Can You Hear Me Now?

Transformational Communications- The Space Segment

By the DON CIO Telecom/RF Spectrum/Wireless Team

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DoD's Future Communication Architecture

In the Jan-Mar 2005 edition of *CHIPS*, multiple aspects of the Department of Defense (DoD) planned Transformational Communications Architecture (TCA) were explored. This follow-on article focuses on the TCA space segment, which is a composite of space-based assets of the National Aeronautics and Space Administration (NASA), DoD and the Intelligence Community (IC). These combined assets will interoperate and they will be supported by the other three TCA segments, which are primarily earth-bound: the terrestrial infrastructure segment, the terminal segment and the network and management segment.

The TCA Space Segment

The space segment will extend the Global Information Grid (GIG) to users without fiber connections, providing improved connectivity and data transfer capability resulting in a revolutionary change in satellite communications for the warfighter. Figure 1 shows the types of services that currently compete for satellite bandwidth. These services will benefit from the planned improvements in satellite communications.

Role of Satellites in Recent Conflicts
Battle Management
Communication
Surveillance
Space-based radar
Photo-reconnaissance
Weather Monitoring and forecasting

Figure 1.

Transformational Communications System-MILSATCOM (TCM) will enable high data rate connections to space and airborne intelligence, surveillance and reconnaissance platforms. Using the data from these platforms, future networks of advanced battlefield sensors will be able to monitor, discriminate and report minor changes, such as types of vehicular/pedestrian traffic, environment, etc. The projected growth in TCM capabilities would allow broader distribution of this type of sensor data.

The satellite components of the TCA will incorporate radio frequency (RF) and laser communication links to meet joint agency requirements for high data rate protected communications. Included in the space-based programs are:

Wideband Gapfiller System (WGS), a follow-on generation for wideband communication

Mobile User Objective System (MUOS), a next generation narrowband solution providing critical connectivity for more than 80,000 UHF devices, such as small antenna radios (as small as 1 foot) found in tactical ground vehicles, hand-held man packs, and even airborne systems

Advanced Extremely High Frequency (AEHF) satellites, for updated protected communication to support strategic assets with upgraded EHF protected/survivable features

Transformational Satellite (TSAT)

As the terrestrial aspects of communication in the TCA evolve, so will DoD satellite resources. The stated goal of the Transformational Satellite communications system is to provide improved, survivable, jam-resistant, worldwide, secure and general purpose communications as part of an independent but interoperable set of space-based systems that will support NASA, DoD and the IC. TSAT will ultimately replace the DoD's current satellite system and supplement AEHF satellites.

The TSAT proposes a radio frequency (RF), i.e., traditional radio-based, crosslink to complete the AEHF group of satellites or constellation. The constellation is called the Advanced Polar System (APS), which supports strategic and national users in the polar region. The APS is designed to withstand nuclear attacks and support the strategic mission with uninterrupted service. These satellites introduce the use of jam-resistant laser crosslinks for connection into the TSAT.

The TSAT includes satellite resources and TCM satellite operation centers, TCM Mission Operations Systems and ground gateways. This creates an Internet-like transport architecture between space, air, ground and sea nodes. This design will culminate in a flexible Enterprise warfighting environment. The full GIG implementation, supported by TSAT, means every asset in the

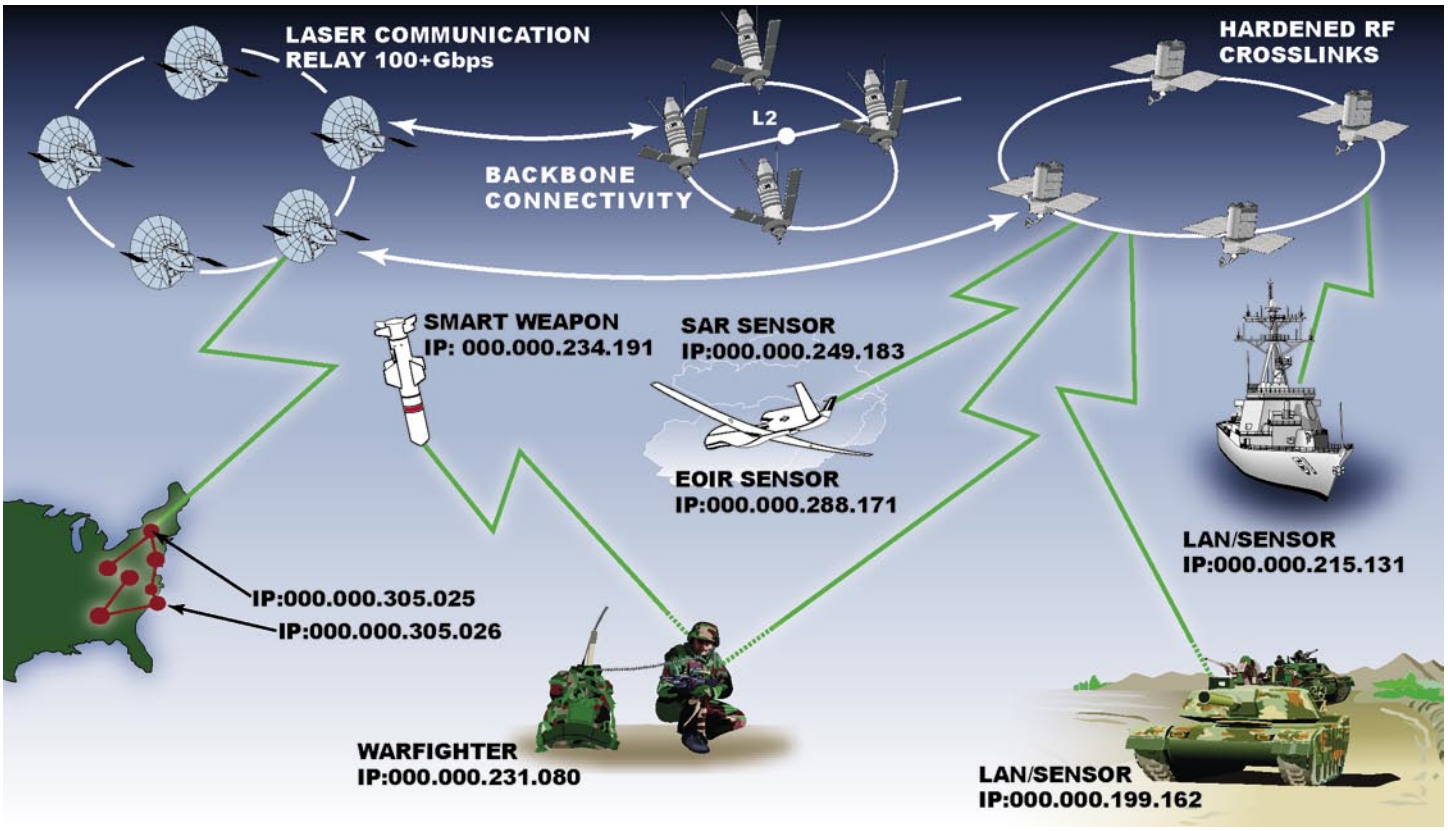

Figure 2. IP-Based and protected by IA initiatives, each platform and each sensor is accessible and integrated with warfighters.

battlespace would be addressable and capable of generating, processing or routing information. Current TCA vision calls for the U.S. Air Force, as program sponsor, to launch a constellation of five transformational satellites or TSAT spacecraft about 2011. This constellation will form the DoD ring. In this scenario, the Department of the Navy will design a service-specific architecture to leverage the spacecraft capabilities.

The TSAT assets of the DoD ring support RF data rates up to 45 Mbps and laser communication user data rates into the 10-100s Gbps range. A design objective of the DoD ring is to provide multiple, simultaneous user access to laser-based communications. This feature creates a virtually jam-proof environment. The TSAT also offers an enormous increase in total bandwidth capacity with loaded capacity of about 2 Gbps of RF per vehicle compared with 250 Mbps for AEHF.

DoD Initiatives Being Satisfied through TCA

Several Secretary of Defense initiatives are being satisfied through the TCA and its unique implementation of the space segment including: (1) providing protection from attack for our information networks; (2) utilizing information technology to link different organizations so they can fight jointly or provide coordinated homeland security; (3) maintaining protection and unhindered access for our space capabilities.

Figure 2 depicts future satellite networks that provide hardened RF crosslinks. While it is easy to define requirements and presume success, much of the technology needed to succeed will need to be developed by a public–private partnership engaging government and industry. In fact, laser communication technology is dependent upon a level of industry investment to produce multi-access laser communication receivers, develop and integrate laser communication terminals to airframes, and further develop communication-on-the-move vehicular antenna technology.

International efforts to identify services for commercial wireless implementation will support some of the same technologies. The Navy Marine Corps Intranet (NMCI) will act as the Department of the Navy's terrestrial component to support, distribute, analyze and respond to the information collected and transmitted by the satellite components of the TCA.

TSAT Enables our Shifting Naval Strategy

Naval strategy is shifting from threat-based, platform-centric to an effects-based, network-centric force. Our warfighters' information environment has seen exponential growth. The need to execute bold strategies, versus reactionary and temporary responses to situational demands, is critical to creating capable resources for future requirements.

At an interoperability level, the concept of Naval Power 21 poises the Department to embrace the GIG environment, ready to exploit joint capabilities and partner in the distribution of information. The vision for the Transformational Communication Architecture would exploit new technologies to support critical communications capabilities for the warfighter and the commander.

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