

Milsat Magazine



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ADVANCED MILITARY COMMUNICATIONS



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Communications On-the-Move (COTM) is an enabler. The technology allows those who protect, defend, and serve to be in constant communication with one another, with command structures, and support facilities, regardless of location. COTM affords “no-matter-where” communications for the warfighter. As part of this issue’s coverage, COTM is brought to the forefront. A number of subject-matter experts were queried regarding their analysis and expectations of COTM.

I asked *Eric Béranger*, CEO *Astrium Services*, where he sees the COTM market going this year, as well as where he believes the growth areas will be experienced. “We have been supplying COTM solutions for a number of years, particularly with part of the X-band spectrum dedicated to mobile users. With *Skynet 5*, we now have very high power X-band with multiple shapeable and steerable spot beams. These provide high gain that can provide high data rates services to small, disadvantaged terminals. Therefore, we see COTM expanding further into the FSS bands as the terminals and mobile networking techniques become available to match the increased satellite performance.



As far as what issues *Astrium Services* might have to confront, and how such “opportunities” will be addressed, *Eric* answered, “*Astrium Services* has built significant heritage in Aero and Naval COTM solutions based on FSS solutions. As a specialist operator, we also have experience of spread spectrum techniques that can be a requirement for many COTM applications, particularly UAVs. UAVs are a growing part of the COTM market. Our current communications solutions have given us a valuable insight into the complete UAV system parameters. Our principal challenge is the weight of the RF suite and size, weight and profile of the antenna on the mobile platform.

In addition, when it comes to immediate plans for additional programs and projects within the COTM arena, the CEO stated, “*Astrium Services* has a significant R&D budget, and we are involved in a number of ongoing development programs. Our focus is on developing the market through terminal and networking technologies.”

Significant issues facing COTM for military and government organization over the next five years... “For Aero applications, antenna size and weight are critical. For small land mobile terminals, particularly on vehicles, form factor is another critical issue. Once we’ve established a low profile, bandwidth efficient FSS antenna, we anticipate a marked increase in demand as communications services via satellite provide a coherent and ubiquitous platform for applications.”



Newpoint Technologies' President *Wally Martland* voiced his opinions regarding the market in this manner, "Short term, we expect to see most of the growth from the US Army, Navy and the Marines. The ongoing "War on Terror" and the Army's transformation to a lighter and leaner force has placed more emphasis on providing the

war fighter with the most up to date information available in conjunction with complete situational awareness. We expect to see more efforts by the Army similar to the MET Program, which is to modernize the existing COTM infrastructure, and also provide additional terminals to support the forces.

"Additionally, the Navy and Marines have also recently started a modernization effort. We anticipate COTM will be a very important aspect of this effort, and we expect to see it in increased activity by these two organizations, although we have not directly started to work with them as of this writing. Overall, COTM is a most important and critical requirement for the US military, if it is to achieve it's goal of net centric warfare and pushing the situational awareness information down to the war fighters.

"Outside our own forces, we are also noting much more activity internationally with NATO, the United Nations, and other NATO countries who are following the lead of the United States. As more of the peacekeeping responsibilities in Iraq and Afghanistan move from the US to these organizations, COTM solutions will become a critical part of their efforts."

I asked Mr. Martland what issues he feels his company will have to confront, and how such issues will be addressed?"

"Newpoint has been providing solutions for managing remote and transportable terminals to commercial and civilian organizations for many years. Our COTS solutions are already proven in providing "lights out" operation of these terminals in this environment. One of the unique challenges in applying these products to the military COTM marketplace has been managing the treatment of secure and unsecured data, essentially managing the handling of the data on the Black and Red networks, which could, potentially, be carried on the same COTM Terminal. We are fortunate that *Scott Herrick* recently joined us, having retired as a Lieutenant Colonel in the U.S. Air Force. Scott has extensive experience in this area. Our parent company, ISI, also has expertise that has helped us find a path to solve this problem.

"Most of these terminals are awarded to the large prime contractors. As part of the solution, they have to provide the remote management of the terminals. Often times, these companies elect to build these solutions out on their own. The renewed emphasis on COTS by all of the organizations has helped. However, we are still working hard to get our solutions in front of these primes to demonstrate that we have a viable COTS alternative. This alternative can dramatically reduce the cost of initial deployment of the COTM terminals as well as reduce the long-term sustainment costs of maintaining these terminals. This is managed by providing fully upgradeable software that is user maintainable. As this is our livelihood, we really have to be lean and innovative to stay competitive and remain ahead of the trends. We are continuously assessing the landscape for new ideas and capabilities, to ensure our products will always be based upon the latest technologies available."

When queried as to whether Newpoint Technologies has any immediate plans for additional programs or projects within the COTM arenas, Mr. Martland answered, "Newpoint has a number of R&D efforts underway that will significantly enhance our offerings to the COTM marketplace. The first is a service based management system, which will sit on top of our core Compass management platform. This will allow the operators at the COTM Network Operations Center (NOC) to manage all of the services being carried out via the network. It will allow them to view from source to destination all the equipment associated with the delivery of a particular service. In the event of a failure of any equipment in the network, they can see the affected services. This will allow them to re-assign resources on the network, and enable them to restore the high priority services, immediately based upon the available resources.

"Combined with this platform is a profile manager, which will associate a terminal configuration database for each of the services that use the network. In this manner, they will only have to select the source and destination terminals and then apply the profile

to bring the service online when scheduled to come up. Operators can also save new profiles or change existing profiles for each service as conditions dictate.

"As far as significant issues facing COTM over the next five years or so, Newpoint is seeing more and more emphasis on the 'lights out' operation of these terminals. As they are deployed into a

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particular area of operation, the terminal itself can be brought online and managed by technicians who are located safely away from any danger. This is also the case for military terminals, as well as terminals being deployed to support disaster relief organizations.”

Newpoint’s President continued, “In order to achieve this objective, we have to look beyond managing the satellite RF Equipment, but we also have to look at managing the UPS, generator, and power subsystems, the HVAC systems, and everything else a technician on site would be monitoring that could affect the operational capability of the terminal. This includes automating many of the routine tasks an operator would take on, such as accounting for rain fade and other weather conditions, and also providing orderly shutdown of the terminal when the generator is out of gas and the UPS is running low. This automation is essential to the operation of the terminal and is required for truly ‘lights out’ operation.

“Technology refresh could also become an important factor, as the rate of change in technology and capability continue to increase. As we have already seen and experienced over the last decade, the days of taking 10–years to field a system, then have it in operation for another 10–15–years, is no longer in the equation. Systems fielded today could well be obsolete in five years. This is what makes COTS solutions attractive, and one of the ‘checkboxes’ we always look at is how to provide technology refresh efficiently and cost effectively. The short answer is that you really need to map out a means to upgrade your system during the initial design phase.”

Tom Badders, the Director of Wireless Networking for **Telos Corporation**, stated that COTM is typically being used in military deployed environments, and will continue to be used in such a manner. He says the growth will continue to be driven by military and first responder organizational needs, with “growth including interoperability between military and civil/first responders.”



As far as the primary issues that will need to be confronted, Mr. Badders believes the “primary issue to a successful COTM deployment is having a complete understanding of customers requirements as well as a solid concept of operations. Plus, companies must educate the customer on the capabilities the industry has to offer. There are many advanced technologies available today that are just not being used. Integrating the various technologies into a workable system, tailored to meet the customers communications needs, is the key to ensuring a successful mission.

According to Tom, Telos Corporation is pursuing opportunities with multiple potential customers in the deployed military environs and military/civil defense organizations. “However, there are still many legacy systems fielded and new systems being fielded that are not compatible across services.

The issues facing COTM will be related to ensuring that components built into the system meet the needs of as many potential joint operations as possible. Integrators such as Telos have the capability to combine many technologies into a single, mobile, IP-based, interoperable on-the-move communications system. Matching this capability with the needs of the customer and educating the customer on what can be done will continue to be the challenge.”



Ric VanderMeulen, the Vice President and General Manager for **ViaSat's Government Satcom** division, believes there will continue to be a great deal of experimentation within the Mil-COTM environs, as well as some limited development targeted to the use of existing satellites in addition to the new, dedicated satellite systems.



"The technology for broadband COTM is available, to be sure. Operational networks are serving the VIP Special Air Mission (VIPSAM) fleet of aircraft, new Stryker deployment, as well as a C-130 Gunship deployment by USCENTCOM. Both the VIPSAM and Stryker are using the equipment we built for Boeing's Connexion and the C-130 Gunship is using our commercial ArLight network. The experimentation and limited development efforts include PM WIN-T and PM MBCOTM. These groups are encouraging the development of alternatives."

The military envisions the future Mil-COTM market to be served by the TSAT satellites—the systems using existing or commercial satellites have not been considered the main event.

Mr. VanderMeulen believes the primary COTM market growth will actually be on the commercial side. "We are seeing steady growth in both business jets and maritime market segments. These segments have been served by L-band (Mobile Satellite Services), but we are noting growth and transition to Ku-band services, such as our ArLight system, which offers greater throughputs at lower equipment and operational costs.

"The growth will be in business jets, maritime (yachts, shipping, etc.), and eventually ground applications. Perhaps with further development

and expansion of service areas on the commercial side, the military will be able to leverage such technologies for their own use.”

When it comes to the issues facing COTM-involved business, Ric says, “The issues are neither technical or regulatory. The technology is proven and the Ku-band FSS (Fixed Satellite Services) has been licensed to provide COTM services. The issues that do exist include market acceptance and coverage areas. The L-band MSS satellite providers have achieved two or more decades of market acceptance, and they have coverage of most of the earth’s surface including land and ocean coverage.

“The Ku-band FSS satellite services, such as ArcLight, offer greatly improved throughput (speed and capacity) at much lower price points. Their presence in the marketplace is growing, as well as the coverage areas available to use them. Current coverage areas include the U.S., Caribbean, North Atlantic, Europe, and Mediterranean, with further expansion planned for this year.

“The issues of market acceptance and coverage area will be addressed through continued acceptance of the Ku-band service offering, similar to the further penetration (acceptance) of mobile cellular that then created further investment in coverage area. We have plans to expand the COTM market segments in both the commercial and military markets. We have significant backlog for programs serving commercial business jets, maritime yachts and shipping, and military transports. We see direct growth within these market segments and into adjacent market segments.”

Inquiring about the issues to be faced ahead, ViaSat’s Government Satcom Vice President stated, “The significant issues facing the military organizations include ‘organic’ versus ‘commercial’ development, understanding COTM versus COTP (common-the-pause, or portable satcom) utility, and dealing with the lack of available satellite capacity. “Due to the newness of the technology, the mil-

itary is using commercial capacity, and developing its own organic capability. VIPSAM, Stryker, and the C-130 Gunship efforts are all examples of adapting and employing commercial technology to a military need. PM WIN-T and TSAT are examples of organic development to achieve the same fundamental utility. Small antenna terminals providing COTM consume more satellite resources than large antenna terminals providing COTP. There is an architectural tradeoff between COTM versus COTP with local area coverage.

“The military will need to determine the value of actually operating on the move, versus operation from a deployed forward location. A simple analogy is the time required for a fire department to travel to a fire, versus the time the fire department spends at the fire location.”

Ric closed by adding, “Capacity for the beyond line-of-site mission (i.e., satellite) continues to be greater than the available capacity. During the next five years, the deployment of UAVs and other types of ISR platforms will continue to drive the demand for this capacity. Therefore, the need to provide capacity for the COTM mission will contend with the need for ISR and other communication platforms on a priority basis.”

My thanks to the subject-matter experts for their insights into the critical COTM environment—*Hartley Lesser, Editorial Director* **MSM**

THE SATELLITE—FIBER CONNECTION

by Paul Dujardin, CEO, Genesis Networks

For everything from training programs and videoconferencing to entertainment programming for soldiers, satellite transmissions play a prominent role in the military's global communications strategy. While satellite will continue to be a critical transport mechanism for the military to deliver signals out of remote areas, in many situations, a fully managed, fiber optic network offers a superior option by offering lower latency, increased flexibility, and additional value.

As military technology has come of age in the satellite era, the armed forces tend to be extremely satellite-centric in their communications. Yet, many military organizations are questioning the practicality, and logic, of inserting a 23,000-mile satellite hop in a connection between two geographically close locations. In recent years, fiber optics has become an extremely attractive option, given the development of new technologies that have facilitated high-performance terrestrial delivery from origination to destination.

IP, for example, is enabling broadcasters of sports, news, and entertainment to economically transmit multiple standard

and HD channels through a single fiber link at collective bit rates that would far exceed the bandwidth available on a satellite transponder.

This is good news for the military, which, in many countries such as the U.S., is mandated to provide global communications to all service men and women regardless of where they are stationed. This includes

not only Internet access but high-quality television programming such as that provided by Armed Services Radio and Television Service. Troops stationed in Iraq expect — and deserve — to watch the Super Bowl at the same quality as the viewers on the home front. In such a situation, which requires delivery of a signal into a remote area that might have limited or sub-par domestic fiber-optic connectivity, some military organizations are approaching satellite and fiber as complementary tools for global transmissions.

This hybrid satellite-fiber approach relies upon satellite services transmitted through mobile units or a telecom infrastructure for “first or last mile”, with fiber providing the linkage for international transmission. By maintaining partnerships with satellite providers throughout the world, the managed fiber-optic provider is able to receive and aggregate satellite signals, and then transmit them terrestrially to far-flung locations. This configuration works just as well in reverse, with the content being delivered into the region by fiber and satellite providing the last-mile delivery to the destination.

With a managed fiber network working hand-in-hand with satellite, the military now has a reliable and cost-effective means of delivering programming to the troops wherever they are stationed, while limiting the human intervention and satellite double- or triple-hops that often result in operational errors. Likewise, content can be brought out of the area via satellite and inserted into programming for delivery, via fiber, to audiences back home.

Televised entertainment is not the only realm in which a managed fiber optic network adds great value for military communications. As I've said,

terrestrial fiber is a more reliable, efficient, and cost-effective option for linking sites in areas that have well-developed fiber optic connectivity, offering clean transmissions without the degradation in signal quality that sometimes results from multiple satellite hops. This makes it ideal for videoconferencing among key military decision-makers, training of troops across widely scattered geographic locations, and even medical consultations in which physicians in field hospitals can connect with larger medical facilities to share high-definition images such as x-rays and CT scans. Further, the security of fiber makes it better suited for transmission of classified information, since, unlike copper cable, fiber cannot be tapped.

In many situations, such as natural disasters, military and government applications of hybrid fiber-satellite communications extend beyond wartime. In the aftermath of Hurricane Katrina, for instance, FEMA relied on mobile satellite transmissions from the heaviest-hit areas, which were downlinked to a managed fiber network, and transmitted to FEMA headquarters to help the agency survey damage and determine what aid resources to send in.

In these stressful times, as military resources are stretched and budgets tightened, managed fiber optic networks offer the armed forces one more powerful weapon for “doing more with less”. As a replacement for, or as a supplement to, satellite communications, fiber presents a high-quality, and highly flexible, solution for occasional-use communications links as well as permanent networks. **MSM**

About the author

Paul Dujardin is Chief Executive Officer, Genesis Networks.

WHEN IT COMES TO SATELLITES

by Robert Bell, Executive Director, WTA

The leadership of the U.S. military is really hoping for a Hollywood ending when it comes to satellite. At least, that is the impression left from three days of government and military content at ISCe 2008, the California satellite show that ended June 12.

Quite a few films have been based on the ancient idea of selling your soul to the devil in order to gain extraordinary capabilities in life. There are two ways the story can end. In the more realistic one, the hero mispends his life, meets his inevitable downfall, and receives, shall we say, a warm welcome in the afterlife. In the Hollywood ending, the hero redeems himself through some act of selfless love, gets his soul back and heads to heaven.

The Army, Air Force, Navy and Marines have indeed gained extraordinary capabilities from satellite. Excellent presentations by officers including DISA's Brig. Gen. *Jennifer Naper*, US Army Col. *Patrick Rayermann*, Maj. Gen. *James B. Armor* USAF (Ret.) and Rear Admiral *John R. Hines, Jr.*, Deputy Commander of the U.S. 3rd Fleet, made clear how net-centric the US Armed Forces have become. It was a remarkably short time ago that voice, supplemented by data at dial-

up modem speeds, was how the people at the sharp end of conflict exchanged information, controlled operations and reported on results. Today, armed conflict is all about remotely piloted vehicles, satellite-based, force-tracking systems, shared situational awareness, and data downloads to the warfighter. With the Wideband Global Satcom (WGS) satellites now entering service, one speaker reported, the Navy looks forward to soon being able

to deliver 8 Mbps to ships at sea for the broad range of digital applications that today's military requires, from data networking to meteorological reports to crew morale applications.

At that point in the presentation, a question arose from the audience. Eight megabits per second? Isn't that kind of, well, unimpressive for the primary link to a ship carrying the population of a small town? Rear Admiral Hines explained that getting that capacity to the sailors, rather than just to the ship, means rewiring vessels, which is an immense job requiring years fleet-wide. Eight megabits is only the first step; speed and capacity are slated to rise with the launch of the full WGS constellation.

However, after two days of listening to my colleagues in uniform, I thought that other factors were also at work. First, the rate of changes reflects the innate conservatism of people who need systems to work when people are trying to kill them. When the Internet connection goes down in my office, I may be upset but I am not rendered suddenly blind to an incoming threat.

But the deeper reason that the military's most advanced satcom system is behind the curve, compared with civilian systems, goes to the heart of the unease the Armed Forces have about the devil's bargain they have made. Unlike civilian communications, military communications have to be satellite-centric. Neither ships at sea, nor motorized battalions, go to war dragging optical fiber behind them. In addition, satellites are vulnerable. Jamming them, as another officer pointed out, is child's play for a person with the right equipment and knowledge. Blowing them out of low-earth orbit, as the Chinese recently demonstrated, is a task within the scope of several nations. Even GEO systems are presumably vulnerable, though no one wanted to go into detail on that.

So, the military is becoming highly dependent on communication systems that are highly vulnerable to attack by nations and non-state adversaries. This vulnerability was the theme of all the speeches by the most senior officers at ISCe 2008. For entirely justifiable reasons, this concern has slowed adoption of technologies that would make the military even more dependent on com-

munications satellites. No one would discuss in a public forum what they are doing about the problem, but they certainly want the commercial industry to understand their concerns and collaborate on finding answers.

In a luncheon keynote, Lt. Gen. *William Shelton*, Commander of the Air Force's **Joint Functional Component Command for Space**, raised another issue much on the minds of the U.S. military. He contrasted China's January 2007 downing of one of its own satellites with the U.S. Navy's destruction of a spy satellite in February 2008. The Chinese, he noted, destroyed the satellite in low earth orbit, a particularly crowded piece of space, and the debris cloud they created is mostly still in orbit, creating a significant hazard to other spacecraft. They also did it without pre-announcement, for reasons that the Chinese government has yet to make clear. In contrast, the Navy announced the event in advance, provided a justification, and carefully plotted the impact so as to drive most of the debris on trajectories that would take it into the atmosphere, where it has harmlessly burned to ash.

In addition to making it clear who the good guys are, Gen. Shelton's speech was about the thousands of pieces of debris already in orbit and the very real possibility that allowing warfare to extend into Earth's orbit could render space unusable for hundreds of years. Of all the threats I heard about during ISCe 2008, that one gave me shivers. It would take so little to bring it about: just a cascade of fear and misunderstanding, bolstered by disregard for consequences. All very familiar human failings. The threat can only be addressed in the way that the nuclear powers dealt with mutually assured destruction during the Cold War. Whatever the tensions and geopolitical maneuvering, we have to make sure that everybody understands the simple truth: in some games, the only winning move is not to play. **MSM**

About the author

Robert Bell is Executive Director of the World Teleport Association. Since 1985, WTA (www.worldteleport.org) has been the only trade association focusing on the business of satellite communications from the ground up. He can be reached at rbell@worldteleport.org.

COMMERCIAL COTM FOR MILITARY USE

by Jose del Rosario

Senior Analyst + Regional Director, Asia-Pacific, NSR

Communications-on-the-move (COTM), broadband-on-the-move, or next-generation mobile satellite systems, have been discussed for a number of years, particularly for military use. COTM generally refers to on-the-move systems of at least 60 mph with throughput levels of 2 Mbps for inbound and outbound traffic.

The main driver for government/military COTM systems has been proprietary military systems. However, commercial solutions are required as well for redundancy and flexibility. And, due to budget considerations as well as the continuing capacity gap between the military's requirements and their ability to address their internal needs, commercial solutions are becoming key components of the COTM ecosystem. In speaking to Inmarsat for instance, the company indicated to NSR that it was exploring cooperative and collaborative efforts with the major prime contractors including **Raytheon** and **Boeing**, in incorporating commercial L-band solutions in multi-band system development. Moreover, the recent budget challenges faced by the U.S. Military's Transformational Communications Satellite System (TSAT), which according to an Air Force official "took a serious hit" in FY2009

and beyond, will adversely impact the military's internal systems development for COTM capabilities.

Market Forecasts

Commercial COTM equipment and services should continue to serve many needs within the government/military sector due to the flexibility and convenience that military staff, soldiers, aid agencies, as well as other civil government personnel demand.

Government use of broadband mobile terminals is expected to increase, particularly when the technology has established a record of accomplishment. To say that there is pent-up demand within the government for true or “on-the-move” broadband solutions is an understatement and indeed, the military has signed contracts with prime contractors over the next decade in the \$billions for true COTM systems.

In forecasting the market, some key restraints are important to outline that impact demand. Apart from budgetary challenges, some limiting factors are, by nature, technological such as antenna systems that are, or should be, compact, which have not been fully developed. In Ku-band for instance, market penetration has been limited since land mobile units have not been deployed in significant numbers, due to the issue of the ability of antennas to point to the right satellite while traveling at high speeds. Moreover, the ability to throughput at 2 Mbps while moving at 60 Mph has also been difficult. As such, the strict definition of COTM in terms of operational requirements is still not a hard and fast rule. For current operational requirements by the U.S. Military, COTM is often defined as on-the-move communications of at least 60 mph for throughput rates of 128 Kbps. These rates are generally accepted today and historically; however, military entities will demand much higher throughput levels from prime contractors for terminals and systems over the next one to two-years.

Finally, development costs that are highly expensive are part of contract awards from the DoD. There are contracts as well that include only the development of prototype systems before full-scale or large orders are placed by the DoD. Although initiatives within the private sector are taking place for prototype development intended for commercial use, the immediate need to fund COTM systems rests currently with the military sector, since it has the most pressing needs for such systems. But as mentioned previously, the military is currently facing budgetary challenges. On the private sector’s development for the commercial market, the current economic outlook also has a limiting factor in terms of investment risk.

Having outlined some market challenges, the need for commercial COTM going forward for military use re-

mains healthy. The delivery of high data rate communications to current operational forces, all the while providing a solid architectural baseline for the migration of these systems to support future Homeland Security objectives and important military programs such as Future Combat Systems (FCS), and Warfighter Information Network-Tactical (WIN-T), is crucial.

Based on the market potential by 2015 (and beyond), historical market performance, thus far, indicates a market that is still on the developmental stages of the business cycle. Both the number of units and revenues are expected to exhibit high growth within the forecast period. The forecast assumes that technical challenges will be overcome within the next few years, leading to greater procurement, and the fulfillment of deliveries for contracts signed thus far, between the DoD and system developers, or prime contractors.

Expectations are that the United States will lead procurement, and by a wide margin, with the forecast. The contracts currently being signed, as well as in the future, will originate from U.S. agencies, specifically, the DoD. Historically, this trend has already taken place where the United States procured or accounted for over 90 percent of the COTM market. Over time, although entities outside the United States are expected to procure COTM equipment in greater quantities, the U.S. will likewise accelerate its contracting with the major primes which will lead to a sustained share of the market as compared to other nations.

COTM by Platform

COTM is embedded in the U.S. Military as well as military agencies outside the United States in current operations. In the future, this will become even more pronounced as the mobile soldier, as well as unmanned assets for intelligence gathering and reconnaissance missions, increases.

At the heart of this capability are land mobile systems since wars, peacekeeping missions and the footprint necessary for intelligence gathering rests in land-masses. The land mobile sector is expected to account for the vast majority of in-service units as well as revenues until 2015. The other sectors (maritime, aeronautical and UAVs), although accounting for a relatively small part of the market, are expected to ex-

hibit healthy growth as well. It is worth noting that the entire COTM market is expected to be a large market segment, and the small slices of market share for these other segments represent healthy, and sustainable, annual growth.

The UAV Market

Although small in terms of its share of in-service COTM units, the unmanned aerial vehicle (UAV) is expected to become one of the most important COTM platforms over time, in terms of military missions, as well as revenue generation. Most of the globe's UAV programs that have been contracted belong to the U.S. Military, and this should continue to remain so until 2015. NSR foresees three scenarios that will likely take place in terms of affecting U.S.-based procurement:

UAVs will likely take the place of troops, especially once the technology for tactical, or weaponized, UAVs become more stable and reliable. For Afghanistan and Iraq, reconnaissance missions will probably continue even if, or when, the troop pullout takes place. U.S. support for friendly forces using UAV systems will likely continue in order to remain engaged in these regions. The DHS, DEA and border patrols will likely enhance demand for UAVs going forward, as evidenced by some contract announcements since 2006.

Reconnaissance satellites will play a large and growing role in surveillance activities and here, UAVs that rely heavily on commercial satellite capacity, will sustain demand for commercial COTM. According to the U.S. Military: Class III UAVs are to be multifunctional systems intended to be employed at the battalion level. A Class III UAV is planned to also provide an enhanced communications relay capability, mine detection, chemical, biological, radiological, and nuclear detection, and meteorological survey. The Class III UAV is to be able to take off and land without a dedicated airfield, and is intended to be able to stay aloft

for six hours over a 40 kilometer area with a maximum ceiling of 12,000 feet. Class IV UAVs are intended to provide the UA (brigade) commander with a long endurance capability encompassing all functions in Class I through Class III UAVs. It is intended to stay aloft for 72 continuous hours and operate over a 75 kilometer radius with a maximum ceiling of 16,500 feet. It is also planned to interface with other manned and unmanned aerial vehicles, and be able to take off and land without a dedicated airfield.

Of the close to 1,500 Class III and Class IV UAVs that weigh over 500 pounds that NSR expects to be in-service by 2015, the Africa/Middle East region should account for half of demand due to the growing concerns and potential flashpoints in the region. The continuing security situation in Iraq, growing concerns in Iran, Israeli conflicts with its neighbors, and the all important politics of oil, should lead to increased deployment and missions for UAVs for situation assessment. In light of troop pullouts in Iraq, the need for UAVs in terms of fleet expansion, number of missions and flight hours, should also likely increase.

Conclusion

In NSR's view, commercial COTM will remain an important, if not permanent, component of military COTM capabilities. The ingredients for military COTM that have a mix of unique systems engineering as well as "off-the-shelf" and "plug-and-play" elements, necessitate the role of commercial development and participation within the COTM industry. In fact, some commercial initiatives are ahead of military developments, where the military has enjoyed the benefits of reduced cost and speed in helping run their missions. For the long term, the partnership between the military and the commercial industry for COTM should become even stronger to the mutual benefit of both entities. **MSM**

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COLONEL MICHAEL D. SARCHET

Commander

Protected Satellite Communications Group

Air Force Space Command's

Military Satellite Communications Systems Wing

The leader of the *Advanced Extremely High Frequency (AEHF) satellite communications system delivery* is Colonel *Michael D. Sarchet*. He is the Commander for the Protected Satellite Communications Group, Military Satellite Communications (MILSATCOM) Systems Wing, Space and Missile Systems Center (SMC), at Los Angeles Air Force Base. AEHF is designed to aid all warfighters by providing secure, survivable communications, no matter the level of conflict within which such needs to be employed.



MilsatMagazine was delighted to have the opportunity to speak with Colonel Sarchet regarding his career and his current position with the U.S.A.F.'s critical AEHF program. With responsibility for a \$6.7B budget, the \$1.3B Enhanced Polar System, as well as Milstar constellation sustainment, Colonel Sarchet is an extremely busy individual.

His previous career assignments have encompassed a variety of leadership, engineering, and program management positions within electronic warfare systems, space acquisition, C4ISR ops and special communications. Prior to his current position, Colonel Sarchet was the Chief Engineer for the MILSATCOM Systems Wing at L.A.A.F.B.

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Colonel Sarchet, we thank you for interrupting your busy schedule to talk with us. Would you please offer us some insight into your Air Force career?

Colonel Sarchet

I have been with the Air Force for just over 22 years. My first assignment was to the *Air Force Electronic Warfare Center, Kelly Air Force Base*, Texas, where I worked on a variety of projects to improve the operational effectiveness of Air Force electronic warfare systems. In that assignment I received my first experience with space systems—and I was hooked!

In 1989, I moved to the *Office of Special Projects, Los Angeles Air Force Base (LAAFB)*, California, which was the Air Force arm of the **National Reconnaissance Office (NRO)**. I served as a systems engineer and worked on requirements and system testing, as well as new satellite concept development.

In 1993, I moved to **Wright-Patterson Air Force Base**, Ohio, where I earned my Masters Degree at the Air Force Institute of Technology. In 1995, I moved to the NRO in Chantilly, Virginia where I led a variety of satellite ground system developments. In 1998, I moved on to *Headquarters U.S. Special Operations Command, MacDill Air Force Base* in Florida. There, I directed the 24x7 operations of the command center, network operations center, and communications center. Working with special operators was a new and fantastic experience for me, and it strongly influenced my career from that point forward.

In 2001, I returned to the NRO in Chantilly and led a variety of satellite command & control and special communications programs. I also served as the Chief of Staff for the *Signals Intelligence Directorate*. In 2007, I moved to the *Military Satellite Communication (MILSATCOM) Systems Wing, LAAFB*, where I served as the Wing's Chief Engineer.

On April 11, 2008, I assumed command of the MILSATCOM System Wing's *Protected Satellite Communications Group*. Throughout my career, I have been extremely fortunate to work with exceptionally skilled professionals across the electronic warfare, special operations, and space communities. I want to take

this opportunity to thank them for all they have done to positively shape my career.

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Colonel, would you please highlight the events you've participated in that you are most proud of the final results?

Colonel Sarchet

I am extremely blessed to have been part of several high-performing teams that have delivered new space reconnaissance capabilities to orbit for our nation. I have experienced, first-hand, how valuable the information from our satellites is to our nation's warfighters and senior decision makers. Truly, that gives me a tremendous sense of professional satisfaction and pride. I look forward to leading the team that delivers the first AEHF satellite to orbit in 2009, and being able to share this same sense of professional satisfaction and pride with all of the team.

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Do you know how were you selected to become the Program Manager of such an important U.S.A.F. project as AEHF?



Colonel Sarchet

Advanced EHF is the flagship program of the Protected SATCOM product line. I suspect that my 15-years of experience in acquisition of space systems, and my background as a communications officer played in my selection for this specific program. I'm honored and privileged the Air Force selected me for such an important position, and has the trust and confidence in my abilities to execute this nationally important mission.

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AEHF is rather unique for an Air Force program due to its international flavor. How have you managed to



This photo is of the core propulsion module for the 2nd satellite, prior to delivery from Lockheed Martin's Mississippi Space & Technology Center to its Sunnyvale facilities in November of 2007

influence the other nations' program managers so all have a unified approach to the end result?

Colonel Sarchet

Our strategy in working with AEHF's international partners is not necessarily one of influencing our allies' program managers, but more of a mutual understanding of the common goal that unifies us. With that common goal in mind, the most important part of our strategy regarding the international community is in communicating how the program itself is achieving that common goal.

We focus on maintaining an information flow between the program office and the international partners via regularly scheduled teleconferences, written communiqués, and face-to-face working groups. Of special

importance is in-person communication—such is essential to ensure our allies are actively engaged in the acquisition process. The 'personal touch' of meeting face-to-face and having open discussions, as opposed to impersonal email traffic or teleconferences, helps maintain a strong relationship with each ally. In addition, this personal involvement gives each ally a greater sense of system ownership.

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What other nations are involved?

Colonel Sarchet

Canada, the United Kingdom, and the Netherlands.

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Colonel, can you tell us how many satellites will actually comprise the completed AEHF program?



This photo shows the first AEHF satellite following the successful mate of the propulsion core structure and the payload module at Lockheed Martin's Sunnyvale, California, facility. All AEHF photos courtesy of Lockheed Martin



The first Advanced Extremely High Frequency (AEHF) satellite in acoustic cell testing structure at Lockheed Martin's facilities in Sunnyvale, California

Colonel Sarchet

Currently, there are three AEHF's on contract. Based on Congressional direction, we have initiated the advance procurement of long lead parts for the fourth AEHF satellite.

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Protected communications are critically important to the warfighter—will AEHF manage to accomplish this goal and help our nation, as well as our allies, to secure the battlefield, and, what other U.S. services are involved in this \$6.7 billion project?

Colonel Sarchet

The AEHF constellation will help secure the battlefield by providing global, secure, protected, and jam-resistant communications for high-priority military ground, sea, and air assets. The physics of the AEHF waveform make the satellite well suited for strategic communications in a nuclear stressed environment, as well. The tight beam is an enormous benefit to tactical and special ops units due to the low probability of detection and interception. AEHF offers significantly more coverage opportunities with the addition of the electronically steerable beams and the accommodation of simultaneous users. The AEHF mission planning will be much more flexible by allowing users in the field to borrow/trade versus going back to a headquarters for a re-apportionment approval and retasking. In addition to the Air Force, other AEHF users will be the Army, Navy, and the Marine Corps.

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Finally, Colonel, what do you perceive as among the most serious challenges facing our nation's security, challenges that can be remedied through the use of our space technologies?

Colonel Sarchet

There are multiple threats to our national security: weapons of mass destruction, terrorism, and cyber attacks just to name a few. As these threats have grown, so has our reliance on space-based capabilities. Our nation's communications, missile warning, navigation, weather, and reconnaissance space systems all play an integral role in our ability to combat these threats.

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We appreciate your insight into the AEHF program and thank you for your time, Colonel.

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DAVE HELFGOTT

*President and CEO
DataPath Inc.*

DataPath Inc. is well known for establishing and maintaining communications anywhere in our globe, delivering total network control, even in the most extreme conditions and under the most urgent time frames. With their wholly-owned subsidiary, SWE-DISH, DataPath creates satellite and wireless based network solutions and mobile satellite communications systems that solve communications challenges. Based in Duluth, Georgia, U.S.A., the company operates via dozens of offices, distributor locations and field support bases around the world.

As the President and CEO of the company, Mr. David Helfgott, a 20 year vet of the satellite industry, is responsible for the strategic direction and operational program implementation. No easy task, given the company's involvement in the military and commercial arenas. As the past President and CEO of the SES Global, S.A., subsidiary Americom Government Services, Mr. Helfgott has been responsible for increasing company market share and revenues. We managed to locate DataPath's CEO on one of those rare occasions when he could take a few minutes to chat with us.



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Mr. Helfgott, please tell us about your experience in the satellite industry? How did you arrive at DataPath?

Dave Helfgott

My early career was centered on marketing, sales, and business development at information technology and telecommunications companies such as eFusion, Bell Atlantic, and MCI. In 2000, I joined **GE Americom** as senior vice president of marketing. In 2001, **SES** ac-

quired GE Americom and the new **SES Global** formed the *Americom Government Services* subsidiary. I was named president and CEO of that new business.

I joined **DataPath** in 2006 as president and COO, and this year I was appointed CEO. I have been very fortunate. My time in the satellite industry has been spent with dynamic, young organizations where I've worked with talented people to set the strategy and help grow businesses.

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DataPath really came on to the stage with their involvement in the U.S. Army's Joint Network Node and the U.S. Marines Corps' Support Wide Area Network (SWAN) programs that started in 2004. The company has really grown since then. Can you tell us about the reasons behind such growth and where that has led the company today?

Dave Helfgott

The core driver of our business has been the U.S. Department of Defense **C4ISR** market. Since 2001, there has been a rapid acceleration of the use and evolution of satellite and wireless communications technology in U.S. military operations. The availability of high-bandwidth SATCOM connectivity has dramatically altered the speed of communications and increased the efficiency of gathering, analyzing, and acting on critical intelligence. This is where DataPath focused and what



DataPath terminals and personnel rolled into Iraq in 2003 with U.S. forces and have worked side by side with them there, including at forward operating bases, ever since.

drove our growth. In 2001, when the U.S. military entered Afghanistan to set up forward-operating bases, we supplied transportable SATCOM hubs, and other systems that placed the network onto that battlefield. In Afghanistan, DataPath SATCOM terminals provided, for the first time, widespread access to high-bandwidth connectivity in direct support of large combat operations. Among other benefits, intelligence from video delivered by unmanned aerial vehicles (UAV) and other sources quickly became actionable on the ground.

DataPath's role in delivering communications networks evolved and grew in Iraq. We provided semi-permanent and mobile Deployable Ku-band Earth Terminals, or DKETs, which provided a wheeled platform highly suitable for quick positioning in Iraq. DataPath DKETs went "live" in Baghdad as troops established control over the Iraqi capital. These terminals delivered bandwidth that was many times greater than what had previously been deployed—in fact, this enabled a headquarters level of network capability in the capital city at the heart of a battle zone.

Once the DKET network delivered greater availability of bandwidth to commanders in Baghdad, the U.S. military envisioned a solution that would move that capability closer to the front line. This quickly evolved

into the Joint Network Node, also known as the Warfighter Information Network-Tactical Increment One, or WIN-T. For this program, DataPath created a highly specialized terminal, the DataPath Satellite Transportable Terminal, or STT.

These rugged, trailer-mounted terminals can go anywhere a Humvee can travel. We've delivered more than 850 STTs to date, creating one of the largest,

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most robust tactical battlefield communications network ever deployed.

In parallel to the JNN/WIN-T deployment, we have also been involved with the U.S. Marine Corps' SWAN program, which delivered a similar network using STTs, fly-away terminals, DKETs and wireless systems. SWAN has become global, with the program expanding into many deployments around the world. They have relied heavily on the network for command and control communications as well as for ISR applications such as unmanned aerial vehicle video on the frontline.

They also use a DataPath wireless system to extend high-bandwidth capability many miles beyond the SATCOM link. This is a really innovative battlefield development using a hybrid network to maximize capabilities.

The DKET, JNN/WIN-T, and SWAN programs have been the building blocks of network-centric communications in the field, and were the building blocks of our business. Since 2006, we have been actively diversifying through developing a broader military customer base and expanding into the civilian government and commercial media segments.

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Of interest to our readers is the fact that your relatively small company played such a major role in the building of the modern battlefield network. How did DataPath make this happen?

Dave Helfgott

It was the company's agility to do what was needed quickly, to work closely with the military to customize



commercial off-the-shelf (COTS) equipment, and deliver it with high quality. One of the breakthroughs we accomplished for JNN/WIN-T was the speed with which advanced and dependable SATCOM terminals can now be built and deployed.

The first STT was designed from scratch and built in 90 days. Later, we built many STTs each week. We have built DKET systems, from the ground up, in less than 10 days. DataPath has built more tactical SATCOM terminals for JNN/WIN-T and SWAN in two-plus years than had ever been previously produced and deployed in such a short time frame. When the military is at war, it cannot wait for years of R&D for a solution. Our business and manufacturing model fit right into the military's concept of "spiraling" COTS, with each spiral bringing new innovations.

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What customer benefits (commercial and military) are realized from your company's recent acquisitions of SWE-DISH and the MaxView product?

Dave Helfgott

Three years ago, DataPath was largely a satellite communications systems integration company. Since the end of 2006, we have expanded our business and grown from that core into adjacent markets and capabilities.

SWE-DISH, for example, specializes in industry-leading, ultra-portable SATCOM terminals that feature sub-1.5 meter antennas. These include Suitcase® terminals, which are known and used throughout the military, and also by global commercial broadcasters. They also have developed one of the most advanced communications-on-the-move (COTM) systems available. Through



SWE-DISH, we gained new customers and important capabilities that benefit our customers. We've now deployed SWE-DISH terminals to complement our customers' established networks, which are based on our larger terminals.

With **MaxView**, the situation is much the same. In terms of capabilities, MaxView software, as a management and control element to satellite terminals and networks, is a unique product. The difference rests with its capability to manage any device, and to offer a truly universal view of one or many networks. This makes remote monitor and control possible. The power of the application to manage network communications also improves system uptime. In terms of customers, MaxView software is used by the U.S. Defense Information Systems Agency to manage global teleports. It is also the network management software used in the U.S. military Ka-STARs program.

The acquisition of ILC, which developed MaxView, has dramatically expanded our customer base beyond military and civilian government users. MaxView has a blue chip commercial customer base, including many top global broadcasters.

DataPath and SWE-DISH networks and terminals can be deployed with MaxView. Currently, STTs, DKET, and SWE-DISH Fly-Away 150 terminals are MaxView-enabled. We have also been able to optimize our solutions by presenting complementary capabilities as well as a complete range of SATCOM terminals, from the smallest Suitcase system all the way up to large teleports.

In terms of the strength of our business, we had virtually no commercial business and no international business prior to these acquisitions. We were entirely focused on the U.S. DoD. That remains our core competency. However, we've now expanded into allied ministries of defense and the global commercial media markets. This diversifies and strengthens our business, and we also learn more as we work with a more varied customer base.

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Dave, what are the key challenges that you help your customers to solve today?

Dave Helfgott

Our government-focused effort is centered on supporting the U.S. DoD's network-centric vision, which is to ensure secure communications where it's needed, when it is needed, and to those who need it. This is the challenge of the Joint Services and combatant commanders, who, despite obstacles offered by distance, terrain, or other impediments, require long-haul connectivity to the warfighter for tactical reach-back and strategic communications. Along these lines, we focus on developing portable communications networks, such as the systems used in JNN/WIN-T and SWAN. We are developing several COTM systems. We have been working intensively to develop multi-band satellite systems that leverage the latest military networks, such as the Wideband Global SATCOM, or WGS, system as well as commercial networks.

In the civilian government area, we support first responders involved in domestic disaster response. For them, we develop advanced, integrated interoperable command and control systems. Plus, we provide services such as on-site technical support, spares depots, and a network operations center to enable all of our capabilities. Our field expertise is one of the critical factors that help us innovate in close coordination with military users and program managers. Our real-world experience in how systems perform in the field can make an incredible difference as to how we spiral in new designs and technologies to continually improve systems.

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What are the current challenges in order to deliver COTM on the battlefield?

Dave Helfgott

This is a complex and a critical challenge. A mobile command post capability would significantly improve operations on the battlefield. The key is, perhaps, as we have seen with the JNN/WIN-T and other programs, to deliver on most of the requirements quickly and spiral in advancements as they can

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be delivered. We should provide current capabilities into warfighters hands immediately. COTM capability is deployable and affordable today without years of R&D. The major issues we look at in respect to developing COTM solutions include:

Bandwidth—effective COTM systems need to provide large enough bandwidth at a high speed to support advanced applications.

Deployability—systems need to be truly deployable anywhere they need to be present. This means they are FCC-licensed, flexible, and can reliably operate with available satellite assets and the communications infrastructure.

Affordability—systems must be affordable, particularly with respect to bandwidth cost, as this outweighs capital equipment cost.

Interoperability—systems must be seamless within the common infrastructure and also communicate point-to-point with other deployed systems.

Advanced technology—systems must take full advantage of new wireless technology such as 802.16 to establish back-haul connectivity and meet the emerging requirement for larger bandwidth from moving vehicles to the hub.

Size, weight, and power—systems must be powerful enough to sustain operation, but as compact as possible to maximize deployability and enable system integrations on as many vehicles as possible.

Multi-band capability—systems must be capable of operating in X-, Ku- and Ka-bands to maximize bandwidth availability and operational flexibility through WGS and other networks.

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Could you please tell us about DataPath's role in solving COTM challenges?

Dave Helfgott

With COTM, DataPath plays two roles. We are a systems integrator capable of providing enterprise COTM solutions and we are a component manufacturer. Both

our core DataPath business and our SWE-DISH subsidiary have experience developing a variety of land- and marine-based platforms that have been demonstrated with the U.S. Navy, U.S. Special Forces, U.S. Army, the Swedish Ministry of Defence, and others.

By working closely with military users and testing these systems in realistic environments, such as mounted on a fast-moving riverine assault vessel, a humvee, and an armored personnel carrier, we have been able to innovate design and functionality. The innovation is conceptual and technological—we are looking at a variety of technologies and mounting apparatus we believe capable of delivering to the military's requirements.

As a systems integrator, we foresee solutions that combine SATCOM, wireless and land mobile radio technology, as well as address spread spectrum and single channel per carrier issues. Having deployed more than a thousand tactical terminals for the Army, Marines, and Special Forces in Southwest Asia, we've learned a lot about establishing complex network solutions. We bring this perspective to an enterprise view of putting COTM on the battlefield.

One of the systems we developed from this perspective is the Broadband On-the-Move SATCOM System, or the BOSS. This is a combined low-profile COTM and on-the-quick-halt system that also integrates land mobile radio, cellular, wireless networking, remote video surveillance, and other systems, into a complete mobile platform. This system has been demonstrated on a humvee platform at a number of military exercises.



As a component manufacturer, we have very innovative solutions. Our SWE-DISH division has developed a unique, high-performance COTM antenna solution.

The key to the system is the unique antenna design and a four-axis stabilizer that enables unprecedented on-the-move satellite pointing accuracy. The system supports high data rates and low interference in Ku-, operating as a single carrier per channel, non-spread spectrum system. This is a breakthrough COTM antenna system that offers an affordable alternative to spread spectrum, and promises improved performance in Ka- and X-band.

capability, similar to a headquarters' capability, that could be achieved at the battalion level. The innovation was getting many systems in the field that could set-up in less than 30 minutes at a stationary position during an operation, or at a more permanent, forward-operating base. Forward-operating forces can access NIPRNet and SIPRNet Internet resources, video teleconference, send and receive, intelligence video, and more, all from that location.

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Can you afford us a picture of what the nexgen SATCOM capabilities will look like on the battlefield as you build the network out further to forward-operating warfighters?

Dave Helfgott

Next-generation capabilities are being built to provide every warfighter with high-bandwidth connectivity to enhance situational awareness, information superiority, as well as speed and mobility. Integrated, multi-band, hybrid communications systems that include SATCOM and terrestrial wireless are a very important part of this.

The goal is to move advanced communications capabilities into the hands of warfighters on the furthest edge of the network.

In terms of SATCOM, communications on-the-quick-halt (COTQH), which is the technology we have now, was a big step after 2003. COTQH delivered high-bandwidth

Now, COTM and hybrid networks that use both commercial and military SATCOM networks will take that to the next level by providing all of that capability on the move. Rather than stopping and starting to access high-bandwidth capability, warfighters will be able to move at high speeds while accessing video and satellite imagery. They'll be able to use high-bandwidth applications to track forces, use intelligence applications, and communicate with others via data and voice.

The COTM link will enable extended and integrated land mobile radio, wireless and cellular networks around a command vehicle—every warfighter will have access to video and other applications. Even now, this intel is centered at the division, brigade, and battalion levels. With these advanced networks, we're going to be able to give everyone real-time situational awareness.

As more high-bandwidth applications and communications systems emerge, the real important issues are increasing performance while decreasing size and weight, as well as managing bandwidth requirements. It is critical that we are innovative with terminal designs, including within the ultra-portable and COTM categories, and develop multi-band terminals that operate on X- and Ka-band military networks as well as Ku-band commercial networks.

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What progress has been made in building out the WGS-compatible ground segment since the first satellite launch last year, and what is DataPath's role?

Dave Helfgott

WGS SV 1 is in orbit and is now the DoD's highest capacity communications satellite. This is a significant resource for warfighters as SATCOM is now pervasive in the communications infrastructure and is pushing further to the edge of the network. The key now is building out the ground terminal segment as the military decreases its reliance on commercial networks

Similar to the rapid deployment of the JNN/WIN-T and SWAN programs, this new resource is driving a new spiral of technology into the hands of users. The military now needs WGS terminals that can be rapidly certified and deployed on tight schedules. DataPath plans

to be a key WGS ground segment solutions supplier as well as a software provider.

In building out the ground segment, DataPath has a strong advantage. We're known for our speed and agility as we work closely with our customers. We have the field experience deploying systems side-by-side with our customers to know how to get this done. Moreover, we have been developing WGS systems. For example, we've already developed WGS Ka-band conversion kits for the hundreds of STT and DKET terminals in the field.

We have also released the new V-SNAP multi-band fly-away terminal, which is WGS capable, that can replace many standard military SATCOM terminals. V-SNAP is a flexible solution that is based on the fly-away systems deployed with the Marines and National Guard, and built to interoperate with current JNN/WIN-T, DKET and SWAN networks. This is a proven and cost-effective replacement system, ready for the field.

This year, our SWE-DISH subsidiary will release WGS-compatible terminals on the ultra-portable end of the terminal spectrum, down to a suitcase-sized system. These terminals are based on SWE-DISH's Communi-Case® Technology that features interchangeable components—different modems and antennas can be incorporated and parts can easily be replaced in the field.

Finally, our MaxView software is already a proven solution that is being deployed to support the Ka-STARs program. We are quite focused on helping build the WGS terminal segment rapidly, just as we have built the other critical SATCOM and wireless networks for the U.S. military.

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You mentioned disaster response as a key challenge... since Hurricane Katrina, has there been significant progress in ensuring interoperable communications will be available for first responder command and control?

Dave Helfgott

Through the *Call Home Act* passed last year, a billion dollars in interoperable communications funding is provided specifically to first responders. There are also new congressional bills pending for even more funding of emergency communications, beyond the existing Department of Homeland Security and other first responder agency funding.

The **U.S. Army National Guard's Joint Incident Site Communications Capability, or JISCC**, is a notable example of progress in this area. There are 32 command and control solutions built by DataPath deployed throughout the country. One, or many, of these systems can be towed or flown to a disaster area, and once on site, they can be set up in 30 minutes to establish SATCOM and wireless connectivity as well as interoperable communications with land mobile radio and other systems. JISCC takes connectivity and interoperability to a new level—it integrates SATCOM, wireless, and land mobile radio, as well as applications such as video conferencing, and packages it in one complete, compact and highly deployable configuration.



JISCC users on VTC

We're working closely with the Guard and other first responders to continue to develop and deploy these types of systems.

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Last question, Dave... what major technology advancements, new programs, and other events are you watching and planning for in the future?

Dave Helfgott

We work very closely with our military customers as we plan for tomorrow's needs as well as working to meet today's. Our core business is supporting the military to meet their toughest communications challenges. Along these lines, emerging operational needs and new military networks will present new opportunities to improve the ground terminal system.

Overall, we still have a lot of work to do to build out network-centric capabilities and implement COTM and hybrid networks in support of new applications that warfighters will use. To support these efforts, DataPath has become good at integrating technologies to create systems that are ground breaking. For example, we're making progress in addressing the needs of the military to collect, distribute, manage, and analyze video assets. This capability involves hardware, advanced software, and personnel to go out in the field and ensure these systems work reliably. From a product perspective, we design for flexibility, creating systems such as the **SWE-DISH CommuniCase®** Technology satellite terminals with interchangeable components.

On the software side, MaxView has a great deal of potential to move networks to the next level through remote management and control. We focus on capabilities such as these that address long term needs for reliable, flexible systems that go anywhere, improve performance, and maximize users' control over their networks.

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Thanks for your time, Dave—we appreciate your information and, likewise, see DataPath's future as highly innovative and a solid business model, all the while helping our warfighters accomplish their missions.

MSM

ACTIONABLE INTELLIGENCE

WIDEBAND MILSATCOM—HAS SPECTRUM MONITORING ARRIVED?

by Bob Cooper, Senior Staff, Glowlink
and Michael Downey, CTO, Glowlink

Wideband MILSATCOM spectrum monitoring recently came into the 21st century with the initial fielding of the Wideband Global Spectrum Monitoring System (WGSMS) to the U.S. Military's Camp Roberts in California, and Fort Buckner, Okinawa. Wideband SATCOM Operations Centers (WSOC) Follow-on installations are scheduled for Fort Meade, and Fort Detrick, in Maryland, and Landstuhl, Germany, WSOCs in the coming months.

The WGSMS, developed by Glowlink Communications Technology, is a component of the U.S. procured procured Military Wideband Satellite Communications (SATCOM)



Operational Management System (WSOMS). WSOMS is based on a "System of Systems" architecture comprised of a suite of new, state-of-the-art systems that provide planning, management, and control of X- and Ka-band communications links traversing the Wideband Global SATCOM (WGS) and Defense Satellite Communications System (DSCS) satellites. WGSMS is a powerful Digital Signal Processing (DSP)-based system that provides signal detection and characterization functions, as well as the identification of unauthorized signals accessing the satellites.



A NewGen Of Spectrum Monitoring

WGSMS replaces the DSCS Automatic Spectrum Analyzers (DASA) that have been in use at the five WSOCs. DASA, developed in the late 1970s, has been the primary spectrum monitoring device for wideband SATCOM for more than 25 years. DASA provides conventional frequency domain monitoring capability via an automated spectrum analyzer-based system. DASA measures traditional Frequency Division Multiple Access (FDMA) link properties such as center frequency, channel percentage of power usage, and carrier power to noise density ratio (C/kT), while providing an unauthorized access (UA) detection capability.

While DASA has served the wideband community well, the addition of the WGS satellites to the wideband SATCOM constellation requires an expanded monitoring capability DASA is not capable of supporting. The capacity of a single WGS satellite will result in a nearly ten-fold increase in bandwidth over a DSCS satellite. This results in the need for a more powerful and faster monitoring capability than DASA is capable of providing. Interestingly, the founders of Glowlink were also members of the original DASA engineering team.

New Challenges

The WGS satellite provides greater bandwidth and also introduces a channelizer function to divide each communications channel into bandwidth segments. This creates "virtual" transponders for mapping communications links in an uplink coverage area to practically any downlink coverage area. While this results in incredible flexibility from a communications perspective, this technology presents a new challenge for spectrum monitoring.

Traditionally, spectrum monitoring is accomplished in the footprint of a downlink antenna providing visibility into the majority of the communications links traversing the satellite. However, the bandwidth mapping flexibility of the WGS, combined with 19 downlink antenna coverage areas limits the ability of the WSOC to be in the footprint of no more than a couple of the antenna coverage areas at any one time.

To overcome this limitation, the WGS satellite includes a Spectrum Information Gathering (SIG) feature that taps into the uplink segments of satellite bandwidth and routes them to a downlink antenna coverage area that illuminates the WSOC.

While this provides the ability to monitor the entire bandwidth of the satellite from a single coverage area, it also requires that the spectrum monitoring system be capable of taking the bandwidth segments and reassembling them into a usable spectrum.

The WGSMS provides the capability to track and acquire the SIG segments and digitally reassemble them into a viewable and measurable spectrum, providing frequency and time domain measurements. Thus, WGSMS is the world's first system that performs synchronized monitoring, ushering in a new era in wide-band MILSATCOM satellite communications.

In addition, WGSMS takes the uplink measurements, maps them from the uplink antenna through the channelizer to the appropriate downlink antenna, and then reconstructs a downlink spectrum that provides an operator with the propagated amplitude and frequency assignment for each of the links.

This feature takes the guess work out of determining how a link was

routed through the satellite. Such allows the operator to easily correlate the relationship between the coverage area the transmit link is in with the coverage area the downlink is in.

“WGSMS is the world’s first system that performs synchronized monitoring, ushering in a new era in wideband military satellite communications”

“WGSMS is the world’s first system that performs synchronized monitoring, ushering in a new era in wideband MILSATCOM satellite communications.” In another area of break-through technology for MILSATCOM, WGSMS provides powerful, enhanced spectrum monitoring capability that combines frequency and time domain measurements, while achieving large gains in measurement cycle speeds over that of the DASA. WGSMS employs a high-speed digitizer with an instantaneous bandwidth of more than 72 MHz. WGSMS allows the measurement of the entire 500 MHz bandwidth of a DSCS satellite to be completed in approximately 1/20th of the time the DASA takes.

WGSMS provides the basic frequency domain measurements of center frequency, percentage of power, and C/kT and includes time domain measurements that allow signal characterization functions for the determination of modulation and coding attributes. The WGSMS time domain measurement capability provides special features, such as signal under carrier (SunCar™) detection, which detects the presence of interference under another carrier or communications link as part of its routine monitoring function. Prior to the WGSMS, low-level signals interfering with communications links were not detectable without switching the desired carrier, or link off-air, to see if any signal energy remained.

The WGSMS not only detects the presence of the unwanted signal, it also determines the impact to the primary signal while providing characterization of the unwanted signals to assist an operator in determining its potential origin.

Another state-of-the-art feature of the WGSMS is its ability to automatically assess the health of a satellite to prevent catastrophic failure, such as transponder saturation. Traditionally, power balancing a communications network on the DSCS satellite required

a controller to compare channel percentage of power used against the power levels of all of the links in that channel. Under certain conditions, rain fade and equipment degradation compensation could result in subtle channel compression that, if undetected, could result in full channel saturation.

Operators could find themselves inadvertently raising links that were in alarm without knowing that the channel was in compression. The result of the power raise would put the channel into further compression, which in turn would lead to even more links in alarm. The cycle would continue until it became obvious that the channel was saturated but, all too often, not before impacting the communications links.

The WGSMS introduces a Transponder Operating Point (TOPTM) feature that monitors the operating point automatically and alerts the operator at the onset of compression prior to any link degradation. This allows a much more deliberate power balancing process where the operator is knowledgeable of the operating point of the channel and can perform power balancing without adversely affecting the communications links.



Vital, Seamless Integration

Prior to WGSMS, some vendors have been touting the need to buy an “integrated system” from a single source. While this may sound appealing on a surface level, the customer often ends up in an “all eggs in one basket” predicament. This severely limits future options and places them at the risk of being held “captive” by a single vendor. Perhaps even worse is that the customer ends up being trapped with expensive and second-best, or even third-best, products in each product category.

To help the customer avoid this pitfall, and to accomplish its MILSATCOM mission, the WGSMS is designed with an open architecture and standard protocols so it can readily interface to a variety of other WSOMS elements. The WGSMS can be configured to monitor either a DSCS or WGS satellite via a configuration plan developed by the communications planners and managers located in the wideband SATCOM management sites. The monitoring plan will contain all of the communications links, earth terminal, and satellite attributes necessary to properly configure the WGSMS for performing spectrum monitoring in support of the radio frequency (RF) transmission control mission.

For monitoring the DSCS, the WGSMS will be configured for in-beam monitoring. The configuration plan will provide the only data necessary for the WGSMS to monitor the DSCS spectrum. For the WGS, the WGSMS can be configured for in-beam or for synchronized monitoring using the WGS SIG. When configured for WGS in-beam monitoring, the configuration plan is the only information that the WGSMS needs. For synchronized monitoring, the WGSMS will receive the configuration plan containing the same information as the in-beam plan and also receive the Global Satellite Configuration Control Element (GSCCE) information, which includes the crucial data required by WGSMS to carry out synchronized monitoring tasks.

Comprehensive System Views

WGSMS’s open architecture design allows all of the aforementioned capabilities to be accessed from a diverse set of external users via other WSOMS elements and clients, such as the WSOMS Remote

Access System (RAS). Not only will multiple operators in the WSOC be capable of accessing the WGSMS from any of the Objective DSCS Operations Control System (ODOCS) workstations, remote users at the WSOMS management sites will be able to access satellite and communications link performance gathered by WGSMS via the RAS. Through this comprehensive pan-system view, executive managers of WGS and DSCS are able to ensure the satellites and the communications links traversing them are fully operating within established parameters.

WGSMS is sponsored and operated by the US Army, who is also responsible for the life cycle management of the system. In addition to the five WSOCs, the WGSMS will be deployed in the near future to Fort Gordon, Fort Monmouth, and the Johns Hopkins University Applied Physics Lab (JHU/APL), while the RAS clients will be deployed at WSOMS management sites worldwide. **MSM**

About the authors

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ACTIONABLE INTELLIGENCE

LINK MONITORING—NICE TO HAVE, OR, MISSION CRITICAL?

by Scott Herrick

Director of Government Business Development
SAT Corporation

Persistence, on-demand, real-time Intelligence, Surveillance, and Reconnaissance (ISR) and the ability to deliver weapons without putting an aircrew at risk, are what typically come to mind when the subject of Unmanned Aircraft Systems (UAS) is discussed. This mindset is reinforced by operational successes in Iraq and Afghanistan as well as in non-combat and domestic applications, such as border security and disaster response missions (i.e., monitoring forest fires and assessing flood damage). Unless you are a communications specialist, or frequency manager, rarely do conversations gravitate toward the importance of the communications links that make UAS operations possible.

UAS's are heavily dependent on line-of-sight and beyond-line-of-sight communications for command and control and relay of mission data. For medium and high altitude UAS's, satellite communications are essential for maintaining connectivity. The fact that data links are susceptible to Radio Frequency Interference (RFI) is nothing new. However, when combined with the dynamics of the current UAS environment, the ability to detect and negate RFI may increase in importance and drive changes in how these systems are operated. At SAT Corporation, providers of RF Monitoring and Interference Detection Systems, the belief is that link monitoring for Unmanned Aircraft Systems is no longer a "nice to have"—they are now "mission critical".

The DoD Unmanned Systems Roadmap confirms this assessment...*"In general, there are two main areas of concern when considering link security: inadvertent or hostile interference of the uplink and downlink. The forward ('up') link controls the activities of the platform itself and the payload hardware. This command and control link requires a sufficient degree of security to ensure that only authorized agents have access to the control mechanisms of the platform. The return ('down') link transmits critical data from the platform payload to the warfighter or analyst on the ground or in the air. System health and status in-*

formation must also be delivered to the GCS or UAS operator without compromise. Effective frequency spectrum allocation and management are key to reducing inadvertent interference of the data links."

The Unmanned Systems Roadmap also provides an excellent synopsis of the current environment *"...spectrum availability is becoming increasingly unavailable or shared, whether in the Continental United States (CONUS) or in overseas theaters. Many UAS types, from Global Hawk to Scan Eagle, have lost at least one aircraft to frequency interference or misuse."*

This is compounded by the rapid growth in UAS systems that will drive demand for new capabilities and procedures to safely manage, coordinate, and operate the many systems currently in testing, or planned for deployment, in the near future. In addition to the Air Force, Army and Navy, NOAA, NASA, the Air National Guard, U.S. Forest Service, Customs and Border Patrol, the U.S. Coast Guard, and other national agencies, all are currently operating, or plan to operate, medium to high altitude UAS's. The next logical course of action becomes one of safe deployment and operations, and to identify the tools available to minimize RF Interference.

Currently operational testing and development of UAS systems is conducted on the national test ranges and is essential for maintaining and enhancing current systems as well as pushing technology forward. To operate UAS's solely within the National Airspace System (NAS) requires FAA approval. Such is granted on a case-by-case basis and approved tail numbers are small in number. One reason for this is that the policy and procedures for UAS lost link procedures and NAS flight rules are still being worked out.

Policy and politics aside, there are systems in operations today that can help improve link monitoring for UAS operations. SAT Corporation's Monics Carrier Monitoring and Interference Detection System is one tool that can assist operators in monitoring satellite data links to identify interference and take corrective action before mission impact.

Carrier monitoring combined with on-board sense and avoid technologies being developed by other entities

offers to contribute to the resolution of NAS flight issues, specifically the ability to maintain positive control and safety of flight.

SAT's Monics systems are widely used in the satellite communications industry to ensure quality of service. The system uses digital signal-processing technology to automatically monitor all uplink and downlink carriers on a satellite. The automatic process provides immediate alerts when a carrier problem arises (such as interference), allowing the operator to take corrective action and or switch to an alternate link.

Digital Spectrum Analyzers (DSA) can find interference occurrences within live carriers before the interference becomes a real issue. DSAs can locate interference under the entire live carrier bandwidth and analyze it. With knowledge that interference is occurring, and having access to the analysis of the interference, the operator can work to remove the obstruction.

This same system can be used without modification to monitor satellite links used for UAS operations. Therefore, this really is a COTS mission assurance tool available today and one that can be deployed to any ground station using SATCOM links for UAS command and control.

The other aspect of UAS data link monitoring is to address the potential for line-of-sight interference.

SAT SigMon systems offer another tool to address the potential for UAS line-of-sight interference. Currently deployed on a number of DoD Test Ranges, SigMon is a terrestrial RF monitoring, interference detection, and geolocation system designed to detect and locate terrestrial signals of interest. SigMon

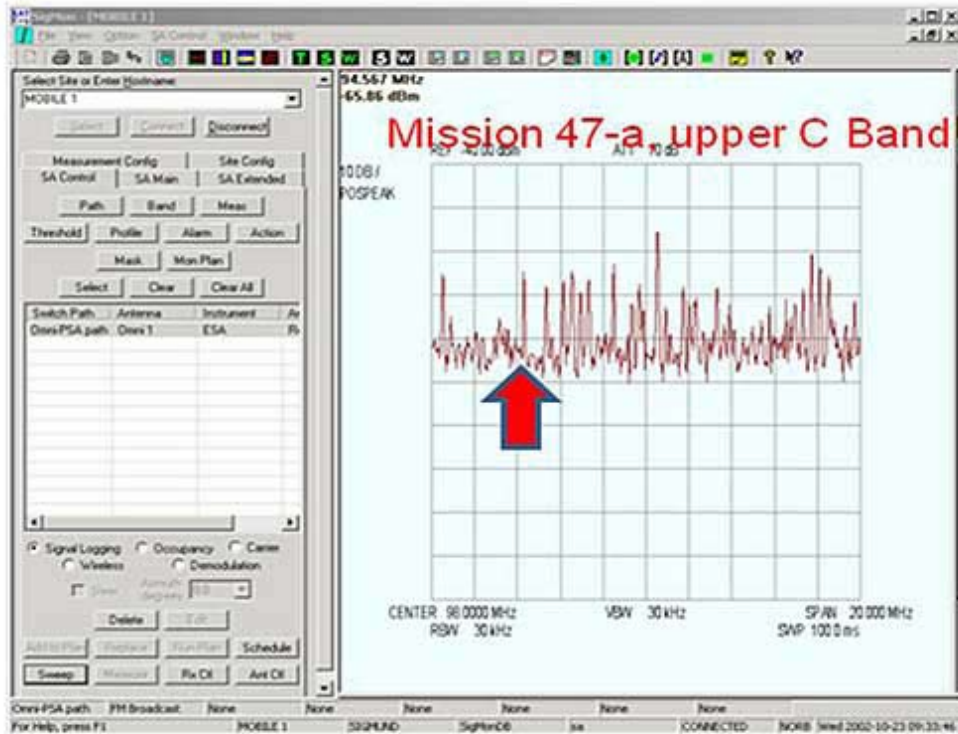


Figure 2 – SigMon Spectral trace with Mission Highlight

conducting operations in the NAS to provide pre-mission RF band clearing, real-time line-of-sight monitoring during mission operations, and for post mission analysis.

For the near term, we see the need for UAS data-link monitoring to continue to grow more as more systems are put into operation. Ideally, we would like to see a monitoring system associated with every UAS operations node, and satellite link monitoring systems at every ground station controlling medium and high altitude UAS's. Ultimately, over the long term, program requirements either from the FAA or DoD that define requirements for UAS link monitoring or

SAT Monics and SigMon systems deployed individually, or as a system (depending on the UAS configuration), offer a cost effective link monitoring capability. This applies to ranges conducting UAS operations and could be expanded to include UAS operators overseas supporting theater operations or

requirements for onboard sensors that will automatically detect interference and switch to a clear backup channel may be required to standardize or baseline UAS operations.

MSM

About the author

Scott Herrick is the Director of Government Business Development for SAT Corporation. One of his primary functions is to identify new Government market areas and applications for the Company. Prior to joining SAT Corporation, he served for more than 20 years as an Air Force Officer in various Space and Command and Control assignments.

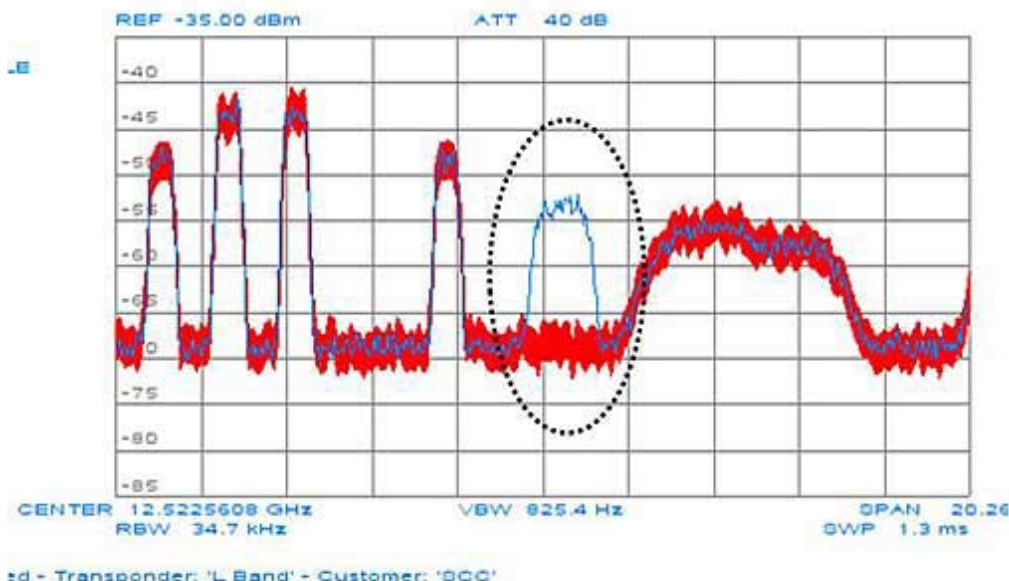


Figure 3 – Suspect Signal

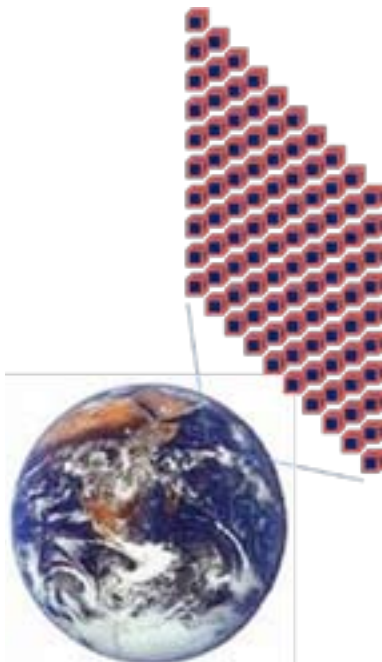
ACTIONABLE INTELLIGENCE

NO SECRETS FROM SATELLITES

by Dr. Len Losik
Founder and President
Failure Analysis

Today, satellites provide essential services to the public and the military environs. Those services include communications, navigation, weather, and scientific information, which has raised the standard of living and daily use of technology in the United States to the highest level in the world.

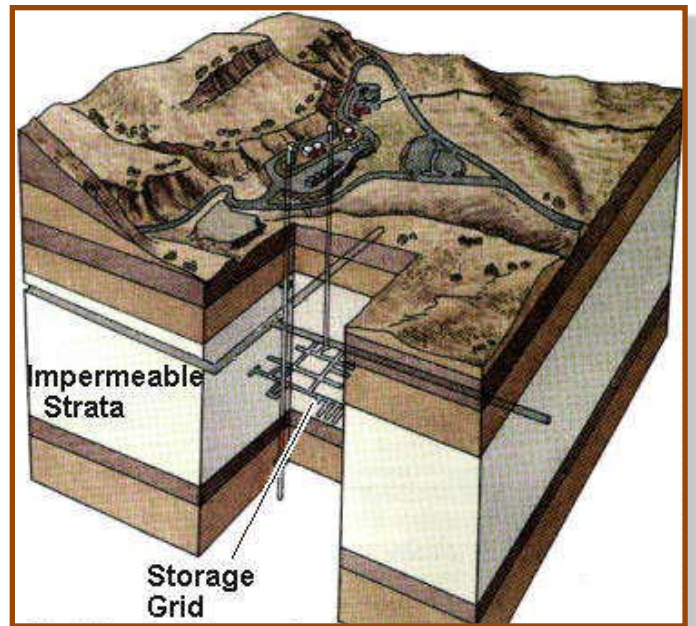
As air and space-based reconnaissance has uncovered threats to world peace, countries around the world have moved critical assets deep underground, outside the view and range of air and space reconnaissance satellites. These underground assets have been undetectable—until now! Many peace-loving nations are concerned that some countries are hiding their weapons of mass destruction deep underground.



DUMSTR in-Orbit Matrix

Satellite technologies from the military and NASA weather satellite programs (DMSP and NOAA) have been married to develop satellite position information incorporating Global Positioning System (GPS) and the signal intelligence from telemetry prognostic technology developed by Failure Analysis. Failure Analysis proposed DUMSTR to the National Reconnaissance Office (NRO).

The DUMSTR mission is to provide the information necessary to identify underground government, civil, and military assets, at any depth. The NRO has now started the development of DUMSTR.

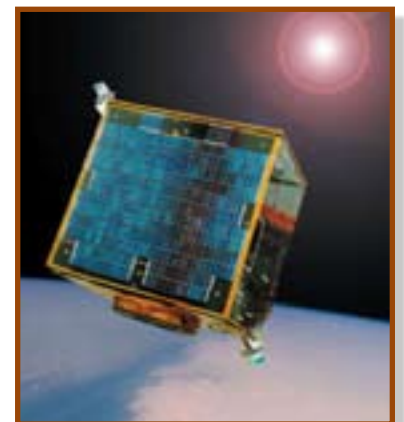


Underground facilities identifiable using DUMSTR

In the 1960's, the military was confronted with developing and maintaining plans to land troops anywhere in the world. The NRO developed the defense, mapping satellite program (DMSP). This was the first satellite-based, low-earth-orbit (LEO) weather mapping satellite to provide tactical information to troops when deployment to any global location became necessary.

In today's global condition, expanding the information available to our military forces to include the location of threatening facilities located underground is important. The operational DUMSTR matrix consists of a 10 x 10 matrix of satellites in low earth orbit that can identify underground facilities that have been, until now, invisible. In-orbit spares will be available in the event of a satellite failure. The matrix will use more than 100 active satellites to generate the information to identify underground facilities.

Each DUMSTR satellite will orient itself in space and remain at fixed distances from each of the other satellites, at distances



from 10 ft to 500 ft. This means the matrix will shrink and expand, based on the need to map underground facilities.

The DUMSTR satellites will map underground to a depth of 50,000 ft. The design driver for DUMSTR satellites' size will be the on-board fuel necessary to maintain each satellite's attitude and repositioning. The large number of DUMSTR satellites needed may provide, for the first time, a user for in-orbit refueling services. NASA pioneered these services for use for the International Space Station (ISS) in the 1980's.

Early NASA concepts for the space station incorporated in-orbit refueling for commercial, communications, geostationary satellites, all due to the large number of satellites used in geostationary orbit. DUMSTR propellant tanks are expected to be the largest ever used in space. The many giant geostationary communications satellites use bi-propellant rocket fuel, carrying both oxidizer and fuel, to avoid using a solid rocket motor for apogee injection.

These are excellent candidates for DUMSTR. Using satellite technology from DMSP and GPS, each DUMSTR satellite will use a 3-axis controlled, 0-momentum biased, attitude control system, side-mounted

radar, in a satellite in a sun-synchronous orbit (SSO). The program is planned to be long term and will use several hundred satellites during its 30 year planned program life. As more information is available, minimizing the advantages for locating military assets underground, DUMSTR underground mapping technology is expected to be replaced.



Satellite RADAR system needed DUMSTR

Other large constellations of satellites used for dual civil and military access include the first navigation program by Applied Physics Laboratory called TRANSIT, the National Research Laboratory TIMATION, GPS, and INTELSAT. These programs rely on the same technology DUMSTR satellites will use.

DUMSTR will provide an opportunity for satellite builders to produce satellites on an assembly line in much the same way automobiles are created. With almost 100 satellites proposed in the initial operational constellation, DUMSTR will be the first satellites to be mass-produced.

Originally, GPS satellites were seen as the first opportunity to mass-produce satellites as the system will require more than 50 satellites during its 10-year mission life. Satellite builders were originally told by the Air Force to propose mass production. After the operational GPS constellation was filled, the Air Force decided to award replacement satellites only a few at a time. New services and technology were added when such became available or were needed, which forced satellite bidders to maintain low prices.

DUMSTR will need to quickly launch more than 100 satellites for the final operational matrix. This will stretch current launch vehicle capacity—DUMSTR will be compatible with the space shuttle, ATLAS V and DELTA 4 rockets, making all available as large launch vehicles.

If DUMSTR satellites are built soon, the space shuttle may get a reprieve from its scheduled operational halt in 2010. The space shuttle could launch four DUMSTR satellites, simultaneously. The number of DUMSTR

satellites needed to be launched quickly will certainly provide the needed incentive to produce a launch vehicle tailored to the DUMSTR dimensions and weight, just as the DELTA 2 rocket was designed to launch GPS Block II satellites. As DUMSTR satellites will use many, well proven satellite technologies, material costs will be similar for any satellite builder. The non-recurring design engineering (NRE) costs are also low, meaning costs can be spread across many satellites.

Non-recurring design costs are often the reason many builders do not bid on large programs. Low cost, current suppliers of satellites for NASA and military missions are obvious suppliers for DUMSTR satellites. However, the large size and high number of satellites needed for DUMSTR will enable many other builders of small and large, complex geostationary and medium earth orbit satellite builders to become viable bidders.

DUMSTR will also provide geodesy science data. Geodesy, also called geodetics, is a branch of earth sciences that measures and offers representation of the Earth, including its gravitational field, in 3D, time-varying space. GPS satellite positioning information has been a great boon to geodetics. In addition to the Earth's gravitational field, geodesists also study geodynamical phenomena such as crustal motion, tides, and polar motion. DUMSTR will identify plate tectonics movement—this may well suggest that earthquake prediction is just around the corner. DUMSTR satellites will also measure the growth of lava chambers that are thought to cause earthquakes in seismically active areas. **MSM**

About the author

Dr. Len Losik is President and founder of Failure Analysis and has designed many of the nations largest and advanced satellites and launch vehicles while working at all major U.S. aerospace companies. Dr. Losik will be presenting papers at the NSS ISDC 2008, AIAA Space 2008, and ITC 2008 conferences. He can be contacted at len-losik@failureanalysisco.com and the Failure Analysis' web site is at www.failureanalysisco.com.

ARMY SIGNAL UNIT INTEGRATES FIRST REGIONAL HUB NODE

by Major Brian P. Bailey
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The Army Signal Community has successfully integrated the first Regional Hub Node (RHN) into the South West Asia Theater of Operations strategic network. The newest asset will support the warfighter through the three-fold combination of satellite communications transmissions capability, user services through Global Information Grid connectivity, and Network Common Operating Picture with Network Management systems. In addition to the listed functionalities, the RHN provides a limited set of common user enterprise services, including VoIP call management, file transfer protocol (FTP) / trivial file transfer protocol (TFTP) servers, and anti-virus software.

As designed, the RHN provides the following User Defined Functions identified by the Warfighter:

- The ability to rapidly transition from a home station/garrison environment to the area of operation
- Access to the full range of network services immediately on arrival in the AO
- A continuous, seamless flow of information throughout all phases of an operation
- The ability to quickly obtain network service when maneuvering / repositioning forces and command posts
- The ability of on-the-move elements to access network services
- Reduction in strategic lift requirements and deployed footprint

The Soldiers, DA Civilians and Contractors assigned to the **160th Signal Brigade** at Camp Arifjan, Kuwait, in coordination and collaboration with the **335th SC (T)**



(PROV), USARCENT, CIO-G6, NETCOM, CENTCOM, and MNC/F -I planned, engineered, implemented, and brought the RHN to *Initial Operating Capability*.

One of the RHN's primary objectives is operational agility, which will allow services to be provisioned quickly upon initial entry into the USCENCOM AOR and sustained throughout all phases of *Full Spectrum Operations*.

The 160th Signal Brigade's network engineering team initiated actions to plan and engineer the deployment of the SWA RHN into the SWA network in early summer of 2007. In conjunction with the 160th Signal Brigade activities, **PM DCATS / SCS** were responsible for the overall coordination of the RHN program implementation and installation effort pertaining to terminals, baseband equipment, NetOps, and connectivity.

With the PM DCATS published timeline that started RHN installation on *August 19th, 2007* through the *December 15th, 2007* completion date, the deployment occurred in three phases that included the **Acquisition Phase**, the **Sustainment Phase**, and the **Operational Phase**, as listed in the *RHN Operations and Control (O&C) Plan*. Each of the three phases included multiple milestones of varying complexity that the 160th Signal Brigade engineers, soldiers, and civilians worked to completion with the intent to conduct a **COMMEX** from December 15 through January 15, 2008 and meet IOC no later than January 15, 2008.

This case study focuses on the Acquisition and Operational Phases, which will describe both the 160th Signal Brigade Engineering Team actions to bring the latest communication asset into the Army's inventory, as well as explain the actions that a potential customer will complete to draw services from the SWA RHN.

The first discussion, **Acquisition Phase**, recounts the network engineering processes and milestones associated with integrating the RHN into the SWA

production network. In reaching the *Initial Operational Capability (IOC)* date, the engineer team focused on the administrative actions and documentation necessary to (1) *procure satellite space frequency*, (2) *extend DISA-provided strategic services to the Operational Base facilities*, and (3) *delineate Network Operations relationships*.

The second discussion, **Operational Phase**, identifies the processes that **JNTC-S** compatible Warfighters will use to request services from, or provision their unit onto, the SWA RHN. The generalized, systematic instructions outlined in this document will specify organizational roles and responsibilities, as well as identify the required information flow, coordination, and documentation throughout the requisition process.

As PM DCATS completed the physical construction of the facilities, the *Operation and Maintenance (O&M)* engineering team met to execute the final actions required to move the RHN from the planning and engineering (P&E) stage into operational status. During the coordination meeting, the team commenced planning for the gaps, shortfalls, and risks that inevitably result as newly fielded systems move from the conceptual stage of P&E to the functional O&M stage. From the first conversations, the RHN operators and Wide Area Network engineers talked about the challenges associated with integrating an Army-procured and managed communications platform into a Joint, or Multi-National, communications architecture. They recognized the challenge of creating a “flat, open network architecture” in an operational environment that consists of a “confederation of networks” unique to the Joint environment existing in the CENTCOM AOR. The engineering team worked through the processes associated with (1) *procuring the pre-provisioned Operational bandwidth*, (2) *receiving DISA approval for extending DISN services*, and (3) **the Network Operations functions that are managed through both Army and Joint organizations**.

Conceptually the CIO-G6 identified that as a *key performance parameter (KPP)*, the RHN maintains a set amount of pre-provisioned space segment in the CENTCOM AOR intended to support short-notice warfighter deployments. The pre-provisioned space

segment would be supplemented with a process to rapidly procure additional space segments to support the additional flow of forces into the theater.

As designed, the RHN NOC will act as the intermediary between the JNN-N enabled/compatible units and the commercial satellite NOC. Throughout the planning and engineering of the RHN Acquisition Phase, the Engineering Cell and the RHN NOC worked consistently with NETCOM, CIO-G6, and commercial satellite vendors to procure the appropriate satellite space segment.

However, in the operational environment, CENTCOM CCJ6 controls the spectrum management of **Army Service Component Command**'s assigned bandwidth in the AOR. USCENTCOM Transmissions section's reluctance to recognize the significance of this key performance parameter and its inflexibility to support the CIO-G6 intent of pre-provisioned bandwidth locally managed by the RHN NOC has resulted in constant transition of the frequency spectrum used by the SWA RHN.

First, the SWA RHN required an entire set of new Block Up and Block Down Converters as a technical refresh in order to make use of the available Ku-band frequency that wasn't already controlled by CENTCOM units. This technical refresh delayed IOC by six weeks.

Second, customer units and the RHN NOC transitioned through four different Transmission Plans and Task Orders during the testing phase and operational implementation to include US ARCENT's *Early Entry Command Post and Operations Command Post (EECP /OCP)* during Communications Exercises preparing the ARCENT Staff for Full Spectrum Operations.

Lastly, the SWA RHN terminals were assigned frequencies that had been previously assigned to another organization. This resulted in a loss of operational availability to a customer during a scheduled exercise. The three listed incidents would have been avoided with permanently assigned, pre-provisioned bandwidth managed and administered by the RHN NOC satellite terminal operators, as intended by design of the CIO-G6.

A second Key Performance Parameter requires the SWA RHN to be collocated with, and permanently connected to, a DoD gateway, and will extend to deployed tactical users access to the following pre-provisioned DISA services:

- Non-secure Internet Protocol Router Network (NIPRNET)
- Secret Internet Protocol Router Network (SIPRNET)
- Defense Switched Network (DSN)
- Defense Red Switch Network (DRSN)
- DISN Video Services - Global (DVS-G)

While planning and engineering the provisioning of DISN services, the 160th Signal Brigade and PM DCATS certification and accreditation process converged into the “perfect storm”. As PM DCATS worked the RHN system accreditation, the 160th Signal Brigade worked the *Connection Approval Process (CAP)* to enable the RHN to join the SWA network.

Coincident to those activities, the main NIPR and SIPR circuits providing connectivity between **SWA TLA Tier 1** and **DISA Tier 0** were expiring and needed CAP approval. Hindering the situation, the *SWA TNOSC Circuit Engineer* had submitted *Telecommu-*

nication Service Requests (TSR) to provision circuits specific to the RHN, in order to extend services on those circuits to the operationally based SWA RHN.

The last impediment to achieve IOC was the connectivity of the RHN to the TLA stack that services



the **MNF-I** network. The TLA that services MNF-I is housed in the same Technical Control Facility as the SWA TLA Stack. The TLA Stack discussion will be expanded in greater detail during the discussion of the third Key Performance Parameter, clearly delineating security boundaries and Designated Approval Authority assignments.

OBSTACLE: submitting approval of each tactical user through CENTCOM to DISA. Local DAA has the authority to allow a tactical user access to the SWA Network through the IATO / IATC of the local circuit.

SOLUTION: Extend DISA services through CAP / IATO / IATC to the RHN routers, allow SWA Network DAA the authority to accept tactical users. This will enable immediate access.

The JNN-enabled / compatible unit completes an abbreviated Connection Approval Process (CAP) that will authorize connection to the GIG, through the RHN Operational Base circuits, in order to draw pre-provisioned services. The CAP requires a *Memorandum of Agreement*, *SIPRNET Connection Questionnaire*, and *Network Connectivity Diagrams*. The 160th Signal Brigade and the Unit share the responsibility to complete the MOA.

The contents of the MOA consist of the **Consent to Monitor (CTM)**, a statement of residual risk; architectural changes notification, and IAVA scanning arrangements. The template of a CAP package is available through the 160th Signal Brigade Information

Assurance team. The SIPRNet Connection Questionnaire consists of 15 questions that range from IP addresses, Contractor Network Access, Foreign National Access, and Network Connectivity.

The third and last Key Performance Parameter to discuss during the Acquisition Phase of deploying the RHN is the delineation Network Operations relationships, which turned out to be the most cumbersome action. The CIO-G6 intent of the RHN is that each supported unit enclave will be allocated a separate physical, or logical, firewall instantiation to allow the unit to maintain its IA boundary and to provide a sufficient level of granularity to allow for unit-specific requirements. The CENTCOM network architecture employs multiple, *Top-Level Architecture (TLA)* routing and switching devices (stacks).

As mentioned in the previous topic, the TLA stack that services MNF-I is housed in the same Technical Control Facility as the SWA TLA Stack. In order to enable SWA RHN interoperability with Service Component and Joint customers, the WAN engineers needed to determine the simplest solution. This solution had to be able to enable the SWA RHN provide connectivity to the Army's *LandWarNet (LWN)* and the **Joint Task Force's Iraqi Theater of Operations (ITO)** network, by providing a routing solution through the SWA TLA Stack and the MNF-I TLA Stack, respectively.

During the *Rehearsal of Concept (ROC)* drill conducted the week of April 7th through December, 2007, the engineering team developed multiple courses of action to determine the appropriate physical solution to a logical networking challenge. Using the military decision-making process, the engineers concluded the acceptable solution would be to physically connect the RHN via fiber optic cable from the aggregate Tier 2 switch to the MNF-I TLA stack on the NIPR and SIPR networks. The two most significantly recognized reasons for implementing this physical cross-connect to the MNF-I TLA are:

- **Autonomous System Number (ASN);** the ITO had an established mesh topology within Iraq providing redundancy for the tactical elements, which enables them to talk to strategic units without the signal leaving Iraq over satellite

transmission. The team determined that to change this methodology would require a re-engineering of the MNF-I network in order to enable information to route through the RHN using the SWA TLA stacks because of the ASN.

- Security boundaries and management of assets. USCENTCOM CCJ6 acts as the CENTCOM DAA. The theater DAA has overall authority for the theater. The ARCENT CDR has appointed ARCENT C6 as the DAA for the SWA network. The MNF-I Commander appointed MNF-I CIS as the DAA for the ITO.

Although the RHN is located in *Arifjan* and is controlled / owned by ARCENT DAA, connected Iraq-based joint assets belong to the ITO managed and controlled by the MNF-I DAA.

OBSTACLE: multiple confederations of networks by service component and joint communities. Asset Network Operations, particularly DAA and security boundaries, become unclear.

RECOMMENDATION: U.S. ARCENT C6 / 335th SC (T) Commanding General be DAA for Operational base and tactical network connectivity.

In summary, during the Acquisition Phase, 160th Signal Brigade identified and advertised the SWA

RHN as providing numerous benefits to the warfighter that included:

- A continuous, seamless flow of information throughout all phases of an operation
- The ability to rapidly transition from a home station/garrison environment to the area of operation

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- Access to the full range of network services immediately on arrival in the AO
- The ability to quickly obtain network service when maneuvering/repositioning forces and command posts
- The ability of on-the-move elements to access network services
- Reduction in strategic lift requirements and deployed footprint
-

While operating in coordination and collaboration with the multiple key stakeholders, the 160th Signal Brigade worked through a number of obstacles to achieve IOC. Some of the hurdles that needed to be overcome were:

- Legacy technical processes and procedures that require long lead time (Cold War processes for a cold war army, not the modular army)
- Combatant Command control of Satellite Bandwidth (Component Spectrum Managers not involved in management of locally used space segment)
- Recognized authority of local DAA to enable customers to join the network
- Network Management Common Operational Picture between Service Components and Joint elements

The stakeholders influencing RHN operations are: customer, RHN NOC, SWA TNOSSC, 160th Signal Brigade, 335th SC (T), USARCENT, USCENTCOM, DISA, GSSC, and the CIO-G6.



In achieving IOC of the Army's first RHN, the SWA RHN Team identified the solutions needed to achieve a high degree of operational agility, as envisioned by the CIO-G6. The following capabilities will need to be realized:

- A well-defined Designated Approval Authority (DAA) chain and a stream-lined Authority to Connect / Authority to Operate (ATC / ATO)

process in accordance with the DoD Information Assurance Certification and Accreditation Process (DISACAP) Guidance

- Pre-positioned or pre-negotiated SATCOM space segment operated and maintained by the local satellite controller at the RHN NOC
- Pre-positioned baseband services available to the customer for use activated by the SWA TNOSSC WAN Engineers using templates of connectivity

The second part of this paper will explain to potential customers of the SWA RHN the processes and procedures related to requesting and receiving services from the SWA RHN while deployed to the CENTCOM AOR. With the mission as a component for theater reach back to support JTF and Army JNN-equipped units, the RHN provides connections with Enterprise-level services and direct access to the ARCENT/CENTCOM portion of the GIG.

The process is generalized in four categories (1) *Service Request Process*, (2) *Planning and Engineering Process*, (3) *Service Acquisition Process*, and (4) *Theater Network Operations Support*. All products generated by the processes and the lead engineer of the engineering cell within the SWA TNOSSC will coordinate procedures identified within the four categories.

The RHN Engineering lead will consolidate all administrative documentation into a Mission Folder and submit that folder to the RHN NOC. The RHN Engineer lead will enable direct coordination between the customer unit and the RHN NOC early in the provisioning process.

This section describes the process that will be followed to request satellite and gateway connectivity into the FRHN. These requests will leverage and use DISA's *Satellite Access Request (SAR)* and *Gateway Access Request (GAR)* procedures. It is important to note that these procedures have been streamlined for the sake of operational agility.

For all space segment requests, a SAR will be required. A SAR will also be required if changes are made to the existing allocation of the satellite space segment, or terminating equipment (e.g., antenna size) change. This is due to the continued need to in-

terface with the *Global Satellite Service Center (GSSC)* or *Regional Satellite Service Center (RSSC)* as an interface to the *DISN Satellite Transmission System-Global (DSTS-G)* for generation of a transmission plan (TP), licensing, and so on.

The 335th SC (T) will submit a RFS to DISA to establish initial DISN services provisioned to the FRHN. This will be accomplished as part of the *Initial Operational Capability (IOC)* of the FRHN. The SC (T) to DISA will submit a RFS and TR if the baseband and/or DISN Tier 0 service requirements exceed the quantity pre-positioned and/or installed DISN services at the FRHN. An ASR will be submitted by the warfighter to the ASCC for the original requirement. An ASR is a modified GAR that is scoped for FRHN baseband operations. The ASR is not intended to go to DISA for any actions, and will be handled internal to the theater Army organizations in a highly expedited manner.

Expeditionary Signal Battalions (ESB) supporting Division and Corps assets will obtain Ku-band (future Ka-band) services from the FRHN using the SAR/ASR process. The supported S6/G6 will be responsible for submitting the SAR and ASR. The ESB S3 or *Tactical Theater Signal Brigade (TTSB)* will assist the supported unit with SAR and ASR development. ESBs may support joint operations (e.g., *Joint Task Force (JTF)*) and may derive their services via a DoD Gateway. This would require a normal DISA SAR and GAR submission. All X-band requirements (*Ground Mobile Force (GMF)* and **Phoenix** terminals) for service through a DoD Gateway will continue to follow the DISA SAR and GAR submission procedures.

Note that the IP connectivity (e.g., NIPRNET and SIPRNET) between the FRHN and co-located gateway will be accomplished via **Army Tier 1** and **DISA Tier 0** connectivity on the installation. Terminals down-linking at a DoD Gateway will have high-bandwidth, low-latency connectivity to users operating off the FRHN. As previously mentioned, the ability to leverage a local **LandWarNet** perimeter security stack will provide a high level of assured connectivity between FRHN and DoD Gateway customers by keeping the interface local to both facilities, thereby keeping traffic between them internal to the theater.

(1) Service Request Process...

Step 1

- Warfighter submits a SAR, Request for Service (RFS), Commercial Satellite Team (CST) Service Survey (CSS), ASR, Network Diagram and ATO/IATO to the SWA Theater ASCC (ARCENT) or CENTCOM (CONUS)
- Warfighter coordinates with SC (T)/Corps/Division (as appropriate/applicable) during the development and submission of the SAR/RFS/CSS/ASR, Network Diagram, and ATO process. The 335TH SC (T) (PROV)/Corps validates the submission paperwork and forwards to ARCENT



(2) Planning and Engineering Process...

Step 2

ARCENT validates request and assigns mission priority ARCENT coordinates with the 335TH SC (T) (PROV) and FRHN NOC to ensure resources are available to support mission requirements ARCENT coordinates requirement with combatant command if:

- Space segment is funded by combatant command
- Joint mission supported (e.g., JTF)
- Adjudication of resources necessary for competing joint mission requirements
- If disapproved the SAR/ASR is sent back to the requesting unit noting disapproval

ARCENT and 335TH SC (T) (PROV) will work with the tactical unit to identify alternative courses of action (e.g., Out-of-theater FRHN or Teleport access) ARCENT submits SAR/CSS to the organization responsible for commercial SATCOM (COMSAT) management

- CONUS COMSAT Manager-NETCOM/9th SC (A)
- OCONUS COMSAT Manager-335TH SC (T) (PROV)

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(3) Service Acquisition Process...

Step 3

- 335TH SC (T) (PROV) or NETCOM/9th SC (A) incorporates mission requirement into SAT-COM access schedule
- Determines whether there are competing requirements for space segment resources and adjudicates conflicts with ARCENT and/or CENTCOM for Army or joint missions, respectively

Step 4

- 335TH SC (T) (PROV) or NETCOM/9th SC (A) forwards SAR/CSS to the GSSC or RSSC
- GSSC/RSSC receives SAR/CSS from COM-SAT Manager and submits the package to the DSTS-G contractors
- The DSTS-G contractor selected, develops transmission plan (TP) and coordinates licensing, landing rights, and frequency clearance
- GSSC/RSSC assigns mission number and develops the SAA

Step 5

- The SAA and TP are sent back to 335TH SC (T) (PROV) or NETCOM/9th SC (A) . In the case of training missions the COMSAT Manager tracks space segment utilization. In the case of joint missions (exercise & operational), the COMSAT Manager disseminates the SAA and TP to the combatant command J6 for theater space segment use and frequency management.
- 335TH SC (T) (PROV) or NETCOM/9th SC(A) reviews IATO/ATO and authorizes connectivity
- Coordinates with FRHN NOC to identify equipment set to support mission
- The 335TH SC (T) (PROV) develops the ASA from the ASR and incorporates the mission number from the SAA into the ASA

Step 6:

- The 335TH SC (T) (PROV) or NETCOM/9th SC (A) provides the Authorization to Connect

(ATC), Army Service Authorization (ASA), and SAA/TP to tactical unit and FRHN NOC

- The FRHN NOC and tactical unit coordinate, as necessary, the development of equipment crew assignment sheets
- FRHN NOC and tactical unit implement crew assignment sheets and prepares systems for operation
- FRHN NOC develops crew assignment sheets and implements equipment configurations as per SAA/ASA/TP/crew assignment sheets and provides coordinating authority for satellite and baseband services at the FRHN
- Tactical unit implements equipment configurations as per SAA/ASA/TP/crew assignment sheets and coordinates with the FRHN NOC for access to satellite and baseband services

These are the processes and procedures the 160th Signal Brigade executed to successfully integrate the SWA RHN into the existing Component and Joint network architectures. Through illustrating and focusing on the Acquisition and Operational phases of the SWA RHN deployment, the key points have highlighted the benefits of the RHN, the obstacles inherent in fielding the RHN as a new system, the stakeholders, and the solutions presented. **MSM**



MILITARY SATELLITE HISTORY—PART II

*by U.S.A.F.' Space and Missile Center's History Office
Los Angeles Air Force Base*

The Space and Missile Systems Center is the birthplace and cradle of military space and the central hub of military space acquisition excellence. SMC's mission is to deliver unrivaled space and missile systems to the joint warfighter and our nation, producing innovative, affordable, and operationally effective space systems of separate subsystems that could carry out different missions.

We continue our review of military satellite systems and we examine...

Infrared Early Warning Systems

The MIDAS program, the third offshoot of WS 117L, focused on developing a satellite with an infrared sensor to detect hostile ICBM launches. It began its life as a separate program when AFBMD placed the infrared portion of WS 117L under a separate contract with Lockheed effective 1 July 1959.

The payload consisted of an infrared sensor array and telescope inside a rotating turret mounted in the nose of an Agena spacecraft. Plans which were never carried out called for an operational constellation of eight satellites in polar orbits to constantly monitor

launches from the Soviet Union. Unfortunately, the program's first four test satellites launched in 1960 and 1961 ended in a launch failure and early on-orbit failures.

DOD kept the program in a research and development phase rather than approve an operational system in 1962. The MIDAS program was lengthened



Left: The Agena spacecraft for MIDAS I waits for installation on Atlas 29D before its unsuccessful launch on February 26, 1960.

Right: The payload for an advanced version of MIDAS, known as AFP 461, is covered with the Agena's nose cone before its successful launch as MIDAS 6 on December 17, 1962.

and renamed Program 461. The next two launches in 1962 also ended in an early on-orbit failure and a launch failure. Finally, a satellite launched on 9 May 1963 operated long enough to detect 9 missile launches.

After another launch failure in 1963, the last Program 461 satellite, launched on 18 July 1963, operated long enough to detect a missile and some Soviet ground tests. Data collection and analysis continued until 1968 under Lockheed's contract for Program 461 to support the next early warning program. Additional launches in 1966, using improved spacecraft and sensors, demonstrated the system's increasing reliability and longevity.

Although a launch on 9 June 1966 failed, launches on 19 August and 5 October 1966 placed their spacecraft into highly useful orbits, where their infrared sensors gathered data for a year, reporting on 139 American

and Soviet launches. The MIDAS program and its successors were declassified in November 1998.

DOD initiated a new program late in 1963 to develop an improved infrared early warning system, which ultimately became the Defense Support Program. After an early phase known as Program 266, a contract for development of Program 949, the Defense Support Program (DSP), was awarded to TRW for the spacecraft on March 6, 1967 and to Aerojet for the infrared sensor on March 1967.

The new concept involved placing the satellites into orbits at geosynchronous altitude, where only three or four would be necessary for global surveillance. Like MIDAS, the satellites would employ telescopes and IR detectors, but the necessary scanning motion would be accomplished by rotating the entire satellite around its axis several times per minute. An evolving network of two, and later three, large ground stations



The first DSP satellite, known as DSP Flight 1, is shown in testing at the facilities of TRW, the prime contractor. It was launched on November 6, 1970, from Cape Canaveral

in Australia, Europe, and the continental U.S. controlled the spacecraft and data. The first DSP satellite was launched on 6 November 1970, using a Titan IIIC launch vehicle.

A long series of increasingly larger, more sophisticated, and more reliable satellites followed,²² all of them except one launched on Titan III or Titan IV vehicles.²³ By early 2003, twenty DSP satellites had been successfully launched.²⁴ They provided a level of early warning that was, by then, indispensable for both military and civil defense. They also carried sensors that performed nuclear surveillance, a mission inherited from the Vela system. Although designed for strategic uses, DSP proved to be more versatile. During the Persian Gulf War, it provided early warning against tactical missiles as well.

By 1997, SMC and Air Force Space Command had exploited that capability by adding central processing facilities and tactical ground stations to provide DSP tactical data to battlefield commanders more rapidly and efficiently.

During the early 1990s, SMC pursued concepts and technologies for follow-on systems to replace the Defense Support Program (DSP). By 1994, the concept for a system to succeed DSP was known as the Space-Based Infrared System (SBIRS). SBIRS would be an integrated system that would support several missions: missile warning, missile defense, battlespace characterization, and technical intelligence.

The SBIRS concept actually included two planned satellite systems, referred to as SBIRS High²⁵ and SBIRS Low.²⁶ Both were heirs of infrared technology developed for the Ballistic Missile Defense Program (earlier known as the Strategic Defense Initiative) during 1983–1995.

SBIRS High was focused on the detection and tracking of missiles during the earlier phase of their flight, while their motors were generating heat and infrared signatures in short wave lengths. SBIRS Low would add the capability of tracking and reporting other data about missiles during the middle portions of their flight, when their infrared signatures were at longer wave lengths.

SMC awarded a 10-year development contract for SBIRS High to Lockheed Martin on 8 November 1996. The SBIRS High program had to be restructured during 2001 to deal with potential cost and schedule overruns, but its technical progress continued. In December 2001, a consolidated SBIRS Mission Control



The first operational fixed ground station for DSP, known as the Overseas Ground Station (OGS), was located at Woomera Air Station, Australia. It became operational in 1971.

Station (MCS) at Buckley AFB, Colorado, was declared operational. The MCS provided a central capability for command and control of all operational DSP satellites.

The completion of this first segment of the ground system upgrade allowed older DSP ground stations to be closed. Plans called for the ground system to continue to evolve to support satellites of the SBIRS High system. By early 2003, a payload for elliptical orbits in SBIRS High was undergoing ground testing. To prepare for the development of SBIRS Low, SMC awarded contracts for on-orbit demonstrations to TRW on 2 May 1995 and to Boeing on 2 September 1996. However, the SBIRS Low program began a gradual transfer of oversight back to the Missile Defense Agency during the same period. **MSM**

References

²² DSP satellites launched during 1970-1973 weighed 2,000 pounds, had a design life of 1.25 years, and incorporated 2,000 lead sulfide detectors operating in the short wave infrared range; they could see targets only below the line of the earth's horizon. Satellites launched beginning in 1989 weighed 5,250 pounds, had a design life of 3 years, and incorporated 6,000 lead sulfide detectors with an additional set of mercury cadmium telluride detectors operating in the short wave and medium wave infrared range; they could see targets both below and above the line of the earth's horizon. See Major James Rosolanka, "The Defense Support Program (DSP): A Pictorial Chronology, 1970-1998," SBIRS Program Office.

²³ DSP-16 was launched on a Space Shuttle (STS-44) on 24 November 1991.

²⁴ Two more DSP satellites remained in storage: Flights 22 and 23. No more were under contract because plans had called for DSP's successor, the Space-Based Infrared System, to reach operational status in time to take over operations from DSP's orbital constellation.

²⁵ The technological basis for the high-altitude follow-on system to detect missile launches was an earlier program under OSD's Strategic Defense Initiative (SDI) known as the Boost Surveillance and Tracking System (BSTS). It had been transferred to the Air Force in FY 1992 and had gone through several conceptual changes known as the Advanced Warning System (AWS), the Follow-on Early Warning System (FEWS), and the Alert Locate and Report Missiles (ALARM) program.

²⁶ The technological basis for the low-altitude follow-on system to track missiles in the middle portion of their trajectories had also been an SDI program. It had been known as the Space Surveillance and Tracking System (SSTS) during the mid and late 1980s and as Brilliant Eyes during the early 1990s.

To Be Continued...

Please join us in the next issue of MilsatMagazine as we continue with the history of military satellites, courtesy of the U.S.A.F.' Space and Missile Center's History Office, Los Angeles Air Force Base, El Segundo, California



MSS OFFERS DISASTER PREPAREDNESS SUPPORT

by
Edward Topasna, Program Manager
& Marc LeGare, CEO
Proactive Communications Inc

In the aftermath of natural disasters, military and other first responders often face enormous communication challenges that inhibit their ability to efficiently manage crises. If properly deployed, satellite telecommunication networks are the most effective way to ensure the phone, email, and Internet connectivity necessary to support federal, state and local emergency personnel. These satellite networks have proven to provide a reliable transport mechanism for all types of traffic in environments that are complex and difficult to integrate.

The disaster response scenario is one of the most difficult communication environments in which to operate, for the following reasons:

There is no real equipment standardization policy across the multiple levels of government first responders (*aka interoperability*). This issue is compounded if the incident location spans two or more state boundaries and if non-governmental organizations (NGOs) also arrive and need to be integrated into the communications architecture.

Second, if the environmental conditions include a damaged communications infrastructure, normal transport methods to establish communications nodes are damaged or non-existent. The dilemma is that the larger the incident, the greater the need for rapidly deployed, widespread, integrated communications capabilities. Satellite telecommunications, if deployed by quickly transporting multiple forms of data streams, has proven to be an effective tool in the Incident Commander's communications tool kit.

There are two primary factors that make satellite telecommunications an essential tool for Incident Commanders.

Satellite telecommunications links have many features that make them a "jack of all trades". These include large footprint, rapid reconfigurability, proven network security, and the most important feature —

reach-back beyond line of sight to the "safe haven" of an established communications node.

Multiple data types can be turned into IP (Internet Protocol) data streams and sent through this satellite link to reach all intended destinations.

Satellite Capabilities

Satellite networks offer a wide range of capabilities that make them a perfect fit for disaster recovery situations. The large footprint allows regional to national use of network resources. Plus, network providers can access any number of satellites that cover all regions of the U.S. at one time, ensuring no marginalized areas within the network. This means that network providers can have operational customers in one area of the U.S. with one set of requirements, and another set of customers with a different set of requirements in another region, both supported by the same network.

This network can also support communications on the move, communications (COTM) on the halt and fixed sites. The value to the Incident Commander is that over the duration of the incident, the satellite network can support various forms of satellite links. These links can be constructed for those personnel who must be able to communicate on the move to the incident area through voice over IP (VoIP), video teleconference (VTC), radio over IP (RoIP), camera, and data.

The same network can also support mobile nodes with auto-deploy antennas and a larger link for additive capabilities such as day and night camera, cell phone back haul, and wireless access. This network can support fixed antennas for the small, medium, and large office node until the infrastructure is replaced.

The satellite network is controlled from a central *Network Operations Center (NOC)*. Should a node require greater capacity for duration, the NOC can change the modem option file to create a larger link. The NOC can also engineer "quality of service" files to ensure the node's priority traffic is transported first before other types of data.

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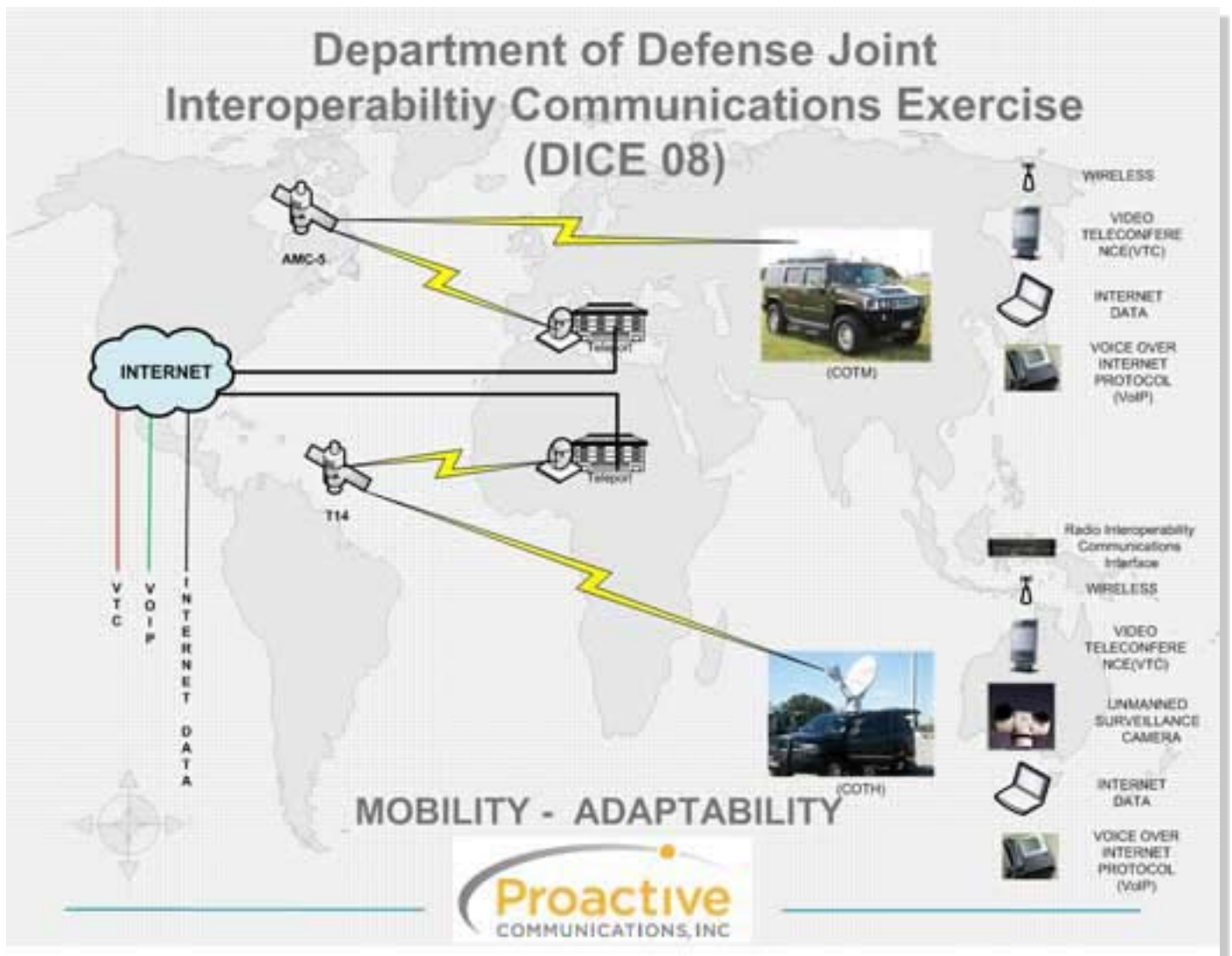
Finally, the network can be secured to the degree required by the customer. In a disaster response scenario, personal, financial and HIPAA information may be transported over the link. Network security measures can be easily deployed, but this requirement should be thought through ahead of time as much as possible.

For example, our company, **Proactive Communications, Inc. (PCI)**, has engineered a vehicle that allows for satellite communications on the move. PCI's *Satellite Platform and Remote Tactical Access Network (SPaRTAN™)* provides the Incident Commander the ability to communicate and provide real time information updates over Internet Protocol (IP) to the *Rear Operations Center*. Communications such as Ku On the Move/Halt, Internet access, voice over IP (VoIP), video teleconferencing (VTC), tactical confer-

ence bridge (radio over IP) and real-time video with an unmanned surveillance camera are aggregated at the vehicle/node and transported over commercial satellite/IP to the designated communications center. The PCI SPaRTAN™ also provides the capability of a standalone carrier division multiple access cell base station with the NSA approved TYPE I encryption QSEC 2700 secure cell phone.

Interoperability

The preceding paragraphs describe the flexibility of satellite networks, which provides little to no value to the Incident Commander unless it can reliably transport all the different communications capabilities that could be in use at the remote site(s). This is an interoperability challenge that can be overcome through technology. Devices now exist that turn legacy/analog



communications channels into transportable IP data streams. This type of technology is called *Everything over IP (EoIP)*, which enables the Incident Commander to rapidly integrate a large number of communication systems into the satellite pipe for long haul back to the “sanctuary” for reintegration into mainstream communications channels or, just as important, linkage to other nodes in the incident area.

The *Department of Defense Interoperability Communications Exercise (DICE)* is an annual event sponsored by the **Joint Forces Command** and conducted by the *Joint Interoperability Test Command*. DICE is the only exercise dedicated to testing interoperability between systems from the Services, DoD agencies, coalition members and commercial vendors. Networks are developed during DICE that replicate as closely as possible the typical Joint Task Force networks that are in use by operational units on real world missions. *Please see the network diagram from March 2008 DICE on the previous page*

During the DICE '08 exercise, PCI demonstrated that our SPaRTAN™ vehicle was able to interface and communicate with **Army North (ARNORTH)** and the **Federal Emergency Management Agency (FEMA)**. PCI was able to conduct VTCs, VoIP calls, and email exchange with various Army units, as well as with federal and state emergency agencies.

The following EoIP capabilities were highlighted at the March 2008 DICE event:

Radio

The Incident Commander's Radio Interface permits the connection of 10 different agency radios in an interoperability network, and their division into four independent “talk nets” or “talk groups” using clearly definable rotary switches. The talk group capability provides an Incident Commander with expanded control to separate special teams and agencies into task-specific radio nets. This device provides simple-to-configure, easy-to-operate, cross-band, cross-platform radio interoperability across typically incompatible equipment. It supports all commercial trunking and conventional radios, military radios, satellite

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phones, cell phones and VoIP connectivity. Based on the design and engineering of all Incident Commanders' radio interfaces (ICRIs), the ICRI for an emergency operations center can be set up in less than five minutes, creating voice connections without technical assistance, special training or computer interfaces.

Voice over IP

Any standard VoIP call can be transmitted over the satellite link. The engineering challenge is in selecting a digital data stream encoding/decoding device (called a codec) with an appropriate protocol to achieve a low circuit workload of 25 kbps. Other options exist, but these may require larger satellite circuits to handle the same phone call at 180 kbps or higher.

Video Teleconference

VTC enables the Incident Commander to have real time collaboration with any similarly equipped node by providing visual communication and information sharing. The visual information sharing capability allows the conferees to see slide shows, video presentations, or hand-made drawings on an electronic white board.

Camera

Camera over IP provides a highly interesting capability to the Incident Commander. This type of camera can be controlled by a hand held device at the base node, another remote node, or from the NOC to allow remote viewing that is independent of the ground operator. This is ideally suited for day and night perimeter security, maritime surveillance, and Department of Homeland Security/DoD applications. The camera is based on Forward Looking InfraRed technology developed for the U.S. Military.

Featuring a sleek, integrated pan and tilt design, the camera is capable of continuous 360° panning and a +/- 80° tilt and is able to withstand temperatures ranging from -40° to +60°C. These cameras include an advanced mid-range thermal imager that can see in complete darkness and through a multitude

of environmental conditions including smoke, rain, snow, dust, and dense fog.

Data

Access to raw Internet data enables the Incident Commander to surf the web and check email through a virtual private network back to the headquarters, or through an Exchange Server using Microsoft Outlook. Microsoft Outlook Web Access, Yahoo, and Google are other mail services that can be accessed. In addition to Internet data, connectivity provides the Incident Commander the ability to file transfer (FTP) large photos to the Rear Operations Center FTP server.

Continued Challenges

While hardware, software and systems integration may overcome most of the technically based challenges with disaster recovery communications, there are still many hurdles to overcome. The "come as you are" scenario can be planned for in exercises such as DICE, but there always remains the unforeseen complication or unannounced agencies who support the Incident Commander in reality. In these cases, national/industry standards such as Project 25 compliant radios are being developed to help, but implementing a satellite network infrastructure as described in this article gives Incident Commanders the best chance to successfully accomplish their disaster recovery missions.

MSM



About the authors

Mr. Edward Topasna was brought into the company as a Program Manager in 2007. After serving for more than 20 years in the U.S. Army as a Signal Warrant Officer, he continued to work with the III Corps, G6 as Network Planner prior to joining PCI. Mr. Topasna served various Signal Battalions, Brigades and Corps G6 staff positions for the U.S. Army worldwide as a Network Controller, Network Technician and Network Planner. Mr. Topasna accompanied the 13th Corps Support Command to Iraq during Operation Iraqi Freedom II (OIF II).

Mr. Marc LeGare became CEO of Proactive Communications, Inc. in 2006 after serving as the company's Chief Operating Officer and Operations Manager since 2003. Under Mr. LeGare's leadership as CEO, Proactive Communications has become the first U.S. company to work directly with the Iraqi Ministry of the Interior. Prior to joining PCI, Mr. LeGare was Senior Consultant and Operations Manager for Force XXI Battle Command Brigade of TRW/Northrop-Grumman. From 1981 to 1999 Mr. LeGare served various command and staff positions for the U.S. Army worldwide including Battalion Commander from 1999 to 2001. LeGare earned a B.S. from the United States Military Academy, West Point, a Master of Science from the Air Force Institute of Technology and a Master of Military Arts and Sciences from the School of Advanced Military Studies.

About Proactive Communications

Proactive Communications, Inc. (PCI) is a 40 employee IT and Satellite Telecommunications Company with a worldwide footprint. It specializes in creating communications solutions in complex environments. Its telecommunications experience in Iraq and Afghanistan in 2003-2005, an invitation to get involved in Katrina Relief effort was offered. From that experience, PCI has branched out to communications solutions for first responders such as the Florida National Guard.



ACTIONABLE INTELLIGENCE

SATELLITE COMMUNICATIONS FOR EMERGENCIES

by Dr. Markus Werner
TriaGnoSys

With sirens blaring, 20 fire engines and ambulances tore into the smoke-covered field at the German Aerospace Centre (DLR) outside the village of Wessling, near Munich. One hundred and twenty fire fighters, emergency physicians, and Bavarian Red Cross teams sought and found the dead and injured, gave them emergency first aid where possible, and assessed and classified the extent of their injuries. Classification was based on the triage system of three colors; black for fatalities, red for life-threatening injuries, yellow for the severely wounded, and green for the walking wounded. The injured were conveyed to hospital according to severity of their injuries.



First responders arrive at the emergency

Waiting hospital staff had two great advantages. Before the victims reached them, their patient records had arrived, via the on-site emergency doctors' PDAs. The hospital could also check, in real time, the exact location of each patient using GPS technology. The combination of both pieces of data meant the hospital could plan patients' treatment well before their arrival for care.

Both the patient and geo-location information was transmitted by satellite, making the data independent of the local communications infrastructure, which could have been destroyed or disabled by the emer-

gency. All the satellite communications hardware was transported to the smoke-covered site in a single suitcase, carried by one person. The hardware is also available in a rucksack version.



Data transmitted via satellite phones



The hardware has been designed to fit into a rucksack. The mobile phone handsets and the computer monitor provide the scale.

This was, of course, a simulated emergency, designed to test and demonstrate one of the key applications of a new satellite communications system that will help to save lives in real emergency situations.

The demonstration revealed one of the key uses of satellite communications as first-line emergency responders. The technology, which has been developed using EU funding (more on the EU funding later in this article) can also be used in natural disaster situations. This is often where the local telecoms infrastructure has been destroyed, or is non-existent in the first place, and where there is often no contingency for emergencies.

When disaster strikes, such as an earthquake or a tsunami, co-ordinating a response is often hampered by lack of information, or the ability to communicate to emergency services, governments, and aid organizations. Without information about what is needed and where, support can easily become redundant while, conversely, others receive no help at all.

A key use of this new satellite equipment is as a communications' center, to gather and map information and intelligence about the impact of the disaster, and to direct the recovery effort. The fact that the equipment is small enough to allow a single person to carry and deploy it means communications can be carried into the most hostile of environments: larger and heavier equipment would have taken days to arrive on scene.

The GSM-network can be set up in a matter of minutes, has a range of 700 meters, and anyone within that area using a GSM compatible electronic device—such as a GSM mobile phone, or a BlackBerry can use it in exactly the same way as if the user was in the middle of a city. The network eliminates the need for expensive satellite phones, which is the current available solution during the early stages of a disaster, that can only be used by a single person or organization. The network

simplifies the communications process and is an affordable solution.

WISECOM

The technology, developed by WISECOM (Wireless Infrastructure over Satellite for Emergency *Communications*), a DLR-led project, part-funded by the EU, has the objective of developing rapidly deployable lightweight communications infrastructures for emer-

gency or disaster conditions, in particular following a natural or industrial hazard. The infrastructure is designed to cover immediate needs in the first hours and days, as well as medium to longer term needs, during the recovery and rebuilding phase.

The WISECOM system consists of a ruggedized portable base station for voice and data communication, which is linked via a small satellite terminal to the public telephone network and/or to the Internet. The three main components of the equipment (which weigh a total of around 6kg) are the GSM base station, the industrial PC, and the satellite modem. The equipment is powered by rechargeable Polymer Lithium-Ion (Li-Ion) batteries, which provide about three hours of normal usage per charge, and weigh around 2.5 kg; a small 100W petrol (gas) generator can be used for longer-term use.



The key hardware: GSM base station, industrial PC, and satellite modem

The satellite communications element of the WISECOM technology has been developed by TriaGnoSys, a leading provider of mobile satellite communications' solutions, and one of the key partners in the project.

The idea behind the satcoms is to break down the signalling and the data communication between the GSM Base Transceiver Station (BTS), part of the WISECOM equipment, and the Base Station Controller (BSC), which receives the signals from the satellite. The BTS captures the GSM packets, which are then converted into IP packets for satellite transmission by the Terminal Side GSM Server (TSGS). On receipt by the Network Side GSM Server (NSGS), those packets are then converted back to GSM, forwarded to the BSC, and switched to the core network elements.

System Architecture

The TSGS is basically a ruggedized industrial computer running TriaGnoSys' Mobile GSM Infrastructure software, called TriaMoGis. The software, which has been commercially deployed in the air transport world to allow airline passengers to use their mobile phones during flights, performs the following functions:

- **Satellite bandwidth on demand:** the software dynamically requests the required bandwidth in the satellite modem; when no more resource is available, the incoming call will be blocked
- **BSC signalling suppression:** TSGS and NSGS collates GSM messages and sends them periodically, to minimize the satellite usage and therefore required bandwidth
- **Codec selection and IP compression:** to use the scarce satellite resource most efficiently, the TSGS supports different types of voice codecs to reduce the size of the voice packets. Both GSM full-rate and Adaptive Multirate narrow band (AMR-NB), with rates as low as 4.75 kbps, are supported. Further decrease in the transmission bit rate is achieved by robust IP/UDP/RTP header compression

Other functions such as Quality of Service (QoS) support, GSM BTS automatic control functions, GSM service selection, and network management are also supported. The WISECOM project is co-ordinated by the German Aerospace Centre, DLR. Project partners are TriaGnoSys GmbH, AnsuR Technologies AS, Astrium SAS, Steinbeis Forschungszentrum GmbH, Reach-U Ltd. and Thales Alenia Space. The project is co-funded by the European Union as part of the FP6 IST Programme.

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About the author



Dr. Markus Werner is one of the founders of TriaGnoSys and he is responsible for TriaGnoSys' emergency response and disaster recovery work. He received the Best Paper Award of ITG conference "Mobile Communications" in 1993. The co-author of more than 120 publications, including two scientific textbooks and numerous scientific journal papers, Marcus also teaches satellite communications courses for telecommunications professionals.

TECHNIQUES FOR MANAGING ENTERPRISE TRANSITION

by Rob Byrd and Earl Pedersen, SI International

Within the satellite industry, whether on the military or commercial side, the agency- or company-wide framework that incorporates all of the computing, information and management systems is known as the Enterprise Architecture (EA) or Solution Architecture. EA is the model for the operation and organization of a company, agency, command, and so on, as defined in various documents that deal with the structure and formation of various information systems or services. Such is commonly defined within one of the structures of the EA, that being the architecture domain. There's business architecture, data architecture, applications architecture, and technical architecture. These cover everything from protocols, server nodes, software modularization, application interaction, data in motion and storage descriptors, business goals, and roles. A complex environment, to say the least, but one crucial to the success of any military, agency, or commercial endeavor in the satcom industry.

Which is why we've asked SI International (SI), a leader in object-oriented analysis and design (OOAD) application, to reveal their Unified Modeling Language (UML)-based method, *Net-Centric Enterprise Architecture*, which defines and models target enterprise operational processes. Such aids in facilitating transition planning to a service-oriented architecture (SOA), which brings into play interoperable services and IT infrastructure definition, with functionality grouped around business processes.

Why is SOA so important? It forms distinct services from the functions, makes all accessible via a network for merging, and reuse in business application production. Data is passed from one service to another, or an activity is coordinated between services, and the communication between the various processes exchanges the information quickly and reliably.

SI professional services include a repeatable technique to capture mission requirements in context of operational use (Requirements Understanding); to discover common, extendable, and reusable pro-

cesses (Integrated Enterprise) and to assist in the implementation of target enterprise capabilities via a well-managed spiral model (Managed Change). Their EA Center of Excellence (COE) in Colorado Springs is a showcase of state of the art architecture development facilities designed specifically for enterprise model development.



The architecture challenge evolves around developing processes and methods that provide requirements understanding using an integration framework while laying the foundation for portfolio management and managed change.

SI's object-oriented (OO) approach leads to the production of highly integrated, agile, and affordable systems, fielded in a shorter amount of time compared to the traditional structured analysis approach. SI determined after much research that UML business models used to manage functional requirements are easier to understand by business analysts and, ultimately, the developers tasked to build the systems. As the software development industry is acutely aware, the significant power of an OO approach is the ability to identify reusable elements within and among enterprises using a service-oriented architecture approach, to include:

- Processes (operational or business activities)
- System components such as enterprise workstations and servers
- Interfaces such as those between internal and external data sources

- Nodes taking into account organizational considerations

Architectural concepts such as information exchanges The power of service-orientation can, if properly exploited, reduce development costs, schedule, and risks, while facilitating integration and interoperability. SI has continuously matured their method since 1997 and now has more than 35 certified, practicing enterprise architects working for their Colorado Springs EA COE. SI leverages their Enterprise Architecture COE, described later in this article, in every Business Process Reengineering (BPR) and EA engagement they perform. This article provides an overview of SI's EA practice and demonstrates how enterprise architectures can assist service-oriented architecture transition efforts.

The Case for Object-Oriented UML Enterprise Architecture

The UML is an industry standard for the creation of visual models that represent behavior of business systems for object-oriented software development. It combines the best diagramming practices applied by software developers over the past 40 years. The Object Management Group (OMG) formalized the notation in 1997 and the DoD community is formalizing a common UML approach through OMG's UML Profile for DoDAF (Department of Defense Architecture Framework) and MODAF (United Kingdom Ministry of Defence Architectural Framework) (UPDM).

The acquisition of all major DoD weapons and information technology systems are required to develop and document an EA using the views prescribed in the DoDAF. Complete systems definitions are required by MODAF for the procurement and integration of defense systems in the UK. The entire modeling standard is known as the Unified Profile for DoDAF and MODAF, or, UPDM. The UPDM standardizes a common UML profile to ensure consistency of method and architecture data elements throughout the defense enterprise.

The UML is not a computer software language such as Java or C++, among others; rather, the UML is a visual language using semantically rich, graphical and textual design notations to capture information technology conceptual designs. The UML improves commu-

cation among conceptual teams as the design evolves and the community reaches agreement. The language allows the reader to reason about the design. The language provides an unambiguous basis for implementation. The UML shows the essentials of the system from a particular perspective and hides the non-essential details. The following paragraphs describe an object-oriented architecture purpose and benefits.

Reduced Complexity - Object-orientation is exactly what it implies — orientation toward the object, rather than functional decomposition, which is oriented toward decomposition of functions. Objects are abstractions, a way of describing the real world by addressing the information about the object that is important to your purpose or the problem you are trying to solve. Thus, the OO modeling notations provide the architect a way of modeling important requirements, while hiding unnecessary information (such as implementation details) that can unnecessarily complicate the higher-level problems under investigation.

UML diagrams provide a foundation that allows architects to focus on differing perspectives of the solution. UML packages provide additional flexibility to segment (package) portions of the overall solution. These packages allow visionary teams to group implementations by contracts (agreements between stakeholders) while maintaining the integrity of the architecture's desired effect.

Adaptation and Flexibility—SI's early innovation with UML was to create UML Use Cases abstracted to the enterprise level rather than software coding level. Initially, SI used this approach to model command and control (C2) functions built once and reused (extended or adapted) many times to reducing system implementation cost. As service-oriented architectures became prevalent, SI realized their enterprise level use cases were descriptions of service behaviors and reusable in many different ways - achieving many differing effects. Just as developers were able to maintain reusable software components in class libraries to provide a system level service, SI maintained reusable use cases in a repository of business level libraries. Thus, their robust use case repository provides agility to create new mission threads more efficiently.

Cost and Risk Reduction—OOAD goes hand-in-hand with other modern software development best practices such as visual modeling, iterative development, and risk-driven development, among others. These techniques target the well-known “IKIWISI” phenomenon in software development, that being the user who can’t quite describe their requirement, except that “I’ll know it when I see it.” This tongue-in-cheek acronym describes a very serious risk to projects—lengthy requirements evolution and meticulous software development, but when end users try the final product, they find they really wanted something different.

Discovering this disconnect late in the effort, after significant design concepts have been locked in, after significant cost has been expended, and after significant schedule has passed, can often be fatal to a project. SI believes the solution includes the development of UML Use Cases to place requirements in context; visually modeled to better communicate requirements; iterative and incremental development to capture early user feedback; and early rather than late introduction of high risk areas to accommodate change prior to significant cost and schedule consumption.

Common Language and Method—UML is an industry standard with more than 10 years of successful use. Its popularity has grown with OO development and Web technologies. Today, most computer science graduates learn the UML, staging the notation as a tremendous tool to communicate requirements between architects and developers. One of the compelling reasons for using the UML to describe an enterprise is the idea of leveraging the common notation to describe requirements from concepts to code, providing traceability from mission requirements to the implemented services. In a partnership with the MITRE Corporation, the team demonstrated a complete UML framework where use cases successfully drove software and system design (also using the UML).

Transition Planning—During software development, coders logically package elements of the architecture into subsystems or logical components targeted at providing similar functionality, and those subsystems or logical components are mapped to platforms that realize performance, availability, fault tolerance, scalability and other non-functional requirements.

At the enterprise level, after modeling a representative number of target mission threads and use cases to the stakeholders’ satisfaction, this same process of logical and physical realization can begin. However, at the EA level of abstraction, we focus on understanding how adequately current IT resources fulfill the use case requirements.

At this stage of the architecture, Class Diagrams capture required services and assist in identification of gaps in capability. Packaged in logical groups, the use cases provide a contextual understanding to determine solutions via (1) existing IT resources, or (2) new projects targeted at closing the gaps. Where existing IT resources fulfill required services, UML Deployment Diagrams capture applications and servers providing a mapping (trace) to the physical platform. Our process provides the architectural foundation to close capability gaps through well-defined prioritizations, schedule, and cost into portfolios achieving the enterprise’s objectives.

Sequenced over multiple budget cycles, well-defined capability gaps compete better in any given year for limited funds. Before commissioning actual projects, priorities must be set each year through a formal Capital Planning and Investment Control process. All government agencies have this process: For example, the DoD uses the Planning, Programming, Budgeting and Execution (PPBE) system. *Figure 2* on the next page shows how EA fits into an Enterprise Management Model where the ability to provide “CONOPS-to-code” has real-world management significance.

For complex systems, SI mastered the process and method to use UML architectures as the basis for portfolio management

***SWOT - Strengths, Weaknesses, Opportunities and Threats**

CPIC – Capital Planning and Investment Control
Some notable differentiators of SI’s enterprise architecture approach include:

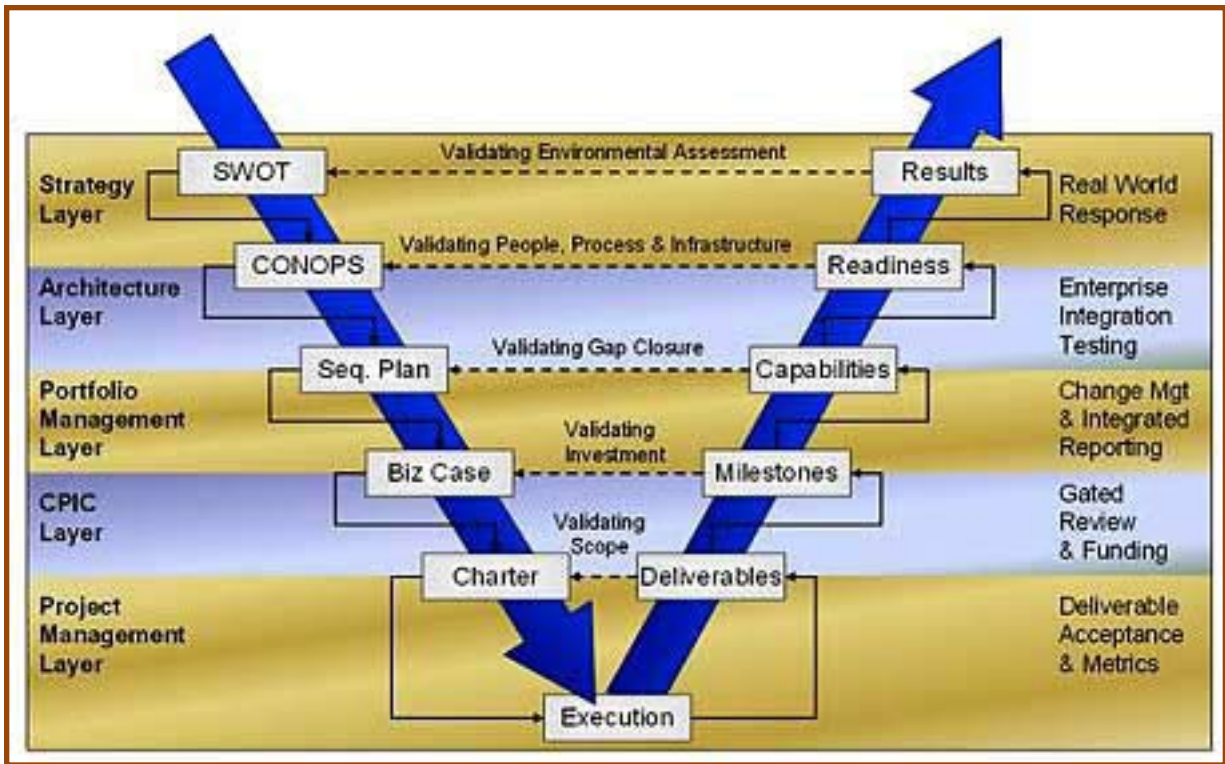


Figure 2 - Architecture's Role in Enterprise Management

Enterprise Architecture COE—SI's Colorado Springs EA COE provides an environment where SI concentrates their expertise and centralizes support to architecture and BPR efforts wherever their clients may be located. Building a UML modeling team with the necessary skills and resources from scratch in a new location can take as long as one to two years, depending on the availability of a skilled staff.

SI's staff includes many Senior Principal and Principal Enterprise Architects with OMG UML Professional Certifications practicing the object-oriented trade in excess of eight years. Their architecture staff currently consists of 35 trained and experienced object-oriented UML professionals, anticipated to be the largest concentration of UML enterprise expertise in the country.

As architecture is extremely collaborative, SI emphasizes facility considerations. To be successful in developing use cases, architects collaborate and mentor in architecture laboratories properly equipped with large visual displays, computers, and controlled data access points. The large displays are necessary to observe all

views of the use case and the many data sources (concepts documents and other information sources etc.) sometimes used to understand the required behavior (i.e., use case description) being modeled.

Their architecture environment allows architects, subject matter experts, and stakeholders to collaborate on the architecture and agree on the optimal solution. SI hesitates to consider these architecture laboratories optional—they are so productive that they built six laboratories and they're in regular use today.

Tools and Repositories—SI has extensive experience building enterprise repositories, managing their configuration, and delivering their contents to clients via the web and/or on CD/DVD. They offer the use of their labs to save schedule and client investment cost. After extensive UML tooling research, they deployed **IBM Rational Software Architect and Modeler (RSx)** in their Architecture COE. They determined the most significant strength of IBM Rational tools is their popularity within industry.

IBM includes founders of the UML (then Rational), their tool provides a proper object-oriented imple-



Figure 3— At SI International, they take architecture seriously. They built six architecture laboratories specifically dedicated and designed for architecture collaboration, configuration management, and presentation

mentation (another significant attribute). IBM still provides UML leadership today through the Object Management Group (OMG). In addition, SI has a strong partnership with IBM Rational; IBM recognizes SI as enterprise architecture thought leaders in object-oriented enterprise modeling and regularly collaborates with SI on tooling considerations. The use of UML stereotypes (i.e., symbols, relationships, etc.) does not necessarily mean the underlying tool storage mechanisms are object-oriented.

Scalability is important, and this is particularly true if you're modeling complex enterprises, or you intend for your business models to go to code. Business models built using RSM are importable into Rational Software Architect (RSA), a UML tool that provides code generation. This approach allows the business model to evolve simultaneously with the implementation system model with no data concordance issues. This approach provides full traceability from CONOPS to code laying the foundation for UML models as a portfolio management and decision making mechanism.

Architecture Verification and Validation—Having standardized on the IBM Rational platform, SI built specialized plug-ins to IBM's toolset providing capabilities found nowhere else in the industry. Their enterprise mission threads link UML Use Cases to achieve an end-to-end business process. Even with standard operating procedures in place, there is no guarantee the entire mission thread (with use cases developed by differing teams) will execute properly. To resolve this problem, SI determined that object flow was essential for use case integration. The company built a verification tool that checks object flow within, and between, use cases through any business thread. In the Rational tool, the observer actually sees an animation of objects moving from one use case activity to another. If the animation stops, SI architects know they have a problem. More importantly, they know where to focus their corrective actions. Their tool greatly reduces architectural risk and portfolio development risk.

Another significant SI innovation is the development of a UML tool plug-in that creates 2D animations actually driven by the architecture. This validation tool plug-in allows SI to depict, visually, the mission thread in a context that users and mission executives can understand. They use these visualizations to demonstrate deployment of military resources on world maps; portray network information exchanges; and to animate business processes both within the office and beyond the enterprise boundary.

Their technique engages stakeholders because they see and understand the model they are developing, providing participation and buy-in to the requirements development process. SI architects continue this validation approach iteratively until the mission animation runs exactly as the stakeholders want it. Often, this facilitates agreement among stakeholders.

Using the integrated architecture, SI data mines their UML models to extract information to create important documentation communicating progress, areas of emphasis, development of functional requirements, as well as planning and acquisition documentation.

Figure 4 shows a PC screenshot during the execution of such an animation, where a UML model (left screen shot) of an electronic purchase order system (e-PO) is driving a 2D animation (right screen shot) of interactions across enterprise boundaries and throughout a large metropolitan area. SI International visualizations provide a simplified view the non-architect can easily understand.

Summary

SI International's object-oriented approach to enterprise architecture provides a proven and industry-leading capability to manage today's complex web and network-based SOA transitions. SI's processes and tools capture all the architecture information necessary to provide a concept to code capability, including the ability to align the expectations from the highest-level executives, project managers, and developers.

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Figure 4 — Example screen shot from a 2D animation

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