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Spanish Forces in Afghanistan Communicate Via Satellite

TACTICAL COMMUNICATIONS

Enabling More Advanced Military Operations

Manmade Stars Boost Warriors' Agility

Real-time satellite communications drive high-capacity bandwidth, combat flexibility.

By Clarence A. Robinson Jr.

Existing X-band commercial communications satellites with fundamental high power and bandwidth advantages enable communications-on-the-move dexterity. Spacecraft advances and state-of-the-art tracking technology with small but stable antennas facilitate a wide variety of high-data-rate communications for mobile military missions encompassing land, sea and air.

Dramatic demonstrations aboard boats in heavy seas, land vehicles traveling over rough terrain and aircraft bouncing in turbulence consistently supply continuous commercial X-band satellite links with abundant bandwidth. Military demonstrations using XTAR LLC commercial satellites with their 100-watt power and 72-megahertz transponders enhance tactical prowess with antenna apertures as small as 18 inches in diameter.

The commercial X-band satellites were designed and built to provide communications exclusively to U.S. and allied governments worldwide for military, diplomatic and security requirements. The XTAR satellites also enable use of smaller-diameter antennas that can lock on to spacecraft and track them

The Defense Department's Stiletto experimental naval craft demonstrates communications on the move while cruising at 40-knot speeds off the Virginia coast. An advanced antenna system and X-band commercial satellite demonstrated improved communications, situational awareness and speed vital to the warfighter. During the annual Trident Warrior exercise, sensors aboard the boat were controlled from a continent away via satellite link.

despite vigorous platform movement, explains Dr. Denis Curtin, XTAR's chief operating officer.

One of many demonstration examples involves participation in the Navy's annual Trident Warrior exercise. DRS Codem Systems Incorporated confirmed X-band communications on the move (COTM) onboard the Force Transformation Stiletto experimental naval craft. While moving at 40-knot speeds in rough seas off the coast of Virginia, an X-band satellite terminal enabled video from the boat's electro-optical, forward-looking infrared and radar systems, and an integrated electronic suite, to be relayed to the U.S. Naval Postgraduate School in Monterey, California, Joseph A. Johnson illustrates. Based in Merrimack, New Hampshire, he is vice president of DRS Codem's antenna and wireless business.

An 18-inch-diameter satellite terminal from DRS Codem acquires an XTAR communications satellite during a Special Operations demonstration. The communications-on-the-move antenna mounted on a Rigid Hull Inflatable Boat can maintain contact with the spacecraft at 20-knot speeds in sea states 2 and 3 with bi-directional datalinks at rates of 3 megabits per second.

"Exercise participants could actually command cameras aboard Stiletto from California while the boat cruised along the East Coast, pulling live video and data over XTAR satellite links in real time. This COTM system uses sensor input from any platform—accelerometers, gyros, compass and inertial navigation units. The vehicle may be bouncing around, pitching or rolling, and the system senses that movement. A stabilization algorithm uses this sensor information to compensate, so that the antenna aperture remains fixed on the X-band satellite," Johnson reveals.

Broadband real-time communications at 3 megabits per second (Mbps) on the Stiletto clearly demonstrated beyond-line-of-sight reach-back capabilities. The demonstration also established enhanced situational awareness, enabling remote control of the boat's integrated electronic suite and secure wireless broadband Internet access for the crew.

"The Stiletto demonstrations worked so well that a DRS COTM terminal was purchased for the vessel, along with an additional six months of XTAR satellite time," Johnson maintains. "Demonstrations onboard Stiletto are continuing in the Caribbean with DRS Codem support, providing broadband Internet connectivity."

Operating from 7.25 to 8.4 gigahertz, and depending on modem and antenna size, XTAR satellites routinely provide data rates of 150 Mbps. Rates of 200 Mbps also are being demonstrated using a terminal with a 2.4-meter (7.9-foot)-diameter antenna. This is a vast improvement over the 8 Mbps attained with legacy equipment, Curtin explains. "These X-band satellites use two global beams, with one in each polarity, one fixed beam, three steerable beams with no beam movement restrictions and beams that can be stacked over the same area. The satellites demonstrate a capacity of up to 1.6 gigabits per second [Gbps], much of which is immediately available to U.S. forces and allies without modifications or improvements."

The two X-band satellites offer beam cross connections with the ability to route multiple transponders through a single beam. The steerable high-power beams, with near-real-time response, function within minutes from receipt of request, or in seconds using pre-planned positions. XTAR services support high-intensity military operations, Curtin points out, especially for rapidly deploying forces with mobile, high-capacity bandwidth in small terminals.

A two-satellite geosynchronous XTAR constellation provides coverage of two-thirds of the Earth's surface, from Denver, Colorado, to Singapore. With dynamic spot beams and onboard switching, satellite coverage can be repositioned immediately to meet on-the-move requirements such as troop relocation, security or disaster response, Curtin continues.

Headquartered in Rockville, Maryland, XTAR LLC is a joint venture between Loral Space and Communications, which owns 56 percent, and HISDESAT (Hispanic Defense Satellite), Madrid, Spain, which owns 44 percent. Curtin's company owns and operates XTAR-EUR, the satellite launched in 2005 (*SIGNAL* Magazine, December 2005, page 35) into geostationary orbit at 29 degrees east longitude. Additional X-band capacity also is available on XTAR-LANT, a payload on HISDESAT, or on SPAINSAT, located at 30 degrees west longitude.

SPAINSAT is the culmination of planning between Spain's Ministry of Defense and its aerospace industry to meet government bandwidth demands. HISDESAT is owned by HISPASAT, S.A., the Spanish commercial satellite services company, INSA and Spain's aerospace industries: EADS-CASA, INDRA and SENER, Curtin says (see page 45).

Spain's desire to become a major NATO member focused its attention on developing and deploying a military communications satellite. The nation also wanted a backup capability, which led to a joint venture with Loral Space and Communications.

Contributing troops to coalition forces in Afghanistan, Spain's Defense Ministry makes routine use of XTAR communications. All of Spain's forces deployed overseas are equipped with a variety of X-band satellite terminal sizes. Detachments, including those in Afghanistan, routinely engage in multi-video conferences using 2.4-meter-diameter or smaller antennas.

Belgium's Ministry of Defense awarded HISDESAT a contract for use of XTAR-EUR and XTAR-LANT services. Denmark, Germany and the Netherlands also are subscribers.

The U.S. State Department's Diplomatic Telecommunications Service Program Office (DTSPO), Fairfax, Virginia, is steadily increasing use of the XTAR-EUR and XTAR-LANT transponders to exploit expanded spacecraft footprints. The State Department contracted for a maximum of $137 million for use of XTAR satellites through 2010.

The spacecraft enable operating a variety of government-owned terminals and antenna sizes at some 260 diplomatic posts around the globe. These diplomatic sites represent approximately 50 U.S. agencies, including intelligence, law enforcement and security organizations. DTSPO leases the satellite capacity and uses it however it chooses, Curtin states.

In addition to the DTSPO contract, XTAR has added the Defense Information Systems Agency, General Services Administration SATCOM III and Schedule 70 as contracting vehicles. However, until recent COTM demonstrations, DISA and U.S. military organizations have been slow to embrace commercial X-band applications, Curtin allows. "In part, this is a matter of timing. The Iraqi War started in 2003, and the first XTAR was launched in 2005. During the war, U.S. military forces became accustomed to routinely leasing commercial Ku-band capacity from large satellite companies, or using the Defense Satellite Communications System [DSCS]. By recent estimates, only a fraction of satellite capacity can be handled by U.S. military systems."

XTAR LLC is seeking to shift Defense Department thinking about commercial X-band communications.

Terminals and equipment mounted in the front compartment of a high-mobility multipurpose wheeled vehicle (HMMWV) display data and imagery from X-band satellites. This DRS Codem ruggedized communications-on-the-move system connects with other mobile platforms—vehicles, ships and aircraft via satellite. An 18-inch-diameter antenna is mounted on the vehicle's roof.

"People in uniform immediately think Ku-band satellite communications, then Ka- and C-band, respectively. However, these satellites may often be oversubscribed, expensive and difficult to access. We want to convince them to also think of X-band as part of the commercial spectrum, obtaining the capacity for mission accomplishment for a dollar spent. XTAR is not a competitor for DSCS or the Wideband Global Satellite Communications System [WGS], which also uses X- and Ku-bands. We are in a totally different business," Curtin maintains. One WGS is on orbit, with another two scheduled for launch within the next two years building toward an eventual constellation of six spacecraft.

Nevertheless, what increasingly captures the U.S. military's attention is the location and high power of the XTAR spacecraft. With no other satellites nearby, small COTM antennas do not have to be "exactly dead-on the satellite to communicate. And, XTAR's bandwidth capabilities provide from 2- to 8-Mbps data rates regardless of terminal size. With other satellites, the COTM rate is often in the kilobits per second [Kbps] range. We have lots of capacity available in areas of interest in North and South America, Europe, Africa and Asia. This is especially important in Africa, where a new U.S. combatant command and forces operate with little infrastructure and limited Ku- or C-band availability, if at all," Curtin discloses.

Lt. Gen. Steve Boutelle, USA (Ret.), concurs. "The armed services rely heavily on their legacy X-band systems. This situation will continue for many years. These systems are still a backbone and a critical part of the infrastructure." Until last year, Gen. Boutelle was the chief information officer of the U.S. Army, or G-6, responsible for the service's worldwide use of information technology. "Part of the Tri-Services Tactical (Army), or TRITAC, systems, the AN/TSC-85s and An/TSC-93s—antijam satellite communications terminals—have gone through periodic updates. However, they are currently not operating at the potential [that] XTAR has demonstrated to the Army and the Air Force.

"Circa 2005, XTAR worked with the Army in Europe, using existing TSC-85s, demonstrating that the satellite terminals could be boosted from 8 Mbps to well over 100-Mbps rates by a modem change and minor adjustments," the general verifies. "XTAR confirmed comparable improvements with the Air Force in Europe using the USC-60A satellite terminal. These demonstrations, combined with XTAR's slot position, allowing single-hop communications from Persian Gulf states to the eastern part of the United States, had the potential to breathe new life into the military's X-band terminals.

"XTAR was willing to negotiate a pricing rate that was more than interesting to me as the then-G-6 to provide point solutions for specific high-bandwidth needs in certain areas of the world," Gen. Boutelle comments. "XTAR also offered to lease, sell or install the modems for the Army. As the [former] G-6, I do not believe the Defense Department adequately assessed the value of

XTAR, and the potential benefits that could be achieved, nor did the services pursue potentially valuable XTAR solutions." Now vice president of the Global Government Solutions Group, Cisco Systems, the general advises government customers on business practices and technology solutions. Cisco has no business relationship with XTAR LLC and, therefore, he is free to address XTAR's performance.

Another important COTM example is the Space and Naval Warfare Systems Command, which is using small-diameter, mast-mounted satellite antennas on submarines to harness the power of XTAR data rates. The spacecrafts' transponders limit vulnerable submarine surface exposure times through their inherent speed, reducing transmissions from minutes to seconds. Called the Submarine High Data Rate (Sub HDR) program, demonstrations establish Mbps data rates, replacing typical Kbps rates for submarines. Sophisticated satellite tracking, however, is not necessary for such short durations. The satellite's position and power allows rapid and easy antenna acquisition.

Developing X-band COTM technology, DRS Codem is demonstrating satellite tracking software algorithms. Using XTAR, the result is high-quality video, voice and data. These demonstrations encompass U.S. military, allied and coalition forces. The X-band capability opens up myriad uses with Internet protocols, Web-based applications and real-time situational awareness.

With robust Special Operations community interest, DRS Codem also conducted X-band satellite demonstrations on an 11-meter-long Naval Special Warfare Rigid Hull Inflatable Boat (RHIB). These boats perform short-range insertion and extraction of Special Operations Forces, coastal surveillance and resupply missions, Johnson says. "Similar to the Stiletto demonstration, the RHIB, operating at more than 20-knot speeds in sea states 2 and 3, using a small COTM terminal, confirmed bi-directional broadband links and data rates at 3 Mbps over XTAR-LANT. Again, operating off the Virginia coast, the RHIB system reached back to the Naval Postgraduate School with high-speed data transfer, voice over Internet protocol and video conferencing."

Yet another application involves the Mk V Special Operations craft. Capable of speeds in excess of 50 knots and ranges of 500 nautical miles, the Mk V was designed specially to move Navy SEALs and other special warfare forces close to shore. "There are significant advantages in data rates with X-band versus Ku- or Ka-band, especially when intelligence missions differ from command and control [C^2] missions. Intelligence platforms tend to uplink more information, where C^2 vehicles download more information," Johnson notes. "Other advantages in using X-band satellites are enhanced performance that avoids rain fade interference, and spacecraft that are not as closely spaced, limiting adjacent satellite interference."

In addition to U.S. demonstrations, DRS Codem also is working with European allies, operating small COTM terminals aboard frigates and other vessels in the Mediterranean. NATO counties are embracing the DRS technology and negotiating arrangements for its use, possibly with XTAR or other X-band satellites.

Loral Space and Communications technicians assemble an XTAR X-band commercial satellite prior to launch toward geostationary orbit. The launch, aboard an Ariane 5 ECA rocket from Kourou, French Guiana, provided the second of two powerful, high-bandwidth satellites that form a constellation covering two-thirds of the Earth's surface with 100-watt, 72-megahertz transponders.

The 18-inch X-band dish antenna is designed to transmit 3 Mbps per second uplink and receive 10 Mbps downlink. This COTM terminal uses an integrated inertial navigation system, open-loop pointing and closed-loop tracking, a direct-drive elevation over azimuth gimbal with high-resolution feedback and an X-band radio frequency transceiver with an L-band interface. The system uses Ethernet remote control and diagnostics and is modem agnostic, according to Johnson. A second-generation DRS COTM terminal uses a lightweight cast structure, a single-board computer for control and stabilization, a low-cost custom navigator and can support X-, Ku- and Ka-band operations.

DRS Codem also provides a ruggedized COTM terminal with the small antenna mounted in a dome atop a high mobility multipurpose wheeled vehicle (HMMWV). This system provides up to 3 megabytes per second of bi-directional link—0.5 Mbps uplink and 3 Mbps downlink, Johnson observes. "The 'Hummer's'

modem allows flexible network design, enabling connectivity to other ground mobile vehicles, ships, aircraft and unmanned aerial vehicles. An airborne system, mounted in a window in an aircraft's fuselage, provides a 75-gigahertz, 1-gigabit-per-second air-to-ground datalink for reconnaissance, surveillance, near-real-time imagery and communications."

Providing approximately $2 million to DRS Codem, the Army's Communications-Electronics Command Research Development and Engineering Center is investing in next-generation COTM terminals that would allow Army tactical forces to use X-band terminals. Meanwhile, the Air Force Information Directorate, Air Force Research Laboratory (AFRL), Rome, New York, successfully developed and demonstrated an X-band manportable terminal that weighs about 20 pounds. This antenna successfully transmits at 1.5 Mbps over XTAR satellites and receives at up to 10 Mbps.

However, the AFRL may have to scale the antenna up to 1 meter in diameter to permit use with the Defense Department's X-band spacecraft. The AFRL developed this small terminal internally. Several other contractors, in concert with the laboratory, also have developed X-band manportable terminals. Among them is Panther, a rugged system developed by L-3 GCS, Victor, New York. This flat-panel, phased-array antenna exploits intuitive visual and audio indicators for pointing.

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WEB RESOURCES

XTAR LLC: ***www.xtarllc.com***

DRS Codem Systems Incorporated: ***http://www.drs-cs.com***

Spain's Satellites Facilitate Forces

Operating in far-flung regions, Spanish military forces are harnessing technical advances in commercial X-band satellites and employing them for communications on the move. Spain's Ministry of Defense routinely exploits satellite links, including daily videoconferences, with troops operating in Afghanistan against al Qaeda and Taliban enemies.

Spain's armed forces already employ communications-on-the-move (COTM) terminals for use with both their conventional and special operations forces. The terminals are designed to exploit the power and bandwidth of XTAR satellites, according to Rear Adm. Enrique San Jose, SPNA. As the J-6, he heads the communications information systems (CIS) division of the Ministry of Defense in Madrid.

The Defense Ministry's military satellite communications system is based on two satellites: SPAINSAT, or XTAR-LANT, launched in 2006, and XTAR-EUR, launched in 2005 (see page 37). "Spain's 778 troops and detachments in Afghanistan maintain precise daily communications with our headquarters in Madrid, thanks to the XTAR-EUR satellite using 2.4-meter or smaller-size antennas," the admiral explains.

"We are well-informed about communications-on-the-move technology demonstrations using X-band and have followed all of them since one with the U.S. Army in the spring of 2006. That demonstration employed SPAINSAT, operating at 30 degrees west longitude," Adm. San Jose relates.

"Our armed forces currently have two COTM vehicles, and three more will become available this year as armored

Spanish forces operating with the coalition in Afghanistan employ communications-on-the-move (COTM) advances. An X-band antenna mounted atop a van near Herat, Afghanistan, enables COTM at high data rates. Several of these vehicles, including armor, are in the pipeline. XTAR satellite communications play a major role in deployments of Spain's forces.

vehicles from a Spanish company, but based on DRS Codem's technology," the admiral discloses. "There also are other Spanish companies developing this technology. It is quite clear, however, that this new capability is necessary, and we are implementing it as operational concepts evolve with new conflict scenarios," he emphasizes.

COTM terminals are not used specifically for special operations missions but rather to extend voice and data via WiMAX, wireless broadband connectivity, to vehicles in a column or convoy of regular forces, the admiral clarifies. Spain also is exploiting manportable satellite communications terminals. Spain's armed forces "already have 79 manpacks, which are actually used by our Special Forces, but also employed by any of our forces at the lowest command levels, where conditions of terrain or distances make it necessary," Adm. San Jose notes. Because of the new X-band satellite, traffic has significantly increased for use within the global beam. Demand assigned multiple access (DAMA) managers, developed by Spanish industry, also enable better spectrum management.

"For Special Operations, a cased terminal is under consideration, using an X-band flat antenna that weighs some 12 kilograms [26 pounds] and provides a 128-kilobit-per-second capability. One person can deploy this system in less than 5 minutes, and it can have broadened spectrum modulation and an Internet protocol coder," Adm. San Jose points out. New Hampshire-based DRS Codem Incorporated, current partner of Spanish companies in the sale of COTM antennas, has shown interest in this development because the product, he notes, is necessary for U.S. Defense Department operations. The use of X-band will result in replacement of other satellite equipment and in lower costs.

"The trend in satellite terminals toward 'miniaturization' over X-band, with an array of small broad-beam antennas, will meet blue force tracking and messaging needs of the Spanish armed forces. Equipment weighing 3 kilograms [6.6 pounds] can be carried in any type of vehicle that proves feasible because of the excellent amplifying capability of SPAINSAT and XTAR-EUR satellites," the admiral declares.

Numerous examples exist where using XTARs for satellite communications with Spanish forces has proved

Rear Adm. Enrique San Jose, SPNA, serves as assistant chief of staff, communications information systems division for the J-6, Ministry of Defense, Madrid.

valuable for tactical operations, Adm. San Jose admits. "One example is the frigate *Álvaro de Bazán*, which managed to keep the link with XTAR-EUR's global beam from up to 110 degrees east longitude, with the antenna elevated only 2 degrees. Another example is the use of tactical terminals at 2-megabit-per-second speeds, even in intra-theater scenarios, without a fixed, or anchor, base," the admiral notes. "With manpack terminals, which can communicate through XTAR's global beam, an operational advantage is added. The large footprint of Spain's satellites enables this capability, allowing our troops to communicate over reduced-size terminals, with Spanish territory from practically all areas of interest on the planet."

All of Spain's military units deployed overseas are equipped with a variety of X-band satellite communications terminals, which are designed for use with either XTAR-LANT or XTAR-EUR satellites. Whenever Spain executes deployment plans, satellite communications are a major element because the new X-band system overcomes communications problems. One advantage of the satellite system is the extent of the coverage using both XTAR satellites—from the United States around to Asia, the admiral concludes.—*CAR*

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