Military Satellite Communications: Space-Based Communications for the Global Information Grid

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Military satellite communications (MILSATCOM) systems are critical elements in DoD's vision for a Global Information Grid (GIG). Modeled after the commercial Internet, the GIG will provide global connectivity to support a broad range of military user applications. Commercial networking technologies, coupled with military-unique radio communications equipment, enable the GIG to support the demands of the highly mobile warfighter operating in complex radio environments. MILSATCOM is divided into three categories—narrowband, wideband, and protected—matching user requirements to suitable frequency bands. APL is active in the development of MILSATCOM systems, leveraging more than 20 years of expertise in satellite communications to ensure the global reach of the GIG.

THE GLOBAL INFORMATION GRID

Over the last decade, the Internet has enabled tremendous gains in business productivity via rapid global information sharing, effective collaboration, and communications across organizational boundaries. Motivated by the immense success of the Internet in the commercial world, the DoD, the intelligence community, and NASA have collectively embarked on an ambitious effort to migrate their information systems and networks to a common IP backbone, providing infrastructure and application platforms for network-centric operations and warfare. It is worth noting that, despite the intent to leverage commercial technology, the development of the Global Information Grid (GIG) will inevitably require the incorporation of military-unique features into the commercial solutions to address information assurance issues such as communications security, transmission security, and the integration of priority and precedence with commercial quality of service.

Even with a common IP layer for networking, the physical and link-layer technologies will vary significantly across the network segments that will compose the GIG. Depending on geographical location, communications environment, user density, and other factors, each segment of the GIG will apply novel solutions to meet the warfighter's requirements. The MILSATCOM systems are excellent examples of diverse physical and link layers, designed to address unique user requirements. The frequencies at which MILSATCOM systems

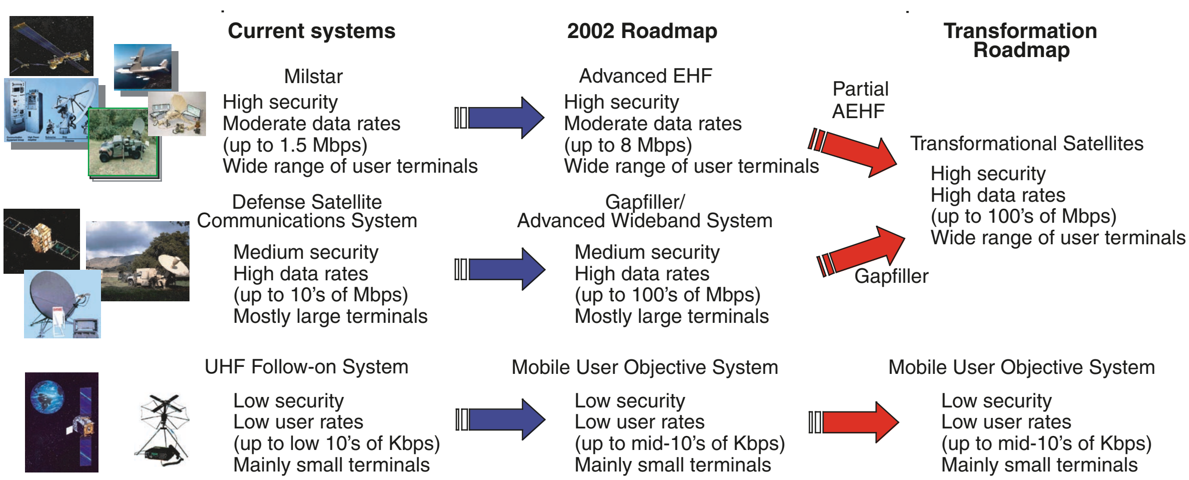

Figure 1. Transformational Communications Study impact on the DoD MILSATCOM Roadmap.

operate were chosen to best address a range of user requirements: narrowband communications at UHF, wideband communications at SHF, and protected communications at EHF. Each of these frequency bands provides distinctive capabilities and presents new challenges in terms of integrating with the network-centric vision for the GIG.

Before 2002, the MILSATCOM Roadmap was focused on a continued presence in the three primary frequency domains (UHF, SHF, EHF), representing three classes of users and technology. The Roadmap depicted in Fig. 1 shows that, before 2002, modifications to systems in many cases were evolutionary, not revolutionary. In each frequency band, the Roadmap called for a new system to replace current satellites, incrementally improving performance through state-of-the-art technology insertion. In January 2002, the DoD initiated the Transformational Communications Study (TCS) to consider ways to revolutionize MILSATCOM systems. One TCS goal was to create a high-capacity IP backbone in space. As a result, the post-2002 TCS Roadmap sought to consolidate functionality across the previously separate wideband and protected satellite systems and, through the application of advanced optical technology, to achieve a MILSATCOM architecture that would remove communications as a constraint to the warfighter.

While the TCS Roadmap has remained unchanged since 2002, the timelines and programmatics to bring the vision to reality continue to be refined. The integrated system-of-systems MILSATCOM architecture for the transformation is better illustrated in Fig. 2, which highlights the satellite systems to be deployed over the next 5 to 15 years. The Mobile User Objective System (MUOS), Wideband Gapfiller System (WGS), and Advanced EHF (AEHF) will be deployed earlier, while the Transformational Satellites (TSATs) and the Advanced Polar System (APS) will come onboard mostly after 2012. The low data rates of the MUOS make it suitable primarily for tactical applications. The other systems can be used for tactical, strategic, and backbone applications. Together, these systems represent a major commitment to MILSATCOM and to realizing the GIG vision.

An additional challenge in achieving this vision is to interconnect these satellite systems to ground- and air-based tactical networks and to high-capacity wireline backbones like the GIG Bandwidth Expansion (GIG-BE) fiber-optic network. A large part of this challenge

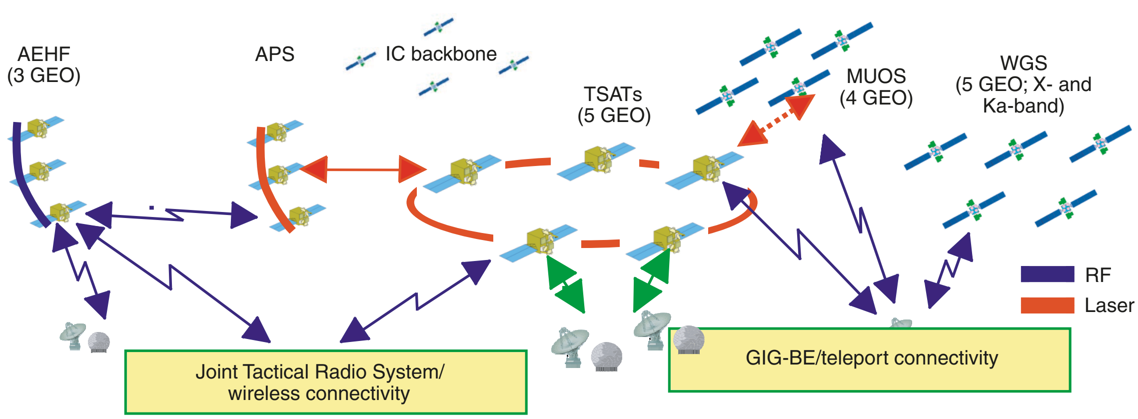

Figure 2. MILSATCOM system of systems (GEO = geosynchronous Earth-orbit satellites).

is being addressed by the DoD Teleport Program. This program is aimed at allowing true multiband capability so that different satellite systems as well as different ground-based systems can interoperate by connecting at one of the global Teleport sites. Although initial deployment of Teleport provides only circuit connectivity, a future generation will have IP capabilities consistent with the vision for the GIG.

The following sections briefly describe the MILSATCOM systems, the Teleport Program, and APL's involvement in the integration of these network segments to create the GIG.

NARROWBAND SATCOM

DoD's narrowband SATCOM systems yield low-data-rate (less than 64 Kbps), beyond-line-of-sight (BLOS) communications. These systems have been designed with the mobile, tactical warfighter in mind. This is apparent in the satellite constellation design and frequencies of operation as well as the system's support of relatively simple, low-cost, mobile terminals.

These narrowband systems are designed to operate in the UHF band (290–320 MHz uplink and 240–270 MHz downlink). Systems operating in this band are better able to penetrate foliage and atmospheric conditions such as clouds, rain, or fog. UHF SATCOM terminal antennas have relatively broad beamwidths, which allows the mobile user to communicate even if terminal antenna pointing is imprecise. UHF SATCOM is provided by geosynchronous satellites, enabling worldwide coverage up to approximately ±70° latitude. Therefore, it can be seen that the UHF SATCOM systems were designed to enable BLOS communications anywhere, anytime.

Although DoD's UHF SATCOM is protected by encryption, it is not designed with anti-jam, low probability of intercept (LPI), or low probability of detection (LPD) capabilities. While one could certainly see the utility of these features in many military applications, the absence of this functionality keeps the design of these UHF SATCOM systems relatively simple. This helps keep terminal costs low compared with other DoD MILSATCOM systems and allows DoD to field tens of thousands of UHF SATCOM terminals for the warfighter.

The UHF Follow-On System

Narrowband SATCOM is currently provided by a constellation of UHF Follow-On (UFO) satellites. The full UFO constellation consists of two active satellites in each of four global coverage regions. The subsatellite points are located over the Americas and the Atlantic, Indian, and Pacific oceans. The constellation also consists of spare on-orbit satellites that provide backup or surge capability when needed. The first UFO satellite was launched in 1993, and the constellation was completed with the launch of UFO Flight 11 in December 2003.

Because narrowband SATCOM can support a wide variety of applications, the UFO system and its predecessors have been consistently oversubscribed. To mitigate this problem, DoD has developed multiple access protocols to allow a single UHF SATCOM channel to be shared by many applications. These protocols use time-division multiple-access schemes, with access granted either on demand or according to a predetermined plan. While these protocols do allow wider access to UHF SATCOM resources, the consistent and sustained growth in demand for such access since the first Gulf War continues to leave the system oversubscribed.

The ongoing development and evolution of the DoD Teleport Program (discussed later in this article) will give the UFO user access to the GIG and some Defense Information Services Network (DISN) services. Although access will be somewhat limited in terms of dynamic accesses and the number of DISN services provided, this is an important first step in bringing the GIG to the mobile tactical user.

The Mobile User Objective System

MUOS is currently under development as an eventual replacement for the UFO system. To meet future MILSATCOM requirements, it has become apparent that dramatic improvement is needed in some areas, such as capacity and support of communications on the move (COTM). While DoD's narrowband SATCOM systems have always supported mobile platforms, the military's conception of COTM has evolved significantly over time. For example, over the past 30 years, the concept of "on the move" has evolved from ships at sea to include aircraft, vehicles, single-person portable terminals (to fit in a backpack), and even missiles such as Tactical Tomahawk. The concept continues to evolve as the military pursues support of communications to handheld terminals (resembling very large cell phones) in the MUOS era. Support of this latter terminal type will bring UHF SATCOM capability to users at the "tip of the spear," further increasing the demand for UHF capacity. Also, current and future military operations may place these users in highly challenging propagation environments (such as urban terrain and heavy foliage) that are not well served by today's UHF SATCOM systems. As a result, MUOS will be required to provide increased capacity to platforms that are highly mobile and are operating in the most challenging propagation environments.

MUOS must also be integrated into the GIG to facilitate warfighter access to DISN services. This access will be provided via the DoD Teleport and will bring a new set of capabilities to bear. For example, a MUOS user could use DISN services to communicate with a non-MUOS user or to pull pertinent information from appropriate databases on the GIG. In the latter context, the MUOS user would be analogous to a cellular phone user with Internet access, obtaining key information on an as-needed basis.

Given the large DoD investment in terminal infrastructure and the impracticality of an instantaneous transition from the UFO system to a new system, MUOS must also support backward compatibility with terminals designed for operation with the UFO System. This constraint further exacerbates the technical challenges (improved capacity, COTM, GIG access) discussed previously.

The Navy serves as executive agent for narrowband SATCOM, and therefore has responsibility for the development and procurement of MUOS. MUOS initial operational capability (IOC) is currently scheduled for 2010, with full operational capability in 2014. A key tenet of the Navy's strategy for overcoming technical challenges is to design MUOS as a system of integrated segments. In previous MILSATCOM systems, the space segment (satellites) was typically developed separately from the various ground segments (which were typically developed separately from each other). By developing all MUOS segments concurrently, the MUOS Program is able to ensure a coherent design and optimize the system's cost-effectiveness.

Another key tenet in the development of MUOS is to leverage advances in commercial technology. While not necessarily a commercial success, the construction of technically advanced mobile satellite phone service systems like Iridium, ACeS, and Thuraya has provided a wealth of advances that MUOS can leverage. For example, the state of the art for large on-orbit antennas, linear amplifiers, and modular spacecraft buses has been significantly advanced by these commercial systems. Furthermore, the explosion of the cellular phone industry over the last decade has been accompanied by significant improvements in both terminal (i.e., phone) technology and the ability to provide on-demand access to wireless communications services. Leveraging these technologies will result in more efficient resource utilization, increased effective capacity, and improved COTM.

APL Contributions to UHF SATCOM

APL has provided technical support for narrowband SATCOM since the very early days of DoD's first UHF system. This support has continued for the UFO and MUOS programs, where APL has served in a trusted agent role. In this role for MUOS, APL has assisted the Navy in the development of reference architectures for consideration.[1,2] The Laboratory has also been deeply involved in the performance assessments of more than 24 proposed architectures for the MUOS analysis of alternatives (AoA) and continues with the assessment of detailed architectures under development by industry teams. APL is also actively involved in the development of the MUOS Performance Specification, which is the principal technical guidance for the development of the system. In addition, the Laboratory was recently asked to use its UHF SATCOM expertise as a primary author of the U.S. proposal for the provision of UHF SATCOM service to NATO. Finally, APL provides technical support to the UHF SATCOM user community. As a recent example, the Laboratory has been the technical direction agent from concept development to field testing for the Tactical Tomahawk Missile Program, which uses UHF SATCOM for in-flight communications with a Tomahawk missile.

Many technical challenges lie ahead as the detailed MUOS design is refined and the system is fielded. By recalling the Navy's two key tenets for overcoming these challenges, one sees the technical contributions required of APL in its trusted agent role. One key tenet of the Navy's approach is to design MUOS as a system of integrated segments. The Navy relies on APL to understand the technical details of each segment and also how these segments must be integrated to achieve the desired performance. In this light, APL is also responsible for providing independent system performance assessments of various architectures. The second key tenet of the Navy's approach is to leverage leading-edge commercial technologies. Success requires an understanding not only of these technologies but also of military-unique requirements and methodologies. The Navy relies on APL to provide this understanding, to assess how commercial technologies can be applied to meet military requirements, and to identify situations where modifications to these technologies are needed or development of alternative technologies is called for.

PROTECTED SATCOM

DoD's EHF SATCOM systems offer protected BLOS communications for strategic, tactical, and coalition-partner users. These SATCOM systems use onboard partial processing, advanced signal processing, and frequency hopping to provide robust communications that can operate in the presence of interference and within the most challenging environmental constraints. These systems have also been designed to minimize the probability of interception and detection, enabling increased covertness.

The Milstar Program and Advanced EHF

The Milstar Program began in the 1980s primarily as a strategic system to support nuclear command and control for U.S. bombers, ballistic missile submarines, fixed-site and mobile nuclear missile systems within the United States, and mobile nonstrategic nuclear forces in Europe. The first-generation EHF SATCOM system, Milstar-I, achieved its IOC in 1994 and is designed to give anti-jam and LPI/LPD protection superior to that of other MILSATCOM systems. Milstar-I provides extremely robust communications for command and control of U.S. strategic forces by using a very large bandwidth (2 GHz uplink and 1 GHz downlink) to deliver up to 92 low-data-rate communications channels at a maximum data rate of 2400 bps. The Milstar-I satellites also implement cross-links between satellites so that U.S. forces can communicate around the world without requiring any ground relay stations.

As a result of the end of the Cold War and lessons learned from Operation Desert Storm, the Milstar Program was restructured, placing heavier emphasis on support of tactical users. Milstar-II achieved its IOC in 2001 and supports strategic and tactical users with data rates of up to 1.544 Mbps. It also uses adaptive uplink beamforming techniques to mitigate uplink jamming. The current EHF constellation consists of two Milstar-I satellites and three Milstar-II satellites, along with a variety of other EHF payloads hosted onboard other DoD satellites. The next-generation EHF SATCOM, the AEHF Program, will take advantage of new technology to provide higher data rates, up to 8 Mbps, to support the rapidly growing requirements for protected communications within both strategic and tactical user communities. The first AEHF satellite is scheduled to be launched in 2007, with two more launched at 1-year intervals. Additional AEHF satellites may be procured pending decisions on the next generation of EHF satellites.

Transformational Communications Satellites

Through the TCS mentioned earlier, leaders in the DoD, intelligence community, and other federal agencies determined that the current legacy satellite communications infrastructure (including AEHF) lacked the capacity, interoperability, control, adaptability, responsiveness, and coverage to support operations. This resulted in the MILSATCOM restructuring depicted in Fig. 1. As part of this restructuring, the AEHF constellation was reduced from five to three satellites and the WGS constellation of three satellites was increased to five. To address the challenges posed by this restructuring, the Transformational Communications Office (TCO) was established on 3 September 2002 by authority of the Under Secretary of the Air Force to develop and coordinate implementation of a Transformational Communications Architecture (TCA) to maintain America's asymmetric information and decision superiority and address the need of replacing numerous aging legacy systems. As shown in Fig. 2, the central system in the TCA is the TSAT system, which will provide a constellation of interoperable satellites that will objectively improve connectivity and data transfer capability while removing bandwidth constraints for worldwide U.S. requirements across DoD, civil, and intelligence community operations. The TSAT system shares many similarities with previous EHF systems but supports other frequency bands including Ka-band. The TSAT system is unique, however, in that TSATs will host routing functionality, enabling space-based IP routing. TSATs are envisioned to also provide increased link data rates, improved efficiency through dynamic bandwidth resource allocation, and support for DoD quality-of-service concepts. In addition, they are envisioned to support a vehicular COTM capability, which is considered essential to support the Army's future warfighting concepts and next-generation systems such as the Future Combat System.

APL Contributions to Protected SATCOM

The principal role of APL in the development of DoD EHF SATCOM has been in support of Army and Navy Earth terminal designs, vulnerability assessments, and network management. Since the mid-1980s, the Laboratory has worked for the Army Project Managers for EHF Earth terminals at Fort Monmouth, New Jersey. This work has included a diverse set of activities such as the development of concepts for the use and remote control of networks of Army EHF terminals,[3,4] contributions to the concepts and specifications for the Earth terminals, modeling and simulation of network performance,[5] introduction of new technologies (such as turbo-codes) into the signal processing of the terminals,[6,7] and development of software tools for decision making and algorithms to support the military deployment of the terminals.[8–11]

Over the same period, APL has supported the Navy's EHF terminal programs by evaluating the critical aspect of performance against jamming and intercept threats for both surface ships and submarines. This has been done through modeling and simulation and by empirical testing of ships and submarines at sea over approximately a decade.[12] APL has also influenced the design of the space segment of the Milstar and AEHF systems in specific areas, such as satellite onboard nulling antennas and resource control algorithms that affect Earth terminal performance. Recently, the Laboratory has been determining the role that SATCOM will play in the Army Future Force.[13] These APL activities are expected to continue through the AEHF timeframe and into the TSAT generation of EHF SATCOM.

WIDEBAND SATCOM

The wideband SATCOM segment of the MILSATCOM architecture is built around the Defense Satellite Communications System (DSCS), which has provided the bulk of SATCOM capacity for the military for decades. The origin of MILSATCOM can be traced back to Project SCORE (Signal Communication by Orbiting Relay Equipment), launched in 1958.

A subsequent effort, called the Initial Defense Communication Satellite Program, was developed for operational use. Its employment during the Vietnam War prompted its name change to the Initial Defense Satellite Communication System.

The Defense Satellite Communications System

Current DoD wideband capabilities have evolved from these simple beginnings to the current generation of satellites, DSCS-II and -III. The DSCS-II communications payload had four channels with various combinations of bandwidth and antennas. The combinations provided the flexibility to handle a wide variety of links and to communicate with terminals of various sizes. Initial terminals constructed at major nodes had 18.3-m-dia. antennas. The first 2 DSCS-II satellites were launched in November 1971; by September 1982, 14 had been launched, 4 were not placed in orbit as a result of launch vehicle failures, and 6 were operational with varying degrees of availability.

The DSCS-III is the third-generation general-purpose military communications satellite. It evolved from a spin-stabilized satellite to a three-axis body-stabilized satellite, offering significantly greater capacity, longer life, and improved resistance to hostile activities such as jamming. DSCS-III development started in 1977. The first was launched in 1982, and 11 additional satellites have been launched since then. The DSCS Service Life Enhancement Program ensures continual, robust wideband communications for many years to come.

As capacity requirements ballooned in the 1990s, the DSCS was augmented through the leasing of commercial transponders. In current military operations, these transponders support 80% of the DoD SATCOM requirements.

The Wideband Gapfiller System

In anticipation of the end of life for the DSCS constellation, DoD initiated WGS acquisition to provide three high-capacity satellites that leveraged available commercial technology. Each of the WGS satellites will support 2.3 Gbps of throughput, more than the capacity of the entire DSCS constellation. Based on commercial satellite designs, the WGS supports the traditional DSCS frequencies at X-band and adds the capability for communications at higher Ka-band frequencies (30.5 GHz uplink, 20.0 GHz downlink). The addition of Ka-band increases the available spectrum from 500.0 MHz to 1.5 GHz.

The key to the flexibility of the WGS is the digital channelizer (a digital signal processor), which divides the communications capacity into 1872 subchannels of 2.6 MHz each and switches and routes these subchannels. The channelizer can also provide receive-to-transmit communications bandwidths of multiples of 2.6 MHz up to a maximum of 125.0 MHz. It has the ability to merge multiple uplink signals into a single downlink band or to multicast a single uplink signal by connecting it to multiple downlinks. It also allows ground monitoring of the spectrum of any uplink signal.

The first WGS is scheduled for launch in 2007. Originally, the WGS was intended to bridge the gap between the end of the DSCS and the beginning of a future system to be called the Advanced Wideband System (AWS). However, during the TCS and subsequent SATCOM architecture analysis by the TCO, funding for the AWS was used to enhance funding for the TSAT system. To offset the loss of the AWS, the decision was made to launch three additional WGS satellites to extend the life of the wideband constellation until the TSAT system could pick up the wideband requirements in addition to the protected requirements. What was originally a three-ball gapfiller has since become a full constellation that will provide a dramatic capacity increase to the warfighter over the next 10 years.

Commercial IP Modem Systems

The presence of low-cost COTS modems that support IP-based traffic on a demand-assigned basis is profoundly affecting the future of the transponded MILSATCOM systems. These commercial modems provide the ability to more effectively share the limited SATCOM resources among a community of users within the satellite coverage area.

With the high cost of commercial transponder leasing, current military operations are already migrating to these commercial modems to improve operational efficiency. The Defense Information Systems Agency (DISA) is leading an effort to identify a standard IP modem to ensure DoD user interoperability. A DISA-led working group has identified the open standard for digital video broadcast/return channel satellite (DVB/RCS) as the preferred solution. Originally built for video distribution by satellite, the addition of RCS to DVB creates a low-cost user terminal that can support Internet-access types of services in a hub-spoke architecture. Future military operations will also require full-mesh connectivity among user terminals, and multiple options are being considered for a DoD standard. As the DVB/RCS is not well suited to the demands of the highly mobile warfighter, the Army is expected to separately procure an IP modem that meets their tactical requirements.

APL Contributions in Wideband SATCOM

For over a decade, APL has been at the forefront of the control system architecture for wideband MILSATCOM. Each of the MILSATCOM systems requires a sophisticated planning and management capability. For the transponded wideband satellites, there are five wideband satellite operations centers (WSOCs) around the globe, which are responsible for planning, configuration of the satellite, control of terminal power, and spectrum monitoring. These functions ensure that the satellites are operated efficiently and that users are not adversely impacting one another.

Since 1992, in support of the U.S. Army Project Manager for Defense Communications and Army Transmission Systems at Fort Monmouth, New Jersey, APL has developed the Objective DSCS Operational Control System (ODOCS) architecture for the DSCS (and soon the WGS) and has been providing technical direction over the integration of control systems into the ODOCS architecture at the WSOCs. In addition to developing the architecture, APL developed the software functions that tie all control subsystems together.

A key element in the ODOCS architecture is the DSCS Integrated Management System (DIMS), which provides a single console from which all other subsystems can be monitored and controlled. In addition, DIMS acts as the interface to legacy systems that cannot otherwise be integrated into the ODOCS. Underlying DIMS are the software services with which new subsystems must comply to operate in the WSOCs.

Leveraging an extensive background in wideband control, APL is working with the wideband community to develop a network-centric management approach for transformational transponded MILSATCOM[14] to better support the vision of the TCO. This forward-looking concept for 2015 wideband SATCOM is shown in Fig. 3. As the GIG moves toward a network service provider paradigm, it is a logical progression to view each constituent network as a service provider.

In Fig. 3, the WGS is shown in this light, providing peering and transport agreements with neighboring networks including, for example, GIG-BE and TSAT. User access services are also provided to both tactical and strategic user communities. With the high-capacity WGS satellites and the efficient, net-centric IP modems, the transponded MILSATCOM segment represents a powerful element in the delivery of network-centric enterprise services (NCES) to the warfighter. Key elements needed to achieve this vision include enhancements at the planning and operations centers, as well as at Teleport sites, to enable the users to establish IP network services, based on a service-level agreement, for both in-theater communications and interconnection with the DoD terrestrial infrastructure.

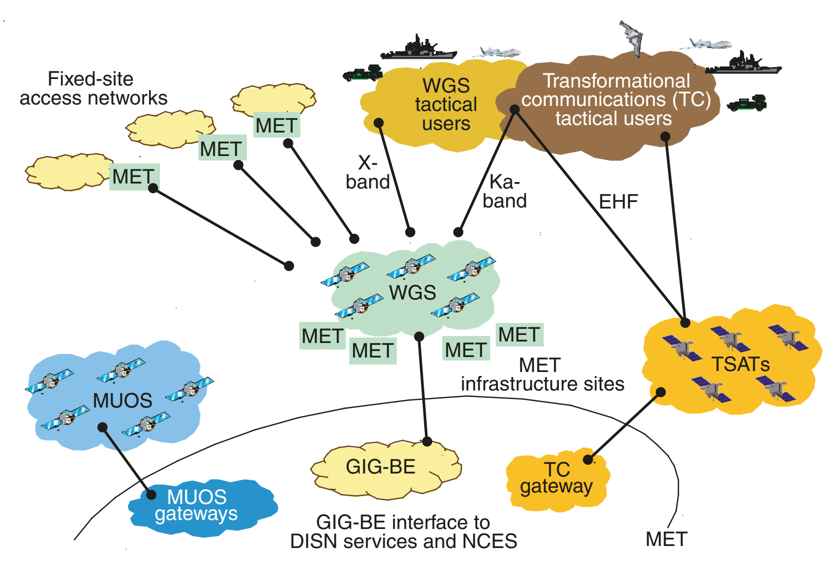

Figure 3. A 2015 wideband SATCOM framework (MET = modernization enterprise terminal).

THE TELEPORT PROGRAM

Connectivity

The DoD Teleport Program, managed by DISA, provides satellite connectivity between deployed warfighters and the DISN, as shown in Fig. 4. Prior to the Teleport Program, the only means of achieving connectivity was through the heavily used X-band DSCS satellites using 1 of the 15 standard tactical entry point (STEP) gateway sites. The program is upgrading selected STEP sites with additional satellite terminals and baseband equipment. Upgrades encompassing three generations are being phased in.

In the first generation, which began in April 2002 and is nearing completion, the Teleport Program is upgrading 7 of the 15 STEP sites to provide access via commercial satellite bands (C- and Ku-band). UHF terminals are currently being deployed, and EHF terminals will be added during the next fiscal year. In generation 2, which started in 2004 and will end in 2007, Ka-band WGS capability will be added to Teleport sites. During generation 3, which concludes in 2012, Teleport sites will be further upgraded to provide access to the next generation of military satellites, including AEHF, MUOS, and TSATs.

Recently, the Teleport Program Office was directed by the Office of the Secretary of Defense to transition from its current circuit-based, time division multiplexer approach to a network-centric IP-based capability. Toward this objective, a prototype IP capability will be implemented at two Teleport sites by the end of FY2005. During generation 2, the IP capability will be upgraded and deployed to all six core sites. This approach will enable more efficient use of satellites and will eliminate the complexities associated with the great number

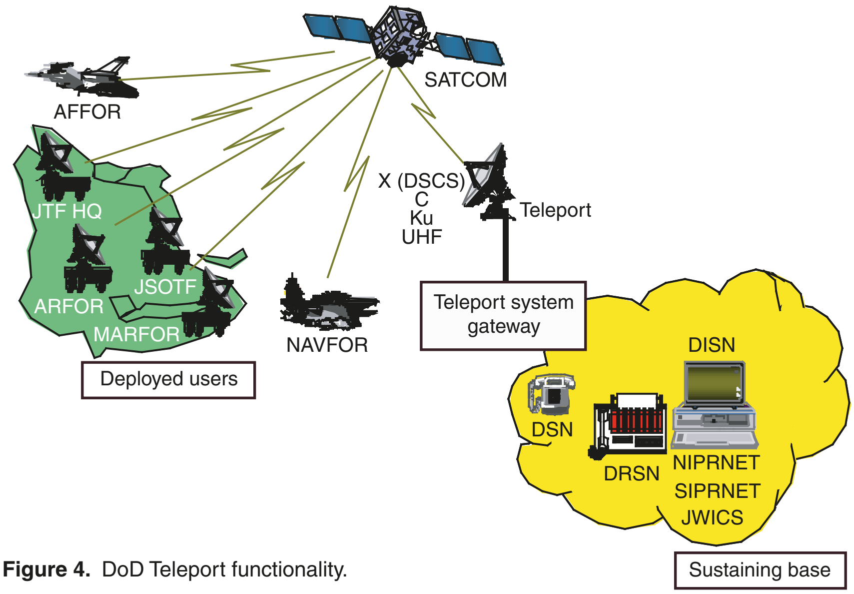

Figure 4. DoD Teleport functionality.

of service-unique multiplexers and baseband equipment currently in use.

APL Contributions to the Teleport Program

APL has been involved in the Teleport Program from its inception. In 2000, staff members played a leading role in conducting the Navy's AoA, which led to the implementation of the program as it exists today.[15] The AoA report considered the existing global sites with the requisite equipment and studied issues including Teleport site optimization through MILSATCOM and commercial SATCOM coverage analysis, traffic capacity assessment, protocol analyses, subsystem specifications, and overall hardware architecture approaches. During this period, APL supported DISA in laying the fundamental groundwork for the Teleport Program.

In April 2002, the program received government approval and the Teleport Program Office was formed within DISA. APL served as the systems integrator for Teleport and has played a key role in systems engineering, integration/implementation, and testing. The Laboratory worked with the Joint Staff on requirements definition and with the Army on overall baseband design, was a key contributor to asynchronous transfer mode baseband design and testing, led the integration of Teleport with DISN services, and had a significant role in the early implementation of UHF SATCOM capabilities[16] and the monitoring and control subsystem designs. APL staff members have conducted numerous studies, including geographic coverage, system capacity, and system availability analyses, and participated in planning and conducting developmental and operational tests and evaluations as well as operational demonstrations. In addition, the Laboratory was assigned as the integration and implementation lead in each of the theaters to work with their government counterparts to coordinate site implementation activities. Finally, APL performed risk analysis and mitigation activities and provided training to Teleport site operations staff and operational support for warfighter missions using new Teleport capabilities.

More recently, APL has been coordinating and conducting the initial testing of IP equipment (e.g., the 2004 Joint User Interoperability Communications Experiment) developing the requirements for IP capability, and designing the prototype router suites that were first deployed in 2004.[17,18]

CONCLUSION

MILSATCOM will continue to play a critical role in military communications architecture because it can provide voice, video, and data communications to users globally. As warfighting applications evolve, MILSATCOM must integrate and adapt new technologies to support these applications. APL has been involved in the development of these systems from both the conceptual and the deeply technical perspectives for decades. It is envisioned that this critical role for the Laboratory will continue in support of the nation's military capabilities.

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