MilsatMagazine

ORS-1 Launch, photo courtesy of U.S.A.F.

Artistic rendition of the ORS-1 satellite

DISPATCHES

MILSATCOM Reset After Typhoon

Marines with 7th Communication Battalion reestabished communications August 8th for Exercise Ulchi Freedom Guardian, immediately after Typhoon Muifa's passing.

UFG is a defense-oriented, routine exercise that enhances the ability of the ROK-U.S. alliance to defend the ROK, deter against external aggression, and maintain stability on the Korean peninsula.

More than 530,000 troops from the Republic of Korea, the U.S. and seven nations from the United Nations Command are participating both in the Republic of Korea and at U.S. military headquarters in the Pacific and the U.S.

The exercise is designed to improve the alliance's ability to defend the Republic of Korea by exercising senior leaders' decision-making abilities and by training commanders and staffs from both nations in planning, command and control operations, intelligence, logistics and personnel procedures.

"It is challenging and realistic training focused on preparing, preventing and prevailing against the full range of current and future external threats to the Republic of Korea and the region," said Gen. James D. Thurman, commander of Combined Forces Command. "We are applying lessons learned out of Iraq and Afghanistan, as well as those garnered by the alliance's recent experiences with North Korea provocations on the peninsula and past exercises," Thurman said.

On Okinawa, Marines were preparing for the exercise but had to retrograde to their respective camps before Typhoon Muifa hit the island August 5.

When the "all clear" was issued August 6th, Marines with 7th Comm. Bn., III Marine Expeditionary Force Headquarters Group, III MEF, began reestablishing communications at Kin Blue, while other Marines with III MEF Headquarters Group prepared for the exercise on Camps Courtney and Schwab on August 7. The Marines worked through the night to set up tents, barriers and communications equipment.

"This is 7th Communication Battalion's biggest exercise of the year. It's important that we set up in a timely manner to not waste time," said Cpl. Chelsea Sanchez, satellite operator and maintainer with 7th Comm. Bn.

"The storm caused a (temporary) delay to the communication mission in support of UFG," said 1st Lt. Dustin Dvorak, platoon commander, with 7th Comm. Bn., "but these Marines are committed to this exercise and strengthening our relationship with our South Korean allies."

*Story by
Lance Cpl. Tyler Vernaza,
III Marine Expeditionary Force
Public Affairs*

Good Stuff To Bad Places

***Theater Deployable Communications Team** at the Electronic Systems Center here is continuing to ensure warfighters have the key communications infrastructure they need while deployed.*

"We are looking for capability modernization and to update the equipment modules that make up TDC as they get to end-of-life," said *Marc Bastien*, the TDC program manager. "The TDC is the backbone for communications, such as computers, phones and imagery in a deployed location."

After successful completion of a Production Readiness Review, the TDC program management office recently gave approval to contractor Northrop Grumman Corp. to begin producing a Wireless Distribution Module (**WDM**). WDM extends deployed communications and information to remote users over greater distances, with more bandwidth, while reducing the airlift and operational footprint.

"We were able to take two diverse requirements and be able to meet those needs with this one product," said *Joe Morrissey*, the MITRE technical lead for the project. "And we're making communication for warfighters easier, so they can stay out of harm's way."

As size, weight and power are always concerns, especially in austere environments, combining capabilities can reduce logistic burdens and also reduce cost. The team also ensures training is included in the acquisition.

"As a part of the acquisition, we do ensure for a train-the-trainer process," said Bastien. "Bringing a network up from scratch is a skill set that not a lot of people have."

Although the program originated in 1993, and the original requirement document dates back to 1995, the team is continually meeting with the user community to ensure that what is being provided is what the users need and want. **Air Force Space Command**, which is the lead command for the TDC, also is updating the requirement documents so additional capabilities, such as video teleconferencing, can be included.

The thrust for this year has been voice modernization, according to Mr. Bastien. For the future, upcoming plans for the TDC include looking at a wireless capability.

"We're looking to establish a wi-fi, if you will," Bastien said. "So when you're out in the desert, your WiFi enabled device will pop up information and you'll be able to receive it that way."

One area the team is always thinking about is information assurance.

"Security plays a big part in what we do," Morrissey said. "Technology

Marines with 7th Communication Battalion, III Marine Expeditionary Force Headquarters Group, III MEF, reestablish communications August 8 for Exercise Ulchi Freedom Guardian following Typhoon Muifa.
The equipment had been dismantled before the storm hit Okinawa August 5.
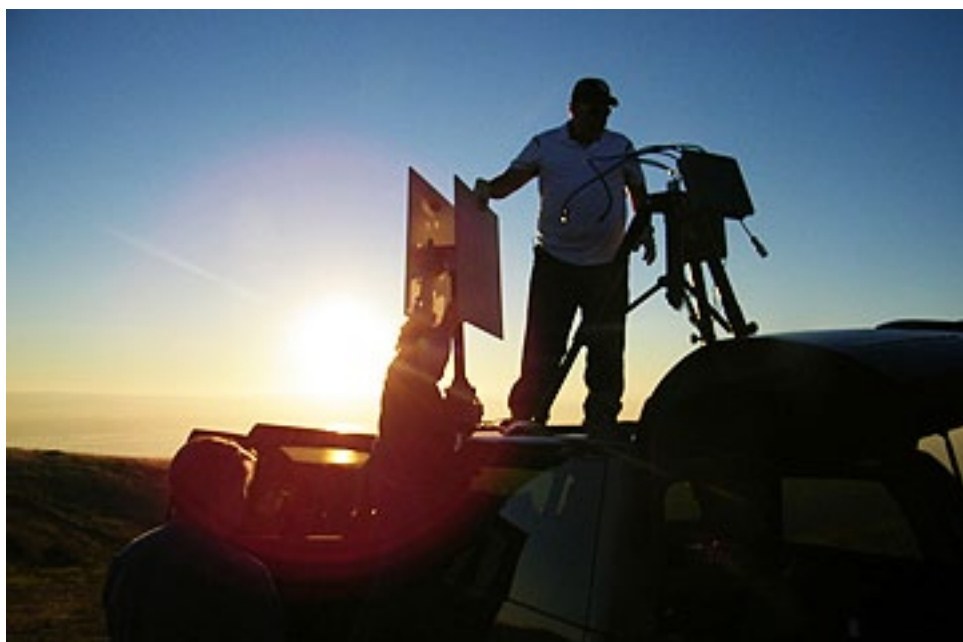
Members of the Theater Deployable Communications Wireless Distribution Module Team set up equipment in preparation for testing recently in California. The WDM is being incorporated into TDC in order to extend deployed communications and information.

is growing in leaps and bounds, and we need to ensure our IA keeps up."

TDC can be established as soon as a runway is available for the pieces to be brought in. So, in addition to warfighting missions, the TDC can support other activities such as humanitarian relief operations and building coalition partnerships. It recently has been used in Japan to assist after the earthquake and tsunami, and previously has supported humanitarian relief operations during last year's earthquake in Haiti, and also during Hurricane Katrina.

The system was first used in Kosovo, and since then warfighters and others have been impressed with it, Morrissey said.

As a colonel in the Air National Guard, Morrissey has deployed to locations where TDC equipment was used and has received user feedback first-hand. "The guys loved it," he said. "It works and it does what it's supposed to do." In addition to getting praise from users, the program office has been acknowledged for its work as well, recently winning the **2010 ESC Team of the Year** award.

"We're a team with only a small amount of personnel who are accomplishing a large mission," said Jacquelynn Coles, the TDC deputy program manager. "We're proud of the work we're doing."

As the program is in sustainment, it will be transitioning to *Ogden Air Logistics Center* at **Hill Air Force Base**, Utah.

"We provide the equipment that allows deployable comm units to rapidly become the phone company, the

Internet service provider and the radio company to warfighters and others in remote, austere locations," Bastien said. "We bring good stuff to bad places."

Story by Patty Welsh
66th Air Base Group Public Affairs

Farewell To A Sat Friend

Members of the 3rd Space Operations Squadron, with their counterparts from the 53rd Signal Battalion, waved a farewell to a trusted old friend on August 12th. Lt. Col. Kevin Mortensen, 3rd SOPS commander and Lt. Col. Benjamin Jones, 53rd SB commander, took the honors, shutting down the final components of the satellite simply known as B9, with a couple of mouse clicks.

With that, a **Defense Satellite Communications System** vehicle that served both the U.S. Air Force and U.S. Army for 18 years sent its last bit of vital information.

"A lot of world events happened under the footprint of this satellite," said Lt. Col. *Greg Karahalis*, 3rd SOPS operations officer. "It's 18 years old and been in service on active duty longer than many of us. It's a Soldier and an Airman and that's how we like to talk about it. The events it has been through bare some recognition in terms of how it has performed and the contribution it's made to extending the life of the DSCS constellation."

Launched from **Cape Canaveral Air Force Station** aboard an *Atlas II* rocket July 19, 1993, *DSCS B9* reached geosynchronous orbit on schedule and entered service following a two-month checkout.

While Air Force operations squadrons have controlled the space vehicle, its communications payload has been managed and operated by Army units. B9 served users as the West Pacific wideband satellite for most of its operational life.

Lt. Col. Kevin (center) and Lt. Col. Benjamin Jones (second from right) lead 3rd Space Operations Squadron members in deactivating the Defense Satellite Communications System B9 satellite August 12, 2011 at Schriever Air Force Base Colorado. Colonel Mortensen is the 3rd SOPS commander. Colonel Jones is the 53rd Signal Battalion commander. (U.S. Air Force photo/Scott Prater)

According to Maj. *Mike Reeder*, 53 SB executive officer, B9 supported multiple missions, including the **Diplomatic Telecommunications Service**, the **U.S. Navy**'s *Surveillance Towed Array Sensor System,* and the *White House Communications Agency* [presidential support]. It also supported U.S. military operations, including **Global Thunder** and **Terminal Fury** and assisted in humanitarian efforts such as the Tsunami relief of 2004.

Spacecraft control authority for the entire DSCS constellation was transferred from the **5th Space Operations Squadron** to **3 SOPS** during 1996. Launched with a design life of 10 years, B9 easily blew through that envelope, serving for 13 years on orbit before telemetry data indicated that it was running low on fuel. Rather than give up and dispose of a fully functional satellite, the DSCS team refined and improved its fuel estimation capabilities and managed to squeeze an additional two and half years of life out of the spacecraft.

The DSCS team earned the *2006 Air Force Chief of Staff Team Excellence* award for that specific effort on B9, but the old bird showed that it wasn't done just yet. During April 2008, B9 was placed in super synchronous orbit as a test asset.

"The best simulator on the ground is nowhere near as good as an actual satellite on orbit for realistic testing," Karahalis said. "The DCSC team has used B9 as a test asset for more than three years and we've made every effort to take full advantage of the unique opportunity."

As the spacecraft crept up in age, B9 was used in more than 15 end-of-life tests, which provided valuable information applicable to the entire DSCS constellation.

The spacecraft aided 3rd SOPS during anomaly investigations by allowing engineers to recreate abnormal conditions and helped extend the life of the constellation by enabling engineers to validate contingency procedures and mitigation strategies prior to implementation on operational vehicles.

"It has also provided a platform for running experimental procedures," Karahalis said. "This helps us push the operational envelope of the constellation and maximize spacecraft utility."

Capt. *Kyle Volpe*, 3rd SOPS' DSCS III engineering section chief, explained that B9's deactivation process was spread out over a two day period as crews first purged the vehicle of any remaining fuel and then began shutting off the payload and subsystem components on the subsequent day.

Even then, B9 refused to go quietly. Following a command to shutdown its reaction wheels, the satellite responded by deactivating only two of the four on board. It succumbed after the command was sent a second time, however, and few minutes later 3 SOPS and 53 SB members said their final farewells.

"DSCS B9's amazing mission accomplishment can be traced to the tremendous community that has supported it over the past 18 years," Mortensen said. "From Air Force and Army operators flying the satellite and payload, respectively, to our joint, acquisition, and industry partners working in close collaborations to ensure we provide National Command Authorities, Combatant Commanders, joint and allied forces, and other users around the world with reliable wideband satellite communications."

Story by Scott Prater
50th Space Wing

ORS-1 In Place

The Department of Defense's **ORS-1** *satellite — after a weather delay and an equipment check — was launched by the U.S. Air Force aboard a 70-foot tall Minotaur 1 rocket from NASA's Wallops Flight Facility in Virginia. Integrated by Orbital Sciences Corporation (OSC) , ORS-1 is the Operationally Responsive Space Office's first operational prototype satellite and represents the potential of low-cost, tactically focused satellites designed to provide critical battlespace awareness capabilities to the joint warfighter.*

The launch vehicle was the four-stage Minotaur I — two of the stages were refurbished Minuteman II stages and the other two were developed by OSC. The Minotaur is about 70 feet tall and 5 feet wide. This was the fourth Minotaur I rocket launched from Wallops and the Mid-Atlantic Regional Spaceport since December 2006.

This launch was an impressive achievement by the S**pace and Missile Systems Center**'s *Space Development and Test Directorate*, the *Operationally Responsive Space Office*, and their contractor teams. ORS-1 is the Operationally Responsive Space Office's first operational prototype satellite and represents the potential of low-cost, tactically focused satellites designed to provide critical battlespace awareness capabilities to the joint warfighter.

"Words cannot express how proud I am of the entire ORS-1 team," said Col. *Carol Welsch*, then SMC/SD's Acting Director and ORS-1 Mission Director. "The men and women of the Space Development and Test Directorate, the Operationally Responsive Space Office, and our industry partners of Goodrich, ATK, and Orbital have all worked tirelessly to move forward on the concept of a responsive space capability designed to support the warfighter. Their teamwork and dedication is simply inspiring." Rapidly developing and fielding ORS-1 is an important step to demonstrating the possibilities to meet emerging and persistent warfighter needs in operationally relevant timelines. "Our team was able to develop, integrate, test and launch this system in just over 30 months which is a remarkable achievement," said Colonel Welsch.

ORS-1 was initiated as a result of a requirement from the Commander, **U.S. Strategic Command** to the ORS Office to support **U.S. Central Command**.

Artistic rendition of the ORS-1 satellite

COMMAND CENTER

Steven Schenk, V.P. + G.M., Comtech AeroAstro

Mr. Steven Schenk serves as the Vice President and General Manager of Defense Programs for Comtech AeroAstro, Inc. In this role, Mr. Schenk is responsible for execution on all emerging defense programs. Prior to this appointment, Mr. Schenk was the Director of Advanced Concepts while concurrently functioning as Program Manager for the AFRL's Advanced Plug-and-Play Technologies Program to further develop and reduce risk for emerging Plug-and-Play technologies. Mr. Schenk additionally functioned as Program Manager of the Comtech AeroAstro ORS Multi-mission Modular Space Vehicle preliminary design phase program. He led the team that developed a flexible ORS spacecraft design that employed plug-and-play technology throughout. Mr. Schenk has over 20 years of experience in program management, engineering management, project leadership, structures/mechanisms engineering and space segment/spacecraft systems engineering in the satellite and alternative energy industries. Mr. Schenk has a proven track record in spacecraft design and development. Prior to working at Comtech AeroAstro, Mr. Schenk was the Program Manager responsible for the NASA Goddard GLAST space vehicle and DARPA Streak space vehicle programs at General Dynamics.

MilSatMagazine (MSM)
How long has Comtech AeroAstro been in business?

Steve Schenk
Comtech AeroAstro has been providing innovative space components and microsatellites since 1988. There have been a few acquisitions; most recently, we were acquired by **Comtech Telecommunications**.

MSM
Steve, what can you tell us about your career and the programs you've managed?

Steve Schenk
I started out as a Structure Design Engineer at Spectrum Astro in 1991, performing that role on a number of Spectrum Astro space vehicles. I then took over the Structures Department and managed 12 structures engineers.

After being at Spectrum Astro for about 10 years, I was promoted to Program Manager and managed the *DARPA STREAK* and *NASA GLAST* programs. DARPA STREAK was a 24-month, single-string spacecraft with minimal mission assurance requirements and GLAST was a major NASA Observatory program, which was fully redundant and had a 48-month development timeframe.

This contradiction in space vehicles provided a very well rounded experience base that allows effective management of Comtech AeroAstro Defense Projects such as the *JMAPS* program for the **Naval Research Laboratory** and the *Advanced Plug-and-Play Technologies Program* for the **Air Force Research Laboratory**.

MSM
What can you tell us about the current Defense trend in small satellites?

Steve Schenk
In today's limited government budget environment, the push is towards smaller spacecraft with more rapid development times (less than 24 months) than traditional systems, which are averaging 48-60 month development timelines. I have always been a proponent of small satellites and the "faster, better, cheaper" philosophy. Customers can field systems with high utility, lower cost, and high reliability in a very rapid timeframe to meet their mission needs. This is a trend that I hope is embraced for a generation as the fielding of smaller systems with high utility sustains our country's diminishing spacecraft workforce, fields a variety of key operational systems to meet a growing national defense threat from other nations, and lowers system cost through increased procurement of unique spacecraft components.
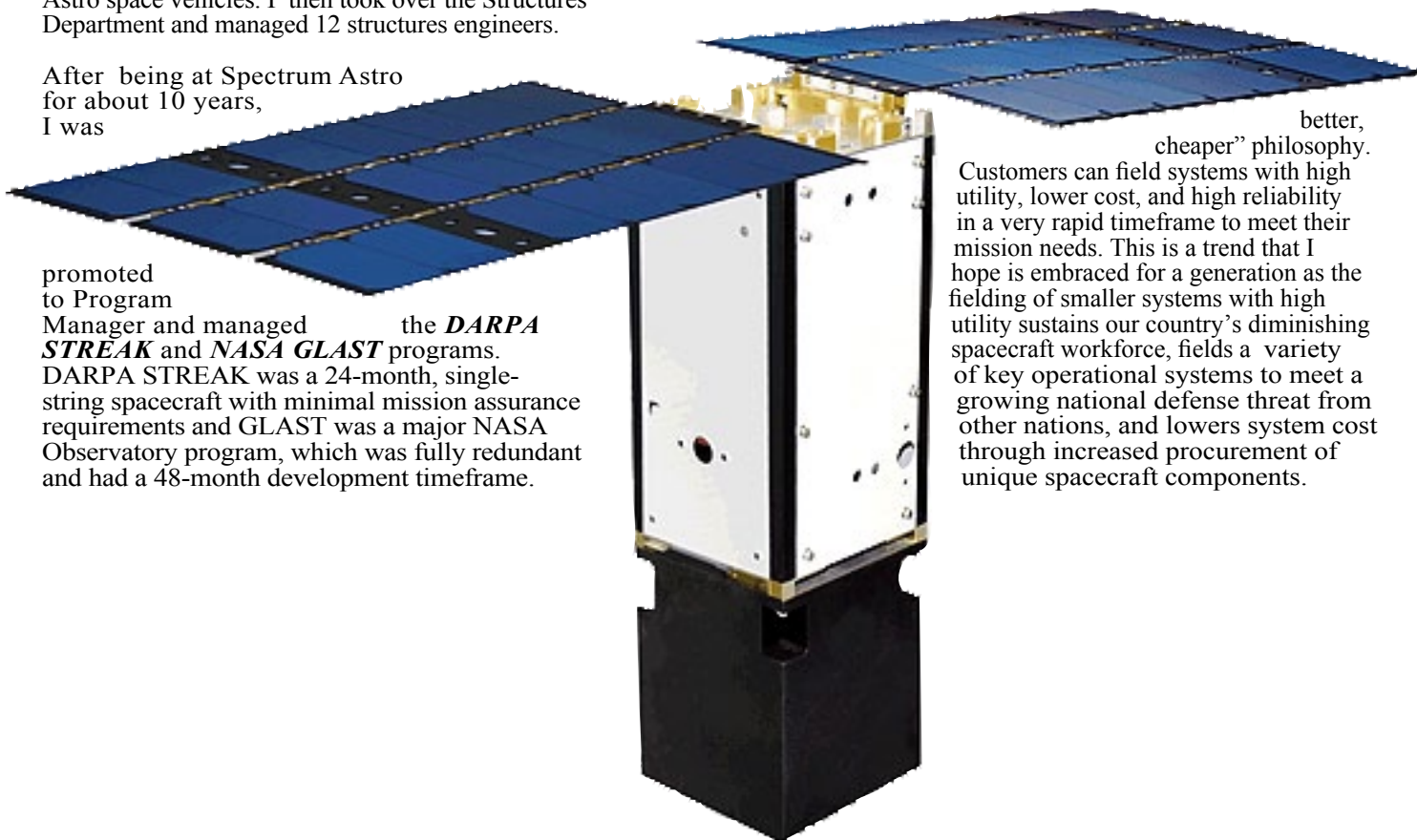
MSM
How did the plug-and-play program begin? Why was it developed?

Steve Schenk
Over the last few years, Space Plugand-Play (PnP) development and risk reduction efforts have resulted in significant progress toward a demonstration of viable PnP hardware andsoftware architecture with the potential to change the paradigm of space mission development. Successful implementation of PnP architecture will result in vastly reduced development timelines, enhanced component or system response to detected faults. Our unique and robust fault management approach reduces risk at the PnP hardware component level (including power hub, SpaceWire router, and Appliqué Sensor Interface Module [ASIM]) while incorporating the current SDM software as a baseline—but does not depend on any specific hardware platform for hosting.

MSM
How will PnP affect the satellite future?

Steve Schenk
PnP has two key impacts on future satellites including,

- **Significant reduction of satellite non-recurring costs (NRE), and,**
- **Development of reconfigurable systems in months versus years.**

First, Comtech AeroAstro has done a detailed business case analysis using PnP, and we are highly confident that adoption of PnP can save a traditional satellite program 30 percent, mostly in non-recurring engineering costs due to adherence to standard interfaces at the hardware and software levels. This NRE reduction enables Comtech AeroAstro to be much more cost competitive in an environment of reduced government procurements.

Second, use of PnP allows Comtech AeroAstro to rapidly reconfigure our satellite bus for different components, subsystems, payloads, and/or missions in days versus years with minimal impact to program cost or schedule.

MSM
What else are you currently working on at Comtech AeroAstro?

Steve Schenk
Comtech AeroAstro has invested heavily in a high-performance cubesat, which we call Coral. The Coral bus design meets the stringent pointing/slew requirements of electro-optical or space situational awareness missions, as well as the higher payload power requirements for communications or synthetic aperture radar missions. The power design features two deployed solar array wings along with a Lithium-Ion battery that provides significant payload power during all mission timeframes. The attitude determination and control subsystem features excellent
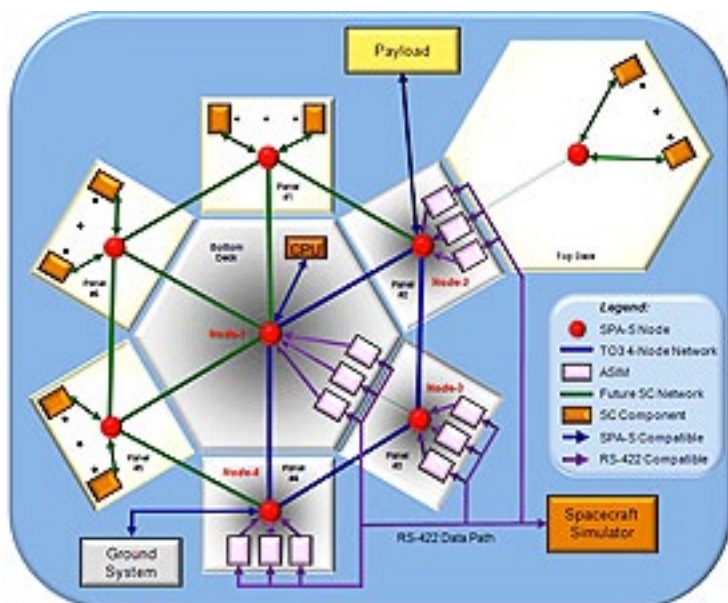
Comtech AeroAstro's
***Antares* Plug-and-Play Testbed**

agility/stability performance and excellent pointing accuracy performance through the use of a miniature star tracker, also developed by Comtech AeroAstro. Coral's communications system features a high data rate transceiver supporting these specialized missions. Coral's avionics subsystem communicates over a high bandwidth, standardized bus that provides a number of external interface options to the payload. The command and data handling software architecture allows rapid integration of any payload hardware or software option with little or no impact to the bus architecture design at any point within the program timeline. Coral facilitates rapid assembly and disassembly of the spacecraft and provides clear access to external interfaces at all times. The Coral bus also provides the ability to be easily upgraded for additional capabilities (*e.g.*, addition of propulsion and power, downlink and encryption upgrades). ❖

More info at http://www.aeroastro.com/

About Comtech AeroAstro

Comtech AeroAstro, Inc. manufactures satellite systems, components, and advanced communications technologies. Its spacecraft and components incorporate modular architectures and plug-n-play technologies in an efficient, agile, and highly responsive design and integration environment. The firm has developed and launched a variety of highly capable small spacecraft platforms including the *DoD Space Test Program*'s **STPSat-1** on the first ESPA launch in March 2007, and the **STPSat-2** bus delivered in December 2008 and launched in November of 2010. In March 2010, the **United States Navy**'s **Naval Research Laboratory** awarded the firm the spacecraft bus design and development contract for the *Joint Milli-Arcsecond Pathfinder Survey* (**JMAPS**) mission. Innovative payload solutions that apply systems engineering expertise focused on RF and EO phenomenology, space situational awareness and low data rate communications technology are developed. In addition, reliable, low size, weight and power satellite components, all designed and engineered for multiple mission applications, are offered.

The Antares Plug-and-Play Technology Architecture
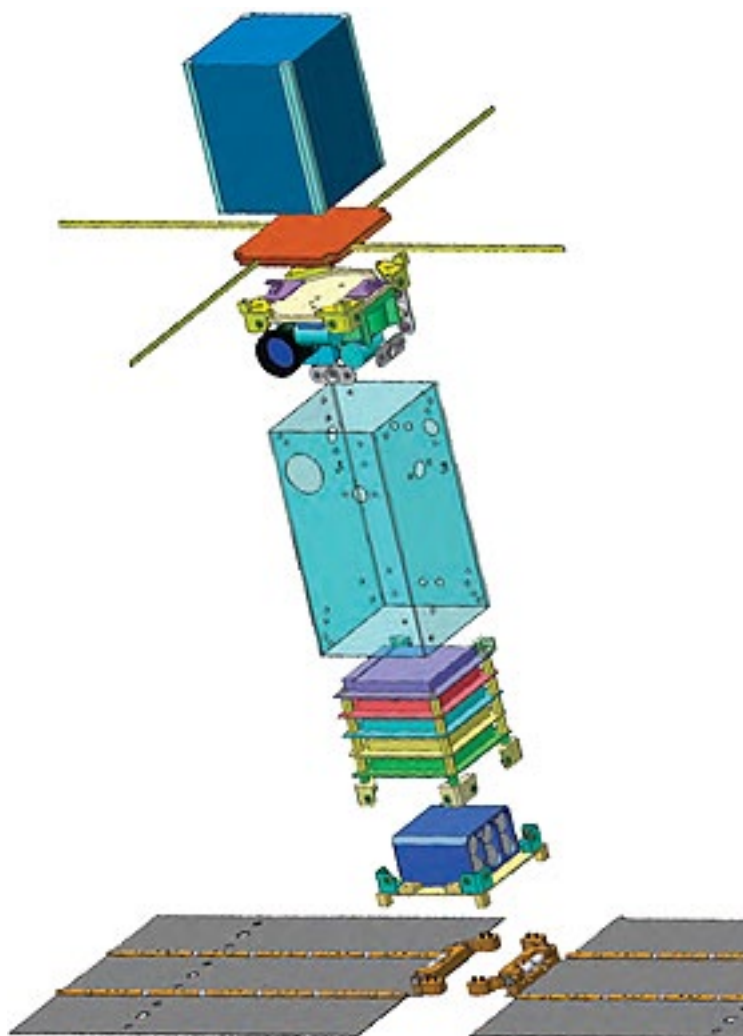
The Coral bus design enables greater mission and payload flexibility with high-heritage, flight-proven, components.

Current Comtech AeroAstro (CAA) Projects

PACS

The Company has developed a novel, new, and revolutionary approach to support *Low-Earth Orbit* (**LEO**) Space Traffic Control called the ***Payload Alert Communications System*** (**PACS**). PACS provides low-cost, low-size, weight and power (SWAP) position, velocity, time (PVT) information along with low-data rate Host vehicle health and status reporting using the CAA patented *Code Phase Division Multiple Access* (**CPDMA™**) waveform. CAA uses a unique *tagging, tracking and locating* (**TT&L**) device in conjunction with the existing ***Global Positioning Satellite*** (**GPS**) system and **Globalstar** data-messaging infrastructure to provide PACS services to users.

PACS is an innovative approach to significantly reduce the manpower required to monitor and develop *space situational awareness* (**SSA**) associated with LEO spacecraft of all shapes and sizes. PACS leverages the CAA-developed *Sensor Enabled Notification System* (**SENS**) technology developed for terrestrial tagging and tracking to provide the customer with an easily integrated tool. This data availability can be critical during post-launch initialization and anomaly resolution, as the availability or lack of information for extended periods can be the difference between the rescue or loss of an orbiting asset. PACS uniquely leverages the existing SENS, GPS, and Globalstar infrastructure for autonomous reporting of position, velocity, spacecraft ID, and limited health and status data messages to provide the customer assured SSA in the densely populated LEO environment.

The primary objective of PACS is to provide round-the-clock *state-of-health* (**SOH**) and state-vector data, independent of ground system infrastructure and constraints. Data latency
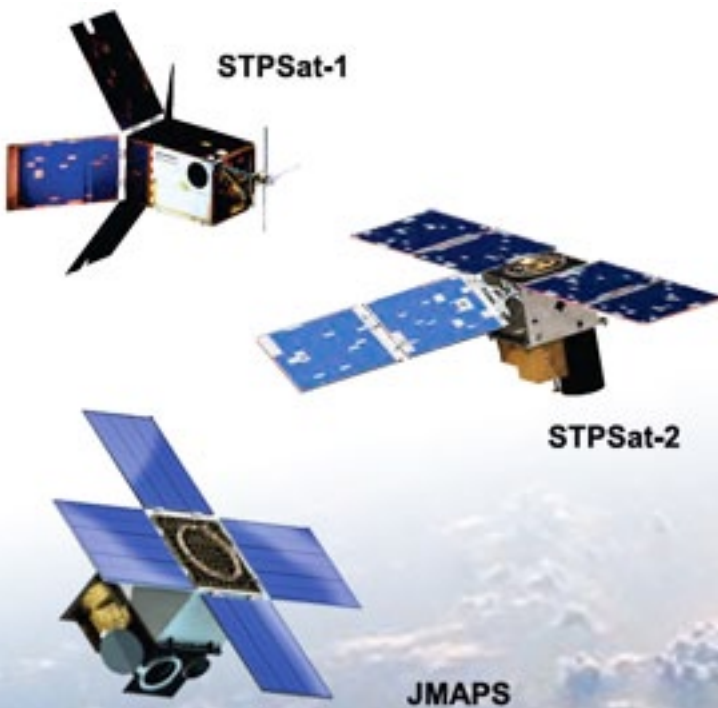
timelines (minutes) are orders of magnitude faster than those accomplished by existing ground assets (daily to weekly). Spatial resolution of the data is substantially greater than commonly used radar or UHF / VHF communications system ranging methods. PACS also provides a valuable low data rate alternative communication path to the spacecraft owner, as the successful transmission probability with link closure (>90%) far exceeds traditional ground stations.

NVIS

Near-Vertical Incidence Skywave (NVIS) uses the effects of vertically directed RF signals and ionospheric characteristics to track transmitters over long distances (hundreds of miles), without the need for overhead communication relay platforms (airborne or spacecraft). Comtech AeroAstro has pioneered unique capabilities in low power HF signaling systems using NVIS links to address sensitive and difficult RF transmission environment requirements for multiple government customers.
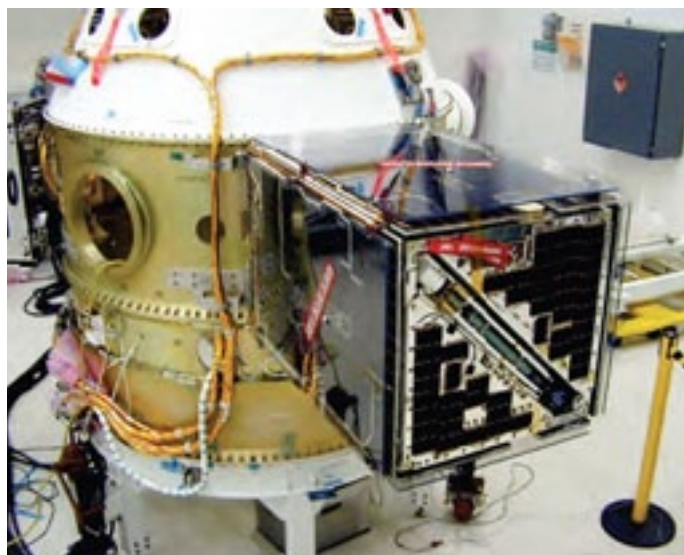
Astro 200AS bus
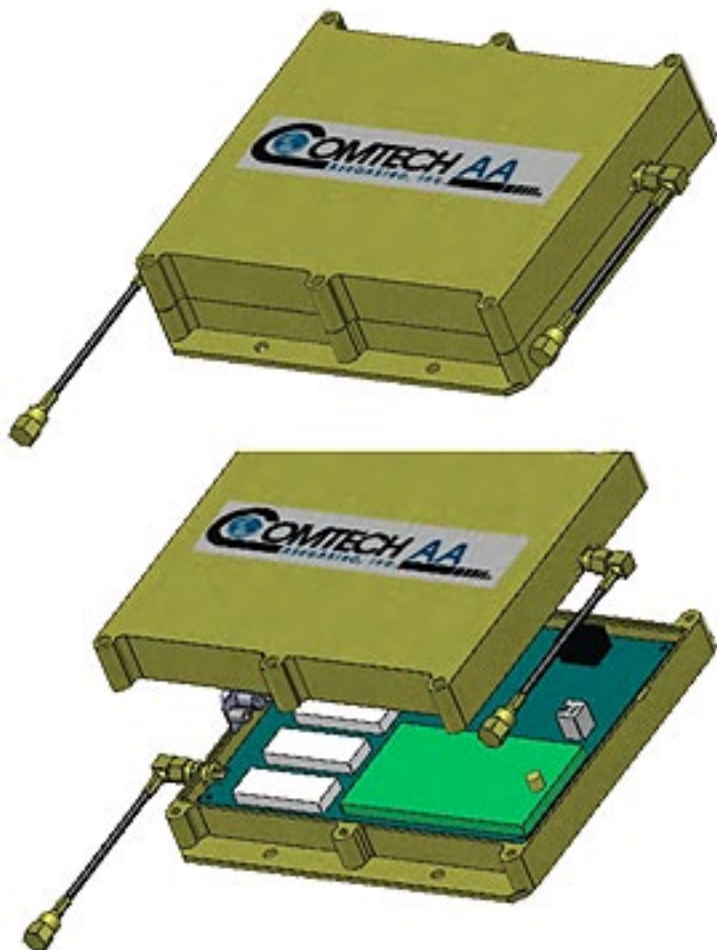
A specific application of this technology, developed in partnership with its *AFOSR Phase I STTR* partner **Virginia Tech**, is the development of a laboratory prototype system capability to perform multiple, synchronized, multi-tone oblique ionosphere soundings using a regularized array of low cost, low power HF transmitters and data post-processing. The data may be used to study spatial and temporal electron density structure and dynamics with fine resolution.

JMAPS

The *JMAPS* mission is a **Department of the Navy** space-based, all-sky astrometric bright star survey that's scheduled for a 2013 launch. JMAPS will produce an all-sky astrometric, photometric, and spectroscopic catalog covering the magnitude range of 1–12, with extended results through 15th magnitude. The secondary mission is to perform off-points to support unique astrometry missions like quasar mapping and surveys of the GEO belt. The JMAPS space vehicle uses the Company's *Astro 200AS* bus to host the JMAPS instrument over a three-year mission life. Evolved from spacecraft developed for the **Department of Defense**'s *Space Test Program*, *STPSat-1* and *-2*, the Astro 200AS provides unparalleled stability and pointing accuracy — measured in arcseconds — for a vehicle in its size class.

Comtech AeroAstro has been a participant in JMAPS mission development since 2005, building continuously on work originally performed for the **Air Force Research Laboratory** (**AFRL**) and the **Defense Advanced Research Projects Agency** (**DARPA**) under several *Small Business Innovative Research* (**SBIR**) contracts. These prior risk reduction efforts, which included critical-path hardware development for the JMAPS instrument, have demonstrated that the demanding technical requirements for JMAPS spacecraft stability, agility, and total pointing accuracy can be met with a microsat-class space vehicle (<200 kg). The Company is working closely with the **Naval Research Laboratory** (**NRL**) and the **U.S. Naval Observatory** (**USNO**) to provide a proven spacecraft bus incorporating extraordinary jitter control,

significant software reuse, and use of high-TRL components to enhance reliability and overall mission success. ❖

About Comtech AeroAstro

Comtech AeroAstro, Inc. offers satellite systems, components, and advanced communications technologies. The spacecraft and components incorporate modular architectures and plug-n-play technologies in an efficient, agile, and highly responsive design and integration environment. In March of 2010, the United States Navy's Naval Research Laboratory awarded Comtech AeroAstro, Inc. the spacecraft bus design and development contract for the Joint Milli-Arcsecond Pathfinder Survey (JMAPS) mission.

INTEL

Improving Warfighter Access To Geospatial Intelligence

by Michael Bufkin, Founder & Chief Solutions Architect, TerraGo Technologies

Over the past five years, we have seen a dramatic shift in the military and government using more commercially available products when it comes to creating and implementing geospatial solutions. The use of commercial satellite imagery from companies such as GeoEye and DigitalGlobe, to the implementation of software solutions that aid the timely sharing and dissemination of intelligence data to the warfighter, the concept of *Commercial-Off-The-Shelf* (COTS) has taken on a life of its own. The result is that the military and government can be far more nimble and provide timely solutions to urgent geospatial needs.
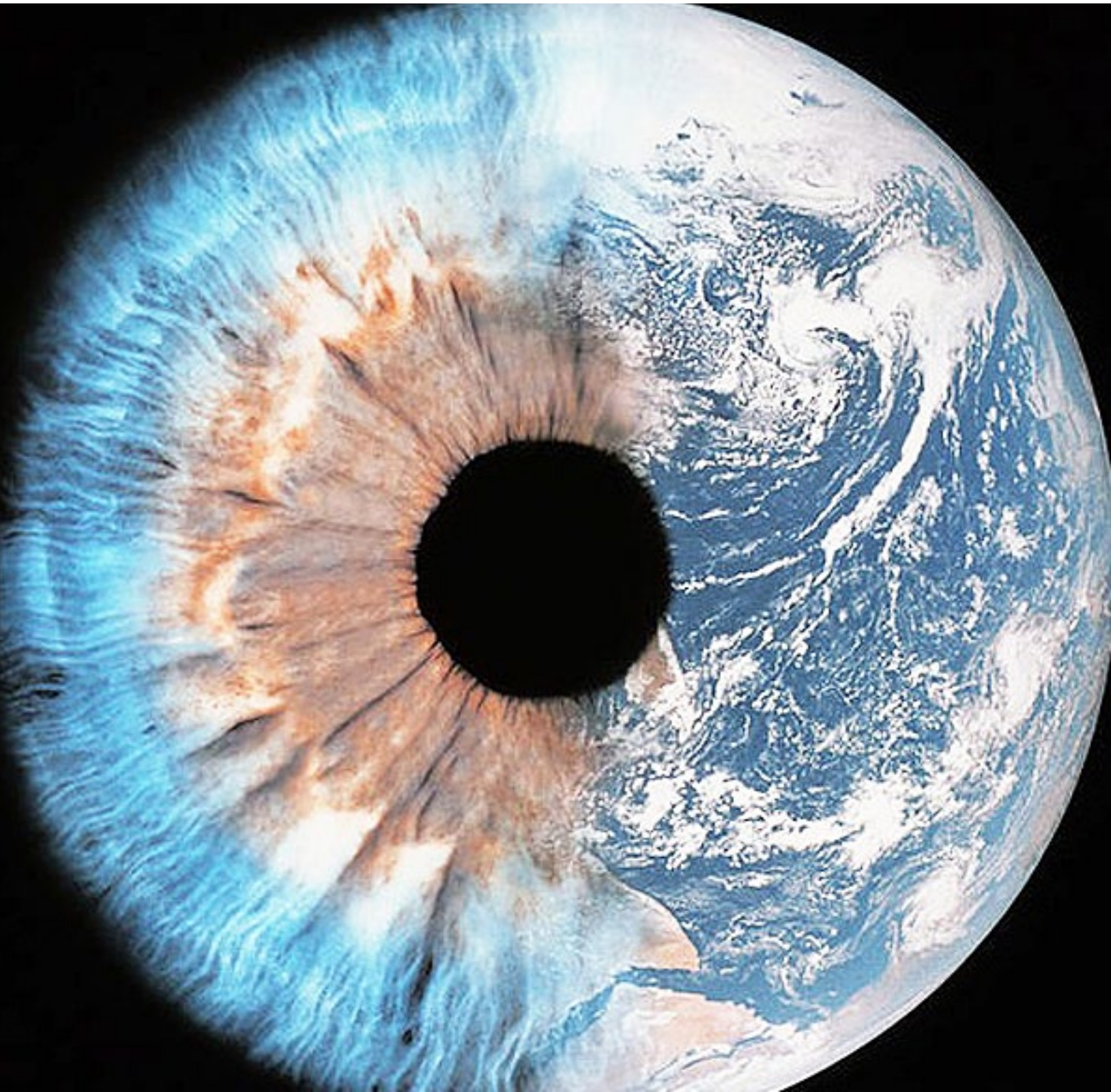
This image of the U.S. Capital provided by GeoEye allows consumers of the GeoPDF to measure and markup the image with additional information. This GeoPDF was created using the static RGB option in TerraGo Publisher for Raster; therefore, the band combinations used for display cannot be changed in this GeoPDF map, but the file size of the final product has been reduced. If file size is a concern, Publisher for Raster provides a number of options for controlling and optimizing the production of your GeoPDF map.

The *GeoPDF* reading software (TerraGo Desktop) can be downloaded free from the developer, TerraGo Technologies. It is, essentially, a toolbar that is added to Adobe Reader that makes it possible to see the layers, to do a few spatial calculations (distance and area), and with a single click, hop into *Google Maps*.

Newer COTS solutions also provide the military with the flexibility to use available technologies to enhance, update and share key intelligence on the ground at anytime — without needing to invest a tremendous amount of capital in building out their own solutions.

In addition, the use of innovative geospatial intelligence solutions by military operations has evolved over the past decade. Access to geospatial assets, particularly those in digital form, used to be limited to a small number of geospatial specialists. Today, the U.S. military emphasizes network-centric capabilities that put GIS' information in the hands of every warfighter.

Dynamic Developments
GIS in the form of dynamic digital maps, imagery, and intelligence data is now considered vital to the success of deployed warfighters around the world. Rather than relying on maps printed weeks or even months prior to an operation, today's warfighters are equipped with current intelligence based on COTS solutions that can be accessed on a computer in a disconnected environment. They can even be printed in the field by a mobile geospatial engineering team.

In addition, one of the biggest geospatial challenges that faces the Department of Defense is the development of solutions for quickly disseminating key GEOINT data to the warfighter in near real-time. Over the past several years, there has been an explosion of COTS-based innovation that focuses exclusively on capturing imagery and data, which has created a major data overload situation. Often the most actionable geospatial intelligence is inadvertently left on the cutting-room floor.

The **U.S. Army Geospatial Center (AGC)** is a center of innovation for geospatial capabilities within the **U.S. Department of Defense**. Its mission is to coordinate, integrate, and synchronize geospatial information requirements and standards across the Army; to develop and deploy geospatial enterprise-enabled systems and capabilities to the Army and Department of Defense; and to provide direct geospatial support and products to warfighters.

As the AGC continued to seek more practical methods for providing actionable geospatial data to warfighters in near real-time, the agency saw an opportunity to significantly improve the rapid, widespread distribution of maps and imagery, as well as the quality and richness of its products for mobile, operational end-users in the field.

Solution Realization

This opportunity was realized when the COTS-based *TerraGo® GeoPDF®* and *TerraGo Toolbar™* emerged as innovative new technologies for providing anyone, anywhere with easy access to geospatial products. These TerraGo offerings allow the AGC to produce compact, digital GeoPDF maps and imagery, then enable military personnel to access, update and share mission-critical, geo-referenced field intelligence.

Esri ArcGIS is the AGC's GIS solution for storing current geospatial intelligence and the complementary TerraGo solutions easily integrate into the ArcGIS workflow. GeoPDF maps and imagery produced with *TerraGo Publisher™* for ArcGIS use geo-referenced PDF files as highly portable containers to deliver maps, imagery, and intelligence as geospatial applications. Mobile users — whether operating in disconnected environments in the field or on the desktop — can use GeoPDF and TerraGo software, including the free TerraGo Toolbar, to easily access, update, and share geospatial intelligence. Since the launch of the initial project, the AGC has used TerraGo Publisher for ArcGIS to produce a wide variety of battlefield geospatial products, including *Urban Tactical Planners* (**UTP**), *Engineering Route Studies* (**ERS**), *Urban Water Graphics* (**UWG**), the *Buckeye Map Book* (**BMB**), *Cultural Maps*, and *Country/Area Overviews*.

In addition, AGC has used TerraGo Publisher for ArcGIS to produce approximately 15,000 GeoPDF products in-house along with more than 24,000 GeoPDF products created with *TerraGo Composer™* for *Acrobat*. These files cover all corners of the Earth and give the warfighter and support personnel the valuable geospatial assets they need, regardless of their connectivity status.

The AGC's key benefits from this project include:

- *Reduced costs*: By reducing the need to print maps in the U.S. and ship into the field, Army geospatial engineering teams can now create customized maps for soldiers from highly mobile vehicles operating on the battlefield. In addition, the consumption of GeoPDF products only requires free Adobe Reader, which has helped the Army keep the costs of implementing software to a minimum.
- *Maximized resources*: Since GeoPDF technology provides a standard way for operational users to exchange and use intelligence, the AGC can better use its internal resources. For example, GeoPDF maps and imagery can be customized and distributed rapidly from the AGC to government decision makers, battlefield commanders, and forward-deployed warfighters. Command personnel working with geospatial and intelligence experts at operations centers can easily prepare, update, and email maps and imagery as needed to forces preparing for operations.
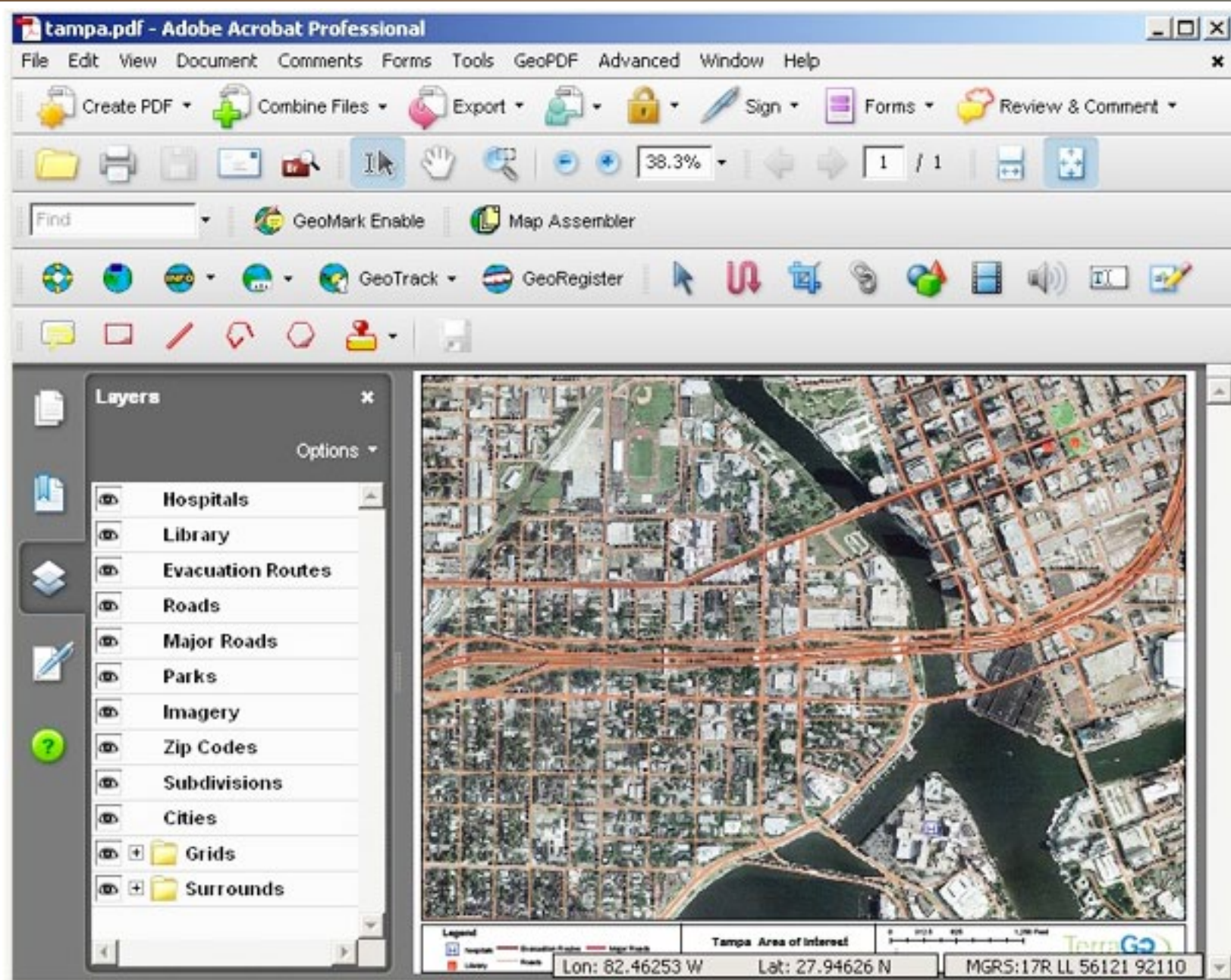
TerraGo Technologies Publisher Suite allows users to create a geo-enabled PDF for others to view using Adobe Acrobat Reader and the GeoPDF Toolbar, which is available freely from their site. The website also includes sample maps.

- *Improved cross-functional collaboration*: **With access to a laptop or handheld mobile device, warfighters can mark-up GeoPDF maps and imagery with new information, share it with others in the field, and send it back to geospatial and intelligence analysts.**
- *Accelerated innovation*: **GeoPDF technology establishes a baseline of capabilities on which AGC continues to innovate, including enabling warfighters with a rugged handheld GPS device to access and mark-up GeoPDF, as well as creating 3D GeoPDFs from LiDAR and other elevation data for improved terrain and infrastructure visualization.**

In addition to the tangible benefits that GeoPDF has brought to the AGC, here are some other key products and services:

- **Country Area GeoPDF MapBook Products**: The AGC created rich, interactive GeoPDF map books of the 50 U.S. states and approximately 200 countries.
- **Dynamic GeoPDF MapBook Server**: The AGC and TerraGo created a browser-based solution based on TerraGo Composer for Server for military users to create customized mapbooks. They simply select an area of interest, the types of data they require, and configure a specialized GeoPDF product that meets their exact needs.

- **USGS Map Locator:** The AGC helped the U.S. Geological Survey convert nearly 60,000 topographic quad maps of the U.S. to GeoPDF. With these, the USGS created an online resource that is available to the public and is especially useful in support of Army National Guard, FEMA, and local emergency management and response efforts.

The military and government have benefited tremendously by implementing COTS-based geospatial solutions for managing some of the most challenging data sharing and collaboration situations. AGC's use of combined GIS and geospatial collaboration solutions is a real-life example of just how beneficial commercial-based products are to helping achieve our missions.

As a result, the AGC significantly improved *common operating picture* (**COP**) and situational awareness from rapid and cost-effective distribution of current geospatial intelligence at all levels of the U.S. military. The AGC continues to work with innovative partners to deliver geospatial intelligence and collaboration capabilities into the hands of U.S. warfighters.

For more information, visit **www.agc.army.mil** or contact *Ray Caputo*, Geographer, **U.S. Army Geospatial Center** or *Michael Bufkin*, Founder and Chief Solutions Architect, **TerraGo Technologies**. ❖

This article's opening and closing image is courtesy of **Science Photo** **www.sciencephoto.com/**

About TerraGo Technologies
As inventors of the GeoPDF, this Company has spent the past five years delivering powerful software solutions that are helping soldiers in the field, intelligence officers on a mission, first responders in emergency situations, utility workers in the field, natural resource managers in the field, and thousands of other people access complex maps and images in the simple-to-use GeoPDF file format. TerraGo Technologies has been focused on a single mission: Improving the productivity and effectiveness of non-GIS experts who depend on geospatial information. Success is driven, in most part, by the

firm's pioneering spirit. From their roots of working with GIS experts who wanted to convert paper maps into digital files, to inventing the world's most widely used geo-registered PDF, to advancing geospatial applications now used in the most intense intelligence and military situations, TerraGo's pioneering spirit continues to innovate and spawn unique solutions in the GIS world.

In working with the world's most sophisticated GIS teams, the Company has helped to build some of the most advanced geo-enabled applications. Such includes digital atlases with associated forms to collect information from field resources. In the process, a solid reputation has been established for

incorporating customer-driven capabilities into the core product. Industry-leading GIS vendors have recognized the value TerraGo solutions can bring to their customers and have selected to incorporate the firm's software into their offerings. TerraGo works with our partners, including ESRI, ERDAS, Intergraph and BAE Systems, to provide a seamless experience for our customers. In addition, TerraGo leverages the Adobe platform and capabilities as one of the select few Adobe Gold partners. ❖

About the author
A founder of TerraGo and co-patent holder for the process that creates georeferenced PDF, Michael Bufkin has been involved in the evolution of TerraGo GeoPDF and the products that produce and display GeoPDF maps and imagery since the beginning. Today his role is primarily in architecting solutions for customers who want to "push TerraGo products to the limits, creating applications that we never thought possible when we founded the company."

TerraGo Technologies Case Work

Disaster Damage Assessment in Japan

When a 9.0 magnitude earthquake struck northeastern Japan on March 11, 2011, it was the worst in the country's history and the fourth most powerful ever recorded. The earthquake was so strong that it moved Honshu about eight feet east and shifted the Earth on its axis by estimates of between four to 10 inches. The ensuing tsunami unleashed waves up to 128 feet high and reached six miles inland. Together, the killer quake and tsunami took the lives of more than 15,000 people, left nearly 8,000 missing, displaced 450,000 more and damaged in excess of $300 billion worth of property.

Adding to the unprecedented scope of these natural disasters was the compromise of the multi-reactor Fukushima nuclear plant complex, which released radiation necessitating evacuation of the surrounding area.

Once the immediate challenges of search and rescue were accomplished, attention shifted to recovery and damage assessment efforts. Federal, prefectural and local governments needed a way to rapidly disseminate, update and share information to determine which buildings and homes were damaged and to what degree so that property owners could receive government-issued disaster victim certificates.

Once the certificates were issued, compensation could be made to property owners and reconstruction could begin. Complicating matters was the inability to physically enter the nuclear evacuation zone to conduct on-the-ground inspection of property damage.
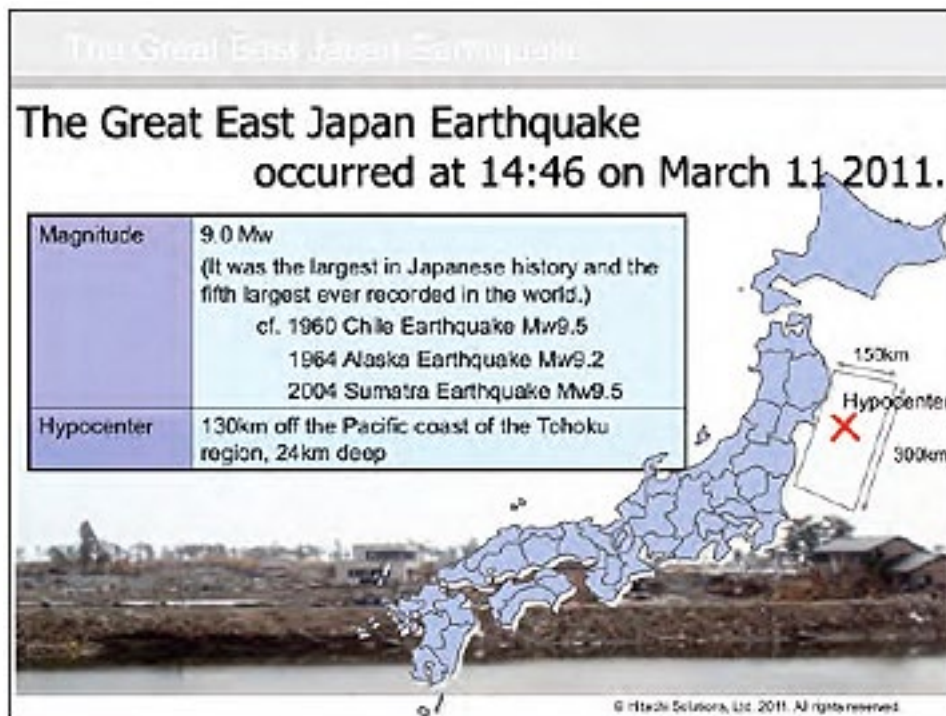
Damage Assessment With
Georeferenced Maps + Imagery

Because the Great East Japan earthquake so radically altered and submerged the coastline, geospatially referenced maps and imagery were the obvious choice by which to visualize and exchange information. In addition, because no one could enter or fly over the evacuation zone near the Fukushima nuclear plant due to radiation exposure issues, satellite imagery was the only way to safely assess damage.

Hitachi Solutions, Ltd. proposed that by using pre- and post-March 11 maps and satellite imagery combined with property boundary information, damage assessment could be accomplished much more quickly and as a result, clerical work of issuing disaster damage certificates could be dramatically simplified. The maps would need to cover the more than 600 sq. mi. affected by the disaster in the *Iwate*, *Miyagi* and *Fukushima* prefectures.

Due to the urgency of the disaster, the maps must also be able to be produced rapidly and be easily distributed and updated. Hitachi turned to **TerraGo® Technologies** for its geospatial collaboration software and *GeoPDF*® solutions to produce the map atlas. Hitachi Solutions is the TerraGo distributor in Japan and East Asia and a joint development partner.

Using TerraGo Publisher™ and Composer™, Hitachi created 38,501 TerraGo GeoPDF® maps and combined them into 42 map books. The GeoPDF atlas maps are comprised of three layers: Residential cadaster maps from before the earthquake, post-disaster SAR (Synthetic Aperture Radar) flood estimate data and satellite imaging. The GeoPDF atlas incorporates residential map data from "*Zmap-TOWN II*" by **Zenrin Co**., Ltd., flood estimate data by **Pasco Corp**. and satellite images by **DigitalGlobe**.
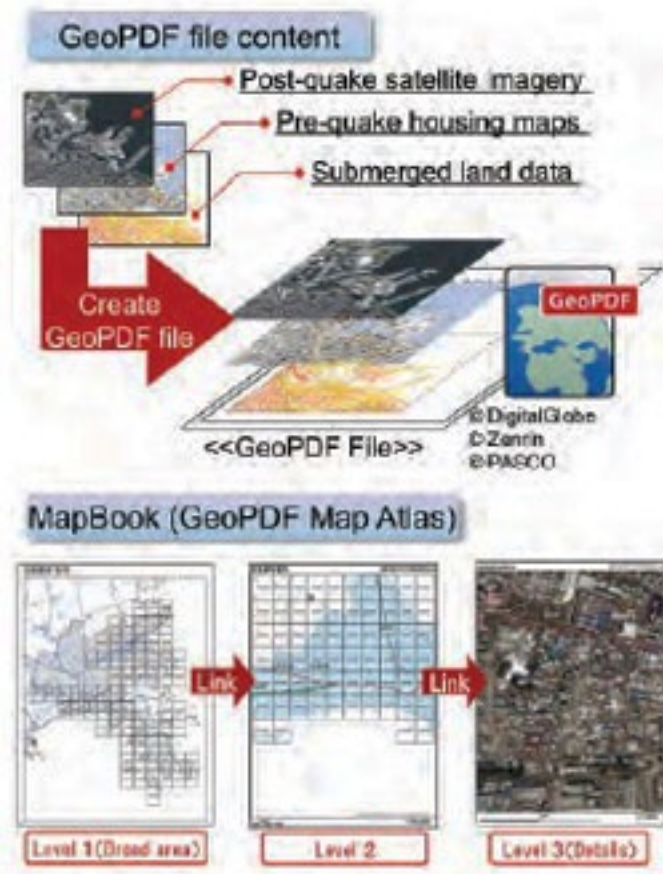
Faster Response To Those in Need

Even in situations where on-site visual inspection was necessary, the use of GPS and geographical coordinates in the atlas greatly expedited the inspection process. The GeoPDF maps and satellite images also enabled area-by-area damage assessment for use in planning reconstruction schedules. Furthermore, progress could be monitored by uploading the status of documented recovery efforts on the GeoPDF map atlas.

By the end of May 2011, approximately 150,000 of the 180,000 applications for disaster victim certificates had been processed with GeoPDF maps playing a critical role. In the Fukushima nuclear evacuation zone, where on-the-ground inspections were not possible, 183 property owners received the Risai Shomeisho disaster victim certificates exclusively on the basis of the GeoPDF satellite imagery maps.

"Disaster response and reconstruction are greatly aided by the ability to disseminate geospatial information and to incorporate the most current intelligence from the scene to be shared by individuals and between organizations whether in a connected or offline disaster environment," said Jeff Vining, Gartner vice president and research analyst for government, homeland security and law enforcement.

Hitachi Solutions plans to expand support coverage in response to requests from local governments, provide add-on tools for integrating data on the GeoPDF maps using cloud services and continue to seek ways it can assist in reconstruction efforts. ❖

The map atlas was produced in just two days after deciding the specification. Hitachi then officially donated it to the Japanese Cabinet office, which in turn distributed discrete maps from the atlas on DVDs and USBs to the respective prefectural and local governments. GeoPDF maps, which can compress geospatial data by as much as 20:1, are easy to distribute to the field where users can readily view, update and share information. Users were able to confirm the condition of affected areas by comparing the different map layers and utilize geographical coordinates when adding information and images to each location. Certification of property damage, which had previously required confirmation on site, could now be carried out much more quickly through the comparison of residential maps containing homeowners' names and post-disaster satellite images.

Hitachi also provided Nikon-Trimble "GPS Pathfinder SB" handheld devices with TerraGo Mobile™ software to write data on the GeoPDF maps, permitting on-site uploading of current georegistered data and images to the GeoPDF map atlas. (GeoPDF maps can support the inclusion of georegistered audio, video, notes, web services and other intelligence. In addition, the company supplied its StarBoard® interactive whiteboards, which can be placed in disaster response headquarters and other command and control centers to more efficiently visualize spatial information and coordinate support efforts.
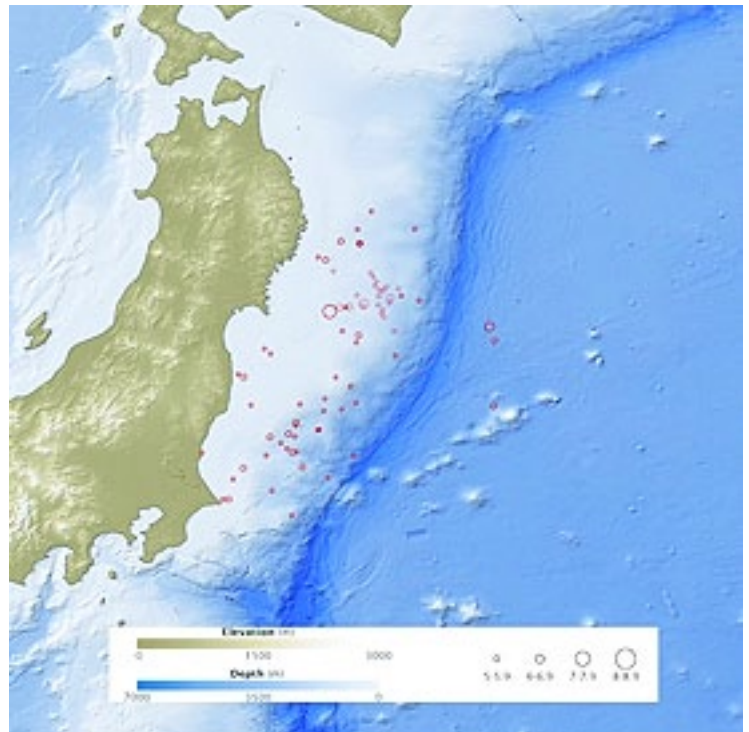
This USGS map shows the location of the March 11 earthquake, as well as the foreshocks (dotted lines) and aftershocks (solid lines). The size of each circle represents the magnitude of the associated quake or shock.

Affordable Compliance With e-NOA/D Regulations

With the release of United States Coast Guard (USCG) regulations to extend Notice of Arrival/Departure (NOA/D) reporting to domestic as well as foreign vessels, captains and fleet operators have a new, onboard administrative challenge — especially if their vessel was not previously required to carry a SATCOM system with access to the Internet. Electronic notice of a vessel's arrival and departure from U.S. ports, Caribbean community (CARICOM) ports, or the St. Lawrence Seaway is required at least 96 hours prior to arrival or departure, as applicable, with the electronic NOA/D (e-NOA/D) web format as the preferred method of submission.

When an e-NOA/D is completed and submitted properly, it provides all of the information required by the Federal regulations listed in the USCG and Customs and Border Protection regulations and eliminates the need to send separate notifications with slightly different information to multiple agencies. As electronic data is typically seen and processed quickly, e-NOA/D is viewed as a faster process to reduce the chance that a vessel would be delayed or denied entry into (or exit from) a port. NOA/D information is used to:

- assess risk to vessels; identify vessels
- identify individuals associated with vessels that may pose a safety or security risk to the U.S.
- facilitate the entry and departure of vessels into and from the U.S.
- assist with conducting maritime safety and security missions in accordance with international and domestic regulations.

Faced with the expansion of this regulation to domestic vessels, as well as the requirement for NOA/D submissions for every arrival and departure, affordable and easy-to-use broadband connections are critical to the efficient operations of commercial vessels. That's why many competitive fleet operators are selecting a **KVH** turnkey *mini-VSAT Broadband* SATCOM solution to ensure that they have the fast, affordable, reliable, and efficient data connections required to make

KVH TracPhone V7 and V3 Maritime VSAT Systems

e-NOA/D compliance simple and cost-effective. KVH's end-to-end commercial system equips each vessel with a powerful, cost-effective communications suite perfect for e-NOA/D submissions as well as ship operations and crew moralel, thanks to:

- The global mini-VSAT Broadband network with downloads as fast as 2 Mbps, high-quality connections, and low latency
- The commercial-grade 24" (60 cm) TracPhone® V7 or 14.5" (37 cm) TracPhone V3 antennas

This article offers a quick look at what the e-NOA/D regulations mean to commercial operators as well as how KVH's fully integrated SATCOM and network management solution will play a significant role in making compliance effective and affordable.

The e-NOA/D Process

Submitting an e-NOA/D to the **U.S. Coast Guard** is a relatively straightforward, if tedious, process — provided your vessel captain has access to the Internet. First, a visit the e-NOA/D site at https://enoad.nvmc.uscg.gov/ is required and an account must be created. Once that account is validated, an e-NOA/D may be submitted directly from this site via a sequence of screens. These forms will need to be submitted with each arrival or departure. If the vessel is not capable of submitting its reports online, NOA/D reports will need to be filed by the fleet office on shore via fax, potentially slowing the process and delaying the approval for arrival or departure.

e-NOA/D Compliance

Given the fact that tugs, OSVs, and crewboats have not previously been required to carry a computer with satellite Internet service, e-NOA/D implementation is a technically challenging requirement. In a study conducted by the **Offshore Marine Service Association**, it was estimated that a fleet of 50 vessels could incur up to $1,850,000 in costs to obtain and install equipment, plus an approximate $540,000 per year minimum for bandwidth. As noted in an FCC "frequently asked question" on the *Notice of Proposed Rulemaking* (**NPRM**), a single U.S. vessel without Internet capability will now submit more reports in a single month than the NPRM assumed the entire industry would submit in a year.

Commercial operators required to comply with the e-NOA/D application should ensure that their IT department, operations group, and fleet managers should research the best solution for the fleet's vessels. Consider the equipment size compared to vessel size, where vessels travel, estimated data use, and budget. e-NOA/D reporting can easily be done onboard by the ship's crew, instead of by agents, ship owners, or managers if your vessel is equipped with a reliable, affordable SATCOM system such as KVH's mini-VSAT Broadband network and its compatible TracPhone systems.

A Fast, Affordable Resource For Compliance

The mini-VSAT Broadband network is the first next-generation maritime satellite communications solution. The global spread spectrum satellite network, built with **ViaSat**'s patented *ArcLight*® technology, offers more affordable airtime, voice service and Internet access as fast as 2 Mbps (shore to ship). KVH offers two mini-VSAT Broadband-compatible antennas:

- The 24-inch (60 cm) TracPhone V7
- The 14.5"-inch (37 cm) TracPhone V3

In 2010, the mini-VSAT Broadband network delivered more than 60 terabytes of data and handled more than 1.5 million voice calls to and from vessels around the globe.

Sample e-NOA/D Screens

Comparison of mini-VSAT Broadband and Inmarsat Maximum Data Rates in Kilobits per Second (Kbps)

CommBox Onboard IT Management

KVH's mini-VSAT Broadband solution also offers the option to add the *CommBox™ Ship/Shore Network Manager*. CommBox offers a wide range of capabilities, including web compression and acceleration, easy file transfers, crew e-mail tools, fleet management capabilities, configurable firewalls, and data encryption. CommBox also supports automatic least cost routing, which allows the vessel to rely on the faster, more affordable mini-VSAT Broadband service for everyday use and then switch to a complementary service such as *Inmarsat FleetBroadband*, GSM cell phone, or shore-based WiFi, if necessary.

Reducing Operational + Regulatory Costs

Compliance with e-NOA/D doesn't have to be difficult or expensive to implement. The mini-VSAT Broadband-compatible antennas are 85 percent smaller in size than traditional VSAT systems, with lower hardware and installation costs on par with Inmarsat's compact FleetBroadband antennas. KVH customers report that installation can be done in hours versus days by one to two people, and in port or while underway.

Most importantly, from an e-NOA/D compliance perspective, the mini-VSAT Broadband service offers very economical and flexible airtime subscription plans designed to meet commercial vessels' budget and data speed requirements. With a basic metered plan, users can enjoy Internet access and email for just $0.99 per MB along with crystal-clear voice calls worldwide for only $0.49 per minute. This is one-tenth the cost of published airtime rates of $10-13 per MB from competing L-band services. Airtime costs for mini-VSAT Broadband service can be even lower when choosing a fixed monthly plan or a fixed seasonal plan (if a fleet's vessels don't operate year-round).

Required e-NOA/D compliance is coming to the commercial maritime industry and with it comes a dramatic increase in data and bandwidth requirements. Vessels need affordable and fast solutions for convenient global compliance and KVH's TracPhone V-series, together with mini-VSAT Broadband service and KVH's CommBox Ship/Shore Network Manager are a solution that should be considered. ❖

About KVH Industries

KVH provides global high speed Internet, television, and voice services via satellite to mobile users at sea, on land, and in the air. KVH is also a manufacturer of high performance sensors and integrated inertial systems for defense and commercial guidance and stabilization applications. The Company sees an increasing demand for mobile access to live media and information on the move — their goal is to connect mobile users to satTV, communications, and Internet services customers wish to use while "on the go." An ISO 9001-certified company, KVH has five facilities located in Middleteown, Rhode Island and Tinley Park, Illinois, USA; Kokkedal, Denmark; Singapore and Horten, Norway.

KVH's *TracVision®* and *TracPhone*® products offer:

- A family of solutions for the mobile consumer on sea, land, and air
- In-motion passenger entertainment via high-powered regional satellite TV services and our fully stabilized antenna technology
- Mobile satellite communications around the globe via our powerful mini-VSAT Broadband satellite communications service and Inmarsat airtime services
- The benefit of strong relationships with other industry leaders, including ViaSat and Inmarsat; and
- A commitment to quality customer support through our Certified Support Network (CSN), an international network of skilled technical dealers and support centers

Also offered is a portfolio of digital compass and fiber optic gyro (FOG)-based systems that meet the rigorous requirements of military and commercial customers for precision guidance, stabilization, and navigation. Defense products include precision FOG-based systems that help stabilize remote weapon stations, gun turrets and radar units, as well as provide guidance for munitions. The FOGs are also used in commercial applications such as industrial robotics, optical stabilization, autonomous vehicles, and remotely operated submersibles. In addition, the TACNAV® tactical navigation systems provide uninterrupted navigation and pointing information for a broad range of military vehicles. These systems offer...

- Stabilization and guidance for remote weapon systems and torpedoes; gun turrets, optical targeting systems, radar, and communication antennas in both the military and commercial markets;
- Field-proven, continuously available navigation for combat and combat support vehicles participating in operations in Iraq, Afghanistan, the Balkans, and elsewhere
- Integration and aggregation of data from on-board systems, both for the crew and vehicle commander, as well as for communication with digital battlefield systems, friendly units, and command centers

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COTM: Much More Than A Wish — A Need

Susan Miller, CEO, Spacenet Integrated Government Solutions Division

Information is absolutely vital to an effective military campaign. Through its rich history, no force has grasped this idea more clearly than the military of the United States of America, nor has any force been more innovative in its methods of relaying that information.

From Paul Revere delivering news by horseback on his "midnight ride" to warn the American colonists that the British forces were coming during the American revolution, to the U.S. Marines employing Navajos to transmit messages by telephone and radio in their native language during WWII — a code that the Japanese never broke — the U.S. military has long been inventive when it comes to implementing communication methods.

With the latest developments in IP content delivery, the military is creating new opportunities and capabilities never previously considered possible.

Today, U.S. military forces are at the forefront of using broadband technology in all aspects of their various missions. A key aspect of this has been the ability to combine mobility and access to critical data in any theatre of operation. The military, more than any other communications user, simply cannot compromise its ability to execute operations due to lack of access to data.

Key to accomplishing ubiquitous access has been the innovation of mobile communications, or *Comms-On-The-Move* (**COTM**). COTM is, quite simply, the ability to support various broadband communications while operating at a high rate of speed. While this has long been possible on ships and aircraft, it is a relatively new development at the infantry level. COTM offers the ground troops significantly improved command and control by allowing for continuous communications without

concern for location or line of sight proximity to fixed communications assets. For commanders on the ground, this means full-time situational awareness, and better ability to execute.

Focus On The Goal

The military's goal to provide its soldiers with the most updated information possible is especially important — and challenging — as operations are underway in theaters which lack existing communications infrastructure. Ground troops have to bring any required communication assets with them, and they must be able to support and maintain this equipment on the ground. As the military faces the challenges of unfamiliar terrain and innovative styles of warfare, it is imperative that a system of reliable communication be constantly available and more covert. The system should:

- **Be expeditionary in design**
- **Operate in austere environment**
- **Operate during precarious weather**
- **Be user-friendly**
- **Possess the ability to integrate with other networks**
- **Function beyond the line of sight (BLOS)**
- **Above all — support full mobility**

Satellite Communications-On-The-Move (**SOTM**) meets all of these requirements. Through smaller mobile antennas, soldiers are able to stay in contact with their commanders and each other while fully mobile in virtually any environment. COTM relies on satellites to create consistent and effective mobile broadband connection — satellite communications are ideal for most military operations. Satellite service, particularly VSAT (Very Small Aperture Terminal) communications can provide:

- **High broadband rates**
- **Support for virtually any communications requirement (voice, video, data)**
- **Delivery of service anywhere**
- **High security access (including type 1 encryption)**

The new generation of SOTM solutions can maintain all these benefits much more easily and with greatly improved form factors. Today's SOTM antenna is a rugged, low profile (height of only 7-inches) device requiring little maintenance. This allows the antenna to remain operational at high speeds and minimizes the potential impact of environmental factors. Additionally, and most importantly, the antenna does not broadcast to the enemy which vehicle is supporting the vital communications, avoiding high value vehicle targeting by the enemy.

According to **Tom Smith**, Vice President of **Spacenet Integrated Government Solutions RaySat Antenna Systems** division, "The real value of the low profile antenna is its ability to maintain virtually any operational communications requirements without hanging a 'shoot me first' sign on the vehicle".

The value of the low profile element of the equipment cannot be stressed enough — enemy forces understand the value communications capabilities provide to troops and exactly what a force multiplier COMs have become. They recognize the impact on operations that disrupting communications would have...they would wish for nothing more than to disable or eliminate command and control vehicles. They are a high value target that helps to maintain operational capabilities as well as protecting the lives of the troops using them.

**Top:
SIGS' StealthRay 5000 dimensions**

In Example

One such COTM implementation is the **StealthRay 5000** (pictured on the previous page). This unit was developed specifically to offer higher return link data rates. The antenna supports the transmission of high-resolution, high-quality, streaming video from mobile units in the field to a fixed station. Similar to the other mobile satellite antennas in this product line, the StealthRay 5000 antenna employs a GPS and gyro-assisted mechanical tracking system.

The built-in GPS and gyro are used for a fast and fully automatic satellite acquisition. High-speed satellite tracking technology supports communication at speeds up to 350 km/h. The StealthRay 5000 can be configured for use with virtually any Ku-band satellite to enable IP connectivity on fast-moving vehicles for real-time, high-quality, streaming video, VoIP and high-speed data applications. ❖

About the author

Susan Miller has more than 20 years of experience in the telecommunications and satellite sector and has a broad background in management, technology and operations. She is responsible for overseeing the strategic direction of Spacenet's government services unit, Spacenet Integrated Government Solutions, with a focus on delivering network and communications solutions to the Department of Defense, Homeland Security, the Intelligence Community and other government related agencies.

Ms. Miller has also served in several government advisory capacities including as a corporate representative to the National Communications System (NCS) National Security Telecom Advisory Committee (NSTAC) National Coordinating Center (NCC) for Telecommunications. Ms. Miller earned a BSEE from Rensselaer Polytechnic Institute and a MSEE with a concentration in satellite communications from the University of Southern California.

About Spacenet Integrated Government

In September of last year, **Spacenet Integrated Government Solutions** (SIGS), a wholly owned subsidiary of **Spacenet Inc**., announced the Company was managing operations of **Raysat Antenna Systems**' (**RAS**) U.S. division. RAS, a leading provider of Satcom-On-The-Move antenna solutions, was recently acquired by **Gilat Satellite Systems**, Spacenet's parent company — all U.S. operations were integrated into SIGS. SIGS is focused on delivering network and communications solutions to meet the unique requirements of the Department of Defense, Homeland Security, the Intelligence Community

and other government agencies. The integration of RAS will enable SIGS to expand its communications offerings and increase business opportunities in the government market.

"This is great news for any government agency with a requirement for highly mobile, secure communications," said SIGS CEO *Susan Miller*. "The integration of the RAS family of Comms-On-The-Move antennas with the satellite networking expertise of SIGS will deliver a new level of high speed, highly mobile communications for the military, emergency response organizations, and other markets with a need for fast, flexible, on the move communications. Comms On The Move is one of the many application areas we see poised for rapid growth,

and with this acquisition, we are well positioned to lead this market and deliver new solutions."

SIGS provides stand-alone and hybrid telecommunications solutions that are tailored to meet the unique mission-critical requirements of military, homeland security, emergency response and disaster recovery, humanitarian and other Government organizations. SIGS leverages a strong history and culture of technical excellence, R&D and system integration capabilities to deliver reliable, vendor-agnostic, standards-based, interoperable and flexible solutions to meet the needs of our clients.

SIGS specializes in the development and provision of low-profile, in-motion, 2-way satellite antenna systems and emergency communications systems. The company's RaySat™ line of Stealthray™ low-profile satellite antenna systems provide government agencies with reliable SATCOM-On-The-Move (SOTM) capabilities to enable secure transfer of real-time Beyond-Line-of-Sight information exchange between field and command locations.

The Company's *Emergency Communications System* (**ECS**) is a rapidly deployable, modular, scalable, and flexible communications platform designed to support emergency response and COOP operations during planned and unplanned events. It can be employed to enhance **Coalition Tactical Edge C3** systems and **ISR** capabilities and provide secure, deployable, modular, wireless communications in support of distributed small unit operations. ECS supports both unclassified and classified communications using satellite links and *Commercial-Off-the-Shelf* (**COTS**) equipment.

A Change Of Face

by Giles Peeters, Defence Sector Director, Track24 Defence

The 20th century's industrial warfare has developed into the 21st century's war amongst the people. Tactics and technology need to adapt as a consequence. Giles Peeters, ex-MoD and NATO satcom subject matter expert, and Defence Sector Director at Blue Force Tracking Specialists, Track24 Defence, considers the paradigm shift and the commercial implications for militaries around the world.

British troops engaged at El Alamein in World War II

Three Markers

Let us consider how war has changed. A linear approach to the subject provides a good stock of examples and allows us to focus on three major events.

The first Great War was fought between states. Sovereignty was at stake and there was fierce industrial warfare between developed Western nations. This defined a war between states.

The Second World War marks the point in history linked to the shift in paradigms between industrial warfare and war amongst the people: The atomic bomb. While WWI had been almost entirely played out between states on the battlefields of Europe and the Mediterranean and North Sea, WWII saw the first attack on the people in the modern Western World. It was still very much a state-versus-state conflict, but there was also a clear element of the state-versus -the-people to consider. The Luftwaffe bombing London during the Blitz, for example, was a direct attack on the people as opposed to the state; this tactic however, was epitomised by the dropping of Little Boy and Fat Man on Hiroshima and Nagasaki. Within the first four months of those attacks, around a quarter of a million Japanese civilians died. Such a monumental strike against the people led to Japan banning the possession and manufacture of nuclear weapons as well as their introduction into Japanese territory. This was the turning point for warfare and the advent of war amongst the people. It also moves us onto the third prominent marker in the transition: September 11, 2001.

Up until this point in time, war recognisable to us had been conducted by states; sovereignties looking to gain land or defeat rival armies on a battlefield. However, 9/11 demonstrated how warfare had evolved into the people attacking the state. Nations that had fought industrial wars for centuries were now given the clearest signal that a latent threat had become a patent one, and this new enemy was playing by a different rule book.
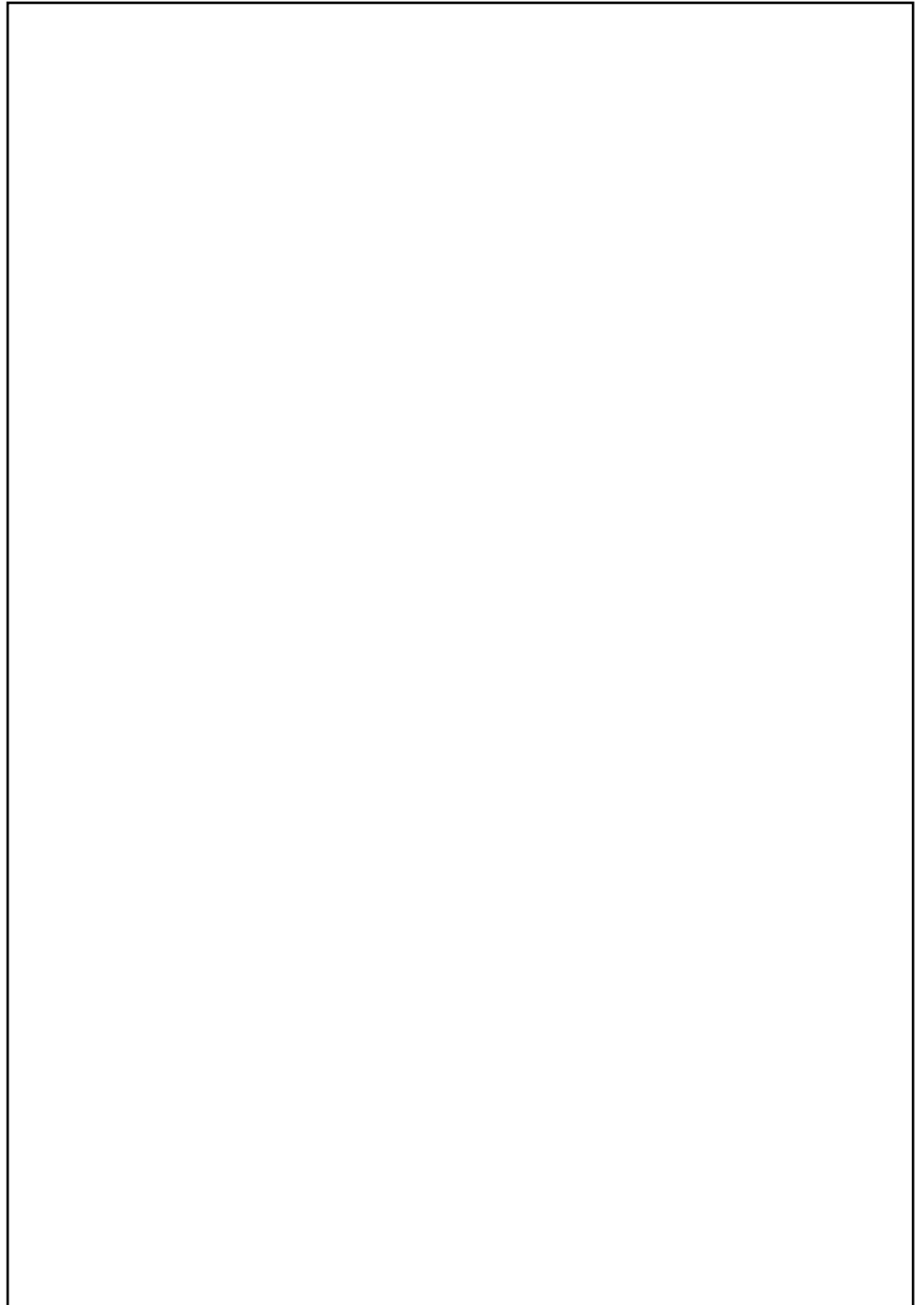
Ever Evolving Threat

A decade later, we now find ourselves facing the same dilemmas. Al-Qaeda isn't interested in playing by our rules. Why would they be? They are technologically inferior and will never have even a tenth of the resource our Western forces enjoy. They will not engage in heavy artillery shelling, helicopter dog fights, or tank battles. In fact, the last tank battle was in the Arabian Desert in 1974.

The confrontation in this case is clear, a war against 21st century terrorism, but the conflict is not. Winning the hearts and minds of the population in Afghanistan while reinforcing local democracy and eliminating terrorist groups, for example, will bring stability and long-term viability to the area. However, it is very much a war amongst the people; while the terms of the confrontation may appear straightforward, employing resources developed during industrial warfare against an enemy that has fine-tuned its own form of guerilla warfare, is not.

This neatly brings us onto the point of this article: Militaries born from industrial warfare are suffering because of their inability to rapidly evolve resources. Why did U.S. forces complain about having to reinforce their 'soft skinned' back line vehicles with scrap metal in 2004? The answer is the vehicles were designed to transport officers stationed behind the front line in a typical industrial battle. Where is the front line in Afghanistan? If you look hard enough, you might see it in the

German armed forces on patrol in Afghanistan.

and maintain the state of the enemy. This is not a case of listening for the thunder of an armoured division moving up your flank, more a small boy complaining of a strange smell coming from a nearby house.

The best tactic against an industrial force is not to mass against it. Guerrilla warfare dictates small cells of fighters and dispersed resources. While the U.S. and U.K., for example, may want to bring their technological advantage to the fore because it has proved effective in the past and cost billions to develop, the tools of industrial warfare are just not suitable for war amongst the people, and have not been for some time.

It is clear, therefore, that the technology employed needs to evolve

sand as you pass through the front gates of Camp Bastion.

War amongst the people nullifies traditional markers and instead requires constant intelligence and feedback to assess

to suit the circumstances. To defeat a state's armies on the battlefield in the past would have led to a completion of a main objective linked with the war and a collapsing of time scales associated with victory. Fighting two men on motor bikes in the desert is no less a battle, but a much smaller influencer on the overall objective and outcome of the war. These smaller conflicts are often indicative of a much longer confrontation and one in which different tactics should be employed, including a heavy focus on two of the most important operational elements of a timeless conflict, communication and interoperability.

A nation state in the 21st century is unlikely to engage in a war amongst the people without the backing of a multi-state organisation such as NATO for example, as much due to the budget required to fund such a long confrontation, as its hostile implications. The timescales and multiple parties involved necessitate a level of interoperability unique to this new type of war, and place an increased emphasis on communications. However, let us first consider the level of

U.S. Army soldiers with the 4th Battalion, 23rd Infantry Regiment, 5th Brigade Combat Team, 2nd Infantry Division and Afghan National Army soldiers conduct a combined patrol in the village of Shabila Kalan, Zabul, Afghanistan. DoD photo by Tech. Sgt. Efren Lopez, U.S. Air Force.

communication necessary in a war amongst the people.

Importance Of Allies

Communications during industrial warfare were based on the fact that a nation owned and controlled the ground and the battlespace. If a commander could not see where the platoon or armoured tank division was, he could more than likely contact them via VHF/UHF radio.

However, in modern day war amongst the people this is not always possible and certainly not consistently so. Take Afghanistan as an example: The Camp Bastion HQ is hundreds of miles away from villages being patrolled by ISAF troops. A country with spectacular scenery but an austere landscape does not lend itself to VHF/UHF transmissions and instead requires beyond-line-of-sight (BLOS) communications capability.

Because of ISAF's origins in industrial warfare, a very simple problem becomes a serious issue. The technology and concept of operation is slow to be adapted and accepted, and the solutions have not evolved to suit the conflict as a consequence.

A platoon that has to enter a mountainous region may boast the latest high-tech Battlefield Management System (BMS) that employs voice and data communications, providing command and control and situational awareness capability, but may find it rendered inoperable due to its reliance on line-of-sight radio — a system still of use in a war amongst the people, but primarily developed for industrial warfare.

Consider smaller conflicts again. Because the enemy won't mass, it makes it impossible to achieve the objectives of the confrontation with a single conflict, thus extending the time taken to win the war. The best chance a force has to win a war amongst the people is to win over the hearts and minds of the people themselves. In order to do this a force must create local allies in the communities with which they are engaged.

In Afghanistan, the only way to remove foreign troops from the battlefield is to empower local authorities, such as the police force, to maintain order and help the Government of the Islamic Republic of Afghanistan achieve effective and consistent governance. To do this you need to be able to equip them with technology that allows them to communicate with your forces, and is simple and affordable for them to maintain themselves. A multi-billion pound BMS is not suitable for this function as it was designed for a nation state engaged in an industrial war.

Note — I mentioned a singular nation-state. Another

arrives in Afghanistan to take over from outgoing personnel who have served their time. This new coalition partner has brought its own vehicles to enhance NATO's capability, including urgently needed heavy lift helicopters. Under ISAF command, the recent arrivals have been told that it is mandatory to have Blue Force Tracking (BFT) capability. These systems send a GPS positional report at pre-determined intervals into the NATO Common Operating Picture, providing real time situational awareness, reducing friendly fire incidents.

When the new force requests BFT capability for its vehicles and helicopters, it is informed that there are only a limited number of systems available, due to the expense — the new force is only allocated a minimal number for its 100-vehicle fleet and told there is no such capability available for the helicopters. Furthermore, these systems are required to be permanently hard-wired into vehicles with the appropriate data security proto-cols, often meaning the bureaucracy of implementation ends up denying critical capability.

This may sound like a ridiculous scenario, but unfortu-nately, it is all too common. Fit for purpose capability that is interoperable, secure and available requires an intuitive communications approach to counter the war amongst people, allowing multiple allies to quickly and easily configure and operate recognisable platforms.

Where Do We Go From Here?
How is flexibility achieved when delivering BMS and BFT, or any other type of communications capability? Most militaries have a tradition of trying to solve communications capability gaps without re-evaluating the evolving information exchange requirement. For example, large projects are commissioned with long lead times that often provide cutting-edge technology, for a problem that no longer exists by the time it is ready to be used.

If it were possible that resources could be allocated to indi-vidual confrontations in an order-to-type manner, then we prob-ably wouldn't have fighter-bombers patrolling no-fly zones in Iraq and Bosnia, or multi-billion pound aircraft carriers being built for a state-to-state confrontation that may never happen. In fact, it stands to reason that you cannot develop resources for a confrontation and its subsequent conflicts unless you understand what you are fighting against in the first place, and then regularly review this.

Logically a force needs to carefully consider its purchasing options and not fall into the trap of buying more of what won the last industrial war decades ago and abiding by the same purchasing principles today. For large projects such as aircraft carriers, it is understandable that the build time is susceptible to the fast changing environment of conflict. However, for commu-nication capability, there is no excuse for not providing a flex-ible procurement strategy to fulfil requirements when there are suitable commercial off-the-shelf (COTS) solutions.

A military organisation needs to adopt a flexible contracting mechanism in this communications arena, at the least, where the information exchange requirement, not the procurement process, determines the critically-needed solutions.

More info at www.track24defence.com

Blue Force Tracking in a Hummer, Iraq.

About the author
Giles Peeters spent 19 years working as a communications specialist for the United Kingdom Ministry of Defence, before moving to the private sector to consult for organisations such as NATO, on Blue Force Tracking requirements. Now Defence Sector Director at Track24 Defence, Peeters is the driving force behind the launch of the company's new, commercial-off-the-shelf (COTS) blue force tracking solution, Situational Command & Control (SCC).

presiding communications factor that has so far been featured in war amongst the people is the requirement for high-level secure interoperability, due to the 21st century multi-nation approach to confrontation. The International Security Assistance Force (ISAF) in Afghanistan consists of nearly 150,000 troops from 48 different countries; a resultant issue from day one has been the ability to effectively and affordably communicate with troops from all these different armies: each industrial force boasts different systems.

Take the following as an example: A new military force

About
Track24 Defence

Track24 is a leading global provider of security tracking and crisis management solutions, providing tracking hardware and software to enable organisations to track personnel, vehicles, aircraft and maritime vessels. At any given time, the company is tracking thousands of people across and around 40 countries. The company originated during the post-Iraq war reconstruction effort when its founders realised that they could help improve the risk management of commercial contractors and security companies in Iraq by introducing technology that would allow them to see where their vehicles were in the country and also send alerts if they were in distress. By introducing tracking and emergency alert systems using satellite technology all linked to a secure online risk management platform most organisations operating in Iraq experienced a significant improvement in their ability to respond quickly to incidents. Panic alarms have been pressed in earnest over 600 times and many lives have been saved as a result of receiving a faster response.

Track24 describes the market sector they are in as the Security Tracking and Risk Management Sector (STRMS). This is in order to distinguish the distinct requirements of the STRMS from tracking companies operating in the fleet management or logistics sectors. Track24 is a leading global player in this sector and has leveraged this experience and technology to develop the capability for the defence sector. The Company operates with, and supports, clients on a global basis, operates seamlessly with many devices and communications networks, providing high levels of system security, durability and reliability, with excellent customer support, and can deliver an online platform specifically designed for security risk management.
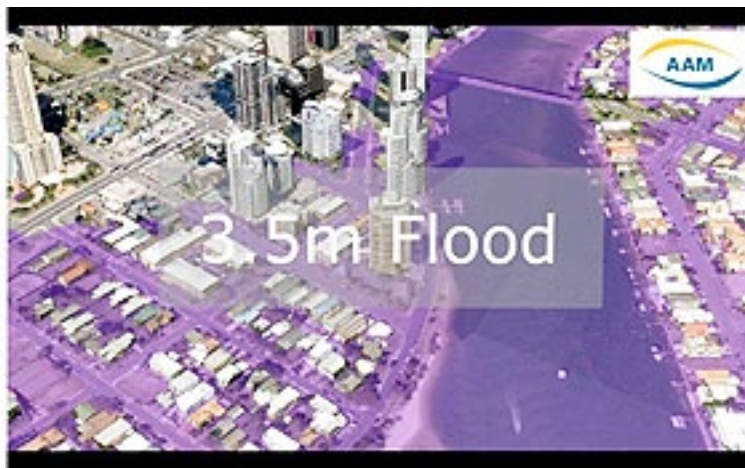
HERE'S LOOKING @ EARTH

Imagery Software Offers Flood Crisis Assistance

AAM's 3D Flood Simulation of Brisbane was used extensively by Australian and global media during the flood crisis in Brisbane, Australia, earlier this year. The videos were shown on most television news channels in the hours leading up to the Brisbane flood peak and they supplied residents, business owners and the public with realistic 3D representations of the predicted flood event. The videos proved to demonstrate the primary use and benefit of 3D visualization — clear communication!

The flood simulation was based on accurate geospatial terrain data created by **AAM Pty**. and it was produced by a new generation of spatial data accumulation and 3D modelling technologies. These technologies enable a number of Australia's major cities and towns to use accurate computer models of the built-environment and infrastructure, to support **Disaster Monitoring and Management** functions, including pre-planning for response and evacuation.

3D simulation of the expected 5.5m Brisbane flood peak.

3m and 3.5m flood simulation models.

How The Models Were Made

When creating building models such as for the Brisbane flood simulations, the first step is to begin collecting data. AAM collects data by flying over a city with a special camera system known as Pictometry®, which photographs in five directions simultaneously — forward, backward, left, right and straight down.

After the captured imagery is processed, a wire frame model of the buildings is constructed with façade textures automatically harvested from the oblique's, using a special proprietary 3D photogrammetry technique.

AAM also collects information on ground-level and surface features using vehicle-mounted LiDAR and Spherical Video. Aerial LiDAR is also used to check the height of buildings to ensure that the wire frames are accurate and to also form the ground-level Digital Terrain Model (DTM). This provides the accurate base for building models and other structures to be positioned on.

John Blackburn, Spatial Solutions Consultant at AAM, says the combination of photogrammetric and LiDAR technologies are vital to build an accurate spatial model of the real world. Additional spatial data and information from GIS, LIS and Asset Management Systems can be incorporated. It is essentially a "3D framework" of spatial data that can come from multiple sources.

Once the data is organized in this 3D framework, buildings and features can be added or removed as the city changes. The model is then maintained by the council as an up-to-date record of what the city looks like, as well as the components of its built form. AAM often re-flies cities to provide updated models. This is why in particular the 5.5m flood scenario simulation was a highly accurate and valuable tool as the flood began to reach its peak. Inundation modelling of any city or regional area can be addressed in this way, when the so-called "spatial data stack" is available. A request from the Flood Manager or Emergency Management Coordinator for several flood level scenarios would see the scenarios created within an extremely quick turnaround time.

The 3D Visualization

AAM's own software, ***K2Vi*** was used for the actual modelling. K2Vi is an innovative, real-time interactive, 3D visualization and virtual reality software platform that allows the user to quickly generate interactive 3D environments from a wide variety of data formats. As a software tool, K2Vi allows the user to both visualize and interface with spatial data from 'within' a virtual reality environment.

The key strength and major point of difference between K2Vi and other 3D visualization products is the interactivity of K2Vi and real-time display of 3D spatial data that may be stored and managed in the corporate GIS.

Many 3D solutions allow you to visualize a development in 3D and sometimes navigate along a fixed path through the

K2Vi used for mining.

Wellington Harbor tsunami simulation model.

scene. However, most of these visualizations are pre-rendered and do not allow interactivity such as freedom of navigation, *on-the-fly* shadow analysis, scenario toggling. and real-time visibility analysis. The power of K2Vi interactivity becomes apparent when K2Vi is used during design discussions, consultations and like the flood simulation model—disaster planning and preparation.

"They can view in real-time from any angle, and any position" says *Blackburn*. "Then they can change the model to reflect a proposed new development and see how it would look, how it would affect the local area in terms of visual impact, skyline, shadows, and how it would obscure views from other buildings".

Other Uses

K2Vi is used extensively for 3D visual communication in property development, resource/planning consents, military applications, landscape design, town planning, civil engineering and mining. The mining and resources sector presents many opportunities for 3D applications, which even include simulation of the extent of inundation from major rainfall events and the impact on operations and production. The software has also been used to demonstrate and communicate the effects of sea-level rise from climate change at the Copenhagen Summit and the inundation from a real tsunami threat, such as Wellington Harbour.

The role of 3D spatial data for visual communication is now widening to devices in the field of operations by emergency services, homeland security or the public who are in the situation domain. 3D data streaming to personal devices and smartphones is now technically and practically a reality as the personal navigation application on the wireless device becomes a tool to aid situation awareness and evacuation. ❖

Virtual city display on iPhone and iPad at the viewer's location