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MilsatMagazine

First Responder + NGO Comms

Rescue mission in the Canadian Rockies.
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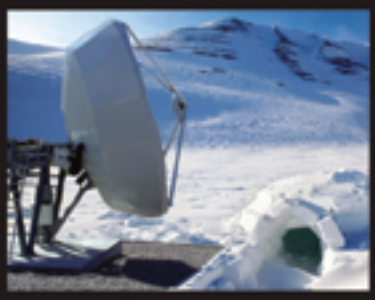

De-Ice System

Plenum De-Ice Systems prevent snow and ice buildup that degrade your signals. Unique hot air enclosure (Plenum) design mounts behind antennas — from 5 to 32 meters. Most reliable and economical system on the market. Uniform surface heating minimizes distortion losses — unlike electric pad or heat tape anti-ice systems. Electric, natural gas, or liquid propane heater options available.

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March 2014

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DISPATCHES

NORTHROP GRUMMAN—SPEEDY DOWNLINK FOR PROTECTED COMMS PAYLOAD

Two downlink antennas that are the fastest of their kind to operate in space are being integrated into the protected communications payload built by Northrop Grumman Corporation for the fourth Advanced Extremely High Frequency (AEHF) satellite.

The company delivered the Super High Frequency Array Unit (SAU), as the antennas are called, in early March to AEHF system prime contractor, Lockheed Martin, in Sunnyvale, California.

These high-speed downlink phased array antennas, the first to operate at 20 GHz in space, provide assured point-to-point connectivity using electronically steerable beams that reach military users at fixed-site and mobile terminals.

Under a hybrid integration plan, Lockheed Martin is now integrating the satellite bus unit within the system module while a team from Northrop Grumman simultaneously completes the remaining payload integration.

Northrop Grumman produces phased array antennas, which are a new technology developed specifically for AEHF satellites. High-speed downlink phased array antennas are the first of their kind to operate at 20GHz in space.

High-speed uplink phased array antennas operating at 40GHz provide direct radio frequency beams electronically rather than by moving reflectors mechanically.

Advanced EHF anti-jam payloads communicate via super high frequency downlinks, transmitting in the 20.2 to 21.2GHz frequency band, and EHF uplinks, which also are the first to operate at 40GHz in space.

"This allows one array to do the job of many reflectors, giving the flexibility to point-on-demand in fractions of a second to hundreds of coverage areas, greatly improving access and automatically countering signal jamming by adversaries," said Stuart Linsky, vice president, Communication Programs, Northrop Grumman Aerospace Systems.

This agility and flexibility of the beams formed by the phased arrays are critical to providing coverage to the dispersed tactical and strategic users on the AEHF system.

Artistic rendition: AEHF satellite on orbit. Image courtesy of Lockheed Martin.

The high-speed phased arrays are used to form multiple beam types concurrently including high gain Earth coverage anywhere in the satellite field of view, super high gain Earth coverage to up to 160 locations, and up to 24 medium resolution coverage area spot beams.

The next generation of protected military satellite communications satellites, AEHF provides vastly improved global, survivable, highly secure, protected communications for strategic command and tactical warfighters operating on ground, sea and air platforms.

The system also serves international partners including Canada, the Netherlands and the United Kingdom.

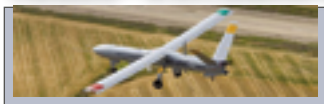
With the more compact phased array, AEHF can process greater amounts of information. It will deliver 10 times greater total capacity and channel data rates six times higher than that of Milstar II communications' satellites.

AEHF is the successor to the Milstar system.

The SAU was built by Northrop Grumman's Antenna Products Center, which also provides EHF Uplink Phased Array unit, jam-resistant nulling antenna subsystems, crosslink antennas and steerable spot beam antennas for the AEHF Payload.

Previous ahead-of-schedule deliveries included the uplink phased array (UPA) high-efficiency converter that operates the payload's UPAs. Commercial application specific integrated circuits were also delivered on time, along with hardware consisting of electromechanical switches, passive microwave filters and beam select switch assemblies.

THALES—WATCHKEEPER IS RELEASED TO SERVICE



Watchkeeper, the unmanned aircraft system (UAS) developed by Thales for the British Army, has been given a Release To Service by the UK's Ministry of Defence (MOD).

Watchkeeper is the first UAS to be awarded a full Release To Service (RTS), and is the only UAS of its type allowed to fly in UK airspace. The RTS follows the MOD's rigorous safety and airworthiness reviews to ensure the system can be operated safely by the British Army.

It will support British Army operations by allowing training on the system in the UK. Watchkeeper is a high-performance, multi-sensor, all-weather UAS that can remain airborne for more than 16 hours in a single mission.

The tactical UAS will be deployed by the British Army for life-saving surveillance and intelligence capabilities in support of military operations and is unarmed. Crucially, Watchkeeper is certified to the same safety standard as manned aircraft.

The RTS moves the Watchkeeper program from the testing and evaluation phase—previously undertaken by Thales operators in the approved test airspace near Parc Aberporth, West Wales—to full flight training for British Army operators.

It follows the announcement (24 February) that the British Army will begin training flights from Boscombe Down, Wiltshire. The RTS will allow army crews to fly sorties in segregated airspace, integrating with the military exercises taking place on Salisbury Plain.

Lt. Col. Craig Palmer of the British Army said, "The safety bar for Watchkeeper has been set very high. The detailed reviews and testing of the whole system have provided significant evidence that the system is maturing rapidly; sufficiently enough to support an RTS recommendation."

"The process of achieving RTS and the other certifications required for Watchkeeper has been ground-breaking, not only for Thales but also for the MOD and the CAA", said Victor Chavez, CEO of Thales UK. "Much painstaking work has been required by all parties to deliver the comprehensive and rigorous certification, but our collective achievement is a great one: the first tactical UAS allowed to fly in UK airspace."

For further information regarding Watchkeeper, please access ***https://www.thalesgroup.com/en/spain/aerospace/what-we-do-aerospace-uas/watchkeeper***

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The AMT 73L was the World's first deployed modem with certified compliance to the MIL-STD-188-165A standard, designed to fulfill two way satellite communication requirements in Defence Satellite Communications Systems (DSCS).

The 25W GaN X-Band BUC is perfectly suited for harsh environments such as man-pack terminal deployments. Constructed in a compact cooling enclosure for outdoor operation is the smallest fully integrated unit on the market today.

Advantech Wireless' S5920M Ruggedized VSAT Terminal is a complete DVB-RCS modem that can be used in very harsh environment as in military and desert operations. The RAR9160 Ruggedized Router is designed to provide best in class performance for critical applications under harsh environments.

Advantech Wireless KR Series products empower system integrators to address US and allied defense departments and government agencies with rapid, reliable, secure, global satellite & wireless communications networks abilities.

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DISPATCHES

USAF—Space Ops Award To Lt. Col. Little

Lt. Col. Samuel A. Little was recently named by the National Space Club as recipient of the prestigious General Bernard Schriever Award, honoring excellence in military space operations and acquisition. "The best part of our team's job here at the Cape is hearing that the spacecraft we ushered through launch have been fully checked out and are entering operational life," Little said. He is the director of operations, 45th Launch Support Squadron, Patrick Air Force Base, Florida. (U.S. Air Force Photo/Shawn Walleck)

Lt. Col. Samuel A. Little, director of operations, 45th Launch Support Squadron was recently named by the National Space Club as recipient of the prestigious General Bernard Schriever Award, honoring excellence in military space operations and acquisition.

Little was selected by a panel of experts from across the aerospace and defense industry. He will be presented the award at the National Space Club's Goddard Memorial Dinner on March 7 in our nation's capital.

The annual Dr. Robert H. Goddard Memorial Dinner is the major event of the Washington space calendar, first celebrated in 1958.

A 1997 graduate from the University of Florida, and a Central Florida native, Little was commissioned through the Air Force ROTC program. He never thought his career path would reach to the stars.

He didn't pick Space as a career; Space picked him.

"As an environmental engineering major at UF, I fully expected an Air Force assignment in the Civil Engineer arena. But that didn't happen," he said. "Only one of us went the CE route and the rest were commissioned as 62Es [Developmental Engineer]. "In addition, I was selected for the Operational Space and Missile Tour program. That program put me in an operational space and missile tour for my first assignment and then sent me to an acquisition tour second.

"So, I went to Undergraduate Space and Missile Training at Vandenberg AFB and on to the 3rd Space Ops Squadron as a satellite vehicle operator," he added. He has been a member of the 45th Space Wing Sharks since 2011.

According to Col. Matthew Skeen, commander, 45th Launch Group, Little successfully led his squadron as they integrated and launched six Department of Defense satellites, provided Air Force support to three successful Falcon 9 launches and piloted the groundbreaking Global Positioning System III pathfinder satellite.

Little, who acknowledged great honor in earning the award, said any accolades that come his way are a reflection on the team he is a part of, and the magnitude of the work they do.

"The best part of our team's job here at the Cape is hearing that the spacecraft we ushered through launch have been fully checked out and are entering operational life," Little said.

"That means we did everything right and gives us a huge sense of accomplishment. Building on that, we've gotten feedback from the users of these satellites about the impact they have on missions close to home and downrange," Little said.

"Our team also works with the Falcon 9 program on their certification effort to become a DoD launch provider. So seeing a successful Falcon 9 launch is a huge reward for us."

He also emphasized how little room [meaning none] there is for error in his unit's job performance.

"One hundred percent mission success is our driver for how we manage our force. We have one shot at success in the launch mission and these satellites are crucial to the nation," Little said, adding there is always room for improving his unit's methods and processes.

"We are always re-evaluating our mission execution after each launch to identify areas where we can improve or change processes to bolster mission assurance. We have to do this to be successful now and in the future," he said.

"Colonel Little led the squadron to a flawless performance in a year with the most demanding operations tempo in the squadron's history," wrote Brig. Gen. Nina Armagno, commander, 45th Space Wing, in a memorandum to Air Force Space Command Headquarters.

"Sam also guided his team of young military engineers and experienced Noncommissioned Officers as they adapted to a dynamic schedule. He also leveraged his unrivaled space operations expertise and extraordinary leadership ability to make invaluable contributions to our nation's space capabilities this year," she wrote.

Story by Chris Calkins, 45th Space Wing Public Affairs

DoD—Sharing...

The Department of Defense announced its electromagnetic spectrum strategy for sharing with the commercial wireless industry on February 20th—the electromagnetic spectrum is a range of frequencies of electromagnetic radiation and has many uses, including radio and satellite communications, radar, and GPS.

"Through its plan, DoD recognizes that meeting its own requirements amidst the growing commercial and consumer demand will require cooperation, compatibility and flexibility," said Karl Nebbia, the associate administrator of the Office of Spectrum Management at the electromagnetic spectrum strategy press briefing, February 20th.

"Indeed, a key focus of its plan is to establish goals and objectives to develop systems that are efficient, flexible and adaptable in their use of the spectrum." The focus in sharing the spectrum is balancing the needs of the military and the needs of the commercial wireless industry, both of which have growing demand.

"We cannot shift in a short time frame; we just have too much equipment and too much capability that really has to be transitioned in a very thoughtful way so as not to impose a major burden on budgets and a major burden on the taxpayers," said Teri Takai, chief information officer for the Department of Defense.

In the 1990s, 12,000 troops used an average of 90 megahertz of bandwidth. Now, 3,500 troops use more than three times that amount of bandwidth, on average.

"The longer term spectrum needs for government agencies and industry alike can only be met through spectrum sharing. And we are looking for a top-to-bottom commitment from all stakeholders to make it happen," said Nebbia.

Story by Corporal Sarah Cherry, Marine Corps Air Station Beaufort

DISPATCHES

USAF's 50th Space Wing—Operational Acceptance

The 50th Space Wing has earned operational acceptance for four of its remote tracking station antennas from Air Force Space Command, signaling the start of full operations for the Air Force's newest satellite communication assets.

The Remote Tracking Station Block Change, or RBC antennas represent the latest telemetry, tracking and command technologies in the Air Force.

The RBC antennas work as part of the Air Force Satellite Control Network, or AFSCN, of ground stations located around the world. These ground stations are vital to space operations because they allow satellite flyers in the Air Force's space operations squadrons to communicate with the satellites they command and control.

Brian Bayless, the 22nd Space Operations Squadron AFSCN integration chief., said,

"The AFSCN operations fall under 22 SOPS. The AFSCN provides access to more than 150 Department of Defense, national intelligence, civil and allied nation satellites. Now, we have four new technologically advanced systems to accomplish that mission."

The effort to bring the RBC antennas fully online represents the first upgrade to remote tracking station antennas since Automated Remote Tracking Station 1 antennas were installed in 1987.

The new antennas offer the AFSCN a non-keyhole environment, in other words, they can track an orbiting satellite during its entire pass over a tracking station. "The legacy antennas moved up to 87.5 degrees, but then they have to be manually rotated to 92.5 degrees and reacquire the satellite before tracking the remainder of the pass," Bayless said. "That's just the way the old tracking mechanism worked. With the RBC antennas, we don't lose track of the satellite as it passes over. So, the new antenna gives us an additional five degrees of telemetry." U.S. government contractors built and installed the RBC antennas at a cost of approximately $25 to $35 million at each site.

"These aren't trivial upgrades," Bayless said. "We've replaced the antennas and the hardware, software and control equipment needed to operate them."

The Air Force began installing RBC antennas at remote tracking sites back in 2004, when the first was constructed at Vandenberg Tracking Station. Following installation, antennas are tested and operated for a matter of time before Air Force Space Command leaders deem them ready for operational acceptance.

Operational acceptance means the Air Force can take full advantage of a multitude of enhancements provided by the new antennas. They not only offer a better tracking range, they provide an 85 percent increase in redundancy and allow the AFSCN to perform in a more automated fashion.

"What RBC antennas allow us to do is automate satellite contacts," said Lt. Col Aaron Gibson, the 22 SOPS commander. "The AFSCN can now ingest our network tasking order schedule, build satellite contacts from that schedule, run the contacts and de-configure without a human touching a keyboard." Bayless said the RBC antennas also should reduce, by up to 50 percent, the time tracking stations spend preparing for a satellite pass.

DISPATCHES

Inmarsat + Hughes—A Discreet Move

Inmarsat has signed a contract with Hughes Network Systems, LLC (Hughes) to manufacture the new Low Profile BGAN terminal, which will equip police forces and other government departments around the world with a discreet communications terminal.

Combining the proven reliability of Inmarsat's globally available BGAN service with a lay-flat, rapidly deployable antenna, the new terminal delivers an innovative, remote capability that allows unmanned, concealed surveillance.

"The development of Low Profile BGAN (LPB) grew out of the particular needs of our government customers and draws on the key strengths of our BGAN M2M service; reliability, global availability and the remote set-up , which allows for discreet and truly unattended connectivity," said Peter Dingley, VP Offer Development, Inmarsat Global Government.

"A system that can be mounted discreetly is of great interest to Government departments. From police forces and similar agencies that need to leave unattended equipment or maintain a low profile, to overseas agencies whose SATCOM equipment become a target for malicious damage, this terminal with its lay-flat antenna opens a wealth of new opportunities."

Power and connectivity capabilities are key features in the government market. The Low Profile BGAN offers a viable solution to both of these hurdles when operating in remote areas and, in this regard, provides a unique product offering.

"When you add to this the ability to be buried or camouflaged to avoid detection, the Low Profile BGAN is expected to become the staple SATCOM backbone of future discreet operations," continued Peter Dingley.

"This product directly builds on our successful work with Inmarsat in the machine-to-machine (M2M) communications market," said Graham Avis, vice president of Hughes San Diego. "I can see the low profile BGAN terminal being deployed in a variety of commercial and government applications where a conspicuous installation cannot be tolerated."

The LPB is a rapid-to-deploy, lay-flat, coverable, covert terminal, which allows the user to mount the device outdoors, on flat surfaces or buried under a layer of material, while maintaining high-speed data rate connectivity for applications including the streaming of real-time video, audio and data to a variety of end users throughout the world.

The solution is compatible with a wide range of currently available and future planned surveillance hardware. When fitted to these triggers, the LPB can lay dormant until awoken by a network command from the command center or triggered into action by an event in the field. The multi-phased array antenna negates the need for complex pointing and meets government-level environmental and ingress protection.

The LPB is scheduled for end user testing later this year and the first 100 terminals are due for release from Quarter 3, 2014. Customer commitments have already been secured for a large portion of this first production run, with pre-production orders currently being taken for the remainder of the units.

The Hughes Network Systems infosite is accessible at ***http://www.hughes.com/***

The Inmarsat BGAN infosite is located at ***http://www.inmarsat.com/service/bgan/***

Gen. Shelton To Speak @ 30th Space Symposium

Expect a dynamic start to the Space Foundation's 30th Space Symposium with featured speaker Gen. William L. Shelton, USAF, Commander, Air Force Space Command, opening the general program on May 19th.

The 30th Space Symposium will be held May 19-22 at The Broadmoor Hotel, in Colorado Springs, Colorado, USA. The strong military content will continue as Gen. Shelton is followed on stage Tuesday morning by Brig. Gen. Jeffrey A. Farnsworth, USA, Deputy Commanding General for Operations, U.S. Army Space and Missile Defense Command (USASMDC)/Army Forces Strategic Command (ARSTRAT).

Widely known as the most important worldwide space industry conference, the Space Symposium annually attracts more than 9,000 participants, and more than 100 speakers and panelists representing top space decision makers from military, civil, commercial and academic organizations from around the globe.

Additional 30th Space Symposium military and defense speakers include:

- Col Dominique Arbiol, FAF, Deputy Commander, Joint Space Program, Ministry of Defence, France
- Col. Neal Barlow, USAF, Acting Chief Scientist, Air Force Space Command, United States Air Force Academy
- Lt. Gen. James R. Clapper, USAF, (Ret.), Director of National Intelligence
- Letitia A. Long, Director, National Geospatial-Intelligence Agency
- Douglas L. Loverro, Deputy Assistant Secretary of Defense, Space Policy, Office of the Under Secretary of Defense
- Lt. Gen. John W. "Jay" Raymond, USAF, Commander, 14th Air Force
- Brig. Gen. Roger W. Teague, USAF, Director of Strategic Plans, Programs and Analyses, Air Force Space Command
- Maj. Gen. Martin Whelan, USAF, Director of Requirements, Headquarters Air Force Space Command

As commander, Air Force Space Command, Peterson Air Force Base, Colorado, Gen. Shelton is responsible for organizing, equipping, training and maintaining mission-ready space and cyberspace forces and capabilities for North American Aerospace Defense Command, U.S. Strategic Command and other combatant commands around the world.

A proud tradition at the Space Symposium is the annual Space Warfighters Luncheon, which celebrates the men and women who serve in the military around the world, with Lt. Gen. John W. "Jay" Raymond scheduled to speak at this event. More at ***http://www.spacesymposium.org***.

DISPATCHES

TMS—Going Light With SOTM Offerings

Teledyne Microwave Solutions (TMS) has unveiled three Ka-band Satcom-On-The-Move (SOTM) products that provide a unique value proposition for the most demanding SWaP needs of today's commercial and military customers.

Designed for ultra-lightweight applications such as Airborne and "ManPack" Portable Terminals, the Ka- SOTM Trio consists of a wide-band solid state power amplifier (SSPA), a Low Noise Block Downconverter (LNB), and a Block Upconverter (BUC). Both the LNB and BUC can be electronically switched between commercial and military Ka-bands.

Leveraging TMS' 40 years of experience with 'chip and wire' technology, the three Ka SOTM products are hermetically-sealed for harsh environments and extremely power-efficient for battery-powered applications.

Unlike much larger and heavier market alternatives, their miniature size enables close-proximity mounting on small antenna feeds for minimal loss or optical distortion. The Trio were designed specifically as a COTS suite of products not subject to ITAR regulations.

The products were also designed with a modular approach that enables them to be deployed together as a fully integrated system, or independently giving customers new flexibility and options to maximize performance.

"In addition to setting new SWaP standards, these Ka SOTM products present system integrators with a competitive edge in that they are fully integrated, can be configured for a wide variety of functions, and are switchable between commercial and military bands," said Mike England, General Manager, RF and Microwave Products. "This trifecta of benefits gives integrators immediate Ka- access while reducing the time, costs, and operational complexities of alternative solutions."

Each multi-functional converter easily integrates into legacy and new systems, including either internal or external reference at both 10 and 50 MHz along with blanking and attenuation control. Combined with a standard TMS SSPA, a full transceiver can be configured to operate over the 29-31 transmit band and the 19.2 - 21.2GHz receive band with just three hermetically sealed modules.

A standard TMS SSPA offers 16W P1 or 8W linear output power over the full 29-31 GHz frequency range. The unit also features extensive gain control and forward power monitoring. An internal BIT circuit monitors current, thermal and other critical parameters.

TMS also offers a K-band (19.2 - 21.2 GHz) LNA with an industry leading 1.3 dB noise figure over the full 2 GHz bandwidth. With a total weight of 0.5 lbs. and an extremely small footprint, the unit is ideal for today's integrated, light-weight Ka-band terminals.

Infosite: ***http://www.paradisedata.com/***

DISPATCHES

USMC + US Navy—Practice For Perfection At Pohang

Lance Cpl. Matthew J. Cohen uses a mass reference terminal to balance power between satellite communication links at the 1st Republic of Korea Marine Corps Division Base in Pohang, Republic of Korea March 11. The satellite communication links enable the Marines and sailors participating in Marine Expeditionary Force Exercise 2014 to utilize Internet, phone and video teleconferencing capabilities during the exercise. Cohen is a satellite communications operator with 7th Communications Battalion, III MEF Headquarters Group, III MEF.

In an age where technology enables rapid decision making, and information can be moved in seconds, the ability to communicate is an invaluable asset for all and can make—or break—a military operation.

For Marines and Sailors taking part in the Marine Expeditionary Force Exercise 2014 at Pohang, Korea, communication will be a key element to a successful command post exercisem which will test the abilities of the U.S. and Republic of Korea Marines to react to a crisis situation.

"This is the largest communications architecture that we have deployed in support of a MEF-level exercise," said Capt. John R. Sisson, commanding officer of Company A, 7th Communications Battalion, III MEF Headquarters Group, III MEF. "This is an austere environment which brought new challenges and required considerably more logistical planning than compared to exercises we conduct on Okinawa."

The MEFEX 14 CPX tests the abilities of the ROK and US relationship to operate and communicate effectively across the range of military operations, from disaster relief to complex, expeditionary operations.

Upon arriving at the 1st ROK Marine Corps Division Base in Pohang, 7th Communications Battalion had an empty field of mud and snow in front of them and a deadline of 96 hours to provide multiple Internet systems, phone and video teleconferencing capabilities to a combined operations center.

"It is always a daunting task to come into a barren area but this is what expeditionary operations are all about, this is what we as a Marine Corps are here to do," said Capt. Allen V. Pollard, future operations officer with the battalion. "We are able to come out here into an austere environment, not rely on any pre-existing structures or power supply and set up a command post, complete with Internet and phones, from scratch."

In order to make the 96-hour deadline they were faced with, the battalion had an internal deadline for themselves of 48 hours, according to Pollard.

"Within the first 48 hours we have to have our classified, unclassified and coalition computer networks links operational, our classified and unclassified phone lines connected as well as the ability to perform classified video teleconferencing," said Pollard. "Once we have all these links set up and operational, we will link these capabilities to the COC within the 96 hour point. After the COC is up and running, we will set up links throughout the rest of the camp." Marines worked in 12 hour shifts through the cold Korean nights to accomplish the mission.

"There was still snow on the ground when we first got here and the site was basically a giant mud pit for several weeks," said Lance Cpl. Helen M. Girardot, a native of Royal

Satellite communication systems and radio towers sit outside the combined operations centers at the 1st Republic of Korea Marine Corps Division Base in Pohang March 11th.

Cpl. Daniel J. Estrada configures modem settings on a satellite communications system at the 1st Republic of Korea Marine Corps Division Base in Pohang March 11th.

Oak, Michigan and field wireman with the battalion. "But everything is working now. We never thought we would miss our deadline because we have a great team who went through a month-long workup communication exercise where we did checks on all of our equipment and were able to get everything in place for setting up here in Korea."

Prior planning and having well-trained Marines will have monumental effects on the success of an exercise or operation, according to Sisson.

"We have been planning, preparing equipment, and training Marines through communications exercises since mid-December for this exercise," said Sisson. "The training we performed before coming to Korea was absolutely essential to our success once we were on site. You can't have a command post exercise without communications, so if we were to come out here and failed in our mission, there would not be a command post exercise for MEFEX 14."

This is the largest footprint the battalion has had in Korea, or any other country, in many years to support the III MEF Command Element as a whole, according to Pollard.

"Throughout the year we support any communications requirements and command and control requirements for the III MEF commanding general, 3rd MEB commanding general as well as any III MEF or 3rd MEB-led exercise," said Pollard. "This includes exercises such as Key Resolve, Cobra Gold, Balikatan and MEFEX in which we are currently participating. We are responsible for providing the communications support throughout the entire area of operation. We are also responsible for providing rapid response contingency communications anywhere in the Asia-Pacific within 96 hours. This was seen most recently in the humanitarian assistance and disaster relief efforts of Operation Damayan in the Philippines."

"For MEFEX itself we are providing services to many different areas," said Maj. John R. Boutin, operations officer with the battalion. "We have the MEF main body in Pohang, we have forces providing services in Gwangyang for Freedom Banner, we have Marines on the 31st Marine Expeditionary Unit providing services for Ssang Yong, we have forces prepared for an air contingency Marine air-ground task force back in Okinawa and we have Marines preparing to go to Balikatan in the Republic of the Philippines once MEFEX is over. We are providing the best quality services we can to our customers, the MEF staff and their forces."

As the exercise moves forward, the battalion will continue to provide tactical communication links to approximately 300 users and will additionally add set up commercial connections to provide a better quality of service to the Marines and sailors in Pohang, according to Pollard.

"The Marines have been working their tails off," said Boutin. "We have had 24-hour operations going since we arrived in mid-February. They set up all the tents, ran all the wires, they made a small city here. We want to make sure that each user, no matter the rank, is provided the best possible services we can provide."

The ROK and U.S. Marine Corps III MEF teams regularly conduct exercises to ensure interoperability and maintain strong relationships, contributing to the security and stability on the Korean Peninsula as well as the entire Asia-Pacific (APAC) region.

Story + photos by
Cpl. Matthew Manning,
III Marine Expeditionary Force,
Marine Corps Installations Pacific

DISPATCHES

CPI Satcom Division—Triple Launch

The Satcom Products group of Communications & Power Industries LLC (CPI) has introduced three new products to the market.

From top to bottom:

CPI's 80W and 40W Ku-band GaN BUCs

CPI's 750W TouchPower TWTA

CPI's 40W Ka-band BUC with multi-band option

First, there's a new 80 watt Ku-band, GaN-based, solid state block upconverter (BUC). This new BUC augments CPI's extensive selection of solid state GaN and GaAs products in C-, X-, Ku- and Ka-band.

The 80 watt GaN BUC is nearly twice as power efficient as its GaAs counterparts, features a user-selectable LO frequency for improved operating flexibility, and complements our existing 40 watt Ku-band GaN BUC, which was introduced last year.

"CPI's new 80 watt BUC is ideal for satellite uplinks where compact size and light weight are critical factors in overall system design, such as in maritime, SATCOM-On-The-Move (SOTM), MILSATCOM, offshore energy, emergency response and natural gas extraction applications," said Gary McGovern, director of business development for CPI Satcom Products.

"At only 10.6" x 7.2" x 5.6"and 15 lbs, CPI's 80 watt Ku-band GaN BUC is a great solution for increasingly demanding applications."

Also debuting is the firm's TouchPower™ line of touchscreen TWTAs. CPI's latest high-power amplifier (HPA) represents a significant step forward in rack-mount traveling wave tube amplifier (TWTA) design and is available in C-, DBS- and Ku-bands.

"CPI's newest HPA combines the latest developments in touchscreen technology with other technological innovations to dramatically improve ease-of-use and to maximize the value of the amplifier by reducing cost of ownership," said Colin Eastment, vice president of business development at CPI Satcom Division. "Configurable color displays let the user select which parameters are seen, and our SCOPESCREEN feature provides charts and graphs that display amplifier performance over time. In addition, TouchPower™ amplifiers are available with CPI's patented LifeExtender™ innovation, the only technology in the industry today that actually increases TWT cathode life by up to 50 percent. CPI also offers a companion feature called LifePredictor, which enables users to better plan TWT maintenance over time."

The third new offering is multi-band capability in CPI's Ka- and Ku-band TWT and solid state BUCs. This optional capability will significantly increase the ability of users to switch between different frequency bands using only one amplifier and BUC.

The CPI Satcom Product Group infosite is located at ***http://www.cpii.com/division.cfm/4***

DISPATCHES

Surrey Satellite Technology Ltd (SSTL)—Modernizing GPS With SmallSats

Artistic rendition of a GPS III satellite. Image is courtesy of the GPS.gov website.

People all over the world have depended on the U.S. Global Positioning System (GPS) for defense, transportation, and surveying applications since the GPS constellation became fully operational in 1994.

GPS' civil and recreational use has proliferated since 2000, when then-President Clinton ended Selective Availability—the service the GPS satellite constellation provides has now become a crucial part of everyday life.

GPS has faced increasing challenges as well as competition from other Global Navigation Satellite System (GNSS) systems around the world. In a time when U.S. government departments are operating on tight budgets, but demand for GPS data is increasing, future GPS satellites will need to be able to do more for less.

They must also continue to fulfill essential requirements such as improved accuracy, interoperability with other GNSS systems, anti jamming, and other signal security capabilities. Progress has been made to modernize the system since Congress authorized these efforts in 2000—the first GPS III satellites are due to begin service in 2015.

This is a long concept-to-launch time (and one that has already been subject to delay), meaning that by the time the new satellites reach orbit, they will already be flying outdated technology. Various studies have also identified areas where delivery of subsets of GPS signal data would benefit the GPS military, civil, and commercial user communities.

In 2005, Surrey launched GIOVE-A, the first satellite in Europe's Galileo GNSS system, designed and built by Surrey in 29 months for a budget of around $35 million (today). GIOVE-A far surpassed its design life and secured the Galileo frequency filings, showing that small satellites have their place in space-based navigation systems.

In 2012 the Air Force Research Laboratory (AFRL) selected Surrey to investigate how our small satellite approach could provide increased system capability while reducing the cost of acquisition and management and accelerating the timescales associated with the deployment of GPS satellites and infrastructure.

Our experience developing GIOVE-A and building the navigation payloads for the first 22 Fully Operational Capability satellites for the Galileo constellation were important selection criteria for being awarded the study.

Small satellites are being used for increasing numbers of government, institutional, and commercial programs, where high-capability missions must be cost-effective and delivered quickly to orbit.

A small satellite's low mass and volume mean that launch costs are dramatically reduced and more than one satellite can be launched at a time, which is important for constellation applications.

The increasing need to "do more for less" means that we must approach missions differently and drive innovative development.

This is exactly where the benefits of cost-effective, rapid-build small satellites can play a part in ensuring the long-term sustainability and competitive advantages of the GPS system.

Story is courtesy of the Surrey Blog.

STRATCOM Commander Outlines Deterrence Strategy

Admiral Cecil. D. Haney

While U.S. Strategic Command remains capable and ready to meet its assigned missions, sequestration will continue to stress its human element and ability to meet 21st century threats, Stratcom's commander told the Senate Armed Services Committee on February 28th.

Navy Adm. Cecil D. Haney reported that though the two-year bipartisan Budget Act of 2013 and the 2014 Consolidated Appropriations Act reduce near-term budget uncertainty, significant national security challenges loom, spurring the need for collaboration and a unified command plan.

"Against this dynamic and uncertain backdrop, U.S. Strategic Command's mission is to partner with other combatant commands to deter and detect strategic attack against the United States [and] our allies and to defeat those attacks if deterrence fails," the admiral said.

The unified command plan-assigned missions are strategic in nature, global in scope, and intertwined with the capabilities of the joint military force, the interagency and the whole of government, Haney added.

According to Haney, the deterrence plan will be executed through provision of a safe, secure and effective nuclear deterrent force, partnership with other combatant commands, assessment of challenges in space, development of necessary cyberspace capability and capacity, and preparation for uncertainty.

However, he acknowledged his concern that the current global security environment is more complex, dynamic and uncertain than at any time in recent history.

"Advances in state and non-military capabilities continue across air, sea, land [and] space domains, as well as in cyberspace," Haney said.

The space domain is becoming ever more congested, contested and competitive, Haney reported, adding that worldwide cyber threats are growing in scale and sophistication.

Weapons of mass destruction and nuclear technologies continue to proliferate, Haney said. "No region in the world is immune from potential chemical, biological, radiological or nuclear risk," he said.

Terrorist threats are still a source of significant ambiguity, Haney said, and the threat of homegrown violent extremists remains a concern.

Haney emphasized that America's nuclear deterrent force remains safe, secure and effective.

Story By Amaani Lyle, American Forces Press Service

DISPATCHES

TrustComm, Spectra Group + Inmarsat—L-TAC Leanings

TrustComm Inc. has been designated as a Service Provider for Inmarsat's new L-TAC space-segment services and has signed a distribution agreement, with Spectra Group to provide Slingshot adapters required to access L-band frequencies from existing fielded UHF radios.

L-TAC from TrustComm, available now, uses existing fielded UHF tactical radios to access the Inmarsat-4, L-band satellite constellation when UHF capacity is not available for any reason.

TrustComm has been conducting live demonstrations of L-TAC at selected locations worldwide with excellent feedback, particularly for those users who have a Communications-on-the-Move (COTM) requirement for UHF.

By attaching a Spectra Group Slingshot adapter kit (a small converter and antenna) to the external communications port of commonly used UHF MILSAT radios, users can achieve short-term and/or longer-term network access to private leased channels on Inmarsat satellites that have the same capabilities as UHF 25kHz channels (e.g. one 56kbps wideband channel or five 5kHz ANDVT voice channels) on UHF MILSAT or UHF commercial satellites.

"TrustComm recognizes the value of L-TAC's capabilities and the gap it fills, along with the significant cost savings for government end users when compared to commercial UHF channels. We have dedicated significant resources to field this service, working closely with Inmarsat and Spectra Group," said TrustComm Chief Executive Officer Bob Roe.

"Being selected as an Inmarsat Service Provider for L-TAC demonstrates Inmarsat's confidence in our secure infrastructure and our deep understanding of military COMSATCOM requirements."

More information on L-TAC from TrustComm is available at ***http://www.trustcomm.com/solutions/l-tac/***

DISPATCHES

Track24 Defence—BLOS For Blue Force Tracking

Situational command and control (SCC) specialist Track24 Defence has manufactured and launched a new IP68-rated beyond line-of-sight (BLOS) satellite device, the Echo, for secure blue force tracking (BFT) and command and control.

Functional as a standalone device and as part of Track24's SCC TITAN BFT solution, the Echo operates on the Iridium satellite constellation.

It is a commercial off-the-shelf (COTS) tracking and messaging solution designed for security and defence sector users.

A ruggedized handheld device, the Canadian-built Echo is IP68-rated waterproof to 2 meters, designed to withstand the austere land and sea environments that military users operate within. As well as a satellite tracking and BLOS communications solution, the hardware's M2M functionality means it can connect to an array of tablets, smart phones or sensors to transmit data in near real time to the operational command. This could be situational awareness or vital signs of a soldier. The device has already been adopted by one special forces organization.

Track24 defence sector director Giles Peeters said, "The Echo is smaller and lighter than Track24's existing tracking device, the Whisper, yet represents a more robust, ruggedized option for forces operating in vast and austere terrain.

As a COTS solution, it's cost-effective and delivers secure and reliable BLOS communications, an important operational requirement for BFT—we've already shipped the first units to a special forces client."

The Echo works with Windows and Android operating systems and the solution is configurable over the air using the Track24 SCC Platform—all data communications are secured by AES256 encryption.

"The Echo integrates with SCC TITAN command and control system, relaying GPS position updates, emergency panic alerts, pre-configured text messages and other M2M data reports—all securely encrypted. This information can then be plotted on a common operational picture to enable better and faster command and control decision-making," concluded Peeters.

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

A New Satellite To Gather GEO Intelligence

General Shelton during the Air Force Association meeting. Photo courtesy of the Department of Defense (DoD).

There's a new 'kid' on the block—or rather a classified electro-optical satellite—that the Air Force has acknowledged is designed to spot other satellites and space debris.

The Geosynchronous Space Situational Awareness Program (GSAP) is sure to gain the attention (and ire) of China and Russia, who currently understand the military advantage that space provides the United States.

These newbies are described as upgraded versions of DARPA's MiTEx (Micro-satellite Technology Experiment) satellite.

They were reportedly used, among other things, to get close to, and observe, other satellites.

Brian Weeden, technical adviser for the Secure World Foundation which focuses on the peaceful uses of outer space, in a candid email sent after reading the Air Force Fact Sheet on G-SAP, said, "Having these satellites drifting by everything in GEO [geosynchronous orbit, which allows a satellite to hover over one spot of the globe] would be a big source of information.

"Of course, that's exactly the sort of thing the U.S. military is extremely worried another country will do to figure out what the U.S. has in GEO. So it's likely other countries, especially Russia and China, are going to consider this a threat."

Recently, the U.S. Air Force's General William Shelton explained what makes these new satellites tick:

Once in orbit they can be moved to an area of interest to maintain a vigil to a specific area of interest.

Moving a satellite while in geosynchronous is not a common practice, as the fuel's weight is a major budgetary constraint. Hence the Air Force, which keeps their cards close to their vest, reveals that this is, indeed, a most important mission.

As the satellites are electro-optical it is speculated (as the program's details are classified) that they probably use a combination of sensors and telescopes to spy on objects.

Lastlywv, General Shelton was not offering any information regarding the cost factor of the satellites that are built by Orbital Sciences Corp. That probably means cost could provide a competitor with a good estimate of just what sensors are on board.

The first two birds will launch "later this year," Shelton told reporters after his remarks.

Why is the U.S. building and revealing the existence of these satellites?

Weede speculated, "As far as why they're doing this, I think China is probably part of it, but not all of it. The U.S. has always been concerned about the security of its assets in GEO, particularly the satellites used for missile warning, protected SATCOM [satellite communications], ELINT [electronic intelligence], and SIGINT [signals intelligence].

"Recent activities by China, including a launch last May that some have claimed to be a test of a direct ascent ASAT [anti-satellite] system that could reach GEO, have certainly heightened their concerns. But the Russians developed a co-orbital ASAT system that could reach to GEO back in the late 1990s and early 2000s, so a Chinese ASAT is not the only potential threat.

"This is about more than just detecting potential threats. I think part of it is also the ability to collect better intelligence on what other countries have in GEO."

Why reveal, and why tell the world now at the Air Force Association in Winter Park, Florida?

Presumably the decision to declassify the existence of G-SAP was made at the White House level, probably an interagency decision involving the Office of Science and Technology Policy, the State Department, Defense Department, Director of National Intelligence.

Lastly, in keeping one step ahead of those who track spy satellites as a hobby, unless these sats are as small as MiTEx, they would be visible to these observers, and the government may have wanted to 'show and tell' before it was revealed in news reports and social media.

Certainly, since this announcement by the USAF, Russia, and, for that matter, the world, continues to undergo change—and not necessarily for the better.

DISPATCHES

Naval Postgraduate School + SOUTHCOM—More Than Just A CubeSat Consultancy

The U.S. Southern Command (Southcom) has embarked on an ambitious international CubeSat program and has turned to the Naval Postgraduate School for assistance.

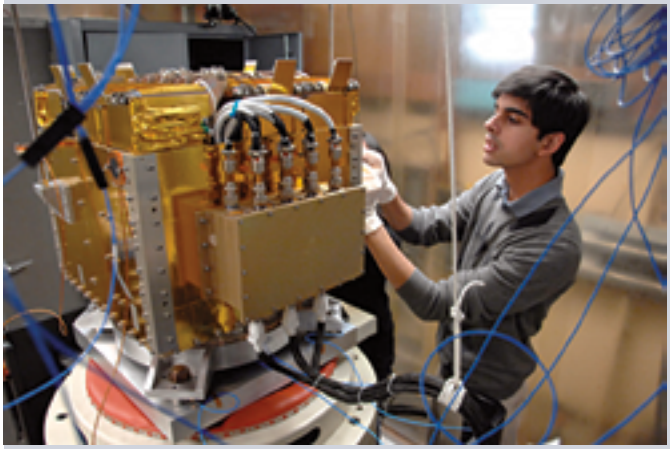
The NPS Distributed Information Systems and Experimentation (DISE) research group, along with the university's Space Systems Academic Group (SSAG), have teamed up to help the combatant command evaluate how low-cost space communications capabilities can support information sharing and tactical communication across the remote and densely-forested areas common to the Southcom area of operations.

A specially-modified CubeSat, dubbed the Space and Missile Defense Command Nano-Satellite-3 (SNAP-3), was launched from Vandenberg Air Force Base aboard an Atlas 5 rocket, and housed inside the NPS SSAG-developed CubeSat launcher, NPSCuL. DISE Research Associate Brian Wood has lead the NPS effort to assess the operational value of the technologies employed by the mini-satellite.

"SNAP-3 is an attempt to fill a capabilities gap associated with the need for other than line-of sight communications in Southcom's heavily-forested area of operations," said Wood. "NPS will be conducting an assessment of SNAP-3's ability to fill that gap." SNAP-3 seeks to overcome line-of-sight limitations in two ways. First, it allows Soldiers on the ground to ping CubeSats in low earth orbit which in turn relay messages to command and control nodes or to other service members.

However, SNAP-3 also uses Unattended Ground Sensor Exfiltration technology. Researchers hope to use unattended ground sensors to gather intelligence, such as the presence of insurgent or criminal groups traveling along known smuggling routes, and then beam that data to orbiting SNAP-3 satellites. The satellites would then download the data to receivers without the need to place Soldiers in harm's way.

"Over the next 18 months, we will be traveling to Brazil and Peru, and possibly other interested nations, where we will set up a scenario that tests the ability of SNAP-3 to perform as designed," said Wood.



Space Systems Engineering student Vidur Kaushish performs final testing procedures on the Naval Postgraduate School designed and built CubeSat payload platform. The launcher will send several CubeSats into Low Earth Orbit when it is launched in August of this year. Photo courtesy of the Naval Postgraduate School.

Space Systems Engineering students Vidur Kaushish, left, and Wenschel Lan, right, are just two of several NPS students to perform thesis research on the Naval Postgraduate School's custom CubeSat payload platform. NPS and the National Reconnaissance Office teamed up to develop the one-of-a-kind launcher. Photo courtesy of the Naval Postgraduate School.

NPS space systems student, U.S. Marine Corps Capt. Clayton Jarolimek of Minto, N.D., is working with Wood on the SNAP-3 assessment.

"One of the things that drew me to this was my past experience on the ground without satellite communication in Helmand Province, Afghanistan," said Jarolimek. "If adopted, SNAP-3 has the potential to bring satellite communications down to squad size units o the ground.

"I will be conducting an analysis of the architecture of the constellation of the SNAP-3 network," continued Jarolimek. "I hope to be able to make recommendations to the U.S. Army's Space and Missile Defense Command and look at the manner in which the Marine Corps may be able to benefit from this technology as it is realized."

Vidur Kaushish and Wenschel Lan, doctoral students in the university's space systems program, are quite familiar with the NPSCuL launcher, and helped get SNAP-3 into the payload for the Southcom launch.

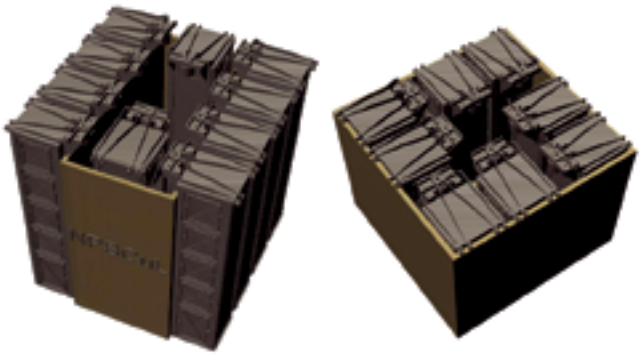
"We built, tested and integrated the system before delivering it to Vandenberg," said Kaushish.

"I used to work on launch vehicles before I came to NPS, but I rarely had the opportunity to get up on the rocket and work with the hardware like we do here," said Lan. "It's something that not many people get to do."

Satellite education is central to the SSAG goal of "blending classroom experience into a hands-on pedagogy that links theory and reality," said SSAG Professor Dr. Jim Newman. Newman has been educating NPS students, and develop satellite technology, since his time as an astronaut in NASA's space shuttle program.

"I realized that CubeSats are an ideal satellite-studies

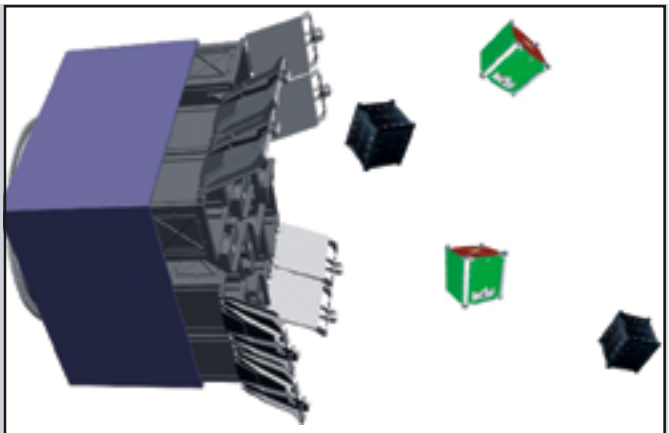
The Naval Postgraduate School campus.



The NPSCul Design

Left: NPSCul — 10 5U P-PODS, ESPA-compatible

Right: NPSCul-Lite — 8 3U P-PODS, ESPA and other, smaller, secondary payload adapters compatible. Image courtesy of the Naval Postgraduate School.



Artistic rendition of NPSCul releasing CubeSats. Image courtesy of the Naval Postgraduate School.

platform due to their cost, the variety of missions they are suited to perform and their ability to be used in conjunction with other CubeSats," said Newman.

That realization has led to numerous CubeSat launches and the incorporation of CubeSat technology into the SSAG curriculum,which has allowed NPS students and faculty to demonstrate the full spectrum of satellite operations.

"You get a rounded experience [at NPS] when it comes to how a satellite is developed from start to launch, its something that you would not see at other graduate institutions," added Kaushish.

Newman insists that satellite research at NPS has both academic and practical value. "There is a need in the fleet to understand what the capabilities of our space systems are. We are educating students to understand and to be able to speak to satellite capabilities... Students have a variety of thesis topics available to them, by studying in this area they know how to apply what they have learned," said Newman.

SSAG's hands-on application of theory is evident in the two CubeSats it has launched this year. These satellites are helping students and researchers to understand the complexities of Low Earth Orbit (LEO) and providing platforms that can be used to test new technologies.

In addition to SNAP-3, NPS also recently launched its Solar Cell Array Tester (NPS-SCAT) satellite. Indicative of the SSAG approach to both satellite education and development, SSAG students and faculty worked together to build and launch the NPS-SCAT satellite in order to test solar arrays in the LEO environment.

"NPS-SCAT has room for four different types of solar cells, ranging from cheap to expensive high-efficiency cells. The experiment will allow us to see how the various cells perform and degrade in a low Earth orbit," said Aaron Felt, an NPS intern from nearby California State University Monterey Bay (CSUMB). Felt is tracking the NPS-SCAT from SSAG's local ground station, the Mobile CubeSat Command and Control (MC3) center.

"There is currently a lot of interest in our command and control center from various groups and academic institutions; NPS currently has the only functioning CubeSat network," said Felt.

NPS has partnered with the University of Hawaii, Utah State University, and the Air Force Institute of Technology to develop the MC3 Center. Partnered universities donate sites for dishes and antennas and in turn, they are able to use NPS-provided ground stations for their own satellite programs.

"Our network of sites allows us to have more frequent and longer satellite contacts," said Felt. "This is important because if you are working with data-intensive payloads, a network gives you more room to download your data." Other members of SSAG's eclectic student body are working on myriad technologies associated with neither SNAP-3 nor NPS-SCAT.

Lt. Jordan Goff of Pittsburgh, Pennsylvania, is working with Newman and Professor Hersch Loomis on the development of a payload processor that will be able to work in the presence of harmful radiation. He hopes that the work that he is doing now will be applied to future CubeSat technology.

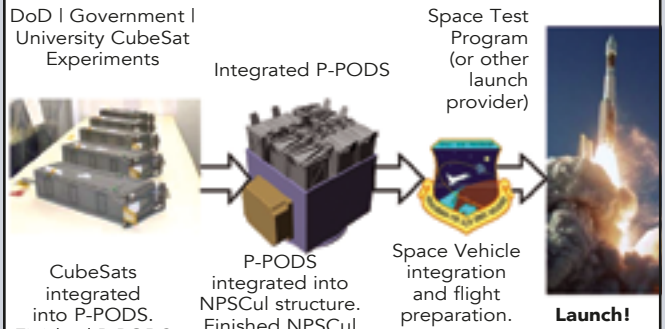
Natasha Nogueira came to NPS as a high school summer-intern. She is working with Newman on a high altitude balloon program to test the conditions of near space.

"A lot of what we do with our balloon is testing capabilities and technologies that will later go into CubeSats," said Nogueira. "Balloons are an inexpensive way to get the equipment we are testing into the Low Earth Orbit environment."

With a broad range of expertise across campus to tap into, NPS' diverse satellite program continues to support student efforts to harness emerging technologies and continue to push the envelope of space education and exploration.

The Naval Postgraduate Schools' infosite is located at ***http://www.nps.edu/***

The NPS Integration Process



DISPATCHES

Hughes Network Systems—GETN Distance Learning Support Contract

Hughes Network Systems, LLC (HUGHES) has been awarded a task order by the U.S. General Services Administration (GSA) in support of the Government Education and Training Network (GETN) to provide commercial satellite communications (COMSATCOM) end-to-end solutions to enable the network's distance learning capabilities.

GETN is a network of eight federal agencies, including U.S. Department of Defense, Executive Branch agencies and Federal Judiciary agencies that share satellite technology, facilities, and distance learning programs.

The task order, awarded through GSA's Custom Satellite Communication Solutions (CS2) contract vehicle, is for a term of four and one half years including the base and option years.

This win marks the second GETN award for Hughes, following the first order in December 2007 under the GSA's SATCOM II vehicle to provide broadband satellite solutions and services.

Tony Bardo, assistant vice president of Government Solutions at Hughes, said, "With federal agency budgets stretched so thin, distance learning is especially in demand, and its well understood that satellite technology is a cost-effective approach to delivering reliable, high capacity network services."

Under the task order, Hughes will provide a one-way video and two-way audio network for GETN users via broadband satellite. Specifically, Hughes will provide:

- Satellite capacity
- Project management
- COMSATCOM engineering system design, configuration, installation, implementation and training
- Maintenance and operational support
- Helpdesk support

Digital video and audio training programs will be broadcast to students located across the 50 states and the Caribbean via a geosynchronous satellite, with return channels from these sites enabling students to interact and communicate with the instructor.

Hughes will ensure cost savings by consolidating bandwidth for the GETN community based on historical usage data estimates, and enable agency users to share programming over the same satellite space segment.

The Hughes infosite: ***http://www.hughesnet.com/***

DISPATCHES

New Space Situational Awareness Satellite Program

General William Shelton, Commander, Air Force Space Command.

The commander of Air Force Space Command announced a new satellite program during a speech about the importance of space and cyberspace at the Air Force Association Air Warfare Symposium and Technology exposition, on February 21st.

General William Shelton told the audience about the new Geosynchronous Space Situational Awareness Program with two satellites being launched on the same launch vehicle later this year.

"GSSAP will present a significant improvement in space object surveillance, not only for better collision avoidance, but also for detecting threats," Shelton said. "GSSAP will bolster our ability to discern when adversaries attempt to avoid detection and to discover capabilities they may have, which might be harmful to our critical assets at these higher altitudes."

According to a new fact sheet on GSSAP posted on the AFSPC website, the program will be a space-based capability operating in near-geosynchronous orbit, supporting U.S. Strategic Command space surveillance operations as a dedicated Space Surveillance Network sensor. GSSAP will allow more accurate tracking and characterization of man-made orbiting objects, uniquely contribute to timely and accurate orbital predictions, enhance knowledge of the geosynchronous orbit environment, and further enable space flight safety to include satellite collision avoidance.

Shelton announced the program during a speech that conveyed concern about the increasingly complex and contested space and cyber environments. He said space and cyberspace are very much a part of everything we do. The dependence on, and demand for, space and cyberspace is higher than it's ever been, he said, noting the changes that have occurred over the years, with 170 countries now having a tangible interest in space to include 11 countries with indigenous launch capability. He said there are no midterm alternatives to the capability provided by space.

"If we're going to be a global power, we want global coverage, we want global access and we want it at a time and a place of our choosing," Shelton said.

Speaking specifically about space, Shelton said despite the increased dependence, the declining budget creates challenges to meet the rising demand. The demand for space includes surveillance, tracking and communication. In addition the focus and actions the Air Force and the nation are taking on space situational awareness, he discussed the need for survivability and resilience of our satellite constellations.

With the additional challenge of declining budgets, Shelton said, "What we're really looking for is the nexus of required capability, affordability and resilience" for the nation's space systems.

"The study work we are doing right now will be effectual for new solutions in the mid 2020 timeframe," he said. "But we've got to get that work done now."

Shelton closed the space portion of his presentation by talking about the Space Security and Defense Program, a vital program that helps find ways to protect the Air Force's spacecraft. SSDP looks at available intelligence and adversary counter space programs, and recommends solutions. He said the program has been a "big plus" for situational awareness and has tangible results in many other areas, even in its early stages.

"[Air Force Space Command] is working very hard to get it right for the future," he said. "[Space] is a vital capability for the nation, for the joint force. We can't let them down, and we won't."

Moving on to cyberspace, the general said it is very different than any other domain as it's man-made and unlike the physical domains people have learned to use over time. Cyberspace more and more defines modern life in the 21st century.

He said cyberspace creates a big advantage in regards to how many people the military has to put in harm's way, however the country's adversaries know cyberspace is the nation's lifeline. Because of this, high-end operators are constantly threatening U.S. systems.

"We've got a lot of cyber enabled weapons these days," he said. "If an adversary can get in and make that weapon system ineffective at the worst possible time—think about that.

"As we've grown our dependence on cyberspace for all the right reasons, it has become an increasingly contested environment for all the wrong reasons. The threats have grown in both sophistication and in number.

A laptop, the right skill set and an Internet connection is all one needs to become a player in cyber warfare, making the low "cost of admission" a major complication.

"We can spend a great deal of treasure on defenses, only to be overtaken by the exquisite talents of a high-end cyber operator who has very little capital invested," Shelton said, noting anonymity makes attribution of these attacks difficult.

"Though the cyber domain is different from any other domain, the application of standard military process is doing well to mitigate a lot of the risk," he said. "Air Force Space Command is developing several tools to conduct cyberspace operations including the potential for offensive cyber capability.

"Our Airmen and industry partners are facing up to these cyber challenges each and every day, and they are ensuring the mission gets done in the 'wild west' of cyberspace," Shelton said.

"We've come a long way in space and cyber these last few years. We continue to provide game-changing capabilities to the warfighter... I think the future of warfare really depends on us having the best, most secure and most capable space and cyber systems."

U.S. Cyber Command recently established a cyber-mission force concept to conduct full-spectrum cyber operations across the Department of Defense, he said. Over the next three years, the Air Force will provide 39 teams, roughly 2,200 Airmen, to contribute to this cyber mission force.

"We must be prepared as a nation to succeed in increasingly complex and contested space and cyber environments, especially in these domains where traditional deterrence theory probably doesn't apply," he said. "We can't afford to wait … for that catalyzing event that will prod us to action."

Story by
Senior Airman Zachary Vucic,
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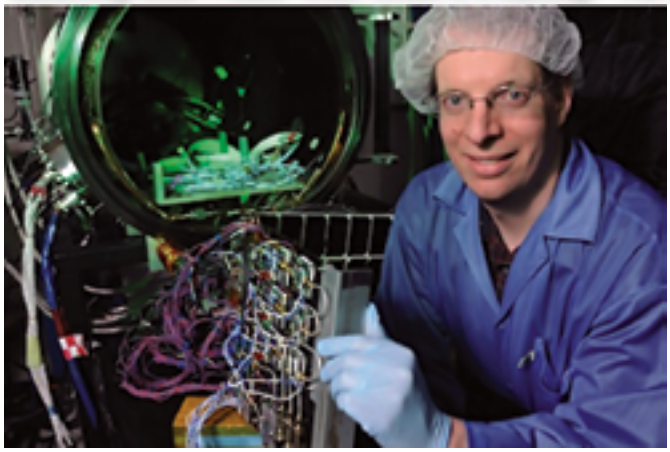
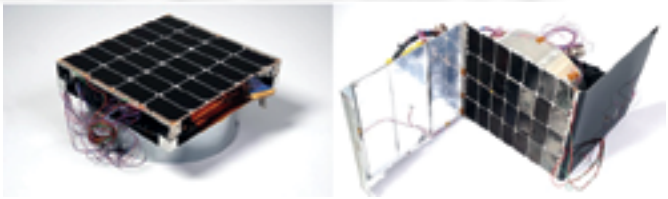
DISPATCHES

Receiving Solar Power Even When It's Raining—The NRL Builds A Space Satellite Module To Try...



"One of our key, unprecedented contributions has been testing under space-like conditions," said Dr. Paul Jaffe. He holds a module he designed for space solar power in front of the customized vacuum chamber used to test it. The photo is courtesy of the U.S. Naval Research Laboratory, Jamie Hartman



Compared to sandwich modules built previously for space solar power, Dr. Paul Jaffe said NRL's is "more than four times as efficient." Left: sandwich with photovoltaic panel, wiring, antenna. Right: step module, which better radiates excess heat and is now in the patent process. Photo: U.S. Naval Research Laboratory/Jamie Hartman

What if you could capture solar power in space, then send it down to Earth?

What if you could launch the hundreds of modules for such a satellite, then use robots to assemble the entire array in space? You could power a military installation, a city—even on a cloudy day, even at night.

Dr. Paul Jaffe, a spacecraft engineer at NRL, has built and tested a module to capture and transmit solar power. Even Jaffe admits the idea of an orbiting solar array that would beam energy to our planet seems kind of crazy. But, like most novel ideas, he said, "Hard to tell if it's nuts until you've actually tried."

As the Department of Defense (DoD) presses forward with energy security investments, solar power has already been proven in places like Hawaii and California. Ideally, a solar power satellite would provide power that was cost-competitive to what was locally available: About 10 cents per kilowatt hour in many places.

However, the military sometimes has energy requirements in extremely remote areas. The U.S. Marine Corps has successfully used solar panels at Experimental Forward Operating Bases in the Middle East and for humanitarian assistance.

Current practices—such as running diesel generators, driving fuel over roads in hostile areas, or even dropping in fuel canisters with parachutes—make power extremely expensive and impact mission and safety.

With multiple, potentially hidden receivers, space solar power could ease logistics for DoD's deployed troops and remote bases.

Jaffe has built two different prototypes of a "sandwich" module. In both designs, one side receives solar energy with a photovoltaic panel, electronics in the middle convert that direct current to a radio frequency, and the other side has an antenna to beam power away.

Jaffe sometimes gets asked about the efficiency of such a system, but the most important metric is the power cost per pound.

"Launching mass into space is very expensive," said Jaffe, so finding a way to keep the components light is an essential part of his design. He can just cradle one module in his forearms. Jaffe's research is innovative in two major ways: In design and in testing.

His sandwich module is four times more efficient than anything done previously. He also has a "novel approach to solving the thermal problem, using the 'step' module."

The step module design, now in the patent process, opens up the sandwich to look more like a zig-zag. This allows heat to radiate more efficiently, so the module can receive greater concentrations of sunlight without overheating.

Additionally, "One of our key, unprecedented contributions has been testing under space-like conditions." Using a specialized vacuum chamber at another facility would have been too expensive, so in typical NRL spirit, Jaffe built one himself. "It's cobbled together from borrowed pieces," he said.

The vacuum chamber is just big enough for one module. In it, Jaffe can expose the module to the simulated extreme cold of space and concentrated solar intensities (mimicked by turning on two powerful xenon lamps in the same spectrum as the sun). By hooking the module up to a tangle of red and blue wires, he measures how well it radiates heat.

Jaffe said most solar panels orbiting with today's satellites are never tested in space-like conditions because the technology is already mature. "But if you wanted to test anything under concentrated sunlight," he said, "you would need something like the simulator we've put together here."

Through trial and error, Jaffe has learned a lot. "The capability we've built up with the testing and vacuum under sun concentration is something that's pretty unusual. And we've actually gotten a couple inquiries from people who may want to use this."

As an example, he's had to modify how he uses the lamps because they don't have uniform intensity, which creates hotspots on the modules.

For the antenna, Jaffe partnered with Dr. Michael Nurnberger, an antenna expert at NRL.

"Antennas look simple," Jaffe said, "You would never believe all of the calculations and analysis." A chess-piece like copper object is encircled by a thin wall of metal. It's mounted on a circular metal board, about the size of a pie pan.

Jaffe and Nurnberger identify the antenna's radiation pattern in one very unique room at NRL, an anechoic chamber. The anechoic chamber allows researchers to measure how an antenna radiates energy into free space. That signature enables communications between the satellite and Earth.

Except for one part of the floor, the chamber is completely covered in stalactite-like blue foam. The cones prevent waves from bouncing around, including muffling footsteps and voices.

One wall, instead of being flat, is pushed out into a sideways pyramid that extends the length of the room to 125 feet. The overall effect is surreal, something out of a funhouse, and almost makes the uninitiated lose balance.

One of the primary objections to space solar power is the idea of an antenna shooting a concentrated beam of energy through our atmosphere. But we already use radio frequency and microwaves to send smaller amounts of energy all the time.

"People might not associate radio waves with carrying energy," said Jaffe, "because they think of them for communications, like radio, TV, or cell phones. They don't think about them as carrying usable amounts of power."

There are a few ways to mitigate this concern. First, the antenna sends energy only to a specific receiver that asks for it. Second, using microwaves to send energy

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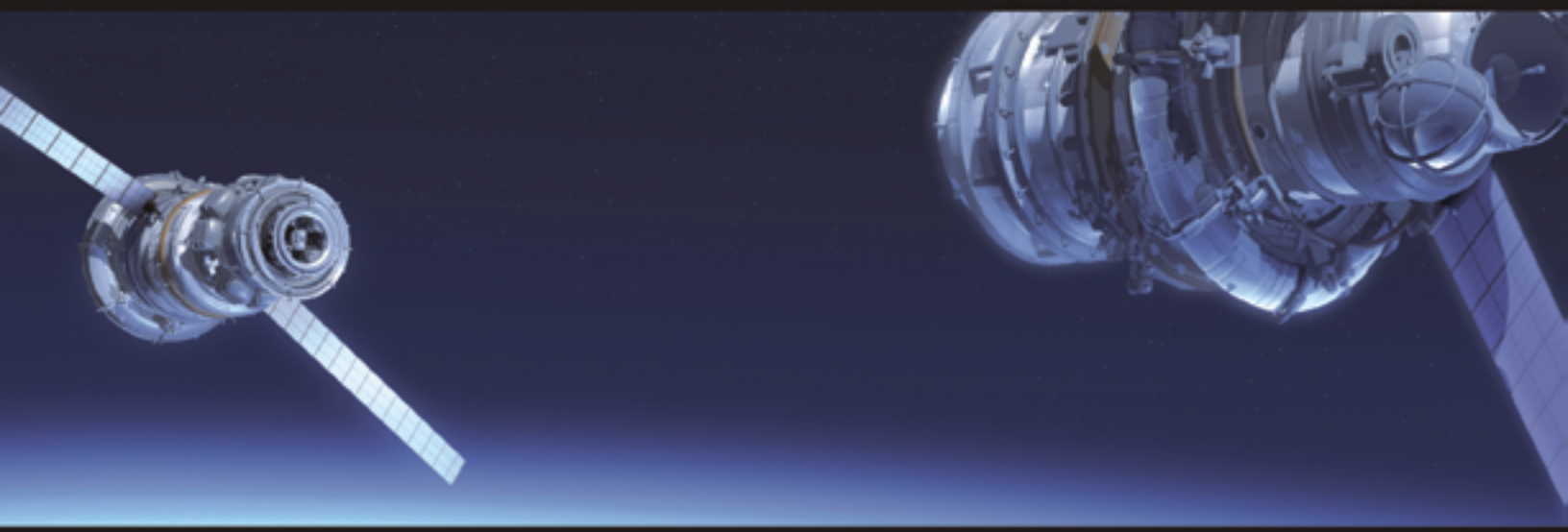

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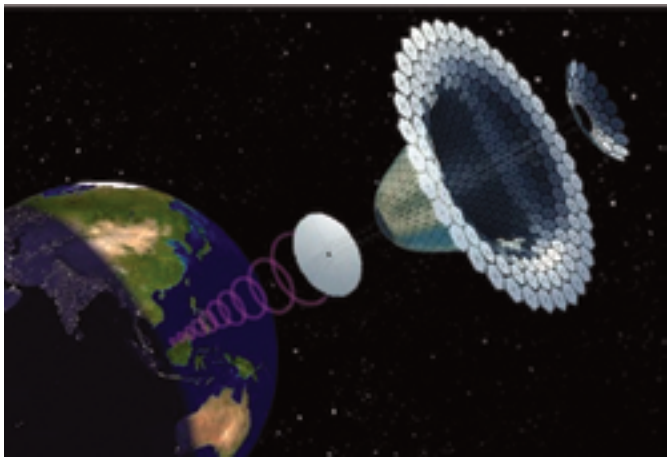

Space solar power SPS-ALPHA concept for space solar power: reflectors concentrate sunlight onto module array. Satellite beams power to a receiver from geosynchronous orbit. "The most sobering thing about all of this is scale," said Dr. Paul Jaffe. Image is courtesy of John C. Mankins.

may be less objectionable than the higher power density required for lasers. Third, sending the energy on a lower frequency increases the size of the antenna and receiver, but decreases the concentration of power. As a side benefit, it also lessens the potential disturbances in the ionosphere to interrupt power: "At 2.45 gigahertz," said Jaffe, "you'll get power in a monsoon."

From Jaffe's perspective as an engineer, however, "The most sobering thing about all of this is scale." He imagines a one kilometer array of modules-not to mention the auxiliary sun reflectors.

The International Space Station is the only satellite that, to date, has come close. It stretches a little longer than an American football field; the array Jaffe is talking about would span nine.

The modules would have to be launched separately, and then assembled in space by robots. That research is already being advanced by NRL's Space Robotics Group.

"Another area ripe for research," adds Jaffe, "is the system that would reflect and concentrate sunlight onto the modules."

As for where his research could be funded next, Jaffe has several proposals. But one challenge to finding a sponsor is that the project cuts across many different federal agencies. (Jaffe's work to date has been funded from NRL's base research budget.)

One proposal is to make the module even lighter, by using thinner solar panels, a flatter and lighter antenna, and, "instead of using these chunky prototyping radio frequency boards, you could make what's called a monolithic microwave integrated circuit and put all that functionality into a little chip."

Another is "a demonstration mission, where you actually manufacture a whole bunch of these things and assemble them as an array in space to investigate some of the other challenges."

NRL and others have also proposed using similar technology, but instead of deploying it to space, setting it up at a very high altitude in the stratosphere.

"You wouldn't get the same 24-hour energy, but you'd be above the clouds and you'd also have a longer daytime because you're farther from the horizon."

The International Academy of Astronautics recently predicted space solar power could be viable within the next 30 years. (The idea has been in circulation since the 1970s, promoted in part by a demonstration in 1964 of a beam of microwave power keeping a helicopter aloft.)

However, we may be approaching a turning point. In 2009, the California utility company, PG&E, committed to buying such power from Solaren by 2016.
Jaffe's aware of two other projects seeking to turn theory into reality. "Prior to this prototyping effort, there had been two groups that made meaningful sandwich modules, both of them were in Japan. Neither of them were tested in space, and we were more than four times as efficient as the most efficient of those."

Russia, China, India, and some European countries have also expressed interest.

Society has yet to decide if we'll invest in space solar, but Jaffe's research informs the economic analysis and has relevance for many other types of projects.

As mentioned, he's improved testing for space hardware, particularly for that designed to perform under concentrated sunlight.

"In terms of the other applications," he added, "the space radar is an obvious one." Jaffe's concept of building large structures in space from modules applies to large phased-array radars.

"The image quality of a radar is related to how big the antennas are and how much power the radar puts out," he explains. With many antennas, each powered by the sun, "you don't have to have a huge, heavy bundle of wires that spreads out to each one of them."

Other applications include the conversion of direct current to radio frequency, microwave power beaming (including as first demonstrated in 1964 to power an aircraft), satellite propulsion, and thermal management architecture (the step module).

One of the exciting things about working at a place like NRL is seeing innumerable ideas before the wheat has been separated from the chaff. It's visionaries like Jaffe, with boldness and ingenuity, who will inform the naval fleets of the future.

About NRL
The U.S. Naval Research Laboratory is the Navy's full-spectrum corporate laboratory, conducting a broadly based multidisciplinary program of scientific research and advanced technological development. The Laboratory, with a total complement of nearly 2,800 personnel, is located in southwest Washington, D.C., with other major sites at the Stennis Space Center, Mississippi, and Monterey, California. NRL has served the Navy and the nation for over 90 years and continues to meet the complex technological challenges of today's world.

For more information, visit the NRL homepage at
http://www.nrl.navy.mil/

DISPATCHES

ATCi— A Laudable Law Enforcement Debut

Antenna Technology Communications Inc. (ATCi), a provider of satellite and digital communications systems, has debuted their complete, all-inclusive, Lawful Interception Warrior Satellite Monitoring System that's designed for the Middle Eastern region's applications.

The Warrior Monitoring System can simultaneously provide complete collection of sky activities spread over 140 degrees with the added upgrades.

The new system's integrated tools can also cross correlate from vast terrestrial monitoring far superior to what is being offered by rival systems today.

Designed for the unique requirements of government, military entities, and law enforcement agencies, the Warrior allows the operator an in depth view of not only the spectrum usage issues involved in distributive carriage, but also the ability to manage, control and archive the tagged DPI content being carried on satellite and terrestrial networks.

"Monitoring critical information from today's communications has become critical for law enforcement applications," said Gary Hatch, ATCi's President. "ATCi has a long standing history in successfully implementing sensitive surveillance and monitoring systems for the Department of Defense and other like government and military agencies in the U.S., as well as foreign defense networks which makes tailoring the quantum powered system for the law enforcement networks a sensible progression for next generation cyber tools.

"It is not enough to simply monitor today's skyway—highway surveillance must also have the ability to associate and provide critical algorithms and patterning data. This can ultimately process and index massive IP data troves thereby delivering greater relational data pattern information to make the best rational decisions," Hatch concluded.

All hardware, software, engineering, and installation services are included with the turnkey Warrior Satellite Monitoring System.

ATCi's infosite is accessible at ***http://www.atci.com/***

DISPATCHES

Defense Summit Budget Presentation + The U.S.A.F.'s Future

Secretary of the Air Force Deborah Lee James addresses attendees of the Bloomberg Government Defense Summit at the Ronald Reagan Federal Building in Washington, D.C., on February 26th. U.S. Air Force photo/Scott M. Ash.

Defense industry leaders and analysts received an insight into the proposed Air Force transformation and a preview of the Fiscal Year 2015 Air Force budget during the Bloomberg Government Defense Transformation Spending and Strategy Summit February 26th.

Secretary of the Air Force Deborah Lee James said the Air Force, like the rest of the Department of Defense, is going through a transition period following 13 years of war, and will be making tough choices as personnel and budgets dwindle and the possibility of sequestration looms during the years ahead.

"We are repositioning to focus on the challenges and opportunities that will define our future," said James. "We have to get ready for the new centers of power, such as the Pacific, and what will be a more volatile and unpredictable world. A world we can no longer take for granted.

"We can no longer assume, as we have over the past 50 years, to dominate the skies, and more recently dominate space. Many other countries are advancing their technologies, so we need to prepare now, not only for that world 10 years from now, but also today. It comes down to balance. That is the strategy." James said during times when strategy and budgets don't match, the Air Force has to make judgment calls, looking at which risks are prudent and which are less so.

Specifically, she referenced tough decisions in the areas of personnel downsizing, force shaping measures, and investments in the future, highlighting the impact with and without sequestration.

While the services have received some relief in Fiscal Years 2014 and 2015, she said that for Fiscal Years 2016 through 2019, the president has asked Congress for a defense budget $115 billion above the sequestration level, with the Air Force getting a share of roughly $34 billion.

"We're doing this because we believe that sequestration-level spending will compromise our security. It will compromise in the short term on readiness and in the longer run on important modernization programs."

On the manpower side, James said the force will get smaller with a cut of up to 25,000 Airmen, mostly from the active duty over the next five years, and each service has also been tasked to trim headquarters spending by 20 percent over a five-year period.

"We looked at some of the overlapping organizations and how they can be combined more efficiently. We need to centralize policy and oversight of installation support in such areas as engineering, security forces and contracting, among others. We want to reduce some of the tasks that are not required by law, and in doing so, we won't foist extra work on fewer people."

James told the audience that in the area of force structure, the Air Force looks at vertical cuts, eliminating entire fleets of aircraft instead of taking horizontal cuts that "take a few from here and a few from there." She said one example is the A-10, retiring about 283 close air support aircraft, beginning in FY 2015. She said the retirement of the fleet will save more than three-and-a-half billion dollars over five years, with no degradation to the close air support mission.

"We chose the A-10 because it's a single purpose aircraft, with a very important mission, but we have other aircraft like the AC-130, the F-15 Eagle, the F-16 Falcon, the B-1 Lancer and the B-52 Stratofortress that can also do that mission. All are dual or multi-purpose aircraft. In fact, 80 percent of all close air support in Afghanistan has been accomplished by aircraft other than the A-10."

James told the audience that the U-2 has also been marked for retirement, beginning in the FY 2016 and FY 2017 timeframe. The Secretary said that keeping both the U-2 and the Global Hawk were too expensive and that they both give more high altitude reconnaissance than the Air Force needs. She added that initially the Global Hawk was earmarked for retirement because of its expense to maintain, but advances in technology over the past couple of years have made the U-2 more costly and the Global Hawk less.

Even some of the expansions, such as combat air patrols like the MQ-1 Predator and the MQ-9 Reaper will increase more gradually than originally planned. She said initially the Air Force wanted to increase the number from 50 to 65, but with Afghanistan winding down, there won't be a need for as great a capability. She said the plan is to slowly phase out the Predators and have an all MQ-9 Reaper inventory.

James also talked about investments the Air Force wants to make, committing to the F-35 Lightning II, the new tanker, the KC-46 Pegasus, and the long-range strike bomber.

However, the Secretary emphasized that sequestration is still the law of the land, and if the Air Force is forced to revert to sequestration limits, as much as $34 billion will be reduced from the budget. In addition, the Air Force would be forced to retire 80 more aircraft, completely retiring the KC-10 tanker inventory; defer sensor upgrades to the Global Hawk; purchase 19 fewer F-35s over the five year defense plan, and have 10 fewer combat air patrols. Also, funds for the next generation jet engine program will not be available.

Air Force Vice Chief of Staff Gen. Larry Spencer participated on the panel with James and addressed issues from Airmen morale to force structure and acquisition costs, to include working to keep requirement costs under control during development.

"What has happened in the past when we've developed new platforms... is the price just starts to skyrocket as people want to put more and more stuff on it," Spencer said. "As technology changes, people want more and more capability. We have had to turn back the temptation to put more on the [long-range strike] bomber. But I can tell you, the people working on this program are really working hard to get us the capability we need for that price, which is what we want."

James told the audience that "tomorrow's Air Force has to be the most agile, credible and affordable one we can provide. Our job, today and in the future is to fly, fight and win our nation's wars. We feel that by making the tough choices today, we will set ourselves on a path to be the most modern and ready Air Force in the world, albeit a smaller one."

Story by Rich Lamance, Air Force News Service

DISPATCHES

General Dynamics—A Priority Component Of The U.S. Army's Modernization Plan

The General Dynamics C4 Systems' AN/PRC-155 Manpack.

The two-channel AN/PRC-155 Manpack tactical networking radios from General Dynamics C4 Systems will be included in U.S. Army's Capability Set (CS) 14, an integrated package of satellite systems, radios, software applications, smartphone-like devices and other network components.

Units scheduled to receive CS 14 include organizations within the 101st Air Assault Division, Fort Bragg, N.C.

The two-channel PRC-155 Manpack networking radio will connect soldiers and commanders to the Soldier's Network, which includes the Warfighter Information Network-Tactical (WIN-T) and other vital mission command-on-the-move capabilities.

"The two-channel PRC-155 Manpack operates on multiple, government-owned waveforms to simultaneously connect soldiers on foot, in vehicles, in aircraft and helicopters to the Soldier's Network. The radio is a priority component of the Army's network modernization plan, and essential to CS 14," said Chris Marzilli, president of General Dynamics C4 Systems. "Soldiers and commanders serving in Afghanistan, Africa, Korea or other tactical locations now have a secure mobile, broadband communications network with mission command on-the-move so wherever they go, the network is right there, just like the network supporting a civilian's smartphone."

Using Low Rate Initial Production (LRIP) contracts since 2011, the Army has been able to maintain vital communications capabilities of the Soldier's Network for soldiers provisioned with CS 13 and 14.

The industry team of General Dynamics and Rockwell Collins has completed the on time delivery of more than 3,400 two-channel Manpack radios in support of Army fielding requirements. When connected to WIN-T, the PRC-155 Manpack and PRC-154/154A radios allow dispersed forces to talk, text, share images and collaborate wherever they serve worldwide. The PRC-155 Manpack also bridges networks—legacy to future, lower to upper echelons and unclassified to classified guard—allowing everyone from the command center to the soldier on the edge of the battlefield to stay connected.

General Dynamics C4 Systems (Scottsdale, Arizona) and Rockwell Collins (Cedar Rapids, Iowa) manufacture the AN/PRC-155 two-channel Manpack radios.

Production of the PRC-155 Manpack radios supports more than 450 technical jobs and engages more than 92 small business and 750 workers nationwide.

For more info, head over to ***http://www.gdc4s.com/***

DISPATCHES

USAF—Two Squadrons From Schriever AFB Collaborate On Successful Launch

Delta IV launch of the GPS Block IIF-5 satellite.

While GPS Block IIF-5 sat atop a Delta IV rocket February 20th at Cape Canaveral, Florida, the men and women of the 2nd and 19th Space Operations Squadron here were busy preparing for liftoff.

These two squadrons epitomize the quintessential relationship between Reserve and regular Air Force organizations that make a successful total force team.

The casual observer may have guessed the February 20th launch marked the start of operations for the Air Force's newest GPS vehicle, yet, it was hardly the beginning for 19 SOPS, as the airmen have been testing and training on the GPS constellation's newest addition for months.

"We conduct countdown, launch and early orbit operations," said Maj. Kim Adams, 19 SOPS launch lead. "But, we work in tandem with 2 SOPS, the Space and Missile Systems Center and contractors. We work well together and communicate effectively. This launch was our smoothest yet."

Though 2 SOPS is most commonly associated as the command and control unit responsible for operating GPS, the 19 SOPS team of reservists plays a critical role in providing GPS service to the military and civilian sectors, especially during satellite launches.

Artistic rendition of a GPS IIF satellite.

"We conducted eight major tests and activities with Cape Canaveral starting about 120 days prior to launch," Adams said. "We also conducted a mission dress rehearsal alongside Space and Missile Systems Center personnel at Los Angeles AFB about 30 days before launch."

Once the vehicle launched, the team, composed of 95 percent 19 SOPS personnel, sprung into a whole new mode. Just as the launch countdown began Lt. Col. Matthew Brandt, 2 SOPS director of operations, settled into a seat inside the 2 SOPS/19 SOPS operations floor here.

"I was fascinated by the show," he said. "Our team of 2 SOPS, 19 SOPS, SMC personnel and contractors first acquired the satellite while it was still attached to its booster rocket."

After the booster separated, the vehicle began turning on its own. Later in the evening, it achieved sun-safe operations. That's when the team stabilized it, deployed its solar arrays and sent its first commands.

"It's a riveting event to watch," Brandt said. "The teams are working together, Major Adams is coordinating with 19 SOPS, SMC and contractors, and you can hear personnel from Cape Canaveral on the telecom speakers. Everyone is communicating back and forth, saying, 'we're go for this action; we're go for this stage.' And, it all went off perfectly."

Though this team has launched and orbited five satellites in the past few years, Brandt said the technical marvel never ceases to amaze.

"I can't even get my garage door opener to work, but we can launch a satellite that's traveling at thousands of miles an hour, thousands of miles from Earth and every step occurred at exactly the time it needed to occur," he said. "It's fascinating to see the team come together and place the vehicle exactly where it needs to be."

Satellite vehicle No. 64 is the fifth GPS IIF vehicle on orbit. GPS IIF satellites incorporate greater navigational accuracy than legacy vehicles through improvements in atomic clock technology, an increased design life of 12 years, a new third civilian signal [L5] that provides a more robust signal for commercial aviation and safety-of-life applications, and a second civilian signal [L2C] available for dual frequency GPS receivers.

This launch marks the beginning of an event filled year for these space professionals. Capt. Steven Miller, 2 SOPS assistant director of operations, said this launch was in many ways a rehearsal for the next one because the Air Force plans to launch and orbit three more GPS IIF satellites in 2014.

GPS IIF-6 is slated for a May liftoff, while another is due to occur in July and another in October.

Story by Scott Prater, Schriever Sentinel

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PEG GRAYSON, PRESIDENT, MTN GOVERNMENT

Peg Grayson brings more than 30 years' experience in the telecommunications industry to MTN Government. A presidential appointee to the National Infrastructure Advisory Council (NIAC), she actively participates in the development of policy recommendations and guidance to the White House through the Department of Homeland Security.

Appointed to the NIAC by President Bush in 2002, Grayson is currently serving at the request of President Obama. An expert in cybersecurity and information sharing, she has participated in several comprehensive studies advising the president on the security of the nation's critical infrastructures and information systems.

Prior to MTN Government, Grayson held leadership roles at technology companies, focusing on finance, policy, regulatory compliance, and risk management. As president and CEO of V-One, she worked closely with federal, state and local government agencies on the requirements and design of security products, developing deep expertise in cybersecurity, data integrity and information sharing in wired, wireless and networks.

Other key positions include CFO of MTN Inc., federal compliance manager for Tremco Inc., President of Coalescent Technologies Corp., President of AEP Networks, vice president and CFO for SPACEHAB, Inc., and CFO for Sirius Satellite Radio. Grayson started her distinguished career as a senior finance manager for Honeywell Aerospace and Defense.

Grayson earned a B.S. in accounting from the State University of New York Buffalo, an MBA in finance from the University of South Florida, and a certificate in international finance from Georgetown University. She serves on the board of directors for several public and private companies and is on the Dean's Council and Advisory Board of the School of Business at the State University of New York in Buffalo.

MilsatMagazine (MSM)

Would you please inform our readers of your background? How did you become interested in the satellite communications side of this industry?

Peg Grayson

Prior to my current role as the president of MTN Government (MTNGOV), I was in leadership roles at technology companies and I was focused on finance, policy, regulatory compliance and risk management. I became very interested in satellite communications as president and CEO of V-ONE. I worked closely with federal, state and local government agencies on the requirements and design of security products, developing deep expertise in cyber security, data integrity and information sharing in wired, wireless and satellite networks where latency issues across satellite links for encrypted data has to be solved.

In 2002, I was appointed to the National Infrastructure Advisory Council (NIAC) by President Bush and am currently serving at the request of President Obama. My expertise is in cyber security and information sharing and I have participated in several comprehensive studies, through the Department of Homeland Security, advising the president on the security of the nation's critical infrastructures and information systems.

MSM

MTNGOV has a legacy of innovation that spans across many industries. How do you translate your commercial satellite communications innovations to defense, homeland security and intel?

Peg Grayson

For more than 30 years, our company has been at the forefront of satellite communications innovations. We brought to market many industry firsts, including the first maritime VSAT antenna (aboard the USS Iwo Jima), the first Ku-band Comms-On-The-Move (COTM) for media embedded with the U.S. Army, and the first onboard Internet café on a cruise ship.

Our company's legacy of innovation spans across industries, and in recent years, has expanded to include cloud computing and cyber security technologies to meet the ever-evolving government marketplace. The U.S. Government has arguably the most intricate communications requirements in the nation, maybe even the world, and we are able to offer a comprehensive range of communications solutions designed to meet those requirements and improve agencies' operating efficiency.

MSM

What services offered by your company are experiencing the most demand? Why do you believe this is occurring?

Peg Grayson

MTNGOV has the ability to offer the worldwide infrastructure of our parent company, MTN, to provide satellite, terrestrial and teleport communications anywhere and anytime our customers need to be connected. Our network operating centers for both commercial and government customers ensure the reliability and security of our networks. This capability continues to be in the highest demand. Our significant capacity is always being strengthened by the awareness that technology is never static. We are always seeking ways to bring new communications solutions to our customers.

From the start of the wide spread use of network communications, security concerns have been—and continue to remain—a primary challenge, and we remain a leader in designing secure, robust and resilient networks for commercial and government users. Today, strong network security must be enhanced to augment traditional security solutions and further protect organizations against security threats. There is a great need to address this emerging threat through predictive analytics.

MTNGOV now offers cybersecurity managed services for government focused on detecting and analyzing emerging threat vectors in social media targeting our country's leaders and agencies. We take an intelligence-first approach to tackling the advanced cyber threat, and use advanced big data algorithms in the cloud to ensure the ability of identifying and predicting a hacker's next move before it can reach its target..

MSM

What new markets are you hoping to enter over the coming years?

Peg Grayson

MTNGOV plans to leverage our global communications infrastructure to deepen our role in the provision of ISR services for manned and unmanned aerial systems. Our strength is in providing end-to-end solutions. We will expand this by including analytics.

MSM

How has MTNGOV dealt with the impacts of the government budget concerns (and last year's shutdown), and how has such impacted services?

Peg Grayson

We recognize how important value is to our U.S. government customers. We engineer our satellite solutions for value and efficiency and we are investing in cloud computing, cyber security and intelligence services innovations that maximize value for our customers.

MSM

Do you see hosted payloads as playing an even greater role for MILSATCOM over the next year or so?

Peg Grayson

The U.S. Air Force Space Command issued a call last year for proposals on how commercial satellites could host military payloads. The budget bill approved by Congress last month directs the Department of Defense to look at both longer commercial satellite leases and hosted payloads as a means of filling military requirements. Both of these are very big steps forward. The economic advantages to the government of using commercially hosted payloads are significant and I think they will play an increasing role in meeting the military's requirements for satellite capacity.

MSM

Will small satellites (i.e., nano, pico, micro, mini) become a major consideration for businesses as they confront reduced budgets for communications projects, given the interest impetus by DARPA and other agencies for these technologies?

Peg Grayson

This trend toward smaller satellites has been happening over time, with much of the interest in developing countries where affordability has been the key driver. The timing is ripe now as it matches the changes in capacity afforded by cloud computing, and new analytical tools that can make sense of big data. DARPA could play a huge role in changing the shape of satellite constellations with small, very-low orbiting satellites that will deliver affordable on-demand information to military in the field.

MSM

As a presidential advisor on the NIAC, what do you see as the main imperatives for the satellite community?

Peg Grayson

NIAC recently delivered a report to the White House responding to requests by the President regarding the strength and resilience of our cyber infrastructure. From these findings, we deduced that communications remains a critical infrastructure for protection, resilience and recovery and as one of the lifeline sectors, as important as energy, water and transportation.

I believe that the commercial satellite community needs to shift from merely "transmitting in the clear," or keeping data flowing from point A to B, to a culture with an intrinsic shared responsibility to provide secure communications. Moreover, the federal government needs working partnerships between agencies, local governments and industry to achieve national resiliency because of the complexity and interdependencies of our critical infrastructure.

MSM

An area of concern for many businesses is that of an adequate talent pool from which to hire for crucial projects. How can we, as an industry, support increased STEM training in our schools and colleges? Is MTNGOV involved in any such projects?

Peg Grayson

As a former college professor, I recognize the importance of capturing imagination and encouraging students interested in furthering their science and technology education. MTNGOV offers a learning extension program for our staff, which provides financial and other resources that enables them to advance their education and/or add a degree. This investment helps develop a talent pool that benefits our company and customers, as well as the industry.

Case in point, we currently have a staff member who is pursuing a Master of Professional Studies in Technology Management. He has been able to leverage his prior work experience and his Masters education to develop a new line of intelligence services meeting specific customer needs in our market.

MSM

What do you see in the future for federal sector satellite and cybersecurity endeavors? What are your hopes and plans for the next year or so?

Peg Grayson

While IT and other areas are seeing declining or flat-lined budgets, the U.S. government is committing more budget dollars to cybersecurity than ever before. Congress wants to more than double the funding of the U.S. Cyber Command, the White House has issued directives to protect the nation's critical infrastructure, and more than one top official has predicted recently that "the next war will be fought in cyberspace." Therefore, my hope for the next few years is that the federal government continues to expand the development of working partnerships between agencies, local governments and industry to achieve national resiliency because of the complexity and interdependencies of our critical infrastructure.

MSM

Lastly, given your 30+ years of professional work within our industry, when you look back upon your career, what projects bring you the most satisfaction for a job well done?

Peg Grayson

That is a difficult question, as I have had the privilege to work with some of the most committed individuals one could hope for in an industry that is fundamental to the information age.

Always a stand out as I reflect on my career is my work with a NASA-sponsored public/private partnership with my then company, SPACEHAB. Through this program, NASA, our international partners and private industry worked together to design and develop scientific

modules that flew on board the space shuttles. These modules enabled research experiments to be performed in zero gravity conditions and prove the need for and viability of this new frontier as a valuable laboratory for making our lives better through pharmaceutical and other product development that cannot be done on Earth.

Clearly, working with the NIAC Committee on studies that bring so many committed people from government and industry together is a project that I am really pleased to have the opportunity to support. Our committee provides guidance that identifies recommendations to mitigate threats and risks to our critical infrastructures that enable our national security and way of life. As each report is submitted for consideration, there is continuous recognition that sharing information and learning what is needed to secure our way of life is a job that will never be done.

Lastly, my work today as president of MTNGOV is extremely rewarding because this company is a personification of 30 years of innovation and contribution as a part of and for the satellite communications industry. I find that the greatest satisfaction is not just serving our customers on time and on budget, but hearing them say, "Thank you, I did not realize that what you did for us was possible."

In homage to the servicemen and women who make daily sacrifices to serve the United States and allied governments, MTN Government has adopted the moniker, Steel Force Blue.

It represents the company's determined spirit to continuously create innovative solutions to help warfighters and civilians do their jobs to the best of their ability. Conducting business with a Steel Force Blue frame of mind, MTN Government consistently strives to emulate servicemen and womens' dedication, commitment and capabilities.

Artel + MTN Government
A Productive Partnership

Recently, Artel, LLC and MTN Government formed a strategic alliance to collaborate and team together to develop select business opportunities.

Through this expanded relationship, the Artel-MTN team will integrate Artel's proven end-to-end secure managed network services and MTN Government's global network infrastructure.

"The Artel-MTN Government alliance enables our team to quickly respond to our government customer's need for reliable, cost-competitive global coverage," said Ted Hengst, President and CEO, Artel, LLC. "Our combined expertise will deliver the throughput and tailored innovative solutions for secure access and delivery of content across all their networks and infrastructures, in every domain and environment."

"MTN Government delivers satellite communications, cyber and intelligence services and innovations purpose-built for military and government customers," said Peg Grayson, President of MTN Government. "We are pleased to be teaming with Artel on a series of new and exciting business opportunities that leverage our complementary company strengths and industry relationships."

For more information regarding MTN Government Services:
http://www.mtngov.com/

For more information regarding Artel:
http://www.artelllc.com/

MTN Government also provides Intelligence, Surveillance and Reconnaissance (ISR) services for manned and unmanned aerial systems. These services are all based on the firm's global communications infrastructure.

A range of services consists of full communications support for various platforms, analytics, systems integration, ILS and field support, as well as SATCOM and long-haul connectivity to provide the crucial backbone for the ISR devices.

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LIFE SAVING THAT'S SPOT ON...

By Gavan Murphy, Director of Marketing EMEA + LATAM, Globalstar Europe Satellite Services

Whether providing food and medical assistance to stricken communities following a natural disaster, or co-ordinating a countywide search for a missing child, in times of crisis, first responder emergency teams need to swiftly mobilize and co-ordinate resources.

Extreme weather conditions are dominating the news—bringing floods that are devastating the coastline of the United Kingdom, to rampaging forest fires in California. There are earthquakes and volcanoes around the Ring of Fire, typhoon devastation in the Asia-Pacific region and starvation in Africa caused by drought and political upheaval. Emergency teams must be able to react quickly and decisively to save lives and property around the globe.

Somewhere in the world, each day of each year, there seems to be a state of emergency that requires efficient and rapid collaboration among law enforcement and environmental agencies, national and regional transportation authorities, ambulance and fire services as well as other trained entities, all doing their best to alleviate suffering. While we watch these real-life dramas unfold on our TV screens, thousands of people working for international, national and local emergency services and relief organizations struggle to help people in often highly complex and usually hazardous environments.

Achieving true interoperability and optimizing highly effective communication among public safety agencies and first responders has always been a challenge. This quite dramatically came to public consciousness in the wake of the tragic events of 9-11. Now, more than a decade later, while lessons have been learned and improvements have been made, frustrations persist over poor communications and interoperability during almost any natural disaster or crisis that requires inter-agency response, whether on a massive scale such as a tsunami, or even in the case of rapid co-ordination to search for a missing person.

Thankfully, there are now communication systems that can provide real-time situational awareness to first responders. These systems have paved the way for the development of advanced technologies in the global first responder command, control, communications and intelligence (C3i) and emergency response market.

Analysis from Frost & Sullivan (***http://www.defense.frost.com***), *Assessment of Global First Responder C3i and Emergency Response Market*, reveals that the emergency communications market represented revenues of $50.41 billion in 2012 with estimates of $131.62 billion in 2019. North America accounts for the largest share of the market, followed by the countries of Asia Pacific.

Heightened awareness of terrorism further highlights the crucial need for law enforcement, fire and emergency medical services to be equipped with the technologies that will help them ensure public safety.

Traditionally, first responders have relied on radio networks that require microwave-based transmission systems and a plethora of masts and repeaters. Mobile telecommunications networks have been used to provide supplementary help to emergency teams when radio networks are insufficient in their reach because there simply aren't enough repeaters installed to carry the communications.

However, in remote regions located in mountain ranges, rural farmlands, and even in steel and glass avenues of a city, mobile coverage simply is not good enough to provide the connectivity that first responders require.

Increasingly, emergency services, including military first responder groups, recognize and have come to rely on the reliability, versatility and unparalleled reach of satellite communications networks such as Globalstar, and in particular SPOT—they are putting these tracking and communications solutions to work at the heart of their rescue operations.

Steve Wood, Chairman of leading mapping solutions provider Mapyx, has seen first-hand how Globalstar's SPOT system has been adopted by numerous UK emergency and rescue services.

"The rationale is simple," Wood said. "In an emergency situation, numerous agencies need to mobilize rapidly and they must have reliable and interoperable communications systems. Failure is simply not an option when it comes to preserving life and preventing death."

Mapyx works closely with UK Mountain Rescue England & Wales, Lowland Rescue, the UK Ministry of Defence (MoD) Military Mountain Rescue and Police Forces. Additionally, Wood has an in-depth understanding of the operational needs of fire services throughout the length and breadth of the UK. The flooding that battered the UK coastline in the early months of 2014 has really driven home the need for world-class asset tracking and communications technologies for the agencies involved in providing emergency support.

The terrestrial-based radio networks that military, government and civilian rescue organizations depend on for their communications—all proven and reliable technology—can be lacking when ubiquitous, uninterrupted communications in remote areas are needed.

"Radio communications work perfectly within the radius in which ample repeaters have been installed," said Wood. "However, the story is quite different in remote areas."

In remote regions where repeater stations are fewer or have not been installed, and where mobile cellular coverage is weak, unstable or non-existent, when there is a need for reliable communications, satellite truly is the only answer.

Wood is all too familiar with the fact that publicly funded organizations are under more budgetary constraints than ever before in post-recession Britain, as well as in other countries around the world. Cutbacks in military spending are a reality in the U.S. and beyond.

Those rescue services that rely upon charitable donations are facing even more acute funding challenges—donations are down and in some cases funding is insufficient to carry on an organization's operations, to the point where some volunteer first responder agencies have had to cease their good works.

Wood argues, however, that in terms of the human cost of failing to reach lost people and to deliver food and medical supplies to regions cut off by flood and fire, first responders simply must have communications systems they can depend on to carry out their roles with maximum efficiency.

"Quite a lot of publicly funded rescue organizations are looking at satellite communications," he said. "We ourselves have seen more and more selecting Globalstar solutions for asset tracking. A host of Mountain Rescue and Fire Service organizations are turning to satellite communications as that is really the only solution that can be completely reliable."

"The adoption process can sometimes be slow: There is a lot of educating that still needs to be done," he added. "But the progress is sure and steady. Rescue organizations that have adopted satellite-based solutions, such as Globalstar and SPOT, are vocal about how these solutions have transformed the way they work." Indeed, many of these groups are nothing short of evangelical in their advocacy of SPOT's tracking capabilities.(*Please read the accompanying sidebar.*)

SPOT Gen3 from Globalstar: SPOT devices have been used in more than 2,921 rescues in 69 countries around the globe. Wood is optimistic about the uptake of satellite services. "With the pricing of today's satellite-based communications being lower than ever before, we can anticipate a much wider adoption of solutions such as these."

Wood anticipates that more emergency responder groups will use SPOT for tracking in emergency situations in multiple geographical environments.

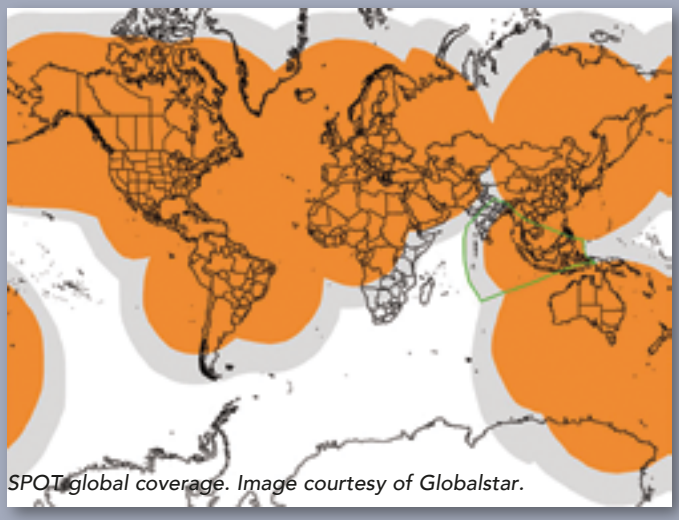
All Londoners vividly remember the "7/7" terrorist attacks that occurred in July 2005. Rescue efforts were hampered by the fact that all mobile networks buckled under the pressure of call traffic. During such instances, mobile network operators give priority of use to emergency services. Consumer usage is given a lower priority. Even so, the networks seized up as they were inundated by calls from people trying to determine the safety of loved ones.

This highlights a unique feature of satellites orbiting in Low Earth Orbit (LEO). The perceived wisdom is that satcom is ill-suited to urban usage as, typically, line of sight is required to maintain a connection with the satellites orbiting in geostationary orbit.

However, with a large fleet of satellites moving rapidly across the horizon in LEO, there is built-in redundancy. In fact, the Globalstar network configuration allows a customer's handset to communicate with up to three different satellites at any given time and ultimately choose the satellite with the best signal strength. This effectively means that an emergency call or tracking signal can remain connected at all times. Furthermore, the system can potentially bear a much higher volume of traffic than radio or cellular alternatives due to the high bandwidth and capacity of satellites.

SPOT GPS Messenger Coverage

"SPOT devices are being used to track vital operational assets so that teams can get those assets to the incident faster," explained Wood.



SPOT global coverage. Image courtesy of Globalstar.

"A paramedic can get a more accurate picture of how many minutes it will take an air ambulance to arrive, and where a cardiac defibrillator is located in order to engage in a speedy response to a casualty to increase the odds of saving a life."

"If you know where your assets are, you can deploy them more effectively," Wood said.

In the example of a missing person search, all rescue groups have to swiftly mobilize under the direction of local police. All rescue teams involved need to be able to communicate seamlessly on the same platform. Such interoperability is critical. Any incident commences with dissemination of key information and soon becomes a planning and control exercise. Search teams must be able to accurately know which areas must be searched, and, equally importantly, to know which areas have already been searched. Knowing the location of your assets is vital and that is where the SPOT system comes in to its own.

"The SPOT network can be accessed everywhere, even in remote areas, and first responders don't need to worry about their communication systems being incompatible or getting clogged up with traffic."

Mapyx adds a highly valuable layer of functionality to the solution in that it provides a full search management, control system and tracking interface that ties into local Ordnance Survey maps, aerial imagery and even building plans. This type of mapping provides highly granular information on local terrain conditions as well as helpful local information, such as landmarks and features that typically do not appear on Google Maps. The combined solution of SPOT and Mapyx solutions deliver a powerful communications and intelligence tool that UK relief and rescue organizations are rapidly considering to be invaluable.

"We are finding that, when working with our emergency response partners in the UK, satellite communications from Globalstar are very efficient and highly effective in a huge range of rescue and relief situations."

http://international.findmespot.com/
http://www.mapyx.com/

Editor's note
The rescue imagery is courtesy of Mountain Rescue England & Wales.
All additional imagery is courtesy of Mapyx + Globalstar.
SPOT global coverage. Image courtesy of Globalstar.

International Emergency Response—Help Is At Hand Wherever + Whenever Needed

The GEOS International Emergency Response Coordination Center (IERCC) was officially founded in November of 2007 as part of the GEOS Alliance, with the culmination of various 24×7 monitoring centers that individually focus on travel safety, security services and monitoring for clients.

The monitoring activities of these centers—which were disparate and separate entities—covered a number of services and technologies involved in notification, tracking and emergency alert messaging. Independently, these centers have been operating since the late 1990s. They now operate collaboratively across the globe via reciprocal agreements and have agreed upon common practices—in effect, their combined facilities now act as a global safety and rescue network.

Mark Garver, CEO of GEOS Response, shared his insights on the range of rescues that owe their success to SPOT from Globalstar.

"When we started working with SPOT in 2007, the majority of rescues were in North America, typically in remote locations. The really unique aspect of the SPOT system is the ability to pinpoint where the emergency is situated. When we receive an emergency activation coming into our center, we are able to look at the latitude and longitude of the event. When we call first response organizations, we can inform them quickly as to the location of the emergency, whether the person is moving, what direction he or she was going, and so on. We can guide the first responders rapidly to the emergency site and exactly where the victim(s) are located.

"We have grown our organization and have developed extremely good relationships with first responders, worldwide. There were other systems in existence prior to SPOT. However, what has made SPOT so successful is its GPS positioning. Previously, when an emergency was reported to us, it identified a pretty broad area.

"Rescuers had to engage in a formulaic search pattern—they would send out search parties and eventually they would get closer and closer to where the incident was taking place. In the end, they would hear the distress beacon and could then provide the rescue. With the advent of the SPOT device, rescuers can move directly into that all-important four-meter range. This allows those teams to more closely zero in on where an incident has occurred. SPOT ensures emergency services get to the site far more quickly as well as to a more precise location to render aid—no question, this is a great life-saving device.

"The range of contexts in which SPOT has played a critical role is huge. Just north of Houston, Hurricane Katrina destroyed communications networks. When a house caught fire, the owner activated his SPOT device and we were able to get the local fire department to the scene rapidly. We were also able to pinpoint the location of several SPOT users who issued distress calls during the 2012 tsunami in Indonesia. We swiftly co-ordinated rescue relief and liaised with the U.S. State Department to share the location of U.S. citizens in need of help.

"Similarly, when Haiti was devastated by an earthquake in 2010, most first response resources were immediately occupied with emergencies all over the country. Communications networks were totally non-functioning, but with the aid of SPOT, our organization was able to locate an available relief team and then dispatch them to a user in need of aid.

"During avalanche season in the U.S. and Canadian Pacific Northwest, each year we receive a growing number of SOS calls from skiers and snowmobilers who are lost or injured. In fact, in one instance, two mountain rangers were caught in a whiteout in Colorado and became disoriented. Following a SPOT activation, we were able to quickly put them in touch with other members of their organization, who were instantly informed of where their colleagues were located. We were able to give them dynamically updated location information which they then plotted on a mapping interface, enabling them to see ridge lines and additional guiding landmarks. The rangers had dug a snow cave for themselves, thinking they would spend the night totally snowbound. However, we were able to safely guide rescuers to their location and all reached shelter before the freezing nightfall.

"One of our most interesting rescues involved a French SPOT user and his daughter who were kayaking in northern Siberia. They suddenly found themselves in waters too wild to be navigated. They activated their SPOT device and we contacted Russian Search and Rescue. The rescuers—transported with the aid of a sure-footed mule—soon located the pair in the remote region and successfully transported them to safety.

Garver added, "There is one key message I would like to share with rescue and relief agencies who are considering the procurement of communications and tracking technology: Equipping your staff with a device that pinpoints location and does not rely on terrestrial communications can really be a life-saver.

"No matter what the emergency, with a device such as SPOT, the push of a single button places you into direct communication with an organization that has close relationships with a worldwide network of agencies that rapidly assist, wherever aid is needed.

"What would I say to first responder organizations that are hamstrung by budget cuts? That's a tough one, but I would say, try to find the money, from somewhere. One life lost is something that no one wants to experience. The cost of these solutions is minuscule when compared to the lives that otherwise could not receive aid in time during an emergency and be lost."

http://www.geosalliance.com/geos-services/worldwide-search-and-rescue/
http://www.findmespot.com/en/index.php?cid=104

SPACE SECURITY, DOWN TO THE NANOSECOND
WHY THE GPS SYSTEM REMAINS ESSENTIAL TO MODERN WARFARE

By Colonel Bernard J. Gruber, U.S.A.F., and Colonel Jon M. Anderson, U.S.A.F., Retired

Return to the year 2008, when Michael Phelps swam into the history books with an astonishing finish to win his seventh gold medal by one one-hundredth of a second against Milorad Cavic.

By any stretch of the imagination, the time differential in this historic race was imperceptible, but for the Global Positioning System (GPS) an error of one one-hundredth of a second would be a disaster.[1] Why?

For the GPS, one nanosecond (0.000000001 second) would result in the equivalent of approximately a one-foot error on Earth. Translated, Phelps's razor-thin margin of victory would have produced an incredible error of almost 10,000,000 feet or approximately 1,894 miles. Although the GPS provides so much more than just timing accuracy, this measurand has become one of its key hallmarks, as have its space superiority and force-multiplying capabilities.

Joint Publication 3-14, Space Operations, defines "space superiority," a primary focus of this article, as "the degree of dominance in space of one force over any others that permits the conduct of operations at a given time and place without prohibitive interference from space-based threats" (emphasis added).[2] Although not yet fully operational at the time, the GPS was first used for combat in Operation Desert Storm, often called "the first space war."[3]

From initial air strikes by Pave Low helicopters to General Norman Schwarzkopf's famous "left hook," the GPS served as a key force enabler, even with a very limited deployment of receivers.[4] Furthermore, the GPS has been a crown jewel of the American military's superior space capabilities for decades, through Operation Enduring Freedom. Yet, emerging threats and increasingly sophisticated foreign capabilities present new challenges to maintaining US technical and operational advantages.

Provided free of charge by the US Air Force and acquired and operated by Air Force Space Command, the GPS is a critical national asset. A tangible symbol of US economic and military might and a system unmatched in performance, cost, and availability, the GPS is now used by well over 1 billion people and has been integrated into more than 2 billion devices, both commercial and military.[5] Its applications are wide ranging and diverse, from aircraft navigation to network synchronization (*see the table on the following page*).

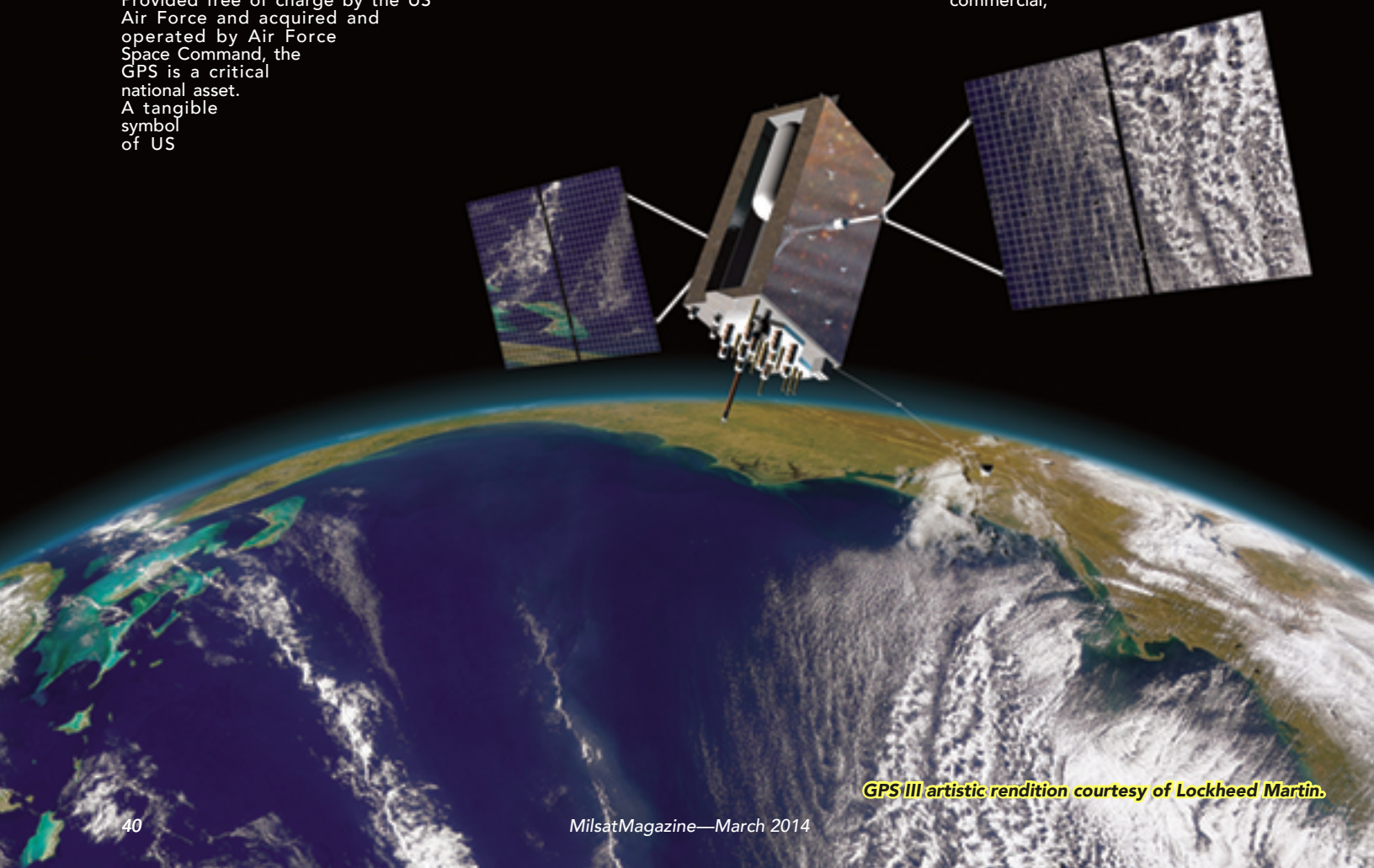
Although the law guarantees availability of the GPS to users worldwide, the system also serves as a critical fiber in our nation's defense, clearly enabling space superiority as defined by Department of Defense (DoD) policy.

This article highlights how the GPS has become an integral part of our nation's war-fighting and commercial capabilities, why it will remain essential to both national economic power and US military superiority, and how it will get better in the future. The article offers unique analogies, examples, and the firsthand experiences of two senior leaders of the GPS Directorate who have worked GPS strategy, policy, technology, and acquisition for more than 20 years combined.

The Importance Of The Global Positioning System

Positioning, navigation, and timing (PNT), a term rarely heard outside the US government, usefully consolidates under a single banner the various systems, policies, and activities concerned with providing critical positioning information, navigation capabilities, and time dissemination. By most measures, PNT is a thriving, healthy, global enterprise, largely due to the ubiquity of the GPS, which the United States has offered as a free global utility since the inception of the GPS program office in 1973.

Today, more than 3.3 million jobs rely on GPS technology, including approximately 130,000 in GPS manufacturing industries and 3.2 million in the downstream commercial,



GPS III artistic rendition courtesy of Lockheed Martin.

Application	GPS Enabler	Effect	Military Counterpart
Agriculture	Precision farming	Demonstrated increases in annual crop yields of 10 percent. Reduction in fuel costs of 52 percent Reduction in labor costs of 67 percent	Minelaying, unmanned ground vehicle positioning
Aviation	Next generation Air Traffic Management System	Single large aircraft descent: 1,600 lb. of fuel with a corresponding reduction of two metric tons of carbon dioxide	Military aircraft navigation
Maritime	Automatic Identification System (AIS)	Vessel traffic control around busy seaways	Minesweeping, maritime navigation
Surveying	Control survey points	Costs reduced from $10K to $250 per point	Target location
Precise Time	Worldwide distribution	Cellular networks, satellite communications, ATM machines as well as many other "consumer" services, and the underlying banking, data handling, and pubic utilities. Time order of battle	Tactical network synchronization
Environmental	Optimization of fleet management systems	Reduction of fuel consumption by 4.5 billion gallons	Aircraft fuel reduction
Disaster Relief	Rescue teams	Instant beacon location	Combat search and rescue
Humanitarian	Airdrops (e.g., Joint Precision Airdrop System)	260 acres of space required (1999) to five acres (2012)	
Military	Precision munition guidance Combat search and rescue	Joint Direct Attack Munition, joint standoff weapon, small-diameter bomb, Tomahawk cruise missile, Excalibur projectile Combat Survivor Evader Locator radios, Motorola XPR6550–multiple examples	

Table 1. Applications of the Global Positioning System. (Data extracted from the nomination of the Global Positioning System for the International Astronautical Federation's 60th Anniversary Award, 2011.)

GPS-intensive industries. In light of high financial returns, we expect the commercial GPS adoption rate to continue to grow across industries. Consequently, the system's technology will create $122.4 billion in benefits per year and will directly affect more than 5.8 million jobs in downstream commercial, GPS-intensive industries when penetration of the system's technology reaches 100 percent in those industries.[6]

The GPS has proven brilliantly successful and so universally adopted that Russia, the European Union, and China have all developed imitations and are in various stages of deploying them. Additionally, more than 50 nations have developed GPS augmentations. In many ways, the GPS was the first truly global utility—one that is only now realizing its potential as new commercial applications emerge every year. The system has also become a symbol of military interoperability, boasting agreements with 55 US allies as authorized users of the military's precise positioning service.

The GPS largely owes its success to the fact that no other system or technology can match its performance, cost, and availability. Traditional radio navigation aids are far less accurate and do not provide global coverage. Inertial systems are capable of very precise short-term accuracy, but physics dictates that their accuracy will diminish over time unless synchronized periodically with the GPS or a similar system. Atomic clocks keep accurate time but are costly, requiring significant power and thermal control.

Promising new technologies such as Chip-Scale Atomic Clocks, Cold Atom Inertial Systems, and Wi-Fi Navigation all reduce dependencies on the GPS alone; however, they probably will not deliver similar accuracy and pervasive availability for the foreseeable future. Instead, these technologies work best when integrated with other sensors—especially the GPS. As such, the US military continues to rely on the GPS, even as new technologies are integrated into weapon systems.[7]

Background

Like cell phones, computers, and the Internet, the GPS is used worldwide by ordinary citizens and the military forces of both allies and adversaries. Since the launch of its first satellite more than 30 years ago, the system has transformed navigation and precise timing. From the first GPS satellite launch on 22 February 1978, any user—military or civilian—could access the unencrypted coarse/acquisition (C/A) code on the primary GPS frequency L1 (1575.42 megahertz [MHz]).

From the system's inception, military leaders have been concerned about universal access to the precise PNT offered by the GPS to friend and foe alike; thus, its "dual-use" phenomenology has, at times, caused friction between the military and civil user communities. As the commercial use of and reliance on the GPS increased, the effects of the "selective availability" methodology—the original means of limiting universal capability—proved too hard to bear for the US government.

The concept behind selective availability involved the employment of positioning and timing accuracy as a discriminator between military and civil users. The signal was intentionally degraded to 100-meter accuracy, a condition that authorized users with a valid decryption key could remove.

This practice not only was enormously unpopular with the civil GPS community but also was eventually circumvented by differential techniques. In fact, the Department of Transportation funded and developed differential GPS, leading to the untenable situation in which one arm of the federal government undermined another.

The downing of Korean Airlines Flight 007 by an aircraft of the former Soviet Union over the Sea of Japan on 1 September 1983 emphasized the critical need for a global civil-navigation system. A series of US policy initiatives promoting adoption of the GPS by civilian and commercial users followed, including Presidential Decision Directive no. 6 in March 1996, and culminated with the elimination of selective availability in May 2000.[8] Its removal offered civilian GPS users the

The first GPS satellite—launched on 22 February 1978.

reliable accuracy previously delivered only to the US military and spawned explosive growth in the development of high-precision civilian applications in such fields as surveying, agriculture, and earth science.

On 27 September 2007, the White House announced that selective availability would no longer be included in future procurements of GPS satellites. Today, there is little difference in the accuracy available to US forces, civil users, or adversaries.

The Air Force took the additional step of committing to specific levels of civilian performance and backed up that commitment with US law. The GPS Standard Positioning System Performance Standard (SPS PS), first published in 1993, established minimum levels of GPS service in terms of constellation coverage, signal accuracy, and integrity for C/A code users. These GPS performance commitments—particularly important for safety-of-life applications—have allowed certification of the system for commercial aviation by both the Federal Aviation Administration and the International Civil Aviation Organization.

The SPS PS has been updated multiple times over the years, most recently in 2008, and will continue to undergo updates to account for the deployment of new civil signals. The US government's commitment to GPS standards for civilian users has allowed receiver manufacturers and other commercial developers to commit resources to developing products and services based upon accurate, reliable, and globally available GPS signals. As new, developing service providers of the global navigation satellite system—such as the European Galileo system and Chinese BeiDou (Compass) system—begin operations, users will also demand similar commitments, particularly for safety-of-life applications.

During more than 30 years of operation, the GPS has made continuous improvements to its operational control segment, which monitors the health and status of the constellation. This segment produces data on GPS satellite orbits and the atomic clocks on board each GPS spacecraft that all receivers use to compute their position and timing solutions. In the last decade alone, these improvements have led to 50 percent reductions in the signal-in-space user-range error. In fact on 21 April 2013, the GPS system recorded a user-range error of 51.4 centimeters, setting an all-time-record low.[9]

Considering that the minimum standard guaranteed by the US government is six meters, this accomplishment is quite spectacular.[10] Moreover, the GPS tripled the number of monitor stations with the addition of 10 from the National Geospatial-Intelligence Agency, starting in 2005. These extra stations supply more data, which improves the control segment's estimates of the satellite orbits and atomic-clock time offsets, leading to improved accuracy for the user. In fact, the GPS time scale now typically differs from the time standard maintained by the US Naval Observatory in Washington, DC, by fewer than five nanoseconds.

These improvements ensure that the GPS system's importance to space superiority will continue. Further, the approximately $32 billion already invested in the system and the ongoing improvements envisioned within it assure war fighters that they can rely on the attributes of the GPS. However, the removal of selective availability, coupled with the continuous and significant accuracy improvements to the globally available civil GPS service, magnifies the challenges presented by the system's dual-use nature, offering potential adversaries precise PNT at low cost.

GPS In The Navigation Warfare Era

In 1996, Presidential Decision Directive NSTC [National Science and Technology Council]-6, US Global Positioning System Policy, instructed the DoD to protect the US military's use of the GPS in the presence of jamming, develop the means to prevent its employment by adversaries, and ensure that civil users outside the area of military operations would remain unaffected.[11] Although elements of this initiative, commonly known as navigation warfare, already existed, the three tenets (protection, prevention, and preservation) embodied the notion that the GPS was outgrowing the earlier security features embedded in its design and that a different approach was needed—one that did not include selective availability. The navigation warfare tenets were further codified by direction from Congress in Title 10, United States Code, and in the White House's policy on space-based PNT in 2004. Given the ubiquitous nature of the GPS and the growing prevalence of both sophisticated and brute-force jamming threats, military leaders and US policy concerns identified a need for strategic alternatives.

The 2006 Joint Capabilities Document for Position, Navigation, and Timing, developed by US Strategic Command, states that "no other capability permeates the fiber of joint operations like PNT."[12] Although the GPS is not the sole source of PNT for the US military, it is the primary one for most users. Compared to the next-best alternatives, GPS is simple, inexpensive, reliable, and highly accurate. It has changed not only how US forces navigate but also how they fight. Like their civilian counterparts, the Soldiers, Sailors, Marines, and Airmen of the US armed forces take the availability of the GPS for granted; experience has taught them that it works nearly everywhere and nearly all of the time.

Although eminently functional in most environments, the GPS has limitations. Its signals are very weak, well below the ambient noise level in GPS receivers, and easily blocked by obstructions such as buildings and terrain; further, unlike some signals, they do not penetrate under water, under ground, or through thick foliage. Additionally, GPS signals are vulnerable to radio frequency interference, both intentional and unintentional.

The accuracy of the time or position obtained by the GPS user is directly related to the geometric relationships between the user and the visible satellites, resulting in degraded performance whenever a portion of the sky is obscured. Consequently, the Joint Capabilities Document identified several primary PNT gaps, including access to PNT in the presence of "geospatial impediments," which include environments such as indoors, underwater and underground locations, and both natural and urban canyons.

Unlike individuals who employ inertial navigation systems and local timing sources, PNT users dependent on GPS must rely on external radio signals. As is the case with radar and radio communications, adversaries can jam these signals in a variety of ways—a situation that led the original GPS developers to incorporate secure encryption and anti-jamming features into the design.

The secure military signal, known as P(Y) code, is used by the US military, some federal agencies, and the military services of several allied nations. In addition to providing an element of assurance to the military user, this code signal is more resistant to jamming than the civil (C/A code) signal, and military users have access to two frequencies rather than the single frequency available to civil users today.

Encryption also creates a form of military exclusivity, which gives authorized users a uniquely available signal, although many high-precision commercial receivers utilize techniques that exploit general characteristics of the military signal while ignoring the encryption. Growth in applications based on these techniques has led to a commitment by the US government to maintain the signal characteristics until a second coded civil signal becomes fully operational and available from the GPS constellation.

Anti-jamming for GPS users exists in several forms, from natural body masking on aircraft and terrain masking for ground users to technical innovations such as adaptive antenna arrays, narrowband frequency filters, and "tight" integration with inertial sensors. Unlike commercial receivers, military GPS receivers are designed to operate under jamming conditions and are generally more robust. They also typically use older technology than modern, commercial GPS receivers primarily because of the much faster commercial-product lifecycle time, additional unique requirements levied upon military electronic equipment, and the acquisition process to procure military receivers.

High-end systems used on military aircraft, ships, and some missiles and munitions are typically part of an integrated navigation system. Oftentimes they operate outside the range of the most likely threat—ground-based jamming. In recent years, attention has mainly focused on low-end users, especially military handheld GPS receivers—also widely used in vehicles. For these users, size, weight, and cost are critical factors, so aircraft anti-jamming techniques offer limited benefits. Toward that end, Air Force Space Command has made GPS modernization and the protection of military signals a priority.

Modernization Of The Global Positioning System

The only practical method of denying the use of GPS to an enemy while limiting the effects to a geographical region involves the employment of local electronic warfare. Unfortunately, GPS civil and military signals share the same frequency range. Although the military originally enjoyed access to a second frequency unencumbered by a civil signal, pressure from civil agencies led to this frequency becoming dual use as well.

After searching for a tractable solution that would enable military use of the GPS in the presence of "friendly" jamming of the civil GPS signal, the Air Force developed a new military signal—military code (M code)—which shares the current GPS frequency bands yet is sufficiently separated from the civil signal to provide secure GPS to military users in the presence of friendly jamming operations against the civil signal.

To meet the direction from the White House and Congress to prevent adversaries from using the GPS, modernized receivers must be robust in the presence of friendly jamming. Spectral separation of the M code signal from civil GPS signals (see the figure below), combined with modern signal processing, will enable war fighters to navigate securely while aggressively jamming enemy use of satellite-based navigation systems. Thus we can ensure space superiority well into the future.

The first satellite with M code launched in 2005, and the 12th one in 2013. By 2017, 24 modernized M-code-capable GPS satellites will supply global coverage and capability to US military and allied users. M code offers several advantages in addition to "spectral separation" (i.e., the frequency allocation of M code does not directly overlay the civilian signals). Its inherent design improves the accuracy and jamming resistance of the military signal, and it includes several enhanced security features. Increased transmitter power aboard the satellite—one of the key attributes of jamming resistance—bolsters the jamming power necessary to defeat friendly receivers, making higher-power jammers easier to detect, locate, and target.

The GPS III satellite program, currently approved for eight modernized satellites, will provide M code signal power up to eight times stronger than legacy military signals supplied by GPS II satellites.[13] Although this extra power will not in itself defeat known threats, more power complements every other anti-jamming technique. More power adds more "bars" to the signal meter, providing a signal under tree canopies

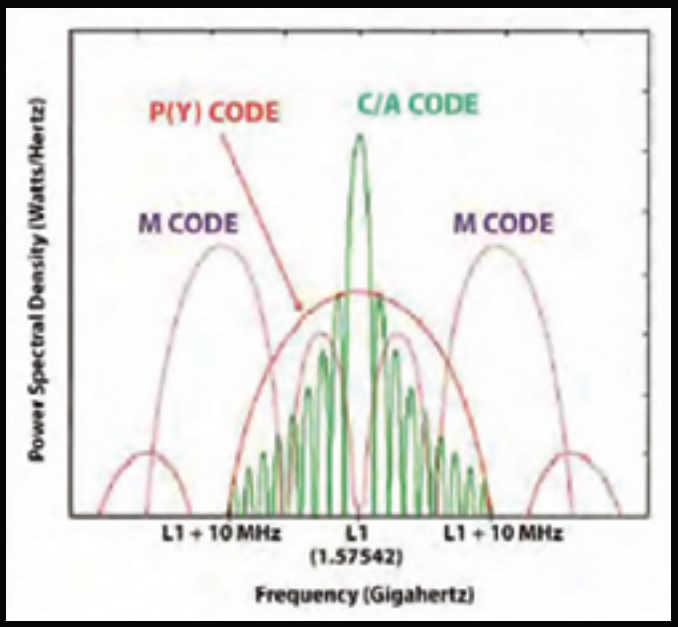


Figure 2. GPS spectrum on L1 (primary GPS frequency)

and possibly in buildings; moreover, it overcomes many annoying, interfering sources that occur regularly in the field. Additional power will come from advanced beam-shaping antennas on future GPS satellites, further improving performance in both impeded and highly jammed conditions.

The GPS has matured in a manner analogous to radar's development. From the early days of World War II to the present day, an unrelenting pursuit of technologies has yielded tremendous improvements in radar performance. Radar evolved from early continuous-wave radars to monopulse radars, followed by pulse-Doppler radars, phased array radars, and, finally, today's state-of-the-art synthetic aperture radars. Further, the US military, civilians, and users worldwide rely upon "identification, friend or foe" radar frequencies to distinguish themselves from enemy forces.

Similarly, the original GPS signals were designed in the 1970s, around the same time that Steve Jobs and Steve Wozniak worked on the Apple 1 computer. M code incorporates a modern signal design that enables sophisticated signal-processing techniques which, when combined with the higher signal power on GPS III, will decrease the effective range of enemy military jammers against GPS receivers.

Just as radar has continued to evolve since its inception, so will GPS anti-jamming technologies continue to mature and offer distinct advantages for the US military and allies. In addition to jamming, the GPS has proven vulnerable to "spoofing," a deception technique using electronic warfare to fool a GPS receiver into locking onto false signals rather than GPS satellite signals.

Professor Todd Humphries of the University of Texas recently testified to Congress that his team of graduate students used a spoofing transmitter to take control of a GPS-guided remotely piloted vehicle, causing it to dive toward the ground.[14] The DoD has long known of this threat and has taken measures to prevent it.

Anti-spoofing has always been a feature of military GPS, using encrypted signals as the first line of defense. Moreover, M code cryptography is far more advanced than its older sister, the P(Y) code. Code signed by the GPS Directorate and the National Security Agency, M code is comparable to modern systems that protect much more critical data, and it will protect war fighters from spoofing for decades. Additional measures include smart algorithms incorporated into the Military GPS User Equipment Program, whose receivers can sort out false signals from the satellite signals and reject them, giving the user high assurance.

In the early 2000s, the DoD began employing the Selective Availability Anti-Spoof Module, which introduced over-the-air rekey, over-the-air distribution, and contingency recovery—a technique that resets GPS receivers from possible compromise of the GPS key, thus improving positive control and resiliency. GPS modernization takes this even further. Working with the National Security Agency to leverage its key management infrastructure, US Strategic Command will have even more tools to ensure that only authorized users have access to M code, that the user is protected from spoofing, that keys are readily available to US and coalition partners, and that the drivers of security expenses for user equipment remain minimal.

The launch of the fourth GPS IIF satellite on 15 May 2013 once again has demonstrated Air Force Space Command's commitment to mission success. Because of the current limitations of the ground-control segment, the launch of this latest satellite will "max out" the constellation with 31 operating satellites at 11,047 nautical miles above the earth in an inclination of 55 degrees to the equator. To ensure continued service, the GPS Program Directorate at the Space and Missile Systems Center, Los Angeles AFB, California, has already delivered five additional GPS IIF satellites to storage, a precedent not attained in well over a decade. These satellites now allow tremendous flexibility to launch on demand when the operational need arises, should a significant series of failures occur.

The GPS Directorate is also investing in the future capability of both the satellite constellation and the ground segment to provide improved command and control of GPS signals. Next-generation GPS IIF and III satellites are in various states of assembly, integration, test, and production in an effort to improve the average user-range error from 0.9 meters—established and maintained for the last three years—to a rootmean-squared user-range error of 0.5 meters by 2016.

Clearly, space superiority is based as much upon PNT accuracy as upon the ability to conduct land, sea, or air operations at a given time and place without prohibitive interference by an opposing force. Toward that end, the GPS III satellite system, with its first launch scheduled for 2015, employs up to eight times the amount of M code power; a designed 15-year lifespan; a new, internationally compatible civil signal (L1C); and greater accuracy.

To maintain a competitive edge over other global navigation satellite systems and to reduce costs, the GPS Directorate is also funding technologies that will provide a return on investment. For example, lithium ion batteries greatly reduce the weight of the satellite, and improved solar cells produce more power at reduced cost, as does the combining of star trackers and inertial measurements into a single component on the spacecraft. Furthermore, digital waveform generation (the ability to change on-orbit signals in space via software commands instead of hardware upgrades, necessarily requiring the launching of new satellites) could become an integral part of the future enterprise architecture.

In addition, the Next Generation Operational Control System (OCX) is designed to command and control our modernized secondary civil signal L2C (1227.60 MHz), safety-of-life signal L5 (1176.45 MHz), and the internationally compatible L1C (1575.42 gigahertz) signal. These additional civil signals include the ability to correct for ionospheric effects and achieve a resulting improvement in accuracy currently enjoyed by military receivers. Importantly, the OCX will no longer be limited to the command or control of only 31 satellites since the system is being designed to accommodate up to 64 GPS satellites. The OCX's expandability and service-oriented architecture will give users and operators the security, information assurance, and flexibility they simply do not have today.

Affordability + Innovation

Even with all of these improvements, affordability demands innovative ways to deliver the GPS to war fighters. More than 165,000 precision lightweight GPS receivers (PLGR) have been procured worldwide and over 478,000 defense advanced GPS receivers (DAGR) have been ordered (the PLGR and DAGR are the most common military receivers in the DoD).[15]

The initial DAGR was a marvel, weighing just one pound versus the PLGR's 2.7 pounds and adding dual-frequency GPS as well as a map display. Both the PLGR and DAGR have become the standard GPS receivers for ground forces. Today, however, most of them (60 to 70 percent) are used in vehicles, often with three or more DAGRs mounted in an Army vehicle, all operating independently. The functionality and user interface of the DAGR, a handheld device, don't compare well with those of the lightweight, user-friendly commercial devices to which Soldiers have become accustomed. If the DoD designed something equivalent today, it would not keep pace with the innovation and life cycles typical of commercial technology.

The Army recognized this challenge and established a policy in 2009 that called for procurement of embedded receivers, initiating the development of two devices known as the "HUB" and the "PUCK." In many cases, these new devices will enable the Army to replace up to five DAGRs in a vehicle such as a tank with a single embedded ground card. Embedded devices will also replace the concept of GPS handhelds; instead, systems for dismounted Soldiers will be developed with GPS embedded to support an evolving human interface.

In March of 2012, the Army introduced the Army Marketplace, with 12 initial apps available for iOS devices. Most of these concentrated on training needs and handbooks, but in other research activities, the

service has developed and tested other apps for combat support, including augmented reality and navigation.[16]

Given the ready availability of devices such as smartphones and iPads, it no longer makes sense for the DoD to invest in stand-alone devices with archaic user interfaces. The GPS Directorate is working with Aberdeen Proving Ground to marry commercial off-the-shelf technology, which changes quickly, with secure, enhanced, and robust GPS.

A key cornerstone in our overall strategy entails production of the Common GPS Module. Explicitly designed with a small, minimalist package to support diverse applications, it will prove suitable for integration in a wide range of devices, from smartphones to secure radios. The module will be indistinguishable from the human-machine interface, delivering performance in an electronic warfare environment. Further, it will be a key element of munitions programs such as the small-diameter-bomb direct-attack munition and the precision guidance kit for mortars.

As affordability becomes more important, procurement strategies can adapt according to the mission need. In some cases, situational awareness of an enemy jamming or spoofing in the area may be sufficient. For example, the Rifleman Radio, carried by individual platoon members, is used primarily for voice communications, but it has an inexpensive C/A code chip that reports location to the platoon leader, who has a display. An affordable upgrade may involve providing a secure, lightweight Selective Availability Anti-Spoof Module or M code capability to the platoon leader using the Common GPS Module. Operating procedures could produce the same effect as giving every Soldier the anti-jamming/anti-spoofing capability of M code but at a fraction of the cost.

Many systems may not need M code at all. Consider, for example, the T-6 Texan II, the T-38 Talon, and T1A Jayhawk aircraft, flown primarily at bases in the continental United States for undergraduate pilot training. In such a basic training environment, spoofing and/or jamming is highly unlikely, obviating the need for such code.

As the GPS has become more sophisticated, delivering more capability to both civil and military users, the cost of the spacecraft, including launch, has increased tremendously. The expenditure necessary to put a GPS III in orbit now approaches half a billion dollars. Furthermore, national policy and worldwide expectations are driving the minimum constellation size to 30 satellites on orbit even though a 24-plus-three (on-orbit spares) satellite constellation is considered nominal.[17]

As aging Block II satellites reach the end of their life span during the next decade, this higher expectation will become burdensome for the DoD. To explore alternatives, Air Force Space Command has initiated an architecture study to define an augmentation strategy with GPS III to reduce the total ownership cost while meeting performance expectations.

This strategy, known as "Navsat," calls for producing and launching simpler, lighter, and cheaper satellites two or three at a time. Navsat will ensure that the Air Force delivers on the White House's objective that GPS remain the premiere satellite navigation system in the world. Moreover, by augmenting the GPS III satellite system with eight to 12 cheaper satellites, we can retain competition, bolster the defense industrial base, and reduce total life-cycle costs.

GPS As A Cornerstone Of Space Superiority

In many ways, today's satellite navigation technology resembles automobile technology in the 1960s. For example, consider some models of the Chevy Vega, whose aluminum engine block warped, or the 1960 Corvair, called by many the most dangerous car ever put on the road.[18] Or consider any automobile before the 1964 Mustang, which marketed seat belts as an option until they became mandatory in 1968.

Since the 1960s, cars have incorporated system safety and efficiency features that did not change the fundamental nature of the car but arguably saved lives and reduced costs.

According to the National Highway and Traffic Administration's estimates, child restraints, seat belts, and airbags saved over 90,000 lives from 2003 through 2007.[19] Power steering, power brakes, and fuel injection have improved control and comfort. Fuel emission standards have reduced air pollution in major cities—easily confirmed by observing the thick smog in television shows filmed in Los Angeles in the 1970s. Many of these auto safety initiatives were expensive, premium features when introduced, and resistance to safety legislation from consumers and legislators was intense. Yet, the evolution of the automobile has improved millions of lives.

Similarly, the GPS must evolve, and the delivery of GPS modernization is critical for US battlefield superiority in the future. The GPS was conceived in the late 1960s and early 1970s, deployed in the 1980s, and widely adopted in the 1990s. Anti-jamming and anti-spoofing are like seat belts and air bags insofar as they improve the reliability and availability of precision PNT to aircraft, bombs, ships, vehicles, communications systems, and personnel. Enhanced signal and key management are like power steering and power brakes insofar as they make the system more effective and efficient.

Just as Congress specified requirements for seat belts, so does Title 10 United States Code, section 2281, demand that all military GPS receivers be M-code capable. And just as the seat belt met resistance, so is there reluctance to program M code receivers into the Future Years Defense Program even though, like the automobile, M code receivers—in terms of safety—will be superior to commercial receivers.

The GPS has its competitors, the most formidable of which have the backing of their national sponsors. The Russians have reinvigorated their Global Navigation Satellite System (GLONASS) and since October 2011 have provided a full 24-satellite constellation for the first time since late 1995. The Chinese are rapidly populating the satellite constellation of their BeiDou system but actually rely on the GPS constellation to operate fully. The Japanese Quasi-Zenith Satellite System augments the GPS through highly inclined satellites with long dwell times over the home islands. The European Union has recently committed to buying what will become a full-complement system with 30 satellite vehicles.

The GPS is—and for the foreseeable future will remain—the best global satellite navigation system in the world, and the United States has the ability to retain the space superiority enabled by the GPS. Like a high-performing NASCAR team, America must continue to rely on engineering excellence, innovative management, and sustained operational excellence to maintain the leadership position that the GPS now enjoys.

The United States and the Airmen who provide this vital global utility free of charge for the world should be justifiably proud of its history and capabilities. The GPS must continue to evolve as warfare evolves. As General Giulio Douhet aptly observed, "Victory smiles upon those who anticipate the changes in the character of war, not upon those who wait to adapt themselves after the changes occur."[20]

Notes

1. The GPS is a space-based positioning, navigation, and timing system. With a constellation of at least 24 satellites (currently more than 30) in medium Earth orbit, it provides global positioning and timing by broadcasting radio frequency signals at three frequencies in the L-Band: L1 (1575.42 megahertz [MHz]), L2 (1227.6 MHz), and L5 (1176.45 MHz). The user's GPS receiver obtains position and time by tracking four or more satellites and determining the time of arrival of each radio signal, which propagates at the speed of light. For more information on GPS, see "The Global Positioning System," GPS.gov, 17 January 2013.

2. Joint Publication 3-14, Space Operations, 29 May 2013, GL-8.

3. "Desert Storm: The First Space War," in Gray Space and the Warfighter, 17 June 1997.

4. Ibid.

5. The GPS is integral to nearly all smartphones today. According to CNET, "During the third quarter [of 2012], the total installed base for smartphones worldwide hit 1.04 billion, jumping from the 959 million smartphones in use during the second quarter, research firm Strategy Analytics announced today." Don Reisinger, "Worldwide Smartphone User Base Hits 1 Billion," CNET, 17 October 2012.

6. Nam D. Pham, PhD, The Economic Benefits of Commercial GPS Use in the U.S. and the Costs of Potential Disruption (Washington, DC: NDP Consulting Group, June 2011), 1, http:// www.saveourgps.org/pdf/GPS-Report-June-22-2011.pdf.

7. "Because the Global Positioning System (GPS) was so accurate (although not as accurate as laser-guided bombs) and could be used in all weather, the Joint Direct Attack Munition was the favorite. While designed to be used against high-value, fixed targets, JDAMs were heavily used against relatively low-value targets and in close air support missions flown by bombers at relatively high altitudes. The extensive use of precision-guided munitions greatly improved the Air Force's ability to hit targets, in any weather." Kristin F. Lynch et al., Lessons from Operation Iraqi Freedom (Santa Monica, CA: RAND Corporation, 2005), 95.

8. "Selective Availability (SA). Protection technique employed by DoD to deny full system accuracy. On May 1, 2000, President Clinton announced the discontinuance of SA effective midnight 1 May 2000. The effects of SA went to zero at 0400 UTC on 2 May 2000." Department of Defense, Global Positioning System Standard Positioning Service Performance Standard, 4th ed. (Washington, DC: Department of Defense, September 2008), C-4.

9. "Instantaneous User Range Error (URE). An instantaneous URE is the difference between the pseudorange measured at a given location assuming a receiver clock that is perfectly calibrated to GPS time and the expected pseudorange as derived from the NAV [navigation] message data for the given location and the assumed receiver clock. The instantaneous SIS URE [signal-in-space user-range error] includes only those pseudorange data set error budget components assigned to the GPS Space and Control Segments (i.e., not including the error budget components assigned to the GPS User Segment such as the troposphere delay compensation error, multipath, and receiver noise)." Ibid., C-2.

10. Ibid., 22.

11. Presidential Decision Directive NSTC-6, US Global Positioning System Policy, 28 March 1996.

12. United States Strategic Command, Joint Capabilities Document for Position, Navigation, and Timing (Offutt AFB, NE: United States Strategic Command, 28 September 2006), 4. FOUO. Information extracted is unclassified.

13. GPS II refers to the second generation of GPS satellites although Block II was actually the first series of operational GPS satellites. The designators IIA (advanced), IIR (replenishment), and IIF (follow-on) represent the versions of Block II satellites. To date, four of 12 IIF satellites have been launched.

14. House, Professor Tom Humphreys, Statement on the Vulnerability of Civil Unmanned Aerial Vehicles and Other Systems to GPS Spoofing, Submitted to the Subcommittee on Oversight, Investigations, and Management of the House Committee on Homeland Security, 112th Cong., 2nd sess., 19 July 2012.

15. Data obtained from GPS User Equipment Division contracts.

16. "Another app, called 'sSoldierEyes,' turns a smartphone into a sort of battlefield navigation device. In addition to displaying a digital map, it features an "augmented reality' mode that enables the user to flip on the camera and scan the horizon. Digital markers pop up on the screen, displaying the direction and distance to objectives on the battlefield." Nathan Hodge, "Killer App: Army Tests Smartphones for Combat," Wall Street Journal, 3 June 2011.

17. "According to Dr. Sheila E. Widnall, Secretary of the Air Force, the Air Force recognizes the tremendous civil and military aspects of GPS, and fully intends to maintain a 24-satellite constellation for the duration of the program." "President Opens Door to Commercial GPS Markets: Move Could Add 100,000 New Jobs to Economy by Year 2000," press release (Washington, DC: White House, Office of the Press Secretary, 29 March 1996)

18. "The Most Dangerous Cars of All Time," CarsDirect.com, 24 February 2012.

19. National Highway Traffic Safety Administration, Lives Saved FAQs (Washington, DC: National Highway Traffic Safety Administration, December 2009), 4.

20. Giulio Douhet, The Command of the Air, trans. Dino Ferrari (1942; new imprint, Washington, DC: Office of the Air Force History, 1983), 30.

About the authors

Colonel Gruber (BSME, North Dakota State University; MSBA, Central Michigan University) is the director of the Global Positioning Systems Directorate. He is responsible for a multi-service, multinational systems directorate that conducts development, acquisition, fielding, and sustainment of all Global Positioning System (GPS) space segment, satellite command and control (ground), and military user equipment. The $32 billion GPS program, with a $1 billion annual budget, maintains the largest satellite constellation and the largest avionics integration and installation program in the Department of Defense. Commissioned in 1986, Colonel Gruber is a graduate of Squadron Officer School, Air Command and Staff College, Air War College, Defense Systems Management College, and Joint Forces Staff College, and has commanded at the squadron, group, and wing levels.

A member of the Acquisition Corps, he is a certified joint specialty officer and National Defense Fellow alumnus. Colonel Gruber has distinguished himself in a variety of leadership positions within the operations, intelligence, launch, engineering, and acquisition disciplines. He has served in key positions at major command, Air Staff, Joint Staff, and Defense Agency levels. Prior to assuming his current position, Colonel Gruber served as one of four mission panel chiefs on the Air Staff, responsible for future budgeting for all space and intelligence, surveillance, and reconnaissance programs across the Air Force.

Colonel Anderson (BSEE, University of Kansas; MSEE, South Dakota State University; PhD, Air Force Institute of Technology) is the former chief of the Global Positioning System (GPS) User Equipment Division. He was responsible for leading over 299 military, civilian, and contractor personnel executing multiple development and production contracts valued at more than $2 billion and delivering secure GPS capabilities to Department of Defense and allied users. Commissioned in 1988, Colonel Anderson is a graduate of Squadron Officer School, Air Command and Staff College, and Naval War College.

He has commanded at the squadron and group levels and has a broad Air Force background, with experience in missile operations, technical intelligence analysis, systems engineering, operational test support, national and international space policy, and program management. Colonel Anderson was recently recognized by the Institution of Navigation as the recipient of the 2012 Captain P. V. H. Weems Award for sustained contributions to modernized military GPS, leading enhanced capabilities for US and allied military operations in a navigation warfare environment.

Editor's note

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UPDATE
GPS IIF-5 ENSURES CAPABILITIES + SAFETY OF TROOPS

United Launch Alliance

On February 21st, at Cape Canaveral Air Force Station in Florida, a United Launch Alliance (ULA) Delta IV rocket successfully launched the Global Positioning System (GPS) IIF-5 satellite for the U.S. Air Force from Space Launch Complex-37.

This is ULA's second launch in 2014 and the 79th launch since the company was formed in December 2006.

"Congratulations to the entire mission team on the successful launch of the GPS IIF-5 satellite," said Jim Sponnick, ULA vice president, Atlas and Delta Programs. "GPS provides vital capabilities for the men and women protecting our freedoms around the world and also provides ever-expanding benefits in our daily lives. We are privileged to collaborate with our dedicated government and industry partners seamlessly working together to deliver these capabilities safely to orbit with a focus on mission success, one launch at a time."

This mission was launched aboard a Delta IV Medium-plus configuration Evolved Expendable Launch Vehicle (EELV) using a single ULA common booster core powered by an Aerojet Rocketdyne RS-68 main engine, along with two ATK GEM-60 solid rocket motors. The upper stage was powered by an Aerojet Rocketdyne RL10B-2 engine with the satellite encapsulated in a four-meter diameter composite payload fairing.

GPS IIF-5 is the fifth in a series of next-generation GPS satellites and will join a worldwide timing and navigation system utilizing 24 satellites in six different planes, with a minimum of four satellites per plane positioned in orbit approximately 11,000 miles above the Earth's surface. The GPS IIF series provides improved accuracy and enhanced performance for GPS users.

"This launch marks the 25th successful launch of our Delta IV product line," said Sponnick. "Delta IV has successfully delivered numerous satellites for the National Reconnaissance Office (NRO), as well as GPS satellites for the Air Force and weather satellites for NASA.

ULA's next launch is the Atlas V NROL-67 mission for the NRO planned for March 25, from Space Launch Complex-41 at Cape Canaveral Air Force Station, Florida.

United States Air Force

The U. S. Air Force successfully launched the fifth Global Positioning System (GPS) IIF satellite carried aboard a United Launch Alliance Delta IV launch vehicle at 8:59 p.m. EST from Cape Canaveral Air Force Station, Florida, February 20.

The Boeing-built GPS IIF satellite will join the GPS constellation providing world class space-based positioning, navigation and timing capabilities to support users around the globe. The new capabilities of the IIF satellites will provide greater navigational accuracy through improvements in atomic clock technology, a more robust signal for commercial aviation and safety-of-life applications, known as the new third civil signal (L5), a second civil signal (L2C) available for the dual frequency GPS receivers and a 12-year design life providing long-term service. These upgrades improve anti-jam capabilities for the warfighter and improve security for military and civil users around the world.

"I am pleased with the outcome of today's launch. The new capabilities provided by the IIF satellites will improve operations, sustainment and overall GPS service for the warfighter, international, commercial and civil communities," said Colonel Bill Cooley, director of the Space and Missile Systems Center's Global Positioning Systems Directorate.

"The modernized capabilities that are coming on board with the successful launch of GPS IIF-5 will support the worldwide GPS community for years to come. I would like to recognize the outstanding commitment and the superb dedication to mission success from the 45th and 50th Space Wings, our industry partners: Boeing and United Launch Alliance, and the GPS IIF and Delta IV program teams at the Space and Missile Systems Center," said he said.

GPS provides accurate real-time position, navigation and timing services and plays a major role in information resources supporting a variety of civil, scientific and commercial functions on land, sea, and air. Operated by U.S. Air Force Space Command, the GPS constellation provides precise services worldwide 24-hours a day, and the Air force is committed to providing improved capabilities to ensure users around the globe receive the maximum benefits provided by GPS.

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 acquisition excellence for acquiring and developing military space systems. Its portfolio includes GPS, military satellite communications, defense meteorological satellites, space launch and range systems, satellite control networks, space based infrared systems and space situational awareness capabilities.

COMMAND CENTER
COLONEL WILLIAM T. "BILL" COOLEY, DIRECTOR, GPS DIRECTORATE, SMC, AFSC

Colonel Cooley is responsible for a multi-service, multinational systems directorate which conducts development, acquisition, fielding and sustainment of all GPS space segment, satellite command and control (ground) and military user equipment. The $32 billion GPS program, with a $1 billion annual budget, maintains the largest satellite constellation and the largest avionics integration and installation program in the Department of Defense.

Colonel Cooley was commissioned in 1988 through Air Force Reserve Officer Training Corps and graduated from Rensselaer Polytechnic Institute, Troy, New York, with a degree in mechanical engineering. In addition to his continued technical education, which culminated in a doctorate of philosophy, engineering physics, Colonel Cooley's professional military education includes Squadron Officer School, Air Command and Staff College and National War College.

Colonel Cooley's assignments include System Program Director for operational command and control programs, including the Air and Space Operations Center; Program Manager, Air Force Distributed Common Ground System; Defense Sector Program Manager, Office of Security Cooperation—Afghanistan, Kabul, Afghanistan; Program Element Monitor for Military Satellite Communications at the Pentagon; staff officer at the Warrior Preparation Center, Einsiedlerhof Air Station, Germany; Branch Chief, Semiconductor Laser Branch, Directed Energy Directorate, Air Force Research Laboratory, and Commander Phillips Research Site and Materiel Wing Director, Space Vehicles Directorate, Kirtland AFB, New Mexico.

An artistic rendition of GPS II, IIR, IIF and III over the Earth. Image is courtesy of SMC.

MilsatMagazine (MSM)

Colonel, a good place to start would be to learn what education and training was required to enter the satellite environment within the USAF after your graduation from college? Was there something readily identifiable that pointed your Air Force career into this crucial field of endeavor?

Colonel Cooley

I was very fortunate because after graduating from Rensselaer Polytechnic Institute I attended graduate school while working at Sandia National Labs and then began my Air Force career in the Air Force Research Laboratory working on space technologies.

This spurred my interest in physics, so I pursued a PhD in physics while active duty at the Air Force Institute of Technology. From there I had a variety of assignments—some directly related to space and some not—but all of the experience I gained has helped prepare me for the leadership positions I've held. Although every experience is important, I have to say that my technical education forms the foundation of my understanding and career success.

MSM

The Global Positioning System (GPS) recently achieved 20 years of on-orbit service—please define what GPS is as a Global Navigation Satellite System (GNSS).

Colonel Cooley

The GPS Directorate is proud to celebrate 20 years of on-orbit service, marking the 20th anniversary of the declaration of initial operational capability (IOC) on 8 December 2013. The best way to think about GPS is as a global utility—GPS provides high-quality, precise positioning, navigation and timing (PNT) for the military and civilian users, all the time and at every place around the globe and in space. This is what it means to be a Global Navigation Satellite System. The men and women of the GPS Directorate take great pride in providing a capability that is the GNSS "Gold Standard" because the performance has met or exceeded our commitment to all users since 1993 and is available free of charge to all nations.

MSM

Colonel Cooley, your responsibilities for, arguably, one of the most crucial, global constellations would seem to be massive in scope. Would you please explain your duties and those of your command to our readers?

Colonel Cooley

First let me say that I don't do any of this myself—I have a terrific team in the GPS Program Office and I get a lot of help from a terrific team at Space and Missile Systems Center. As the GPS Program Director, I am responsible for developing, producing, and maintaining the PNT gold standard that is GPS.

As GPS is crucial to both military and civil users, I need to understand and support each community's needs. The Standard Positioning Service Performance Standard (SPS PS) and the Precise Positioning Service Performance Standard (PPS PS) for civil and military users, respectively, help to communicate to a diverse audience what they should expect and to build confidence in the PNT service promised by GPS. To meet these commitments, it takes careful and constant program management of the GPS Enterprise—balancing cost, schedule, and performance—and a passion for this important mission.

MSM

The GPS IIF series built by Boeing brings one L1, two L2 and a new L5 frequency into play. What are these frequencies used for?

Colonel Cooley

For reference, the GPS IIR-M series introduced one new L1 and two new L2 signals, while GPS IIF introduced the new L5 signal. All of these signals are part of the GPS IIF navigation payload and provide information including the GPS date and time, satellite health, satellite ephemeris (for individual satellite positioning), and almanac information (for information on other satellites in the constellation).

The L1 frequency carries the L1 C/A code for civil users, and the L1 P(Y) code and L1 M-Code for military users. The L2 frequency carries the first modernized civil signal, L2C, and the L2 P(Y) code and L2 M-Code for military users. Finally, the L5 frequency carries the newest modernized civil signal. The L1 C/A with the addition of the L2C civil signal enables all GPS customers to be true dual-frequency users, which allows for very precise ionospheric corrections which greatly improves the PNT accuracy. The new L5 signal will be used for Federal Aviation Administration safety-of-life requirements.

MSM

There are currently 31 satellites in the GPS constellation. From Block II to Block IIF, what iterative improvements have been made for today's generation of GPS satellites? What new services are provided?

Colonel Cooley

Currently, there are 31 satellites available for customer use. Each new generation of GPS satellites provides enhanced capability over the previous generations. Accuracy improvements have been achieved through advancements in atomic clock technology. Space vehicle design life has been steadily increased from 7.5 years with GPS IIA to 12 years with GPS IIF. The increase in the number of navigation signals available to users is one of the most significant upgrades. The GPS IIR satellites provide the legacy standard service (L1 C/A) for civil users and the precise service (L1- and L2- P(Y) code) for military users.

The GPS IIR-M satellites provide the legacy signals, plus the second civil signal, L2C. GPS IIR-M also provides M-Code on L1 and L2 for military users; M-Code enables operations closer to jammers and under trees and is much more secure than the legacy code. The latest GPS space vehicle, GPS IIF, provide a new operational third civil signal (L5) that benefits commercial aviation and safety-of-life applications.

Artistic rendition of GPS Block IIF. Image courtesy of USAF, SMC.

In addition to an increased number of signals, GPS IIF also provides more than twice the legacy power levels, has an increased design life of 12 years and three highly accurate and stable atomic clocks per satellite. Following GPS IIF, the next-generation, in-production GPS III satellites will provide a fourth civil signal, L1C, which provides the first internationally interoperable signal. GPS III will provide even more signal power and greater resistance to jamming and spoofing, increases the longevity of the constellation with a 15-year design life, and provide search-and-rescue capabilities.

MSM

There are challenges to GPS from other nations around the world: Europe's Galileo, Russia's GLONASS, China's BeiDou, India's GAGAN. Why so many differing systems when all, basically, provide similar information? Why the challenges to the U.S.-developed constellation?

Colonel Cooley

The increase in foreign satellite navigation systems mentioned in your question (also Japan's Quasi-Zenith Satellite System, QZSS) stems from the unparalleled success of GPS around the globe. For the United States, GPS serves as a critical part of our nation's infrastructure by supporting transportation, communication, public safety, agriculture, financial systems and other key areas while also bolstering the economy.

In many cases, foreign governments see these benefits and wish to provide the critical infrastructure support via their own systems. Some foreign providers intend to provide a global navigation service very similar to GPS (Galileo and GLONASS). In other cases, the navigation systems are regional and provide capabilities such as improved accuracy in challenging urban environments (QZSS, BeiDou and the India Regional Navigation Satellite System, IRNSS).

MSM

Given the various GPS constellations, are there any considerations underway for cooperative linkages between systems with other nations?

Colonel Cooley

Yes, under the guidance of 2010 National Space Policy, the GPS Directorate actively engages other nations to enhance PNT capabilities through international cooperation. Specifically the 2010 National Space Policy states, "Engage with foreign GNSS providers to encourage compatibility and interoperability, promote transparency in civil service provision, and enable market access for U.S. industry."

Furthermore, this policy also states that the United States may use foreign satellite navigation services to augment and strengthen the resiliency of GPS. The GPS Directorate chiefly supports this task by participating in the International Committee on GNSS (ICG) established in 2005 under the United Nations to promote cooperation on matters of mutual interest to international, civil satellite-based PNT.

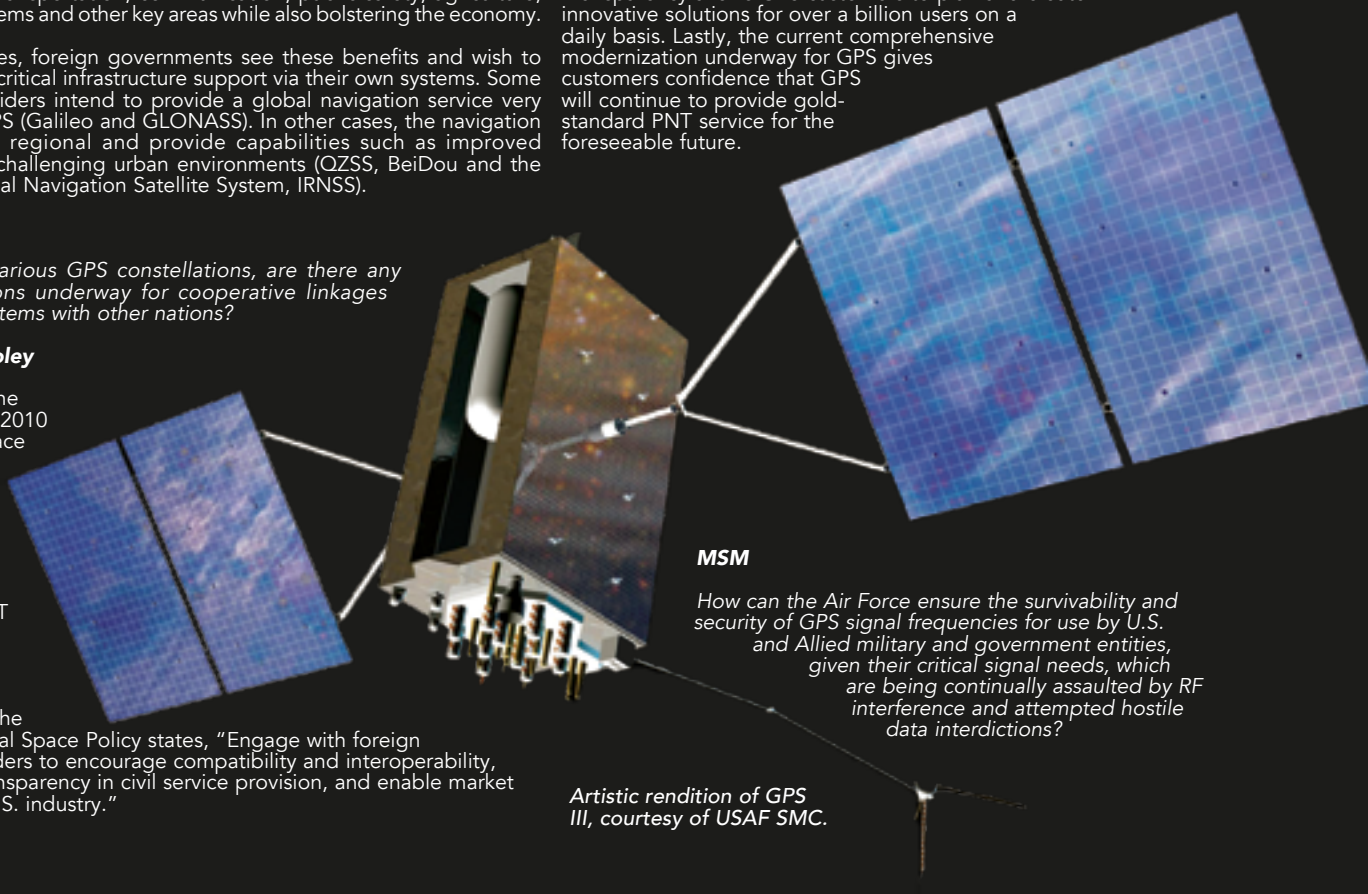
MSM

What makes the U.S. GPS system more desirable than other nation's offerings?

Colonel Cooley

The proven, reliable, and unparalleled performance of GPS makes it a very desirable GNSS system. Simply put, GPS embodies the only global navigation satellite system that has provided continuous operations since satellite-based navigation began. For over twenty years, GPS has provided high-quality PNT, referred to as the gold-standard of PNT.

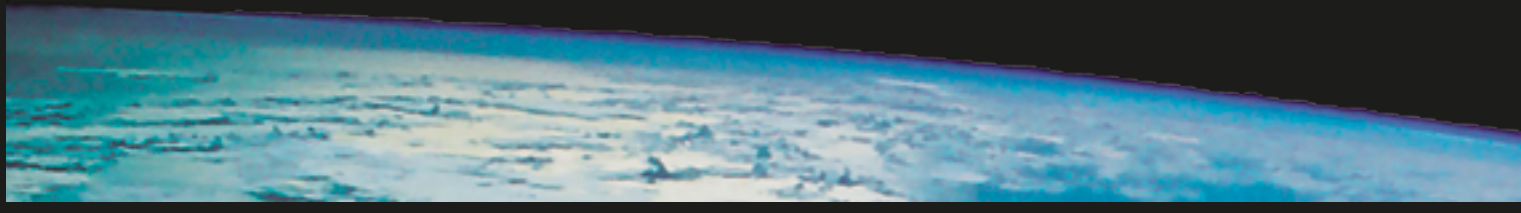
In addition, GPS makes a clear promise to its users in the Standard Positioning Service Performance Standard (SPS PS) on key parameters including accuracy, availability, and reliability. Transparency allows GPS customers to plan and create innovative solutions for over a billion users on a daily basis. Lastly, the current comprehensive modernization underway for GPS gives customers confidence that GPS will continue to provide gold-standard PNT service for the foreseeable future.



MSM

How can the Air Force ensure the survivability and security of GPS signal frequencies for use by U.S. and Allied military and government entities, given their critical signal needs, which are being continually assaulted by RF interference and attempted hostile data interdictions?

Artistic rendition of GPS III, courtesy of USAF SMC.



Colonel Cooley

We actively monitor and coordinate with the various regulatory bodies that govern the usage of the electromagnetic spectrum to protect the survivability and security of GPS for the future. In the United States these include both the Federal Communication Commission (FCC) for commercial users and the National Telecommunications and Information Administration (NTIA). Internationally, the regulatory body is the International Telecommunications Union Radiocommunication Sector (ITU-R). These organizations exist to prevent electromagnetic services from interfering with one another by managing frequency allocations.

In addition to protecting the spectrum, the USAF continually updates its space systems, including GPS, to ensure that US space systems are at the highest state of readiness possible at all times. Key upgrades such as higher power, more signals, and advanced receiver techniques in the GPS user equipment (e.g., adaptive antennas) provide increased protection to the future of GPS.

The USAF conducts extensive on-orbit and ground testing to mitigate risks prior to operational use of GPS and other space systems to ensure there are no adverse impacts to currently fielded military and civil GPS receivers. Furthermore, the GPS program has made significant investments to a modernized GPS system that features higher power from space, military receivers more resistant to jamming, and innovative software development to increase resistance to spoofing.

MSM

The primary role of government is the security of a nation's citizens yet unwise budget cuts continue by those who do not understand that. How do you manage to ensure continuing financial and personnel support for the GPS Directorate?

Colonel Cooley

The Air Force works closely with the Department of Defense and Congress to ensure decision makers have the information needed to properly and prudently allocate resources. The GPS Directorate and our industry partners work tirelessly to reduce cost whenever possible yet continue to provide the Gold Standard PNT service our military and nation expects.

MSM

There are a number of commercial companies working diligently on small satellite development, from Earth Observation to ISR and other communication projects. Do you see a time when the Air Force would contemplate the use of several satellites to further MAG data acquisition and delivery? Could small satellites ever play a role within GPS missions?

Colonel Cooley

The Air Force has identified and studied a range of alternative GPS architectures offering the potential of cost reductions. The two most promising alternatives to reduce costs are saving on launch cost via a dual launch capability, and a smaller navigation-only (without the NDS payload) satellite sometimes called a NavSat. While these alternatives have potential, both require up-front investment with savings years away. These alternatives, along with several others, will continue to be a potential area of interest for the Air Force.

MSM

As you review your career to date, what project, or projects, truly bring a sense of satisfaction to you?

Colonel Cooley

Without a doubt, my current position with GPS is the most satisfying. Although I've had a terrific career and opportunities that I would never have dreamed possible, the GPS mission and team are truly exceptional. There is a passion and energy for this important mission that the entire GPS Directorate shares. Having the opportunity to bring a capability that billions of people around the globe rely on every day is really remarkable. I am thrilled to be a part of this terrific program!

An Anniversary Of Note

The Global Positioning System (GPS) Directorate celebrated the 20th Anniversary of achieving Initial Operational Capability (IOC) for GPS late last year.

In 1973, the Navstar Global Positioning System Joint Program Office (JPO), headed by then-Colonel Bradford Parkinson, developed the GPS architecture and initiated efforts to field a prototype system to prove the concept of space-based global navigation would work. Since that time, GPS has evolved from an idea, to a prototype, to a global utility. It continues to evolve, with modernization bringing forth new capabilities for the 21st century.

Since the launch of the prototype Block 0 satellite June 22, 1977, GPS has provided high quality navigation signals to suitably equipped users across the globe. Beginning in 1978, after the first four developmental Block-I satellites were launched, GPS started to provide full four-dimensional positioning, navigation, and timing (PNT) services to military and civilian users on a limited, but worldwide, basis. By 1985, the seven remaining developmental Block I satellites were launched to expand the availability of PNT services around both time and space. The second stage of GPS began February 14, 1989 when the first operational Block II satellite was launched into orbit. More Block II and Block IIA launches followed rapidly thereafter until, December 8, 1993, United States Air Force Space Command (AFSPC) declared IOC for GPS when a grand total of 24 Block I and Block II/IIA satellites were operating in their individual orbits and providing the Standard Positioning Service (SPS) to civilian users and the Precise Positioning Service (PPS) to authorized military users.

After IOC, additional Block IIA satellites were launched to fully populate the baseline operational constellation of 24 slots arranged in six orbital planes—the remaining developmental Block I satellites continued providing high quality navigation signals even though they were not part of the baseline operational constellation. Once system testing was complete, AFSPC declared Full Operational Capability (FOC) for the GPS constellation April 27, 1995, signifying the system met all requirements with 24 operational Block II/IIA satellites in their assigned orbital slots and providing both the military PPS and the civil SPS.

Today, the GPS constellation remains healthy, stable and robust with 31 operational satellites on-orbit broadcasting the PNT services 24 hours a day, 7 days a week, 365 days a year. In the 20 years since IOC, GPS has never failed to deliver on the global PNT service commitments made by the Department of Defense in the PPS Performance Standard (PPS PS) and in the SPS Performance Standard (SPS PS)—both of which trace directly back to the original Global Positioning System (GPS) Standard Positioning Service Signal Specification (SPS SS) which was officially promulgated on December 8, 1993 by the Assistant Secretary of Defense for Command, Control, Communication and Intelligence (C3I) as the formal document which defined IOC. Amazingly, though many Navstar satellites have been launched and been decommissioned over the past 20 years, four of the original Block IIA satellites which made up the IOC constellation (SVN-23, SVN-26, SVN-34, and SVN-39) are still operating and providing reliable PNT services as of this 20th Anniversary of IOC.

GPS has grown to become a vital worldwide utility serving billions of users around the globe. GPS multi-use PNT services are integral to the United States global security, economy, and transportation safety, and are a critical part of our national infrastructure. GPS contributes vital capabilities to our nation's military operations, emergency response, agriculture, aviation, maritime, roads and highways, surveying and mapping, and telecommunications industries, as well as recreational activities. It is not an overstatement to say GPS is fundamental to today's technical infrastructure and culture. GPS provides the 'winning edge' to our warfighters and allies by delivering premier space-based PNT services to the nation and the world.

For more information regarding the GPS Directorate, access ***http://www.losangeles.af.mil/library/factsheets/factsheet_print.asp?fsID=5311&page=1****.*

THE PIVOT TO APAC IS UNDERWAY… AND SO IS THE DEMAND FOR CAPACITY

By Bob Gough, Senior Contributor

Over the last decade the world has seen a significant change as dominant economies have shifted from the West, to the Asia Pacific region.

In 2011, President Obama made a series of announcements that indicated the United States would shift resources to intensify their already significant presence in the Asia Pacific.

Prompted by the withdrawal of military personnel from Iraq and Afghanistan in correlation with the growing economic importance of the region, the Obama administration aimed to rebalance attention towards planning for future challenges and opportunities, resulting in the Asia Pacific pivot we see today.

Growth in the Asia Pacific (APAC)

The historical and current economic trends of the region support making the Asia Pacific a priority. The International Monetary Fund (IMF) projected a 6.75 percent real growth in 2012 for the region as a whole, higher than any other region; while between 1980 and 2010, Asia (including China, East Asia, South Asia, Southeast Asia, Australia, New Zealand and the rest of Oceania) almost doubled its imports and exports. Indonesia is an example of one of Asia's strong emerging economies: Isolated from the impact of other volatile economies, Indonesia currently has the 16th largest economy in the world and is expected to be the 7th largest by 2030, with a 1.8 trillion dollar market opportunity in consumer services, agriculture and fisheries, resources and education. Unable to support a population this size alone, supply and demand opportunities have been created in the surrounding region, as well as further abroad.

New areas of military cooperation

As well as joining the East Asia Summit and negotiating in the Trans-Pacific Strategic Economic Partnership free trade agreement, one of the key moves from the U.S.has been the increase in military personnel in the Asia Pacific region. New areas for military cooperation in the Philippines have begun by discussing options such as rotating surveillance aircraft and rotating U.S. troops more frequently into the country. Further, new naval deployments to Singapore by having four littoral combat ships stationed at the city-state's naval facility are also being planned. Australia has seen the most significant change, with an increase from 250 military personnel that has now expanded to a force of 2,500 Marine Corps personnel—a full Marine Air Ground Task Force.

Satellite communications for military

With this shift in focus comes an increased demand for connectivity and a growing user appetite for bandwidth, thus satellite communications are experiencing significant growth within the Asia Pacific. Satellite ensures fast, reliable and secure communication services locally and globally while providing time critical Internet, voice, video and data services that enable global communication—important for continued regional growth as well as for disaster recovery missions, which is essential in the Asia Pacific.

In an area prone to natural disasters, particularly cyclones and earthquakes, military services are often required to distribute aid and deliver medical care, as well as to establish communication systems. In such devastating circumstances ground infrastructure is often destroyed, leaving locals without the means to communicate and relief efforts stalled.

In November 2013, typhoon Haiyan swept through the Philippines claiming more than 6,000 casualties and destroying as much as 80 percent of the structures in its path. The most immediate needs for water, medicine, and shelter were hampered by a lack of information. The re-establishment of communication links was vital to support the humanitarian relief efforts that were being deployed as well as to aid the effectiveness of rapid response efforts. Satellite technology in such instances are essential to getting the country back up and running and enables instant connection in order for aid to be delivered, connections with family and friends, and the global disbursement of crucially-needed information.

VSAT mobility

VSAT terminals able to operate from trailers, vehicles, planes and boats are ideal for government and military communication requirements, such as disaster recovery and deployed personnel. The unique requirements from government and military organizations, particularly in relation to maritime intelligence, surveillance and reconnaissance (ISR), are also key demand drivers for increased bandwidth capacity.

Approximately 75 percent of VSAT terminals are on offshore facilities, tankers, passenger and commercial ships and these account for about 85 percent of bandwidth used. From another maritime perspective, as a key export region, Communications-On-The-Move (COTM) in APAC for commercial purposes is also essential; an estimated 50 percent of the world's container traffic and 70 percent of ship-borne oil and petroleum transit the Indian Ocean, while Australia is the fifth largest exporter of liquid natural gas, with the resource industry continuing to grow into remote and isolated areas. Additionally, Australian shipping has seen a 130 percent growth over the last 10 years to a new level of 52,206 voyages annually.

The benefits of Australian teleports

Situated between New Zealand and Indonesia, and close to South East Asia, the Philippines and China, Australia is in an ideal location to support the Asia Pacific's growing satellite requirements. Ground infrastructures—teleports—are important and essential for reliable satellite communications.

Australia provides some of the best satellite communications in the world. With low rainfall and mild temperatures, as well as being geologically stable with no major earthquakes, Australia's remoteness also ensures minimal frequency interference. The geographical location of Australia enables optimal look-angles into the Middle East, Africa and across Asia Pacific, providing better coverage into those regions, while also being able to provide direct cable access back the U.S. via the Southern Cross fiber cable.

Fresh capacity over Asia Pacific

Currently, mobility coverage is limited over the Pacific. Most satellite providers design footprints to cover land mass, though Eutelsat 172A (previously GE-23 satellite) is a popular satellite, as it has a South Pacific Ocean beam—AsiaSat's four satellites in orbit (AsiaSat 3S, 4, 5 and 7) cover the APAC region.

Looking forward to this year, 2014 will see NewSat launch the Jabiru-2 communications payload. Jabiru-2 will provide highly targeted Ku-band coverage in and around Australia, Timor Leste, Papua New Guinea and the Solomon Islands. The additional capacity from these

new satellites will satisfy the growing demand for reliable and cost-effective communications, ranging from military and government (MAG) sectors, as well as from the oil, gas, mining, media, and carrier-grade telecommunications sectors.

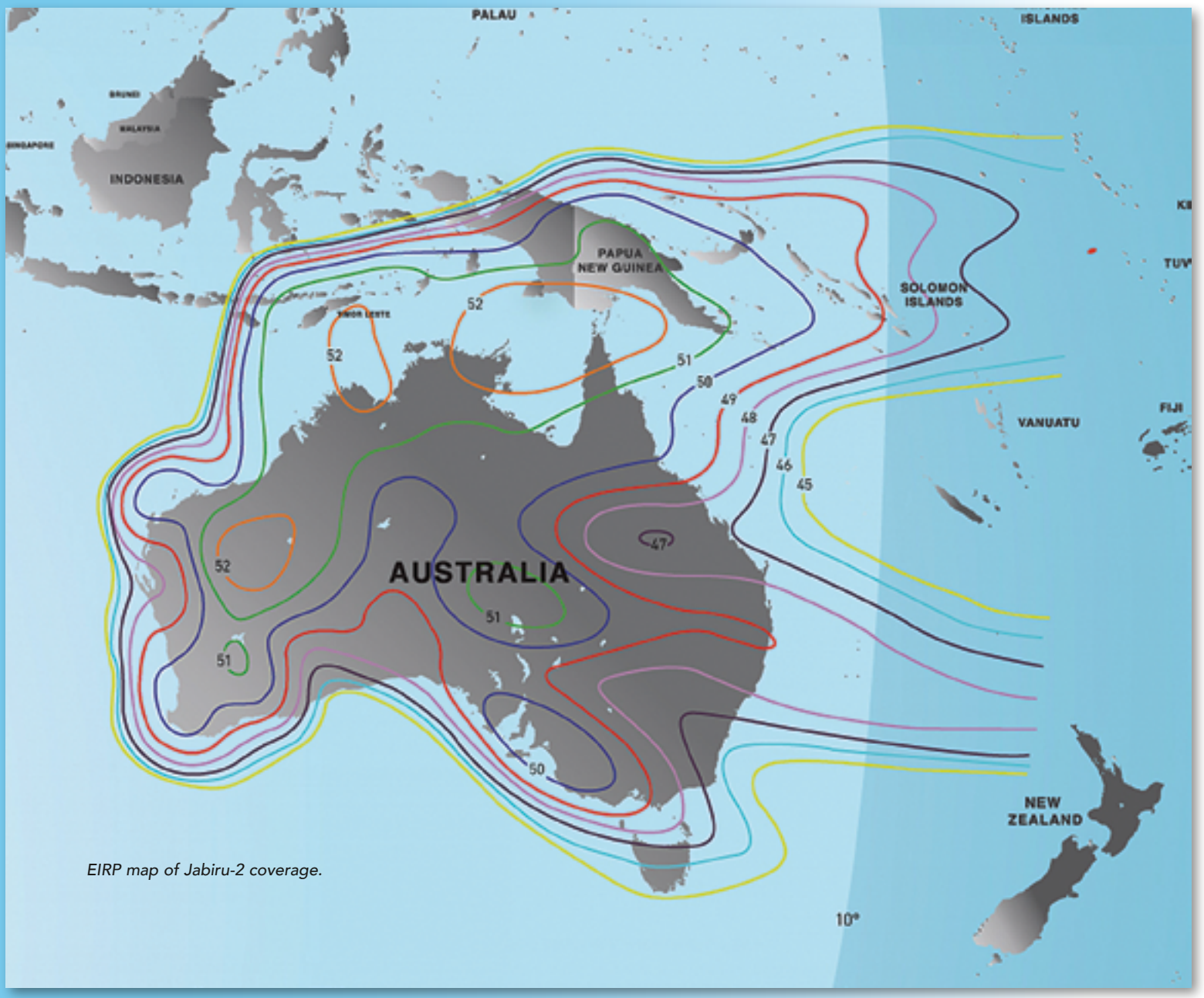
About the author

Bob Gough is a communications systems engineer who has spent over 35 years in the satellite communications business, both with the European Space Agency and in Industry.

During seven years at ESA Bob worked on a number of communication satellite projects, and was involved in spacecraft and Earth station development as well as end-to-end satcom system design. Bob worked as part of the teams that developed the very first European Ku-Band and Ka-Band satellites.

In addition to Earth station design and troubleshooting, mathematical modeling and computer simulation of FDMA, TDMA and CDMA signal transmission through end-to-end nonlinear satellite links is a specialty.

Upon leaving ESA Bob founded a successful satellite communications equipment manufacturing company with an international customer base. Tracking systems, VSATs and digital modems were a specialty. He subsequently held senior management positions in publicly listed defence, computer and communications companies. Now based in Australia, Bob runs an independent satellite communications consultancy, Carrick Communications Ltd. Bob Gough, BSc (Hons), PhD, MIET, CEng is a Chartered Engineer, a member of the Institution of Engineering & Technology and a member of the Association of Old Crows.



EIRP map of Jabiru-2 coverage.

HELP THE GOVERNMENT LEVERAGE SATELLITE DATA

By AJ Clark, President, Thermopylae Sciences & Technology

Two years ago, when Congress and the White House fired the sequestration shot across the military's bow, the Department of Defense (DoD) exchanged places with industry.

Businesses mired in the economic doldrums of 2007-08 were loath to take on risk or spend money to innovate when they were laying off employees, cutting dividends and watching stock prices plummet.

However, while the economy was being repaired, the U.S. was fighting two wars where the military learned and acquired new uses for data from satellites, from pilotless airplanes, from the ground—from everywhere. With plenty of DoD investment to drive it, Big Data grew bigger—so big that military leaders spoke of swimming in sensors and drowning in data.

Then came sequestration, concurrent with the need to manage and store data that grows with every satellite launch, with every UAV combat air patrol, and with every soldier's glimpse through new eyewear that generates information. Data that will continue to grow, because even as U.S. involvement in Afghanistan winds down, other military commands around the world stand in line to use technology that will be freed up. Those commands will generate even more data from more places to make them more efficient.

For the government to cope in an era of increased austerity, it can learn from the way industry dealt with its economic plight half a decade ago. In doing so, government will only be going back to when it functioned best: When synergy drew it and industry together to generate the wherewithal to fight a World War.

When industry struggled with the recession, contractors who worked both sides of the government/commercial highway found solutions by adapting them from technology built for the military. Commerce discovered that geospatial data, satellite imagery and other military staples had places in the for-profit realm. They discovered those elements at a time when technology made them easier and cheaper to acquire, creating an explosion of data.

All of that followed a continuum. For example, flight for the military became air transportation, the Internet evolved into use in culture and commerce, and Geographic Information Systems (GIS) developed for bomb guidance, all part of the foundations for cell phones.

With all of those commercial discoveries for data use came the need for more efficient ways to process and store information that was outgrowing capability. Enter the cloud, which offered economy with the capacity to expand in lockstep with data requirements that enabled the commercial sector to embrace the cloud and its efficiencies.

However, government had been less willing to do so. A tug-of-war between accepting risk and protecting information has long been a drag on government-cloud innovation, though that seems to be slowly shifting. One reason for that lack of speed—and it may be our biggest challenge—has been that security policies have not kept up with potential technological advances.

Policies are created and people are trained to comply with those policies. Five years go by, ten years go by, and while technology may have rendered those policies obsolete, they continue to drive critical security decisions.

In October of 2013, the watershed move by the Central Intelligence Agency (CIA) to award $600 million to Amazon to build a cloud was a step in the correct direction, both for the willingness of government to look to industry for data processing and storage solutions and for the Intelligence Community (IC) to understand that security issues that have hindered cloud-development can be successfully managed.

The award reflects government's understanding that future solutions may be different than those perceived only three years ago and that sometimes there has to be a front-end investment to realize back-end savings. Similar to purchasing a hybrid automobile to save on fuel, money still has to be spent to obtain the car and in the sale of your old gas-guzzler.

Along with this mindset is a look toward convergence; again adapting the way commerce does things. Convergence layers a process, allowing each of those layers to be baked by companies that do it best, whether it be building a cloud or analyzing imagery or visualizing technology or collecting data.

It allows a company such as Thermopylae Sciences & Technology (TST) to contribute iHarvest technology to be a part of the whole—generating models to help analysts and operators determine what data is worth harvesting and, therefore, worth saving.

For example, rather than collecting all of the data a satellite can gather in a pass, an iHarvest model can determine that 90 percent of imagery consumption is in a certain region, so efforts should be focused on that region and then dialed back on the resolution of data from other areas that can be surveyed.

In addition, it helps generate a greater return on investment of analysts' time and capability as well as on processing and storage needs. It also shows how companies such as TST fit into a larger ecosystem that can come through convergence as it addresses one layer more efficiently than anybody else.

In the end, the layers combine for a better overall solution. It's potentially part of government's greater acknowledgement for cost-savings without sacrificing capability, an appreciation driven by a future of increased fiscal accountability.

In the commercial sector, demand is driven by capability and price. For example, satellite imagery is used in agriculture to predict the weather and to evaluate crops. That imagery and other pictures help commerce survey sites and transportation patterns, and the use of that imagery and pictures expands daily. GIS systems are increasingly a part of industry's framework.

All of these capabilities exist and are proliferating, at least in part due to the cost of data being driven down by the technology that was originally developed for the military. Of course, the cloud is also driving down the cost of processing and storing that data.

Government is realizing cost-savings in things such as satellite imagery, which is driven by an increasing number of satellites, streamlining data collection, reducing redundancy, and developing an increased willingness to hang sensors on commercial satellites. Government's answer to processing and storage for this flood of data from this cloud of satellites could be in another cloud—one developed as a solution by, and for, private industry.

To learn more about Thermopylae Sciences & Technology, please visit ***http://www.t-sciences.com/***

About the author

AJ Clark is the President of Thermopylae Sciences & Technology (TST), a leading provider of web-based geospatial capabilities, mobile software framework and applications, situational awareness, and cloud computing solutions for the U.S. military. To learn more about TST, click here.

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