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GLOBAL BROADCAST SERVICE FOR THE EXPEDITIONARY WARRIOR

by

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June 1997

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The battlefield has changed tremendously during the past decade due to major technical innovations. These changes have resulted in a requirement for high-speed, multimedia communications and greater bandwidth capabilities. Global Broadcast Service (GBS) technology is a military application of the commercial system Direct TV and is one way the military can address the need for greater bandwidth. Many of the two way systems in the MILSATCOM architecture could be relieved of their burden by use of GBS. This thesis focuses on the Marine Corps and how its decision makers can integrate GBS into the existing communications architecture. This is illustrated by using a Marine Expeditionary Unit as an example. This technology meets the warfighters need to have a high data rate, high volume information transfer available. Crucial to the successful integration of GBS into the communications architecture is ensuring that the MEU command ships, and other amphibious vessels in the Amphibious Ready Group, are equipped with the GBS receive suites during MEUs workup and deployment cycle. Finally, command and control issues are discussed and how GBS can expedite the decision making process.

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GLOBAL BROADCAST SERVICE FOR THE EXPEDITIONARY WARRIOR

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ABSTRACT

The battlefield has changed tremendously during the past decade due to major technical innovations. These changes have resulted in a requirement for high-speed, multimedia communications and greater bandwidth capabilities. Global Broadcast Service (GBS) technology is a military application of the commercial system Direct TV and is one way the military can address the need for greater bandwidth. Many of the two way systems in the MILSATCOM architecture could be relieved of their burden by use of GBS. This thesis focuses on the Marine Corps and how its decision makers can integrate GBS into the existing communications architecture. This is illustrated by using a Marine Expeditionary Unit as an example. This technology meets the warfighters need to have a high data rate, high volume information transfer available. Crucial to the successful integration of GBS into the communications architecture is ensuring that the MEU command ships, and other amphibious vessels in the Amphibious Ready Group, are equipped with the GBS receive suites during MEUs workup and deployment cycle. Finally, command and control issues are discussed and how GBS can expedite the decision making process.

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I. INTRODUCTION

A. BACKGROUND

The battlefield has changed tremendously during the past decade. The military is a part of the global technology revolution that has gripped our nation and changed the way we think about the battlefield and our enemy. As a part of this new operating environment, the Marine Corps has a requirement for high-speed, multimedia communications. During the next few years the Marine Corps will procure and field an entire generation of systems that will provide greater information capabilities to the tactical commanders than ever before. One of the systems being fielded to the Marine Corps is Global Broadcast Service (GBS). GBS technology is a military application of the commercial system Direct TV. Marine Corps program planners, network architects, and tactical users must formulate strategies now in order to be ready to capitalize on these enormous turn-of-the-century changes.

B. OBJECTIVES

The objective of this study is to identify the major issues that must be addressed as the Marine Corps prepares to field Global Broadcast Service receive suites. This work provides recommendations for utilizing that technology to its maximum capability.

C. ORGANIZATION OF THE STUDY

This thesis provides Marine Corps decision makers with information regarding the major issues of the technology provided by GBS. Following analyses of both the current capabilities and the next generation of capabilities are presented and how they can be implemented by a Marine Expeditionary Unit is discussed. Finally, recommendations are made for issues needing further study.

Chapter II provides background information regarding Global Broadcast Service and describes research efforts related to future development of a more capable service.

Chapter III presents an overview of the military satellite communications architecture.

Chapter IV presents a discussion of the Marine Expeditionary Unit as a type of Marine Air Ground Task Force (MAGTF). It also presents an example of the Marine Corps communications architecture by focusing on equipment that supports the Marine Expeditionary Unit.

Chapter V briefly discusses the role of technology and the impact it has on the command and control structure. It also identifies the benefits of employing GBS as a part of the MEUs communications capability.

Chapter VI then fuses the information from the preceding chapters to produce recommendations for GBS. It identifies options available to the Marine Corps as well as key issues that must be considered in the development of a GBS strategy.

II. GLOBAL BROADCAST SERVICE: AN OVERVIEW

A. INTRODUCTION

The Joint Staff validated the need for GBS in November 1995 by allocating approximately $900 million in funding to establish a Joint Program Office to manage the GBS program. The Air Force was named as the lead agency, and the US Army is responsible for formulating the GBS Operational Requirements Document. Currently there is no single, approved system architecture for GBS. The GBS concept closely resembles the commercially marketed Direct Broadcast Satellites (DBS). GBS will be able to provide a high data rate to all echelons of command.

B. HISTORY AND CONCEPT DEVELOPMENT

1. Direct Broadcast Service (DBS)

DBS is a commercially viable means of broadcasting digitized multimedia applications to a small (18") antenna with large throughputs. To adapt DBS to military applications encryption/decryption devices were added to protect classified data. The GBS concept, demonstrated at the Joint Warrior Interoperability Demonstration (JWID) 95, also showed the ability of the prototype GBS technology to move video and data using the Asynchronous Transfer Mode (ATM) and new encryption devices. GBS allows the broadcast of video, data, and voice signals at throughputs up to 23 megabits per second (Mbps). Another testbed contributing to the development of GBS is the use of the technology in Operation Joint Endeavor in Bosnia. [JWID 95 GBS Demonstration Assessment, pp. 1-9]

2. Shortcomings of Existing Systems

Currently the MILSATCOM systems are oversubscribed. It is expected the aggregate MILSATCOM duplex communications requirements for Naval units will exceed current capabilities by the turn of the century. [Boyd, p. 1] The introduction of GBS in the MILSATCOM architecture will reduce the number of users on existing oversubscribed communications systems. Many of the two way systems could be relieved of their burden by use of GBS. Table 1 illustrates a comparison of the data rates provided by existing systems and the data rate provided by GBS. This increased capacity could easily decrease the time it takes to send various information types over GBS.

SATCOM Throughput Example Information	2.4 Kbps (for example) Milstar & UFO	512 Kbps (for example) SIPRNet	1.544 Mbps (for example) Milstar MDR	6 Mbps GBS
Air Tasking Order (DS) 1.1 Mbytes	**1.02 hour**	**17.19 sec**	**5.7 sec**	**1.5 sec**
Tomahawk MDU 0.03 Mbytes	**100 sec**	**.47 sec**	**.16 sec**	**.04 sec**
DS TPFDD (log support) 250 Mbytes	**9.65 days**	**1.09 hour**	**21.59 min**	**5.6 min**
2K * 2K Image SID 4 Mbytes	**3.7 hour**	**1.0 min**	**20.7 sec**	**5.3 sec**

Table 1. GBS High Capacity Data Dissemination

After Ref. [NRO GBS/JBS Brief]

GBS hosted on the Ultra High Frequency (UHF) Follow On (UFO) satellite system represents the best opportunity for the DoD as compared to other MILSATCOM systems on the basis of cost, capability and timing. [Report on GBS to DoD Appropriations Conference Report 104-261, p. 13] Additionally, it increases the satellite communications capabilities for the military at a reduced cost. Figure 2, illustrates some of the costs of current communications systems as compared to those provided by GBS.

Communications Service	Throughput Cost
INMARSAT (A)	**$39.00 per Kbps-hour**
INMARSAT (B)	**$12.90 per Kbps-hour**
Challenge Athena	**$0.18 per Kbps-hour**
Global Broadcast Service	**$0.05 per Kbps-hour**

Table 2. Communications Service-Throughput Cost Comparison

From Ref. [CNO N631F, p. 13]

3. Purpose for GBS

The ability for the U.S. military to win an information war is dependent on providing information to commanders when and where they need it. Dissemination throughout the battlefield can be accomplished inexpensively using a GBS system derived from commercial direct digital broadcast satellite technology. It is revolutionary because it utilizes the latest digital satellite broadcast technology. GBS is not intended to be "the" solution to the military's information needs, rather it is intended to relieve the burden placed on existing duplex systems. It will provide service to many users at once and will deliver a high data rate to small user terminals. GBS will allow existing and future duplex communications systems to support other, lower volume communications requirements as well as provide a means to transfer information in response to GBS user requests.

The "smart push/user pull" philosophy will be used to request information products to avoid saturating deployed forces with unnecessary information. A simplistic definition of "smart push" is standard products and theater tailored information that are placed on a broadcast as they become available. "User pull" occurs when operational requirements dictate the information products requested by the user. GBS will use "smart push" and "user pull" to provide information products at the right time and place to the users.

With the promise of GBS comes high-speed, cost effective, one-way information flow of high volume data to units in garrison and on the move. The wide bandwidth feature of GBS allows rapid transfer of data for unique and unforeseen needs of military forces in warfighting environments. Communication systems for deployed or mobile forces are quickly saturated in the early phases of any conflict. GBS will alleviate this problem by providing additional bandwidth and a responsive system for the users.

> The Conduct of the Persian Gulf War--The Final Report to Congress, April 1992 highlights the limited ability of current military and civilian satellite communications systems to provide responsive, high-capacity communications to deployed, mobile tactical units. [GBS JORD, p. 7]

C. GBS DESIGN

1. Type of System

The GBS system is proposed to serve garrison and tactical users as a satellite-based broadcast capability. This one-way broadcast will provide relevant tactical and non-tactical products to the users. The broadcast signals would be transmitted to a large number of user receive units within the Commander in Chief's (CINC)s' area of responsibility (AOR). This information flow is one type of multicast that allows simultaneous broadcast of a variety of data and video products to specified users. The system can provide these products to all users, a small subset of users, or in some cases, a single user depending on how the information is addressed. The capability to provide a high data rate bit stream of video, data, imagery, and other information from high powered broadcast satellites to commanders, mobile forces, and various users has previously not been a capability that the military could provide within the existing architecture. As the

UFO satellites 8, 9 and 10 are launched with the GBS payloads, they will provide continuous and simultaneous coverage from 70 degrees north latitude to 70 degrees south latitude in support of highly mobile, and often times disbursed warfighter. The CINCs will have authority over apportioning GBS within their AOR of control. One plan currently under consideration is to assign spot beams from each of the UFO satellites to the CINCs.

GBS will provide a high data rate bit stream transmitted from a limited number of fixed and deployable injection terminals. The content will be managed by the broadcast management segment in each satellite field of view. Ideally multiple sources will provide information content to the satellite broadcast manager at the direction of the CINCs. As with existing satellite capabilities, the CINCs theater information manager will establish priorities, authorize user access, coordinate broadcast schedules, and allocate resources. The details of the daunting task of information management have yet to be worked out at the time of this writing. It is anticipated the DoD will look to commercial industry for additional products and technologies. [GBS JORD, p. 1]

The development of the program has been divided into three distinct phases which represent a measured approach to fielding a GBS capability in an affordable manner.

a. Phase 1. (FY96-FY 98)

Phase 1 (FY96 - FY98):] Limited Demonstration: Leased commercial satellite services operating in the Ku-band with limited coverage areas used for concept development, demonstrations, and limited operational support. [GBS JORD, p. 2]

b. Phase 2. (FY98- FY06+)

Phase 2 (FY98 - FY06+): GBS payload packages will be hosted on UFO 8, 9, and 10. Operating in the Ka-band, each satellite will have two steerable

500 nautical mile (nm) spot beams, and one steerable 2000 nm spot beam. Because these satellites will be equipped with the Ka-band payloads, the continued lease of commercial satellite services in the Ku-band will be required to augment UFO GBS where coverage gaps exist. [GBS JORD, p. 2]

c. Phase 3. (FY06+)

Phase 3 (FY06+): In Phase 3 GBS will achieve the objective on-orbit capability and provide robust capability. It will provide worldwide broadcast coverage with near continuous or time critical information to broadly dispersed users. [GBS JORD, p. 2]

2. Proposed Architecture

a. Space Segment

During Phase 2 (FY98- FY06+) the space segment will consist of the UFO GBS payloads, a satellite control element, and leased satellite services. The GBS transponders, in the Ka-band, are being added to the UFO satellites 8, 9, and 10. They will provide data and video products with nearly worldwide coverage. The coverage areas will be limited by the spot beam locations and orbital positions. The uplink will be from 30.0-31.0 GHz, and the downlinks will be from 20.0 to 21.2 GHz. [GBS Phase II System Specifications, p. 10]

b. Broadcast Management Centers

The key aspect of GBS is the ability of the CINC to be responsive to users and tailor the broadcast to meet their needs. This capability is provided by giving the CINCs control over apportioned resources in their AOR. The broadcast management segment will perform a variety of functions in managing the broadcast based on the CINCs priorities. This segment has the undefined task of accepting, coordinating, and packaging information from several sources. The goal for the Broadcast Management Center (BMC) is to ensure GBS is used in an efficient manner. The BMC will work closely with the Theater Information

Managers (TIMs) in coordinating the broadcast to satisfy the users requests. The TIMs will have primary operational control over what, when, and to whom information is disseminated in a particular AOR.

CINCs will have the ability to tailor broadcast services for field units to optimize the "smart push" aspect of the system. In order to accommodate "user pull," users will request information through existing information retrieval paths. Requested information will then be provided through existing information source paths to users, or using GBS when appropriate.

The BMC will maximize on-orbit capabilities to include uplink and downlink beam steerage and transponder configurations. It includes both transmit and receive management functions. The Transmit Broadcast management (TBM) function will build broadcast data streams and manage the information flow to the appropriate injection point for transmission to the satellite. The Receive Broadcast Management (RBM) function will support the filtering of user information from the broadcast streams and the dissemination of the receiver information from receive suites to end users' systems. [GBS JORD, p. 3]

c. Theater Injection Points

CINCs require the ability to broadcast real-time and near real-time in-theater source information to the in-theater users. This may be accomplished by either the Theater Injection Point (TIP) or by virtual injection. The TIP is a transportable uplink terminal with broadcast management functionality for direct injection to a satellite's GBS payload. Virtual injection is the ability to transmit in-theater source information back to the broadcast management segment via other communications resources for ultimate transmission to the theater via a Primary Injection Point (PIP). The TIP is responsible for transmit broadcast management and transmit uplink. Their functions include the ability to accept, coordinate, package, and to transmit vital information to the space segment. Located either ashore or afloat, the TIP will be a transportable system. [GBS JORD, p. 4]

d. Primary Injection Points

The PIP will uplink information received from the broadcast management segment to the space segment. The PIPs will be fixed facilities. For Phase 2 there will be a PIP located within the footprint of each GBS equipped UFO satellite. [GBS JORD, p. 3]

e. Receive Broadcast Manager

The Receive Broadcast Manager (RBM) is the end user's tool to process the broadcast so that information can be disseminated to end user systems such as workstations and networks.

3. Joint Operational Concept

The current battlefield requires highly mobile forces to receive large volumes of information tailored toward specific operations. There are a variety of tactical information products which can be disseminated using GBS to include: Air Tasking Orders (ATOs), logistics, movement time tables, message traffic, weather, imagery, intelligence. It also has the ability to carry tactical video such as the Unmanned Aerial Vehicle (UAV) video currently in use in Bosnia providing near, real-time intelligence. Commanders will also be able to receive news, AFRTS, and commercial TV products.

As a part of the military satellite communications (MILSATCOM) architecture, GBS is an extension on the Defense Information Systems Network (DISN). As such, GBS is not designated as a critical command and control system, meaning that it will not have nuclear survivability and hardening features incorporated in other satellite systems. If the system must be used for critical C2, it will be as a secondary delivery means. GBS will interface with, and augment other DoD information systems, such as the Global Command and Control System

(GCCS), as well as other theater information management systems. To accommodate for different security levels and classes of users, the proposed architecture will provide broadcast services to selected echelons through a layered or scaleable architecture. The receive suite equipment will support a variety of configurations. Depending on the user's needs, the equipment may be stand alone or in a networked configuration. [GBS JORD, p. 4]

D. GBS CAPABILITIES

1. Technical Capabilities

GBS is characterized by the high-power satellite transponders, which provide a high-speed, wideband, simplex broadcast signal and a total data rate of nearly 96 Mbps per satellite. UFO satellites 8, 9, and 10 will each have four transponders at 24 Mbps per transponder. [UFO GBS, p. 1.] Dramatic advances in power and weight capabilities, as well as on-board processing enable the systems to reach high data rates to small, mobile tactical terminals. The GBS system will have two distinct satellite broadcast patterns that can provide coverage to specific areas. A broad area coverage beam can cover a portion of the area in the satellite's field of view. The 2,000 nm diameter spot beam is capable of supporting a data rate of 1.5 Mbps. Spot beams are steerable and can handle transmissions using high data rates. Each of two steerable spot beams cover an area of 500 nm in diameter and support data rates of up to 24 Mbps per transponder. The primary uplink will push two distinct broadcast signal to one of the spot beams as illustrated in Figure 1. One of the transponders is switchable by ground command from the 500 nm spotbeam to the 2000 nm spot beam.

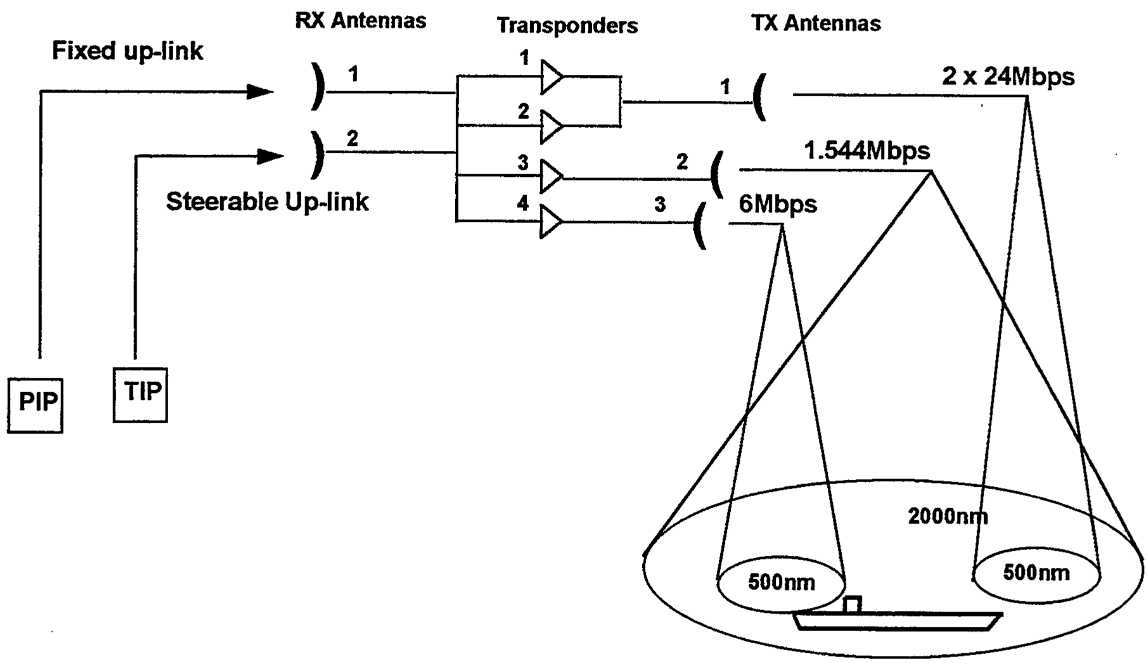

Figure 1. Potential Configuration on UFO 8, 9, and 10

After Ref. [U.S. Space Command, p. 10]

2. Ka-band

The military has selected the Ka frequency band for GBS. If the growth in the use of this band is similar to that of the commercial sector, then the military can anticipate congestion in the future. The military Ka-band has a 1 GHz bandwidth available on both the uplink and downlink. This frequency band however, is susceptible to interference due to frequency reuse. Weather conditions such as rain have a dramatic impact on the signal as well. The Ka-band used on GBS offers a high data rate and the ability to use steerable spot beams. These two considerations provide a dramatic increase in the capacity of the military satellite communication architecture. [Carroll, R. T. and others, pp. 358-360]

3. Link Budget

The baseline link calculation is based on an implementation that the government believes is achievable. When providing contractor information for preparing the link calculations, the government's link budget was structured to end with the margin available to counter atmospheric losses. It was recommended that contractors presenting variations from the baseline link should provide the technical data that supports the viability of their design. The contractors provided the government with atmospheric loss margin, the satellite locations, and the link elevation angle. Each of these inputs were applied to a computer program which iterated the link performance over that portion of the earth's surface visible to each satellite. By using Crane's model for rain attenuation and the NASA Propagation Handbook for gaseous attenuation, the program calculates the downlink availability at each point. [GLIMSE/Link Budget, p. 1]

4. Environmental Issues

In planning for the use of GBS in a variety of scenarios, varying climatic conditions have an effect on it's ability to provide desired services. It is anticipated that the system will be operated at all levels of command and will be deployed worldwide. The receive suites will be designed to operate in temperature ranges of -0^0 F to 110^0 F, and antennas capable of operating in blowing sand, dust and snow environments during 30 mph winds, in -25^0 F to 110^0 F and at all humidity levels. These specifications were designed to ensure continuous service to the users in the most hostile of environments. [Rationale For The JORD web page, Mar 97]

III. MILITARY SATELLITE COMMUNICATIONS SYSTEMS

A. INTRODUCTION

For the last ten years, the military communications satellite has been the preferred option for long-haul, also known as over the horizon, contingency communications. For the foreseeable future, it is almost certain that this trend will continue. Wideband architecture is one of the three broad groupings of satellites. The three groups are: tactical/mobile, nuclear-capable, and wideband. [Jain, p. 1176] For the purpose of this thesis only the wideband group of resources will be covered. Wideband users are those users that require multi-channel, point-to-point, extensive network connectivity with multi-channel transmissions between terminals whether fixed or mobile, and would also include the capability to move volumes of information at high data rates.

Additionally, non-DoD satellite communication (SATCOM) resources are an important part of this wideband satellite architecture. Commercial SATCOM provides the military with an additional capability that augments MILSATCOM. Commercial SATCOM provides additional channels for routine communications, and they can also be used as an alternative transmission path, in case of loss or disruption of links over military circuits. [Jain, p. 1177] In many cases it is operationally and fiscally responsible to augment MILSATCOM with commercial satellite services. Recent contingency operations have seen an increase in the use of commercial satellites that supplement MILSATCOM.

Often times single channel satellite terminals are preferred in high operational tempo situations because they are wireless, can operate while they are mobile, use disposable or rechargeable lightweight batteries, provide high-quality secure voice or data service, and are usually man-packed or require very small mounting space in vehicles, aircraft, or ships. Multi-channel satellite systems can carry many equivalent voice duplex conversations or data circuits at one time. Multi-channel satellite terminals provide a significant increase in communications capability over single channel systems. They are, however, generally much larger and require a significant increase in logistic support. Usually mounted on vehicles or trailers, multi-channel systems are powered by portable electric generators which must be brought by the contingency force if commercial power is not available. Military satellite terminal equipment is generally standardized throughout DoD. For example, a Marine Corps multi-channel ground mobile force satellite terminal, is interoperable with a like terminal from the Air Force. Multi-channel system setup normally takes longer to set up than single channel systems and requires a team of operators to run the systems. [Contingency Intelligence Communications Systems (U), Appendix G, pp. 3-5, 3-6]

B. EXISTING SYSTEMS

1. UHF SATCOM

UHF SATCOM is the principal means for over-the-horizon tactical activities because it provides a flexible communication system for the tactical or mobile user community. UHF offers terminal portability, simplicity of operation, but limited throughput. UHF satellite communications are designed to provide worldwide coverage between the latitudes of 70 degrees north latitude and 70 degrees south latitude. All military services have UHF capability and it provides critical information to CINCs and the National Command Authority. UHF provides options for secure voice, data, and facsimile service. It can be man-packed or configured aboard aircraft, ships, or vehicles. The UHF system can be can be interfaced with telephone, messages systems, or data systems to access the Defense Information Infrastructure (DII) directly. [USEUCOM, (U), Appendix A, pp. 4-76]

Military Ultra High Frequency (UHF) operates in the 225-400 MHz frequency spectrum. UHF satellite constellations consists of Fleet Satellite (FLTSAT), Leased Satellite (LEASAT), and UFO satellites in geosynchronous equatorial orbits providing global coverage over four satellite areas: CONUS and the Atlantic, Pacific, and Indian Oceans. [Contingency Intelligence Communications Systems (U), Appendix G, pp. 3-8] UHF networks are operated 24 hours a day and satellite communications are prioritized and shared with other Unified Commands. During Desert Storm the sharing of the resources became a difficulty because there was insufficient UHF satellite capacity for all of the terminals deployed. To alleviate some of this problem additional satellites are being launched under the UFO program. [USEUCOM, (U), Appendix A, pp. 4-76]

a. FLTSAT

Fleet satellite orbiters have both Fleet Satellite Communications (FLTSATCOM) and Air Force Satellite Communications (AFSATCOM) transponders as a part of their communications payload. It is a constellation of four geosynchronous satellites that enables communication between the fleet assets and ground stations. The four satellite areas share a set of four FLTSATCOM and three LEASAT spacecraft in synchronous equatorial orbits. FLTSATCOM was designed to predominately serve the Navy, where AFSATCOM was designed to serve the Air Force. FLTSAT provides a jam resistant fleet broadcast channel for transmitting command and control (C2) instructions to ships and submarines operating in the coverage area. [Jain, p. 1177] The FLTSAT constellation allows both FLTSATCOM and AFSATCOM to support communication for any service, any CINC, the National Military Command and other DoD assets during contingency operations. [Contingency Intelligence Communications Systems (U), Appendix G, pp. 3-8] *b. LEASAT*

As a result of Congressional review of the DoD satellite communications systems, in the late 1970's Congress directed the military to increase its use of leased satellite systems. Leased Satellite (LEASAT) service is provided by contractor owned satellites and provides services identical to FLTSAT. Currently three LEASAT satellites are an operational part of FLTSAT. Both FLTSAT and LEASAT have multiple 25 kHz and 5 kHz channels, and one 500 kHz channel. On FLTSAT the narrow band belongs to the AFSATCOM system, while the 500 kHz channel is shared between the FLTSATCOM and AFSATCOM systems.

c. UFO Satellites

The UFO satellite will have the same user community as FLTSATCOM. They will be compatible with existing UHF single channel terminals and Navy Demand Assigned Multiple Access (DAMA) systems. Because satellite requirements have grown at such a rapid rate, the UFO constellation will provide some relief to an oversubscribed system. The UFO plan is to launch ten satellites, with eight functioning in an operational role, and the remaining two serving as a reserve. Currently UFO's 2 - 7 are on orbit and the anticipated launch date for UFO 8 will occur during fiscal year 1998.

Each UFO satellite will support 21 narrowband 5 kHz channels, 17 wideband 25 kHz relay channels, plus one 25 kHz fleet broadcast channel. Capable of transmitting up to Top Secret/Sensitive Compartmentalized Information (TS/SCI), the system will employ DAMA time division multiplexing techniques to allot more capacity to users. UFO 8, 9, and 10 will be equipped with EHF package that includes three EHF broadcast downlinks and an EHF telemetry, tracking, and command link as well as GBS packages. The SHF payload is being removed from UFO's 8, 9, and 10. [USEUCOM, (U), Appendix A, pp. 4-74]

2. International Maritime Satellite (INMARSAT)

International Maritime Satellite (INMARSAT) has 74 member nations and is headquartered in London, England. It operates a constellation of four satellites in geosynchronous orbit, plus seven on-orbit spares. Originally it was designed to support commercial ships and the international public communications networks, but is increasingly grown in popularity for use both on land and sea.

INMARSAT provides voice, data at 9600 bps, high speed data up to 56 kbps, fax, and slow video. INMARSAT uses L-band for communications with ships, and C-band for communications with shore stations. This frequency plan uses both L-band and C-band for the uplink and downlink. The uplink is a single C-band channel for shore-to-ship, and four L-band channels for ship-to-shore. Just the opposite is true for the downlink with a single L-band channel to communicate from shore-to-ship, and four C-band channels to communicate ship-to-shore. [Comparetto, p. 8]

There are various types of INMARSAT terminals available. The original terminal was INMARSAT A and is operational on ships, ground terminals and aircraft. Introduced in 1991, INMARSAT C is a miniaturized terminal providing data-only service at 600 bps, or a single voice channel using an antenna as small as 12 inches high and 8 inches in diameter. INMARSAT B is an all digital system with 16 kpbs data rate, and 9600 bps facsimile. INMARSAT M, is a briefcase sized terminal providing 2400 bps data and 4200 bps facsimile. [USEUCOM, (U), Appendix A, pp. 4-40]

There are several drawbacks with using INMARSAT. Primarily the $7 per minute charge to operate the terminal. Another deterrent from using the system is the potential for delay. If several other users are trying to contact the same ground station, there will be a delay.

3. Defense Satellite Communications System (DSCS)

The Defense Satellite Communications System (DSCS) operates in the 7.25-8.4 GHz frequency band. The SHF capabilities exceed UHF single channel systems, and are used when larger, heavier, less mobile systems can supplement or take the place of the UHF systems. DSCS III satellites provide world-wide, high capacity multi-channel communications for secure strategic and tactical voice and data transmission, and national security command and control. The satellites are equipped with six transponders that provide the flexibility to interface with various users through numerous terminal types. [Contingency Intelligence Communications Systems (U), Appendix G, p. 3-2.]

DSCS is an integral part of the global Defense Information Systems Network (DISN), designed to provide vital communications service to the United States and Allied Forces throughout the world by means of satellites. Users of the system range from airborne terminals with 33 inch diameter antennas to fixed installations with 60 foot diameter antennas. Mobile terminals supporting ground and naval operations communicate with each other and the command chain through the satellite. [History of DSCS web page, Nov. 95]

4. Military Strategic and Tactical Relay Satellite

The Military Strategic and Tactical Relay Satellite (MILSTAR) was originally conceived as a strategic command and control system that would be able to withstand a nuclear war between the US and the Soviet Union. In light of the end of the Cold War, the program has changed. Currently MILSTAR is a joint service satellite communications system that will provide secure, anti-jam, communications.

The operational MILSTAR satellite constellation will be composed of four satellites positioned around the Earth in geosynchronous orbits plus a polar adjunct system. MILSTAR satellites are designed to have a ten year life. They operate in the EHF, UHF, and SHF frequency bands. The first MILSTAR satellite was launched February 1994 aboard a Titan IV expendable launch vehicle. The second low data rate satellite was launched November 1995. With the third launch in 1998, global earth coverage will be between 65 degrees north latitude and 65 degrees south latitude. [Contingency Intelligence Communications Systems (U), Appendix G, pp. 3-13] Starting with the launch in 1998, the satellites will have greatly increased capacity because of an additional medium data rate payload.

The multi-satellite constellation will link command authorities with a wide variety of resources, including ships, submarines, aircraft and ground stations. Unlike other MILSATCOM systems, MILSTAR will be decentralized to give the CINC more authority over apportioning communications assets within the AOR. The Joint Staff however, will continue to maintain overall apportionment of MILSTAR.

Each MILSTAR satellite can direct traffic from terminal to terminal anywhere on the Earth. The requirement for ground controlled switching is reduced because the satellite processes the communications signal and links with other satellites through cross-links. The user still has interaction by directing required communications circuits. MILSTAR terminals will provide encrypted voice, data, teletype, or facsimile communications. A key goal of MILSTAR is to provide interoperable communications among the users of MILSTAR terminals. [Milstar Facts web page, Mar 97]

IV. MARINE CORPS COMMUNICATIONS: AN EXAMPLE

A. INTRODUCTION

Communications equipment provides commanders with the capability to extend the flow of data and information beyond the sound of one's voice. Communications can be a simple as an AM radio or as complex as the Global Command and Control System (GCCS). The performance of these systems directly affects a leaders ability to direct and control operations. The purpose of this chapter is to provide a better understanding of the communications architecture employed by the Marine Corps.

An architecture describes how the pieces of equipment are fit together to accomplish the mission. It can be thought of as a collection of systems, components, wires, hardware, firmware and software. Basically it describes the elements that work together to form the system. Each communications architecture is designed in light of the equipment selected by the communications officer. There is no one specific Marine Expeditionary Unit (MEU) communications architecture, rather it is dependent upon the planning performed by the communications officer and the requirements of the MEU commander. This example however, will use a generic model to describe the communications equipment.

In this chapter we will consider a MEU in examining such an architecture and will discuss some of the communications equipment common to several Marine Corps units. Appendix A contains a more detailed description of the various types of communications equipment not discussed in this example.

B. MARINE AIR GROUND TASK FORCE

Today's warfighters must be able to work together within and across service boundaries. They must be able to obtain and use the information from national assets and process this information in forward areas whether they are ashore or afloat. This requirement necessitates that information quickly and seamlessly flow to the commander. A Marine Air Ground Task Force (MAGTF) is an example of an organization that needs this capability to achieve battlespace dominance. These forward-deployed forces provide a U.S. presence, a deterrence force, and also maintain regional stability.

All MAGTFs consist of a Command Element (CE), Ground Combat Element (GCE), Air Combat Element (ACE), and Combat Service Support Element (CSSE). MAGTFs are forward deployed units that provide a global presence as well as the ability to respond to any crisis. There are three types of MAGTF organizations; a Marine Expeditionary Unit (MEU), a Marine Expeditionary Force (MEF), and a special purpose MAGTF (SPMAGTF). A SPMAGTF is a unique organization, task organized to accomplish specific expeditionary operations in response to a crisis or a peacetime missions that would be inappropriate for a MEF or a MEU to perform. They carry out such tasks as humanitarian missions and disaster relief.

C. THE MEU

In this chapter the MEU will be used in an illustration when describing a Marine communications architecture. As such, the MEU is discussed in greater detail than other MAGTF units. Normally a MEU is task organized to perform a variety of combat operations of a limited scope and is structured accordingly to accomplish specific missions. The MEU, as a part of a flexible naval expeditionary force, is capable of operating in severe climates. They frequently provide the initial response to a crisis and often can resolve the situation without additional forces. [Marine Corps Master Plan 1994-2004, pp. 2-4]

The forward deployed MEU is uniquely organized and equipped to provide a theater CINC or joint force commander with a rapidly deployable, sea-based capability. A MEU has 15 days of self-sustainment optimized for forward presence and crisis response missions. They may also serve as an enabler for larger Marine forces and often times are used for joint or combined forces when the situation requires additional capabilities and resources. The MEU is a self-sustained, amphibious, combined arms air-ground task force capable of conventional and selected maritime special operations of limited-duration. [MCO 3120.9, Policy for (MEU(SOC)), pp. 1-5] Typically the missions a MEU may be tasked with are:

- Amphibious raids
- Non-Combatant Evacuation Operations (NEO)
- Security Operations
- Tactical Recovery of Aircraft and Personnel (TRAP)
- Direct Action
- Humanitarian/Civic Assistance

The MAGTF organizational structure is illustrated in Figure 2. The MEU CE provides the command and control (C2) functions and the command, control, communications, computers and intelligence systems (C4I) necessary for effective planning and execution of all MEU operations. The GCE is formed around an infantry organization and is usually a Battalion Landing Team (BLT). The BLT conducts ground operations in support of the MAGTF mission. The ACE is typically a composite helicopter squadron (HMM(C)) that conducts air operations in support of the MAGTF mission. The CSSE element is a MEU Service Support Group (MSSG). It is a task organized unit designed to provide a host of combat service support functions such as communications, logistics and medical services. ["Marine Air Ground Task Force," February 1997]

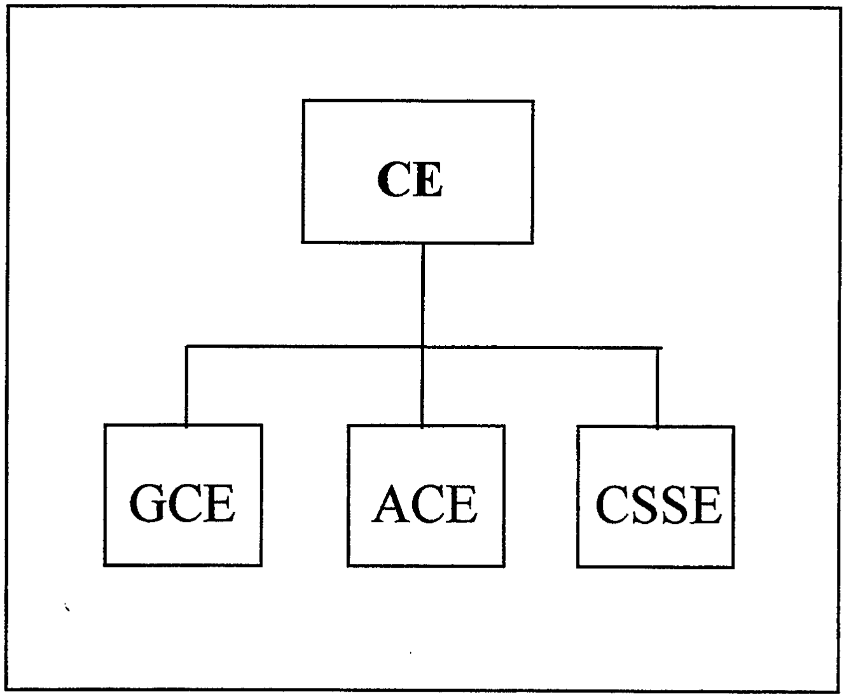

Figure 2. Organizational Structure of MAGTF

D. PURPOSE OF COMMUNICATIONS

Primarily the purpose of communications is to convey information to a person, place or object. In a military application, communication is the means for controlling or directing organic assets, relaying orders, mission information, or a host of other activities to higher, adjacent, supporting and supported units. Communication is a critical element in providing a commander the ability to convey information to the forces and implement plans.

The principal Marine Corps warfighting organization is the MEF. There are three standing MEFs: I and III MEF (Marine Forces Pacific), and II MEF (Marine Forces Atlantic). Each of the MEFs provides a MEU to their area of operation and each MEU conducts operations in a different region of the world. The MEU renders a unique amphibious capability to the theater CINC by providing a means of dealing with the uncertainties of future threats with a deployed unit that is sustainable, flexible and responsive. Consequently, MEUs communicate with a number of different commands during a deployment. Although each MEU is responsible for a unique region, they share the common responsibility of planning for and providing similar communication capabilities and connections to amphibious commanders, theater commanders and external agencies.

Each MEU has a communications officer. This individual is responsible for proper employment of communications equipment for the unit. As a staff officer for the MEU commander, the communications officer has a variety of responsibilities including personnel, equipment, facilities, and training. The planning provided by the communications detachment ensures the MEU communications are adequate for all phases of the amphibious operation. [Communications (FMFM 3-30), pp. 2-3] The planning and preparation made by the communications officer directly affects the commanders capacity to utilize MEU command and control capabilities.

In this example, the MEU CE will be given a limited number of communications capabilities. To guarantee that the MEU commander has the necessary communications assets for effective command and control, direct coordination with the Commander Amphibious Task Force (CATF) is essential. The communications assets must provide the MEU commander the ability to effectively initiate action when required, and monitor the results of these actions, as well as provide the commander the ability to receive direction and report to the CATF or other senior leadership.

E. CONNECTING USERS

The users of a MEU network must be able to communicate with other personnel on demand. The MEU CE local area network (LAN) provides interconnectivity to the MEU staff. The staff sections need to communicate among themselves, as well as communicate with external agencies such as the amphibious element, or the theater commander. The transmission medium that connects the users can be wire, coaxial cable, or wireless. In this example, the MEU CE is connected by ethernet. The Marine Corps' LAN uses a Banyan VINES operating system. To ensure the transmission is protected, the nonsecure signal is scrambled by an encryption device which is located with the terminal equipment.

Often times when a MEU CE is located ashore, or during the conduct of an amphibious operation, not all of the units are physically co-located. During these times a variety of radio nets are established. The kind of service required depends on the type or volume of traffic to be handled by that net. Additionally, the communications equipment must be selected based on the tactical situation, the distances between stations, and the terrain. For example, a typical net established in the HF range is the Wing Command Net. This net provides a means for the wing commander to exercise command and coordinate functions for aviation assets. [Communications (FMFM 3-30), p. B-14]

Frequently the equipment organic to a MEU is relatively spartan, therefore not all nets listed in Appendix B will be provided. Typically, a dozen or so radio nets will be sufficient for a given exercise or operation, but this is a rule of thumb and is heavily mission dependent. Often times when a MEU CE is established ashore additional Marine Corps communications assets are brought in to enhance their capabilities. These assets are not discussed in this thesis, but the reader should recognize that the MEU CE communications assets are organized to support short term actions ashore. These capabilities specific to a MEU are discussed below.

While aboard the ships, communications are largely dependent upon the ship's capabilities. Even when the MEU has established itself ashore, robust capabilities such as a variety of SATCOM support are provided by the Navy afloat. Figure 3 illustrates the scenario when the MEU is ashore and the Navy is afloat. Ordinarily the communications assets available on ship are significantly more robust than a MEU CE established ashore. As a result, the MEU communications capabilities are limited by the amount of equipment available ashore and the data rate at which they can communicate. In this example, the MEU is dismounted from the amphibious support and the maximum data rate between ship and shore is 32 Kbps provided by the AN/MRC-142 radio.

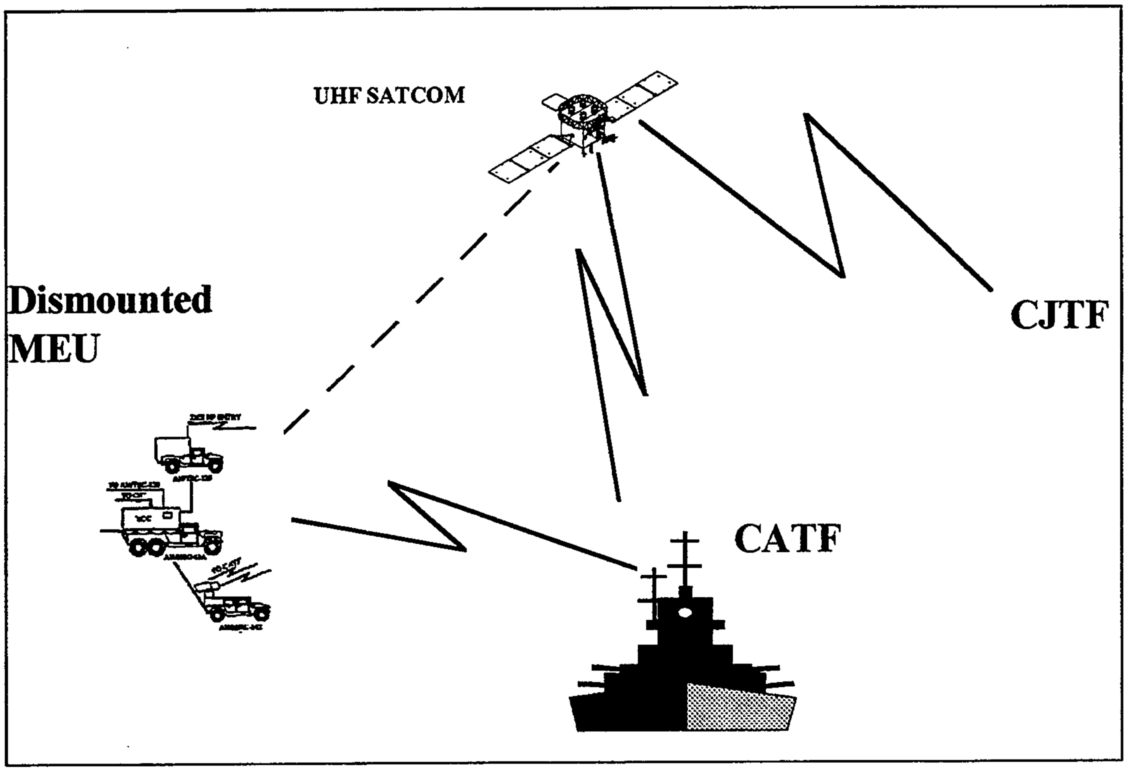

Figure 3. Dismounted MEU

After Ref. [IT 21, ADM A. Clemins Brief, 14 Mar 97]

F. TRANSMISSION SYSTEMS

The MEUs primary means of communicating among remote elements is the terrestrial radio. The principal single channel radio utilized is the Single Channel Ground and Airborne Radio System (SINCGARS). These radios, with their jam resistant, frequency hopping features, provide interoperable communications between surface and airborne command and control assets. SINCGARS is a lightweight FM radio that offers the MEU commander's tactical users a great deal of flexibility for short range, line-of-sight communications.

The most commonly used communication link for the MEU commander to the CATF is the AN/MRC-142 radios. This vital connection keeps the MEU commander linked throughout the decision cycle. The AN/MRC-142 is a multi-channel radio set mounted on a HMMWV. It operates from fixed positions to provide voice and data UHF communications over line-of-sight distances up to 35 miles. The AN/MRC-142 is tied into the MEU CE LAN via a switchboard indicated as SB-3865 in Figure 4. The Digital Subscriber Voice Terminal (DSVT) is used to connect to the telephone switching system, SB-3865. The DSVT, also known as the KY-68, is a ruggedized digital telephone terminal commonly used for server to server connections in the field. The DSVT contains audio processing, signaling, and cryptographic functions necessary to provide secure and non-secure voice/data access to the digital circuit switches. [MAGTF C4I Systems, Jun. 95] The DSVT performs analog to digital conversion and encrypts/decrypts at a 16 or 32 kbps rate to provide secure communications to the telephone switching system. [USAF Technical Training Manual, p. 3-2]

To provide the MEU commander with communications between units ashore and amphibious command and control elements afloat, the AN/TSC-120 is part of the equipment the MEU CE establishes ashore. The AN/TSC-120 is a self-contained, one kilowatt, HF communications system. It is used primarily for long-haul HF, and point-to-point communications within an area of tactical operations for over-the-horizon communications. The AN/TSC-120 provides interoperability with existing deployed systems and is the entry point for DoD-wide Defense Communications Systems (DCS). This connection provides world wide access from each theater of operation. It is a user-friendly, computer controlled AUTODIN message processing center that provides system control and monitoring. The data rate is 75 to 2,400 bps for unsecure traffic, and 75 to 1,200 bps asynchronous KG-84A/C for secure traffic. It operates in the 2 - 29.9999 MHz HF frequency range and provides voice, data and teletype information types. [Jane's C4I Systems, p. 132]

The AN/PSC-3 is a single-channel UHF satellite radio system that communicates over FLTSATCOM, AFSATCOM, LEASAT, and GAPFILLER satellites. It handles data and voice communications. Although done infrequently, the AN/PSC-3 can be used for point-to-point line-of-sight communications. While not pictured in Figure 4, the AN/PSC-5 will replace the current AN/PSC-3 as a result of the JCS mandate for DAMA UHF SATCOM capability by 30 September 96. The AN/PSC-5 will serve as a primary command and control radio for all MAGTFs and will allow increased ranges and reliability for intra-MAGTF as well as theater connectivity.

G. CONCLUSION

Each of the communications equipment illustrated in Figure 4 provides the commander a set of capabilities based upon the missions they are expected to perform. The effectiveness of a MEU depends on the communications available. When communications equipment is functioning properly, it is expected to be responsive and provide flexibility to the commander. This example however, is a generic one and each MEU commander has the ability to add or change the components of the communications equipment embarked aboard ship. The trade off with taking more communications capabilities is leaving behind some other piece of equipment since space is limited on the ship. An alternative for the commander is to arrange to have additional equipment flown to a site if proper planning is performed before the unit leaves on deployment.

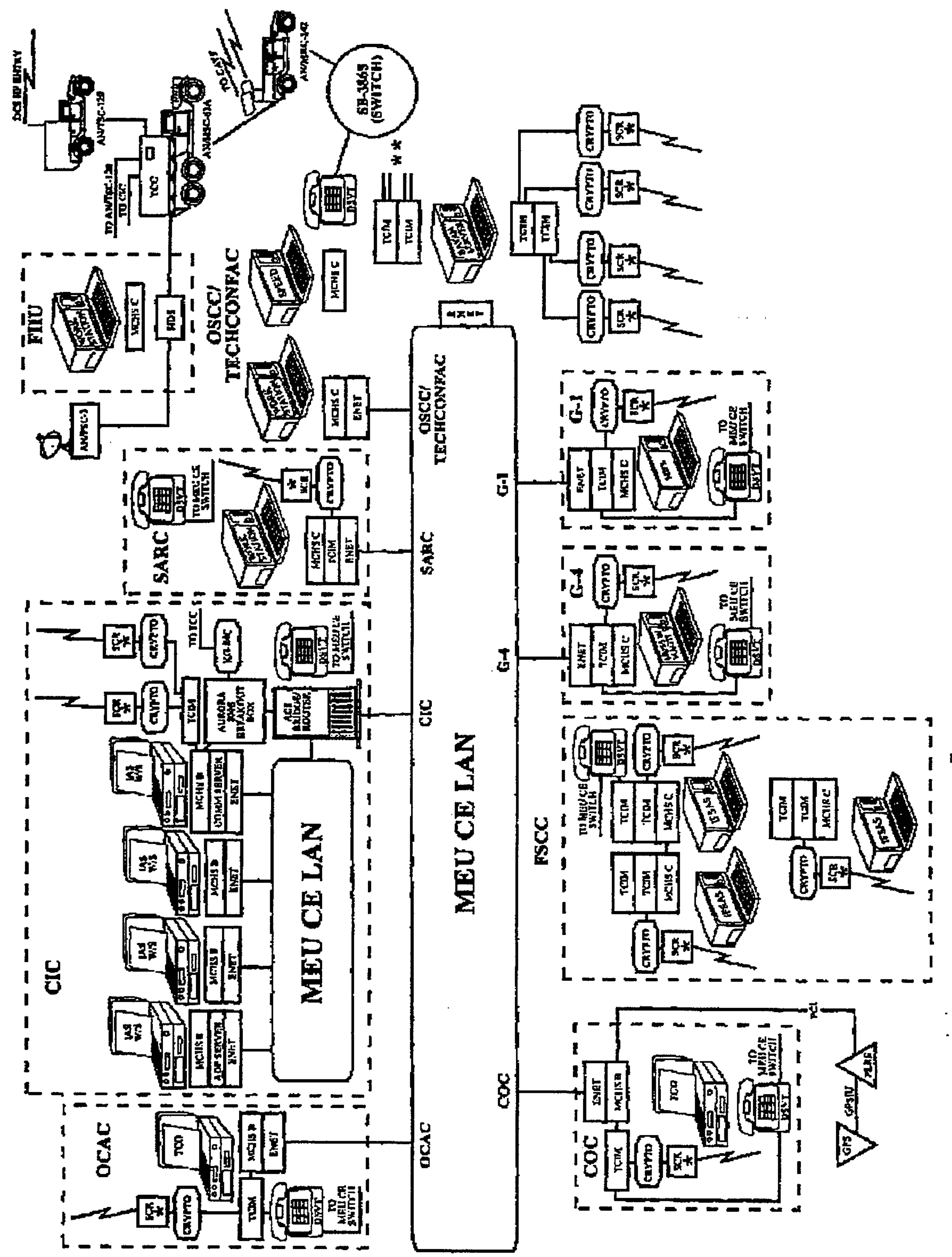

Figure 4. Marine Expeditionary Unit Command Element Headquarters

After [*MAGTF C4I Systems*, pp. 2-13]

V. GBS SUPPORTING A MEU

This chapter looks at the organizational structure of a MEU and how this organization utilizes command and control in the accomplishment of its mission. The aspect of including GBS in a MEUs communications package and how a MEU would benefit from GBS is discussed.

A. COMMAND AND CONTROL

Command and control are critical parts of how a MAGTF operates. The ability to accomplish the mission depends largely on the success or failure of an organization's command and control capabilities. Command and control will continue to become more complex as technology improves due to the speed and distance at which decisions will be made. A commander's decision making ability will be impacted by the ability to collect, process and disseminate intelligence information. Tools to reduce the time needed to plan, decide and execute must be made available to the commander. [Marine Corps Master Plan 1994-2004, p. 3-3]

Recently published Navy and Marine Corps doctrine discuss command and control at length. Command can be described as the individual who is responsible for the accomplishment of the mission. This includes the authority to plan, direct, coordinate and control forces and operations. Control is a feedback mechanism for the commander that may influence outcomes or require a change to adapt to fluid situations. [Naval Doctrine Publication 6, p. 6] The Marine Corps publication has a more dynamic view of the command and control relationship. This relationship is illustrated in Figure 5. In this instance, command is the exercise of authority and control is the feedback. Command is initiated by directing or influencing the actions of others. Control continuously flows information back to the commander. Feedback can come to the commander in any form from any direction. This mechanism allows the commander to modify actions as needed. This relationship is viewed differently from other models which show command and control as unidirectional rather than having a reciprocal influence on one another as illustrated below.

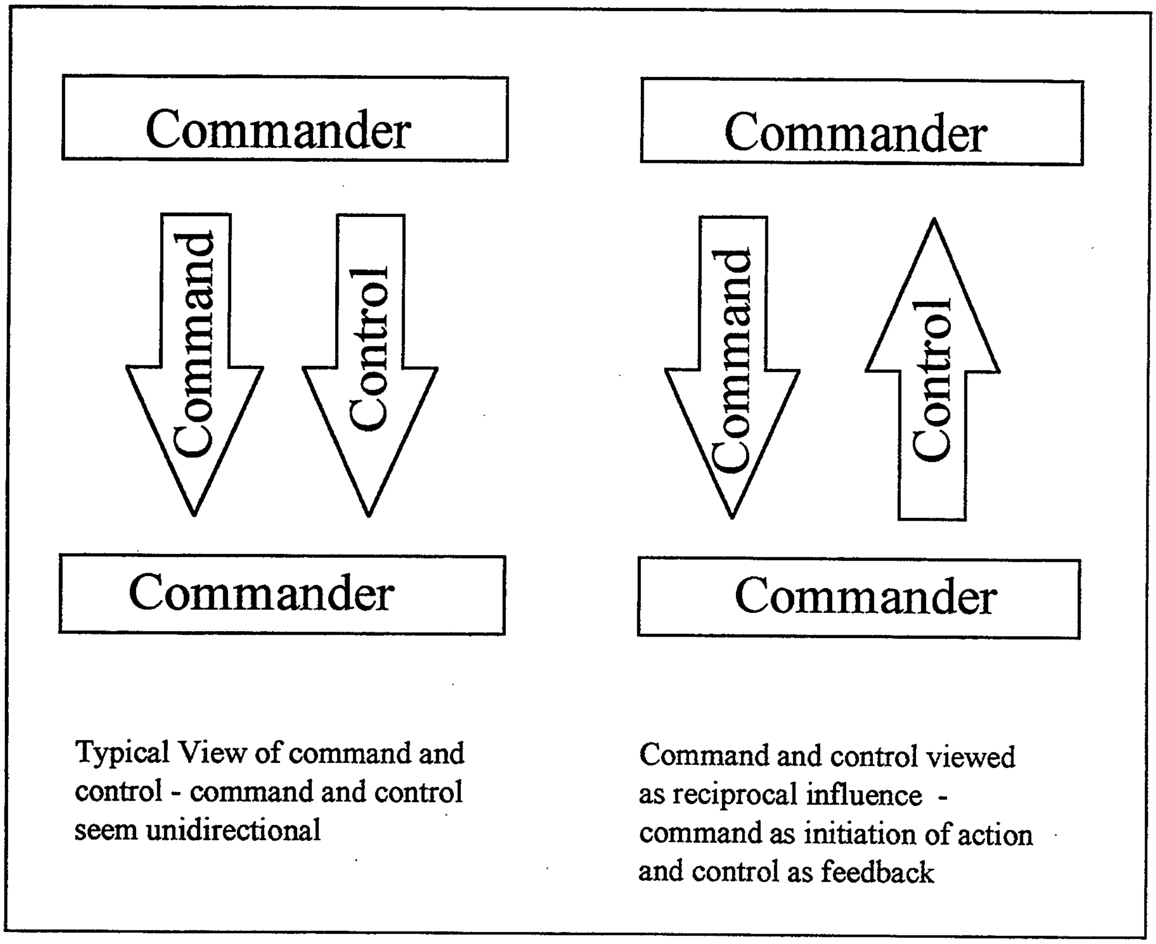

Figure 5. Two Views of the Relationship between Command and Control
After Ref. [MCDP 6, Command and Control. p. 41]

While both command and control can be precisely defined independent of one another, when viewed together, each have a direct influence on the other. In this context, it is difficult to completely define one without considering the impact of the other. This reciprocal relationship between command and control is what gives the commander the ability to adapt to any situation. In extreme situations however, command and control is not the simplified picture described above.

Modern warfare is complex, and often times is a turbulent, chaotic environment for the leader. Providing the commander with information for decision making is a complex task requiring the coordination of people and equipment. It can be a time critical and sensitive matter to give the commander the right information at the right time. It is not enough to provide the decision maker with a great deal of data. The content must be filtered to provide meaningful and timely information. Giving the commander too much information or untimely information can result in bad, or sometimes deadly, situations. In short, what the commander needs is an effective command and control system to deliver the information. [MCDP 6, Command and Control, pp. 40-47]

B. OODA LOOP

In order to describe the command and control process, the Observation, Orientation, Decision, Action (OODA) loop model is frequently used. The OODA loop drives the decision making process and is illustrated in Figure 6.

The phases of the OODA loop are:

- Observation. When a leader is engaged in battle, one must observe the situation as it unfolds. Frequently in today's battlefield, sensors, information systems and situation reports are used to observe the environment.
- Orientation. Next the leader must orient himself by performing an analysis of the situation. Sensor information is converted using a variety of tools to display the analyzed information.
- Decision. Based on the orientation just performed the leader obtains an understanding of the battlespace. Then the leader makes a decision and comes up with a course of action.
- Action. Once the decision is made, action is taken by the leader.

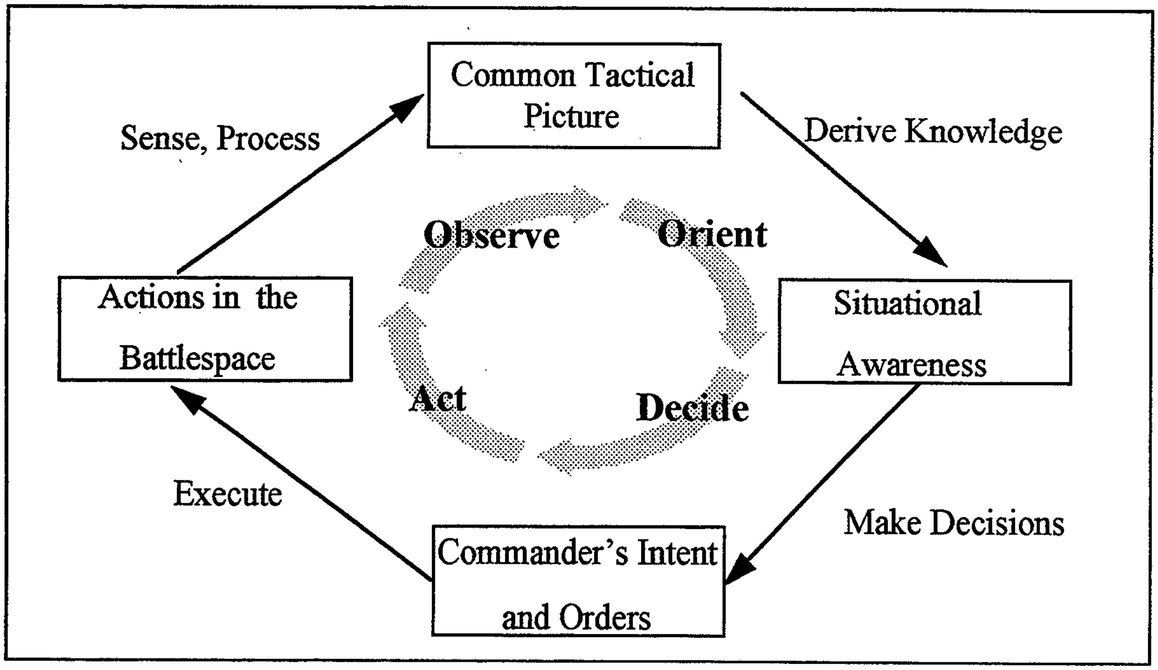

Figure 6. The OODA Loop

After [NDP 6, Naval Command and Control, p. 18]

The model has taken the leader full circle and the cycle begins again. [Naval Doctrine Publication 6, Naval Command and Control, pp. 18-19] Decision making is a continuous process, and technology aides the decision maker by providing tools that give more complete and accurate results during the decision making process. The importance of generating tempo is the lesson to be learned from the OODA loop model. To increase the speed of command and control the decision cycle must be made shorter. [MCDP 6, Command and Control, pp. 63-65]

C. CHANGING THE NATURE OF COMMAND AND CONTROL

The nature of command and control is changing rapidly due to technological advances. Technology shapes the way the military conducts warfare, and consequently commanders attitudes will be driven by the rapid changes. The capacity of commanders to adapt to these changes will impact their ability to fight and win wars in the information age. Leveraging technology will help the military achieve battlefield dominance.

Joint Vision 2010 discusses the changing battlefield of the future. Admiral Clemins, Commander in Chief, Pacific Fleet, addressed this issue when he presented IT 21, Information Technology for the 21st Century, to the Naval Postgraduate School. His attitude was reflected when this issue was addressed in a recent message sent to CINC, Atlantic Fleet.

> Information superiority is the foundation of Joint vision 2010 battlefield dominance, as well as the Warfighting vision for each service. Network warfare, robust infrastructure and information dissemination to dispersed forces are key elements in achieving information superiority. IT-21 is a fleet driven reprioritization of C4I programs of record to accelerate the transition to a PC based tactical/tactical support warfighting network. [Administrative message, Routine, R 300944Z MAR 97, ZYB PSN 038075M23, FM CINCPACFLT, Pearl Harbor, HI]

One example, shown in Table 3, is ADM Clemins' expectation that a MEU should have connectivity at 1.5 Mbps out to 200 nm. This goal can be partially achieved through the successful integration of GBS into the MEUs communication architecture.

Communication Path	**Bandwidth**	**Range**
UHF LOS **(DWTS - MRC-142 equivalent)**	**288 - 576 Kbps**	**20 NM**
HF	**4.8 - 56 Kbps**	**100 NM**
UHF SATCOM	**6 - 9.6 Kbps 5 KHz Non-DAMA** **48 - 64 Kbps 25 KHz Non-DAMA**	**SATCOM** **SATCOM**
SHF SATCOM	**256 Kbps**	**SATCOM**

Dismounted MEU required connectivity = 1.5 Mbps out to 200 NM

Table 3. CATF/Dismounted MEU C4I

After [IT 21 ADM A. Clemins Brief 14 Mar 97]

D. BENEFITS OF GBS

GBS technology is a viable wideband, low cost, broadcast mechanism that will expand the communications architecture of a MEU and other tactical and garrison units. Returning to the example from the previous chapter, the addition of GBS to a MEU's communication architecture would considerably improve current command and control support capabilities of a MEU. Technology provided to a commander should enhance their capability to collect, process and disseminate data and information. GBS would provide a wide bandwidth source previously unavailable.

GBS provides a path for the MEU to receive a variety of video products while either ashore or afloat. For example, GBS is an ideal path for sending unmanned aerial vehicles (UAV) video to forces on the ground or aboard ship. Currently in use in Operation Joint Endeavor, the UAV video has provided vital, near real-time intelligence to the commanders. GBS equipped units in the satellite broadcast footprint will be able to receive continuous, periodic information products or other on-demand products from CINC or commander of the joint task force (CJTF) via a TIP. This would furnish the commander an additional means of gathering reconnaissance information prior to or during an amphibious operation. The current assets in a CE communications architecture do not provide the capability for a commander to get this type of information unless aboard a Naval vessel. However, even existing shipboard communications severely limit the data rate at which the information products can be received. GBS provides far superior bandwidth over existing duplex systems for one way transmissions.

One functional area that will benefit from GBS is the intelligence area. GBS can greatly enhance the intelligence picture ashore by providing the commander battle damage assessment updates, operation order changes, weather information, and other valuable information products. For instance, in a particular situation a MEU commander may want his S-2 officer (MEU intelligence officer) to perform intelligence functions ashore and other intelligence personnel to perform intelligence gathering afloat. Intelligence updates or requests for information are either relayed via voice, or often times by messenger. The messenger in many cases is flown from ship to shore. This can be a time consuming task and delays providing the commander the intelligence picture required. While the joint intelligence center (JIC) aboard ship is very robust, the addition of GBS to the MEU CE assets ashore would greatly enhance a commanders ability to request and ultimately receive timely, necessary information.

One of the conventional capabilities that is key to the MEUs overall operational success is the ability to perform rapid staff planning. A MEU must be able to immediately plan and be prepared to commence execution of operations within six hours of the receipt of the warning order or an alert order. Usually operations commence by the launch of forces by either air or surface means. This may range from the insertion of reconnaissance and surveillance assets in support of the mission to the actual launch of an assault force. Rapid staff planning could be enhanced by the bandwidth capability provided by GBS for gathering reconnaissance information.

Others will also benefit from the integration of GBS into the communications capabilities. The administrative officer can receive messages, the operations officer can receive mission planning information, logistics can receive material movement, and the aviation assets can receive air tasking orders. The possibilities are only limited by the mission requirements and CINC broadcast availability.

E. MEU COMMUNICATIONS ARCHITECTURE REDEFINED

The inclusion of the UFO GBS in a MEU architecture provides a data rate of 1.544 Mbps in a 2000 nm area coverage beam. Or if a 500 nm CINC spot beam is allocated to the MEU, a data rate of 6 Mbps is provided. Compared to existing capabilities ashore, this increases the data rate dramatically. The addition of a GBS receive suite should be an integral part of the communications architecture. GBS can be configured as a stand alone element in a communications architecture, or it can be networked into the existing system. GBS receive suites are being designed to receive and disseminate a variety of different security levels. Since the information products will be both classified and unclassified, GBS provides a means of delivering a variety of information products when the SIPRNET and NIPRNET are established ashore.

Critical to the success or failure of GBS in a MEU's communications architecture is the ability to receive the same information products while aboard an amphibious vessel. The GBS capability can provide identical video and data broadcast products to both sea going vessels and Marines on the ground. Since the GBS broadcasts will disseminate time-sensitive information, it will be critical to command and control functions to receive the GBS data stream prior to an amphibious landing.

The Navy priority for fielding GBS receive suites is as follows:

1. Battle Group Deployers and Command Ships
2. Middle Eastern Forces
3. Other ships

The concern with this plan is fielding suites to the amphibious vessels after GBS receive suites have been fielded throughout the Marine Corps. While UFO 8 will be launched in February 1998 over the Pacific Ocean, according to Table 4, the MEF will not have the use of GBS receive suites until FY99. The Marine

Corps must ensure they will be able to fight like they train. The MEU must be able to have the same capabilities afloat as they will ashore.

Fielding Plan	Deployment	TCD
PAC	C. Vinson (9 of 11 ships)	5/98
Fleet Flags	USS Coronado & USS Blue Ridge	5/98
Command	USS Kitty Hawk & USS Belleau Wood	5/98
LANT	Enterprise (11 of 13 ships)	5/98
LANT	T. Roosevelt (11 of 13 ships)	10/98
MEF	(5 ships)	FY99
Fleet Flags	USS Mount Whitney & USS La Salle	FY99
PAC	Constellation (11 of 13 ships)	1/99
LANT	G. Washington (11 ships)	1/99
PAC	J.C. Stennis (10 of 12 ships)	7/99
LANT	D.D. Eisenhower (11 of 13 ships)	8/99
MEF	(3 ships)	FY99
PAC	A. Lincoln (8 of 11 ships)	3/00
MEF	(6 ships)	FY00
others	(54 ships and 4 submarines)	FY00
others	(63 ships and 3 submarines)	FY01
others	(40 ships and 11 submarines)	FY02
others	(24 ships and 8 submarines)	FY03

Table 4. Navy GBS Terminal Fielding Plan

After [GBS Briefing to NPS Students]

F. CONCLUSION

The integration of GBS into a MEUs communication architecture is essential in order to achieve an effective command and control support structure in a MEU. The addition of equipment such as GBS receive suite will allow a MEU to more effectively execute a full range of conventional and special operations missions. The addition of GBS would provide a more robust set of tools than currently exists and meet one CINCs connectivity requirement. The key to successful integration of GBS is to ensure that the flow and content of information is useful to the decision making process of the commander. GBS will greatly enhance a commanders communication capability to receive critical information ashore in a more efficient manner. This technology meets the warfighters need to have a high data rate, high volume information transfer available. Crucial to the successful integration of GBS into the communications architecture is ensuring that the MEU command ships, and other amphibious vessels in the Amphibious Ready Group, are equipped with the GBS receive suites during MEUs workup and deployment cycle.

VI. RECOMMENDATIONS AND CONCLUSION

A. CONCLUSIONS

GBS will augment existing MILSATCOM systems by providing the capability to quickly disseminate large amounts of data and video to deployed users. When considering the types of technologies to invest in, it is important to keep in mind the assumptions military planners make about the types of conflicts the U.S. will face in the future. During the next decade the military can expect to face new threats and the DoD must acquire technologies to deal with these threats. Technological innovations such as GBS offers the U.S. the ability to maintain our technological superiority over enemies.

The previous chapters have discussed the need for GBS as well as the GBS joint concept of operations. The capabilities that GBS will provide to the Marine Corps were also reviewed. A MEU was used as an example of one unit that could benefit from the integration of GBS into the communications architecture. The successful fielding of GBS receive suites to the Marine Corps will depend largely on the attention given to the program by planners at the Headquarters level. With the introduction of GBS, the Marine Corps will make significant gains in wide bandwidth capabilities for garrison and tactical users.

B. FUTURE TESTING

Currently GBS technological capabilities continue to be tested at Joint Warrior Interoperability Demonstrations (JWID). Held annually and hosted by a different service each year, JWID provides essential testing of the information products GBS provides. Plans to test GBS as the delivery mechanism in JWID 97 will enable end users to designate additional categories of data for broadcast. Another planned test will demonstrate a reachback circuit which is integrated with the Global Broadcast Service. The reachback will provide a means for requesting additional information to be disseminated via GBS or other in-theater dissemination means. [JWID 97, GBS JPO Web Page]

C. RECOMMENDATIONS FOR FUTURE WORK FOR THE MARINE CORPS

1. Develop a Marine Corps GBS Concept of Operations

Affordability is the overarching goal in the acquisition of military technology. Lower budgets dictate judicious use of affordable, longer lived purchases. The GBS receive suites are expected to be relatively expensive items at an estimated $30,000 per suite. The Marine Corps concept of operations must consist of more than the purchase of the technology merely because it is available as a joint program. GBS represents the Marine Corps best opportunity to exploit the addition of greater bandwidth capabilities at a more affordable rate than other alternatives such as INMARSAT. A great deal of thought by the joint community has gone in to writing the GBS JORD. Equal effort should be applied by the Marine Corps to develop a concept of operations.

2. Utilize the GBS Joint Program Office (JPO) Testbed

The Marine Corps could benefit by utilizing the services provided by the GBS JPO. The GBS JPO operates a testbed facility which is used primarily to help GBS users develop and mature user concepts of operating a wide bandwidth satellite broadcast system. This GBS CONOPS Testbed, currently located in the Joint Information Management Center (JIMC) in the basement of the Pentagon, broadcasts only to CONUS locations. When the GBS JPO establishes regular operations, they will provide standard, yet minimal, broadcast. The broadcast will consist of one SECRET IP channel, one unclassified video channel, and a BER testing stream. This is a unique opportunity for the Marine Corps to begin testing GBS's capabilities.

3. Involve Marines in the Joint GBS Planning Process

Military operations in the next millennium will be joint. In light of this reality, the Marine Corps must be well represented throughout the GBS planning process since it is a joint program. This would include the difficult task of information management. Information management represents the most difficult aspect of GBS, however, representation will provide the Marine perspective to planning future use and growth within the MILSATCOM architecture. It will also identify the considerations that must be factored into the information management systems design.

4. Conduct Studies to Determine Requirement for GBS

The current acquisition, and future distribution, of 70 GBS receive suites to Marine Corps units was driven by monetary constraints rather than from a communications architectural aspect. Since the budget drives many of the acquisition decisions, perhaps a detailed study of the Marine Corps' requirement for GBS will better determine the quantity needed now and in the future.

5. Design GBS Experiments

Design a set of experiments to determine the applicability of GBS at a variety of command levels. For example, utilizing GBS in Sea Dragon exercises, such as Urban Warrior, would help determine if GBS should be used by Marine units below the regimental level. Due to fiscal constraints, the current fielding plan does provide GBS receive suites at the lowest level. This should not prevent the Marine Corps' from providing this technology to a smaller, more agile organization during the experimental phase. The Commandant's Warfighting Lab should be intimately involved in the design of the experiments. Outside the lab, GBS could also be tested in Combined Arms Exercises (CAX) or Desert Fire Exercises (DESFIREX). These types of experiments could test the equipment in a variety of climates, and determine whether or not they are "Marine Proof." An additional consideration from these experiments would be to assist the communications planners in determining whether or not the addition of GBS to the communications architecture can reduce other communications equipment requirements for deployed users.

6. Delivery of Receive Suites to the Marine Corps

UFO 8, which will host the GBS payload, will be launched during FY 98 and be in orbit over the Pacific Ocean. The first units to receive training, conduct testing, and obtain equipment should be West coast units. This would include units such as MARFORPAC, I MEF, III MEF and Expeditionary Training Group Pacific. West coast MEUs as well as the 31st MEU in Okinawa should schedule GBS broadcast capabilities during deployment work ups and while they are deployed.

7. Inform the Marine Corps

The community that appears to be the most prepared to utilize the capability of GBS is the intelligence community. Their enthusiasm should serve as an example to other communities. To ensure GBS in not relegated to serve solely as another intelligence system, other communities such as logistics and communications should take an proactive approach to learning about the technology. During Desert Storm, a preponderance of bandwidth was used by logistics requirements. Certainly GBS would serve as an ideal platform for logistics needs. A forward thinking approach, communicating with Marine Corps leaders, and educating Marines about acquisition programs is the best way to get Marines to anticipate the fielding of new technology.

8. Develop a Training Plan

Although the GBS JORD indicates no additional training should be required to operate a GBS receive suite, it will still be a new system. Training will be necessary to ensure that the full potential of GBS is realized. System documentation will also be an essential part of this training program.

D. RECOMMENDATIONS FOR THE GBS PROGRAM

The DoD will continue to be asked by Congress to do more with less. Although our requirement for global presence has not changed and new peace keeping missions are being added to the growing list of responsibilities, end-strength and budgets will continue to decline. GBS represents a program, if managed correctly, that can help maintain our technological superiority while maximizing the dollars the U.S. spends on the MILSATCOM architecture.

1. Information Management

The GBS JPO should continue to work on the concept of information management. While it is certainly the most difficult aspect of the program, using CNN as a model is not the way to solve the problem. The military has needs unlike civilian news media. Although there is merit to the CNN programming concept, the military does not need the same type of information content re-broadcast with such frequency. The flow of information content should be flexible enough to change as a crisis develops. Establishing the CINCs priorities first will help to develop information management.

2. Ground Segment

The Ground Segment is not in sync with the space segment. The space segment appears to be on track with the forthcoming launch of UFO 8. The ground segment however, is delayed by the design issues. The importance of good terminal design is important in making the whole system function well.

3. Emphasis On Interoperability

> Emerging technologies and parallel interoperability improvements are giving C4ISR systems the ability to provide the joint force commander rapid and reliable situation awareness, and fast and

secure information exchange. [Govt. Computer news, 18 March 1996]

There will continue to be a focus on interoperability as budgets drive the future of the military. GBS is designed to be an integral part of the DII.

E. THESIS SUMMARY

In this thesis the author has examined GBS and the opportunities it offers DoD and in particular, the Marine Corps. The MILSATCOM architecture, as it currently exists, was discussed. GBS has the potential to revolutionize the way tactical Command and Control information is disseminated on the battlefield and in battlespace. GBS should provide a critical resource to support the commander that will permit rapid planning and decision making, as well as information dissemination.

The example of a MEU has been utilized to examine the potential of GBS as a component in the MAGTF C4I architecture. The approach outlined in Chapters IV and V demonstrate that it is possible to effectively utilize GBS in a MAGTF organization. These chapters illustrate that there is value to the commander in possessing this capability. However, in order for this equipment to reach its potential, considerable resources will be required to make the equipment available throughout the Marine Corps.

Lastly, command and control issues have been examined. In order to successfully utilize GBS the commander must first understand the potential capabilities and how it supports the concept of command and control. Having understood the importance of being able to utilize GBS will assist the commander in future mission planning.

F. CONCLUSION

Acquisition of technology such as GBS is now based on the cost sharing of government and industry partnerships. This relationship continues to develop revolutionary technology. The future of these technologies certainly holds promise for providing the U.S. with the inventions of tomorrow. Technology offers the U.S. the ability to maintain our technological superiority over enemies. Technology enables weapons systems to have flexibility and maximize the capabilities of warfighters. In the future, technology improvements such as GBS, will result in dramatic new military capabilities. As a result, the U.S. can anticipate leading the world of technology into the next century.

APPENDIX A. MARINE CORPS COMMUNICATION SYSTEMS EQUIPMENT

OVERVIEW

The purpose of this appendix is to provide an overview of the Marine Corps' communications systems equipment. It is meant to serve as a reference resource at an executive level. It is not intended to be exhaustive, rather to provide background material for the reader to better understand the existing equipment as it pertains to this thesis topic.

TRANSMISSION EQUIPMENT

MULTI-CHANNEL EQUIPMENT. Multi-channel equipment transmission paths are always present, meaning they do not have to be rekeyed to establish a path. Multi-channel radios are full-duplex, that is, capable of both transmitting and receiving at the same time. In a sense, the capabilities are similar to the service provided by the public telephone network.

In 1971 the DoD established the Joint Tri-Service Tactical Communications program to develop and acquire tactical switched communications equipment for all services. This program is used to integrate terrestrial and military tactical communications. TRI-TAC is a family of hybrid tactical communications equipment that was designed to accommodate the gradual transition begun in the late 1970's from obsolescent analog and mostly nonstandard assets to a fully digital and automatic objective system. TRI-TAC is divided into five main areas: terminals switching, control transmission, and combining. [Contingency Intelligence Communications Systems (U), Appendix G, pp. 3-6]

AN/TRC-170 TROPOSCATTER RADIO SET. The AN/TRC-170 is an air or ground transportable tropospheric (TROPO) microwave terminal. The terminal provides secure trunking between major nodes of a TRI-TAC communications network. The multi-channel radio terminals interface with other TRI-TAC systems. These radio terminals are also used in a stand-alone applications. The AN/TRC-170's are complete TROPO or line of sight terminals that include antennas, radio transmitting and receiving equipment, and digital multiplexing equipment. [USAF Technical Training Manual] The inherent flexibility of the AN/TRC-170 is the ability to switch select several data rates. At lower data rates, high path losses and wider multipath can be accommodated. [Joint Pub 6-05.4, pp. 3-5]. It is a transportable super high frequency (SHF) radio set developed to provide the capability for transmitting and receiving digital data, both voice and data over varying distances up to 100 miles. When used for line-of-sight transmissions, it can transmit and receive distances up to approximately 35 miles. [MAGTF C4I Systems, Jun. 95] The AN/TRC 170 passes traffic in a full duplex mode, provides 32 channels, and can improve the quality of transmission by using two antennas and two receivers to provide space diversity reception. The modulation type used can be either QPSK or BPSK depending on the bandwidth and data rate. Radio Frequency (RF) operation is in the 4.4 to 5.0 GHZ frequency range with either a 3.5 or 7.0 MHz bandwidth.

AN/TSC-120 HIGH FREQUENCY COMMUNICATIONS CENTRAL (HFCC). The AN/TSC-120 is used primarily for long-haul HF, point-to-point communications within an area of tactical operations or to distant, fixed communications stations. It is frequently used for over-the-horizon communications between units ashore and amphibious command and control elements afloat. In addition, it may also be used as an HF terminal for air C2 TADIL-A data links, and for shore-based data, voice, and record traffic terminal systems. [MAGTF C4I Systems, Jun. 95]

AN/MRC-142 DIGITAL WIDEBAND TRANSMISSION SYSTEM (DWTS). The most commonly used communication link for deployments and exercises is the AN/MRC-142. A multi-channel radio set mounted on a HMMWV, it operates from fixed positions to provide voice and data medium range UHF communications over line-of-sight distances up to 35 miles. [MAGTF C4I Systems, Jun. 95] With its data rate of 16 or 32 Kbps/channel, it is a reliable piece of equipment. The AN/MRC-142 provides trunk or cable connections for the AN/TTC-42. Trunk communications can be encrypted or decrypted at the AN/MRC-142 using the KG-194 trunk encryption device. [1st FSSG Data Communications Manual, p. 74.] A fiber-optic appliqué is planned to be added in the future. This will permit the interconnection of the separate channels of a fiber-optic multi-channel cable with the separate channels of the AN/MRC-142. [MAGTF C4I Systems, Jun. 95]

SATELLITE EQUIPMENT

AN/TSC-85B SATELLITE COMMUNICATIONS TERMINAL. The AN/TSC-85B is a nodal or point-to-point trunking SHF SATCOM terminal. It is capable of transmitting and receiving voice, data, and teletype transmissions. The AN/TSC-85B hub terminal can simultaneously communicate with up to four AN/TSC-93B spoke terminals. The AN/TSC-85B is normally located at a Marine Air Ground Task Force (MAGTF)'s Command Element (CE). [MAGTF C4I Systems, Jun. 95] The AN/TSC-85B terminal transmits a single SHF uplink carrier with voice and/or digitized data. The external interface is compatible with TRI-TAC group inputs, up to 4.9 Kbps. Up to four carriers can be received simultaneously on the downlink, can be demodulated and switched via a demultiplexing equipment to the user interface. [1st FSSG Data Communications Manual, p. 69.] It can provide secure voice and data over 6, 12, 24, 48, or 96 channels. It weighs approximately 6100 pounds and is configured for transport in two 2-1/2 tom or 5-ton truck. A 15-kW generator supplies power. The system uses the 7.9 to 8.4 GHz range for transmission and 7.25 to 7.75 GHz range for reception. Antenna options include an 8 foot or 20 foot parabolic dish and the power output is 500 watts. [Contingency Intelligence Communications Systems (U) pp. 8-15.] The AN/TSC-85B is ideal for deployments because it can quickly and easily be set up. It is not well suited, however, for any long term situation.

AN/TSC-93B SATELLITE COMMUNICATION TERMINAL. The AN/TSC-93B is a nodal or point-to-point SHF SATCOM terminal that operates in conjunction with the AN/TSC-85B to enable the user to transmit and receive voice, data, and teletype transmissions. The AN/TSC-93B is normally located at a MAGTF's Air Combat Element (ACE), Ground Combat Element (GCE), and Combat Service Support Element (CSSE). [MAGTF C4I Systems, Jun. 95] It furnishes secure voice and data over 6, 12, or 24 channels via a single SHF uplink. It can support both digital and analog circuits. The digital circuits must use either the KG-84, with wireline adapter or the KY-68 at rates of 16 or 32 Kbps. [1st FSSG Data Communications Manual, p. 72] Weighs approximately 5200 pounds and is configured for transport in shelters on 1-1/4 ton vehicles. Power is supplied from dual 10-kW generators or from various commercial power sources with different transformer configurations. Uses the 7.9 to 8.4 GHz range for transmission and the 7.25 to 7.75 GHz range for reception.

AN/TSC-96A(V) SATELLITE COMMUNICATIONS CENTRAL. The AN/TSC-96A(V) is a transportable ground-based station that contains the voice, data teletype, and communications security (COMSEC) equipment to terminate the Fleet Broadcast Channel, to enter the Fleet Satellite Communications (FLTSATCOM) secure-voice network and to be a Common User Digital Information Exchange System (CUDIXS) subscriber. It may be used anywhere in the world within the footprint of the satellite. It is transported an entity in its own shelter. Typically the AN/TSC-96A(V) deploys within the Marine Expeditionary Force (MEF), Marine Expeditionary Brigade (MEB), and the Marine Air Wing

(MAW). It interfaces with the AN/MSC-63A Communications Central via a KG-84C for automatic message distribution. [MAGTF C4I Systems, Jun. 95]

AN/PSC-3 PORTABLE UHF SATELLITE COMMUNICATIONS RADIO. The AN/PSC-3 is a single-channel UHF satellite radio system that communicates over FLTSATCOM, AFSATCOM, LEASAT, and GAPFILLER satellites. It will handle data and voice communications. The AN/PSC-3 can be used for point-to-point line-of-sight communications. The MRC-140 is the vehicle version of the AN/PSC-3. The AN/PSC-3 is being replaced by the AN/PSC-5. [MAGTF C4I Systems, Jun. 95]

AN/PSC-5 Enhanced Manpack UHF Terminal (EMUT). The AN/PSC-5 will replace the current AN/PSC-3 as a result of the JCS mandate for DAMA capability by 30 Sept. 96. The AN/PSC-5 will serve as a primary C2 radio for all MAGTFs. Ultimately, the AN/PSC-5 will be employed down to the battalion level allowing increased ranges and reliability for intra-MAGTF as well as theater connectivity. [MAGTF C4I Systems, Jun. 95]

SINGLE CHANNEL RADIO EQUIPMENT

Single channel radio equipment operates half-duplex and are keyed to establish control of a transmission channel. Signals travel in one direction at a time.

HF Single Channel Radio

AN/PRC-104 RADIO SET FAMILY. The AN/PRC-104 HF family consists of the AN/PRC-104 man-pack, AN/MRC-138B vehicle-mounted, and the AN/GRC-193B base station configuration. All versions of the radio sets are capable of data communication, but the man-pack version does not possess an integrated modem. [MAGTF C4I Systems, Jun. 95]

AN/GRC-213/213A. RADIO SET. The AN/GRC-213 is a new lightweight, tactical, vehicular radio which is to be used in the Marine Corps Light

Armored Vehicle (LAV) Program. It integrates the AN/PRC-104's Receiver-Transmitter and an amplifier/antenna tuner into a vehicle mount. The mount provides an additional radio capability while preserving the man-pack as a pull-out unit for extra-vehicular radio operations. The AN/GRC-213A radio set provides improved Electronic Counter Measures (ECCM) protection. [MAGTF C4I Systems, Jun. 95]

Very High Frequency (VHF) Single Channel Radio

AN/VRC/PRC-Single Channel Ground and Airborne Radio System (SINCGARS) RADIO SET FAMILY. The SINCGARS radio set family is portable, mobile, VHF equipment operating in the military VHF radio spectrum. These radios, with their single-channel and jam resistant features, provide interoperable communications between surface and airborne command and control assets. Each of the services have developed their own versions of SINCGARS radios and associated support equipment to meet their unique needs. The SINCGARS family of radios contains a standard receiver/ transmitter which may be configured for man-pack, airborne, or vehicular installation. The SINCGARS has Integrated Communications Security (ICOM) and ECCM capabilities. Effective secure communications between services is possible because all SINCGARS variants share common characteristics that permit interoperability. The SINCGARS radio family is replacing the existing tactical VHF-FM radios in the Marine Corps inventory. [SINCGARS, Air Land Sea Application Web Page, May 1996]

AN/PRC-77, RADIO SET. The AN/PRC-77 is a short range VHF portable radio transceiver that provides voice or radio-telephone communication for tactical field operations. The AN/PRC-77 is being replaced by the Single Channel Ground and Airborne Radio System (SINCGARS) family of radios. [MAGTF C4I Systems, Jun. 95]

AN/VRC-12, RADIO SET FAMILY. The AN/VRC-12 family of radio sets provide short range, two-way, VHF radio communications. The AN/VRC-12 family of radios is being replaced by the SINCGARS family of radios. [MAGTF C4I Systems, Jun. 95]

Ultra High Frequency Single Channel Radio

AN/PRC-113, RADIO SET FAMILY. The AN/PRC-113 (AN/MRC-140, vehicle mounted) is a VHF/UHF radio used for ground-to-air communications for close air support missions. It is used primarily by the Forward Air Control Party and Landing Zone Control Party. [MAGTF C4I Systems, Jun. 95]

AN/GRC-171A(V)2 RADIO SET. The AN/GRC-171A(V)2 is a state-of-the-art UHF transceiver, which is remotely tunable. It replaces the AN/GRC-112, AN/GRC-134, and AN/GRC-135A radios. It is used for voice and data communications between ground units and aircraft in flight. It is organic to the Tactical Air Command Center (TACC), the Direct Air Support Center (DASC) and the Tactical Air Operations Center (TAOC). It can be remotely controlled and provides AM narrow band, AM wideband, FM narrowband, and FM wideband (TADILs A & C) data communications over any one of 7000 channels. [MAGTF C4I Systems, Jun. 95]

AN/GRC-171A(V)4 (HAVE QUICK II) RADIO SET. The AN/GRC-171A(V)4 HAVE QUICK II is similar to the AN/GRC-171A(V)2. The major difference is the incorporation of the HAVE QUICK II ECCM capability. The radios are interoperable in the non-frequency hopping mode. [MAGTF C4I Systems, Jun. 95]

CRYPTOGRAPHIC EQUIPMENT

KG-84A/84C. DEDICATED LOOP ENCRYPTION DEVICE. Commonly used for tactical servers, the KG-84A and KG-84C provide for encryption of teletype and data traffic on netted and point-to-point circuits. The

KG-84A and KG-84C can be operated by local control or can be remotely controlled. They incorporate all necessary cryptographic electronics, including key generators, variable storage, variable processing/control, key-generation controls for transmit/receive, and clock and data recovery. The Marine Corps primarily employs the KG-84C. [MAGTF C4I Systems, Jun. 95]

KY-57/58, VINSON SECURITY EQUIPMENT. The KY-57 and the KY-58 (VINSON Family) are portable, tactical cryptographic devices designed to provide security for VHF-FM, UHF-AM, and UHF-SATCOM, half-duplex, radio and tactical wireline communications. The KY-57 is designed for man-pack and vehicular applications. The KY-58 is designed for aircraft and shore installations. [MAGTF C4I Systems, Jun. 95]

KY-65/75, PARKHILL SECURITY EQUIPMENT. The KY-65 and the KY-75 are narrowband, analog, cryptographic devices designed to provide secure voice communications over HF radio and wireline circuits. The KY-65 is designed for man-pack and vehicular applications. The KY-75 is designed for aircraft and shore installations. The ANDVT/MINTERM (KY-99), described below, is replacing the PARKHILL Family. [MAGTF C4I Systems, Jun. 95]

KY-99. ADVANCED NARROW BAND DIGITAL VOICE TERMINAL/MINIATURE TERMINAL (ANDVT/MINTERM) AN/USC-43. ADVANCED NARROW BAND DIGITAL VOICE TERMINAL/TACTICAL TERMINAL (ANDVT/TACTERM). The ANDVT family of cryptographic equipment provides secure transmission of voice or data communications on HF and satellite radios. The ANDVT family consists of the KY99 MINTERM and the AN/USC-43 TACTERM. The ANDVT will initially supplement and eventually replace the VINSON (KY-57/58) COMSEC equipment on SATCOM secure systems and PARKHILL (KY-65A/75A) COMSEC equipment on HF secure systems. It may be used in aircraft, ships, or ground vehicles for the transmission of secure digital voice or data traffic over narrowband channels. The majority of the Marine Corps ANDVT assets will be the KY-99, although some requirements for the AN/USC-43 exist. Generally, the AN/USC-43 is employed in sheltered systems, while the KY-99 is employed with all HF ground radios and SATCOM radios. [MAGTF C4I Systems, Jun. 95]

SWITCHED BACKBONE EQUIPMENT

AN/TTC-42 AUTOMATIC TELEPHONE CENTRAL OFFICE. The AN/TTC-42 is the 150-line member of the Unit Level Circuit Switch family that provides automatic secure and non-secure switched telephone service to primarily digital subscribers. Switching can be automatic or semi-automatic. Analog or digital conversions are provided as required. [MAGTF C4I Systems, Jun. 95]

SB-3865 AUTOMATIC TELEPHONE SWITCHBOARD. SB-3865 is the 30-line member of the Unit Level Circuit Switch family being developed to provide service to primarily digital, secure and non-secure, voice terminals. The SB-3865 selectively replaces the SB-3614 switchboards. [MAGTF C4I Systems, Jun. 95]

SB-3614 TELEPHONE SWITCHBOARD. The SB-3614 is an analog, automatic, 30-line switch, that is stackable to 90 lines. The SB-3614 is being replaced by the SB-3865 in various organizations. [MAGTF C4I Systems, Jun. 95]

SB-22 MANUAL TELEPHONE SWITCHBOARD. The SB-22 is a tactical, analog, manual switchboard that can be rapidly installed to provide field facilities for interconnecting 12 telephone circuits. [MAGTF C4I Systems, Jun. 95]

DIGITAL SUBSCRIBER VOICE TERMINAL (DSVT) (KY-68). The DSVT, also known as the KY-68, is a ruggedized digital telephone terminal commonly used for server to server connections in the field. The DSVT contains audio processing, signaling, and cryptographic functions necessary to provide secure and non-secure voice/data access to the digital circuit switches. [MAGTF C4I Systems, Jun. 95] This system may be used as point to point telephone or used in a telephone switching system. It performs analog to digital conversion and encrypts/decrypts at a 16 or 32 Kbps rate to provide secure communications to the distant end or the telephone switching system. [USAF Technical Training Manual, p. 3-2] The DSVT digitizes voice using continuously variable slope delta (CVSD) modulation. The DSVT operates up to a distance of 2.5 miles when operated in a switched network. The KY-68 is the ruggedized tactical equipment implemented as a single unit. [1st FSSG Data Communications manual, p. 63]

DIGITAL NON-SECURE VOICE TERMINAL (DNVT) (TA-954tTA-1042). The DNVT is a ruggedized field telephone terminal used to provide digital non-secure connectivity through the SBB. The newer TA-1042, with a data port, provides the capability to connect compatible data terminal equipment and digital facsimile terminals to the SBB system in a non-secure mode. [MAGTF C4I Systems, Jun. 95]

TACTICAL DATA NETWORK (TDN) SERVER. The TDN Server is a planned component of an integrated data network that forms the data communications backbone for the MAGTF. The TDN Server provides the capability to share files, perform electronic message handling, and provides the transparent routing of digital messages between the LAN, the circuit switch network, and the SCR networks. The TDN Server also acts as a Banyan VINES file server. The TDN system gives the Marine Corps tactical users the ability to transition from the Automatic Digital Network (AUTODIN) to its mandated replacement system, the Defense Message System (DMS). The TDN Server will be deployed down to the battalion/squadron level, be packaged in transit cases, and be Marine portable. [MAGTF C4I Systems, Jun. 95]

TACTICAL DATA NETWORK (TDN) GATEWAY. The TDN Gateway is a planned component of an integrated data network that forms the communications backbone for the MAGTF. The TDN Gateway provides access to the Defense Information Systems Network (DISN), DSNET1, and other Service tactical packet switched networks. The TDN system gives the Marine Corps tactical users the ability to transition from AUTODIN to its mandated replacement system, DMS. The TDN Gateway is planned for deployment at the MEF CE and division, wing, and force service support group. It is housed in a High Mobility Multipurpose Wheeled Vehicle (HMMWV) mounted shelter. [MAGTF C4I Systems, Jun. 95]

TACTICAL COMMUNICATIONS INTERFACE MODULE (TCIM). The TCIM is an advanced modem that contains appropriate processing and memory capabilities to perform as a front-end communication processor. The TCIM provides two independently programmable communications channels. [MAGTF C4I Systems, Jun. 95]

AN/MSC-63A TACTICAL COMMUNICATIONS CENTER (TCC). The TCC provides semi-automated data communications support for the processing of record general service message traffic to the commander of a deployed MAGTF, or to the commander of Marine forces in a joint theater. The TCC is used as the entry into AUTODIN. The TCC does not have organic communications associated; therefore, communications support must be supplied by external assets. The TCC is compatible with circuit switched systems. [MAGTF C4I Systems, Jun. 95]

AN/MSC-63A SPECIAL SECURITY COMMUNICATIONS CENTER (SSCC). The SSCC is used as the entry into the Defense Special Security Communications System (DSSCS). The SSCC provides semi-automated encrypted data communications support for the processing of record Sensitive

Compartmented Information (SCI) to the commanders of a deployed MAGTF, or the commanders of Marine Forces in a joint theater of operations. The SSCC does not have organic communications associated, therefore communication support must be supplied by external assets. The SSCC is compatible with circuit switched systems. [MAGTF C4I Systems, Jun. 95]

AN/TSQ-188 COMMUNICATIONS CENTRAL. The AN/TSQ-188 consists of multiplexers, modems, a circuit switch, a record communication terminal, a facility management terminal, test equipment, communications security (COMSEC) equipment, and miscellaneous support items housed in a Standard Integrated Command Post Shelter (SICPS). It is transported on a modified Commercial Utility Cargo Vehicle (CUCV) or a HMMWV. The AN/TSQ-188 is planned to be used as a digital technical control facility. [MAGTF C4I Systems, Jun. 95]

AN/TSQ-84( ) COMMUNICATIONS TECHNICAL CONTROL CENTER. The AN/TSQ-84( ) is a transportable analog communication technical control center used to monitor, test, condition, and control tactical telecommunications circuits at the MEF CE, division, wing, and FSSG levels. It provides the capability to coordinate alternate routing and restoration of tactical circuits. The AN/TSQ-84( ) is capable of interconnecting and interfacing various types of communications systems, both voice and teletype. [MAGTF C4I Systems, Jun. 95]

SB-4097/U PANEL, PATCHING. COMMUNICATION. The SB-4097 is a communications patching panel. It provides for operator control in cross connecting and monitoring circuits in the Cable Distribution System. [MAGTF C4I Systems, Jun. 95]

PORTABLE TECHNICAL CONTROL (PTC). The PTC facility provides general purpose technical control for analog circuits on the battlefield.

The PTC is located below the major subordinate command level. It provides communications personnel the capability to perform technical control functions such as to monitor, test, troubleshoot, and restore analog circuits within the MAGTF. [MAGTF C4I Systems, Jun. 95]

Terminal Equipment - AUTOMATED DATA PROCESSING EQUIPMENT (ADPE)

AN/UYK-83 FLEET MARINE FORCE END USER COMPUTING EQUIPMENT (FMF-EUCE) and AN/UYK-85 FMF DOWNSIZED EUCE (FMF-DEUCE). The AN/UYK-83 program replaced ADPE-FMF devices and numerous non-standard computers in the field with ruggedized, TEMPEST certified microcomputers. The program encompasses source data automation, personal computer, automated work station, and word processing equipment. Users are provided with a basic configuration and, where warranted, the ability to select a variety of optional hardware and software. The AN/UYK-85 is a downsized version of the AN/UYK-83. By being smaller, it lacks the expansion capabilities of the larger EUCE. [MAGTF C4I Systems, Jun. 95]

MARINE COMMON HARDWARE SUITE (MCHS) CLASS A: WORKSTATION SERVER/SYSTEM. The MCHS Class A Workstation Server/System is the most powerful workstation in the MCHS product line. It is capable of handling the chores of the network server, a communications server, or a central processor facility with rapid processing and display capabilities. It is based on the Sun Microsystems SPARC system 2 using Sun's SPARC RISC-based computing architecture. [MAGTF C4I Systems, Jun. 95]

MARINE COMMON HARDWARE SUITE (MCHS) CLASS B: NETWORK WORKSTATION. The MCHS Class B Network Workstation is a powerful, portable workstation which provides the general purpose "workhorse" capabilities for the MAGTF. It has the capability to function as a network server, but will function mostly as a highly versatile application workstation either on a network or as a stand-alone device. [MAGTF C4I Systems, Jun. 95]

MARINE COMMON HARDWARE SUITE (MCHS) CLASS C: LIGHTWEIGHT TACTICAL COMPUTER. The MCHS Class C Lightweight Tactical Computer provides the capability for processing and communications under POSIX-compliant operating systems running UNIX or MS-DOS. It could function as a network server, but will normally be used as a lightweight application workstation either on a network or as a stand-alone device. The Army's Lightweight Computer Unit has been selected to satisfy this need. [MAGTF C4I Systems, Jun. 95]

MARINE COMMON HARDWARE SUITE (MCHS) CLASS D: POCKET TACTICAL COMPUTER. The MCHS Class D Pocket Tactical Computer is a hand held forward entry device. It has sufficient capability to replace current hand held battlefield computers with the potential for many new applications. The MCHS D will feature an embedded Global Positioning Satellite capability, menu driven entry, and handwriting recognition features. The system will have an optional docking station to accommodate using vehicle power as well as networking interfaces. The MCHS D requirement will be met by adopting the replacement system for the current Digital Message System (DMS formerly DCT (Digital Communications Terminal)) for general use in MAGTF C4I systems. [MAGTF C4I Systems, Jun. 95]

TACTICAL ADVANCED COMPUTER (TAC-4). The TAC-4 family of computers is the next generation of MCHSs to which the Marine Corps is transitioning. [MAGTF C4I Systems, Jun. 95]

APPENDIX B. DESCRIPTION OF FMF/MAGTF RADIO NETS

A. MAGTF Nets

MAGTF Command Net 1 (HF/UHF-SATCOM)
MAGTF Command Net 2 (HF/UHF-SATCOM)
MAGTF Tactical Net 1 (VHF/UHF-SATCOM)
MAGTF Tactical Net 2 (HF/UHF-SATCOM)
MAGTF Reconnaissance Net (HF/UHF-SATCOM)
MAGTF Tactical Air Command (TACAIR COMD) Net (UHF-SATCOM/HF)
MAGTF Alert/ Broadcast Net (HF)
Fleet Marine Force Mobile Command Net (HF)
MAGTF Intelligence Net (HF/UHF-SATCOM/VHF)
MAGTF Air Observation Net (UHF/VHF)
MAGTF Naval Gunfire Support Net (HF)
MAGTF Fire Support Coordination Net (VHF/HF)
Naval Gunfire Control Net (HF)
Naval Gunfire Air Spot Net (UHF)
Naval Gunfire Ground Spot Net (HF)
MAGTF Artillery Command/Fire Direction Net (HF)
MAGTF Artillery Air Spot Net (UHF/VHF)
MAGTF Convoy Control Net (VHF/HF)
Helicopter Support Team Control Net (HF)
Helicopter Landing Zone Local Net (VHF)
MAGTF Combat Service Support Net (HF/VHF)
MAGTF Damage Control Net (HF)
MAGTF Damage Control Local Net(s) (VHF)
Landing Force Support Party Control Net (VHF)
Shore Party Local Net (VHF)
MAGTF Local Security Net (VHF)
MAGTF Medical Regulating Net (HF)
MAGTF Communication Coordination Net (HF/VHF)

B. Ground Combat Element (GCE) Nets

Division/GCE Command Net 1 (HF)
Division/GCE Command Net 2 (HF)
Division/GCE Tactical Net 1 (HF/VHF)
Division/GCE Tactical Net 2 (HF/VHF
Division/GCE Reconnaissance Net (HF)
Division/GCE Intelligence Net (HF/VHF)

Division/GCE Alert/Broadcast Net (HF)
Division/GCE Air Observation Net (UHF/VHF)
Division/GCE Naval Gunfire Support Net (HF)
Shore Fire Control Party Local Net (VHF)
Division/GCE Radar Beacon Net (HF/VHF)
Division/GCE Artillery Air Spot Net (VHF)
Division/GCE Fire Support Coordination Net (HF/VHF)
Division/GCE Communication Coordination Net (HF/VHF)
Division/GCE Convoy Control Net (VHF)
Division/GCE Damage Control Net (HF)
Division/GCE Damage Control Local Net (VHF)
Division/GCE Local Security Net (VHF)
Military Police Company Command Net (VHF)
Combat Engineer Battalion Command Net (HF)
Engineer Company Command Net (VHF)
Engineer Local Net (VHF)
Tank Battalion Command Net (VHF)
Tank Company Command Net (VHF)
Tank Platoon Command Net (VHF)
TOW Company Command Net (VHF)
TOW Platoon Command Net (VHF)
TOW Section Command Net (VHF)
Light Armored Infantry Battalion Tactical Net (HF/VHF)
Light Armored Infantry Battalion Command Net (HF/VHF)
Light Armored Infantry Company Tactical Net (VHF)
Light Armored Infantry Platoon Tactical Net (VHF)
Light Armored Infantry Battalion Mortar Net (VHF)
Light Armored Infantry Air Defense Platoon Command Net (VHF)
Light Armored Infantry Antitank Platoon Command Net (VHF)
Assault Amphibian Battalion Command Net (HF/VHF)
Assault Amphibian Company Command Net (VHF)
Assault Amphibian Platoon Command Net (VHF)
Reconnaissance Battalion Command Net (HF)
Reconnaissance Company Command Net (HF)
Reconnaissance Platoon Command Net (HF)
Infantry Regiment Command Net (HF)
Infantry Regiment Tactical Net (VHF/HF)
Infantry Regiment Intelligence Net (VHF/HF)
Infantry Regiment Communication Coordination Net (VHF/HF)
Infantry Regiment TOW Platoon Command Net (HF/VHF)
Infantry Regiment Fire Support Coordination Net (HF/VHF)

Infantry Battalion Tactical Net 1 (VHF/HF)
Infantry Battalion Tactical Net 2 (VHF)
Infantry Battalion Mortar Net (VHF)
Tactical Air Control Party Local Net (VHF)
Rifle Company Tactical Net (VHF)
Rifle Platoon Tactical Net (VHF)
Artillery Regiment Command Net (HF)
Artillery Regiment Communication Coordination Net (HF/VHF)
Artillery Regiment Fire Direction Net (VHF/HF)
Artillery Regiment Survey/Metro Net (VHF)
Artillery Regiment Radar Telling Net (VHF)
Artillery Regiment Tactical Net (VHF/HF)
Artillery Battalion Conduct of Fire Net (VHF/HF)
Artillery Battalion Command Net (HF/VHF)
Artillery Battalion Fire Direction Net (VHF/HF)
Artillery Battery Conduct of Fire Net (VHF)
Artillery Battery Command Net (VHF)

C. Marine Aircraft Wing Nets

Wing Command Net 1 (HF)
Wing Command Net 2 (HF)
Tactical Air Command Net (TAC) Net 1 (HF/UHF-SATCOM)
Tactical Air Command Net (TAC) Net 2 (HF)
Command Action Net (MUX/HF/VHF)
Antiaircraft Control Net (AAC) (MUX/HF/VHF)
Air Operations Control Net (HF)
Antiaircraft Intelligence (AAI) Net (MUX/HF)
Combat Information /Detection (CI/D) Net (HF/MUX)
Handover/Crosstell (HAN/CT) Net (HF/MUX)
Low Altitude Air Defense Command (LC) Net (HF)
LAAD Weapon Control (LWC) Net (HF)
LAAD Team Control (LTC) Net (VHF)
Interface Coordination Net (ICN) (HF/UHF/VHF/MUX)
TADIL A (HF/UHF)
TADIL B (MUX)
TADIL C (UHF)
ATDL-1 (MUX)
LINK-1 (NATO) (MUX)
Track Supervision Net (TSN) (MUX/HF/UHF)
DATA-LINK Coordination Net (DCN) (MUX/HF/UHF)
Radar Remote Coordination Net (VHF/HF)

Voice Product Net (VPN) (MUX/HF/UHF)
Wing Communications Coordination Net (HF/VHF)
Direct Air Support (DAS) Net (HF/MUX)
Tactical Air Request/Helicopter Request (HF/VHF)
Helicopter Request Net (HF/VHF)
Air Support Radar Team (ASRT) Control Net (HF/UHF/MUX)
Tactical Air Traffic Control (TATC) Net (UHF/VHF)
Fighter Air Direction (FAD) Net (UHF/VHF)
Tactical Air Direction (TAD) Net (UHF/VHF)
Helicopter Direction (HD) Net (UHF/VHF/HF)
Tanker Net (UHF)
Squadron Common Net (UHF/VHF)
Group Common Net (UHF/VHF)
Guard (G) Net (UHF/VHF/HF)
Crash, Fire, Rescue (CFR) Net (VHF)
Search and Rescue (SAR) Net (UHF/HF)
Air Traffic Control (ATC) Common (MUX/HF)
Landing Zone Control Net (VHF/UHF)
Landing Zone Control Team Local Net (VHF)

D. Combat Service Support Element Nets

Force Service Support Group (BSSG/MSSG) Command Net 1 (HF)
Force Service Support Group (BSSG/MSSG) Command Net 2 (HF)
Force Service Support Group (BSSG/MSSG) Alert/Broadcast Net 1 (HF)
Force Service Support Group (BSSG/MSSG) Damage Control Net 1 (HF)
Force Service Support Group (BSSG/MSSG) Communications Coordination Net 1 (HF)
Combat Service Support Area Local Net (VHF)
Combat Service Support Area Security Net (VHF)
Combat Service Support Request Net (VHF)
Landing Force Support Party Command Net (HF/VHF)
Shore Party Control Net (VHF/HF)
Engineer Support Battalion Command Net (HF)
Engineer Company Command Net (VHF)
Motor Transport Battalion Command/Convoy Net (VHF)
Medical Battalion Command Net (VHF)
Medical Battalion Evacuation Coordination Net (Ground) (VHF)
Medical Battalion Evacuation Coordination Net (Air) (VHF)

E. Force Nets

Force Reconnaissance Company Command Net (HF)
Force Reconnaissance Platoon Command Net (VHF)
ANGLICO Command Net (VHF)
Net 1 MAGTF DSSCS Entry
Net 2 MAGTF SPINTCOMM Net External
Net 3 MAGTF CRITICOMM Net (VHF)
Net 4 MAGTF Internal SPINTCOMM Net
Net 5 Radio Battalion Command and Control Net (VHF)
Radio Battalion Command and Control Net 2 (HF)
Theater Cryptologic Support Net
Radio Battalion CRITICOMM Net (HF/VHF/UHF/SATCOM)
DSU Collection Net (HF/VHF/UHF/SATCOM)
ECM Control Net (VHF)
DF Flash Net (VHF)
DF Report Net (VHF)
Technical Exchange Net (HF)
DF Data Net
HFDF Flash Net

APPENDIX C. ACRONYMS

ACE	Aviation Combat Element
ATM	Asynchronous Transfer Mode
AUTODIN	Automatic Digital Network
bps	Bits per second
C2	Command and Control
C4I	Command, Control, Communications, Computers and Intelligence
CE	Command Element
CSSE	Combat Service Support Element
DII	Defense Information Infrastructure
DISA	Defense Information Systems Agency
DISN	Defense Information Systems Network
DMS	Defense Messaging System
DoD	Department of Defense
DSVT	Digital Subscriber Voice Terminal
FMF	Fleet Marine Force
FSSG	Force Service Support Group
GBS	Global Broadcast Service
GCCS	Global Command and Control System
GCE	Ground Combat Element

IEEE	Institute of Electrical and Electronics Engineers
JIC	Joint Intelligence Center
KBPS	Kilo bits per second
LAN	Local-Area Network
MAG	Marine Air Group
MAGTF	Marine Air-Ground Task Force
MARCORSYSCOM	Marine Corps Systems Command
MARFORPAC	Marine Forces Pacific
MAW	Marine Air Wing
MCCDC	Marine Corps Combat Development Command
MBPS	Mega bits per second
MEF	Marine Expeditionary Force
MEU	Marine Expeditionary Unit
MHz	Megahertz
NIPRNET	Non-secure IP Router Network
nm	nautical mile
NPS	Naval Postgraduate School
PC	Personal Computer
SB-3865	30-line portable digital tactical circuit switch
SCI	Sensitive Compartmented Information (TOP SECRET)

SINCGARS	Single Channel Ground and Airborne Radio System
SIPRNET	Secure IP Router Network
TADILS	Tactical Data Links
TCIM	Tactical Communications Interface Module
TDN	Tactical Data Network
TSQ-188	Digital Technical Control System
TTC-42	150-line capacity digital tactical circuit switch system
UAV	Unmanned Aerial Vehicle
USMC	United States Marine Corps
WWW	World Wide Web
VINES	Virtual Network System (Banyan Inc.)

APPENDIX D. GBS GLOSSARY OF TERMS

Air Tasking Order (ATO) - (DoD) A method used to task and disseminate to components, subordinate units, and command and control agencies projected sorties/capabilities/forces to targets and specific missions. Normally provides specific instructions to include call signs, targets, controlling agencies, etc., as well as general instructions. Also called ATO.

Airborne Receive Terminal (ART) - A GBS receive terminal that is installed on airborne platforms, to include fixed and rotary wing aircraft.

Antenna System - The GBS receive antenna, support structure, tracking mechanism, and Low Noise Block

Area of Responsibility (AOR) - The geographic area assigned to European Command (EUCOM), Atlantic Command (ACOM), Pacific Command (PACOM), Southern Command (SOUTHCOM), or Central Command (CENTCOM)

Backchannel - A communications capability that exists outside the GBS system which allows end users to define "User Pull" requests and is used to ensure reliable delivery of information by the GBS system.

Bit Stream - The modulated RF signal that is the broadcast data stream.

Broadcast Data Stream - The aggregation of file and stream products into a continuous digital stream to be transmitted to the space segment. Broadcast data streams are created by the Satellite Broadcast Manager, processed and transmitted to the space segment by the injection terminal, and received and processed by the receive suite (receive terminal, cryptographic equipment and Receive Broadcast Manager) for subsequent dissemination to end user systems.

Broadcast Management - The set of functions, processes, and systems required to collect, assemble, prioritize, transmit encrypt/decrypt, and disseminate information provided from national and theater sources to end user systems. Broadcast management can be subdivided into transmit broadcast management and receive broadcast management.

Broadcast Management Center (BMC) - A facility that contains the Satellite Broadcast Management functions. See also Transmit Broadcast Manager.

Broadcast Management Segment - One of the three segments of the GBS system, which includes the Theater Information Manager, Satellite Broadcast Manager, and Receive Broadcast Manager.

Command and Control (C2) - (DoD) The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission. Also called C2.

Defense Information Infrastructure (DII) - The resources identified by the Defense Information Systems Agency (DISA) as critical for the flow of information within the DoD. Interoperability and multi-path technologies are being applied to the DII to make it as flexible as possible. DISA is also working on a multi-level security capability for the DII.

Defense Information Systems Network (DISN) - A network of communications paths that support information transfer within the DoD.

End User - The ultimate recipient and/or user of the information products broadcast by the GBS.

End User System - An end user owned and operated system that uses information provided via the GBS.

File - A discrete/fixed size information product. Imagery, weather information, maps, and Air Tasking Orders (ATO) are examples of file products.

Fixed - Not capable of being moved.

Global Broadcast Service (GBS) - An acquisition category (ACAT) ID DoD program to provide a continuous, high data rate, one-way satellite broadcast capability able to support the simultaneous transmission and receipt of national and theater level generated information products to forces deployed, on the move (in transit), or in garrison.

Global Coverage - 90° north to 65° south latitude, 180° west to 180° east longitude.

Ground Receive Terminal (GRT) - A small satellite antenna and receive equipment that will receive and convert the downlink GBS RF signal into a bit stream.

Information Management - The set of functions, processes, and systems associated with obtaining information products from national and theater sources and providing them to users via any available communications path.

Information Products - File and stream products from national and theater sources to be delivered to end users by the GBS system.

Information Source - A provider of file or stream information products. Information sources are categorized as national and theater.

Injection Points - The hardware and software that implements the functions necessary to transmit broadcast data streams to the space segment. Injection Points are categorized as Primary Injection Points and Theater Injection Points.

Integrated Receiver Decoder (IRD) - Receives the radio frequency signal from the LNB, demodulates the signal, and separates the video and data information streams.

Low Noise Block (LNB) - The hardware that receives the GBS downlink radio frequency signal from the antenna, amplifies the signal, and converts it to a frequency that can be received by the integrated receiver decoder (IRD).

Joint Intelligence Center (JIC) - (DoD) The intelligence center of the joint force headquarters. The joint intelligence center is responsible for providing and producing the intelligence required to support the joint force commander and staff, components, task forces and elements, and the national intelligence community. Also called JIC. See also joint intelligence architecture.

Marine Expeditionary Unit (Special Operations Capable) - (DoD) A forward-deployed, embarked US Marine Corps unit with enhanced capability to conduct special operations. The Marine expeditionary unit (special operations capable) is oriented toward amphibious raids, at night, under limited visibility, while employing emission control procedures. The Marine expeditionary unit (special operations capable) is not a Secretary of Defense-designated special operations force but, when directed by the National Command Authorities and/or the theater commander, may conduct hostage recovery or other special operations under in extremis circumstances when designated special operations forces are not available. Also called MEU(SOC).

Mobile - Capable of communicating while moving.

Near Worldwide Coverage - 65° north latitude to 65° south latitude, with longitude coverages limited by the UHF Follow-On satellite footprint.

Near Continuous - Information is either a continuous data stream of long duration (up to hours) (i.e., real-time UAV products) or is bursts of information at regular (i.e., situation awareness products) or irregular (i.e., threat warning products) time internals requiring connectivity on-demand.

Primary Injection Point (PIP) - A fixed injection system that provides the primary uplink of the broadcast data streams from the broadcast management segment to the space segment. For GBS Phase 2, there will be one PIP associated with each GBS UFO satellite.

Receive Broadcast Manager (RBM) - The hardware and software that implements the receive broadcast management functions necessary to process the downlink broadcast data streams for subsequent dissemination to end users systems and services.

Receive Broadcast Management - The set of functions, processes, and systems associated with receiving and disseminating the file and stream information contained within the broadcast to end users. Receive broadcast management functions include, for example: decryption and encryption, storage, de-multiplexing, filtering, broadcast schedule tuning, network management, configuration control of receive terminal equipment, supporting "Smart Push" and "User Pull" requests, and receiving and processing cryptographic key material sent over the air.

Receive Site - A location capable of receiving the GBS downlink directly from the satellite. Receive sites will be fixed, transportable, and mobile.

Receive Suite - The receive terminal, cryptographic equipment, and receive broadcast management hardware and software (i.e., Receive Broadcast Manager) required to support an end user's information delivery and dissemination requirements.

Receive Terminal - The hardware (antenna and associated equipment such as support structure and tracking mechanism, low noise block (LNB) and integrated receiver dedcoder (IRD) or "settop box") and software that implements the functions necessary to receive the downlink broadcast data streams and convert them to bit streams for subsequent processing and dissemination by the Receive Broadcast Manager. Receive terminals are categorized as: fixed ground (FGRT), transportable ground (TGRT), airborne (ART), shipboard (SRT), submarine (SSRT), ground mobile (GMRT), and Manpack (MRT).

Satellite Broadcast Manager (SBM) - The hardware and software that implements the broadcast management functions necessary to assemble the uplink broadcast data streams for subsequent transmission to the space segment.

Satellite Broadcast Management - The set of functions, processes, and systems associated with collecting information products, assembling broadcast data streams, and transmitting these streams to the injection point for uplink to the space segment. Satellite broadcast management functions include, for example: enforcing the Joint Chiefs of Staff resource apportionment and other policies and procedures, creating and disseminating broadcast schedules, collecting information products from national and theater sources, decryption and encryption, authentication, storage, assembling and routing broadcast data streams, network management, configuration control of broadcast management and injection point equipment, configuration control of receive suite equipment (to the extent required to ensure correct delivery of files and streams), controlling the flow of information from the DII and other sources, ensuring reliable delivery of information products, supporting "Smart Push" and "User Pull" requests, and performing over-the-air rekey of receive terminals.

Scaleable Architecture - The notion that the GBS system architecture will support an array of capabilities required to meet the end users' operational needs. For example, the transmit and receive data rates will vary with the capabilities of the injection and receive terminals. Also, the capability of the receive suite will vary depending on whether the equipment will be used in a stand-alone or networked configuration.

Shipboard Receive Terminal (SRT) - A GBS receive terminal that is installed on shipboard platforms. In general, the SRT consists of above deck and below deck equipment.

"Smart Push" - The capability for the end user to define information requirements in advance so that the GBS system can provide those information products as they become available, and in accordance with established priorities.

Space Segment - One of the three segments of the GBS system, consisting of the broadcast satellite packages and satellite command and control systems.

Stream - A continuous/variable duration information product that originates from a national or theater source. Real time video is an example of a stream product.

Submarine Receive Terminal (SSRT) - A GBS receive terminal that is installed on submarine platforms.

Terminal Segment - One of the three segments of the GBS system, consisting of the injection points and receive terminals.

Theater Information Management - The set of functions, processes, and systems that are controlled by the theater commander (e.g., CINC) to manage the dissemination of information at the theater level.

Theater Information Manager (TIM) - The TIM is the CINC's mechanism for exercising control over what, when, and to whom information is disseminated within their Area of Responsibility (AOR) or to their forces supporting one of the geographic CINCs.

Theater Injection - The capability to broadcast information directly from within a theater of operations.

Theater Injection Point (TIP) - A transportable injection system that provides the capability for theater commanders to transmit information directly from within a theater to the GBS space segment. Although functionally equivalent to a PIP, the TIP, as a transportable system, also includes the theater broadcast management segment.

Time Critical Information - Information has high urgency or perishability requiring connectivity on-demand.

Transportable - Capable of being moved from one location to another and communicating from a fixed location.

Uplink Site - A location capable of transmitting the GBS uplink directly to the space segment. Uplink sites will be fixed (PIP), and transportable (TIP).

"User Pull" - The capability for end users to define specific information to be broadcast on demand in response to operational circumstances, or the actual end user request for specific information to be broadcast on demand. "User Pull" requests are made via existing (non-GBS) communications means available to the user.

Virtual Injection - The process of utilizing other (e.g., fiber, leased satellite, MILSATCOM, etc.) communications paths to transmit in-theater generated information to a Primary Injection Point for broadcast to users in theater

Worldwide Coverage - 65^{o} north latitude to 65^{o} south latitude, 180^{o} west to 180^{o} east longitude.

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