

Advancing Military Satellite Communications with Open Standards: The Joint IP Modem

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Satellite Communications (SATCOM) use by DoD has increased dramatically, and has transitioned to IP-based services consistent with concepts for net-centric warfare. The greater use has resulted in a proliferation of commercial IP-based products using government and commercial satellites. Products include the Army-wide Joint Network Node (JNN), the WIN-T, the USMC SWAN network, CSS, GBS, Teleport systems, and others. DISA cited over 23 modems in the inventory at one point.

This greater reliance on commercial SATCOM has benefited the warfighter by allowing rapid infusion of IP-centric, efficient systems. The efficiency of these systems is a core attribute of the commercial market, which embraces principles of optimizing total system cost inclusive of capital acquisition and operational cost. In general these systems have been standards-based, but commercial market segmentation has caused these systems to be optimized for the various market segments they served, ranging from small to large networks and from hub-spoke to mesh topologies.

The Joint IP Modem Program intends to include the benefits of these commercial technologies while providing unique government/military features like TRANSEC cover and a standard for multi-vendor interoperability. The Joint IP Modem (JIPM) is a progressive step to organize this adoption of commercial SATCOM technologies. The JIPM is based on the widely-adopted DVB-S2 and DVB/RCS standards, with TRANSEC and other technical enhancements needed by the warfighter, and supports future upgrades over the life of the program. This paper will describe how the JIPM program is structured to provide an initial open standard for shared network, IP-centric modems to increase warfighter capabilities, and in particular, the benefits brought to MILSATCOM from commercial technologies.

I. Introduction

Satellite communications (SATCOM) has grown to be a common user system, and has been widely adopted in both commercial and government use. As is true for many systems, SATCOM has transitioned to become IP-centric to be compatible with baseband applications that have become the standards in homes and offices. For the military, the use of SATCOM has become crucial for many missions, and especially for forces deployed to areas having little or no communication infrastructure.

What are some of the key military concerns for IP SATCOM and SATCOM in general? A quick list would include the following:

- Interoperability for users
- Low cost for use
- Ease of implementation
- Security

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for the various market segments they served ranging from small to large networks and from hub-spoke to mesh topologies. Hence a standard for IP for the military would need to be optimized for many networks and applications, while at the same time reaping the advantages of the commercial marketplace and commercial technologies.

These concepts have been the impetus for bringing standardization for IP SATCOM in the form of a Joint IP Modem (JIPM). The remainder of this paper will provide the following:

- Insight as to how Joint IP standard was developed
- The IP standard and main features
- The JIPM in service to the Global Broadcast System (GBS)
- The expected benefits from commercial technology

II. NII and TIA Activities

The activities that led to the Joint IP Modem concept were driven by ASD/NII, the Defense Information Systems Agency (DISA), and the Telecommunications Industry Alliance (TIA) and its industry members. ASD/NII and DISA as its agent concluded that the adoption of IP modems could be enhanced if the solution was multi-vendor supported and addressed the government need for information assurance in addition to operational efficiency. DISA cited over 23 modems in the inventory at one point, each with its own separate inventory, maintenance program, training program, and logistics tail. NII and DISA turned to the TIA as a cooperative body representing various facets of industry to recommend a standard.

The TIA did its job through open forums and reviewed candidate modem waveforms, and studied the features of significance for DOD. For example, it analyzed hub-spoke and mesh networking, as well as different modulation and coding techniques. In addition, the National Institute of Standards and Technology (NIST) assisted with the transmission security requirements for the JIPM.

During these studies NII and DISA considered making one of the many deployed systems into the standard, and several IP modem manufacturers were willing to publish their heretofore proprietary air interfaces as an open standard if it was deemed important for our warfighters.

NII and DISA with assistance from other major players such as U.S. Army PEO EIS followed the TIA studies and made conclusions and decisions that led to the current JIPM:

- Need for an open standard
- Should not be a current proprietary system giving one company a major advantage
- The standard should be capable of satisfying users requirements
- An efficient waveform
- Capable for both hub-spoke and mesh
- TRANSEC-capable
- Scalable to large networks

III. Key Features of the IP SATCOM Standard

The recommendations from the TIA were solidified by DISA in a promulgated standard which was known to be a widely-used standard in Europe and had been quickly adopted by several commercial SATCOM systems. The standard is the Digital Video Broadcast Second Generation (DVB-S2) and DVB/Return Channel for Satellites (RCS), which has many of the features desired in a government standard. These standards are international commercial standards allowing for efficient two-way communications for SATCOM systems using small VSATs. A number of U.S.-based commercial systems were using DVB-S2 for higher-order modulation to improve throughput for the SATCOM link from hubs to the remote terminals. These same systems typically have return links (from the remotes to the hub) using a modification of the RCS standard. The selection of DVB-S2 and DVB/RCS was based on this proven, highly-efficient modulation and coding to optimize space segment use and because of wide support in the commercial industry, allowing for eventual multi-vendor bidding and production.

This JIPM standard will be developed to ensure commercial best practice and leverage commercial technology, with the plan to incorporate specific government features. Then the DoD will publish the resultant standard, after the first product was completed and tested, allowing multiple companies to build interoperable modems.

The other major feature was the Federal Information Processing Standards (FIPS) 140-2, Level 2 needed for security. This standard is a nationally certified, commercial encryption methodology for information protection under the purview of the National Institute of Standards and Technology (NIST) and is in wide use in many systems. For example, the MD-1366 and 1367 single channel per carrier modems developed for DISA and PN DCATS are certified for FIPS 140-2, Level 2. These modems represent the new extension to Mil-Std-165A and the revision to this mil-std is currently in draft. Finally, the requirement was for the JIPM to complete a DoD Information Assurance Certification Accreditation Program (DIACAP).

The JIPM was designed to include advanced features such as embedded TCP acceleration, adaptive coding and modulation (ACM), higher order modulation, mesh connectivity extensions, extensive quality of service (QOS), extended network management, and IPv6.

IV. JIPM for the GBS Network

The JIPM will be first modem developed to accommodate the GBS Network and will be deployed in 2009 to 2010. Figure 1 shows the JIPM deployed in the GBS Network, at the Primary Injection Point (PIP) and at the remote terminals. Note that the JIPM remote modems (RMs) will be integral to each terminal, not a separate unit apart from the terminal (the figure shows a notional concept of an RM as part of each of the terminals). The GBS Network will have JIPMs with the field units, and each JIPM will be packaged with two receive demods, as shown by the black and red downlinks. The GBS Network will provide GIG information sent out to the users in the field as well as in-theater broadcasts, depicted by the UAV information.

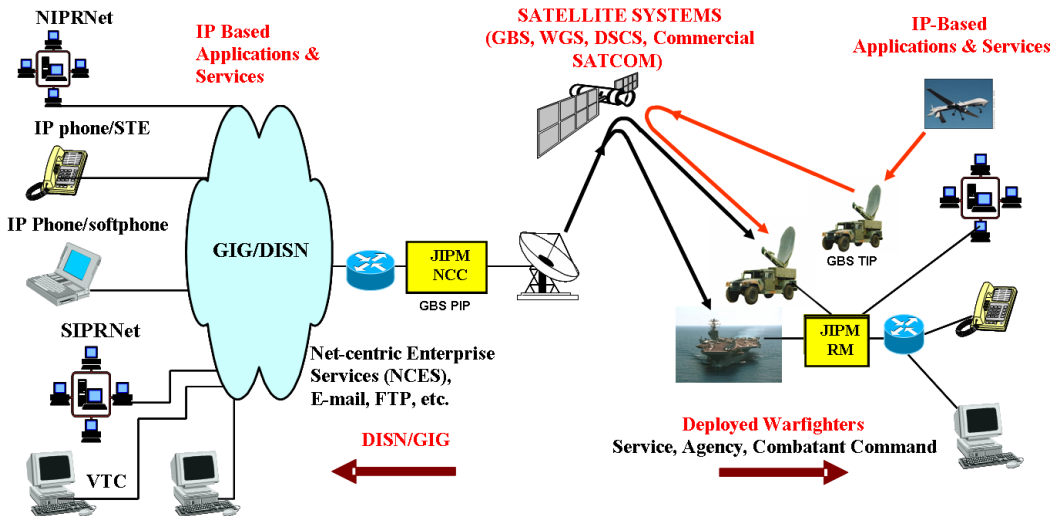


Figure 1. JIPM Deployment for the GBS Network

Here are some key features of the JIPM for the GBS Network:

- Network Topology Star
- Forward Link Modulation QPSK, 8PSK, 16APSK
- Return Link Modulation QPSK, 8PSK
- Forward Link FEC LDPC
- Return Link Modulation Turbo
- Forward Link Symbol Rate 50 Msp

- Return Link Symbol Rate 2 Msps
- IF Interface 950-2050 MHz
- Weight 9 pounds or less
- Certification FCC, CE, RoHS Certification
- Operating Temperature 0-50 degrees C

V. Government Benefits From Commercial Systems

The leveraging of commercial technology for the JIPM has the goal of ensuring interoperability in modems across all deployed networks. The concept of using commercial technology is also to take advantage of their cost savings and ease of use. IP itself reflects the ubiquitous web-based systems which operators and users will find to be virtually the same as on their home computers. The development of a standard IP modem is more an integration of mature, commercially-available technologies than a development of a new modem. The benefits accrued from the standard for an IP modem is as much the advantages of commercial technology as that of interoperability.

The effectiveness of this IP modem standard not only includes interoperability, but also includes ease of implementation, commonality and interoperability, savings in overall costs, etc., and many other advantages:

- Fewer test programs
- Fewer training programs
- Consolidated depot services
- Less sparing and more efficient inventory control
- Fewer logistics tails
- Easier government oversight of modem implementations
- More organized upgrades to the modems

In addition, the costs for users are projected to be much lower. There will be no developments and lengthy test programs as each set of modems is procured. Many modem builders will be able to build and bid based on the open standard. This competition will ensure high quality and low pricing.

One additional advantage for users is that while the modem is commercially based, it will be usable on many satellites systems, including MILSATs. So in particular, some users may use the JIPM on the Wideband Global Satellite (WGS) system. In that case, the space segment can come free to the user without the expense of leasing commercial Ku-band transponders, a common practice today.

As for DVB-S2, the technology has reached a stage of maturity where the number of fielded VSATs with DVB-S2 runs in the hundreds of thousands, and the cost is significantly lower than many other systems. The systems are operationally mature, field-tested, and have been improved with features such as Continuous Coding and Modulation (CCM) and ACM. These techniques allow for efficient throughput even if the parameters of the link are adversely affected by weather or other attenuations.

In conclusion, mature commercial technologies integrated in the right way make possible the JIPM as a standard that will have significant advantages for the DoD warfighter.