Virtual Mission Operations Center

By SSG Dale Schoenfelt

Getting information directly from Space platforms to troops in the field has always been a complicated process. The idea of troops in the field actually controlling on orbit assets to support their operations is viewed as purely science fiction. Not anymore. Thanks to a joint team working on an operationally responsive Space initiative, commanders, as well as mission controllers and Space operations officers, will soon have the capability to command and control Space and near-space platforms and sensors, introducing new possibilities in dynamic Space support.

This next-generation Space capability uses Internet Protocols (IP), and a concept known as the Virtual Mission Operations Center (VMOC), to support command and control of platforms and sensors from nearly anywhere on Earth. Future Spacecraft, also using the concept of open IP standards, will become nodes in the Global Information Grid. Thus, the future of Space support consists of rapid accessibility from any point on the Internet, and VMOC will provide the means to control that access.

According to Steve Groves, the VMOC project director for Army Space and Missile Defense Battle Lab, this project will advance military and NASA air and Space core competencies by laying the groundwork for the use of IP and graphical user interfaces throughout Space communications, leading the way to a single, robust, responsive network for terrestrial and Space operations.

Groves strongly believes in the virtual mission operations concept but says he is a realist and understands that the entire experiment may not go exactly as planned or that the results will all be as expected. However, he said the only failed experiments are those not conducted with true scientific methodology and that the purpose of the Battle Lab is not to push a product but to prove or disprove the utility of new equipment and new concepts to the warfighter.

This concept is an initial proof-of-concept for the Office of the Secretary of Defense Rapid Acquisition Incentive – Net Centricity (RAI-NC) pilot program. It is executed as a collaborative experiment between the Air Force Space Battlelab (AFSB), Army Space and Missile Defense Battle Lab (SMDBL) and NASA's Glen Research Center. This concept was originally developed in 1999 during a NASA technical investigation and General Dynamics proposal; other industry partners in this endeavor include Cisco Systems, Western DataCom and Segovia.

The VMOC system will provide all of the functionality of a typical mission control center from a standard desktop or laptop computer. Users will be linked via the Internet to a server that will in turn be linked to databases, ground stations, Space and near-space platforms and sensors. This system will query and direct resources on the network to provide users with information or to carry out tasks in response to the users' specified needs. For instance, a theater commander will be able to request images of force positions on the battlefield and further specify that the images be no more than 12 hours old. If the requested images already exist and were taken within the specified time frame, they are immediately retrieved and delivered to the commander. If no suitable images exist, the system will automatically determine if the image can be taken from existing satellites, schedule the satellite to take the image, notify the commander when the image will be available, and transmit the image to the commander as soon as it is.

Army SMDBL is deploying equipment and personnel to Vandenberg Air Force Base, Calif., for initial experimentation of the VMOC capabilities in June. The contractor developed an application which will reside on servers and will provide the virtual mission operations environment. The two VMOC servers will operate in a "pilot" and "co-pilot" mode with one functioning as the prime controller and the other shadowing operations so a rapid handoff can be made in the event of a malfunction. The primary VMOC server is located at the Center for Research Support (CERES) on Schriever Air Force Base, Colo., with

SGT Tara Tomasino prepares for a live telemetry pass from UK-DMC satellite through the Virtual Mission Operations Center.

the "co-pilot" server located at NASA's Glenn Research Center in Cleveland, Ohio.

The testing site will be configured similar to a typical deployment location including two Base-X tents and a HMMWV with a mounted shelter. Inside the shelter, the team has a mobile, self-contained Space operations node called the Space Support Element Toolset (SSET). This node includes computers with Space operations analysis and visualization software, in addition to the standard suite of office software, an IP satellite system, encryption devices and power supplies.

Using the SSET, the deployed users will access the Internet and log into the VMOC system, providing them direct access to a micro-satellite. The satellite is one of the United Kingdom — Disaster Monitoring Constellation satellites, built and controlled by Surrey Satellite Technologies Limited. This satellite was successfully launched Sept. 27, 2003. Onboard this satellite, which is also part of NASA's Cisco Router in Low Earth Orbit (CLEO) project, is the world's first Mobile IP router in Space.

CLEO is a joint demonstration, with the Air Force Space Battlelab, Army SMDBL, NASA, Cisco, Western DataCom, Surrey Satellite Technologies Limited, and General Dynamics. The demonstration uses a miniature router, aboard the micro-satellite, that is controlled with an Internet Protocol-based command and control application — VMOC.

Accounts created in the VMOC system will provide the appropriate levels of access to different users, from those authorized to only query online databases, all the way up to individuals authorized to command and control the Space or near-space assets. When users log in, the VMOC authenticates the identity of the users, determines what level of access each user has, and enables them to see and control only their own authorized elements. Since multiple users can simultaneously access the system, it will also handle scheduling and contention control of conflicting requests. Since this test will access an actual on-orbit platform that has a primary mission, limited satellite commands will be sent for command and control in conjunction with the Surrey Satellite Technologies Limited's ground station.

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In simpler terms ...

Virtual Mission Operations Center: Leading us into the future.

By SGT Tara Tomasino

Have you ever wondered what it would be like to make history? To actually do something that has never been done before? That's what members of the Space and Missile Defense Battle Lab did when they deployed to Vandenberg Air Force Base, Calif., in June.

For the first time in history, the open Internet was used to communicate with a satellite in Space using a newly developed concept known as the Virtual Mission Operations Center (VMOC). The VMOC is designed to use Internet Protocols (IP) to control both satellites and their payloads. This is accomplished by a series of communications with a satellite via the Internet to various ground stations.

"Last Wednesday (June 10, 2004) we made history for the first time by being in a standard Web environment talking to a commercial mobile router in Space," Said Capt. Brett Conner from the Air Force Space Battlelab. "That was completely new. That shows a different way of doing business than what we're doing now in Space systems."

What this means is, for the first time, users will be able to request needed information directly from a satellite. Users can do all this from any computer with an Internet browser. "What's astounding about this is, with the same ease of use [as navigating through a typical Web page], these guys are able to task satellite platforms and get the information requirements — the pictures that they need," said Steve Groves from the Army's Space and Missile Defense Battle Lab. "It's not high tech at the user end."

When the requested information is made available, the user is notified that the information is ready for download. This is called a "smart pull." According to SSG Dale Shoenfelt also from the Army's Space and Missile Defense Battle Lab, "The Soldier on the ground can decide what they need and go out and retrieve it, instead of having tons of information pushed at them that they then must sort through."

However, since the VMOC is designed to maximize our use of the information gained from Space, the VMOC allows the user to search existing databases for the information the user needs. In the situation where the warfighter needs images of the battlefield that do not currently exist, VMOC will then take the additional steps to task an on orbit sensor to take the necessary pictures.

"Because the VMOC searches the information that is available before tasking the satellite, this prevents the waste of satellite time and access, which will save us money." SSG Shoenfelt said. "This is some cool [stuff]."

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This experiment will help answer several key questions:

- Can VMOC provide secure operations over the Internet?
- Can VMOC validate multiple users and perform contention control?
- Can VMOC schedule access time to the satellite in relation to users' priority and precedence?
- Can users obtain real time data from the satellite?
- Can VMOC identify the appropriate ground station for routing commands?
- Will fail over from one server to the other be seamless and transparent to the operator?

All traffic, in and out of the system, will be monitored and outside agents will conduct active intrusion testing to prove system security. The combination of operations and security testing will help determine if Internet Protocols are appropriate for these tasks. When asked why this concept was so important, Groves replied that Space communications and operations must rapidly adapt to keep up with the changing needs of the military.

With the current state of satellite operations, each satellite has its own dedicated architecture, stovepiped command, control and communications systems, and a highly asymmetric data flow. Each constellation is a standalone system and requires entirely new software applications for testing, training and operating, all at enormous costs for each new system.

According to a DoD chief information officer document entitled Net-Centric Checklist, Version 2.1, "The Transport Infrastructure is a foundation for Net-Centric transformation in DoD and the Intelligence Community (IC)." To realize the vision of a Global Information Grid, ASD/NII has called for a dependable, reliable and ubiquitous network that eliminates stovepipes and responds to the dynamics of the operational scenario – bringing Power to the Edge. To construct the Transport Infrastructure DoD will:

- Follow the Internet Model
- Create the GIG from smaller component building blocks
- Design with interoperability, evolvability and simplicity in mind

The new Transformational Communications Architecture will utilize Internet Protocols to ensure interoperability between terrestrial and Space-based systems. DoD networks currently use IPv4 and the DoD CIO's stated goal is to "Enterprise-wide deployment of IPv6" by FY2008. New satellite systems will be net centric and have dual purpose. They will continue primary missions of communications or collection of data but they will also operate as nodes on the network and will provide connectivity for other systems in the shared infrastructure.

VMOC will be an integral part of the whole system by providing security and management for all users throughout the system.

Virtual Mission Operations will also provide significant cost savings by allowing "test before you fly" of satellites. A not uncommon problem is finding out late in satellite integration that some parts will not work with others, or simply do not work at all. This means months or years of delay and additional expenditures to the satellite program as well as programs dependent on that satellite. If the problem is serious, the satellite may have to be disassembled and returned to the various facilities to determine what went wrong and make corrections.

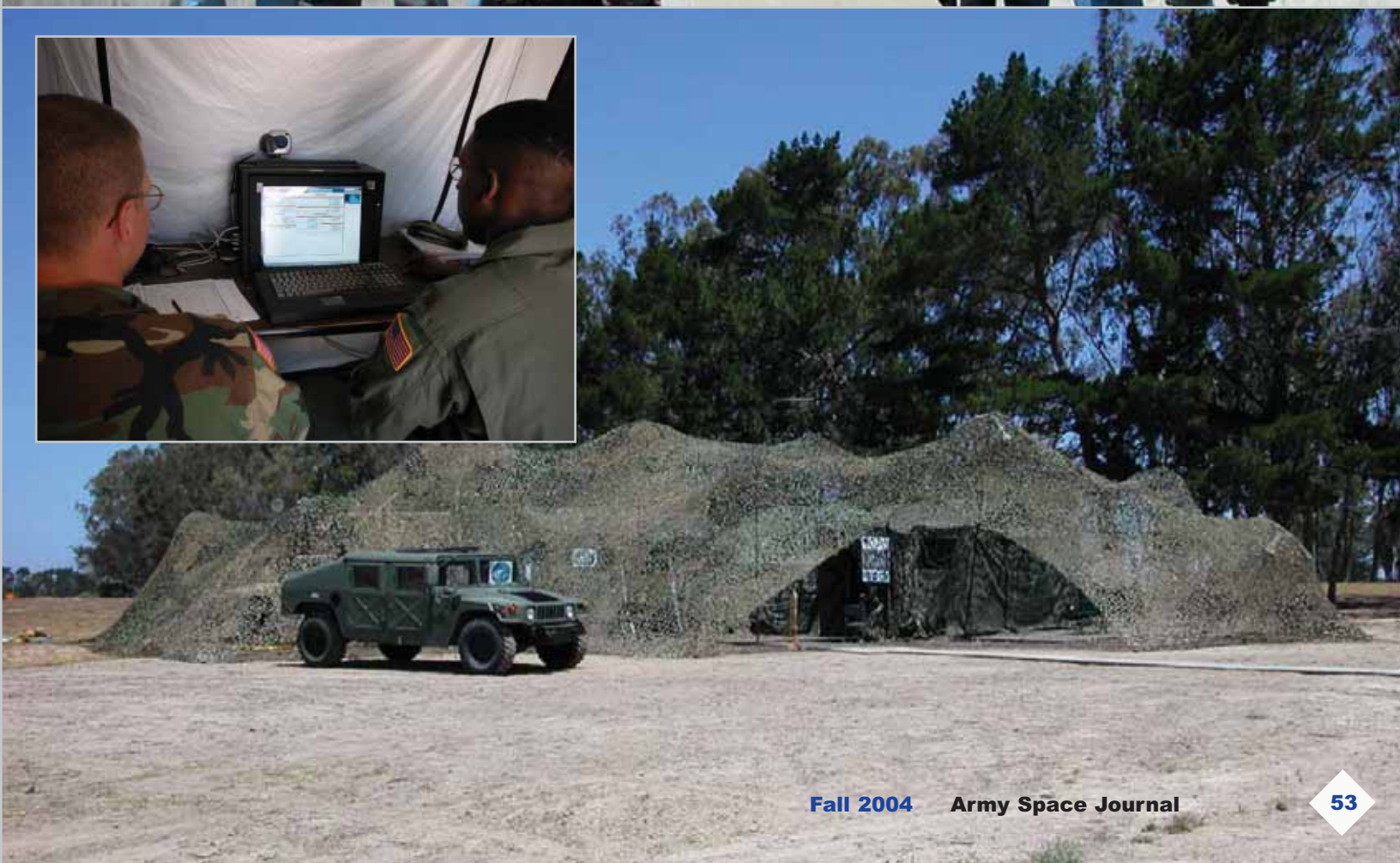
When satellite components are designed with common interfaces and protocols, integration testing of the components can be conducted while the components are still "on the bench." It will be a simple matter of connecting the components via the network regardless of where they are in the country. Problems that would prevent integration can be detected long before the first physical integration. The Virtual Mission Operations Center will provide a controlled, secure testing environment and is a vital part of that scenario

Space systems will become integrated with the global communications infrastructure. In the same way the different terrestrial systems created to carry voice, data and video are merging into one network, Space systems will merge with the terrestrial network. By applying open standards and machine-to-machine tasking, a user on one system will be able to request information from another system without having to learn the specific commands of that distant system or wait for human intervention. Virtual mission operations will provide users, especially at the "last tactical mile," the ability to operate systems and get the information they need to accomplish their mission.

SSG Dale S. Shoenfelt is the Space and Missile Defense Battle Lab Virtual Mission Operations Center (VMOC) NCOIC. Shoenfelt has been assigned to SMDBL since August of 2003. He has worked on various projects such as LEOPARD, the Multi-use Ground Station and the Virtual Mission Operations Center. Shoenfelt has traveled to many states within the continental U.S. in support of Net Centric Command and Control (NCC2), to include Vandenberg Air Force Base, Calif., for the initial VMOC experiment and demonstration.

SGT Tara R. Tomasino is the Space and Missile Defense Battle Lab Near-Space NCOIC. Tomasino has been assigned to the SMDBL since August of 2003. She has worked on various projects such as Blue-force Tracking, the Space Operating System, the Space Support Element Toolset, Near-Space initiatives and the Virtual Mission Operations Center. Tomasino has traveled to many states within the continental U.S. in support of Net Centric Command and Control (NCC2), to include Vandenberg Air Force Base, for the initial VMOC experiment and demonstration.

Top: The Virtual Mission Operations Center team stands in front of the Air Force Space Command missile at Vandenberg Air Force Base, Calif.

Bottom: The Virtual Mission Operation Center experiment set-up and location.

Inset: SSG Dale Shoenfelt and Air Force Maj. Hawkins watch live telemetry updates from UK-DMC satellite