Military Applications of Commercial Communications Satellites

Mr. Otto Hoernig & Dr. Des Sood
Spacelink International
3400 International Drive
Washington, DC 20008-3098

1.0 Abstract

The increasingly global role of the US Military has put an added emphasis on the communications infrastructure to meet the administrative, intelligence, and operational communications requirements of the forces deployed around the world. The Military's tactical communications assets are unable to cope with the increased demand for communications resources and, in any case, must be reserved for tactical and strategic war fighting needs.

The commercial communications assets have been expanding at a much faster rate both in terms of global coverage and capacity, and, hence, offer an attractive option to supplement the Military's tactical assets. This paper presents a succinct survey of the commercial assets available to fulfill the Military's needs and the benefits of using these assets.

The commercial communications assets with global coverage are comprised of constellations of low earth orbit (LEO) and geostationary earth orbit (GEO) satellites. These assets are capable of operating with personal communications devices such as pocket-sized phones and low speed data transceivers, suitcase-sized terminals, or readily deployable earth stations for larger bandwidth applications. The Military requirement for security can be easily met through the use of approved encryption equipment.

The value and feasibility of commercial assets has been amply demonstrated on several missions such as Desert Storm, Desert Watch, and the Bosnia peacekeeping operation. Commercial telecommunications companies such as Spacelink maintain an inventory of commercial transportable earth stations that can be deployed in a matter of days to enable the Military to set up duplex communications links where terrestrial communications infrastructure is poor or even non-existent. The commercial transportable earth stations range in size from 1.8 to 5.6 meters and afford the advantage of readily matching the end user capacity requirements.

Use of commercially available communications assets offers many benefits to the Government. By leasing these commercial resources, the Government does not have to incur capital expenditures, nor maintain an inventory, to meet the deployment and surge requirements. Another benefit is in vastly reduced infrastructure costs such as personnel, training and logistics. These costs are borne by the commercial operators.

2.0 Introduction

Military operations usually entail deployment of forces into areas without commercial communications infrastructure, thus necessitating the deployment of tactical satellite communication assets. The tactical infrastructure is, by design, geared to maximizing survivability of the critical communications resources within a hostile environment and is best left to fulfill the mission critical command and control function. The addition of the global peace keeping role to the US military mission has further strained the tactical military communications infrastructure.

With advances in video technology and data applications, the bandwidth demand for intelligence sharing has also increased tremendously, putting even further strains on the tactical communications assets. Communications, in this information age, are rightfully regarded as force multipliers and must be provided if the military is to successfully accomplish its new role. Two alternatives exist to address the Military's communications needs: increase capacity of the tactical communications assets, or find some other way of meeting these requirements. Commercial communications assets offer an excellent way to offload administrative, personnel, intelligence, and logistic traffic from the tactical assets and present a much less costly alternative to expanding capacity of the tactical assets.

This paper describes the range of commercial communications assets available for military applications, and the rationale for expanding the role of these assets.

3.0 The Advantages of Commercial Communications Assets

Expanding and strengthening the Military's telecommunications and information management infrastructure is a well-accepted measure to cost effectively enhance our operational capabilities. As we implement this concept we have created an instantaneous demand for more communications alternatives. See Table 1.

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Table 1: Commercial Services Offerings of Interest to Military

Service/ Equipment	Data Rate (KBPS)	Typical Supplier	Size (Typical)	Constellation
Messaging	<2.4	Orbcomm	Pocket	LEO
Satellite Phone	2.4	Iridium	Handheld	LEO
Data Terminal / Satellite Phone	Up to 64	Inmarsat	Suitcase	GEO
Rapidly Deployed VSAT	9.6 to 2,048	Spacelink and Others	2.4 meter antenna, electronics and power source	GEO
Trailerized Terminal	Up to 45,000	Spacelink and Others	3.7 meter antenna, with electronics, generator	GEO
Transportable Terminal	Up to 90,000	Spacelink and Others	4.2/5.6 meter antenna, with electronics, generator	GEO

The commercial telecommunication infrastructure is rapidly expanding to meet these new demands.

A major advantage of utilizing and leveraging the commercial telecommunications industry infrastructure is that the military does not need to maintain these assets. The military surge requirements represent a small increment to the business base of the commercial communications industry, and, therefore, are very cost-effectively met through service and/or equipment leases. The military also benefits from not having to maintain equipment inventories, logistics infrastructure or trained personnel. The commercial assets tangibly increase the operational flexibility of the tactical assets, thereby increasing the potential of mission success.

4.0 Commercial Communications Assets

The commercial communications assets with global coverage are comprised of constellations of low earth orbit (LEO) satellites and geostationary orbit (GEO) satellites. The GEO and LEO constellations can also be categorized as “Wide Bandwidth” and “Narrow Bandwidth”, respectively. This categorization, as the names imply, define two distinct service capabilities. The GEO constellations can provide video, data, voice and fax services and are very well suited to meeting the Military’s requirements for intelligence imagery and other high bandwidth services. The LEO constellations operate with hand-held devices and are more suited for very low bandwidth applications such as telephony. Table 1 presents a summary of the services in terms of data rates that the two types of constellations can fulfill.

4.1 LEO Constellations

The LEO constellations, categorized as “Big LEO” or “Little LEO” depending upon the size and mechanism of information delivery to the recipient, have been under development for the last 10 years and are now nearing full operational. The Big LEOs (typified by Iridium) are targeted at mobile users with instantaneous global connectivity requirements. The Little LEOs (typified by Orbcomm) are more modest in their service offerings and are focused on delivering messages of a few hundred bytes, with delays that could be as much as 1 hour or so.

The business situation with LEO constellations is very dynamic. It is not unusual for these new systems to be announced with big fanfare, only to be never heard from again. Table 2 and 3 present an abbreviated list of the operational and planned LEO systems.

The next generation of LEO constellations, typified by SkyBridge and Teledesic, are still in the planning phase. These constellations are intended to deliver broadband multimedia services in Ka band. These systems face a myriad of regulatory and financial challenges before they become operational within the next 10 years.

The LEO systems, as previously noted, work with hand-held devices or suitcase-sized portable terminals and offer the prospect of providing advance contingents with readily available verbal or very low data rate communications. However, their usefulness is rather limited for applications requiring large bandwidth such as transmission of large data files. The systems based on GEO constellations are ideally suited to fulfill this role.

Table 2: Big LEO Systems

Constellation	Operator	Number of Satellites	Weight (Kg) Per Satellite	Frequency Bands
Iridium	Iridium LLC	66	689	L/S
Globalstar	Globalstar LP	48	450	L/S
ECCO	Constellation Communications, Inc.	46	280	L
Ellipso Concordia	Ellipsat (MCHI)	7	175	L
ICO	ICO Global Comm.	10	2,450	S

Table 3: Little LEO Systems

Constellation	Operator	Number of Satellites	Weight (Kg) Per Satellite	Frequency Bands
Orbcomm	Orbcom, LLP	48	43	VHF/UHF
Leo One	Leo One USA	48	125	VHF
FAIsat	FAI, Inc.	26	100	VHF/UHF
E-Sat	Echostar	6	113	VHF

4.2 GEO Constellations

GEO constellations, as well as the earth stations that operate with these constellations, are technologically mature products that offer field-proven and reliable means of communications. The reduction in weight, size, and power requirements, fostered by rapid advances in microelectronics technology, makes it practicable to deploy high capacity earth stations rapidly and to start services in a matter of days after receiving authorization to proceed. More importantly, these assets are best suited to meet the integrated communications requirements- voice, video, data, and Internet and database access- of base camps and regional headquarters.

INTELSAT, New Skies Satellites, PanAmSat, and Orion each own and operate a GEO constellation which provides global coverage. Operators such as Eutelsat, ARABSAT and AsiaSat offer regional coverage. In addition to these global and regional systems, many countries have or are developing national systems. However, their focussed coverage somewhat minimizes their usefulness for military applications. There are several domestic carriers which operate systems with coverage that significantly extends beyond their domestic borders. These systems, such as Loral and Hughes, not only provide service to US domestic markets, but also to Canada and South American countries.

5.0 Commercial Facilities for Operation with GEO Constellations

Commercial communications facilities for operation with GEO constellations include fixed and transportable earth stations with appropriate baseband equipment. These facilities permit users at remote locations to use familiar devices such as telephones and computers to make and receive calls, to be globally networked, to access large databases and to browse the Internet. Communications security can be embedded through the use of Government-furnished security devices, such as STUIII or KG's, or commercially available devices based on the DES-3 encryption standard.

The earth station antennas and electronics fall into the category of commercial off-the-shelf (COTS) equipment, and major components, such as antennas, carry type

approvals from organizations such as INTELSAT and Eutelsat. These are important factors because the market forces keep the prices affordable and type approval drastically reduces satellite operator imposed testing requirements.

The earth stations and the GEO constellations operate in what is referred to as the Fixed Satellite Service (FSS) spectrum band. The international bodies have reserved 3 commercial bands, C-band (4/6 GHz), Ku-band (11/14 GHz) and Ka Band (20/30), for these services. Currently, Ku and C-band stations are extensively deployed and are available in the global market. Multiple band stations capable of operating at X band, C-band or Ku-band satellites are also available albeit with the associated weight and cost penalty. The earth stations may be fixed (i.e., the antenna is installed on a permanent concrete foundation), or transportable (i.e., the antenna and the electronic equipment shelter are mounted on a load frame or trailer). The transportable earth stations are ideally suited to the Military's requirements. Earth stations as large as 5.6 meters can be deployed and placed into operational service in just a few days.

5.1 Earth Stations

Earth stations using GEO satellites are normally deployed at sites where presence is substantial and is expected to be of extended duration. The earth station sizes range from 1.8 meter to 5.6 meter with capabilities in terms of the aggregate data rates ranging from a few hundred kilobits per second (KBPS) to 90 MBPS. The antennas are usually installed on a concrete foundation but can be installed on load frames. The RF equipment for small earth stations is usually in weatherproof containers suitable for outdoor mounting. Therefore, no shelter is required.

For larger earth stations, all RF/electronic equipment is integrated in an environmentally controlled building to shelter located in close proximity to the antenna. Power is normally supplied from a commercial source, if available, or from a diesel generator. The earth station equipment complement invariably includes a diesel generator to serve as a backup power source in the event commercial power supply is interrupted. Figure 1 shows a typical load frame mounted commercial earth station installation supporting a military mission. Commercial earth stations can be deployed fairly quickly once the authorization to proceed is received. Spacelink has deployed these stations within a few days.

Figure 1: 4.2 meter Earth Station

5.2 Transportable Earth Stations

A transportable earth station is either trailerized for towing to the site or is mounted on a truck for transportation to the site. These earth stations can also be carried onboard military cargo planes. These stations can be setup and made operational in a matter of hours after reaching the site, since they are self-contained and fully integrated.

Spacelink, for example, deploys a team of trained personnel to not only install the earth stations, but also to provide the interfacility link, and day-to-day operations and maintenance. Figure 2 shows a typical, trailer-mounted, transportable earth station.

6.0 Acquisition Approach

Leasing is the most appropriate contractual vehicle for acquisition of commercial communications facilities for military applications, since time is of the essence for these requirements. Some companies, such as Spacelink, maintain an inventory of earth stations that are ready to deploy at a short notice.

The companies maintain an inventory of earth stations and the logistics infrastructure to offer these services on a short notice. By utilizing these commercial resources, the Government is freed from the burden of maintaining and managing the inventory and providing the logistics infrastructure, including installation, operation and maintenance personnel. The Government can request lease rates for short term or long term, as required, to suit the mission-specific needs. Commercial international tele-communications companies with international operations can coordinate and obtain host nation approval, as required. Also, companies such as Spacelink, with INTELSAT direct access authority and on-going relationships with other international and regional satellite service providers, can arrange for transponder bandwidth, local support and end-to-end service.

Figure 2: Transportable Earth Station (Trailer-Mounted)

7.0 Summary and Conclusion

The feasibility and value of using commercial assets has been amply demonstrated on several missions such as Desert Storm, Desert Watch, and the Bosnia peacekeeping operation. Commercial telecommunications companies such as Spacelink maintain inventories of earth stations and are in a position to meet the military surge requirements on a short notice with not only equipment but also trained operations and maintenance personnel and in-place logistics infrastructure. These commercial assets can provide global connectivity and are much more economical than the tactical assets. It has been successfully demonstrated that the commercial assets can supplement and complement the tactical assets and will play an ever increasing role in future military operations.