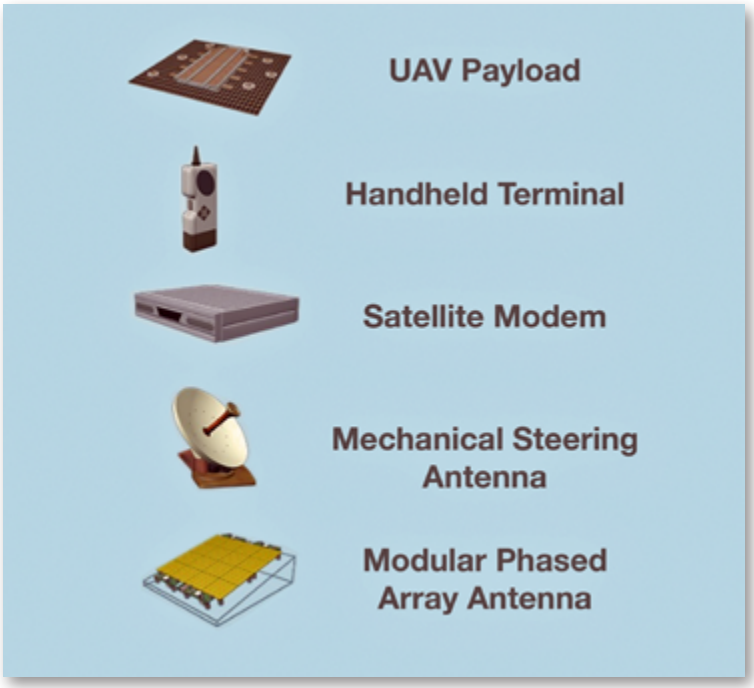
This is the reason why the Agilis Professional Services team brings the best products together around the world to integrate with the firm's own products to create cutting-edge solutions.

Based upon the company's in-depth knowledge and understanding, Agilis has built solutions to meet unique customer needs. For example, the firm's manpacks use customer furnished modems for rapid deployment in ruggedized terrain. Plus, the mobile Earth stations combine the power of high quality satellite communications with the mobility of a durable trailer.

This year, the company announced a key component of our end-to-end solution—the Agilis RealTime Advisor™—based upon the experience of working with customers to run their networks.

The Agilis RealTime Advisor sits at the heart of the business, containing the intelligence to tie all the pieces together across the network, providing true visibility and predictive analytics.

The Agilis RealTime Advisor is designed to provide true end-to-end visibility across all systems, equipment, and access technologies from a single platform in one central location. This is an intelligent system built on modern web technologies with support for multi-vendor network function virtualization and mobile technologies to help turn network data into business value.



An Agilis integrated HAPS system.

Keeping Pace With Satellite Innovation

With an end-to-end model in place, Agilis focuses ever more on bringing products to market in an effort to meet emerging customer and market requirements.

Another key development for Agilis this year was the introduction of the HAPS (High Altitude Pseudo Satellite) UAV Communication Solution. This solution comprises a fully integrated, highly efficient, low latency ground infrastructure and can be differentiated based on the requirements of an individual HAPS vehicle. This solution supports a broad range of applications for commercial and military applications.

Preparing For Technology Disruption

Today's technology innovations are advancing the satellite industry and many are dramatically disrupting traditional market models. There are three disruptive technologies that Agilis closely watched over the past year.

The first disruptive technology is the shift toward phased array antennas, driven by the growth of mobility applications. Phased array antennas allow fast beam switching, which is necessary for spot-beam aero networks, as well as for services that connect to LEO constellations. Their low profile, small footprint and lightweight capabilities enable applications for terrestrial vehicles, aircraft and ships.

Another disruptive technology making a market impact is the programmable ASIC chip, which satellite ground infrastructure manufacturers are embedding into their next-generation modems. The new models of software-defined modems introduce much greater flexibility, as they can be reprogrammed from the field to add additional throughput and market-specific technologies, when required to do so.

The third market disruption focuses on where to engineer the future of network intelligence. One answer is to put intelligence on the satellite to enable that satellite to route data directly with the capabilities of demodulation. The satellite would then act like a full mesh system and decrease latency significantly.

Agilis also expects to witness the further development of steerable beams in order for beams to be reconstructed for power reallocation based on the demand from the ground.

At Agilis and across the satellite industry, 2016 proved to be another milestone year. With both business and technology disrupters in play—those who succeed in taking advantage of, or creating, technology disruption will be those who will ultimately succeed.

agilissatcom.com/

YEAR IN REVIEW: AIRBUS DEFENCE AND SPACE

By Arnaud de Rosnay, Senior Vice President, Telecommunications Satellites, and, Michael Menking, Senior Vice President, Earth Observation, Navigation and Science

If there are just three words to define Airbus Defence and Space's satellite business in 2016, they are competitiveness, flexibility and innovation.

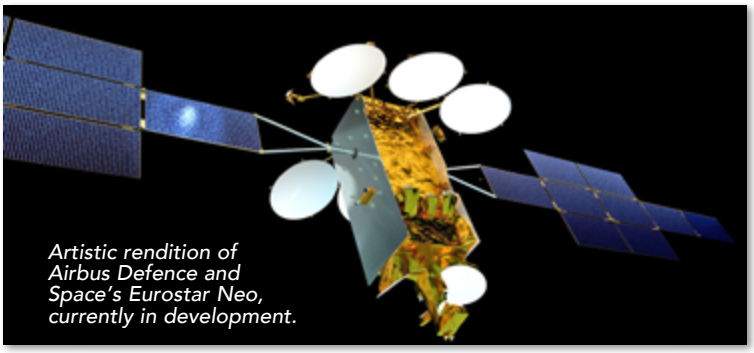
With a market share of around 25 percent in value terms worldwide in 2015, Airbus Defence and Space remains the global market leader for commercial geo communications satellites, having booked four contracts so far this year. Some launches that were planned for 2016 have had to be postponed to 2017 due to the unavailability of launchers; however, demand from customers remains buoyant.

The company has approximately 50 geo satellites in operation and the firm's telecommunication satellites have racked up a total of more than 600 years of successful operation—not one has been lost in orbit.

Airbus Defence and Space is now developing Eurostar Neo, a new generation satellite that builds on the success of the highly reliable Eurostar E3000 that has accomplished 43 launches since 2004. Eurostar Neos provide 50 percent more capacity than the previous generation, with 7 to 25 kW of payload power enabling the most powerful missions, including VHTS (Very High Throughput Satellites, typically more than 250 Gbps capacity).

The company is also introducing new design solutions and production processes to increase efficiency and competitiveness. These improvements reduce planning time by up to six months.

Making the industrial processes more competitive and efficient has been a key factor of Airbus Defence and Space's recent success as well as the increasing use of automation, data exchange and digitalization in driving manufacturing technologies, all in line with the Industry 4.0 "smart factory" approach that has been adopted by the parent company, Airbus Group.



Artistic rendition of Airbus Defence and Space's Eurostar Neo, currently in development.

Electric propulsion is becoming the norm, rather than the exception. Airbus has six high-power, all-electric satellites in production. The Eurostar Neos are designed with electric propulsion in mind.

Also showcasing a highly innovative technology, the company is manufacturing six flexible satellites with a processed payload or software-defined mission, responding to a need from operators for more adaptable missions. The new generation of digital processors provides even more processing capacity.

Faced with economic constraints, customers are hungry for innovations. However, the market remains fundamentally strong and Airbus wants to maintain the leading market position, as the firm is active in all types of applications and missions, notably broadcast, mobile and HTS.

In the military domain, Airbus is building one of the two satellites for France's Comsat NG program. In the export market, the company has scored several contract wins this year and is currently building a complete satellite communications system for an Asian MoD.

Artistic rendition of Comsat NG, or Next Generation.

On the non-GEO constellation side, Airbus Defence and Space is designing and building the 900 satellites for the OneWeb constellation. Manufacturing dozens of satellites each month represents a huge, unprecedented industrial challenge. The design must be adapted, the production processes modified, and the supply chain changed, all with a view to maximum efficiency. Developing a new product opens the opportunity to offer the finished product for other LEO applications, enhancing the company's satellite catalog.

Airbus Defence and Space is constantly innovating in the field of optical technology and has successfully developed and demonstrated optical communications for intersatellite links and data relay services. Earlier this year, the first commercial space segment of the European data relay system was launched.

The company has developed new optical terminals for LEO and GEO telecom missions and optronic solutions are increasingly being introducing onboard our satellites.

On orbit build/servicing could soon become a reality. Airbus is working on concepts such as building large satellites that will be telecom stations in space, with servicing/updating managed by exchanging some modules and tugging satellites from one orbit to another. Operators are already starting to think about this possibility and the space tug is a concept that can be used as a Space Utility Vehicle.

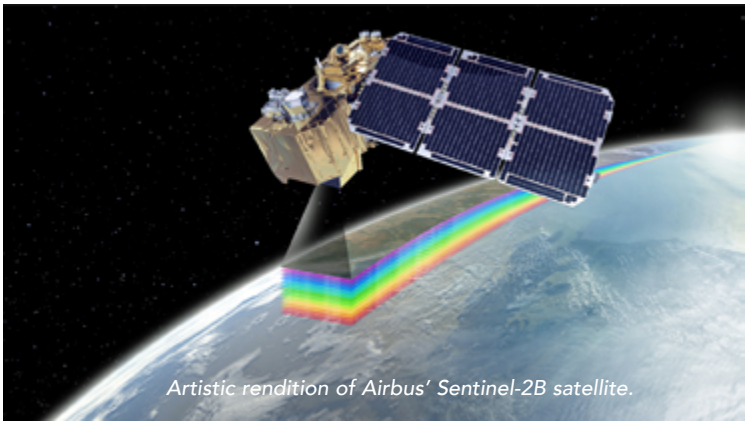
In 2017, the work will focus on two main areas: more capable platforms and more flexible payloads. Next year will see the launch of the company's high-power electric satellites—the first in the world with payload power well above 10 kW.

Depending on applications and business needs, Airbus Defence and Space offers payload flexibility in all domains: frequency/bandwidth, power allocation and coverage. Separately or jointly, depending on the applications market needs, solutions will range from simple, connective solutions to software defined payloads. The satellites which are currently under production (Eutelsat Quantum, SES-12/14 and Inmarsat-6 F1 and F2) highlight the operators' needs for flexible payloads.

On the Earth Observation (EO) front, this has also been a busy year. PerúSAT-1, the first EO satellite based on the AstroBus-S platform, was tested and delivered in less than 24 months after the contract signature, an impressive performance for a sub metric satellite. Now in orbit, the first images from PerúSAT-1 have been delivered and the satellite has become Latin America's most powerful EO satellite.

Also launched this year, the Sentinel-1B radar has joined its twin brother on orbit to complete the Copernicus radar constellation. The first image was sent via EDRS laser, from LEO to GEO and back to Earth and to users in under one minute—that's a new speed record in space. The Payload Data Ground Segment, also developed and operated by Airbus, is now operating with two Sentinels 1 in orbit. Two additional satellites for the Copernicus program are now preparing for launch.

Sentinel-5 Precursor, also based on the Astrobus platform, was completed and fully tested in April and will be launched in 2017. This will be the first satellite dedicated to monitoring atmospheric chemistry. Sentinel-2B has successfully finished its test program and is being readied for lift-off in early March of next year.



Artistic rendition of Airbus' Sentinel-2B satellite.

Offering a "color vision" for the Copernicus program, Sentinel-2B will join its twin in orbit to deliver optical images from the visible to short-wave infrared range of the electromagnetic spectrum.

This has also been an eventful year for on orbit scientific missions. Lisa Pathfinder delivered excellent results, proving that gravitational waves can be measured from space.

The first star catalog from Gaia was released in September, greatly improving upon the results of Hipparcos, ESA's first astrometry mission. Since the launch in 2013, Gaia has mapped more than 1.6 billion stars, thanks to its ultra-stable platform, with data on the positions and intensity of 1.1 billion stars having now been published.

Let's not forget Rosetta which, at the end of September, made a controlled descent onto the surface of the 67P/Churyumov–Gerasimenko comet. Airbus Defence and Space built the Rosetta spacecraft, which is unveiling the secrets of comets and the origin of life.

The new contracts this year include Biomas—the next ESA Earth Explorer contract and the first space-borne, P-band radar. Biomass is due to launch in 2021 and will measure forest biomass to assess terrestrial carbon stocks and fluxes for five years.

The company has also signed the development phase contract for the Second Generation of Meteorological Operational (MetOp-SG) satellites as well as the contracts for two additional satellites for the Sentinel-2 program. These two new models, called "Sentinel-2C" and "Sentinel-2D", will observe the environment and land surfaces and continue from 2021 with the measurements carried out by the first two units as part of Europe's Copernicus program.

Currently, Airbus Defence and Space has 35 satellites in development in the clean rooms, with six planned for launch in 2017. Development activities will also intensify for VHR2020, Airbus Defence and Space's new constellation of very high-resolution optical satellites.

airbusdefenceandspace.com

YEAR IN REVIEW: COBHAM WIRELESS

Ultan Kelly, Senior Product Line Director

There are only a few of us these days who are not familiar with the phrase 'DDoS attack', due to the frequency of incidents and news coverage of these intrusions over the past few months.

According to a recent report, distributed denial of service attacks with greater than 100 Gbps have increased by 138 percent over the past year.

Interestingly, web app attacks decreased by 18 percent over the same time period, implying that cyber criminals are progressing from traditional hacks and, instead, taking advantage of the IoT zeitgeist to a great effect.

Recent attacks were a frustration for end-users and costly for the companies targeted by these barrages. Preventative action must now be taken to avoid a future wherein similar attacks could jeopardize online systems that are used in the critical public services people are dependent upon receiving.

DDoS attacks work by overloading a system with Internet traffic from multiple sources. These sources are often networks of infected computers—or 'botnets'—which are infiltrated and exploited as a means to distribute infected emails or websites.

However, the recent rise in connected devices has provided an alternative route to entry for hackers that are deploying Mirai botware.

Connected devices such as digital cameras and printers, as well as (in theory) connected kitchen devices and light bulbs, are often unprotected and have passwords that have been unchanged for a long time.

The attack on Internet performance management company Dyn last October was subsequently named the world's largest orchestrated hack via IoT devices, with the estimated number of infected devices at the source placed at 100,000, with peaks of over 1 TBps of traffic.

The next high profile hack targeted not just a single company, but an entire country. A massive cyber attack using Mirai botware struck Liberia last month, jeopardizing the Internet infrastructure of that African nation.

Over the course of several days, the perpetrators undertook a sustained DDoS attack, bombarding two Liberian fiber cabling companies with fake Internet traffic and overloading their servers. Liberia's Internet is delivered via a single fiber cable, which meant the nation was a highly vulnerable target, as are nations resident on that same stretch of West African coast which share the capacity of the cable.

As a result of such attacks, Internet users suffer from disrupted Internet connectivity or, in the worst cases, complete outages.

Dyn, as well as the two Liberian companies, will have experienced significant financial losses and face having their reputations tarnished.

With the increase in frequency of these types of hacks and without ISPs implementing preventative measures, the potential damage and disruption DDoS attacks can cause to more critical Internet infrastructure is, unfortunately, huge.

An incident in Finland this month is a prime example. A DDoS attack halted heating distribution in at least two properties in the city of Lappeenranta, located in eastern Finland, by targeting the computer systems used to control central heating.

Imagine this on a larger scale: heating and other energy systems brought down in residential properties and public buildings, such as hospitals, due to cyber criminals infiltrating networks of improperly prepared companies via unsecured IoT devices.

Cobham Wireless' range of DSP (digital signal processing) LTE digital off air repeaters provide LTE coverage in small, medium, large and campus style buildings, inside tunnels and metros and into remote or rural communities. Photo is of of the company's D-SBR 3008 product.

Banks, the backbone of most society's financial infrastructures, are also fair game, as was evidenced by the wave of DDoS attacks which targeted at least five Russian banks this month.

As society sees an increasing number of everyday items connected to the growing IoT environment, many of which are without ample security, so will DDoS attacks continue to increase via these devices.

From the US to Africa and to Russia, the threat is global and requires continuous, automated testing of systems to help identify any potential security holes across an entire business.

IoT device manufacturers need to do their bit to tighten security of these items, but it is also the ISPs which must act immediately.

This action necessity is critical—the threat must be addressed at the network level to prevent attacks which cam affect vital infrastructure and services.

A combined strategy of prevention and defence should be considered, and an ISP's security infrastructure should be pre-validated against emulated attacks in a controlled environment. I is critical that companies implement ongoing and comprehensive stress-testing of its networks.

Cyber criminals have advanced with the technologies, adapting their strategies to take advantage of the rapid adoption and widespread use of IoT devices.

This has already wreaked havoc for firms whose networks have been attacked and which have, no doubt, lost revenue, human hours and potential customers as a result of these invasions.

Traditional security measures such as firewalls are not enough to detect and prevent today's DDoS incidents.

Operators need to adapt in the same fashion as their foes and select a solution that offers real-world defensive solutions against these threats in order to guarantee their networks are secure against possible strikes in the future.

cobhamwireless.com/

Ultan Kelly is the Senior Product Line Director at Cobham Wireless.

YEAR IN REVIEW: COMMUNICATIONS & POWER INDUSTRIES

By Gerard Charpentier, Vice President of Business Development

2016 was another exciting year for Communications & Power Industries (CPI) in regard to technical innovations and new SATCOM product introductions.

The company further expanded their ever-growing line of industry leading solid-state power amplifiers (SSPAs) and block up converters (BUCs) by offering a 160 W peak power, Ka-band, GaN–based, solid state BUC/SSPA, as well as a 1000 W, C-band, GaN transceiver.

In addition, CPI answered the call for liquid-cooled traveling wave tube amplifiers (TWTAs) with offerings in several product lines, and added an uplink power control option to many CPI SATCOM products. This power control option helps maintain uplink signal strength during rain fade conditions by monitoring the strength of a downlink beacon signal and adjusting the RF output power accordingly.

The company also continued to expand the availability of their patented LifeExtender™/LifePredictor technology to more of its products.

160 W Ka-Band GaN BUC

CPI added a new member to their family of Ka-band products in 2016, with an SSPA that provides 100 W of linear output power over 3500 MHz bandwidth (1000 MHz with BUC).

This product is the flagship of CPI's full line of GaN SSPAs and BUCs and has proven to be highly popular among SATCOM operators for various applications; in fact, the company has received more than $3 million in orders for this product over the past six months.

CPI's 160 W Ka-band SSPA/BUC is the most efficient in its class in addition to being the smallest and lightest in the market today.

CPI now offers Ka-band and other millimeter wave amplifiers of every type and description. The company offers TWTAs up to 700 W, GaN and GaAs SSPAs and even Ka-band klystrons up to 270 GHz. In fact, in 2016, the European Space Agency (ESA) used one such high-frequency klystron product for testing purposes.

Liquid Cooling

Liquid cooling of TWTAs and other RF components is not a new concept. As far back as the 1930s, equipment efficiencies were such that the technology practically demanded liquid cooling to maintain reliability.

However, as technology improved toward higher gain devices and more efficient power consumption, the industry turned almost entirely to air cooling or conduction cooling by the 1980s.

Fast forward another 30 years, and liquid cooling is getting another look due to requirements for higher power amplifiers (HPAs) in millimeter wave frequencies.

Combined with the latest amplifier design technologies and the inherent smaller size of higher frequency components, liquid cooling enables the design of smaller and lighter products, allowing for high frequency/higher RF power HPAs to be mounted much more closely to, or even directly on, the antenna. This greatly reduces signal loss, which is more of a problem at higher frequencies, by eliminating the waveguide run that would normally link a centralized shelter and the antenna.

Eliminating the extra size and weight that cooling fans require by installing a liquid cooling system assists in the ongoing effort to make products ever smaller and lighter.

Acoustic fan noise can also be a challenge for Earth station operators and neighbors alike. Liquid cooling overcomes that challenge by completely eliminating the need for

"B5KO" is the 160 W Peak Power Ka-band GaN BUC.

CPI added the firm's patented LifeExtender/LifePreditctor technology as an option to their 750 W ODUs and 1.25 kW SuperLinear TWTAs in 2016.

external blowers and fans. As a result of these benefits, leading amplifier manufacturers, including CPI, now offer liquid-cooled HPAs as a key part of their product range.

CPI is no stranger to advancements in liquid-cooling development and products. The company successfully designed and built an uplink Ka-band amplifier for aviation applications several years ago, using the only available liquid on the airborne platform for cooling—jet fuel.

Water is an even better conductor of heat than jet fuel and CPI has easily applied this experience to water-based liquid cooling in its existing lines of outdoor TWTAs. Several customers have recently taken delivery of liquid-cooled Ka-band and Ku-band outdoor amplifiers from CPI.

Uplink Power Control

Due to the recent significant increase of new satellites operating in frequencies that are affected by various atmospheric phenomena, customers have begun to request an uplink power control (UPC) option for their amplifiers.

This option has been available on CPI klystron power amplifiers for several years, and has now been adapted into CPI's family of TWTAs.

When a CPI amplifier is equipped with this option, the amplifier samples the strength of a downlink beacon signal and then adjusts the output RF power to compensate for any changes.

UPC is currently available on CPI's 750 W outdoor amplifiers, the TouchPower series of 750 W indoor TWTAs, 500 W Ka-band outdoor TWTAs, and the 1.25 kW Ku-band SuperLinear® TWTA.

There's Even A New Mobile App

CPI also recently released a mobile app for customers of their SATCOM products. The app is available on Android and Apple platforms.

In addition to a product configurator, data sheets, and contact information, the app includes an e-version of the popular RF slide-rule calculator that the company gave away at trade shows for years.

Innovation Driven

CPI continues to innovate and expand their already extensive line of SATCOM products and continues to be the only reliable source for all three major amplifier technologies (*i.e.*, solid state, TWT, and klystron amplifiers).

In addition, CPI continues to expand the availability of its patented LifeExtender/LifePredictor technology, which can increase the lifetime of TWTs by as much as 50 percent, via a proven and safe method that is superior to other life-extending technologies.

The company also continues to maintain an industry leading, global product support network with more than 20 locations around the world.

For more information about CPI and its SATCOM products, download the app by searching for CPI SATCOM at the Apple store or the Google Play Store.

cpii.com/

YEAR IN REVIEW: CRYSTAL

By Roger Franklin, Chief Executive Officer

2016 will be remembered as a major milestone for Crystal and our nation. (*crystalcc.com*)

The company is celebrating 30 years of service to the satellite and broadcast industry and the USA has witnessed the most dramatic election cycle since the birth of this great country. Crystal is proud to provide technology that enables the broadcast and satellite industries to better manage the distribution of content, which includes news and support of troops at home and in the field. Personally and professionally, this milestone is a great source of pride. As I look back on 30 years of working with some major broadcasters, governments, and satellite operators to improve operational efficiency, it is easy to see how dramatically the industry has evolved.

As this article is being written, Crystal has just finished an anniversary celebration at the "New" NAB Show New York, in the company of amazing industry peers who have faithfully supported the company over these last 30 years, and who ultimately made this milestone possible.

Crystal continues to grow and support customers across a wide range of sectors, especially military systems. The industry has had a number of challenges over the past 12 months, but also a number of exciting opportunities, which have encouraged new development and innovation.

CARRIER ID

In 2014, Crystal launched the Carrier ID (CID) Detection System, enabling users to verify they have the correct ID allocated to their carrier. A great deal of interest is being generated in this system from satellite operators and users alike, spurred, in part, by the current and upcoming CID deadlines. Naturally, in the first instance, CID deadlines are affecting the broadcasters as the World Broadcasting Union's International Media Connectivity Group's (IMCG) requirements for all SCPC and MCPC transmissions require all to have CID by the end of next year.

However, as I argued in *MilsatMagazine* earlier this year, the military should be embracing the technology as well if unplanned or intentional interference is to be defeated.

With the military being one of the largest users of satellites and satellite equipment, there is no denying that having them on board with the Carrier ID mandate will be a tremendous aide in the fight against interference on a global scale. The military is no stranger to the hassles of interference— they know that having CID allows for simple and almost immediate resolution. CID can also enhance the identification of the enemy through the implementation of exacting analytics.

This year has not seen the mass move by the industry to implement CID as had been expected. The lack of adoption is partly due to the FCC moving their deadline for US broadcaster implementation back to September of 2017. Next year will likely be different, as a number of deadlines are suddenly looming. As CID implementation begins, more and more users will introduce CID with all of their transmissions.

For the military, that will also mean that if you are not using CID, you may end up being instantly recognizable as a military user, and that is definitely not an acceptable position with this technology and mandate.

Crystal's detection solution enables users to ensure that CID is correctly transmitting, even when a terminal is moved. This will be particularly important in the Satellite News Gathering (SNG) as well as the military environments, where satellite equipment is often carried to remote areas and in motion during operation.

NETWORKS ARE INCREASING

Satellite networks are under increasing competition from other delivery methods. However, as Alan Young, Chief Technical Officer at Encompass, pointed out during a Teleport of the Future event Crystal hosted earlier in the year, "*Satellite still has some really strong characteristics*

when it comes to distributing video, one of those being that it is extremely reliable." He continued by pointing out that this was one of the main reasons CID is relied upon by many broadcasters.

The same can be said for a wide cross-section of satellite users—for the military, it is often the only technology able to provide connectivity in remote areas, or in a moving vehicle.

Despite stiff competition, satellite networks are increasing in number and new hybrid networks are evolving or being implemented by the satellite providers.

At the same aforementioned event, Tom Johnson, the Director of Teleport Operations at Intelsat, commented, "*What we have been seeing over the last several years is that a lot of our customers are global. These customers are in multiple teleports and there seems to be an insatiable appetite for bandwidth, and hybrid network capability.*"

As these networks grow in size, the need to monitor them increases, as well. This has been echoed by increased interest in Crystal's monitoring solution (Crystal Control™), which monitors multiple networks 24/7 and alerts to anomalies as well as records user interaction to help with training and avoid repeat issues. The company already has a number of military customers using this system across large networks, and with great success.

SUPPORTING THE ARMED FORCES

Crystal is also supporting the military in other ways—this year, the company was honored in a ceremony on August 12th with the ***Seven Seals Award*** for leadership by the **Employer Support of the Guard and Reserve** (ESGR) organization.

The Seven Seals Award is presented in recognition of significant achievement, initiative or support that promotes and supports the US National Guard and Reserve. In our case, this award was in recognition of the company's support to one of our employees, Jason Chatham and his family. Chatham serves in the Naval Reserves, Naval Special Warfare community, and has been called upon for two tours of duty since working for us. Crystal was extremely honored to receive the recognition, but in truth, it was only natural to support Jason as he fulfills this commitment to our nation through his selfless service. In addition Crystal has two other service veterans: Joe Cleveland, Sr. Account Manager for sales; and Michael Atherton, a senior service team member. Both of these servicemen are valued employees at Crystal and we are pleased to have them as part of the Crystal team. In Joe's case, he has been with the company for more than 13 years.

THE FUTURE OF MILITARY SATELLITE

Satellite will continue to be a critically important tool for military communications. At the same time, to continue to support larger, more complex networks, the technology must constantly evolve to meet the ever-changing demands.

Crystal is excited to be working in this industry and offering innovative solutions to enable the ever-changing landscape of MILSATCOM... here's to the next 30 years.

www.crystalcc.com

YEAR IN REVIEW: HILTRON COMMUNICATIONS

By Jan Molter, Managing Director

Part of the Danmon Group, Hiltron GmbH is Germany's leading integrator of satellite and wireless transmission systems for applications such as broadcasting, telecommunication and defence.

2016 has proved an active and successful year in all three of these business sectors. They are, of course, closely related both socially and technically. In social terms, broadcasting and telecommunication foster human understanding. Defence, when needed, adds extra resources when and where required to maintain global security.

AEROSPACE SATELLITE TRACKING SYSTEM

The company recently completed the installation of a global satellite tracking system for one of the world's largest aerospace companies. The system includes six Hiltron HMAM motorized satellite antenna mounts integrated with a Hiltron HACU antenna control unit and associated motor-control electronics. HMAM (***Figure 1***) is a high-precision, motorized satellite antenna mount designed for two-way VSAT communication or receive-only downlink applications. The antenna can be used for a wide range of applications that include broadcast and telecommunication downlinks.

An optional motorized feed changer allows the head to be moved quickly to a new position for switching between frequency bands. HMAM comes complete with professional-grade drives for azimuth and elevation plus a high-accuracy polarization drive. The combined head and drive form a three-axis motorized mount with 180 degrees of azimuth adjustment, 90 degrees of elevation adjustment range and fully adjustable polarization.

Each of the six installations in the global satellite tracking system is configured to operate in main-plus-backup roles. Two are located at ground stations in the southern hemisphere, two in Europe and two in North America.

Figure 1. Hiltron HMAM motorized satellite antenna.

Each HMAM mount supports a 2.4 meter dish and is fitted with a wind sensor which activates a safety lock if wind speed exceeds 80 km per hour. The system is being used in a variety of modes to ensure continuity of the client's satellite network.

NAVAL FLEET DATA & VOICE COMM SYSTEMS

In the naval communications category, Hiltron Communications also recently completed data and voice communication systems for one of the largest fleets in the NATO Maritime Group. The project was carried out in partnership with a major European company which specializes in naval electronics. This was the latest in a series of projects which has been ongoing on a ship-by-ship basis since 2011. Each installation provides the codec facilities needed for secure satellite-based communication between vessel and land, including IP network access and vocal telephony. The previous systems have proved highly reliable and are based on Vocality codecs, which are among the most efficient of their kind currently available.

Ship to shore communication is a vital aspect of naval operation and is much easier to achieve using satellite links than traditional radio technology. Vocality multiplexers provide the full range of user-facing connectivity, while managing the bandwidth used in multiplexing the services between locations. Four variations are available: portable V25 and V50plus and rackmount V150 and V200. Each voice and data multiplex offers a different layout and density of ports such as voice, Ethernet, serial data or ISDN. As they all operate the same software, their management interface is nearly identical and they are all interoperable.

LONG-RANGE LINK

Long-range links are a natural application of satellite communication technology, whether for defence or civil applications. We recently initiated a satellite link that will be used to carry broadcast television content from South America to viewers in Europe. The system is located in one of the Baltic states and needed to be live by the end of Q2 in time for the 2016 Summer Games in Rio de Janeiro. The new link is a complete turnkey solution with five active channels.

The link is designed to operate as a complete backup system, which can be switched into action if the primary feed fails. Initial planning was completed in partnership with one of the world's largest satellite fleet operators. A site survey

was conducted in the third week of February. Assembly subsequently took place at our headquarters near Stuttgart prior to factory acceptance tests, followed in turn by on-site integration, commissioning and acceptance.

SORBAS SATCOM PRODUCT SERIES

The global tracking system project is the latest in a long series of successful HMAM installations. HMAM forms the core element of our SORBAS satcom product series which is designed to form the heart of customized satellite communication systems. Other elements of the SORBAS include the Hiltron HMCS monitoring and control software, HCS universal control unit and HDCU de-icing control unit.

Another element of SORBAS is the Hiltron HCS-Core. This is a control element for tasks such as switching downconverters, integrated receiver/decoders, digital video broadcast encoders, high-power amplifiers and waveguides. HCS-Core is available in 2U high full-rack-width and half-rack-width versions. The full-rack-width model can accommodate up to 16 modules and is Hiltron's largest and most versatile SATCOM controller to date. The current range of cards includes a monitor, control and power supply for fiber optic devices, a fiber-optic switch, LNB redundancy systems for C- and Ku-band, HPA redundancy control, redundancy for DVB MPEG encoders/modulators/IRDs and a generic monitoring and control module.

The Hiltron HACU is designed to control three-axis motorized antennas. The antenna control unit and associated motor-control electronics are contained in an IP65-rated weatherproof outdoor housing with a hinged front access port secured by dual key screws. The HACU can be operated from a PC running a graphic user interface compatible with standard web browsers. The control GUI displays all the information required to set and maintain azimuth, elevation and polarization, including current and target positions plus a database of potential accessible satellites.

The Hiltron HDCU-E is a combined ice-sensing and dish heating controller for use with large satellite antennas and is capable of handling up to 450 kilowatts of power across multiple heating groups. Each group is divided into three, independently-controlled heater arrays. Each array, in turn, feeds up to three antenna heater circuits. A four-group configuration, for example, allows control of 12 arrays addressing a total of 36 heating circuits.

This modular control approach permits easy configuration of parameters such as antenna size, number of heater pads and the power requirement of each pad. Snow detection is via a reflective sensor with a polarizing filter. Each heater circuit is individually supervised and controlled via user-adjustable minimum and maximum thresholds. Sequential switch-on is performed within the controller to prevent rapid changes in current load when the antenna heating process is activated or deactivated. Sequence timing is user-configurable.

SATCOM TRUCKS & FLYWAYS

Hiltron has long been Germany's leading provider of fully integrated systems for satellite newsgathering (SNG) trucks, both before and since the switchover from analog to digital technology. The knowledge and experience gained by the company enabled us to design highly reliable, efficient and easy-to-operate solutions for mobile military communications.

The central element of these systems is the Hiltron HSACU satellite antenna control unit. This provides fully-automated satellite auto-acquisition and is compatible with all leading motorized SNG antennas. Housed in a compact rack-mountable chassis, the control unit provides easy and efficient control of three-axis motorized antennas of up to 2.4 meters diameter. Azimuth, elevation and polarization control are performed entirely in software.

Full control of the Hiltron HSACU can be performed locally or from a remote IP browser. Local control is achieved via front-panel pushbuttons and a color touch-panel graphic display. In IP remote control mode, the entire system can be controlled from wherever is convenient to the SNG workflow. Fully automated acquisition of accessible satellites can be achieved within less than 2 minutes.

An internal DVB-S/S2 tuner is provided for satellite verification. Heading determination is performed using a GPS and/or a fluxgate compass. The HACU-DSNG includes dual-axis compensation of truck inclination. It is compatible with resolvers, potentiometers, inclinometers and direct-current drive-motors.

LOOKING AHEAD

2017 looks set to be another active year in the military communications business, given the continued need for reliable, efficient and easy-to-operate tools. A significant trend is the increasing demand for compact systems that can be transported easily.

In late Q4, Hiltron completed and delivered a satellite communications flyaway system ordered by a European defence agency. This incorporates a 2.4 meter antenna and is designed to allow secure communication to be made from practically any location. The entire system packs into transit cases and can be deployed by two trained individuals within 30 minutes.

The Hiltron HMAM is operational in several defense-related systems around the world, meeting full military-market demands in terms of very high build quality, high operational precision, and ease-of-use. It has the additional advantage, increasingly important for many customers, of being accountant friendly. This combination of assets is increasingly appreciated by our clients both in the military and civilian communication sectors.

hiltron.de

YEAR IN REVIEW: HONEYWELL AEROSPACE

By Tom Hart, Vice President, Defense and Space

This has been the year of connectivity for Honeywell Aerospace.

In today's fast-paced world, the expectations are to be connected at all times, whether in the office, on an airline or even on the battlefield.

For more than 25 years, Honeywell has been a leader in satellite communications (SATCOM), and this year, the company made major advancements toward the future of connected flight by officially introducing a high-speed, consistent and—most importantly—global connectivity solution for militaries, travelers, pilots, operators, and governments around the world.

CONNECTED MILITARY

This year, the company announced the expansion of Inmarsat's Global Xpress and Honeywell's JetWave hardware for military and government use.

Global Xpress will provide the same consistent and high-speed connectivity experience for military and government users that commercial users receive, improving situational awareness while enabling soldiers to communicate more effectively in battle.

Together, Honeywell's and Inmarsat's connectivity solutions will usher in a battlefield of the future that's not inhibited by spotty, slow and unreliable connectivity.

Military personnel will have unprecedented communication capabilities to provide live video updates and share information across the world using high-speed, high-bandwidth and secure connectivity.

Crews in the air will experience the same WiFi experience as they would expect to receive on the ground, enabling advanced communication capabilities to improve situational awareness and mission success.

Why is access to consistent and reliable high-speed data important for the military and government? In today's military environments, aircraft generate massive amounts of data that needs to be shared to keep a tactical advantage in battle.

Honeywell is uniquely positioned with deep expertise in avionics, engines, satellite communications, and software-based services to connect this data to the people who need it, who make it actionable and who use it to make informed decisions.

Honeywell's hardware and the Global Xpress service will provide users with data speeds on average of 8 to 16 Mbps. However, it's the ability to transmit globally and uniformly at this speed—without interruption—over very long distances and in non-traditional flight paths—that is the key differentiator.

CONNECTED AIRCRAFT

For the past several years, one of Honeywell Aerospace's primary missions has been to bring better connectivity to the sky.

The company wanted to provide an in-flight WiFi solution that works just like being at home or in the office. This solution needed to be built to support today's connected consumers and provide reliable and global service. There was no option of downtime.

In 2016, the company achieved a major milestone with the firm's partner, Inmarsat, and accomplished a joint goal for global, reliable connectivity by launching the Global Xpress connectivity system.

The company spent two months testing Global Xpress during a world tour on Honeywell's 757 flying test bed, flying more than 45,000 miles to more than 10 locations around the world.

During the trip, connection was sustained over land and sea, demonstrating that Global Xpress could provide fast and reliable connections anywhere on the planet.

This demonstration showcased that Honeywell's JetWave SATCOM hardware was ready to enable business and commercial aviation aircraft to connect to Inmarsat's Global Xpress Ka-band service, bringing more bandwidth, data storage, processing and better in-flight connectivity to the aviation industry.

Better in-flight connectivity means new capabilities and opportunities for all involved in flight. Pilots now have more information about the flight environment than ever before.

Through mobile apps, flight support services can provide instant weather updates, optimize air traffic management, and provide increased situational awareness for better decision-making and flight planning.

For maintainers, improved connectivity means faster and more efficient flight operations with access to connected tools, including remote diagnostics of aircraft systems and the ability to dispatch maintenance crews before the plane even lands. For instance, maintainers can get data on usage and faults from connected wheels and brakes or connected engines in real-time to troubleshoot a potential problem.

Passengers also enjoy a new level of comfort and entertainment while in flight. They can stay connected and use their mobile devices like they do on the ground, connecting to family and friends by surfing the Internet, videoconferencing, using social media, sending emails, streaming videos and more.

LOOKING FORWARD

While the company was delighted by these major advancements toward the future of military communications, Honeywell Aerospace didn't want to stop there.

This year, the Global Xpress network was launched, and the service is now live for commercial, business and defense users. Honeywell's JetWave hardware has been certified by Inmarsat and Honeywell and Inmarsat have expanded the network and service beyond general and commercial aviation markets to military and government customers. By continuing to incorporate software solutions into aircraft and improving data sharing and storage capabilities, Honeywell is helping to usher in the dawn of the connected aircraft.

aerospace.honeywell.com

wifithatflies.com

Tom Hart has been with the company for more than 19 years and is the Vice President of the Defense Aftermarket Americas business for Honeywell Aerospace's Defense and Space business. In this role, he is responsible for providing strategic and tactical leadership to achieve the business objectives for Honeywell's Defense Aftermarket business, consisting of all US Department of Defense, Canada and commercial helicopter customers across the Americas.

Honeywell Aerospace JetWave™ antenna installation.

YEAR IN REVIEW: HUGHES DEFENSE & INTELLIGENCE SYSTEMS

By Rick Lober, Vice President and General Manager, and MilsatMagazine Senior Contributor

This past year has generated great optimism at Hughes, as the commercial satellite industry and the Department of Defense (DoD) have worked in conjunction to define much needed technology and innovation strategies for the future.

From discussions about the Wideband Analysis of Alternatives (AoA) to deploying commercial satellite technology for greater resiliency and security, Hughes notes an increased interest from military users and decision makers to formally implement commercial technology into the military space architecture.

As we anticipated, the need for advanced airborne ISR capabilities continued to grow throughout 2016, with demand including both manned and unmanned platforms. Effective airborne communications requires adaptable technology in space as well as on the ground, where equipment must support mobility for all types of users, incorporating technical enhancements to support continuous connectivity, open architecture designs, and various security and cyber safeguards.

All of these actions are driven by one crucial requirement—ensuring military agility and responsiveness. During this year, the DoD keenly focused on the need for advanced technological innovation to support these evolving requirements.

Hughes Defense & Intelligence Systems Division (DISD) anticipated the growing needs and produced a new advanced product in our HM200 modem that provides an open architecture, which allows the modem to work seamlessly with any qualified antenna as well as special security enhancements for operation in contested environments.

To further demonstrate the much-needed capabilities of the HM200, Hughes was selected to provide airborne SATCOM by a variety of manned and unmanned ISR platform integrators in 2016. This area remains poised for growth in 2017 as we also look to grow our offerings to deliver high quality en route airborne SATCOM, similar to our commercial airline solutions.

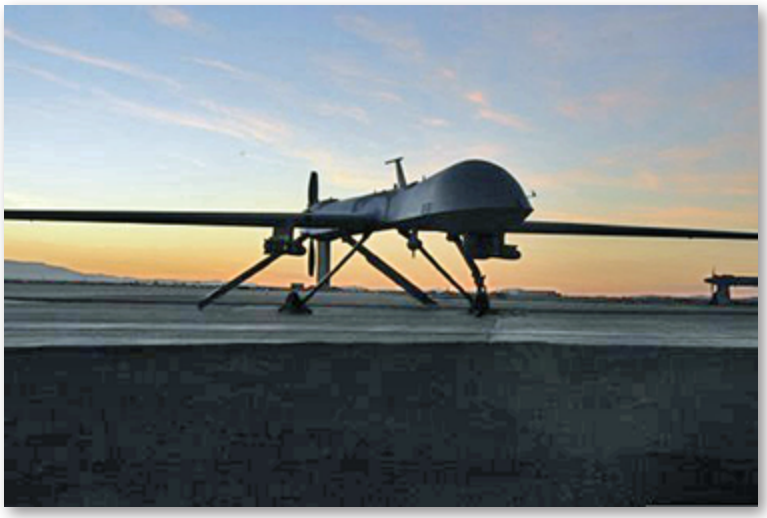
Hughes is continuing to see two major elements as key to enhancing the agility that the company's terminals can provide. The first relates to the SWaP footprint of equipment and hardware. For mobile users and platforms to truly be agile while "on the move," their equipment must be small and lightweight. This cannot be overlooked, as unmanned aerial platforms continue to get smaller, while demands on their capabilities increase.

With equipment manufacturers increasing their focus on small and low-power antennas and modems, the Hughes HM200 airborne modem meets these new standards and can provide data rates over 10 Mbps, even on rotary-wing platforms. These manned and unmanned rotary-wing platforms depend on cutting-edge satellite technology to support their constantly changing missions and environments.

Military leaders worldwide have told us we must continue to innovate, with the goal being to deploy this technology to deliver full connectivity in only minutes. These innovations around SWaP have breathed new life into SATCOM equipment manufacturers, as the hardware in this arena was once considered too big to operate efficiently in the field. Hughes has now achieved reduced airborne system SWaP footprints that also boast roll-on/roll-off capabilities for certain vehicles for rapid deployment.

The other critical element in supporting terminal agility is open systems architecture for military satellite communications networks. Commercial SATCOM system providers have designed their technology to seamlessly augment and complement military satellite communications capabilities. In the contested space environment, diversifying the range of communication paths creates greater resiliency while also complicating the ways that adversaries can target critical space resources. As we see payloads, sensors, software, and computing algorithms and devices continuing to evolve much faster than the vehicle platforms, creating new interoperable component/subsystem interfaces for enhanced modularity represents an opportunity to minimize future lifecycle costs and adapt rapidly to changing threats or newly available technologies.

Hughes continues to focus on terminals and the supporting modems to augment this flexibility and to



enable faster sharing of vital information. The company's mission is to ensure that US commanders have the option of strictly using military assets or relevant commercial systems—or a combination of the two—to give them the most operational flexibility and effective capability across various frequency bands.

Beyond the growing agility requirements, security continues to play a large part in the new technologies that DoD is considering. DoD's work in cooperation with commercial technology companies, such as Hughes, is showing the DoD users that protected tactical communications is a very big priority. Hughes knows that a cost-effective and efficient approach to protected tactical communications is critical, especially as our potential adversaries' ability to disrupt communications for those systems continues to grow. Recognizing this need in addition to the urgency for more resiliency and agility in space, Hughes sees a possibility for protected tactical capabilities in the near term.

Since 2012, Hughes has developed in-depth experience with the integration of secure waveform enhancements. In addition, the company has deep knowledge in design and development that can help create considerable cost savings sooner, while also extending communications capabilities.

2016 has been significant in creating more industry-government collaboration on how best to design and implement next-generation capabilities.

Today's information-centric military, operating in a contested environment, wants to work with commercial providers to fulfill its needs for more flexible systems. The military doesn't want closed systems; they know they want interoperability and must have it sooner rather than later. With the Wideband AoA ready to be introduced and in-depth planning about to start, Hughes would like to see more commercial capabilities and requirements built into the plan from day one, not as an afterthought when the need for more bandwidth arises months or years into the program.

There needs to be long-term commitment that promotes agility and cost efficiencies; having the government simply buy a transponder for three months is not a sustainable action plan. All of the innovation discussed here shows that the time and the ideas are ready now.

Hughes looks forward to an active 2017 in the continuation of the intersection of the military and commercial satellite space and the relationship building that comes with such a dynamic blending.

defense.hughes.com/

Rick Lober is the Vice President and General Manager of the Defense and Intelligence Systems Division (DISD) at Hughes Network Systems, LLC. In this role, he is responsible for applying the company's broad range of SATCOM technologies and services to the worldwide defense marketplace and intelligence community. This includes both fixed Ku-, Ka- and X-band VSAT and mobilesat products and systems. Applications cover satellite communications on the move for both ground based an airborne platforms along with numerous classified development programs.

YEAR IN REVIEW: IDIRECT GOVERNMENT (IDIRECTGOV)

By John Ratigan, President

2016 was a pivotal year for iDirect Government—for the first time in nearly a decade, the company introduced a new hardware platform, the 9-Series, that is smaller, more powerful and with improved efficiency than previous offerings—the 9-Series was definitely worth the wait.

The 9-Series portfolio of remotes and defense line cards brings greater spectral efficiencies and enhanced performance to our government customers, and positions them to be able to receive multiprotocol encapsulation (MPE) broadcasts such as Global Broadcast Service (GBS).

The 9-Series now allows the user to support both one-way and two-way TRANSEC and is certified at FIPS140-2 Level 3. The series consists of the 950mp, which takes the technology to new heights.

Our engineering team has been able to cut the size of its predecessor, the 850mp, in half, as well as simultaneously cutting the power consumption and weight in half, all while doubling the device's performance. The benefit is that our integration customers will now be able to design smaller, lighter terminals for the firm's government users—the new terminals will operate at a higher speed while using less power and generating less heat.

The 900 board and 9350 remote both have dual demodulators. This allows the remotes to support two separate data streams.

The DLC-T and DLC-R next-generation defense line cards enable secure voice, data and video satellite communication links and allow the 9-Series remotes to operate on the new high throughput satellites (HTS). The DLC-T supports one-way TRANSEC and is DVB S2X ready. The DLC-R has an on-board TRANSEC module, can support as many as 16 channels and offers as much as four times more composite Msps and two times increase in per channel time division multiple access (TDMA) and Adaptive SCPC returns.

iDirect Government also introduced 3.4.1 Evolution software, which brings the 9-Series to life. The software supports the 950mp, 900 and 9350 remotes, as well as the DLC-T and DLC-R defense line cards—all from a single platform, enabling 9-Series remotes to operate and coexist in future networks. This helps defense and government customers to easily transition to future software releases.

LISTENING TO CUSTOMERS

We are happy with both the platform and software the company has developed thus far and these innovations would not be possible without great customer feedback and input.

The way the firm handles product development is different from other companies' approaches. iDirect Government operates in a non-traditional format in that we spend our own research and development dollars to develop our products based on the feedback from our customer base. This is done in order to more quickly respond to customers and market needs. Our customers had a direct role in planning the 9-Series and new features in the Evolution software.

Decisions are made based on input from the customer base and then a common intersection of the needed features is developed. Customers want to stay with us, which means providing them with next-generation technology. This allows the firm to move a lot faster this way instead of waiting for a contract.

What iDirect Government develops is perfectly aligned to what customers require. One of the latest features developed from this approach is the dual demodulators. The company developed a satellite technology platform and software that works well and added features to enable customers to easily upgrade to new software.

As an example, with the new 9-Series, a customer can initiate a network with Evolution 3.4 software and then, when available upgrade to 3.5, to have the ability to operate both 3.4 and 3.5 remotes in the same network.

The flexible and scalable 3.4 software enables the 9-Series remotes to operate and coexist in future networks, helping defense and government customers to easily transition to future releases.

All of these new products and enhancements allow for increases in the firm's customer base and into new markets, such as GBS. As of this writing, there are new products on the horizon that include the Tactical Hub, which is a ruggedized, compact, durable and deployable solution that is easy to set up due to the unit's reduced size, weight and power (SWaP). The new Tactical Hub is powered by Evolution software and works with our entire remote portfolio.

However, with all of the successes, the year was not without challenges. One of the biggest challenges for the company during 2016 was trying to move our company as fast as the market wanted. We introduced solutions a bit slower in MILSATCOM due to the sensitivity to networks and making sure such networks are reliable and always available—meaning no failures.

On the horizon for 2017 for iDirect Government are 9-Series enhancements, a 3.5 software release and new aero modems.

The new aero modems are specially designed for military customers to support their vast data and high-speed requirements. The 980 airborne modem, which can operate at altitudes as high as 55,000 feet, allows for a monumental increase in data off the aircraft.

The 980 features improved performance, dual demodulators for make before break beam switching, spread spectrum returns and skew angle compensation support for aeronautical operations, enabling the use of ultra-small and phased-array antennas on military aircraft. The 9800 AR/AE incorporates the 980 module into a fully integrated package.

iDirect Government's 980 integrated satellite router board

HTS IMPACTS MILSATCOM

On the industry front, HTS technology in 2017 will continue to advance SATCOM, while offering Department of Defense (DoD) users the high quality, consistent reliability and lower costs they need.

HTS represents a big change in SATCOM as this new technology enables beams to be focused with a strong signal and, therefore, a stronger, concentrated signal that lends itself to higher data rates on standard-sized antennas as well as high-speed operations. HTS is the biggest paradigm change since the start of the satellite industry.

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

The company expects 2017 to be a big year with products, and the firm looks forward to serving customers' needs by continuing with our customer-centric development approach in order to meet customer requirements whenever and wherever they need MILSATCOM.

idirectgov.com

John Ratigan serves as President of iDirect Government. He started the federal group for iDirect Technologies in 2003 and then established iDirect Government as a wholly owned subsidiary in 2007.

Under his leadership, the group has enjoyed tremendous growth, deploying thousands of terminals in support of Operation Iraqi Freedom and Operation Enduring Freedom, as well as many civilian networks.

Ratigan brings more than 20 years of experience in the satellite communications arena. Prior to joining iDirect Government, Ratigan ran the East Coast operations for both Fairchild Data and EFDATA, and eventually partnered in his own company that helped EFDATA grow from $20 million to $120 million in revenue and as many as 700 employees in 2000. EFDATA became the preeminent leader in SCPC satellite technology in the late 1990s and provided the baseline knowledge and expertise that would later benefit his role with iDirect Government and the migration of technology into TDMA. In addition to starting his own company, he held the position of senior vice president of North and South American sales for the start-up, Broadlogic, as companies started to run IP directly over satellite.

Ratigan began his career in the United States Senate working for Senator Bill Armstrong (R-Colorado), then joined the legal sales team at the Xerox Corporation. He holds a Bachelor of Science degree in marketing from the University of Maryland.

YEAR IN REVIEW: INMARSAT

By Peter Hadinger, President, United States Government Business Unit

A phrase familiar to many in today's armed forces is *"First There"*—this motto was adopted by the US Air Force Special Operations Command's combat controllers, an exceptionally brave group who are first on the ground in uncertain environments.

The motto captures the combat controller's commitment to mission success and to leading the way for other forces to safely follow.

"*First There*" is a good way to describe the work of satellite communications (SATCOM) industry leaders and Inmarsat's partners in government over the course of 2016. Such hasn't been easy, but with determination and forward looking partnership, and a bit of government bravery, great progress is being made and the path to success is being illuminated.

2016 has seen a germination of a government/private industry partnership that is expected to transform the way the military pursues SATCOM acquisitions. Such a partnership will enable the Department of Defense (DoD) to augment its capabilities, while ensuring resiliency in space. It would support seamless, satellite-driven connectivity and functionality, allowing government users to operate anywhere the mission takes them, while promoting greater flexibility and efficiency. Indeed, the following major developments of 2016 speak to the impressive momentum that is building for such a partnership:

- *The National Defense Authorization Act (NDAA) for Fiscal Year 2016 promises to advance the partnership as a means to consolidate, streamline and improve SATCOM acquisitions. It calls for the Secretary of Defense to conduct an analysis of alternatives (AoA) for a future wideband communications architecture that would follow the current Wideband Global SATCOM system (WGS) which includes space, air and ground-layer communication capabilities. In addition, it approved a pilot program through which the Secretary of Defense would deploy a variety of methods to "effectively and efficiently acquire commercial satellite communications services." The plan will contain a detailed cost assessment of SATCOM services, including the projected savings of such consolidation.*

- *As part of the AoA initiative, the Air Force is seeking industry input on the capabilities that commercial companies can provide to satisfy future government needs. Winston Beauchamp, Deputy Under Secretary of the Air Force for Space and the Director, Principal DoD Space Advisor Staff, and Maj. Gen. Roger Teague, Director, Space Programs, Office of the Assistant Secretary for Acquisition hosted several meetings with satellite industry representatives to engage them in dialogue to help shape the wideband AoA. The Air Force expressed keen interest in bringing commercial operators into the analysis to determine the right way forward, rather than simply buying more DoD-owned satellite assets. As part of its analysis, the Air Force is expected to explore new or innovative business relationships with SATCOM suppliers, such as the managed service model. This is a significant recognition of the capabilities the private sector brings to the military's operational picture to augment its legacy satellite resources and to ensure robust and globally accessible wideband delivered as a service in a contested and budget-constrained environment.*
- *US Strategic Command's Joint Functional Component Command for Space announced that it plans to formalize the permanent presence of commercial satellite owner/operators within the Joint Space Operations Center (JSpOC). This follows last year's launch of the Commercial Integration Cell (CIC) pilot program at the JSpOC, one through which Inmarsat and five other satellite services companies—DigitalGlobe, Eutelsat, Intelsat General, Iridium Satellite Communications and SES Government Solutions—have formalized partnerships with the government under the guidance of Cooperative Research and Development Agreements (CRADA). Literally working on the JSpOC floor every day, the CIC has helped the government achieve greater space situational awareness while enhancing the command and control capacity of JFCC Space. It has focused on the improvement of processes and commercial/government integration in conducting conjunction (or debris) assessments and addressing electromagnetic interference and resolution.*
- *"The CIC is a method of pursuing greater cooperation and synergy in the space environment by integrating liaison personnel from the commercial space operator sector within the Joint Space Operations Center*

under the governance of Cooperative Research and Development Agreements," said Rear Adm. Brian Brown, deputy commander at JFCC Space. "The CIC will help facilitate rapid identification, diagnosis and resolution of on-orbit anomalies while also increasing the overall resilience of US government satellite operations."

- *Rep. Jim Bridenstine (R-Okla.) formally introduced his proposed American Space Renaissance Act, described as a "Sputnik moment" intended to advance the "incentivizing (of) industry to innovate and thrive here in the United States." The act encouraged agencies to acquire more services —such as communications, remote sensing and weather data—from private satellite operators. It proposed the authorization of $27 million to competitively award no less than four contracts, with consolidation as the ultimate goal. "It seems like within the national space enterprise, there is a Department of Defense space enterprise, a commercial space enterprise, a civil space enterprise," Bridenstine said in introducing the bill. "There doesn't seem to be one national space enterprise. What we're trying to do is to bring a lot of elements together and make sure that in the end, the technologies being advanced are relevant to all the different enterprises that exist."*
- *Lawmakers have incorporated some of the bill's language into this year's NDAA, including the implementation of preliminary steps needed to transfer space situational awareness oversight from the DoD to the Federal Aviation Administration (FAA), as part of a broader plan to eventually hand over space traffic management duties to the FAA.*
- *Doug Loverro, the Deputy Assistant Secretary of Defense for Space Policy, said during an interview at the 32nd Space Symposium that the Pentagon is in the early stages of revising its space policy for the first time in more than three years, in response to recommendations from the 2014 Space Strategic Portfolio Review. The changes are intended to better utilize commercial offerings to augment military and intelligence satellites—a mandate for a level of resilience in space and on the ground, which ensures the Pentagon has access to satellites it requires for national security at all times and can operate them within any situation, including an attack. Through the increased acquisition of available capabilities via an industry partnership, the DoD can "harmonize policy and the use of commercial space," Loverro said.*

The industry welcomes these and other developments as a forward-looking means of innovation in acquisition and to insert more agility for the end-user. It also clearly illustrates how the future of DoD SATCOM modernization depends upon the industry partnership.

Senior government leaders are acknowledging the need to rely upon commercial satellite communications (COMSATCOM) for the adoption of an enterprise-level, completely integrated SATCOM architecture and strategy. For too long, disconnected procurement practices—frequently driven by Lowest Price Technically Acceptable (LPTA) mandates that lend to commoditization—have forced real value out of timely and effective solutions, eventually resulting in delays and cost overruns, which inhibit the ability to deliver the much-sought robust connectivity to servicemen and women in support of their missions.

In contrast, an integrated architecture will enable the DoD to leverage both COMSATCOM and military satellite communications (MILSATCOM) as a strategically planned holistic capability required for successful mission execution. A strong, forward-looking partnership between the government and industry is required in order to ensure that this vision takes flight, so the warfighter has robust and globally-accessible trusted capabilities.

The satellite industry offers a wide range of capable solution sets well suited for government applications. Additionally, newer business models such as SATCOM as a Service are ideally suited for the type of business models the government is exploring to add greater efficiencies and responsiveness to the DoD requirements, in contrast to broadcast-centric fixed transponder leases.

SATCOM as a Service allows users to leverage COMSATCOM for core functions, while seamlessly integrating with MILSATCOM to address any remaining gaps for superior redundancy, diversity, protection, scalability and global portability—the ideal resiliency approach. It frees up military members from the administering of disparate networks so they can focus on their missions.

With SATCOM as a Service, information flows instantly from Point A to Point B using commercial capacity alongside MILSATCOM such as WGS. As a result, military users employ their existing WGS-certified terminals to affordably attain optimal efficiency and functionality. When world events trigger usage spikes, increased capacity can be readily accessed. Thus, mobile users benefit from the most flexible and immediate of technologies without the need to invest in additional stove-piped or piecemeal infrastructure.

2016 has been a year in which the "First There" attitude of industry and government leadership has led the way for the great changes to follow. I cannot help but be immensely encouraged by the spirit of collaboration taking hold and the recognition that we all can act to enhance space resilience while helping the government save taxpayer dollars and better support end users.

In looking ahead to 2017, I am highly confident that the partnership will continue to retire dysfunctional, siloed SATCOM acquisition processes while empowering government and industry leaders to make an integrated "whole" which is much greater than today's sum of its collective intellectual capital and experience "parts." With this, we will forge more capable and resilient satellite systems —creating immeasurable advantages for military users.

First There!

inmarsat.com/government

YEAR IN REVIEW: IRG (SATELLITE INTERFERENCE REDUCTION GROUP)

By Martin Coleman, Executive Director

2016 has been another busy year for IRG and, as always, activities have involved the IRG Directors traveling around the globe, attending, and in most cases speaking at, industry events, and we have also presented IRG-led events in Dubai, Washington D.C. and Oslo.

As we move closer to 2017, reflecting on the shifts in the military perspective of satellite interference is quite interesting.

IRG has, for some time now, been discussing with military representatives the importance of getting involved with many of the RFI initiatives that are currently available. This is partly because, as one of the largest commercial satellite users, the military is also affected by interference, whether self-imposed or otherwise and, therefore, to really have an impact we need the entire industry on board.

As I commented in my article in *MilSat Magazine* earlier this year, if commercial military services are the only transmissions without Carrier ID (CID), there is a strong likelihood those transmissions will be instantly recognizable as from military sources.

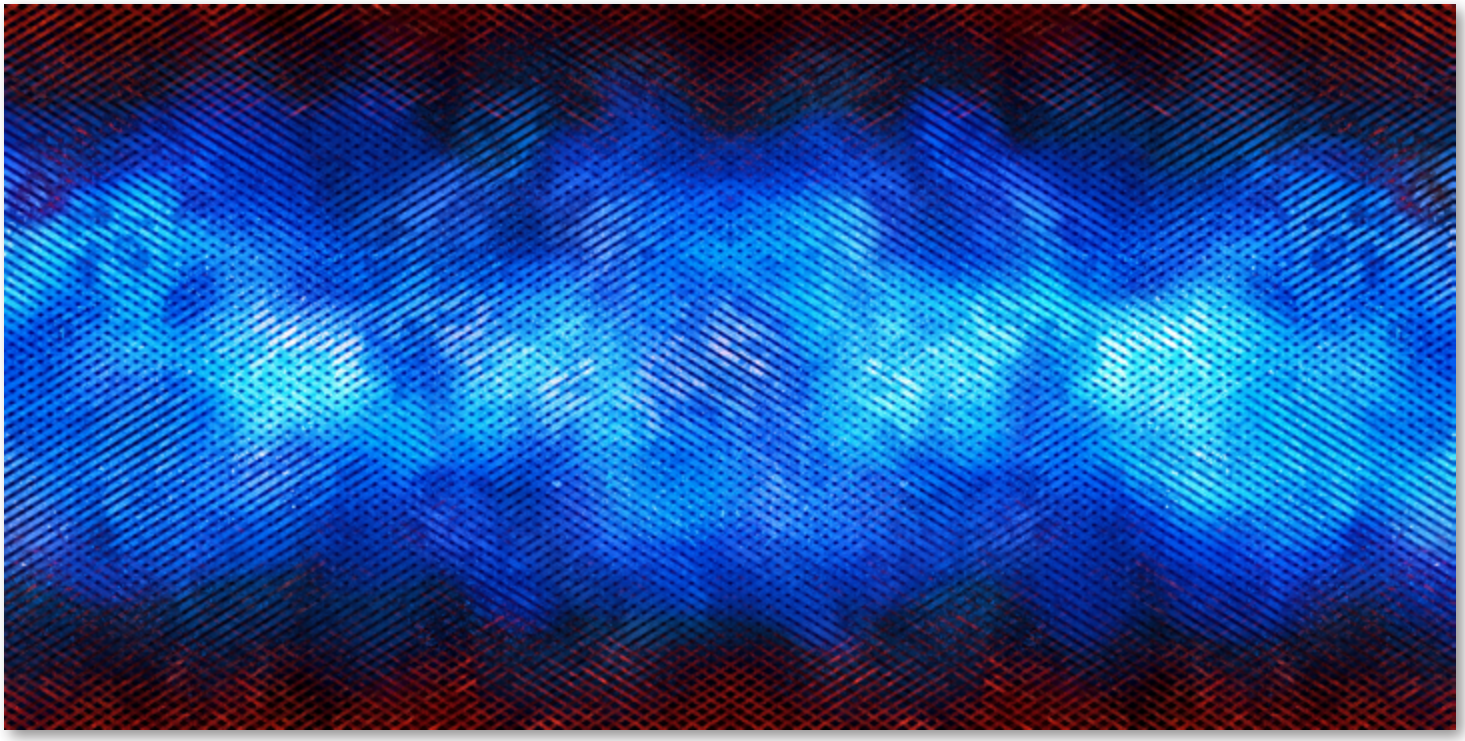
SPREADING THE WORD

I have, therefore, made military events an important part of this year's IRG strategy and was delighted to get the chance to present at Defence Satellites in May of 2016.

Satellite Interference was covered—the effect on the military, talking about why the military should care about resolving interference in all its forms and how it can also have input into commercial services operations. Overall, this presentation was well received and some were won over—at least, some in the room.

As well as having a presence at military events, IRG has tried to bang the interference drum for military involvement through articles in magazines, such as *MilsatMagazine*. I'm pleased to report that these features are having an effect.

IRG has accepted a number of new members this year, including a military entity that cannot be mentioned by name. That is quite encouraging, and the organization is noting that more military entities and associated innovators, such as Airbus, joining the IRG team and taking an interest in the topic and becoming informed as to what can and should be done to reduce and resolve this problem.



In addition, a number of discussions with military operations within Europe and the US have been continued, encouraging further participation and involvement. The IRG directors are working on getting one of our 2017 workshops to be hosted by a military organization, and that is very much work in progress.

GATHERING EVIDENCE

One of the key components when it comes to educating the industry about interference is being able to talk about real life cases. To that end, IRG has begun gathering case studies from members. These case studies can be used in a variety of ways, depending on the nature of the issue.

IRG workshops and events are always full of highly informative and detailed case studies; however, the organization needs to improve the ability to get these studies into other formats for distribution across other channels.

I hope that we can build a massive catalog of this type of content—and not necessarily just from members. Case studies serve to raise awareness of interference as an issue as well as allowing others to experience similar cases in order to gather ideas as to what could be causing interference and how to resolve that challenge.

One of the case studies written so far involved a case of radar interference—a resolution was conceived that involved several satellite operators all working together.

Kratos provided a case study about how they were able to detect interference for a customer using their monitoring solutions. The IRG is still looking for more of this type of content—if you have resolved a case of interference and think that your solution could make an interesting story for others, please let the organization know.

CARRIER ID

I can audibly hear the groans as the audience reads that heading, as I know CID has been one of the topics IRG has been promoting for a number of years now.

A lot of the groundwork has been done, but 2016 seemed relatively quiet for CID after a massive wave of activity with standards and technology in recent years.

The FCC moved its deadline back for US broadcasters to become CID compliant and the organization's initial reaction was one of disappointment. However, after some reflection, this isn't all bad news. Quite the contrary,this it means they are taking CID seriously.

The industry simply wasn't ready this year, but that is starting to change. I believe we should be ready for the new deadline of September 2017—this means that all of those affected by the FCC guidelines need to start implementing and testing CID now to ensure their adherence.

The real issue for military use of CID is the technology. Yes, the technology is present in all of the new modem and modulator models—DVB-S2X has made that possible. However, those commercial services that require CID cannot necessarily change their existing technology overnight just to satisfy the CID requirements.

That is why IRG is looking at the development and production of a cost effective add-on unit—initially L-band—to connect at the transmit output of any modem, etc. This would allow many services to be quickly, effectively and inexpensively upgraded over the next few years. This would create a practical way forward for military services to become compliant without the need to re-equip.

The FCC deadline, which is followed in January 2018 by the guidelines issued by the World Broadcasting Union's International Media Connectivity Group's (IMCG) for all SCPC and MCPC transmission to have CID, will certainly lead to industry implementation.

As more and more users begin to adopt the standard, the military will need to follow suit to become just another "number plate" in the sky. Also, on the flip side, the more users with CID, the easier it will be to identify and resolve issues when errors are made accessing satellites.

MOVING INTO 2017

I would like to see even more interest and involvement regarding CID from the military. IRG has been asked to speak once again at Defence Satellites, this year in Rome in May of 2017. This event was a really great platform last year so I'm excited that IRG has been asked to return.

IRG will also continue with a presence at other, similar events. My team will be ensuring a more military focus at our IRG workshops, which have participants focus intently on the key points and solutions for the resolution of interference.

satirg.org/

Martin Coleman is Executive Director, the Satellite Interference Reduction Group (IRG). Martin is responsible for spearheading a number of significant initiatives and is committed to introducing new technology and processes to mitigate all types of satellite interference: VSAT TDMA Systems, BIG Data; a reference guide to Interference; sorting out those Difficult Cases including new standards and processes within the Geolocation industry; assisting the ITU in dealing with Harmful Interference; and implementing Carrier ID (CID). Martin regularly addresses the industry on the subject of satellite interference, at global industry events, on an individual basis, and at IRG-led conferences and webinars.

YEAR IN REVIEW: KRATOS DEFENCE AND SECURITY SOLUTIONS

By Stuart Daughtridge, Vice President, Advanced Technology

Mr. Daughtridge, 2016 has been a year of some change in the satellite industry with the growth of HTS satellites and the drop in bandwidth costs impacting both satellite and network operators alike. What are Kratos' views on these changes?

Stuart Daughtridge (SD): Well, in addition to HTS's impact on bandwidth capacity and costs, traditional satellite ground systems have been challenged by other industry trends such as the emergence of "Everything over IP" and virtualization, a changing competitive environment and the growth of managed services.

Let's take them one at a time. What's your take on HTS and their impact on bandwidth pricing?

SD: HTS is massively increasing the amount of capacity and driving down prices. However, lower bandwidth costs will enable services that support a wide range of new applications and in the long run will help drive growth in the industry. If you look at the cell phone industry, they continue to offer more data for roughly the same amount of money, yet the industry continues to rapidly grow despite steadily decreasing cost per MB.

How so?

SD: The satellite industry will be able to enter new markets and services from which they were previously economically excluded. Many of these markets will require new ground technologies to be more software-driven than hardware-based to support new applications.

The mobility market is a perfect example of this. Over the last 10 years, technology improvements in antenna systems and amplifiers, along with the growth of the Internet and the need for connectivity, have made the mobility market a significant, exciting, growth market for the satellite industry.

Has the growth of High Throughput Satellites (HTS) had an impact on interference?

SD: Yes, HTS come with their own unique challenges. HTS, due to their spot beam designs, tend to make intentional interference more difficult. However placing so many high-powered beams and satellites closely together, targeting more VSATs with ever smaller, low cost dishes with increasingly sensitive receivers, and the growth of mobile applications are likely to increase the incidents of accidental interference.

This has led to the development of specially designed signal monitoring sensor systems that can be deployed and operated at much lower cost for HTS spot beams. At Kratos, we leveraged our Monics® carrier monitoring system technology to develop Monics 200. Designed for spot beam monitoring, Monics 200 automatically, and cost-effectively, determines modulation type, symbol rate, measured Eb/No, and detects and analyzes interfering signals affecting spot beam transmissions.

In addition to needing tailored monitoring HTS sensors, RF management systems also need to be enhanced with advanced visualization and management tools that provide the operator with the information needed to quickly identify, characterize and rectify problems when they occur. The goal is to enable operations teams to manage the significantly greater bandwidth without having to increase personnel resources.

Last September, we introduced Monics Enterprise to provide these advanced visualization, data management, and sensor management capabilities…and, I'm happy to say, it is already being embraced by satellite operators around the world.

What about VSAT-related interference?

SD: Very Small Aperture Terminals (VSATs) Time Division Multiplexing access (TDMA) networks have been growing dramatically to support data and enabling more efficient bandwidth use, and HTS satellites will only accelerate this growth.

VSATs account for approximately 40 percent of all accidental satellite interference and since a VSAT network can have thousands of terminals, identifying the one or more causing the interference can be a daunting task. Fortunately, new technologies on the market can find and mitigate VSAT interference quickly and effectively. One such product, SatGuard, can actually identify the terminal(s) causing adjacent satellite interference by extracting terminal ID number(s).

Please explain "virtualization."

SD: Virtualization is not a new technology by today's standards. It is, however, somewhat new to ground systems.

Virtualization is happening in many different ways. Traditional satellite software products are moving to a virtual machine environment to reduce operations and maintenance costs, while improving availability. In addition, digital IF technologies like Kratos' SpectralNet® are enabling the separation of the

RF/antenna systems from the processing equipment. This effectively virtualizes the RF/antenna systems, while also enabling the consolidation of processing equipment into fewer, yet higher density computer platforms.

The migration to virtual ground architectures and the virtualization of hardware products into firmware and software applications will result in simplified and more cost effective ground infrastructures, while enabling more dynamic services.

For example, HTS operators can greatly reduce the costs of the multiple gateways needed for spot beam satellites by removing the processing capability from the gateways and, instead, establish regional processing centers. In this case, digital IF can link the gateways to the regional processing centers.

How do you see the industry changing?

SD: As customers become more focused on connectivity, service providers have to provide solutions that include the integration of satellite and terrestrial networks. This convergence of technologies is driving a real shift in our customers' engineering capabilities, from RF expertise to IP expertise and the proliferation of hybrid satellite and terrestrial networks.

Products such as Kratos' NeuralStar® SQM are transforming network management into end-to-end service quality management solutions by combining teleport equipment management, with true enterprise level network management, and RF signal management. It gives operators true end-to-end visibility into the network, providing the information and tools to optimize revenue and profits, based on network performance and customer Service Level Agreements (SLAs).

Your last point, managed services growth, please explain...

SD: In a managed services environment, companies don't sell equipment or software to the client, but instead assume responsibility for operation of key functions, thus enhancing efficiency and flexibility. The explosive growth in the satellite business has greatly increased the need for RFI or EMI monitoring of military satellite communications as well as commercial SATCOM. With so many satellites operating on common frequencies and orbital slots, there are frequent opportunities for SATCOM interference. The Department of Defense (DoD) is increasingly relying on commercial companies for interference monitoring and geolocation services.

Kratos' contract with the Joint Functional Component Command for Space (JFCC-Space) is a good example of this cooperation. JFCC Space is responsible for executing continuous, integrated space operations to deliver theater and global effects in support of national and combatant command objectives. This includes monitoring and protecting the commercial satellite bandwidth leased by DoD.

We provide JFCC Space with a managed services offering whereby we are responsible for RF monitoring, interference detection and geolocation services for all DoD leased Ku-, C-, and X-band commercial bandwidth worldwide. DoD relies on commercial bandwidth to support critical mission needs, including reconnaissance, surveillance and broadband communications between commanders and field units. Our program with JFCC Space illustrates the increasingly important concept of government agencies utilizing commercial managed services so uniformed personnel can focus their attention on critical mission-related activities.

The supplemental COMSATCOM support provided by Kratos and other companies is especially important in light of the fact that an estimated 80 percent of US military satellite communications are carried by commercial satellite operators, rather than by MILSATCOM systems.

kratosdefense.com/

Mr. Daughtridge has been with Kratos-Integral Systems since 1999, and in the satellite and aerospace industry since 1986. In his current position, Mr. Daughtridge leads Kratos' satellite ground segment technology initiatives. These currently include advancement of signal cancellation and digital IF applications, virtualization of ground system operations and development of monitoring and managing technologies for HTS satellites. Additionally, he leads advanced technical planning for the next generation of ground segment technology.

Prior to his current role, he held several senior management positions, including SVP & GM of the Integral Systems Products Group, SVP & GM of the Integral Systems Commercial Group, as well as Program Manager of several major commercial programs. Before joining the Company, Mr. Daughtridge held various management and engineering positions with Orion Satellite Corporation, Intelsat, and Spacecom. Mr. Daughtridge holds a Bachelor of Science from Lafayette College.

YEAR IN REVIEW: L-3 NARDA-MITEQ

By Mitch Haft, Director of Sales

For Narda-MITEQ, 2016 was a most interesting year—in 2016, the merger of two very significant microwave companies, L-3 Narda and MITEQ, was accomplished. By merging the two companies, the company is able to focus on providing reliable, technically advanced solutions for the MILSATCOM and SATCOM markets served.

MERGER PARTICULARS

L-3 Narda Microwave acquired MITEQ in January of 2015. The goal was to build a world-class RF/microwave component and systems company and deliver on-time, quality products to all customers.

In October of 2015, L-3 Narda-MITEQ closed two heritage MITEQ buildings and merged the business into facilities in Hauppauge, New York. The firm also migrated the heritage MITEQ company data onto the Narda ERP system. Both these actions were designed to provide a closer working relationship between the two organizations to form one powerful entity.

The surface mount facility and machine shop that the heritage MITEQ company maintained were sold to local businesses that now support the company's requirements. By closing these areas, L-3 Narda-MITEQ can concentrate on designing and manufacturing our core products.

Due to these changes, L-3 Narda-MITEQ has been working on reducing backlog for the past year and is poised to achieve all on-time delivery goals.

L-3 Narda-MITEQ produces more than 6,000 satellite communications (SATCOM) products each year from the world-class facility in New York. In addition, an extensive production center in Costa Rica, which produces components, modules and subsystems, is fully supported.

Collectively, L-3 Narda-MITEQ has more than 60 years of RF/microwave design experience and 40+ years of experience in SATCOM equipment for commercial and military markets.

PRODUCTS

L-3 Narda-MITEQ manufactures RF/microwave components and systems from 1 Hz to 70 GHz. The Narda side of the company continues to maintain an extensive in-stock inventory of passive components, including power dividers, couplers, attenuators, adapters and terminations.

In addition, L-3 Narda Safety Test Solutions produces leading-edge RF safety monitoring equipment for various applications—personal size, portable and area-wide.

The MITEQ side of the business continues to supply RF/microwave active and passive components, including low-noise amplifiers, mixers, oscillators, synthesizers, switches, modules, fiber-optic transmitters and receivers, as well as spaceborne components and subsystems.

The SATCOM division manufactures dual-conversion frequency up- and downconverters, block converters, switchover units, test translators, fiber-optic links, uplink power controllers, redundant amplifier systems and custom solutions.

A majority of L-3 Narda-MITEQ's products provide a customized solution that is designed to meet the customer's requirements. As the SATCOM products use the L-3 Narda-MITEQ components within the unit, we have total control of the performance—from input to output.

The firm's current products are being used in Earth stations across the globe and the firm has been selected to supply Ka-band communications equipment for many different customers who require specialized, reliable products to meet their requirements.

Ka-band continues to grow as more and more satellites are designed for higher capacity, which allows operators and owners to be more competitive. As the Ka-band spectrum has atmospheric issues, the L-3 Narda-MITEQ uplink power controller solves diversity and power adjustment challenges that come with the territory. The company's uplink power controller unit can be used for L- or IF-Band attenuation, with as many as 10 channels.

The primary Earth station products that we supply are frequency converters. Synthesized up- and down-converters in C-, Ku- and DBS-bands continue to be the most popular with the up and down block converters (to L-Band) directly behind them.

The L-3 Narda-MITEQ UPC2 Uplink Power Control Unit for SATCOM

L-3 Narda-MITEQ indoor redundant block converters use a patented 1/3 rack assembly to form a 1RU form factor for a 1:1 system. Both indoor and outdoor form factors are supplied to support different system architectures for Earth station designs.

L-3 Narda-MITEQ specializes in providing a custom approach when a standard solution is not available. Using the firm's technical ability to understand and solve the issues, our engineering team leverages vast experience and expertise to support custom-engineered designs.

The company is using the combined resources of two excellent organizations to produce products that customers require. The newly merged L-3 Narda-MITEQ business offers many different technical approaches to solve challenges outside the breadth of other companies. This makes the firm's products superior and ultimately helps customers reach their goals.

LOOKING AHEAD TO 2017

Now that the merger has been completed, the company is focusing on meeting customers' needs with even more innovative solutions.

Next year starts with the largest internal research and development budget in the history of L-3 Narda-MITEQ, with a major share going to further the development of Q- and V-band converters, as well as producing a more cost-effective converter for the C-, X-, Ku- and Ka-bands.

In addition, the company will start the year with an improved backlog position in order to achieve on-time delivery goals. L-3 Narda-MITEQ believes that Q- and V-bands will be the next growth area for the satellite industry, just as Ka-band is now—with more and more connectivity, people will demand a better, faster, more reliable and secure method of getting their data and content. The Q- and V-Bands will offer additional choices for expansion once the rain attenuation effect is overcome.

www.nardamiteq.com

Mitch Haft received his BSEE degree from the University of Massachusetts, Amherst, and his MBA from Fairleigh Dickinson University in Rutherford, New Jersey. He is currently the Director of Sales for the SATCOM division at L-3 Narda-MITEQ located in Hauppauge, New York. L-3 Narda-MITEQ, a division of L-3, designs and manufactures RF/microwave components, safety monitoring equipment and satellite communications equipment.

YEAR IN REVIEW: MVS USA

By David Gsell, Chief Operating Officer

The Mobile Satellite (MSS) industry and the organizations it serves is expanding with a plethora of new capacity and high throughput bandwidth options designed to satisfy the needs of the mobile, global end-user.

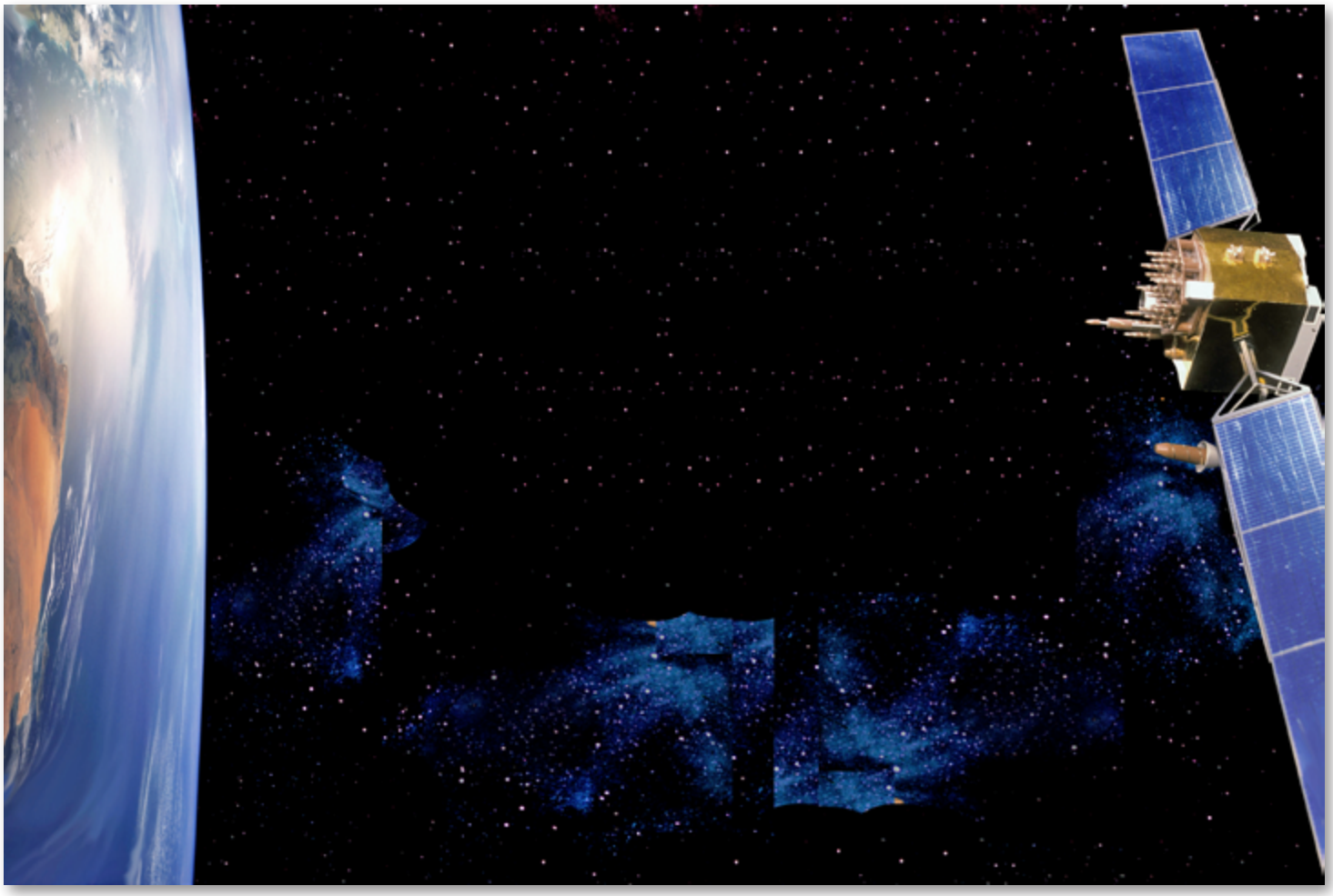
Inmarsat's Global Xpress has officially and fully debuted and is commercially available around the world. Iridium is preparing to begin launching the satellites that will comprise their new $3 billion Certus offering.

Improvements in hardware size, costs and terrestrial interoperability combined with the requirement for secure capacity, reliable, "*go anywhere/everywhere*" connectivity within the government market has opened new opportunities for satellite services to be deployed around the world.

2016 was a step change year for MVS. As a company that has traditionally been steeped in the traditional MSS verticals—maritime and land for government users—this year the company redefined itself in those vertical markets while at the same time growing its technology portfolio and expanding its footprint across the world with new offices and in-country management teams. Because of the priority to provide a high-quality, secure solutions base to our end-users, the company has also increased the focus on Cyber Security to protect the networks the firm establishes and maintains for customers.

CYBER SECURITY

In the improved network infrastructure built out in 2016 to 2017, along with the existing security measures such as the MVS firewall, anti-DDoS and anti-spoofing features, MVS is presenting a Personal Security Center—displaying in a web portal information about threats coming to end-user systems, personalized to that specific traffic.



From the web, portal users will further investigate, mitigate and block attacks that threaten their infrastructure. In addition, capabilities are being increased by the company for creating closed user group networks—grouping terminals together which are able to communicate only with each other and/or with central office or data center connected via leased line or IPSEC VPN.

A closed user group, not being connected to the Internet in the first place, offers users the secure environment that most applications require. With these new additions MVS remains committed to offering customers a secure networking experience as cybersecurity threat levels increase world-wide.

EMERGENCY RESPONSE

In the aftermath of a natural disaster, satellite communications is often the most reliable, if not the only, communications option for first responders and government support teams on the ground.

This past year, MVS USA was once again at the forefront of supporting relief efforts around the world, providing communications equipment as well as needed supplies to places like Ecuador, Haiti and other locations ravaged by earthquakes or hurricanes.

With global warming and dire predictions of more intense natural calamities to come, responding to emergency situations and supporting relief workers will continue to be an important part of the company's work. The MVS USA team will be ready with equipment, supplies and the ability to provide network support around-the-clock.

EXPANDING FOOTPRINT

International expansion was a significant hallmark of MVS' year, with MVS Brazil becoming the first Inmarsat partner to become a GX VAR for Brazil. GX was tested and demonstrated successfully for broadcasters covering this past summer's Olympic Games in Rio. The MVS team in Brazil continues to leverage this technology and is seeing major interest from the utility markets throughout the country.

Elsewhere in the region, MVS expanded its commitment to South American with the opening of a new office in Bogota to serve both government and commercial customers in the country. In November, the company dedicated the new office with a grand opening ceremony that coincided with the signing of a major contract with the Ministry of Defense. The company has been active in Columbia for many years and has grown to the point where a direct physical presence was needed to capitalize on the many business development opportunities and to provide the much needed foothold in the LATAM region sought by many of the company's customers.

2017 & A GLIMPSE INTO THE FUTURE

In 2017, MVS USA will continue its expansion growth plan both in terms of its management team and its global presence. After introducing GX in 2016, the Company will continue to embrace technology and embark on a 'tech forward' path. The company has already hosted Tech Forums for partners and customers and will continue to do so to bring the brightest and most innovative minds and ideas into one room.

In terms of geographic presence, MVS USA forecasts continued expansion with plans for the opening of a west coast office and a strengthening of the company's presence in Washington DC for government customers, both of which will happen in the early part of the new year.

Among the most significant initiatives for MVS USA in 2017 will be the expansion and enhancement and its network. The company is in the process of a network re-design and has made major investments into a new structure that will migrate to the cloud and ultimately offer secure, seamless and fully redundant data networking.

Once complete, customers will have access to a private network within the MVS USA network along with discrete firewalling, Cyber Security and account management tools. Security is on everyone's mind, so the new MVS USA network will feature enhanced security for the entire data network. The core of the new network will be housed in a new state-of-the-art facility in Amsterdam with power and redundant racks well above ground and safe from nature's conflicts.

With additional capacity and the new network architecture in place in Amsterdam, MVS USA expects to tackle a new vertical in 2017—Disaster Recovery storage. Amsterdam is one of the most attractive locations in the world for Disaster Recovery given its political neutrality, absence of government interference and access to undersea cable and teleports to every continent on the planet. MVS will be looking to gain a foothold in their area for US and international customers.

2016 was a year that saw advancements, investments and the introduction of new technologies in MSS. MVS USA continued to make its mark across a wide spectrum of government customers, providing a range of highly mobile and secure satellite communications solutions wherever they may be needed on land or at sea.

mvsusa.com

David Gsell has more than 18 years of senior executive leadership experience across several satellite technology and service sectors. Gsell joined MVS in October of 2015 as Chief Operating Officer. In this position, he is responsible for the management and operation of the global business, including business development, strategic planning, M&A, new market development, technology strategy and government-related activities.

Prior to joining MVS, Gsell held leadership positions in the M2M sector as the GM for Orbcomm, LLC., and prior to that he held several senior management positions in SES Americom.

YEAR IN REVIEW: ND SATCOM

By Michael Weisler, Director, Product Management and Marketing

What were ND SatComn's plans for 2016?

Increase Partnerships

ND SatCom sought to firmly establish itself as an open supplier and partner. In 2016, new international partners joined our group of existing partner companies from the institutional, military and governmental sectors as sales channels or technology partners. Many of these new partners have taken the opportunity to distribute the company's SKYWAN 5G modem to their clientele on site. Additionally, the unique features of 5G have convinced product manufacturers to integrate SKYWAN 5G modules into their own product range, thereby expanding our SKYWAN portfolio.

Focus on CBH Vertical

One major focus in 2016 was to demonstrate SKYWAN 5G's benefits and TCO savings to service providers in the cellular backhaul domain using proof-of-concept tests. For example, ND SatCom conducted and successfully completed a live test in South America under very demanding conditions.

This service provider, now convinced by this network solution, has incorporated SKYWAN 5G in other projects. In addition, a major Asian cellular network service provider is planning to use 5G as the core component of its commercial applications. Offering additional verified solutions with Sevis or XipLink products has proven most helpful.

Focus On "Installing Reliability"

ND SatCom has been known for years as a reliable partner for fail-safe communication solutions for governments, air traffic control, and broadcasting companies. The firm's experience and competence benefit our customers: for years there has been no VSAT network failure and only two customers have reported a single device failure during the last two years. The company is proud of this performance reliability and the value we provide, which SKYWAN 5G will bring to commercial solutions.

Focus On Making Missions Possible

ND SatCom is known in various European countries and beyond as a reliable supplier and logistics partner for military ground units. Partners and end-users are supported through all stages and for many years thereafter. With the firm's commitment to design, validate, deliver and maintain a customer's network, ND SatCom is well prepared for every adjustment and replacement—today and in the future.

The Successes Of 2016

ND SatCom defines success as offering the customer the correct system solution with utmost reliability, all at a reasonable price. To this end, there is continual investment in product development to deliver reliable solutions. Company engineers draw on decades of experience by using the firm's own, or third party, products from SATCOM suppliers to best meet customer requirements.

Regions

ND SatCom's reach expanded and solidified in 2016—two of the largest orders were received from the Middle East and Africa (MENA).

Asia and South America were the biggest source of new customers. In the Brazilian market, Anatel certification for all SKYWAN modems was received.

Europe, especially the military sector, continued to be a significant and stable source for order backlog.

In the American market, the M&C system was updated as a basis of the MFM solution for controlling Satellite News Gathering (SNG) vehicles for ABC.

Markets

The latest SKYWAN 5G product is the universal solution for military networks due to the unit's flexibility to equip each node with the same 5G hardware, regardless of the role of that node in a mission, whether as a flyaway terminal, mobile hub or an anchor station.

This was successfully demonstrated to the first field-test users. With continuing development advances, this product—as well as the terminals developed by its partners—is becoming even more attractive for the military market.

In the telecommunications and media markets, ND SatCom developed, produced, and delivered highly-integrated Production SNGs, customized to order, for HDT, YLE and Free Lens TV. The company was also commissioned by ORF, Magyar Telekom and Telekom Romania to install redundant DBS (Digital Broadcast Satellite) band transmission systems as well as additional uplinks.

Service providers value the performance and ease-of-use of the latest generation of VSAT networks, which have already been demonstrated in customer applications. The excellent quality of carrier grade/ best-in-class VSAT technology is confirmed by the feedback received, such as "best price/performance" and "easy to deploy, operate and maintain".

Products

The SKYWAN 7000 series continues to be the modem for security-relevant networks with FIPS

140-2 Level 3 and WGS certifications. Through cooperation with partners such as Sevis and XipLink, SKYWAN 5G has demonstrated how it is best suited for connecting cellular infrastructures to the core network. The bandwidth savings and flexibility convinced the first customers to invest in the company's MF-TDMA modems instead of in pure star-type or even SCPC technology.

With in-house developed transportable terminals that have performed convincingly in several projects, ND SatCom is the manufacturer for a large and well-known Tier-1 system supplier. Other notable companies are negotiating the use of these systems, which ensure reliable communication in all possible climatic zones.

With a dozen delivered Ka2Go antenna systems for the Eutelsat Newsspotter Service, the firm is just as successful as with the proven SKYRAY antennas for system integrators. Currently being finalized is a new generation of antennas—naturally with Eutelsat approval—and a suitable ACU.

As a company

In 2016, ND SatCom operated as an independent manufacturer and system supplier with a wide product and solution portfolio and expanded its customer base in the global market of cellular backhaul.

CUSTOMER PERSPECTIVE: 2016 HIGHLIGHTS

Establishing a local presence in Asia/Singapore and South America

With the new SKYWAN 5G, ND SatCom launched a commercially attractive product that is suitable for price-conscious customers and countries with poorer or less distinct network infrastructure. With initial successes in the Andean countries, South America is now served from Rio de Janeiro, Lima and Bogota. With Asia as a second growth region, we are managing sales activities and engineering support through a new location in Singapore. The entire South Asian region is thus supported directly and through new local sales partners. As a result, we have inspired many new prospective clients for our product portfolio since the beginning of the year. During CommunicAsia, ND SatCom ensured its large on-site team was accessible and responsive to customers, and since then has held new customer workshops and specialist trainings as preparation for pilot installations and live tests.

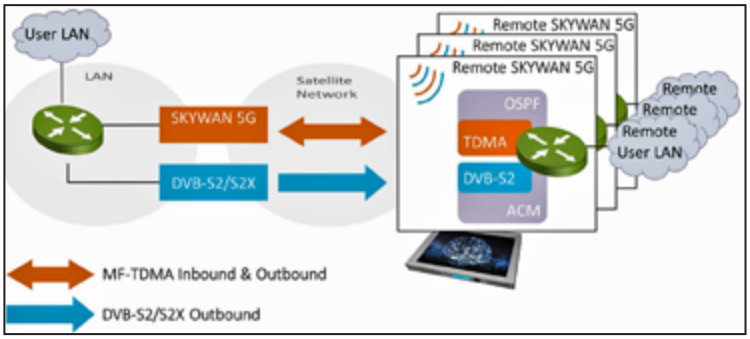
ND SatCom Transportable Terminal.

Delivering to Government and Defence Sectors

In September, we handed over the eighth transportable terminal—on time and error-free—to the buyer for delivery to the end customer.

In 2016, there were two important development steps for SKYWAN 5G: the introduction of guaranteed satellite capacity mechanisms for terminal groups and the expansion for multiple DVB-S2X outbound links. Both features support cellular backhaul applications. With DVB-S2X, a customer can extend their current MF-TDMA network to many ACM-enabled outbounds.

At IBC in Amsterdam, a well-known US antenna manufacturer agreed to integrate SKYWAN 5G into its brand-new Auto-Acquire FlyAway terminal, thus further increasing the reach of 5G.



DVB-S2X system overview.

THE GOAL FOR 2017

ND SatCom will continue the successful partner strategy as a supplier of components and systems for military ground-unit solutions. The SKYWAN product business via resellers and as a system supplier for enterprise networks, including cellular backhaul networks with SKYWAN 5G, will remain our goal, complete with dedicated support of our global commercial customers. Thus, our search for motivated and qualified employees will continue.

ndsatcom.com/

Currently responsible for Product Management & Marketing, Dr. Michael Weixler joined ND SatCom at its very beginning, in April 2000. During his continual career in the communication field, previously he held positions as head of R&D for Nortel Dasa, head of software development for ND SatCom AG and head of R&D for ND SatCom GmbH. Due to his extensive 25 years of experience in communication networks and network records, product development and maintenance, Dr. Weixler excels in his field.

As the head of R&D between the years of 2003 and 2015, he successfully supervised all product development, including SKYWAN. Prior to this assignment, he was responsible for ND SatCom's DVB-RCS hub system, a first in the world. Before his tenure at ND SatCom, he was responsible for development and technical marketing for data communication products at Nortel Networks.

Dr. Michael Weixler earned his Ph. D. at the Institute of Communication Networks and Computer Engineering, University of Stuttgart.

YEAR IN REVIEW: NEWTEC

By Koen Willems, Market Director and Senior Contributor

When looking back at the past year, 2016 will be remembered as a time of significant geo-political shifts and numerous security issues facing nations across the globe.

Major terrorist attacks in Brussels and Nice, combined with the ongoing threat from Daesh, the military tensions on the Russia-Ukraine border and the votes for Brexit and Donald Trump, have created a security situation unlike any other in recent memory.

EUROPEAN DEFENSE & SECURITY

The uncertain global geo-political situation and security issues inside and outside Europe's borders in 2016 has created momentum for a stronger role for these nations to play on the international chessboard.

European policy makers have had to react to growing concerns from citizens about security in the wake of attacks in European cities this year and show that the EU remains relevant, despite the summer's Brexit vote in the UK. No European nation has the resources to confront failing states on Europe's borders, Islamist militants or a resurgent Russia alone, so increased European cooperation in security and defense matters is more crucial than ever.

In order to turn this situation around, European policy makers and individual nations this year stepped up efforts to deepen European military and security cooperation and to strengthen EU defense in tandem with NATO.

WORKING TOGETHER

The desire from the European Defence Agency and the European Space Agency to boost European cooperation for satellite communication led to the launch of the European Government Satellite Communications (GovSatCom) initiative. Through this, the European SATCOM industry has been invited to build proposals and solutions to strengthen continent-wide cooperation on disaster relief and peacekeeping applications

European satellite operators, service providers, integrators and technology providers, such as Newtec, have been grouped in different consortia and have worked together to design proposals to face the satcom challenges presented by such situations.

With the rise of new High Throughput Satellite (HTS) constellations, it is key that satellite operators and providers of next-generation VSAT platforms, such as Newtec Dialog®, join efforts and offer cross-European solutions and services.

An important element in the European GovSatCom initiative is the support of the pooling and sharing requirement. Established back in 2010 to preserve and enhance national operational capabilities, pooling and sharing improves sustainability, interoperability and cost efficiency, and is heavily used nowadays by numerous nations for a variety of military applications.

The alignment of ground and space SATCOM assets is key in providing crisis management and disaster relief network operators the flexibility, scalability and efficiency to engage into operations where these military and government assets are pooled and shared.

With the combination of innovative and market-proven technologies, the Newtec Dialog Multiservice VSAT platform has shown its suitability for the requirements of pooling and sharing for global operational support, autonomy and affordable communications in 2016.

DEFENDING THE SKIES

In 2016, the Newtec MDM9000 modem and the Newtec Dialog Multiservice VSAT platform—Newtec's two core products for the government and defense market—have successfully been adopted in a wide range of humanitarian, government and defense networks.

Newtec's MDM9000 modem.

The Canadian Department of National Defence (DND) selected the Newtec MDM9000 modem as part of its Aurora fleet Incremental Modernization Project Block IV upgrades. The CP-140 Aurora—a long-range patrol aircraft operated by the Royal Canadian Air Force for domestic and international defense missions—is used in a wide variety of operations, including strategic airborne surface (sea and land) and subsurface missions, as well as maritime, overland Intelligence, Surveillance and Reconnaissance (ISR) and Search and Rescue missions.

The fleet contributes significantly to the security of Canada and North America and supports the restoration and maintaining of peace and security in regions around the world.

Under the contract with General Dynamics Mission Systems-Canada, Newtec delivered the MDM9000, a ruggedized ATR-size airborne modem, to provide High Data Rate, Beyond Line-Of-Sight airborne communication between the airborne platform and the DND ground network, also consisting of MDM9000 modems.

Following this application, MDM9000 is set to become the most advanced satellite modem certified to operate on the Wideband Global Satcom (WGS) constellation.

Following numerous deployments in 2016, the Newtec Dialog VSAT Platform will be next in line for WGS certification. This will enable peacekeepers and the WGS member nations to provide their operations with double the throughput, and allow seamless communications at maximum service availability, even in adverse conditions.

Alongside the ISR and military mission support programs, the Newtec Dialog platform has been selected for national elections in Africa, humanitarian and development programs and large school networks across the world.

DOUBLE-DIGIT GROWTH

All these exciting Newtec technologies, products and projects in the government, defense and commercial market have contributed to a double-digit growth for Newtec for a third successive year, achieving an increase in revenue of 23 percent during 2016.

Newtec's growth share for the government and defense market has now surpassed 50 percent and the company plans to extend its workforce with an additional 10 percent in 2017 to keep up with the large amount of projects and developments.

QUO VADIS, NEWTEC IN 2017?

The pipeline of new projects for Newtec in 2017 suggests that the revenue growth will also continue for the company beyond the next year.

A partnership deal between Panasonic and Newtec—announced in November—will see its application in 2017, with Panasonic Global Communications and Newtec developing a new, high bandwidth satellite modem based on the Newtec Dialog Platform.

The solution will offer Panasonic customers twenty times the bandwidth of its current solution, and versions of this new modem will be available across Panasonic's mobility markets including air transport, business aviation, maritime, cruise ships, mega-yachts, and river cruises.

The Newtec Dialog developments linked to the mobility market will also be integrated into the on-the-move and on-the-pause solutions for government and defense applications in order to increase data throughput and assure maximum availability for mission critical communications.

Moreover, Newtec will focus on making the Newtec Dialog platform even more resilient and secure in order to fully comply with harsh environment requirements and to provide the peacekeeping and humanitarian satellite network operators with the necessary tools to embrace the complexity of their operations in a successful way.

www.newtec.eu

Koen Willems has more than 18 years' experience working in different technology industries. Before joining Newtec he was Product Marketing Manager for Europe at the electronics giant TOSHIBA. Currently Koen holds the position of Market Director with focus on the government, defence and humanitarian satcom markets at Newtec. In this role Mr. Willems is in charge of developing the government and defence market worldwide for Newtec and managing large projects.

Koen has a Master's degree in English & Scandinavian Languages (University Ghent, Belgium, 1997) and a Master's degree in Marketing Strategy and Management (Vlekho Business School in Brussels, 1998). More recently Koen also received the degree for 'High Studies in Security and Defence' at the Belgian Royal Higher Institute for Defence.

You may know Koen as a Newtec technology evangelist through his regular appearance in editorials in satellite focused publications, white papers and speaking slots at conferences around the world.

YEAR IN REVIEW: NORSAT INTERNATIONAL INC.

By Dr. Amiee Chan, President and Chief Executive Officer

The satellite industry continues to see increased demand, driven primarily by the backlog of satellite launches, across all sectors of the market including the military and commercial markets.

Norsat's products operate primarily on widely deployed commercial satellites, C-, Ku-, and Ka-band. However, many of the company's products operate on military X- and Ka-band satellites, as well as X-band commercial satellites. Throughout the year, an increase in Comms-On-The-Move (COTM) design wins, including airborne, land-based vehicles and maritime applications, was witnessed.

Norsat's engineering and production teams were busy this year including building and shipping more than 200 portable satellite terminals for a major Eurasian defense contractor that was announced in 2015.

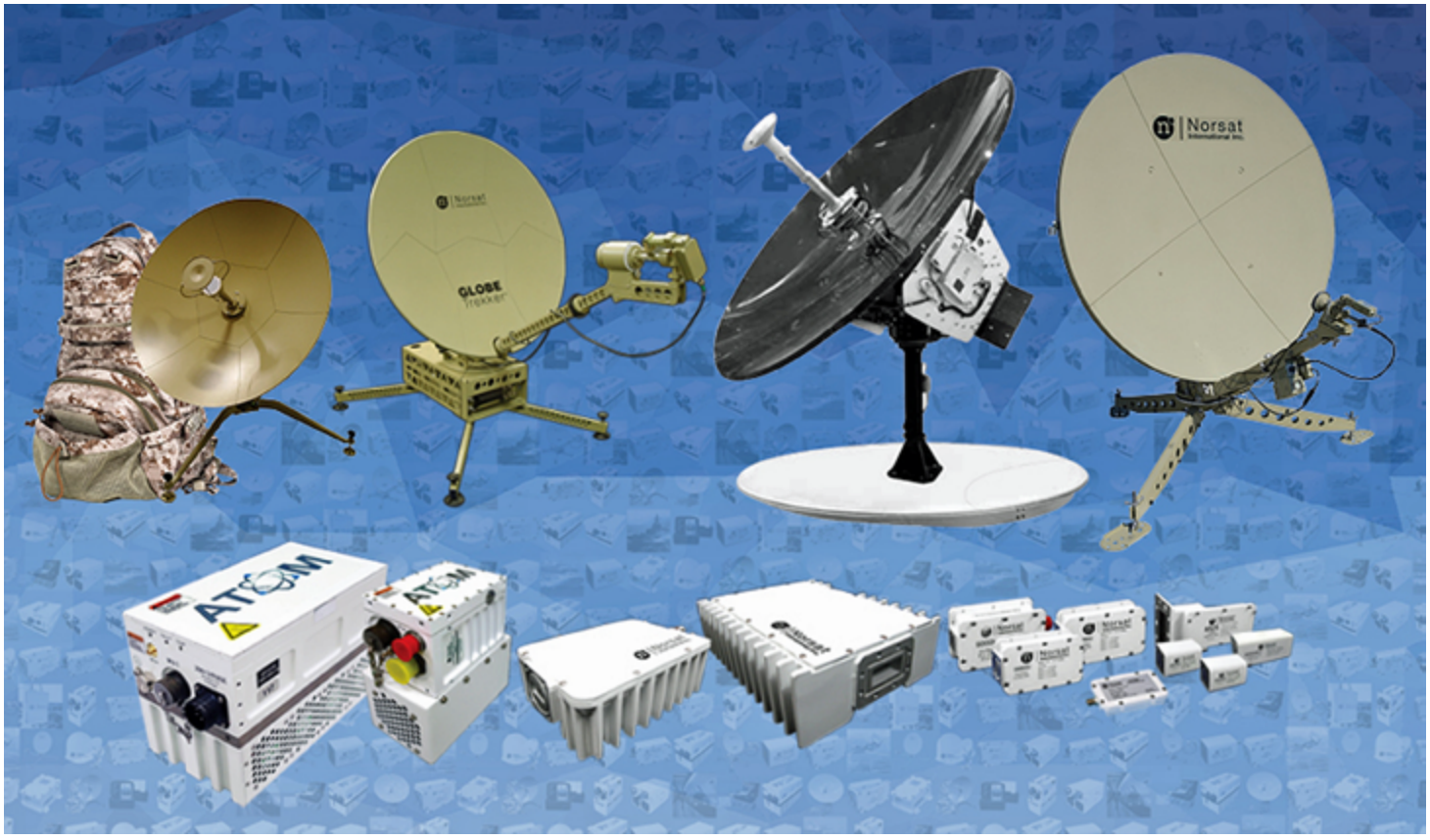
Norsat's new terminal product offering includes the new 0.9 meter Journey Manpack ultra-lightweight, fly-away satellite terminal, the new 1.2 meter Rover Light, the new 1.8 meter SigmaLink light terminal, the 1.2 meter VSAT antenna bundle, and the .7 and 1.0 meter maritime terminals.

Market share was expanded by Norsat in the naval SATCOM market by providing products with EMC (MIL-STD-461E), shock (MIL-STD-901D) and vibration (MIL-STD-167-1) certifications.

WGS certification will be available in Q1, 2017 on Norsat's 1.5 meter MarineLink terminal. Norsat's maritime terminals range from .7 m to 2.4 meters and are available in Ku-, Ka-, C-, and X-band frequencies.

Throughout 2016, Norsat experienced increased interest in the ATOM series of BUCs and Solid State Power Amplifiers (SSPAs). In early 2016, the company started shipping the ATOM 25W Ka-band BUC (dual commercial and military band) and also introduced the ATOM 250W Ku-band BUC. As with the entire ATOM product line, the 25W Ka- and 250W Ku- products are the smallest and lightest in the industry.

Harris Corporation continued to enjoy the excellent performance of the ATOM SSPA and in July placed a $3.8 million follow on order for 100W SSPAs. This was the second phase of a project that Norsat first announced in October



Norsat International's Ku-band 250W BUC (ATOMBKU250).

of 2013. The ATOM series of products continues to provide long-term value for customers who value great SWaP (size, weight, and power).

2016 was a big year for the company's Ka-band products and Norsat released new Block Upconverters (BUCs) and Low Noise Block Downconverters (LNBs).

In the early part of 2016 Norsat added the 16, 25, and 40 watt MEDIAN BUC line to our extensive and growing BUC product portfolio. Designed with performance and value in mind, the MEDIAN series is positioned between the firm's leading size, weight, and power efficient ATOM series of Block Upconverters and the ELEMENT value series.

Norsat has worked with O3b since 2012 and is a certified O3b partner for BUCs and LNBs. In May, Norsat announced the 7020STC 20W dual-band Ka- BUC and 7040STC 40W switchable BUC for O3b Network ground terminals. Now O3b customers can use one BUC to address both O3b frequencies.

The O3b dual-band BUC joins the Norsat dual-band LNB and offers customers the convenience of dual-band solutions or the economy of single-band products, a true one stop shop for O3b solutions.

Norsat is well known as a market leader in Low Noise Block Downconverters (LNBs). For almost 40 years, Norsat developed a reputation for quality, reliability and innovation in microwave components.

In 2016, the company added more than 10 new LNB products that included Ku- and Ka- dual-band and triple-band LNBs to an already extensive LNB product line in order to address different customer requirements from high stability and low noise products to value-oriented and multi-band products.

These new products offer premium performance and reliability and are backed by Norsat's three-year warranty and extensive experience as the industry leader in providing high performance LNBs. With these extensive product lines across all major frequency bands, Norsat is now the only manufacturer in the world offering Ku-, Ka-, C-, and X-band LNBs and BUCs of up to 250 watts.

On the financial front, after three quarters of 2016, Norsat shows positive revenue growth, increased gross profit margins, strong net earnings and sustained profitability for over eight years. Norsat continues to strengthen the capital structure for future M&A possibilities that are synergistic with Norsat's existing divisions.

As Norsat moves forward into 2017, the concentration will be on a strategy of developing new and innovative products that are easily customized to meet the extensive requirements of customers. The firm's ability to provide innovative and a diversified suite of customizable products and solutions continues to be a differentiator in winning contracts. Norsat will also continue to monitor key trends in the satellite industry to ensure significant R&D investments are solid and that the company remains a satellite technology leader for years to come.

norsat.com

Dr. Amiee Chan has more than 15 years of experience in executive management and research & development in the telecommunications industry. Dr. Chan's strategic vision has driven Norsat's innovative product development program and resulted in consistent revenue growth since her appointment as CEO in 2006. Dr. Chan has won several Women's Executive Network Top 100 Awards, ranked in PROFIT/Chatelaine's list of Top Female Entrepreneurs, and led Norsat to win a BC Export Award for Advancing Technology & Innovation. Dr. Chan holds an Executive MBA from Simon Fraser University where she majored in Strategy and New Ventures and a Ph. D. in Satellite Communications from the University of British Columbia. She has been published over a dozen times, and holds three US patents.

YEAR IN REVIEW: PARADIGM

By Ulf Sandberg, Managing Director

Paradigm has made strong advances by providing satellite and communication solutions across many sectors and networks and has developed innovative products which are unique within the industry.

User-Friendly & Smaller Satellite Terminals

High on the list is the development, launch and subsequent excellent market reaction that Paradigm's new flat panel Swarm45 has received. The terminal itself stands out from the competition due to the unit's ultra-portability, impressively high data rates and quick and simple deployment.

Swarm45 provides the BGAN-like simplicity that the industry is demanding—but with the speed of VSAT. The unit's marketing launch and initial deployment in a commercial application at the tail end of 2015 created high levels of interest.

With feedback from key customers and partners, Paradigm has been fine-tuning Swarm45's design throughout 2016 and the result is a truly unique product. Now operational for more than a year on regional satellites and also approved for use on Global Xpress, Swarm45 is suitable for a range of sectors including news gathering, exploration, emergency response, military and government.

Paradigm's Swarm45 offering.

Power Of The PIM

The PIM, designed and manufactured by Paradigm, facilitates meeting the demand for mobile satellite terminals which are quick and simple to setup and point. The Indoor and Outdoor PIMs are common terminal interface controllers for VSATs, operational on all satellite networks in any frequency band.

They integrate pointing and M&C along with any industry-standard modem in lightweight and easy-to-use units. The PIM pointing tool on the ruggedized Outdoor PIM allows terminals to be pointed without a spectrum analyzer using intuitive visual and audio cues to guide even unskilled operators. Also removed is the need for bulky auto-acquire solutions which can adversely affect reliability.

As a Global Xpress (GX) Integration partner with Inmarsat, coupled with Paradigm's engineering expertise, integration of the PIM provides a quick route to the GX market for terminal manufacturers, a fact already used by Datapath for their GX Type Approved terminals.

Increasing Mobility For The Maritime Sector

With the increase of Ka- and Ku-band satellite networks delivering seamless communication across the globe, Paradigm's maritime solutions enable secure and reliable systems to operate wherever they are needed. From design, installation and commissioning, to testing, support and training, during 2016 Paradigm partnered and supplied a number of key projects for maritime customers.

World-Class Testing Facility

2016 also witnessed Paradigm's new facility open in Alton, Hampshire, which is being widely used for satellite equipment testing and training. Well-connected by road and rail to London and all the main London and other airports, this facility offers training rooms, equipped indoor test rooms and outdoor terminal test sites for training, testing and hands-on practical experience.

The facility provides a broad range of satellite equipment as well as good visibility and connectivity to satellite services. Adding value for customers, this test facility does just that. With Paradigm engineers on hand to assist with any training and trouble-shooting required, customers have the space and flexibility to re-create the sort of challenges they can expect when in the field.

Paradigm's Outdoor PIM.

Adding Value

Paradigm has always aimed to go the extra mile and 2016 proved to be a fantastic opportunity to demonstrate such endeavors. Selected to urgently provide multiple VSAT systems for an EU-funded African project, Paradigm was able to ensure a reliable and rapid response to this project.

With Europe's largest SATCOM warehouse, equipment was consolidated, individually crated and the initial requirement shipped within a few weeks. Crucially, each system was custom-crated by Paradigm so that, on arrival, the installation and setup could happen as quickly and easily as possible. As the project progressed, Paradigm's advanced distribution system allowed the remaining order requirements to be rolled out as per the customer's specification.

Showcasing New Technology

Paradigm's new TV channel on YouTube, ParadigmTV, was also launched in 2016. Created to showcase the firm's ground breaking satellite terminals, this channel marks some significant steps forward for Paradigm and has become an excellent source for training and information resources.

Looking ahead to 2017, Paradigm is anticipating another exciting year.

Demand for the ultra-portable Swarm45 terminal is expected to rocket, ramping up Paradigm's manufacturing and distribution. In turn, this will generate further refinements and modifications leading to the nexgen of hardware. Increased mobility and even faster deployment without any specialist skills will always be the driving force. Additionally, Paradigm will be acquiring more approvals on more networks and with more satellite operators.

With Ka- and Ku-band High Throughput Satellites (HTS) creating truly global satellite networks of communication, Paradigm will be aiming to step up the firm's focus through the Middle East and Asia.

The recent appointment of Stephen Rudd to develop international business underlines the significance of these markets to Paradigm. Rudd joins the company from Vislink, where he was most recently CEO and previously held the roles of Managing Director of Advent Communications and headed up Vislink Group's Asia Pacific operation from Singapore. Rudd has a successful track record of developing international business and revenue streams and putting business plans into practice.

In 2017, Paradigm also expects to see HTS becoming more available and more accessible, delivering the speed, the global connectivity and the reliability which the market is demanding. Paradigm's product development and its integration knowhow will be well positioned to take full advantage of this advance.

Where Is The Satellite Industry Heading?

The satellite communications industry is no different than other industries in this modern age. Markets are built on supply and demand and the telecoms market is in the forefront of development with users demanding more bandwidth, faster data speeds and a better communication experience everywhere, on tap, day or night.

The satellite communications industry is driven by these models; satellite technology needs to be lighter, smaller and be able deliver a better feeling for the customer. The improved ability of pointing antennas using simple methods and common core hardware has given customers more confidence, allowing the removal of complex, heavy auto-pointing mechanisms and expensive technical training.

By making the process of pointing an antenna simple and accurate, and building on this user-confidence, hardware becomes faster to point, producing reliable results, over and over again.

The industry has altered its mind-set to favor core, common hardware for that very reason, with confidence and reliability extending beyond the end user. Reducing the size of the equipment has improved the range of applications. Users can now carry hardware as hand luggage on planes, keeping the unit in sight rather than trusting the safety of the plane's hold or requiring specific air-freighting and logistics arrangements to be in place before travel.

The future of the industry is seamless mobility using smaller terminals with simple setups.

paracomm.co.uk/

YEAR IN REVIEW: SES GOVERNMENT SOLUTIONS

Governments and institutions increasingly rely on commercial satellite communications (SATCOM) and solutions to overcome the complex and diverse challenges they face on a daily basis.

Trusted by governments and institutions internationally to deliver vital communication links, SES serves nearly 60 government entities around the world. SES provides the connectivity they need for a wide range of defence applications from Intelligence, Surveillance and Reconnaissance (ISR) missions to communications in remote areas, whether these are terrestrial, maritime or airborne.

SES is at the epicenter of an entire suite of companies that take a global approach to product development and customer service, forming a powerful collection of capacity, services and solutions for the government and institutional sector.

The commercial satellite communications (COMSATCOM) market is growing at a rapid rate, with applications diversifying and customers demanding solutions that provide the necessary service in a cost-effective way. SES operates more than 50 geostationary satellites (GEO) and 12 Medium Earth Orbit satellites (MEO).

EYE IN THE SKY

Earlier this year, SES enhanced its ISR offering with the introduction of Government+ Tactical Persistent Surveillance (TPS), a highly portable solution capable of quick global deployment and operations. TPS is a fully integrated portable surveillance and communications solution designed to provide enhanced situational awareness for border security, special event monitoring and disaster response missions around the world.

The TPS platform is based on Lighter-Than-Air (LTA) inflatable aerostat technology, which hosts a variety of advanced electro-optical (E/O) sensor and communications payload options at altitudes of up to 1,000 feet.

The advanced sensor payload can transmit or backhaul ISR video and data via satellite to a centralized monitoring and control center, using small aperture and quick-deploy flyaway Ku-band antennas.

The cost-effective ISR solution enables security, military defence and first responder teams to monitor areas on demand to detect, locate, characterize, identify and track people, objects and potential threats up to 5 kilometers away.

As part of the technology's modular and multifaceted design, TPS can incorporate MIMO (Multiple Input Multiple Output) radio technology and provide a mobile ad hoc communications network with 3G, 4G, LTE or WIMAX broadband connectivity up to 20 miles from an E/O sensor in areas where infrastructure is non-existent or destroyed.

Satellite-delivered IP service is also an option within the MIMO coverage area, enabling any IP-enabled device to support a broad range of field applications, including video streaming, voice, Internet, and remote mission-critical applications such as biometric identification.

GOVSAT CONTINUES TO GROW

2016 also saw GovSat, a public-private partnership between SES and the Luxembourg Government, awarded with a long term commercial SATCOM contract to support the operational phase of NATO Alliance Ground Surveillance (AGS).

US Army SATCOMs with desert camoflauge.

Joint Terminal Attack Controller communicates a close air support mission.

The contract for an end-to-end service includes the delivery of satellite capacity in commercial Ku-band as well as associated capacity management support to provide the required command and control as well as sensor data communications between the NATO Global Hawk UAVs and ground segment over the AGS operational area.

GovSat will be ensuring the provision of the SATCOM services from its security-cleared facilities with dedicated security-cleared personnel, also deployed within NATO premises. With this agreement, Luxembourg Authorities and the NCI Agency as procurement executive agent respectively acquire and manage the services provided by GovSat.

POWERING TROJAN

The past year has also seen success for SES Government Solutions (SES GS) in the firm's long-running relationship with the US Government. Through the company's satellite solutions, SES GS has powered the US Army's Trojan network since 1995—providing access to a global, end-to-end network tailored to meet specific US Army Intelligence and Security Command (INSCOM) requirements. 2015 saw the continuation of this partnership with the competitive award of two follow-on blanket purchase agreements (BPAs).

SES GS will support the premier Army intelligence network over the next five years. The SES GS suite of capabilities will enhance the combat readiness of military personnel by streaming data, voice, and video to and from intelligence centers, delivering operational availability at the highest levels.

The network encompasses a complete end-to-end customized managed service including satellite segment, ground Earth stations and infrastructure, operational support and bandwidth management services for US Army soldiers and decision makers from numerous locations across the globe.

MAKING ITS DEN-MARK

Not only did the US military make use of SES capabilities in 2016—the Danish Defence Acquisition and Logistics Organization (DALO) agreed for the company to provide two anchor stations for their SATCOM needs.

SES Techcom Services, a wholly-owned subsidiary of SES, has been appointed to provision and maintain two Wideband Global Satcom system (WGS) anchor stations—one in X- and one in Ka-band. These enable the Danish armed forces to communicate through the system, which provides flexible, high-capacity communications for defence operations through the associated satellite constellation and control systems.

The Danish forces will join other nations partnering with the US in the WGS program and thus offer the US State Department satellite-based communication services to users, including marines, soldiers, sailors, airmen and the White House Communications Agency.

SES emergency.lu balloon antenna.

SUPPORT FOR HAITI POST HURRICANE MATTHEW

SES also continued to provide support in crisis situations. In October, when a Category 4 hurricane swept through Haiti, destroying homes and killing hundreds, SES supported the Luxembourg Government in relief efforts by collaborating with the World Food Program (WFP) as the global lead of the Emergency Telecommunications Cluster (ETC) by deploying the ***emergency.lu*** platform.

The platform helps to rapidly establish a communication network in areas that are isolated because of badly damaged infrastructure, assisting with aid and helping individuals contact relatives. In Haiti, SES has deployed two kits, one regular and one 'rapid deployment', and the emergency.lu satellite capacity covering the region has been upgraded to support these missions.

Emergency.lu is a public-private partnership between the Luxembourg government and three Luxembourg-based companies. These companies, SES Techcom Services, HITEC Luxembourg and Luxembourg Air Ambulance, design and operate the platform. Emergency.lu uses dedicated SES satellite capacity and ground infrastructure to re-establish communications networks in support of humanitarian relief operations.

LOOKING AHEAD

As the COMSATCOM industry looks back and reflects on another year of development and innovation, it is important to also cast our eyes forward to what 2017 will afford to involved actors.

Innovations in RPAS-based ISR will continue to appear as end-users search for rapid connectivity, agility and security, while still offering the best available services. Similarly, personnel welfare will be an important topic in 2017, with new developments in the COMSATCOM industry looking to increase the access to connectivity and entertainment to the troops and lower the rate of operational turnover.

ses-gs.com/

YEAR IN REVIEW: SINERGISE

By Grega Milčinski, Chief Executive Officer

Sinergise is a Slovenian software company developing enterprise-level solutions for managing spatial data, particularly in Earth Observation (EO) and the remote sensing fields.

ADVANCED SOLUTIONS

By having projects ongoing in the developed and developing world, one of the main challenges for Sinergise's clients is access to up-to-date imagery.

These countries usually purchase images within World Bank or IMF funded projects. They use this data to develop their land administration systems.

However, once the project is finished, the data is usually older than three years, often even more than five years in age. Purchasing new imagery by these countries usually costs millions of USD, which they simply cannot afford to obtain. They are, therefore, stuck with the old data and that prevents them from updating their land administration systems.

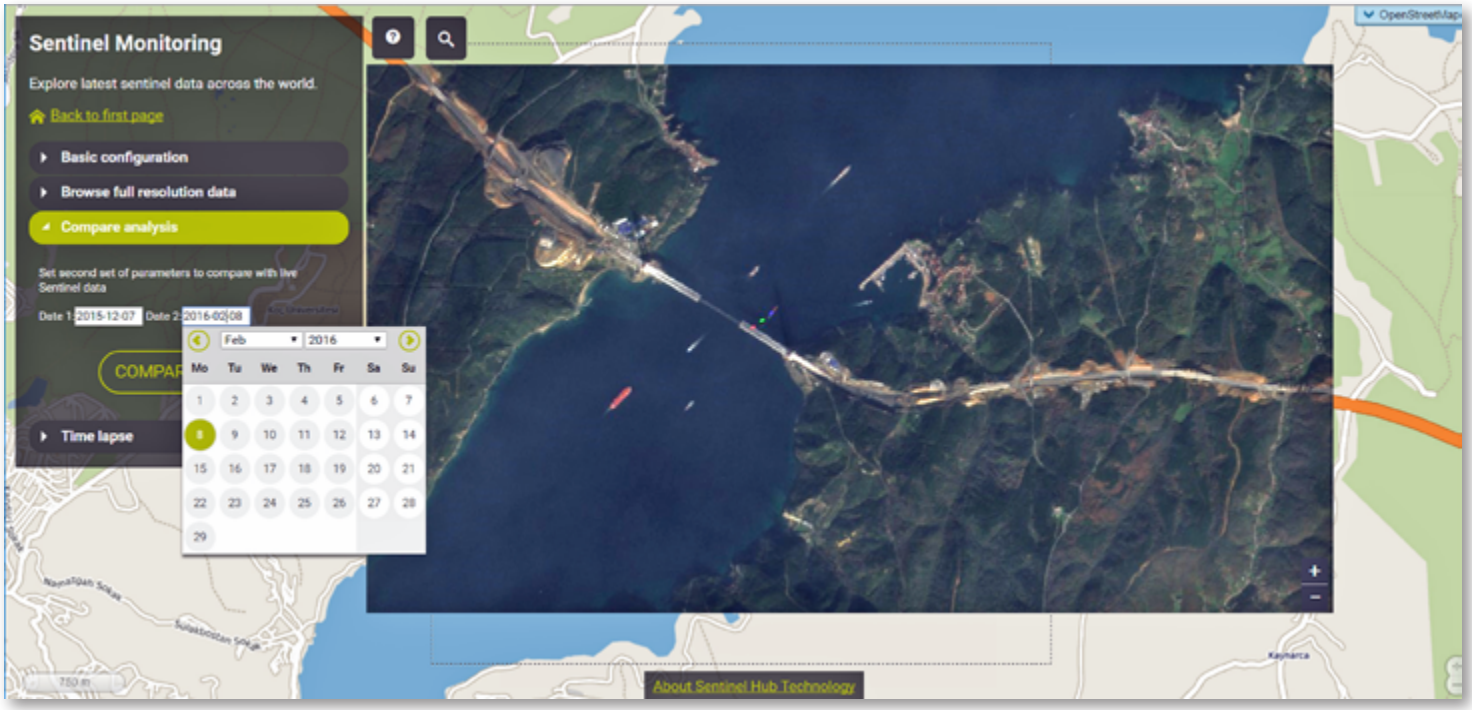
The speed of land changes in these countries, especially in Africa, is enormous, which means that lack of data represents a significant obstacle.

In November of 2015, the European Space Agency, within their Copernicus project, started the operational distribution of their Sentinel-2 satellite data. This data provides a weekly coverage of the entire world in 10 meter resolution and provides multi-spectral data.

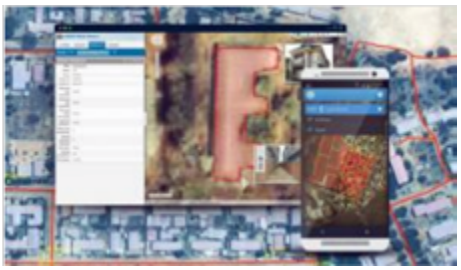
Resolution-wise, the data cannot compete with commercial offerings such as Pleiades, WorldView or similar satellites. However, the quality of the Sentinel-2 data is sufficient to recognize new, built-up areas. Developing countries can now—for the first time—obtain country-wide coverage, updated on a weekly level.

Sinergise is offering easy-to-use solutions for the integration of Sentinel-2 data for any spatial applications —Sentinel Hub. Sentinel Hub is exploiting advanced AWS cloud technology and innovative methods to efficiently process and distribute data in a matter of seconds. This results in easy-to-use and cost efficient ways to exploit the data in any GIS application or integrate them in web application.

The Sentinel-2 Hub removes the hassle of the downloading, archiving and processing of petabytes of data and simply makes the entire global archive available via web services.







Sinergise GIS tools: satellite imagery archive within GIS in the Cloud, mass digitization of spatial data and field data collection.

Due to the use of OGC standards (WMS, WCS, WMTS), it is possible to include these services in existing and proprietary GIS solutions, such as ESRI, QGIS, etc., without any sort of required application update.

In October of 2016, Sinergise was honored with the prestigious Copernicus Masters Award with its "*path-breaking satellite image web service – the Sentinel Hub.*" Sinergise came out on top in the competition's *T-Systems Open Telekom Cloud Challenge* and then edged out the winners of seven other categories for the grand prize.

SECURE, STATISTICAL MONITORING

Vast amounts of Sentinel data makes it possible to automate parts of the processes and integrate advanced statistical and machine learning mechanisms to identify possible threats. Multi-spectral data provide sufficient input to classify some types of land-uses, e.g., separating construction land from vegetation, ships, and so on.

Clients use Sentinel data in combination with commercial datasets, blending very high-resolution, yet older, data with the latest medium resolution imagery.

AGRICULTURE SUPPORT

Rising populations require the increase of agriculture production efficiencies combined with sustainability measures. It is not enough anymore to simply increase the volume of fertilizers used, as this can permanently destroy the land.

Today, there is a significant need for precision farming. However, such often requires a solid awareness of the state of the land. Sentinel-2 data perfectly fulfills this role, due to the continuous data updates (in some areas, every few days) and multi-spectral input.

Governments often decide to offer their citizens the tools and data to make their work easier. Sinergise has developed farm management tools. These tools provide a variety of functions, such as activity planning and management, reporting and support, for precision farming based on Sentinel-2 and Landsat-8 data. Users can easily obtain all standard vegetation parameters, such as NDVI, PSRI, EVI, etc.

THE YEAR AHEAD

With 12 years of operations having been completed, Sinergise has built solutions for large governmental clients from all over the world—from nearby countries such as Croatia, Serbia, Macedonia and Montenegro to France, the United Kingdom, Azerbaijan, Moldova, Ghana, Nigeria, Tanzania and Mauritius.

Altogether, there are more than two million people who annually use Sinergise's tools and the company's technologies to manage more than 50 million property records and more than 500 million euros of annual transactions.

One of the challenges the company is going to face in 2017 is identifying and addressing the market for EO data and derived products. Sinergise's core business will continue to be the development of advanced turn-key solutions for the management of spatial data, mostly for enterprise level clients on a governmental level, and those tasks will occupy many of the company's most highly skilled developers.

During this year, Sinergise increased the team by 60 percent and is now hiring more experts to sustain the firm's development and research with the various EO fields of endeavor—continued growth is expected during 2017, as well.

sinergise.com

sentinel-hub.com

YEAR IN REVIEW: SPECTRA GROUP (UK) LTD.

By Simon Davies, Chief Executive Officer and Senior Contributor

The year got off to a flying start when the company was recognized as a 2015 Top Ten Global Government Partner by Inmarsat.

In recognition of Spectra being one of the top ten revenue earning companies for the Inmarsat Global Government business in 2015, I was delighted to be presented with an award by Andy Start, President of Global Government Inmarsat.

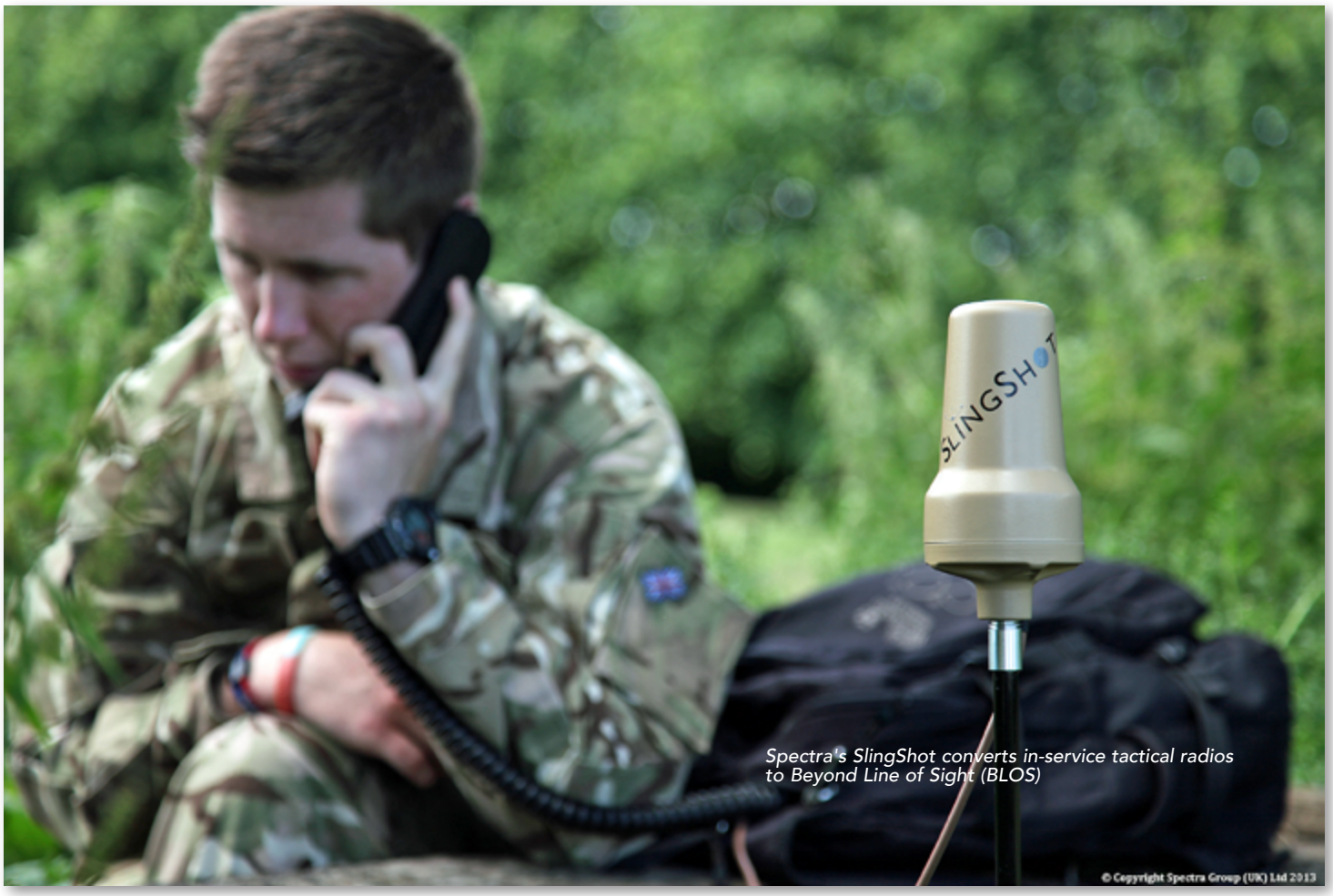
The company is delighted to receive this recognition as it is such a great achievement and also demonstrates that, in SlingShot® and her sister product, SHADE™ (Spectra Hostile Area Deployment Environment), Spectra has been able to use the firm's deep knowledge of the customers in global government to develop real solutions for their specific and crucial communication needs.

In March, Spectra exhibited for the first time at the Fidae International Air and Space Fair when it was announced that Tesacom, a leading provider of satellite communications (SATCOM) in Latin America (LATAM) would distribute SlingShot in Chile.

This significant development came about after Spectra worked closely with Tesacom and the Chilean Navy to successfully test SlingShot in Chile during November 2014, which proved the reliability and operational capabilities of the product in the field for the first time in South America.

A later trial demonstrated the solution working in the far south extremes down to 68 degrees.

This, in conjunction with previous trials that were successfully carried out as far as 83 degrees north, demonstrated that SlingShot is a truly global solution.



Spectra's SlingShot converts in-service tactical radios to Beyond Line of Sight (BLOS)

SlingShot can be used as man-portable, vehicle, maritime or on aircraft for command and control of all units.

LATAM is an exciting new market for Spectra and has many unique challenges, both in traditional defense operations and modern day policing and border security on land and at sea. SlingShot will help to resolve many of the communication challenges posed by the natural geography of South America.

Communications as well as Command and Control have never been easy—sometimes nearly impossible over mountain ranges, deserts, rain forests and large expanses of water. However, with SlingShot, users can depend on the product as an efficient and tested solution.

In the summer, Spectra announced a highly successful outcome to rigorous tests undertaken earlier in the year by the UK's 3 Commando Brigade on Slingshot.

The week-long tests were sponsored by the Battlefield and Tactical Communications and Information Systems (BATCIS) Delivery Team (DT) and monitored by the Defence Science and Technology Laboratory (DSTL).

The results informed the MoD Information Systems and Services Team on how well SlingShot fulfilled the user requirements of key deployable UK Brigades—3 Commando Brigade and 16 Air Assault Brigade—in different scenarios, and in these latest tests, ensured the technology particularly met the maritime concept of the operations.

3 Commando Brigade provided resources in the form of land vehicles and maritime vessels—both fast patrol and logistic craft. Tests followed on from work carried out with 16 Air

Assault Brigade in 2015, which culminated in SlingShot being successfully deployed on Exercise FLYING FALCON.

In 2016, Spectra—once again—supported 3 Commando Brigade when they deployed on Exercise OMANI CHAMOIS—a long range mobility exercise—proving the reliability and utility of SlingShot.

The testing carried out confirmed that SlingShot, as a solution, provides a BLOS capability to the Bowman radio system that will allow operational users to maintain command and control over greatly increased distance and connect Bowman puddles.

SlingShot is specifically designed for highly mobile operations and has excellent SWaP (Space Weight and Power) properties.

These satisfying results mean that the MoD now has the capability to extend the Bowman system range to thousands of kilometers as well as having the capability to offer the interconnection of different pools of radios operating over great distances. SlingShot allows any commander to maintain control of deployed forces anywhere in the world.

The product itself was developed three years ago and approximately 2000 units have been sold to key users that include Special Forces and more than 15 armies ranging from North America to Europe and Africa, the Middle East, to the Far East and Australia.

spectra-group.co.uk

Simon Davies is the CEO of Spectra Group (UK) Ltd. Spectra is a leading provider of Voice and Data services into remote and hostile areas worldwide for Defence, Governmental and Non-Governmental sectors.

Upon leaving the Military in 2004, Simon set up Spectra which has achieved steady growth over the past 12 years through these difficult economic times and is fast becoming a leading Service Provider of Reliable, Robust, Deployable Communications.

Spectra's services are deployed worldwide in some of the world's harshest environments supporting the UK Military and European Union, Stabilisation Unit, to name a few.

YEAR IN REVIEW: THURAYA TELECOMMUNICATIONS COMPANY

By Bilai Hamoui, Chief Commercial Officer

The finalization of FUTURA, Thuraya's nexgen constellation plans; launching the world's only dual mode, dual SIM satellite phone; and the arrival of the company's first terminal to work in North America made for a memorable, disruptive and fascinating year.

For Thuraya, 2016 will always be remembered as a year of innovation, paving the way for a transformative and revolutionary future.

Thuraya's future—FUTURA. Thuraya will become a "one-stop shop" for L-band, HTS, IoT, and GSM, offering an unparalleled portfolio of mobile products, applications and services. Thuraya will extend its geographical reach, move into new market sectors and launch new services and devices.

While continuity is assured with both existing satellites, the L-band network will be enhanced significantly with the planned launch of nexgen from 2020. Thuraya will focus on delivering high mobility services both in existing core and newly accessible markets and will innovate, disrupt, and redefine across land, sea and air.

Earlier this year, the firm promised to unveil initiatives that will push the innovation boundaries in satellite and terrestrial convergence further, and that promise was kept. The company launched the best satellite phone in the world, the Thuraya XT-PRO DUAL, which delivers unprecedented flexibility, transforms usability and choice, and meets rising demand for convergence.

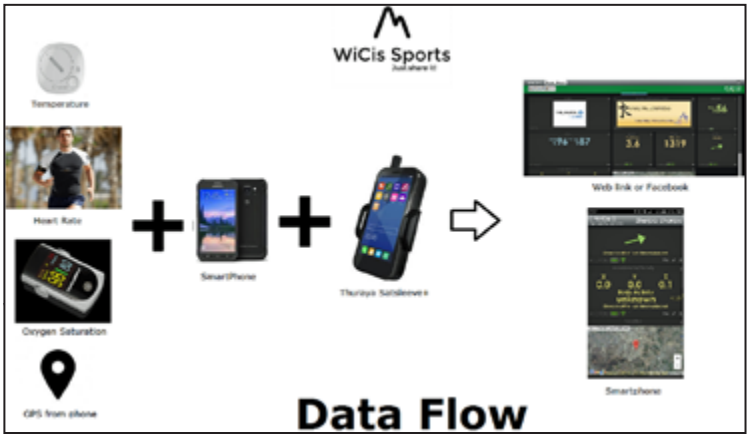
XT-PRO DUAL users can move seamlessly in and out of terrestrial coverage, enjoying connectivity everywhere. Opt for a Thuraya SIM card and a GSM card, or select any combination of SIM cards that meets users' needs.

The new handset's 'Always On' capability allows users to effortlessly alternate between calls, ensuring they are always reachable on both the satellite and terrestrial networks. Callers can be contacted on their GSM number even while on an active satellite call—and vice versa.

2016 was also the year of M2M for Thuraya. The company's dedicated M2M service and terminal became available over North America for the first time. In partnership with ViaSat, Thuraya is now bringing real-time IP satellite communications to a greater share of the M2M market. As ViaSat's vice president and general manager, mobile satellite services, Phil Berry, said, "*Thuraya's FT2225 M2M device running over the reliable ViaSat L-band service will serve a broader class of markets.*"

Launching the world's most rugged vehicular terminal was another proud achievement at Thuraya. The IP Commander, purpose-built for military, government, civil defense and emergency response teams, is engineered to enable mission-critical voice and data connectivity in the remotest of areas within minutes. Offering IP data speeds of up to 444 kbps, this is the only MIL-SPEC vehicular terminal capable of achieving streaming IP speeds of up to 384 kbps as well as user-definable asymmetric streaming functionality.

Thuraya ventured into the connected wearables sector as well, joining forces with WiCis-Sports and achieving groundbreaking positive results. With the WiCis-Sports app running on a Thuraya SatSleeve+ on expeditions to Nepal and K2, climbers and their families enjoyed a more secure experience by resting assured their vital information was continuously being checked.



New agreements and partnerships opened up exciting new markets and ensured that one one is left behind. The company is a pioneer in the Maldives, with Ooredoo, providing fisheries and anglers with satellite connectivity. Fishing operators can access monitoring systems and services, with Thuraya SatSleeve+ and SatSleeve Hotspot devices and data packages.

In Vietnam, Thuraya's first service agreement is helping VNPT VinaPhone establish satellite services across the country. Vietnamese customers can now access the mobile satellite services and maritime communication services they need. Thuraya's XT-Lite handsets and maritime communication solution SF2500 are being introduced to consumers, government agencies and enterprise customers. Costs are being driven down by an average of 40 percent, offering unprecedented value.

Thuraya's reach across the shipping routes of Europe have been extended, as well. As *Satnews* editors put it, "*Into the Black Sea goes Thuraya with a new service partner.*" With NBS Maritime, the firm's first ever service partner in Bulgaria, Thuraya advanced its regional maritime strategy into the Black Sea where an alternative to the status quo is clearly needed.

Thuraya's satellite capabilities were demonstrated at the firm's primary gateway office in Sharjah to a delegation from NASA who were on a visit organized in conjunction with the UAE Space Agency. NASA's Deputy Associate Administrator, Human Exploration and Operations Mission Directorate, Badri Younes, welcomed this "*great opportunity to see just how much Thuraya has grown in recent years. Thuraya has historically*

provided many agencies with tremendous service support, and we at NASA would like to work together closely too."

Saving and improving lives is in Thuraya's DNA. This is the company's purpose and makes a difference when knowing that what the firm accomplishes has such great impact on peoples' lives in other parts of the world. This humbling privilege and responsibility unifies Thuraya as a team and as an organization. In 2015, the company met the call for help that followed the devastating earthquake in Nepal.

Thuraya support continues and the company is still heavily involved in providing communications to humanitarian organizations working on CSR programs for rebuilding remote communities, schools and hospitals. Similarly, in 2016, the ITU deployed 30 XT handsets and five of Thuraya's IP terminals in flood-stricken Sri Lanka.

These are momentous times for Thuraya. New announcements, services, products and updates are looked forward to during 2017, product, services and technologies that will break barriers and will further advance innovation.

Thuraya will start the New Year with the next-generation system RFP on schedule, taking the firm ever nearer to the vast breadth of opportunities to be delivered through the company's FUTURA program.

thuraya.com

YEAR IN REVIEW: VIALITE COMMUNICATIONS

By Martin Ryan, Managing Director, Pulse Power and Measurement Ltd.

ViaLite Communications designs and manufactures RF over fiber links, predominately used in SATCOM.

The company has been established for more than 20 years, during which time the ViaLite products have evolved from ViaLite Classic to ViaLiteHD—new product developments have included the Satcom6 outdoor enclosure.

Market Changes

During 2016 there has been a notable geographic shift in demand for RF fiber links in major SATCOM installations. The company have seen demand move away from Europe with growth being experienced in the Middle East as well as in the US.

Business Changes

In line with US market growth, the company has expanded with a new US office in Washington DC. Located on Pennsylvania Avenue, in sight of the White House, ViaLite feels the office is well situated to serve an increasing number of Government customers. To address the Middle East, this year ViaLite Communications introduced a new distribution partner, Symbolise.

The ViaLite team has also evolved this year. Neil Seager now heads up the sales team, and Natasha Miller has been promoted to marketing manager and Gary Wade has taken on the role of product manager.

Product & Service Developments

One of the many new product developments during 2016 was the introduction of the Blue2 Link. Designed in response to customer demand, the Blue2 can be setup as a dual transmitter, dual receiver or transceiver to suit requirements.

ViaLiteHD L-Band links were upgraded to become L-band HTS, with a widened frequency of 700-2450MHz, which allows higher throughput satellite signals to be sent over a single fiber.

Either 3x500 MHz or 2x800 MHz bandwidths can be transferred over a single link, reducing the number of links required and therefore costs—in some cases, by as much as a third.

When coupled with ViaLiteHD spurious free dynamic range (110db/Hz 2/3), L-Band HTS is deemed the product of choice for major satellite operators.

As part of this development, a number of products in the ViaLiteHD family have been upgraded, including L-Band HTS; Long distance DWDM systems; L-Band HTS and Reference; CWDM multi-channels in a single fiber—all in 50 and 75 ohm.

ViaLite's Blue2 Link.

Further product upgrades this year included the Green OEM Link, which was previously known as the Broadcast Link, and the Yellow OEM Link, which was the Edge module.

The 'ODE' outdoor enclosure range was further expanded with the new ODE-B12. This enclosure holds up to 12 ViaLiteHD RF over fiber links in OEM module format, plus full SNMP (the existing ODE-B holds six links).

ViaLite's Long Distance Link System.

The ODE-B enclosures can also be used to house splitters, frequency sources, LNB and BUC power supplies, RF modules and other ancillary equipment. The ODE-B12 is constructed from stainless steel and is suitable for use in climatically hostile environments. Heating can even be added for cold weather conditions.

The main product of interest this year has remained the ViaLiteHD Ka-Band Diversity System. This has been extremely popular in the market and the company further developed the offering this year.

This is a long distance link system which can connect two locations up to 600 km apart. The system is typically used as a rain fade solution, and as an example, Telesat has found this system to be successful in linking together two of their facilities in the US.

Telesat used the ViaLiteHD Ka-Band Diversity System to connect two dishes that were 60 km apart and now switch between the locations approximately 10 times a day. This provides their customers with the best signal possible, no matter what the weather and without interruption.

The link can also be used to maintain signal during periods of maintenance. The new system was showcased at IBC and generated a great deal of interest.

On the service and support front, this past summer, ViaLite extended the standard product warranty to an industry-leading five years.

The decision was also made due to the shipment of the company's 10,000th RF over fiber link as well as the company's 20th year milestone as well as in recognition of ViaLite's proven product reliability and quality.

Market Prediction & Plans For 2017

With the geo-political environment more uncertain than ever experienced before, predicting what the future may hold is difficult. However, ViaLite has a long list of new products planned and the firm is are ready to reprioritize these in line with market changes and customer needs as the year progresses.

The company remains confident that the satellite industry, particularly the ground segment infrastructure sector, remains on a path of global growth. In fact, ground segment investments have somewhat lagged behind the investment made in the space segment, but this is now changing as the ground services need to come online during 2017 to support the capacity introduced by the satellites launched in 2016.

Technology adoption is also a driver for growth in 2017. There are still satellite ground station operators using copper coax who haven't realized the possibilities of RF over fiber and the impact that technology can have on their service delivery.

Currently, an emerging application is delivering tight cellular network synchronization to support the interleaving of multiple data streams at the receiver. ViaLite is certain there will continue to be new applications where RF over fiber can make a real and significant difference.

vialite.com/

ViaLite Communications is a division of Pulse Power and Measurement Ltd. Martin runs Pulse Power and Measurement Ltd which serves a diverse set of markets from Power Electronics, Test and Military equipment, through to the Satcom industry. Martin has more than 10 years' experience in the satellite equipment design manufacturing industry.

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