Transformational MILSATCOM

Mobile User Objective System Will Provide 3G Cellular Technology for Dismounted Warfighters.

by Adam Baddeley, MIT Correspondent

The first of five Mobile User Objective System (MUOS) satellites is on course to be launched in summer 2010, bringing narrowband UHF military satellite communications into the transformational era. MUOS, the latest means of delivering UHF beyondline- of-sight communications, will operate alongside legacy systems, both military and commercial, to meet enduring warfighter needs.

Rear Admiral Vic See, the executive agent for procuring UHF SATCOM across the Department of Defense, is a key player in that transformation. “As the program executive officer for space systems for the Navy, I buy UHF SATCOM for the DoD that includes UHF Follow On (UFO), commercial LEASAT and, in the future, MUOS,” he said.

See is working to position UHF SATCOM within the Transformational Communications Architecture (TCA), transitioning to a much more network-connected force. “We are changing our polices: the way we operate, how we collect information from multiple platforms and enable large increases in the capacity we put through the network— the whole network down to the last mile, to all our military customers who want much smaller, mobile terminals, enabling communications in near-real time. The significant challenge for all of us is to be able to deliver these capabilities,” he said.

The current infrastructure is a combination of Navy-owned SATCOM, principally the UFO constellation, coupled with commercial bandwidth and contracted via the LEASATenabling contract with Intelsat.

See sketched the DoD’s UHF SATCOM development and current network today. “UHF narrowband has been the Navy’s SATCOM bread and butter. We started with the TACSAT in the late 1960s, GAPFILLER/ MARISAT leased SATCOM from 1976–89 and then a series of FLTSATCOM satellites from 1978, and we still have a FLTSATCOM operating today, 25 years after its launch.

“We now have a commercial contract with industry for LEASAT, and we are about to release a new contract with Intelsat for Skynet 5 UHF channels. We built 11 UFOs. The first was unsuccessful, but today there are eight operating, five of them beyond their design life and degrading at a fairly level rate. The need for MUOS is now, and we are doing everything to deliver that as quickly as possible,” he continued. “Commercial SATCOM is not going away. Every day I am told we need more commercial SATCOM, and demand continues to grow. No matter how much more government MILSATCOM we procure, there will still be need for commercial SATCOM to fill in the gap.”

In addition to conventional commercial procurement, the Navy’s Space and Naval Warfare Systems Command was set this fall to issue a request for proposals for up to $41 million for the hosted-payload program.

INCREASED ACCESS

The requirements driving MUOS are massive, noted See, citing the Army’s need to link many more dismounted soldiers, every Future Combat Systems platform and many other vehicles using the new satellite system. MUOS reflects two ideas—a legacy UFO payload and an existing MUOS payload on a MUOS bus, See explained. “As soon as we launch MUOS 1 and turn on the legacy payload, all of the U.S. users and NATO and partner countries that use UFO today will be able to take advantage of MUOS straight away. That’s a good thing.”

But MUOS is not another UFO. Its value relies on the military adaptation of commercial wideband CDMA technology: 3G cellular technology enabling much greater use of the spectrum.

“The MUOS wideband CDMA payload will give us incredible growth in the number of accesses, the number of people that can use the system and a much greater increase in bandwidth using 3G commercial technology. It’s a very capable system,” he said.

Each UFO satellite supports 1,111 users with a 2.4-Kbps channel—in total, 2.666 Mbps. MUOS exceeds this by greater than an order of magnitude: 16,332 2.4-Kbps accesses, with the additional UFO payload on board each MUOS adding another 424 accesses, for a cumulative throughout of 40.216 Mbps.

Programmatically, responsibilities for delivering the overall MUOS capability are split. “I buy the satellite, the command control, the ground stations and the network management,” See said. “The services are then responsible for buying the user terminals through the Joint Program Executive Office Joint Tactical Radio System (JPEO JTRS). Then the Defense Information Systems Agency is responsible for providing the teleports in various locations, to connect the MUOS systems to the Global Information Grid.”

It is this enterprisewide networking capability that See views as the biggest differentiating factor between MUOS and legacy systems. “If you were to ask what the biggest differences are between UFO and MUOS, it is that MUOS is a worldwide system. You could be on battlefield in Iraq and talking directly to a unit in Australia.”

The ground segment is built on four sites, known as Radio Access Facilities, with DISA Teleport access. They are in Norfolk, Va., Hawaii, Sicily and Australia.

Portions of MUOS will be made available to NATO, although details have yet to be finalized by the Office of the Secretary of

Defense. “Earlier this week I was in Sicily, and we are having negotiations with the Italian government [on construction of the ground segment in Italy]. Italy uses UFO, and I know they are going to want to use MUOS,” See said.

The Navy continues to seek ways to manage users’ appetite for SATCOM, exploring ways, if not to reduce demand, at least to operate more efficiently.

“In November, I spent a day at Paradigm [the prime contractor for the Skynet 5 MILSATCOM UHF and SHF services and commercial SATCOM to the British armed forces and a number of allies]. They have a close connection for how much SATCOM they are going to supply to each individual unit, and that’s how much that unit gets. We in DoD, and I think the Navy especially, get everything they want and more, most of the time,” See said.

“We really need to have a better system to track how much bandwidth we deliver to each ship and how much that ship uses,” he continued. “If they go above that, the Navy has to pay extra. As soon as you tie capability to the pocketbook, there are going to be changes in behavior. I am working with the Naval Network Warfare Command and Joint Forces Command to help them to be a better referee.”

See gave the example of two ships, on the East and West coasts, with completely different utilization of satellite bandwidth. “Why is that? Because they are not using the right policies. We have to educate people to understand how much they are allocated and if they go above that, it is going to cost their command, ship or squadron more money.”

PAYLOAD MODULE

Lockheed Martin Space Systems is the prime contractor on MUOS, having been awarded a $2.1 billion contract in September 2004 for covering the first two spacecraft, with options on a further three that push its potential value to $3.26 billion.

In addition to prime contractor and integrator, Lockheed Martin is providing the A2100 spacecraft that will host MUOS and the UHF payload for the satellite. The A2100 was originally developed by Lockheed Martin for commercial telecommunications satellites. Static load tests in March showed that the 13,000-pound satellite had the structural integrity to survive launch and fulfill its mission, 22,000 miles above the earth. In October, the integrated propulsion subsystem was successfully put through its paces at the John C. Stennis Space Center, marking the completion of MUOS’ core structure.

The team is now in the midst of completing the payload module for the first MUOS satellite. After completion of the payload module, Lockheed Martin will begin integrating the payload module with its A2100 satellite bus and other space vehicle components, followed by environmental and acceptance testing of the fully integrated space vehicle. The first MUOS satellite, along with the associated ground system, is on track for on-orbit handover in 2010.

Boeing Satellite Systems, which initially submitted its own solution for MUOS, subsequently joined Lockheed Martin’s team in 2003, and is responsible for producing MUOS’ secondary UFO payload on board each satellite. This passed its critical design review (CDR) in early 2007.

General Dynamics C4 Systems’ responsibility on MUOS is as the lead for the ground segment, under an $830 million subcontract signed in 2005. This covers the provision of earth-terminal infrastructure and IP connectivity, including switching

facilities, network management and satellite commandand- control elements.

The CDR for these elements to MUOS was cleared in its entirety in 2007, with work now accelerating on completing testing and qualification. The latest milestone passed has been acceptance testing of the antennas in Hawaii, which is currently being conducted. To do this, three 18.4-meter MUOS antennae were placed on 53-foot towers to assess their effectiveness in tracking each satellite, ensuring users remain in constant control of each satellite.

“These antenna installations mark a significant milestone in the development and fielding of the MUOS ground system,” said John Weidman, vice president of national systems for General Dynamics C4 Systems (GDC4S). “The MUOS earth terminals utilize a state-of-the-art Ka-band antenna designed with highly accurate auto-tracking to meet system performance and availability. The antenna design pushes the envelope of what has been fielded in this frequency band in the past.”

A first article test antenna had been assembled in Mexia, Texas, in May 2007 and was used to demonstrate the RF capabilities of the design.

The first two ground system sites are to be installed for the first MUOS launch, while the two remaining sites are to be installed early in 2012. Work began on the Australian RAF site earlier this year, following the signature of a memorandum of understanding with Australia in November 2007.

The Universal Mobile Telecommunications System solution for MUOS and accompanying WCDMA-based MUOS waveform uses 3G core and radio access network software that has been substantially modified in the defense role by GDC4S.

MANPACK IMPLEMENTATION

General Dynamics is the prime contractor for the JTRS Handheld, Manpack, Small Form Fit (HMS) program, responsible for providing the majority of the terminals that will operate the MUOS waveform. This has been beneficial in coordination work between the two programs to ensure terminals are available for MUOS when it is in orbit.

“The customer exercised options on the HMS contract for the MUOS manpack implementation, which includes an LRU power amplifier device that can attach to the side of the manpack,” said Chris Brady, vice president of assured communications systems for GDC4S. “The MUOS capability is being aligned by virtue of our presence in both programs.

“We have some contractual actions on HMS for the MUOS manpack implementation, which will manifest itself as an LRU power amplifier device that can attach to the side of the manpack. The MUOS capability is being aligned by virtue of our presence in both programs.”

The task of Harris Government Communications Systems Division within the MUOS team is to build the 5-meter and 12-meter reflectors developed under a $37 million risk-reduction subcontract awarded in 2005 to design and build the system for the first two satellites, rising to $90 million for all five units. The reflectors are notably larger than predecessor systems, which is a key factor in ensuring communication down to the dismounted mobile user.

The lightweight composite rib structure combined with the gold mesh reflective structure provides for a very large structure to be stowed for launch in a very compact volume, and then deployed out in space to a diameter more than 50 feet. The sheer size of the reflective surface and its highly reflective gold mesh surface make it ideal for supporting missions where high

power is needed to supply much higher bandwidth for mobile voice, data and video services. ♦