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THESIS

A PROPOSED ARCHITECTURE FOR COMMUNICATION PLANNING IN SUPPORT OF MARINE AIR GROUND TASK FORCE OPERATIONS

by

John A. Woodward

March 1989

Thesis Co-Advisors: Dan C. Boger
James G. Taylor

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The author uses a systems approach methodology to address the requirements for a Marine Air Ground Task Force communciation planner. An architecture is developed in which line of sight and beyond line of sight computer programs are used to assist the planner. Particular needs are stated for line of sight information requirements. There is special emphasis on high frequency (HF) communication planning due to the vulnerability of satellite communciations in a wartime environment. In particular, an algorighm for HF communications is designed for HF frequency requests and for HF frequency to net assignments. That algorithm was coded by personnel at the Naval Ocean Systems Center (NOSC) and included as a test module in the latest release of the Advanced Prophet program. A menu driven program is designed and incorporates the features required for a Marine communciation planner to enhance the command and control process for the commander.

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A Proposed Architecture For Communication Planning In Support Of Marine Air Ground Task Force Operations

by

John A. Woodward
Major, United States Marine Corps
B.S., Worcester Polytechnic Institute, 1972
M.S., University of Southern California, 1980

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March 1989

Author: John A. Woodward

Approved by: Dan C. Boger, Thesis Co-Advisor

James G. Taylor, Thesis Co-Advisor

Linda K. Crumback, Second Reader

Carl R. Jones, Chairman
Joint Command, Control and Communications
Academic Group

Harrison Shull
Provost and Academic Dean

ABSTRACT

The author uses a systems approach methodology to address the requirements for a Marine Air Ground Task Force communication planner. An architecture is developed in which line of sight and beyond line of sight computer programs are used to assist the planner. Particular needs are stated for line of sight information requirements. There is special emphasis on high frequency (HF) communication planning due to the vulnerability of satellite communications in a wartime environment. In particular, an algorithm for HF communications is designed for HF frequency requests and for HF frequency to net assignments. That algorithm was coded by personnel at the Naval Ocean Systems Center (NOSC) and included as a test module in the latest release of the Advanced Prophet program. A menu driven program is designed and incorporates the features required for a Marine communication planner to enhance the command and control process for the commander.

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TABLE OF ABBREVIATIONS

ACE	Aviation Combat Element
BLOS	Beyond Line of Sight
C2	Command and Control
CE	Command Element
CEOI	Communication Electronics Operating Instruction
CIM	Cross Interaction Matrix
CSSE	Combat Service Support Element
CUDIX	Common User Digital Information Exchange
DASC	Direct Air Support Center
DCS	Defense Communication System
DI	Diurnal
DoD	Department of Defense
ECAC	Electromagnetic Compatibility Analysis Center
FOT	Frequency of Optimum Transmission
FS	Field Strength
FSCC	Fire Support Coordination Center
GCE	Ground Combat Element
HF	High Frequency
LOS	Line of Sight
LUF	Lowest Userable Frequency
MAGTF	Marine Air Ground Task Force
MCRADC	Marine Corps Research Development and Acquisition Command
MEB	Marine Expeditionary Brigade
MEF	Marine Expeditionary Force
MEU	Marine Expeditionary Unit
MH2	Mega Hertz
MUF	Maximum Usable Frequency
NAVCAMS	Naval Communications Area Master Station
NAVCOMMSTA	Naval Communications Station
NOSC	Naval Ocean Systems Command
RA	Ray Trace
RP	Restoration Priority
SHF	Super High Frequency
SIM	Self Interaction Matrix
TACC	Tactical Air Command Center
TAOC	Tactical Air Operations Center
UHF	Ultra High Frequency
VHF	Very High Frequency

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I. INTRODUCTION

A. PROBLEM STATEMENT

In recent years command and control requirements have changed in many areas The parameters for communication planning have increased in number and become more constrained, the complexity of operations and electronic equipment has increased, the coordination requirements with other services (interoperability issues) have increased and lastly, time and resources available for planning operations have decreased. In fact, the Commandant of the United States Marine Corps has stated that he wants his units "to be able to start a raid within six hours of being given the mission" [Ref. 1]. New equipment which will allow the Marine Corps to make over the horizon assaults either by sea or by air must be balanced with functional and responsive command and control systems.

Command and control requirements as well as the operational requirements must be thoroughly understood by the communication planners in order for the planners to make knowledgeable recommendations to the officer responsible for the operation. As the availability of resources becomes increasingly scarce and constraints more restrictive, the planner must search for methods to perform those functions within the available time while remaining as accurate or improving the accuracy of the estimates and recommendations. The effectiveness must remain at a high level and the efficiency must simultaneously improve.

Communication planning is not an independent activity. It is essentially the intersection of the requirements with the available resources. The communication officer is actually a facilitator of that intersection in that he must thoroughly understand the intricacies of the operational requirements and the capabilities of the available command and control system resources (equipment and the personnel operating the equipment). The communication officer must synthesize the information concerning the requirements and the resources in order to maximize the effectiveness of the command and control systems. From another perspective, the focus could be on the intersection of the problem domain as the requirements and the technological domain as the resources as illustrated in Figure 1-1. The relationship may not always be linear which is indicated in Figure 1-1. Technology can not be thrown at a problem with the expectation that an optimum solution will be determined. Technology should be appropriately and judiciously applied to problems along with the organizational concepts to solve problems efficiently.

We must be practical and find ways to improve our efficiency by using resources/materials already available in

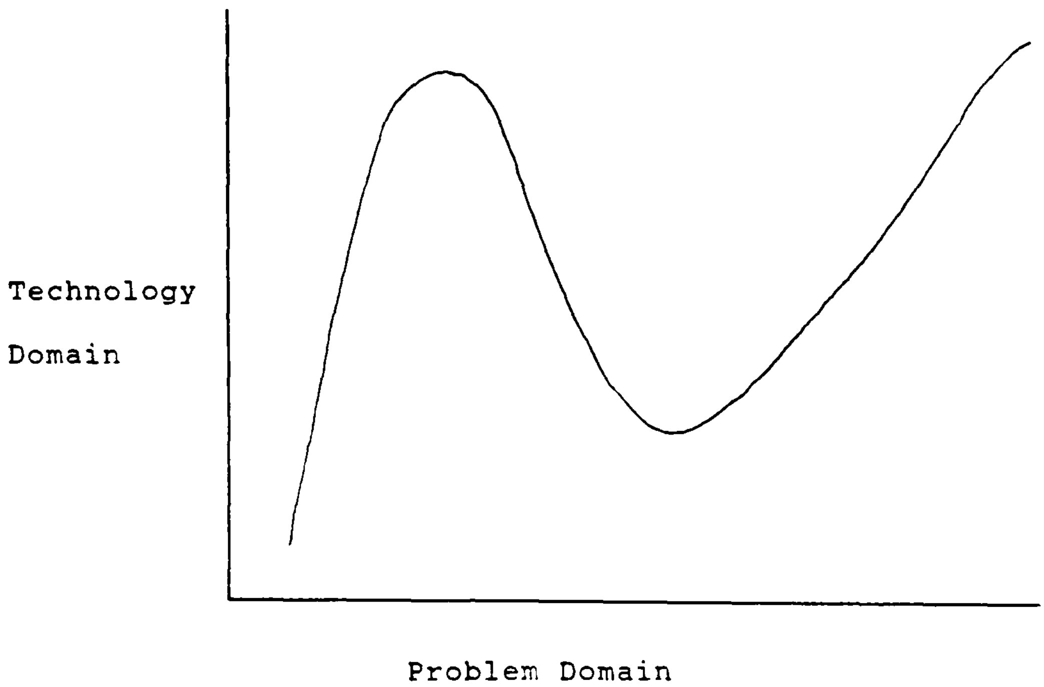

Figure 1-1. Problem And Technology Interaction

more effective methods. This thesis can be considered one of many possible applications of the thesis authored by Albano and Gearhart which proposed that expert systems can assist Marines in many functional areas [Ref. 2].

B. PURPOSE/OBJECTIVE

The purpose/objective of this thesis is three fold:

1. Propose an explicit and standardized process for the area of communication planning (specifically HF communication planning). It will be recommended that several areas be collected under the umbrella of a computer shell/program in order to improve the efficiency and effectiveness of the communication

planner and meet the six hour parameter as set forth by the Commandant of the United States Marine Corps. The planning technique should be interoperable with any service and not just the Marine Corps.

2. Demonstrate the systems engineering approach to the above problem. This approach provides a framework for analyzing requirements, developing alternatives, and optimizing the selected solution while providing an audit trail of the process.

3. Attempt to bridge the gap between the users of systems (the customers) and the producers/designers of systems. Additionally, the author will attempt to reduce the gap between technology and the application of technology. This country is unsurpassed in the development of new technology but frequently our employment of that technology is less than efficient.

This planning architecture is designed for the operational communication planner on the staff of a Marine Air Ground Task Force (MAGTF) element and not the organization responsible for the execution of the plans. That is, this architecture is designed for the communication staff personnel at the following organizational levels: the headquarters of the Marine Expeditionary Force (MEF), the Marine Expeditionary Brigade (MEB), the Marine Expeditionary Unit (MEU), the Marine Division, the Marine Wing and the Marine Force Service Support Group.

In this thesis there is greater emphasis on the area of tactical high frequency (HF) communication planning because it has been neglected in recent years, especially since the introduction of satellite communications. HF communications does not possess all the positive attributes of satellite communications such as high data exchange rates and clear connectivity but it does possess the ability to exchange information between almost any two points on the earth's surface which are not line of sight.

C. STRUCTURE

Chapter II presents a description of the communication planning process in terms of the systems approach. Chapter III describes the analysis of requirements using an example of an exercise conducted in north Norway. Chapter IV is the design of the architecture and proposes a menu structure for the planner. Chapter V is a summary of the implementation of the architecture and includes the alternatives available for the development, the coding and testing of the program. Chapter VI contains conclusions and recommendations for further study.

II. COMMUNICATION PLANNING AND THE SYSTEMS APPROACH

A. INTRODUCTION

Planning communications for a military operation is a complex process which is vitally important to the success of the mission and the safety of the service members involved. The planning process is complicated, time consuming, and requires that the communication planner be aware of all of the aspects of the operation in order to provide proper communication support.

In general, communication management can be divided into two phases: planning and execution. Each of these phases is iterative and consists of organizing and controlling (in the sense of monitoring). See Figure 2-1. Immediately there

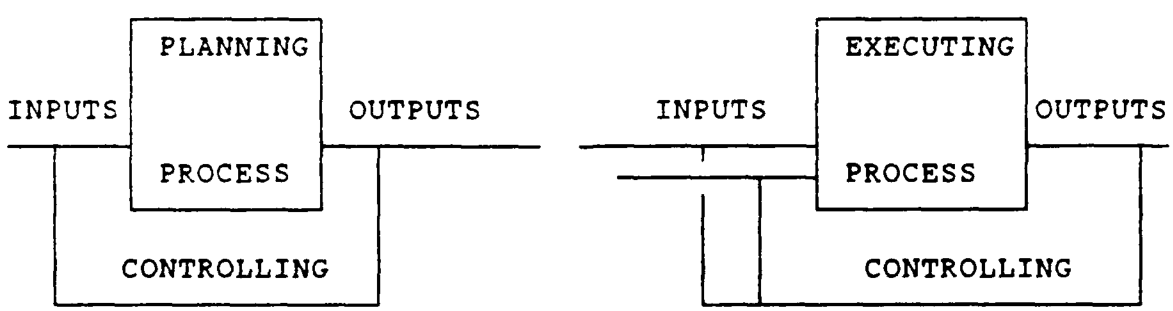

Figure 2-1. Communication Management Areas

are six elements to consider in the management of communications, and the process quickly becomes much more complicated. The six areas are the inputs to the planning phase, the actual planning process, the outputs from the planning phase, the inputs to the execution phase, the actual execution phase, and the outputs from the execution phase. If outputs that should have been developed during the planning phase have not been accomplished, then they must be completed during the execution phase. In many cases the outputs of the planning process become the inputs to the execution process but only if the planner is very familiar with the actual execution phase. An experienced planner can lay the foundation for an easily executed process because the vast majority of coordination has already been accomplished.

It is the opinion of the author that technology can be applied to the process of communication planning in order to quantify and standardize the process. It is also the opinion of the author that the time available for planning will be significantly reduced in the future. The same amount of planning must take place in order to ensure a successful operation but in significantly less time. The Grenada and Libya operations are useful current examples. The operating units had precious little time available to them to devise a communication plan. Inherent in the communication planning should be the concern that satellite connectivity will not be available. In other words, a methodology must be developed to quickly and accurately use other portions of the radio spectrum for those long haul communication links (high frequency radio is an alternative). A methodology must also be developed to quickly and accurately determine where there is line of sight (LOS) and where there is not LOS. These items will be discussed in some detail in this paper. Other areas of communication planning (wire, for instance) are important but will not be considered within the scope of this thesis.

1. Background

Military planning is a continuous process involving a systematic examination of all aspects of a contemplated operation. Planning should identify future tasks and the means to accomplish those tasks. The framework for communication planning can be broad and general while the information for a particular operation will provide the proper focus for detail.

Communication has played an important and indispensable role in the command and control of the military forces since 500 B.C. Sun Tzu, the great military philosopher, said, " And to control many is the same as to control few. This is a matter of formations and signals." [Ref. 3:p. 90] All military communication systems have one goal or purpose--to serve command. There are two basic types of communication: non-electrical and electrical. Examples of non-electrical communication are visual (panel codes, pyrotechnics, signal lamps, signal flags), sound (bells, horns, sirens), messengers, and mail. Examples of electrical communication are radio (high frequency, very high frequency, ultra high frequency, super high frequency, etc.) and wire (point-to-point circuits or switchboard type operations). [Ref. 4]

Radio has played an important part in the command and control of the armed forces since it was introduced in the early 1900's. Radio provided the commanders increased mobility and the capability to coordinate, command, and control their forces on a near-real-time basis. There are two basic types of radio communication systems: line of sight (LOS) and beyond line of sight (BLOS). LOS systems require that the receiver can "see" the transmitter in a straight line and normally consist of very high frequency (VHF) and higher ranges in the frequency spectrum. BLOS systems (normally the high frequency (HF) range and below) cannot "see" in a straight line and require some sort of relay system such as the atmosphere.

2. System Definition

Every system should be specifically defined in order to be properly understood. In general, a system can be defined as a set of elements unified as a whole for achieving a goal. The definition for the communication planning system is derived from the official definition of command and control (C2) from the Joint Chiefs of Staff Publication 1 Dictionary of Terms. The C2 definition is the exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of the mission; these functions are performed though an arrangement of personnel, equipment, communications, facilities, and procedures, which are employed in planning, directing, coordinating, and controlling operational activities of U.S. forces. The communication planning process system can be defined as follows:

> the personnel, facilities, equipment, and procedures essential to a communicator for planning communications in support of the commander pursuant to the mission assigned in war time as well as peace time.

This definition is quite similar to the definition for command and control from the Department of Defense (DOD) dictionary, a logical extension because communication is subordinate to command and control. Figure 2-2 depicts the hierarchical relationship as stated in the command and control definition. This definition guides the reader to recognize the system boundary as the personnel, facilities, equipment and procedures of the senior and subordinate headquarters as well as the unit headquarters conducting this planning. The personnel considered are the personnel on the communication staff section as well as the personnel on

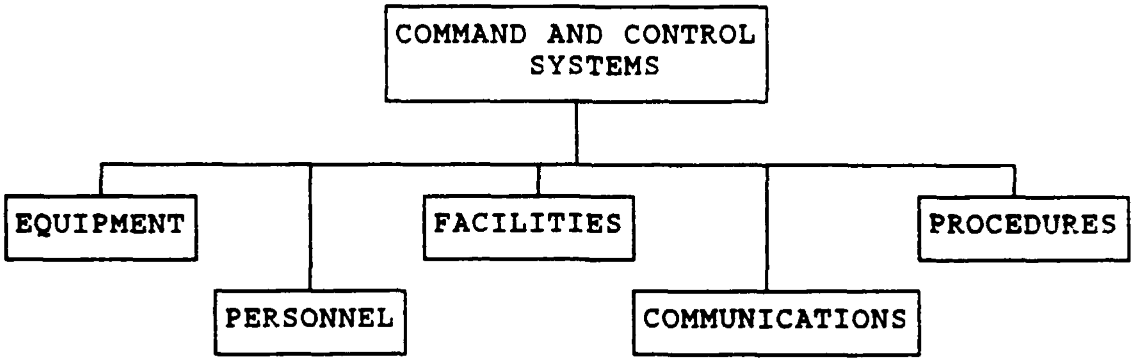

Figure 2-2. C2 Systems Hierarchical Relationship

the communication staff of the higher and subordinate units and the remainder of the staff members of the unit responsible for planning. The equipment consists of that which the units possess such as maps, typewriters, computers and calculators. The communication planning process should be designed to support both war time and peace time operations.

B. THE PLANNING CYCLE

The planning cycle should be a framework for a logical sequence and provide an audit trail of information received and decisions made. The framework, sequence, and audit trail are all important in order to properly analyze the process for effectiveness, efficiency and historical purposes.

Successful methods can be endorsed and unsuccessful methods identified.

The commander exercises lawful authority and assumes the responsibility for effectively using available resources to accomplish the assigned mission. The function of the staff is to assist the commander to arrive at the best course of action in the utilization of his resources to accomplish that mission. The Marine Corps uses the "Sequence for Command and Staff Action". In more general terms, a complex system or problem requires a "systems" approach in order to be adequately and properly analyzed. The Hall Activity Matrix is one of several systems engineering methodologies [Ref. 5] and is a valuable tool available for the study of complex systems in the military as well as other organizations. Both approaches will be discussed. Since the concept of the Hall Activity Matrix is relatively unknown, it will be presented in some detail.

1. Hall Activity Matrix

The elements of a strategic planning model can be taxonomically arranged in the format described by the Hall Activity Matrix which is one of several analysis techniques developed by systems engineering professionals in the decades of the 1960's and 1970's. The Hall Activity Matrix is a two dimensional methodology which contains the dynamic analysis of a complex problem (the time sequence of activities or phases) and the problem partitioning or structure (the logical sequence of activities or steps). These two dimensions, coupled with the knowledge available to study and solve the problem, provide an excellent framework for problem analysis [Ref. 6]. See Figure 2-3.

The Hall Activity Matrix is a reasonable point of departure for this analysis. Some terms used in this paper may be different than those prescribed by Hall and the differences are due to the military application. Any shortfalls in the application of the systems analysis technique are due to the author's inexperience in their application. It is important to remember that the Hall Activity Matrix is just a framework; not all 49 parts of the framework must be utilized. The parts which are appropriate to your particular problem are used and there is no obligation to use any others. Proper and judicious application of this planning tool can enhance the effectiveness of the planner.

The seven phases (vertical activities) of the Hall Activity Matrix are briefly described below:

1. Program planning is a conscious activity to discover the kinds of activities and projects desired to pursue.

2. Project planning is focused on just one project of the overall program.

3. System development means the implementation of the plan.

Phases of the coarse structure / Steps of the fine structure logic →	1 Problem definition	2 Value system design (develop objectives and criterion)	3 System synthesis (collect and invent alternatives)	4 System analysis (deduce consequences of alternatives)	5 Optimization of each alternative (iteration of steps 1–4 plus modeling)	6 Decision making (application of value system)	7 Planning for action (to implement next phase)
1 Program planning							
2 Project planning (and preliminary design)							
3 System development (implement project plan)							
4 Production (or construction)							
5 Distribution (and phase in)							
6 Operations (or consumption)							
7 Retirement (and phase out)							

Figure 2-3. Hall Activity Matrix

4. Production refers to the activities needed to give physical embodiment to the desired system.

5. Distribution means the allocation of the program.

6. Operations overlaps the distribution and retirement phases a little or a lot, depending upon the systems involved and is the reason for all forms of systems engineering.

7. Retirement describes the phasing out of a system while some new system takes its place.

There are seven horizontal steps in this matrix consisting of the following:

1. The problem definition is aimed at determining a descriptive scenario for the situation which presents as much history and data as needed to indicate how the problem came to be a problem.

2. The value system design is used to postulate and clarify objectives proposed to resolve the problem described in step one.

3. The systems synthesis is used to identify potential candidate policies, activities, or controls which might allow attainment of the objectives.

4. The systems analysis is used to develop insight into the interrelationships, behavior, and characteristics of proposed policies.

5. The optimization step is used to rank alternatives in terms of the ultimate satisfaction of the value system.

6. The decision making step is aimed at selecting one or more policies worthy of further consideration.

7. The planning for action step is used to determine and reshape the previous six steps in order to initiate the next phase.

The seven steps and seven phases constitute the Hall Activity Matrix. [Ref. 6] [Ref. 7]

The elements of the first three steps of the Hall Activity Matrix assist in the description of the system boundary. The ingredients can be described by using the following definitions from Hill and Warfield [Ref. 8] [Ref. 9]:

1. Command And Staff Resources: those segments of society which have an interest in the problem and/or its resolution (societal sectors from Hill and Warfield).

2. Needs: the requirements for society in the problem area.

3. Constraints: the restrictions on the problem that in some way limit the means by which the problem could be resolved (physical, political, economic, etc.).

4. Alterables: the factors associated with the potential problem area that could be changed in seeking a solution to it.

5. Objectives: the set of goals which define the value system which is operative with the problem.

6. Objectives Measures: quantifiable indices for the objectives (measures of effectiveness - MOE's) (define type scale).

7. Activities: the functions which must be carried out in seeking to define and/or resolve the potential problem.

8. Activities Measures: quantifiable indices for the activities.

9. Agencies: those organizations involved in the activities.

The elements are arranged as depicted in Figure 2-4. [Ref. 10] The rectangular shapes are cross interaction matrices (CIM) while the triangular shapes are the self interaction matrices (SIM). The CIM depicts the interactions

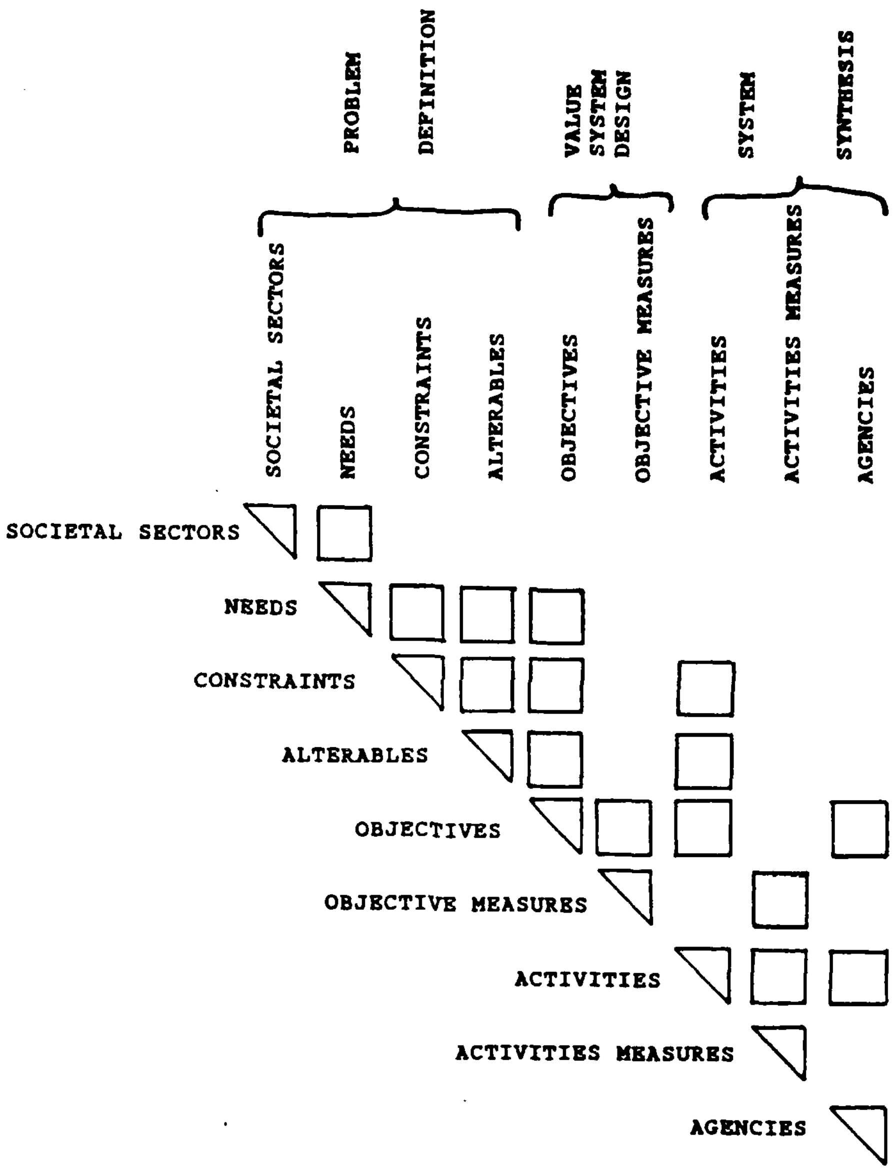

Figure 2-4. Program Planning Linkages

between two different elements while the SIM depicts the interactions between one element.

2. **Command And Staff Sequence Of Action**

The Marine Corps command and staff planning process is similar to the observe, orient, decide, and act (OODA) model developed by Colonel John Boyd with several iterations [Ref. 11:p. 26]. The planning sequence is depicted in Figure 2-5 and is initiated with the receipt of the mission (step 1). The mission is analyzed to develop specific tasks and implied or deduced tasks (step 2). Information requirements are determined in the area of operations, and friendly and enemy capabilities (step 3). The staff briefs the commander with available information and states assumptions made where information was not available (step 4). The commander provides planning guidance to the staff before they prepare their initial estimates (step 5). Proposed courses of action are prepared by the operations office and disseminated to the other staff members (step 6). The staff officers now prepare their estimates for each course of action (step 7). The commander considers all of the staff estimates and makes his estimate of the situation (step 8). He selects what he feels is the best course of action and announces it as his decision (step 9). The commander amplifies his decision by stating his overall concept of the operation (step 10). If required, subordinate units are notified through warning orders and

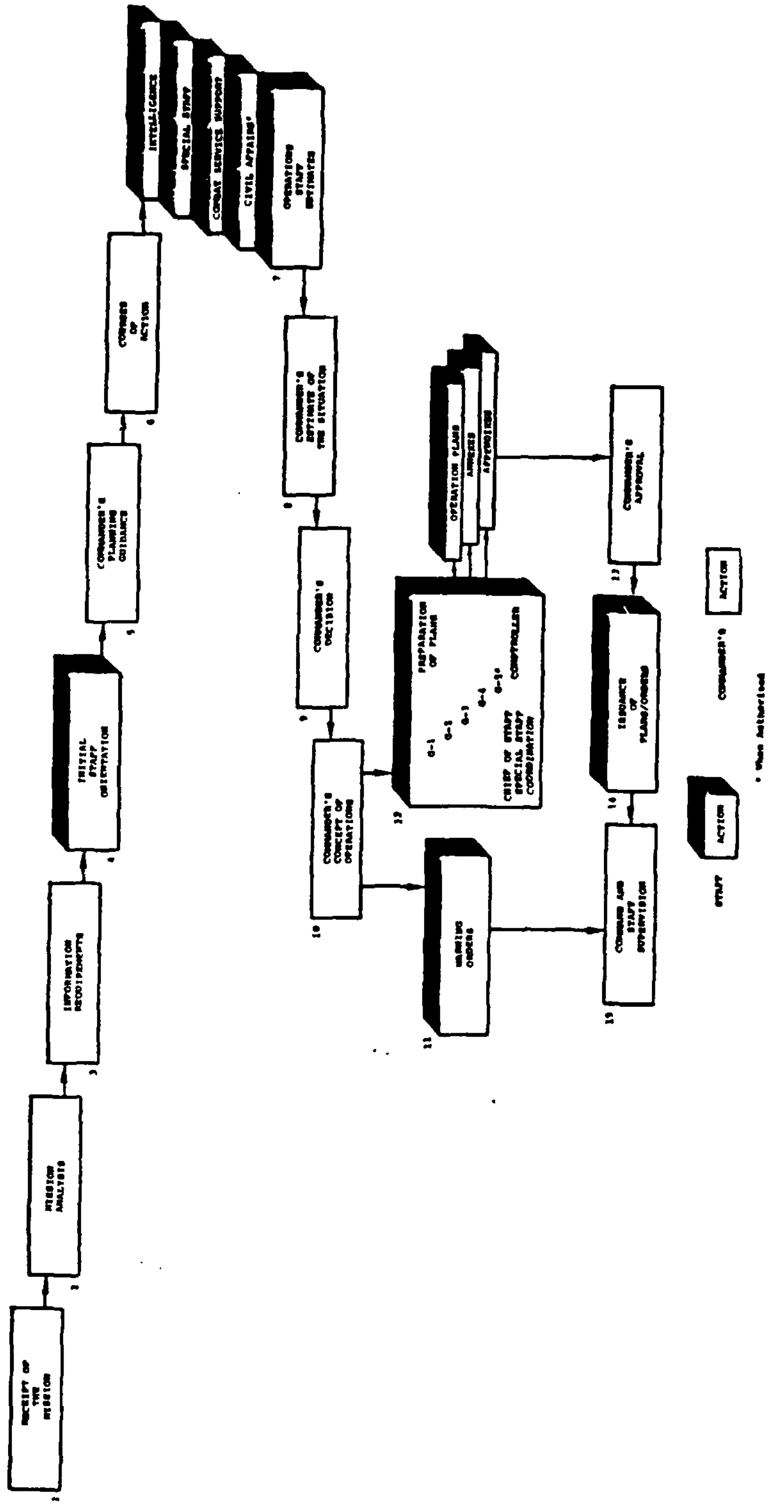

Figure 2-5. Marine Corps Command and Staff Sequence of Action

begin their planning process (step 11). The operation plan and order are developed and given to the commander for his approval (step 12). When approved (step 13), the plans/orders are issued to the executing units (step 14). The supervision of the execution of the orders is continuous (step 15). [Ref. 12]

As noted in much of the literature, supervision and control are very important and occur in this process at two levels--at the planning level by the commander over his staff and by the commander and his staff over their subordinate units. This provides the necessary feedback to the commander in order to properly command and control his assigned forces.

The concept of the Hall Activity Matrix is appropriate to analyze the complex and dynamic problems of planning. The information and interrelationships in planning are complex and that is precisely the reason that a logical approach with an audit trail should be used in the course of planning. The Marine Corps has five distinct activities which make up an amphibious assault: planning, embarkation, rehearsal, movement and assault. The first five phases of the Hall Activity Matrix can be described as or equated to Marine Corps planning phases of amphibious assaults. Phases 6 and 7 of the matrix can be described as the Marine Corps execution phase of the amphibious assault.

C. SYSTEM ELEMENTS

The purpose of using the systems approach is to provide a comprehensive framework for the planner in the area of complex problems. This particular framework forces the planner to consider all the possible combinations of the elements as they are reasonably related to each other. The utility of this process is directly related to the degree of understanding of the process by the user. The major results of this analysis are that the command and staff resources are determined; the needs, alterables, and major constraints are identified; and the interactions among the relevant elements are described. Unique relationships are also made visible in the matrices.

The following is an example of the steps of the Hall Activity Matrix as applied to the communication planning problem. The elements previously defined are listed below for the planning phase of the matrix (these are the opinions of the author):

COMMAND AND STAFF RESOURCES:

1. Commander (CMDR)
2. Executive Officer (EXEC)
3. Administrative Officer (ADMIN)
4. Intelligence Officer (INTEL)
5. Operations Officer (OPS)
6. Logistics Officer (LOG)

7. Communication Electronics Officer (CEO)

8. Subordinate unit commanders and staffs (SUB HQ)

9. Higher headquarters and staff (HHQ)

It is important to note that each of the general staff officers have several subordinate officers within their section (for example: OPS--fire support coordination officer, air officer, naval gunfire officer, artillery officer, plans officer, air defense officer) who also play a part in this process. These officers are also located at the subordinate organization and higher headquarters organization. Again, this is equivalent to the societal sectors from Warfield.

NEEDS:

1. To reduce time required for planning.

2. To reduce time to prepare communication estimate (LOS information).

3. To reduce time to request frequencies.

4. To reduce time to prepare the communication plan.

5. To reduce confusion working with amphibious counterparts (Navy).

6. To reduce the unstructured (almost metaphysical) approach to communication planning.

CONSTRAINTS:

1. Equipment available (IBM compatible computer).

2. High frequency (HF) propagation prediction models.

3. Time required versus time available for other planning methods.

4. Money (temporary additional duty--TAD type).

ALTERABLES:

1. Number of people available to do work.
2. User's interface with HF models.
3. Other prediction models.

OBJECTIVES:

1. To accurately and quickly determine LOS paths.
2. To request usable HF frequencies.
3. To assign HF frequencies to nets properly.
4. To produce a ship's coordination matrix.
5. To produce a usable communication electronics operating instruction (CEOI).

OBJECTIVES MEASURES:

1. Time to determine LOS (hours).
2. Time that HF nets are operational (hours).
3. Correlation of frequency request and assignment with chirpsounder information (percent).
4. Time to produce ships coordination matrix and time saved as a result of it.
5. Time to produce CEOI and is it usable (hours and yes or no).

ACTIVITIES:

1. List all items to be accomplished by the communication officer.
2. Determine which items are best automated.
3. Determine which items the human is best suited to accomplish.
4. Determine logical communication planning sequence.

ACTIVITIES MEASURES:

1. Percent complete activity 1.
2. Percent complete activity 2.
3. Percent complete activity 3.
4. Percent complete activity 4.

AGENCIES:

1. Naval Postgraduate School.
2. Naval Ocean Systems Center.
3. Marine Corps Research Development and Acquisition Command (MCRDAC).
4. Test site I (I Marine Expeditionary Force (I MEF)).
5. Test site II (II Marine Expeditionary Force (II MEF)).

The legend to use for the linkage interactions (see the following figures) is simple: H for high interaction, M for medium interaction, and L for low interaction. A binary legend (yes/1 or no/0) could also be used, if desired, which assists in some mathematical manipulations of the matrices.

D. SYSTEM INTERRELATIONSHIPS

The following is an example of the steps of the first phase of the Hall Activity Matrix. Because of the complexity and the need to be able to depict a high number of relationships, a graphic approach is used. This methodology is a screening process and may not be right or wrong but it is a useful expedient. In many cases we measure with a micrometer and then cut with an axe so we must keep a proper perspective.

1. **Problem Definition**

The problem as originally stated is now analyzed in much more detail. See Figure 2-6. The use of the cross and self interaction matrices assist the user in redefining and rescoping the original problem. Reducing time for planning is a need for more than just the communication staff--all staff sections are in need of the same time savings. The time savings for the communication estimate has a high interaction with the operations officer and the subordinate headquarters. The most difficult portion of the communication estimate is the LOS determination and it is interesting to note that five of the eight command and staff resources have a high interest in this area. The intelligence officer is concerned because it helps to identify avenues of approach by the enemy. The operations officer is interested because it identifies possible avenues of attack available to him. Within the operations section, the fire support coordination officer is concerned because locations of the artillery firing batteries can be identified where the battery can fire from defilade positions. Additionally, the air officer can quickly determine if radar coverage is adequate and if proper terrain masking is available for close air support. The sooner the

	CMD/STAFF RESOURCES								NEEDS						CON- STRAINTS				ALTER- ABLES		
	2	3	4	5	6	7	8	9	1	2	3	4	5	6	1	2	3	4	1	2	3
CMD/STAFF RESOURCES																					
1. CMDR	H	H	H	H	H	H	H	H	H	L	L	M	H	L	M	L	L	M	M	L	L
2. EXEC		H	M	M	H	H	M	M	H	M	L	L	M	L	M	L	L	M	M	L	L
3. ADMIN			L	L	M	M	L	L	H	L	L	L	L	L	L	L	L	H	M	L	L
4. INTEL				H	H	H	H	H	H	M	M	M	M	L	L	L	L	L	L	L	L
5. OPS					H	H	H	H	H	H	L	H	H	L	L	L	L	M	L	L	L
6. LOG						H	H	H	H	L	L	L	M	L	H	L	L	M	L	L	L
7. CEO							H	H	H	H	H	H	H	H	M	H	H	M	M	H	H
8. SUB HQ								L	H	H	L	H	H	M	L	M	H	L	L	M	M
9. HHQ									H	M	M	M	L	L	M	L	L	M	M	L	L
NEEDS (REDUCE)																					
1. PLANNING TIME										H	H	H	H	H	H	H	H	M	H	H	H
2. COMM ESTIMATE TIME											H	H	H	H	H	M	M	L	H	M	M
3. FREQ REQ TIME												H	M	H	H	H	H	L	H	H	H
4. ANNEX K PREP TIME													M	M	M	M	M	L	M	M	M
5. CONFUSION														M	M	M	M	L	M	L	L
6. METAPHYSICAL APPROACH															H	H	M	L	M	H	M
CONSTRAINTS																					
1. EQUIPMENT																H	H	L	H	H	H
2. HF PREDICTION MODELS																	H	L	H	H	H
3. TIME AVAILABLE (6 HOURS)																		L	H	H	H
4. MONEY																			H	L	L
ALTERABLES																					
1. NUMBER OF PEOPLE																				H	H
2. USERS SOFTWARE INTERFACE																					H
3. OTHER MODELS																					

Legend
H high interaction
M medium interaction
L low interaction

Figure 2-6. Problem Definition

communication estimate is completed, the sooner the planning process can proceed and the course of action can be selected by the commander which allows the subordinate headquarters to commence with more detailed planning.

Although the original thoughts were to help the communication officer reduce time in preparing the communication estimate and determining the LOS paths, it has become apparent that the need of the LOS determination is needed in many of the staff sections. The visibility of these relationships is enhanced by the use of the cross and self interaction matrices.

2. **Value System Design**

This analysis indicates that determining line of sight paths involves a large amount of time since it is currently done manually. The request for HF frequencies is also time consuming as is the proper assignment of those frequencies to nets. Both of these items are repetitive processes. The ships coordination matrix is a new but simple way to reduce confusion between the ship's communication personnel and the embarked Marine communication personnel. The communication electronics operating instruction (CEOI) is similar to a telephone book for the radio operators. This CEOI indicates which frequency a unit should be using for a particular net for a given day and time. For a Marine brigade-sized operation, over 325 frequencies could be used on any given day. The equipment constraint has a strong interaction with the objectives, and that is due to the problem of the time delay of procurement of new equipment. Currently the acquisition process takes approximately 12 to 15 years from concept to fielding. The constraint of time available (number 3) is relatively new, but it is the goal of the Commandant of the United States Marine Corps to be able to execute an operation quickly within 6 hours of receipt of the mission [Ref. 1] [Ref. 13]. There are only six high interactions between the objectives and the objective measures: LOS and time, requesting HF frequencies and assigning them properly, producing the ships matrix, and time to produce the CEOI. See Figure 2-7 for the interrelationships.

3. System Synthesis

The system synthesis consists of developing alternatives for attaining each of the objectives. The alternatives appear to be a function of money, people, equipment, and level of automation (fully automated or manual) either separately or in some combination. Determining "what to do" appears to be more important than determining the sequence. The test sites are very interested in what is defined as "to do". If more people are required to perform the job, they must be paid the temporary additional duty (TAD) costs. More equipment does not cost

	OBJECTIVES					OBJECTIVES MEASURES				
	1	2	3	4	5	1	2	3	4	5
NEEDS (REDUCE)										
1. PLANNING TIME	H	H	H	H	H	H	L	M	M	H
2. COMM ESTIMATE TIME	H	L	L	L	L	H	L	L	L	L
3. HF FREQ REQ TIME	L	H	L	L	L	L	L	L	L	L
4. ANNEX K PREP TIME	L	L	L	L	L	L	L	L	L	H
5. CONFUSION	L	L	L	H	M	L	L	L	H	L
6. METAPHYSICAL APPROACH	H	H	H	H	H	H	H	H	H	H
CONSTRAINTS										
1. EQUIPMENT	H	H	H	M	H	H	M	M	M	H
2. HF PREDICTION MODELS	L	H	H	L	M	L	H	H	L	M
3. TIME AVAILABLE (6 HOURS)	H	H	H	H	H	H	L	L	H	H
4. MONEY	L	L	L	L	L	L	L	L	L	L
ALTERABLES										
1. NUMBER OF PEOPLE	H	M	M	H	H	H	L	L	L	H
2. USERS SOFTWARE INTERFACE	H	H	H	H	H	H	L	L	H	H
3. OTHER MODELS	M	M	M	M	H	H	L	L	L	H
OBJECTIVES										
1. DETERMINE LOS PATHS		M	L	L	L	H	L	L	L	L
2. REQUEST USABLE HF FREQS			H	L	M	L	H	M	L	L
3. ASSIGN HF FREQS PROPERLY				L	H	L	H	H	L	M
4. PRODUCE SHIPS MATRIX					L	L	L	L	H	L
5. PRODUCE CEOI						L	L	L	L	H
OBJECTIVES MEASURES										
1. TIME TO DETERMINE LOS							L	L	L	L
2. % TIME HF NETS WERE OPERATIONAL								H	L	L
3. CORRELATION OF FREQS WITH TRQ-35									L	L
4. LEVEL OF COORDINATION										L
5. TIME TO PRODUCE CEOI										

Legend
H high interaction
M medium interaction
L low interaction

Figure 2-7. Value System Design

the unit money directly but it does take time to procure the new equipment (many years--sometimes up to 15). See Figure 2-8. There certainly should be enough people to operate and maintain whatever equipment the unit possesses. If the system is manual, there should be more people. If the system is automated, there may not be an increase in people but there should be a high interaction of the people with the system and appropriate training. Even if there is an automated system, manual expertise must be maintained. What if power were lost or there was an electromagnetic-magnetic pulse (EMP) nuclear burst? In either case, the automated system would no longer work but the planner must continue the planning process. Essentially the alternatives are: (a) more people, (b) more automation, or (c) some combination of more people and more automation.

4. Systems Analysis

The system analysis consists of determining the consequences of the alternatives. The allocation of functions must consider what people will do (characteristic performance) not what they can do (capability). The decision should involve the level and nature of the semiautomation that is appropriate for this system. The dynamics of the man-machine interface can be optimized so that the new system will meet the specified program requirements.

	ACTI-VITIES				ACTIVITY MEASURES				AGENCIES				
	1	2	3	4	1	2	3	4	1	2	3	4	5
CONSTRAINTS													
1. EQUIPMENT	L	M	L	L									
2. HF PREDICTION MODELS	M	H	L	L									
3. TIME AVAILABLE (6 HOURS)	H	H	H	H									
4. MONEY	L	L	L	L									
ALTERABLES													
1. NUMBER OF PEOPLE	M	M	H	M									
2. USERS SOFTWARE INTERFACE	M	H	M	M									
3. OTHER MODELS	L	M	M	M									
OBJECTIVES													
1. DETERMINE LOS PATHS	H	H	H	M					M	H	M	H	H
2. REQUEST USABLE HF FREQS	H	H	H	M					M	H	H	H	H
3. ASSIGN HF FREQS PROPERLY	H	H	H	M					M	H	H	H	H
4. PRODUCE SHIPS MATRIX	H	M	H	M					L	L	M	H	H
5. PRODUCE CEOI	H	H	H	M					L	M	H	H	H
OBJECTIVES MEASURES													
1. TIME TO DETERMINE LOS					L	L	L	L					
2. % TIME HF NETS WERE UP					L	L	L	L					
3. FREQS MATCH WITH TRQ-35					L	L	L	L					
4. LEVEL OF COORDINATION					L	L	L	L					
5. TIME TO PRODUCE CEOI					L	L	L	L					
ACTIVITIES													
1. LIST COMMO OFFICER DUTIES		H	H	M	H	M	M	M	L	L	M	L	L
2. LIST COMPUTER ITEMS			H	H	M	H	M	M	L	L	L	L	L
3. LIST HUMAN ITEMS				L	M	M	H	M	L	L	L	L	L
4. DETERMINE SEQUENCE					L	L	L	H	L	L	M	M	M
ACTIVITIES MEASURES													
1. PERCENT COMPLETE						H	H	M					
2. PERCENT COMPLETE							H	M					
3. PERCENT COMPLETE								M					
4. PERCENT COMPLETE													
AGENCIES													
1. NAVAL POSTGRADUATE SCHOOL										M	L	L	L
2. NAVAL OCEAN SYSTEMS CENTER											H	L	L
3. MCRDAC QUANTICO												M	M
4. II MEF TEST SITE													M
5. I MEF TEST SITE													

Legend
H high interaction
M medium interaction
L low interaction

Figure 2-8. System Synthesis

The human has a high tolerance for ambiguity, uncertainty, and vagueness which are all factors in the initial phases of military planning. The human has excellent long term memory for related events and can become highly flexible in his task performance. Additionally, the human can improvise and exercise judgment on the basis of long term memory and recall. Most important, the human complements the machine; that is, he can sense, extrapolate, set goals, monitor, evaluate and make decisions. The essential ingredients in any system are not the things but the decision makers [Ref. 14].

The machine (or computer) cannot do all these things but it can perform calculations at a much faster sustained rate than man. The machine is well suited to the transformation of data and has as much short term memory as can be afforded. The machine performance is not degraded by illness, long duty periods or by performing the same type task many, many times. There are complementary attributes available to the planner.

5. OPTIMIZATION/COMPARISON OF ALTERNATIVES

The three alternatives are fairly easy to compare and rank. The least desirable solution is to develop and procure more equipment. This is costly in terms of money and time. The next solution is to get more people and use them in mass to reduce the time for planning of communications. This is not a reasonable solution because of the costs involved for temporary additional duty orders or for permanent personnel. The optimum solution appears to be to design some interface between the computer and man in order to make more efficient uses of both. The gap between technology and the application of technology is an underlying problem in the manner in which complex problems are solved in this country.

6. **Decision Making**

It appears obvious that the computer could easily be utilized by the communicator to reduce planning time. Many tasks are repetitious and require accuracy, exactly the type of functions which are best suited for the computer. The problem solution consists of designing software which is user friendly and interfaces with the other appropriate software models to quickly and accurately perform some of the tasks of the communication planner. This software design solution is within the scope of projects which can be accomplished in relatively short periods of time.

This is similar to designing an "expert system" which is really a problem solving tool with a domain expert and a knowledge expert. The domain expert is the person who has the requisite knowledge to state the requirements for an expert system. The knowledge expert is the person who knows how to put that knowledge into the computer. Together they can implement an expert system [Ref. 15]. Software development can be divided into five areas: planning, designing, implementing, testing and debugging [Ref. 16]. These areas are similar to the phases of the Hall Activity Matrix.

7. Planning For Action To Implement Next Phase

This step of the program is used to schedule the level of effort, allocate resources, and design a feedback system for controlling the ensuing action. The elements would be re-examined, re-identified, and reprocessed through the maze of matrices at the next phase which is project planning. In this case, the future project will consist of designing and producing the software to perform several of the tasks which are currently done manually by the communicator and his staff.

E. SUMMARY AND RECOMMENDATIONS

The use of the Hall Activity Matrix and the program planning linkages designed by Hill and Warfield have structured and organized the thought process and increased the visibility of several of the unique relationships of the ingredients of this problem. A complex problem was stated, examined, and redefined. Several alternate solutions have been proposed. The audit trail of this process has been established and explains why certain approaches were followed.

Briefly, the problem was to reduce time to plan without increases in cost while maintaining accuracy. The alternatives consist of some combination of man, machine/equipment, and money. And the solution appears to be the design of software to assist man in reducing planning time without loss of accuracy. The advantages of using the computer in the planning process are obvious.

The use of the systems approach has assisted in defining and understanding a complex problem and guiding the user to possible solutions. This systems approach has not magically produced the optimum answer because it is not designed to do that. It does, however, assist the user in the detailed understanding of the problem which allows a solution to be fitted to the problem rather than developing a solution which does not quite fit the problem.

III. COMMUNICATIONS REQUIREMENTS ANALYSIS

A. INTRODUCTION

1. General

The following are the three essential parts of the communication planning process which can improve the opportunity for successful communications which in turn can improve the command and control of the overall exercise:

1. Determine Requirements (communications/operations)
2. Request the Optimum Resources
3. Optimize the Assigned Resources

(Resources are essentially made up of frequencies, equipment, site locations, etc.)

The information in this chapter is the foundation from which the "automated computer system" should be built. The analyst responsible for developing the system would normally interview the "customers" or users in addition to reviewing this information. The information contained here is from an internal, or user's, viewpoint and may be different from that obtained by someone outside performing a separate study as was conducted in 1986 and reported in 1987 [Ref. 17].

The general requirements for the communications planner are:

1. To determine the communication need lines;

2. To determine the line of sight (LOS) paths and the beyond line of sight (BLOS) paths;

3. To determine if the units possess adequate communication equipment to satisfy the needs (LOS and BLOS);

4. To complete the communication estimate;

5. To request frequencies for optimum communications;

6. To complete the ships coordination matrix for amphibious operations;

7. To complete Annex K of the operation plan/order and the CEOI;

8. To accomplish the above in a very short period of time.

2. Types of Communication

There are two basic types of communication systems: line of sight (LOS) and beyond line of sight (BLOS) . LOS systems require that the receiver can "see" the transmitter in a straight line while BLOS cannot "see" in a straight line and requires some sort of relay system. The LOS systems normally operate above 30 megahertz (MHz) while the BLOS communication systems normally operate below the 30 MHz range of the frequency spectrum. In particular, HF systems operate in the 3 - 30 MHz range and the radio waves can be reflected and/or refracted by the different layers of the ionosphere [Ref. 18]. BLOS communications or in this case HF communications offer advantages that are frequently overlooked: coverage of distances up to several thousand kilometers, reliability of 99%, and survivability of the transmission media (the ionosphere and the surface of the earth). These advantages are often overlooked when a LOS system is compared to a BLOS system because the LOS system advantages are significantly greater than the BLOS system in the areas of bandwidth and baud rate.

The ionosphere is a dynamic system and changes throughout a 24 hour period which results in different frequencies being relayed at different times of the day for a communication link. The changes are cyclical and vary with the time of day, season, sunspot cycle and other parameters [Ref. 18].

There are limitations to any system and HF communications are no exception. The frequencies are a limited resource in high demand and must be properly managed for effective utilization. Units cannot simply request a "bunch" of frequencies spread evenly throughout the band and hope they can later communicate. The tools are available to ask for the specific frequencies needed in order to maintain reliable communications. The responsibility for requesting the proper frequencies lies with the using unit communicator and not the agency ultimately providing the frequency.

3. HF Frequency Prediction Tools

Since long distance HF communications depend on the ability of the ionosphere to return signals back to earth, it is essential that methods be available to predict what frequencies will provide reliable and continuous communications. Several methods are available, and these range from a manual system (charts and tables) to a fully automated computer system. Current prediction models depend on a data base of ionospheric observations. Naval Telecommunications Publication 6 (NTP-6), "Recommended Frequency Bands and Frequency Guide", and its quarterly supplements provide the operator with basic information about frequency selection as well as frequency tables containing the lowest usable frequency (LUF), maximum usable frequency (MUF), and the frequency of optimum transmission (FOT). A supplement is issued to cover areas of responsibility for each of the four Naval Communications Area Master Stations (NAVCAMS). The Electromagnetic Compatibility Analysis Center (ECAC) provides HF frequency predictions to requesting units [Ref. 19]. Naval Ocean Systems Center (NOSC) developed a computer program called PROPHET which runs on IBM compatible personal computers and provides frequency predictions [Ref. 20]. IONCAP is another computer program which provides frequency predictions. Each of these tools can predict frequencies with a mean error of approximately 4 MHz [Ref. 21].

B. DETERMINE COMMUNICATION REQUIREMENTS AND SUPPORTABILITY

1. Communication Planning Cycle

This portion of the procedure is basic to any planning methodology and must be accomplished as early and as accurately as possible. The purpose of this portion of the planning process is to determine if the concept of operations can be supported by communications and then recording that information in some detail in the communication estimate. This portion will assist the planner in determining if the communication requirements will be satisfied by the organic equipment of the assigned units. If there is not enough equipment of different types (HF, VHF), then more equipment (and Marines to operate and maintain it and logistics support for them) must be requested or the concept of operations must be modified. The locations of units and agencies and their communication requirements are critical to a successful planning phase.

The planning cycle that supported a 1987 NATO exercise will be used to describe and illustrate how to implement the procedures which can be applied to any planning cycle. The exercise was conducted in Norway 267 kilometers (160 miles) north of the Arctic Circle and involved a United States Marine Corps (USMC) Marine Air Ground Task Force (MAGTF) at the brigade level.

The planning cycle for this NATO exercise started almost one year prior to the exercise date. The exercise employed a Marine Expeditionary Brigade (MEB) reinforced by one Norwegian army battalion, Norwegian home guard units, and one British infantry battalion. At the initial exercise planning conference, guidelines were established for the conduct of the exercise. The area of operations was defined and the broad concept of operations was discussed. From this conference and later discussions with the operations and the logistics officers, the following information was collected. The MAGTF command element (CE) would probably be located near the airfield in Evenes. The ground combat element (GCE) would be located either at the bridge in Tjelsund or at the southern edge of the city of Harstad. The aviation combat element (ACE) would probably have units located on the island of Andoya (radar units) and the airfields at Evenes and/or Bodo (TACC or TAOC). The combat service support element (CSSE) would pro. ably be located in the vicinity of the airfield at Evenes. The battalions on the ground might be located at any of the following grid locations from the Norge Norway 1:50,000 TJELDSUNDET map series M711 sheet 1332 sections II, III, IV and sheet 1331 section IV :

a. 630270 b. 625201

c. 530225 d. 521066

e. 625055	f. 725197
g. 832994	h. 695985

For this example a deception link will be established between Narvik and Naval Communications Station (NAVCOMMSTA) Rota Spain. The summary of locations is as follows:

1. Andoya	2. Bodo	3. Bridge	4. Evenes
5. Harstad	6. Thurso	7. Narvik	8. Rota
9. 630270	10. 625201	11. 530225	12. 521066
13. 625055	14. 725197	15. 832994	16. 695985

2. Communication Need Lines

We now examine all the possible communication need lines by using a self interaction matrix (see Figure 3-1). At each intersection two questions are asked: is there a need for communications between these locations, and if yes, is it within LOS (approximately 15 kilometers in North Norway)? This approach allows the communication planner to check every possible combination of locations for the need lines and also determine if the link is LOS or BLOS. The program should ask: do any units at location 1 (name, latitude, longitude and list units at location 1) have a need to communicate with units at location 2 (name, latitude, longitude and list units at location 2)? The program should also ask for BLOS communication needs for more than 2 locations. In this example there were no requirements of this nature (referred to as netting).

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	X		X												
2		X	X												
3			X	X											
4				X	X			X	X	X	X	X	X	X	X
5															
6															
7							X								
8															
9									X					X	X
10										X	X				X
11											X	X			
12												X	X		
13													X	X	
14														X	X
15															X

Figure 3-1. Communication Need Lines

Here is the thought process used when filling in the matrix. If there were Marines with radars located on Andoya, they would need to talk with the ACE at either Bodo or Evenes. The direct air support center (DASC) and fire support coordination center (FSCC) could be located at the GCE near the bridge or at Evenes and those Marines would need to talk with the ACE at Bodo or Evenes. A Norwegian battalion may be located near Harstad and need to talk with the DASC at the bridge or at Evenes. The battalions would need to talk to the two adjacent battalions on each side of their location. The MAGTF headquarters will also require a link to a NAVCOMMSTA as a backup entry to the common user digital information exchange (CUDIX) satellite special user [Ref. 4]. The planner should not necessarily rely only on the NAVCOMMSTA's for their entry into the Defense Communication System (DCS). There may be times when those entry points are not available. The planner should identify and plan for other DCS entry points or relay points to enter the DCS.

These are not the final locations but by considering each of the possible combinations the communication planner has provided for all cases (the worst and the best). It is important to note that requirements are based on locations and not particular units although the units are a vital part of the functionality.

3. Link Analysis

This portion of the planning phase can be accomplished in a variety of ways by using the prediction tools previously presented. The tools may be used to perform a link analysis on each of the communication need lines as indicated in Figure 3-1. Since PROPHET has been selected by the Chief of Naval Operations as the Navy model standard, it was used to perform the analysis [Ref. 22]. From a time consuming manual map analysis, all the links are line of sight except those listed in Figure 3-2. The information in each of the blocks in Figure 3-2 lets the user know if there is a requirement (yes or no) and if yes, the distance involved and the link number which is sequentially assigned. From coordination with the subordinate units, adequate/sufficient equipment is available to satisfy those LOS link requirements. (This is an educated decision that the planner must make after consulting with the unit responsible to execute the communication plan. This computer software is designed to augment and not replace the planner.)

C. REQUEST THE OPTIMUM FREQUENCIES

1. General

The number of line of sight frequencies is directly related to the number of line of sight nets plus a number of frequencies to be available as spares. In other words, if there were 250 LOS nets, the number of frequencies to request would be 250 plus spares.

The process for the beyond line of sight portion is more involved. The planner now uses PROPHET on the unit Zenith - 248 (Z-248) computer to predict the frequencies for 24 hour communications by running the diurnal (DI) routine on

	BODO	BRIDGE	EVENES	HARSTAD	THURSO	NARVIK	ROTA
ANDOYA	YES 238 KM LINK 1	NO	YES 101 KM LINK 2	NO	NO	NO	NO
BODO		YES 163 KM LINK 3	YES 156 KM LINK 4	NO	NO	NO	NO
BRIDGE			YES 11 KM LINK 5	YES 12 KM LINK 6	NO	NO	NO
EVENES				YES 21 KM LINK 7	YES 1555 KM LINK 8	NO	NO
HARSTAD					NO	NO	NO
THURSO						NO	NO
NARVIK							YES 2678 KM LINK 9

Figure 3-2. BLOS Communication Need Lines

each of the links [Ref. 20]. The output of the diurnal will list the lowest usable frequency (LUF), the frequency of optimum transmission (FOT), and the maximum usable frequency (MUF) for a 24 hour period (one set of frequencies per hour). Before running the diurnal routine, each of the site characteristics must be loaded as required by the program. The site characteristics include the latitude and longitude of the site (which may be determined by using a military map or using the gazetteer), the radio equipment characteristics (power out and emission type), the antenna, and sunspot number. Run the DI for the dates of the exercise and be accurate when entering the sunspot number. It is very important to be as precise as possible when determining the latitude and longitude of the site because this is the basis for the diurnal routine. See Appendix A for the PROPHET diurnal printout.

2. **Frequency Request**

The beyond line of sight portion of the frequency request is a summary of the information which was previously collected. The FOT is the most important frequency from the diurnal output at this point and will be used to build the frequency request. The planner now uses the cross interaction matrix shown in Figure 3-3 to summarize the FOT's for all the different links and continues to update information on unit locations and make appropriate changes.

LINK / FREQ	L1	L2	L3	L4	L5	L6	L7	L8	L9	SUB TOTAL
K2350 - 2525				4	6		6			16
K2610 - 2800				3	2		2			7
K3250 - 3450					1		1			2
K3500 - 3700				2	2		1			5
K3775 - 3825							2			2
K3950 - 4075				2	2		2			6
K4175 - 4225				3						3
K4350 - 4450					2		2			4
K4525 - 4650				2	3		2		2	9
K4700 - 4900				2	1		2	2	2	9
K4950 - 5150				2	3		3	4	4	16
K5175 - 5275				2	2		1			5
K5390 - 5425				2						2
K6095 - 7025								2	2	4
K7150 - 7250								2	2	4
K9000 - 11115								14	12	26
subtotals	0	0	0	24	24	0	24	24	24	
									TOTAL	120

Figure 3-3. Summary of HF Frequencies Required

For example, as the frequency request was being constructed, the decision was made that the DASC would be located at Evenes and nothing would be located on Andoya which allowed the deletion of the requirement for links 1, 2, 3, and 6. The interval of frequencies in Figure 3-3 was determined by eliminating the frequencies which are used specifically by the Norwegian government (the host nation). (These are known as the frequencies not available.) This completed chart optimum communications--those HF frequencies that theoretically provide the best opportunity for success with the link. The number of frequencies requested equals the number of links used times 24 (in this case 5 X 24 = 120).

The next step for the planner is requesting the HF frequencies listed in Figure 3-3 as well as the other frequencies required for the operation (VHF, UHF, SHF, radar, etc.) using the appropriate frequency request format. (The frequency requirements that are not HF are reasonably standard based on the size of the units involved--MEU, MEB or MEF). In this case the format was the United States European Command (USEUCOM) 14 Point format and the request was required no later than six months prior to the date that the frequencies are needed. In addition to the processing time required by USEUCOM for host nation coordination, the planner must include the processing time needed to confirm frequency assignments, and construct, reproduce, and distribute the communication electronics operating instruction (CEOI). This adds another two months to the lead time requirements. The MEB request was transmitted in June 1986 and the Norwegians had satisfied that request in January 1987 with 113 of the 120 requested HF frequencies almost exactly as requested (94 %), and the line of sight frequencies assigned were adequate to meet the requirements.

D. OPTIMIZE THE ASSIGNED FREQUENCIES

1. Communication Need Lines Review

This phase of the procedure has three distinct steps and should commence three months prior to the actual exercise. The first step is time consuming but critical to success. The communication planner must review and update all the information which was collected in the first phase of this procedure. The planner must make appropriate changes to the site characteristics and delete any sites which are no longer required. In this case link 7 was deleted due to operational decisions and the LOS requirements had not changed. Now the planner assigns radio net names to the appropriate HF links and assigns a restoration priority to each of the radio nets and indicates what crypto will be used on that net. (The planner also lists all the VHF and UHF net information, as well, using the format required by the LOS program.) This information is reflected in Figure 3-4. The descriptions for the nets are located in FMFM 10-1, "Communications" [Ref. 4]. Perform another diurnal routine in order to confirm/update the information on frequencies required for each link. From this updated diurnal output, the planner should select several HF frequencies which will provide continuous communications for each link. Six frequencies were selected because the newer radios can store up to six frequencies and select the best propagating

Link	Site A/B	Net Name	Restoration Priority	Crypto
1	Andoya/ Bodo	deleted		
2	Andoya/ Evenes	deleted		
3	Bodo/ Bridge	deleted		
4	Bodo/ Evenes	MAG command	1 D	crypto A for all HF nets
		AA control	3 B	
		Comd Action	3 A	
		DAS	2 B	
		FSS	2 B	
		CI/D	3 A	
		AEW INT	3 A	
		TADIL A	1 A	
		Link Coord	1 A	
5	Bridge/ Evenes	TAR 1,2	2 B	
		MWSS CMD	2 C	
		RLT CMD	2 C	
		RECON CMD	2 A	
		LAAD CMD	2 C	
		MEB CMD	1 D	
		HD 4	3 C	
		SAR 3	1 A	
6	Bridge/ Harstad	DELETED		
7	Evenes/ Harstad	DELETED		
8	Evenes/ Thurso	FMF MOBILE CMD	1 B	
9	Narvik/ Rota	CMD DECEPTION	1 B	

Figure 3-4. HF Link/Net Listing

frequency at any given time without operator assistance which provides enhanced communication reliability for the users. [Ref. 23:p. 95]

2. Frequency Assignment

The next step starts when the frequency assignment message is received from the host nation. Check with other friendly units involved in the exercise to ensure that the frequencies you received have not been inadvertently assigned to them also. Use a program such as the Battlefield Electronic CEOI System (BECS) to make the daily changing LOS frequency assignments [Ref. 24] and follow the procedure below for BLOS nets.

For the beyond line of sight portion, the planner matches the assigned HF frequencies from the host nation to the HF radio nets required for the operation/exercise in order of net priority (1A having the highest priority and 1B having the next highest priority). The priorities are assigned jointly by the communication planner and the staff officer who requested the net. Make another chart with six columns labeled frequency, link, net name, time, antenna and remarks (see Figure 3-5). Place the frequencies assigned from the host nation in ascending order and starting with the highest priority net find assigned frequencies which most closely match one of the six previously identified frequencies to provide 24 hour communications. When a

Assigned Frequency	Link	Net	Time	Antenna
2366	5	MWSS CMD	19 - 05	
2370	SPARE			
2400	5	MEB CMD	19 - 05	
2482	5	RECON CMD	19 - 05	NVIS
....				
....				
5395	4	MAG CMD	05 - 15	
5400	4	DAS	05 - 15	
5415	SPARE			
5422	4	TADIL A	05 - 15	

Figure 3-5. Frequency Assignment Table

frequency is found and the signal-to-noise ratio exceeds that required by the equipment to properly operate, the planner fills in this chart in order to prevent that frequency from being used again. Use the PROPHET routine field strength (FS) to determine what general time of day to use the frequencies for the nets. See Appendix A for sample field strength printout. To further refine the projections, perform the routine raytrace (RA). When performing the RA, start with the minimums (20 watts of power and the worst antenna) in order to examine the worst case scenario. Continue this procedure until each net has frequencies assigned for the 24 hour period. The frequencies that are not used become spares or are returned to the host nation.

3. Disseminate Information

The last step is action that must be taken during the final phase of the planning step to benefit from the communication planning cycle. The information concerning the type of antenna and time of day to use it must be disseminated to the operators to make the best use of the assigned frequency. The operators should be reminded that the best efficiency is attained when the antenna length matches the wavelength of the frequency even if it means making a field expedient antenna. A center fed dipole antenna cut to the proper length normally increases signal strength by 10 decibels over the whip antenna. The operators should install the antenna in a manner such that the radiation lobe is radiating in the correct direction. They should also make antennas for each of the different frequencies assigned for each radio net and use the proper antenna when frequencies change. This information should be disseminated by the planner even though it is actually part of the execution phase.

E. SHIPS MATRIX

During amphibious operations, there are also requirements for the embarked Marines to communicate during the afloat phase of the operation. The afloat phase includes the time the landing forces embark the ships until the assault phase begins (includes rehearsal and movement). Limited radio resources exist aboard the amphibious ships and proper coordination must be implemented to reduce confusion and make maximum use of these resources. The ships matrix is also a new concept and has assisted in improving coordination with the communication personnel of the ships and the embarked landing forces. Essentially it is a summary of requirements by ship and allows the ship's communication officer and embarked unit communication representative to determine if adequate radios and crypto equipment are available for the embarked landing force. If not, permission can be requested by the landing forces through the appropriate chain of command to provide additional equipment (usually called deck mounting). Deck mounting equipment requires additional planning due to electromagnetic interference (EMI) which is a hazard. Figure 3-6 depicts an example of a ships matrix.

F. SUMMARY/CONCLUSIONS

Improvements to communication planning can be made by employing computers at the using unit level to make more efficient use of the time available for the planning phase.

SHIPS/UNITS / RADIO/INFO Net Name	Type/Crypto	USS MT WHITNEY MEB HQ	USS INCHON RLT HQ MAG HQ	USS NEWPORT Co BLT A	USS RALIEGH BLT A(-) FAAO	USS SAIPAN BLT B MAG ELEMENTS	USS EL PASO BSSG HQ	USS NASHVILLE BLT C TANK BN
LF CMD 1	HF A	X	X				X	
LF CMD 2	VHF B	R	R				R	
LF TAC 1	VHF B	X	X				X	
LF TAC 2	HF A	R	R				R	
LF INTEL	VHF B	X	X				X	
LF FSC	VHF B	X	X				X	
NGF CONTROL	HF	X	X				X	
NGF SUPPORT	HF	X	X	X	X	X	R	
LF LOG	HF A	X	X	R	R	R	X	
MED REG 1	HF	X	X				X	
LF RECON	HF A	X	X				X	
RLT TAC	VHF B		X	X	X	X		X
RLT INTEL	VHF B		X	X	X	R		X
EW CNTRL	HF	X	R	R	R	R	R	R
TOTAL HF	X	7	6	1	1	1	5	0
HF	R	1	2	2	2	2	3	1
VHF	X	3	5	2	2	1	2	1
VHF	R	1	1	0	0	1	1	1

LEGEND
X Guard
R As Required
A Parkhill
B VINSON

Figure 3-6. Ships Requirements Matrix

Improvements to HF communications can be made today by employing the frequency prediction tools that are available and by being more precise in the request and assignment of the frequencies. The PROPHET prediction program can be employed to determine the optimum HF frequency for use by the armed forces while conducting military operations.

Each of the HF enhancement programs within the Department of Defense will still rely on the various frequencies to provide continuous end to end communications. The communication planner must make use of the unit computers and the available frequency prediction programs to improve HF communications.

IV. ARCHITECTURE DESIGN

A. INTRODUCTION

The purpose of the design phase of this architecture is to develop a blueprint for the programs and database and their applications. The applications should mirror the functions of the communication planner and the data flow diagram (DFD) can help depict those applications. From the DFD and interviews with the users, inputs and outputs can be determined as well as some screen designs. [Ref. 25:p. 110]

The first step is to determine if the applications should be menu driven, command driven or some combination of the two. This system will be mostly menu driven because the menus are largely self explanatory and somewhat easier to use than commands. Additionally the system will be a single user and single application on a micro computer and formal training for users will be limited. The disadvantage is that the menu approach may be somewhat slower than command processing but not a significant amount, especially for this application. The menu hierarchy will be object/action oriented vice action/object oriented because this is closer to the users perspective. It is normally easier for user's to "recognize" than it is to "recollect". [Ref. 25:p. 267]

The use of any special purpose keys (such as F1, F2, ESC) should be consistent and pervasive. Those keys should serve the same functions with different forms to reduce confusion, frustration, and aggravation by the users [Ref. 24:p. 277]. In this application, no special purpose keys will be used. However, this program should be consistent in the use of numbers in each menu: 1 for introduction/help and 0 for return or exit.

B. MENUS

The main menu will appear on the screen after the user has been processed through any security and access requirements and will have the following options:

1. Help/Forms/Setup
2. Introduction to Communication Planning
3. Line of sight (VHF, UHF, SHF, etc.)
4. Beyond Line Of Sight (HF)
5. Non-Military Communications
6. Miscellaneous
0. Quit

Each of these options will have sub-menus as indicated below.

1. Help/Forms/Setup
   - 1.1 Help/Introduction
   - 1.2 Forms

1.3 Setup Information

1.0 Return to previous menu

2. Introduction to Communication Planning

2.1 Help/Introduction

2.2 General Information

2.3 Communication Estimate Example

2.4 Annex K Example

2.5 Communication Checklist

2.6 Communication References

2.7 Equipment Interoperability

2.0 Return to previous menu

3. Line of sight (VHF, UHF, SHF, etc.)

3.1 Help/Introduction

3.2 Tutor

3.3 Single Point to Point Determination

3.4 Multiple Point to Point Determination

3.5 Computer Recommended Command Post Locations

3.6 Display Area Of Operations

3.7 Frequency Request

3.8 Frequency Assignment

3.0 Return to previous menu

4. Beyond Line Of Sight (HF)

4.1 Help/Introduction/Forms

4.2 Tutor

4.3 Frequency Request (BLOS)

4.4 HF Frequency to Net Assignments

4.0 Return to previous menu

5. Non-Military Communications

5.1 Help/Introduction

5.2 Leased Lines

5.3 Mobile Telephones

5.0 Return to previous menu

6. Miscellaneous

6.1 Help/Introduction

6.2 Ships Matrix

6.3 Communication Guide for the non Communicator

6.0 Return to previous menu

C. MENU FUNCTIONAL DESCRIPTIONS

Each of the menus will be described in terms of the inputs, the outputs, and the process.

1. Help/Forms/Setup Menu

When the user types in the numeral 1 from the main menu, the next menu to appear will be the Help/Forms/Setup menu. This portion of the architecture is essentially administrative in order to help the user install the program correctly, provide a brief introduction to the program, and contain some of the forms which are used within the program.

2. Introduction To Communication Planning Menu

When the user types in the numeral 2 from the main menu, the Introduction to Communication Planning menu appears. This portion is also essentially administrative in that it contains examples of documents with which the communication planner will frequently work. Examples of these items are contained in Appendix B. The general information section contains basic planning considerations with respect to time. The estimate example, the Annex K example and portions of the references are taken from the Marine Corps Fleet Marine Force Manual 10-1, "Communications" [Ref. 4]. The remainder of the references and the checklist were obtained from a MAGTF CE order [ref.26]. The equipment interoperability portion would be the program which is under development at the Joint Tactical Command, Control, and Communications Agency [Ref. 27].

3. Line of Sight Menu

This portion of the program would be designed to assist the communication planner in determining possible locations for command posts (CP's) in a general area designated by the operations officer. The important electronic item to remember when selecting CP sites is that the sites should be within line of sight of each other. This is supported by the fact that the vast majority of the radio equipment within the combat battalions is very high frequency (VHF) which successfully operates only in the line of sight mode. The selection of sites is complicated by the fact that the communication equipment can be remoted by a distance of

3.5 kilometers. Therefore, an area tentatively selected by the operations officer which has some high ground within 3.5 kilometers for radios/antennas which can be properly defended is a likely candidate for a command post.

The line of sight portion of the program should be able to determine if two points on the ground are within LOS distance and more importantly if those two points are actually line of sight electronically. This involves the use of the four thirds earth surface chart depicted in Figure 4-1 and a map of that area. The process is not complicated. The two points are plotted on the map and a straight line drawn between them. An appropriate scale is selected based on the distance between the two points, and the two points are then plotted on the chart. The elevation readings are determined from the map for the two end points and selected points between them and recorded on the four thirds chart. A line then connects the different elevations between the two points. A line is then drawn from point A to point B and if it does not intersect the other line (distance versus elevation), then it is a line of sight path and should work electronically.

The program should be able to read all required information from a data base and determine if there is a LOS path (output) for any two points (inputs) on the earth's surface. In addition, the program should be able to take

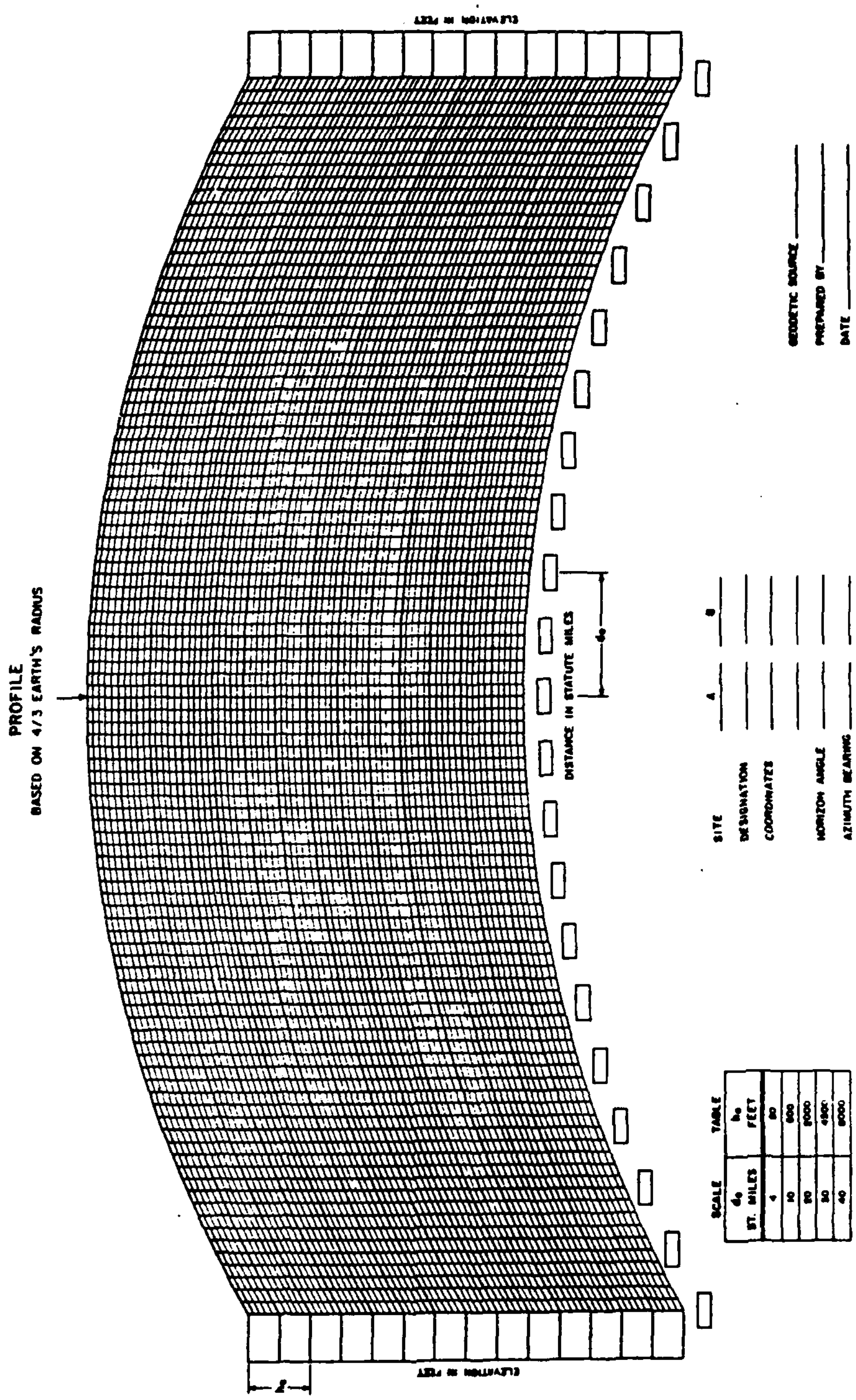

Figure 4-1. 4/3 Earths Plotting Chart

many possible locations and determine which ones provide the optimum LOS coverage. A more difficult task is to input only the boundaries of the operational area and have the computer recommend possible CP locations within 3.5 kilometers of sites which can be used for radio/antenna sites for both the friendly and enemy area of operations. This would assist in the determination of posssible enemy target locations. The computer is well suited for this type of application if the data base is available with appropriate information.

Another important feature is the ability to depict a three dimensional representation of the area of operations and have the capability to rotate it in any direction. This allows the other staff officers to view the area of operations and determine the same things that are currently determined from a map but with greater ease such as avenues of approach for the enemy, possible avenues of advance for friendly forces, routes which can mask friendly movements from the enemy, and water drainage locations.

This portion should also be able to depict RADAR plots similar to the ones which the Electromagnetic Capability Analysis Center (ECAC) currently produces.

This section of the program should also be capable of identifying the numbers of VHF, UHF, and SHF frequencies required for the operation by asking the user several questions and more importantly be capable of assigning daily changing frequencies to nets in order to construct a communication electronics operating instruction (CEOI) similar to the one which the BECS program produces. It is important to have this capability organic to the unit because there may be occasions, such as Grenada, when time to produce and distribute these documents may be severely limited and coordination is critical.

4. Beyond Line ,Of Sight Menu

This menu has two parts: a frequency request portion and a frequency to net assigment portion. These will be described separately in terms of the inputs, the process and the outputs. This program should be loaded to the hard disk of the user's computer system and be used in conjunction with the Prophet program.

a. Frequency Request Portion

INPUTS: Exercise information consists of the following as shown in Figure 4-2: exercise name, dates, anticipated line of sight distance, 10.7 solar radio flux, proposed locations and possible units. HF frequencies not available in the operating area are also inputs.

PROCESS: The process is essentially the need lines analysis discussed in Chapter III. The user is asked if the units at location A (list both the units and the location for site A) have a need to communicate with units at location B (list both the units and the locations). If the

____
classification

FREQUENCY REQUEST
HF COMMUNICATION PLANNING INFORMATION

EXERCISE NAME ________________ DATES ______________

ANTICIPATED LINE
OF SIGHT DISTANCE ________ 10.7 SOLAR
RADIO FLUX ________

PROPOSED LOCATIONS AND POSSIBLE UNITS:

UNIT	LOCATION	LAT	LONG
MAGTF CE (FSCC/DASC ?)			
MAGTF GCE (FSCC/DASC ?)			
MAGTF ACE			
(FIXED WING)			
(HELO)			
(RADAR)			
MAGTF CSSE			
DCS ENTRY			
OTHER/MISC			

____
classification

Figure 4-2. HF Communication Planning Worksheet For Frequency Request answer is yes, the computer should determine if the distance is greater then the line of sight distance. If greater, link numbers are assigned sequentially and FOT's determined for each link. The program should integrate any frequencies not available for request within the predetermined blocks of .3 MHz (from 3 to 30 MHz).

OUTPUTS: The program should print a summary of frequencies required by link as shown in Figure 4-3 which is quite similar to Figure 3-3 and, as an option, also print the FOT's for each link as in Figure 4-4.

b. **Frequency To Net Assignment Portion**

INPUTS: The updated exercise information consists of probable locations of units (see Figure 4-5). If required, additional sites can be included. This portion also requires the location characteristics (see Figure 4-6). Another input is the information from Figure 4-7 concerning the link, radio nets, and restoration priority which is similar to Figure 3-4. Before the link number can be assigned to a net, the need lines analysis must be done again and possibly new link numbers will be assigned. In addition, the restoration priorities must be modified somewhat to include any possible covert nets, that is, nets which should be protected from known enemy direction finding sites or interception sites. For the purposes of this program, those nets will be given a restoration priority of 0A (zero A).

classification

SUMMARY OF FREQUENCIES REQUIRED FOR OPTIMUM COMMUNICATIONS

LINK / FREQ	L1	L2	L3	L4	L5	L6	L7	L8	L9	SUB-TOTAL
SUB-TOTALS										

classification

Figure 4-3. Frequency Request Summary

____
classification

FREQUENCIES REQUIRED

LINK ____ DISTANCE ___________

LOCATION NAME AND LAT/LONG __________________________________
POSSIBLE UNITS __________________________________
____

LOCATION NAME AND LAT/LONG __________________________________
POSSIBLE UNITS __________________________________
____

FREQUENCIES REQUIRED FOR OPTIMUM COMMS

TIME	FREQUENCY
00	
01	
02	
03	
04	
05	
06	
07	
08	
09	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	

____
classification

Figure 4-4. Link FOT Information

classification

NETS TO FREQUENCIES ASSIGNMENT
HF COMMUNICATION PLANNING INFORMATION

EXERCISE NAME ____________________ DATES ____________________

ANTICIPATED LINE OF SIGHT DISTANCE __________ 10.7 SOLAR RADIO FLUX __________

PROPOSED LOCATIONS AND POSSIBLE UNITS:

UNIT	LOCATION	LAT	LONG
MAGTF CE (FSCC/DASC ?)			
MAGTF GCE (FSCC/DASC ?)			
MAGTF ACE			
(FIXED WING)			
(HELO)			
(RADAR)			
MAGTF CSSE			
DCS ENTRY			
OTHER/MISC			
DECEPTION			

classification

Figure 4-5. HF Comms Planning Worksheet For Assigning Freqs

classification

LOCATION CHARACTERISTICS

CHAR / LOCATION	EQUIPMENT	POWER	XMIT ANT	HEIGHT	GRND TYPE	REC ANT	HEIGHT	MAN MADE NOISE

Figure 4-6. Location Characteristics

HF RADIO NET LISTING

LINK	SITE A/B	NET NAME	RESTORATION PRIORITY	CRYPTO	REMARKS

Figure 4-7. HF Radio Net Listing

The covert nets are usually the RECON nets. The deception nets should be given a restoration priority of 5A and have all the frequencies available for assignment except the frequencies assigned to the covert nets and the frequencies assigned to the DCS entry station (if the deception stops at the time of the actual assault). This must be closely coordinated. Any known hostile direction finding sites or interception sites should be included as inputs. Of course, the frequencies assigned for use during the exercise must be inputted and sorted in ascending order to improve the efficiency of the search for a specific frequency. The frequencies available for use at the DCS entry point (either the NAVCOMMSTA or a DCS entry point) should be inputted if the frequencies have been cleared at both locations and they should be marked for use only on the DCS entry net (commonly referred to as the FMF Mobile Command net). Lastly, the required signal-to-noise ratio should be included as an input if it is different from 10 decibels (either greater than or less than).

PROCESS: The frequency portion process is repeated but with the updated information. The first association of nets and links now occur. The other end of the covert links and the deception links are the hostile direction finding and interception sites. In order of restoration priority starting with 0A, select a frequency from those available to cover the longest part of a 24 hour period. Determine if the signal strength is above the required signal-to-noise ratio. If it is, note the assignment of that frequency to that net for that period of time and continue with the process until all the nets have frequencies assigned for the 24 hour period. If the signal-to-noise ratio is below the required level, change the antenna to the next best one and recalculate the ratio. If it is adequate, assign that frequency to that net for that period. If assignment of frequencies for nets is not possible, indicate that appropriately. If there are excess assigned available, assign one frequency per net to the 1A to 2D nets. If there are still excess frequencies available, assign another frequency to the 1A to 2D nets. If there are still excess frequencies available, assign one frequency to the 3A to 4D nets.

OUTPUTS: The outputs of this process are.

1. The listing of the frequencies assigned by the host nation. This listing is used to confirm the proper frequency usage.

2. The frequency to net assignment list as depicted in Figure 4-8 (which is identical to Figure 3-5).

3. The net versus time frequency assignments as shown in Figure 4-9. This is used to confirm that each net has frequencies for a 24 hour period. Ideally, this information could be made available to the signals intelligence personnel for incorporation into their data base for electronic warfare operations.

4. A list of spare frequencies and asterisk those which can be returned to the host nation.

SEQUENTIAL FREQUENCY TO NET ASSIGNMENT

FREQUENCY	LINK	NET	TIME	ANTENNA	REMARKS

Figure 4-8. Frequency To Net Assignment

NET VERSUS TIME ASSIGNMENT

TIME NET	00	04	08	12	16	20	24

Figure 4-9. Net Versus Time Frequency Assignment

5. Non-Military Communications Menu

This section would describe the non-military communications which may be available to the communication planner. This provides another layer of redundancy to the communication structure. The planner should consider the use of the civilian telephone network in conjunction with the military communication network. In most European countries, that network is called the postal telephone and telegraph (PTT) network which is similar to the telephone network in the United States. Telephone drops can be requested in almost any area where there is telephone service. The planner should coordinate with the host nation military counterpart when requesting this service. Several military communication items have been approved for use over the telephone lines and it is prudent to request end instruments for those lines which will not have approved military equipment on them.

Another approach to use in conjunction with the fixed telephone drops is the use of mobile telephones. Consider leasing several mobile telephones for use by the commanders and operations officers of the major units involved in the operation or exercise. Be prepared to lease extra batteries, antennas and battery rechargers for US military vehicles and host nation power supplies. Consider blocking the ability to make long distance calls from the mobile phones. Since the phones will not be secure instruments, use code lists or brevity lists when using the telephones for calls and keep the calls brief.

6. Miscellaneous Menu

This section would be a catch all for items which do not fit neatly into any of the other sections. Two items which should be located here are the ships matrix which was discussed in chapter 3 and the communication guide for the non communicator. The ships matrix can be used to reduce confusion when working with the communicators of the amphibious shipping. An example of one was depicted in Figure 3-6.

The communication guide for the non communicator is useful when describing the communication means available to the other staff members. One axis lists the communication methods available and the other axis lists the from/to locations. It is similar to the yellow pages of the telephone book and is much more understandable than a radio guard chart used by the communication personnel. See Figure 4-10 for an example.

D. SUMMARY

It appears that most of the above information in menus 3, 4, and 6 could be incorporated into a data base and then used in conjunction with the Prophet and BECS programs. Essentially, this architecture is an umbrella which includes

COMMUNICATIONS GUIDE

LINK FROM/TO	LFCMD 1/2	LF TAC 1/2	LF INTEL 1/2	LF COMM COORD 1/2	LF EW CONTROL 1/2	LF RECON	LF FSC	LF ARTY CMD/FD	LF NGF SUPPORT	TAR/HR 1/2	TAR/HR 3(ASHORE)	LF LOG	LF HST CONTROL	LFFP CONTROL 1/2	LF MED REG 1	LF NGF AIR SPOT 1	LF NGF AIR SPOT 2 (ASHORE)	LF ARTY AIR SPOT 1/2(ASHORE)	LF AIR OBS (ASHORE)	NATO LIAISON CMN (ASHORE)	USMC MUX	AN/PSC-3	NORDECA MUX	COURIER	SHIP'S COMM CENTER	NARROW BAND SECURE VOX	PTT (MOBILE)	TROOP COMM TTY(MUX)
MAB MAIN/FWD	X	X	X	X	X	X	X	X	X	X						X					X	X		X				X
MAB MAIN/RLT	X	X	X	X	X		X		X	X		X	X	X	X	X								X				
MAB MAIN/MAG	X	X	X	X	X				X	X		X			X	X					X			X	X	X		X
MAB MAIN/BSSG	X	X	X	X	X		X		X	X		X	X	X	X	X					R			X				
MAB MAIN/FMFLANT																									X	X		
MAB MAIN/II MAF																						X			X	X		
MAB MAIN/SR UMP					X																R					R		R
MAB FWD/RLT	X	X	X	X	X		X		X	X	X					X	X	X	X					X			M	
MAB FWD/MAG	X	X	X	X	X				X	X	X					X	X				X			X			M	X
MAB FWD/BSSG	X	X	X	X	X		X		X	X	X					X	X	X			X			X			M	
MAB FWD/SR UMP					X																R							R
MAB FWD/CPG-2	X																											

LEGEND

X Is Guard
R Is Relay
M Is Maybe

Figure 4-10. Communications Guide

other programs and some interface programs. The requirements of the LOS portion may dictate a computer larger than a microcomputer (a personal computer) but that portion could be run on a larger computer such as a mini VAX.

V. SYSTEM DEVELOPMENT

A. GENERAL

This chapter will describe the thought process used to determine how a computer program could be developed from this thesis. This problem is a continuation of the original problem statement and is actually phase 3 from the Hall Activity Matrix. This systems approach methodology will be used again as another example of the usefulness of that selected process.

The elements of the first three steps of the Hall Activity Matrix assist in the description of the system boundary. The first step is to define the ingredients of this problem and then depict their interrelationships using the self and cross interaction matrices. The ingredients were previously described in Chapter II.

The ingredients for this phase of the problem are different from those listed in the previous phase and are listed as follows:

COMMAND AND STAFF RESOURCES:

1. Thesis author
2. Other officer students
3. Project officers at MCRDAC
4. NOSC project managers

NEEDS:

1. To develop a communication planning program for the Marine Corps from the thesis

2. To test the program adequately

CONSTRAINTS:

1. Time available

2. Money available

ALTERABLES:

1. Thesis with program

2. Thesis without program

3. Stand alone programs or separate programs

OBJECTIVES:

1. To produce an HF program

2. To produce a LOS determination program

3. To incorporate programs for the 3D requirement

OBJECTIVES MEASURES:

1. Time to produce the HF program

2. Time to produce the LOS program

3. Time to incorporate 3D capable programs

ACTIVITIES:

1. To complete the thesis before graduation

2. Develop source of money for program(s)

3. Find a programmer for HF portion

4. Find programs for LOS/3D requirements

ACTIVITIES MEASURES:

1. Percent complete activity 1
2. Percent complete activity 2
3. Percent complete activity 3
4. Percent complete activity 4

AGENCIES:

1. Naval Postgraduate School
2. Naval Oceans System Center
3. Marine Corps Development and Acquisition Command (MCRDAC)
4. Test site I (I Marine Expeditionary Force (I MEF))
5. Test site II (II Marine Expeditionary Force (II MEF))

As before, the linkage interactions will be coded H for high interaction, M for medium interaction, and L for low interaction.

B. SYSTEM INTERRELATIONSHIPS

The following analysis is another example of the seven steps of the Hall Activity Matrix as applied to the problem of how to produce the program for communication planning. A graphic approach is used to depict the relationships.

1. Problem Definition

Adequate clarity is the aim of the problem definition step which allows succeeding steps to progress [Ref. 7]. It is also used in determining a descriptive scenario for the situation which presents as much history and data as needed to indicate how the problem came to be a problem. The problem as originally stated is now analyzed in much more detail. See Figure 5-1. The use of the cross and self interaction matrices assists the user in more fully understanding the problem.

Initially, the problem is a question of how to have the program written from the information in the thesis. In this case, the fundamental problem is how to develop a program within the constraints of time and money. There is an interaction between the Marine C3 Naval Postgraduate School (NPS) student officers and the project officers at MCRDAC. There is also an interaction between the C3 students and some of the personnel at NOSC which is logical since NOSC is the C2 lab for the Navy. This problem of program development is actually a sub problem of how to improve the command and control systems for the MAGTF commander, and it may be appropriate to involve both commands.

The interrelationships have modified the problem statement to be how to "market" this analysis in order to have some agency/command decide to designate the appropriate funding to have the programs developed. This thesis is both the requirement statement and a recommended solution as well. The challenge is to have this requirement included in the funding of a project. In other words, the programs need sponsorship.

	CMD/STFF RESOURCES 1	2	3	4	NEEDS 1	2	CONSTRAINTS 1	2	ALTERABLES 1	2	3
CMD/STFF RESOURCES											
1. AUTHOR		H	H	H	H	H	H	H	H	H	L
2. OTHER STU			L	L	L	L	L	L	L	L	H
3. PROJ OFF				M	L	H	L	M	L	L	L
4. NOSC PM					H	M	M	H	H	L	L
NEEDS											
1. DEVELOP PROGRAM						H	H	H	H	L	M
2. TEST PROGRAM							H	H	H	L	H
CONSTRAINTS											
1. TIME								H	H	M	H
2. MONEY									H	L	H
ALTERABLES											
1. THESIS W/PROGRAM										H	H
2. THESIS W/O PROGRAM											L
3. JOINT THESIS											

Legend
H high interaction
M medium interaction
L low interaction

Figure 5-1. Problem Definition

2. Value System Design

The value system design is used to postulate and clarify proposed objectives to resolve the problem described in step one [Ref. 7]. See Figure 5-2. Time appears to be the dominant factor in this problem with the factor of money being a strong second. The thesis with the program is the most desired state but if that can not be done, a stand-alone program is second. Lastly, of course, is the fact that the program may not be written. The three objectives appear to be equally important with each other--that is, one does not strongly dominate the other. This is deceptive because of the use of the ordinal scale in the legend. In reality, the BLOS program is more important because the two LOS programs are reasonably available while the third program, the BLOS or HF program, must be developed. The portion of the LOS required in the BLOS could actually be accomplished by an approximation using distance as the parameter. With this in mind, the BLOS program is the most important of the three and should have the top priority for development.

3. System Synthesis

The system synthesis is used to identify potential candidate policies, activities, or controls which might allow attainment of the objectives [Ref. 7]. The system synthesis consists of developing alternatives for attaining each of the objectives. See Figure 5-3. The alternatives appear to be a function of money and people. There are several possibilities. First, the author could write the program as part of this thesis. Second, perhaps the program could be

	OBJECTIVES 1	2	3	OBJECTIVES MEASURES 1	2	3
NEEDS						
1. DEVELOP COMM PLNG PROGRAM	H	H	H	H	H	H
2. TEST PROGRAM	M	M	M	M	M	M
CONSTRAINTS						
1. TIME	H	H	H	H	H	H
2. MONEY	H	M	L	H	H	H
ALTERABLES						
1. THESIS W/PROGRAM	H	H	H	H	H	H
2. THESIS W/O PROGRAM	L	L	L	L	L	L
3. JOINT THESIS	H	H	H	M	M	M
OBJECTIVES						
1. Produce HF program		M	L	H	L	L
2. Produce LOS program			M	M	H	M
3. Incorporate 3D features				L	M	H
OBJECTIVES MEASURES						
1. Time to produce HF program					L	L
2. Time to produce LOS program						M
3. Time to accomplish 3D						

Legend
H high interaction
M medium interaction
L low interaction

Figure 5-2. Value System Design

	ACTIVITIES				ACTIVITY MEASURES				AGENCIES				
	1	2	3	4	1	2	3	4	1	2	3	4	5
CONSTRAINTS													
1. TIME	H	M	H	H									
2. MONEY	L	H	M	L									
ALTERABLES													
1. THESIS W/PROGRAM	H	H	H	H									
2. THESIS W/O PROGRAM	L	M	L	L									
3. JOINT THESIS	M	M	M	M									
OBJECTIVES													
1. Produce HF program	H	H	H	L					L	H	M	L	L
2. Produce LOS program	H	H	H	H					L	L	M	L	L
3. 3D features	M	M	M	H					L	L	M	L	L
OBJECTIVES MEASURES													
1. Time to produce program					L	L	L	L					
2. Time to produce program					L	L	L	L					
3. Time to accomplish					L	L	L	L					
ACTIVITIES													
1. Complete thesis		M	M	M	H	L	L	L	H	L	L	L	L
2. Develop money for programs			M	L	L	H	M	L	L	M	M	L	L
3. Find programmer				M	L	L	H	L	M	H	H	L	L
4. Find programs					L	L	L	H	M	M	M	M	M
ACTIVITIES MEASURES													
1. Percent complete activity 1						L	L	L					
2. Percent complete activity 2							L	L					
3. Percent complete activity 3								L					
4. Percent complete activity 4													
AGENCIES													
1. NAVAL POSTGRADUATE SCHOOL										M	M	L	L
2. NAVAL OCEAN SYSTEMS CENTER											H	L	L
3. MCRDAC QUANTICO												M	M
4. I MEF TEST SITE													M
5. II MEF TEST SITE													

Legend
H high interaction
M medium interaction
L low interaction

Figure 5-3. System Synthesis

written by another student as his thesis. Another officer attending the Naval Postgraduate School could write the program, if interested, and if they could get curriculum approval of this as their thesis. There may be a Marine Corps project officer available at MCRDAC who could coordinate the funding for the purpose of writing this program. Lastly, perhaps there is someone at NOSC who has an interest in this type of program who could incorporate it with another project or treat it as a separate project. NOSC would be a reasonable alternative to write this program (or parts of it) since someone there authored the majority of the Prophet program.

Support from the operational field units may generate enough interest to have a project manager designate funding for it.

4. Systems Analysis

The systems analysis is used to develop insight into the interrelationships, behavior, characteristics and the consequences of the proposed alternatives [Ref. 7]. This author could write the program but the thesis would not be done on time and completing the thesis on time is currently more important than having the program written. Another attempt would be to have another student develop the program. However, another student may not understand the importance of developing this program and may not complete it. Another alternative would be to have the MCRDAC staff work on it but that would happen only if funding were available. Another alternative would be to have someone at NOSC fund for the development of the BLOS program.

5. Optimization/Comparison Of Alternatives

The optimization step is used to rank alternatives in terms of the ultimate satisfaction of the value system [Ref. 7]. The alternatives are fairly easy to compare and rank. The best solution in the opinion of this author would be to have NOSC fund the writing of the BLOS program and incorporate the LOS programs under this umbrella. NOSC is the ideal choice because the original Prophet program was developed at NOSC and they may have the talent to rewrite this interface module. This would also demonstrate the coordination that can and should exist between the C3 curriculum at the Naval Postgraduate School and the Navy laboratory for command and control systems. The next best solution would be to find sponsorship for the programs from another project office such as the project officers for the Marine Corps or even the Army. In fact, sponsorship might be obtained from any of the services or the operational J-6's or even the Joint Staff J-6 or the Joint Tactical C3 Agency (JTC3A). Simultaneously, support in the form of operational requirements from the operational units would probably assist in funding for this project. This support could be enhanced if a prototype program were tested at the two field sites--I MEF and II MEF.

6. Decision Making

The decision making step is aimed at selecting one or more policies worthy of further consideration [Ref. 7]. The first approach is to get NOSC to fund the BLOS program and have it developed. At the same time, the thesis should be distributed to the units and agencies listed above in hopes of gaining operational support.

7. Planning For Action To Implement Next Phase

The planning for action step is used to determine and reshape the previous six steps in order to initiate the next phase [Ref. 7]. This step of the program is used to schedule the level of effort, allocate resources, and design a feedback system for controlling the ensuing action. The elements would be re-examined, re-identified, and reprocessed through the maze of matrices at the next phase which is project planning. In this case, the decision to implement the selection made in step 6 is the only action contemplated for this project. The next phase of this thesis is to include the commands and agencies listed in paragraph 6 above in the distribution list of the thesis.

C. SUMMARY

The initial problem statement was examined and appropriately modified after a thorough analysis as a result of the systems approach methodology. A strategy was developed to have the different programs developed and incorporated under the umbrella of this communication planning project. The funding and development of these programs should be made according to the relative importance of the need of this requirement in relation to all the other requirements in the services. The strategy to have this program developed is to include commands and agencies in the distribution list which may be able to have the requirement funded or have the requirement included as part of a larger requirement. If the program is written, it should be tested locally to insure it performs as designed and then it should be turned over to MCRDAC for the proper production, distribution and configuration management.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The purpose of communication is to serve command and command can better be served if computers extend the capability of the planners. In this case the author would conclude that a computer can be dedicated to the communication planner to expedite communication planning in support of the command and control process. In the past, many complex functions were performed at high administrative levels due to computer availability; however, operational units now possess such computer capabilities that can perform these activities. Automation is important and can be of valuable assistance, but users should also develop procedures to accomplish the planning functions in the event a computer is not available.

The most difficult part of any new system or concept is getting that concept on paper, or in this case, getting the program into the computer. The difficult part of an HF planning program is identifying a starting point. These two BLOS modules are a reasonable and appropriate starting point and should be tested, analyzed and improved. After more extensive use of the programs, a standard procedure might be developed which would allow two separated units to run the same program and allow each to select an identical set of six HF frequencies in order to establish communications using the new automatic link establishment (ALE) procedures.

This author worked closely with NOSC personnel in an attempt to develop the BLOS program. The need existed for an HF planning capability and the NOSC personnel believed the BLOS portion of this thesis was a good starting point. The key to producing such a program was the fact that there was an "information broker" at NOSC who was willing and capable of coordinating a need with a proposed solution. The BLOS program was completed in March and field tested at II MEF Camp LeJeune North Carolina, at Communication Officers School in Quantico Virginia, and at I MEF Camp Pendleton California with positive responses from those involved. That program and this thesis will be delivered to MCRDAC for validation and appropriate implementation in the Marine Corps. This architecture is an example of a particular application of a previous thesis which stated that automated or expert systems could be applied to certain functions in the Marine Corps [Ref. 2].

B. RECOMMENDATIONS

During the decomposition of functions for this communication planning process, several questions were raised. The first question is concerned with antennas. The Marine Corps has a requirement for communications within or internal to the organization and requirements for external communications. What is the average distance for the internal communication requirement and what is the average distance for the external communication? After these distances are determined, what antenna(s) best satisfy those requirements and where in the Marine Corps organization should they be placed? Near vertical incident skywave (NVIS) antennas are excellent means to communicate for distances within 300 kilometers without skip zones and there are several excellent antennas for distances in the range of 500 kilometers to 3000 kilometers. The question for the communication planner is why the antennas which units possess are not part of the Prophet program by military nomenclature. If military antennas were loaded into the Prophet program under their military nomenclature, then there would be less room for error when performing the calculations.

There are also some questions concerning the characteristics of HF propagation from point to point. For instance, are circuits of the same distance more reliable in a north south orientation or an east west orientation? What factor should this play in the selection of a DCS entry point? Are circuits more reliable near and within the poles or near the equator? Is there an upper limit on the distance for a particular equipment arrangement? These are important questions which may have an impact on the BLOS algorithm.

Most of the LOS requirements can be satisfied by existing programs. The Electromagnetic Compatibility Analysis Center

(ECAC) currently has the capability to determine line of sight paths and display radar plots. The forestry service has a three dimension program in color for assistance in fighting fires. The J-6 section of Joint Staff has prototype programs for developing a CEOI and crisis planning. These programs or programs with similar capabilities should be available at the tactical level in order to improve the efficiency and effectiveness of the units.

Improvements can be made to this concept of a communication planning module by following an integrated systems approach and letting the system evolve within the guidelines established by appropriate higher agencies. Making the system standard in each of the units in the Marine Corps will enhance the possibility of improvements to the system. The system can be improved by standardizing either the inputs, the outputs or the process or some combination of the three. Perhaps the Marine Corps could agree on standard nets and restoration priorities for each of the MAGTFs. If the standard inputs are possible, each element of the MAGTF could calculate, produce and distribute a CEOI with certain essential information either sent by message via the Automatice Digital Network (AUTODIN) or as a standard package of information or some combination and easily meet the six hour requirement set forth by the Commandant.

These requirements are probably not Marine Corps unique and perhaps the requirements processor at MCRDAC can coordinate with other services and collectively develop packages for use at the tactical level. These packages should be able to run on laptop computers which operate on standard US or European voltage (60 cycle and 110 volts or 50 cycle and 220 volts) as well as the normal desktop computers. The packages should be evolutionary and use modular building blocks for prototyping.

A system should also be established to determine the reliability characteristics for HF communications from and to different points in the world. Such points would be any place there is a DCS HF entry station or relay station and the points where a possible contingency plan may call for the positioning of forces. The matrix could look like Figure 6-1. All the possible combinations could have simulated reliability characteristics determined by the Prophet program, and many could be tested during normal exercises. Results of this information would assist in developing plans to determine which DCS entry point would be the most reliable for a given contingency plan.

Additional shells could be developed for the units which actually implement the plan. Conceivably that program could assist units in improving their efficiency and effectiveness. Automation allows for the process to continue even though

TO / FROM	1	2	3	4	5	6
A	30%	95%	70%	0%	20%	98%
B	78%	63%	54%	80%	0%	0%
C	61%	0%	75%	48%	0%	79%
D	0%	88%	0%	92%	98%	87%
E	34%	0%	77%	82%	0%	64%
F	71%	45%	67%	0%	0%	0%

Figure 6-1. HF Point to Point Reliability Characteristics

certain key people are not available to perform their unique functions. It also permits the user to focus attention on the human coordination which is vitally important in the preparation of any plan.

APPENDIX A

SAMPLE PROPHET OUTPUTS

RAY TRACE

```
***UNCLASSIFIED***
        ADVANCED PROPHET RAYTRACE SYNOPSIS
DATE: 3/20/87  TIME: 08:00 UT  ATMOSPHERIC NOISE: NO  BWIDTH: 3.000 KHZ
FREQ:    3.9  SSN: 72.0  KP: 1.0  MAN-MADE NOISE:  QM  SNR REQD: 12.0 DB
XMTR: EVENES  LAT: 68.5  LON: -16.4  ANT: 101 @ *OMNI*  PWR:    20.00
RCVR: BODO    LAT: 67.3  LON: -14.2  ANT: 101 @ *OMNI*  RANGE: 162.1 KM
IONOSPHERE:   FOE=  .7 MHZ  FOF1=  .9 MHZ   FOF2=  4.9
              HMF2= 350.KM   YMF2=102.2 KM
```

NHOP	1	2	4	0	0	0
MODE	3000000	3300000	3333000	0000000	0000000	0000000
ANGLE	75.45	82.70	86.35	.00	.00	.00
DELAY(MSEC)	2.255	4.476	8.938	.000	.000	.000
LOSS(DB)	100.92	112.90	112.65	.00	.00	.00
GAIN TX/RX	-6/-6	-10/-10	-10/-10	0/0	0/0	0/0
1HZ SNR(DB)	60.33	40.37	40.62	.00	.00	.00
ADJ SNR(DB)	25.56	5.60	5.85	.00	.00	.00
VIR HT1(KM)	328.25	330.69	330.82	.00	.00	.00
FIR HT2(KM)	.00	336.20	333.15	.00	.00	.00
VIR HT3(KN)	.00	.00	336.00	.00	.00	.00

RA>

FIELD STRENGTH

UNCLASSIFIED
DATE: 3/20/87 ATMOSPHERIC NOISE: NO
10.7 CM FLUX: 120.8 X-RAY FLUX: .0010 MAN-MADE NOISE: QM
XMT: EVENES LAT: 68.5 LON: -16.4 ANT: 121 ● *AUTO* PWR: 20.00
RCV: BODO LAT: 67.3 LON: -14.2 ANT: 101 ● *OMNI* RANGE: 162 KM

SIGNAL TO NOISE (DB ABOVE 0 SNR)

	FREQUENCY													
TIME	1			4				8		12	16	20	LF	MF
00	7	21	22	16	-4								2	4
01	6	21	21	14	-9								2	4
02	6	20	20	8	-16								2	4
03	7	23	26	22	16	2	-16						2	5
04	7	23	27	25	19	14	-2	-20					2	6
05		15	24	23	19	17	5	-11					2	6
06			2	12	12	14	7	-7					2	7
07			-18	1	5	9	7	-5	-19				2	7
08				-9	0	6	7	-4	-17				3	7
09				-16	-4	2	5	-4	-17				3	7
10					-7	1	4	-5	-17				3	7
11					-8	1	3	-5	-18				3	7
12					-8	1	3	-7	-19				3	7
13				-18	-5	2	3	-8					3	7
14				-11	-1	4	3	-10					3	7
15				-1	4	8	2	-12					2	6
16			-2	9	11	13	1	-14					2	6
17		4	19	21	18	12	-2	-18					2	6
18	7	23	27	25	19	7	-3						2	5
19	7	23	26	23	12	-3							2	5
20	7	22	24	20	1	-16							2	4
21	7	21	22	12	-9								2	4
22	7	21	22	15	-7								2	4
23	6	21	21	11	-11								2	4

FS>

DIURNAL

UNCLASSIFIED

DATE 3/20/87 SSN+ 72.0 KP3= 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0

XMTR: EVENES LAT: 68.5 LON: -16.4 ANT: 101

RCVR: THURSO LAT: 38.6 LON: 3.7 ANT: 101 RANG: 1467.7 KM

DATA SOURCES: XRAY=DEFAULT KP+DEFAULT SSN=FAULT

UT	LUF	FOT	MUF	XRAY	UT	LUF	FOT	MUF	XRAY
00:00	2.00	5.00	7.14	.00110	12:00	6.86	10.29	14.29	.00100
01:00	2.00	5.25	7.37	.00100	13:00	6.72	10.33	14.06	.00100
02:00	2.00	5.16	7.12	.00100	14:00	6.36	10.27	13.69	.00100
03:00	2.00	4.78	6.48	.00100	15:00	5.77	10.10	13.20	.00100
04:00	2.00	7.39	9.85	.00100	16:00	4.90	9.82	12.60	.00100
05:00	2.00	8.86	11.62	.00100	17:00	3.59	9.11	11.87	.00100
06:00	2.30	9.78	12.62	.00100	18:00	2.00	8.29	10.99	.00100
07:00	4.10	10.29	13.32	.00100	19:00	2.00	7.31	9.85	.00100
08:00	5.24	11.05	13.81	.00100	20:00	2.00	5.78	7.92	.00100
09:00	6.01	11.04	14.15	.00100	21:00	2.00	5.12	7.09	.00100
10:00	6.51	10.90	14.34	.00100	22:00	2.00	4.94	6.91	.00100
11:00	6.79	10.65	14.39	.00100	23:00	2.00	5.16	7.30	.00100

APPENDIX B

COMMUNICATION PLANNING INFORMATION

The sections in this appendix are examples of the information which would be included in the program. They relate to the menu selections as described in Chapter IV.

COMMUNICATION ELECTRONICS PLANNING CYCLE FOR EXERCISES
(MENU 2.2)

PROCESS	TARGET DATES	PRODUCT
1. INITIAL PLANNING CONFERENCE (IPC) 2. FORCE LIST 3. AREA OF OPS 4. EXERCISE DATES	NATO -- 12-15 MONTHS PRIOR (NLT 9 MONTHS) US -- 6-12 MONTHS (NLT 5 MONTHS)	CEOI FREQ REQ (HF, VHF, UHF)
1. INPUT FROM ACE 2. (IMPACT ON EMBARKATION)	NATO -- 9-12 MONTHS PRIOR (NLT 7 MONTHS) US -- 6-8 MONTHS (NLT 5 MONTHS)	RADAR FREQ REQ
1. MAIN PLANNING CONFERENCE (MPC) 2. FINAL PLANNING CONFERENCE (FPC) 3. STAFF COORDI-NATION 4. SUBORDINATE UNIT COORDINATION	NATO -- 6-9 MONTHS PRIOR US -- 7-12 MONTHS	HOST NATION COMMUNICATIONS SUPPORT REQ (LEASE LINES)
1. AFTER FINAL PLANNING CONFERENCE (FPC) 2. COORDINATION WITH UNITS AND STAFF	NATO -- 4-6 MONTHS PRIOR US -- 4-6 MONTHS	DRAFT/SMOOTH ANNEX
1. AFTER HOST NATION /JFMO PROVIDES AUTHORIZED FREQ	NATO -- 1-2 MONTHS PRIOR US -- 1-2 MONTHS	CEOI COMPLETE
1. MESSAGES TO HOST NATION AND/OR ADVANCE PARTY	NATO -- 3 WEEKS PRIOR US -- 3 WEEKS	TELEPHONE NUMBERS
1. REACT TO CHANGES 2. STAFF COORDINATION 3. MEETING WITH SUBORDINATES 4. "WHAT IF" 5. TEMP PLA'S 6. COMM SHIFTS	NATO -- CONTINUOUS US -- CONTINUOUS	FLEXIBILITY

SAMPLE COMMUNICATIONS-ELECTRONICS ESTIMATE
(MENU 2.3)

COMMUNICATIONS-ELECTRONICS ESTIMATE

Ref:

1. MISSION

(This subparagraph contains a brief restatement of the basic mission of the command as a whole as previously announced by the commander. Deduced missions necessary for the accomplishment of the basic mission, along with previous decisions of the commander regarding either deduced or basic missions should be listed in appropriate subparagraphs.)

2. SITUATION AND CONSIDERATIONS

a. Intelligence Situation. (Information known or obtained from the G-2. Where appropriate, reference may be made to the Intelligence Estimate or other intelligence documents.)

(1) Characteristics of the Area. (Those affecting communications-electronics.)

(a) Weather.

(b) Terrain.

(c) Transportation networks/communication routes.

(d) etc.

(2) Enemy Strengths and Disposition of Major Units

(a) Tactical units.

(b) Signals intelligence/electronics warfare.

i) Jamming.

ii) Wire tapping.

iii) Imitative deception.

iv) etc.

b. Tactical Situation. (Information obtained from the commander's planning guidance and from the G-3.

(1) Present Disposition of Major Units

(a) Tactical units.

(b) Communications-electronics elements.

(2) Courses of Actions to be Considered

(a) Course of action number 1.

(b) Course of action number 2.

(c) etc.

(3) Projected Operations. (If known, and which will affect the communications-electronics situation.)

(a) Rates of advance.

(b) Command post location and displacement.

(c) Uncovering of major communication routes.

(d) etc.

c. Personnel Situation. (Information known or obtained from the G-1 regarding personnel matters affecting the communications-electronics situation. Where appropriate, reference may be made to the personnel estimate or other personnel documents.)

(1) Strengths.

(2) Replacements.

(3) Command post organization and operation.

(4) etc.

d. Logistic Situation. (Information known or obtained from the G-4 regarding logistic matters affecting the communications-electronics situation. Where appropriate, reference may be made to the logistic estimate or other logistic documents.)

(1) Availability of equipment.

(2) Condition of equipment.

(3) Availability of repair parts and consumable items.

e. Assumptions. (Any assumptions required as a basis for initiating planning or for the preparation of the estimate.)

f. Communications-Electronics Situation.

(1) General. (Information regarding current communication installations, the status of the overall communication system, and the location and mission of communication and control agencies. Reference may be made to the COMMSOP and COI or to the communications-electronics annexes contained in current operation plans or orders.)

(2) Special. (Items not covered elsewhere which affect the communications-electronics situation.)

(a) Availability and assignment of radio frequencies.

(b) Assignment of call signs.

(c) Availability of shipboard communication equipment for troop use.

(d) Arrangements for communication guard.

(e) Anticipated traffic volumes.

(f) Cryptographic matters.

(g) etc.

3. COMMUNICATIONS-ELECTRONICS ANALYSIS

(Each course of action under consideration is analyzed in the light of significant factors to determine problems which will be encountered, measures required to solve such problems, and any limiting features which will exist.)

a. Course of Action Number 1

(1) Support Requirements

(a) Terrain and Distance Factors. (A discussion of terrain and distance factors that may affect the location of command posts, installations, and the employment of communication means.)

(b) Installations. (A discussion of known or deduced communication requirements for each communication and control agency, and other units. These requirements may be expressed as needlines or may be detailed to include types of circuits and terminal service, or other forms of communications, required by these activities.)

(2) Support Capability. (A discussion of the capability to employ all available means of communications to satisfy the foregoing support requirements.

(a) Radio and Wire. (Discussed in conjunction with the capability to provide various types of circuits and attendant terminal service; e.g., telephone, teletypewriter, and data.)

(b) Messenger

(c) Visual and Sound

b. Course of Action Number 2

(1) Support Requirements

(a) Terrain and Distance Factors

(b) Installations

(2) Support Capability

(a) Radio and Wire

(b) Messenger

(c) Visual and Sound

c. etc.

4. EVALUATION

(Based on the foregoing analysis, the advantages and disadvantages of each course of action are summarized and compared from a communications-electronics viewpoint.)

a. Course of Action Number 1

(1) Advantages

(2) Disadvantages

b. Course of Action Number 2

(1) Advantages

(2) Disadvantages

5. CONCLUSIONS

a. (A statement as to which course of action under consideration can best be supported from a communications-electronics viewpoint.)

b. (A statement of the salient disadvantages which render the other courses of action less desirable from a communications-electronics viewpoint.)

c. (A statement of significant communications-electronics problems to be solved and limitations which may exist.)

d. (A statment of measures required to solve the foregoing communications-electronics problems and offset any limitations which may exist.)

SAMPLE COMMUNICATIONS-ELECTRONICS ANNEX
(MENU 2.4)

ANNEX K (Communications-Electronics) to Operation Order-

Ref. (a) ANNEX K to 11 MAF Operation Order 2000

Time Zone: R

1. <u>GENERAL</u>

a. <u>Purpose.</u> The purpose of this annex is guidance for the installation, operations, and maintenance of communications and electronic system to support the operation.

b. <u>Situation</u>

(1) <u>Enemy Forces</u>

(a) See Annex B. (Intelligence) to Operation Order -.

(b) The enemy has the capability to:

i) Conduct signal intelligence and electronic warfare operations.

ii) Conduct extensive wire tapping.

iii) Insert deceptive traffic on any communication channel.

(c) Abandoned enemy communications-electronics equipment may be booby trapped.

(2) <u>Friendly Forces</u>

(a) See Annex A (Task Organization) to Operation Order -.

(b) Amphibious Task Force (TF 45) will provide communication guard for embarked landing force units; unit communication guard is passed to the landing force headquarters ashore.

(c) This headquarters will provide cryptographic guard for all landing force units.

(3) Attachments and Detachments. See Annex A (Task Organization) to Operation Order -.

(4) Assumptions. All communication organizations within the landing force will be at full TO/TE 30 days prior to embarkation.

2. MISSION

Commencing at H-4, D-Day, -Marine Amphibious Brigade communications-electronics activities provide support for the landing and subsequent operations ashore.

3. EXECUTION

a. Guiding Principles. Current policy emphasizes maximum use of communications security procedures and assets available to enhance communications security. Use ECCM procedures as prescribed in the ECCM plan. Maximum deceptive measures will be used to position communication assets.

b. Operational Concept. This headquarters will employ a two command post concept once ashore, a main and rear. The rear CP will handle the administrative function of the brigade, to include the mobile command entry. The main CP will configure light and a mobile as possible, with a full range of communication assets to command and control support arm, including air operations.

c. Tasks and Responsibilities

(1) Communication Company, 8th Communication Battalion

(a) Install, operate, and maintain communications in accordance with this annex to support the operation.

(b) Be prepared to provide additional communication liaison teams on order.

(c) Activate the FMF Mobile Command circuit to NAVCOMMSTA San Juan on D&Z. 12 Secure channels vice troposcatter and/or tactical satellite-6 telephone, 2 full duplex teletype (100 wpm), 2 data (LVO CPM), and 1 fascimile. Channel allocation in accordance with reference (a) and Appendix 4 (Wire and Multichannel) to this annex.

(2) Regimental Landing Team

(a) Install, operate, and maintain communications in accordance with this annex, and current organizational directives to support the operation.

(b) Be prepared to provide communication support when designated as the alternate command post.

(c) Establish link-up communications as indicated in Appendix 2 (Radio Circuit Plan).

(3) Marine Air Group

(a) Install, operate, and maintain communications in accordance with this annex and current organizational directives to support the operation.

(b) Commencing H-Hour, establish a helicopter/message device between RLT-, MAG-, BSSG-, and their headquarters in accordance with Appendix 12 (Messenger Service).

(4) BSSG

(a) Install, operate, and maintain communications in accordance with this annex and current organizational directives to support the operation.

(b) Be prepared to provide communication support to TACLOG operation or order.

(5) DET 2d Radio Battalion

(a) Provide special security communication center support to the landing force headquarters.

(b) Activate other circuits in accordance with Appendix 2 (radio Circuit Plan).

(6) DET Force Reconnaissance Companies

(a) Activate circuits for advance force operations as defined by the advance force commander.

(b) Upon termination of advance force operations, activate landing force circuits defined in Appendix 2 (Radio Circuit Plan).

(7) Landing Force Artillery Communications

(a) See Appendix 12 (Fire Support) to Annex C (Operations).

(b) See Appendix 2 (Radio Circuit Plan).

(8) Naval Gunfire Communications

(a) See Appendix 12 (Fire Support) to Annex C (Operations).

(b) See Appendix 2 (Radio Circuit Plan).

(9) Air Operations Communications

(a) See Appendix 8 (Air Communications) to Annex M (Air Operations).

d. Coordinating Instructions

(1) Communications security. See Appendix 1 (Communications Security).

(2) Radio. See Appendix 2 (Radio Circuit Plan).

(3) Call signs and frequencies in accordance AMSH-.

(4) Cryptographic instruction and routine indicators. See Appendix 3 (Communication Center Instructions).

(5) TECCON/SYSCON. See Appendix 5 (System Management and Control).

(6) Wire/Multichannel. See Appendix 4 (Wire and Multichannel Radio Plan).

(7) Messenger service. See Appendix 6 (Messenger Service).

(8) Visual and sound. See Appendix 7 (Visual and Sound).

4. SPECIAL MEASURES

a. Daily changing call signs and frequencies will be used in all circuits.

b. MIJI reports will be submitted in accordance with Annex B (Intelligence).

5. LOGISTICS

a. See Annex D (Logistics) and Annex P (Combat Service Support).

b. Third echelon repair facilities will be located at the brigade BSSG.

6. ADMINISTRATION

a. Reports will be accordance with Appendix 3 (Personnel) of Annex E (Personnel).

b. Command Posts

(1) AFLOAT

MAB	LHA1
RLT	LOD2
BSSG	LPH7
MAG	LPH8

(2) ASHORE

MAB	465375
RLT	To be reported
BSSG	To be reported
MAG	961732

(3) All commands will report command post locations when established.

ACKNOWLEDGE RECEIPT

I. R. READY
Col USMC

APPENDIXES:

1. Communications Security
2. Radio Circuit Plan
3. Communications Center Instructions
4. Wire and Multichannel Radio Plan
5. System Management and Control
6. Messenger Service
7. Visual and Sound

COMMUNICATION-ELECTRONICS PLANNING/OPERATIONS CHECKLIST
(MENU 2.5)

Section
(1) General Information
(2) Predeployment checklist
(3) Afloat checklist
(4) Deployment Operational checklist
(5) Post operational/deployment checklist
(6) Communications site selection
(7) Organization chart
(8) Equipment density chart
(9) Cold weather checklist
(10) Desert checklist
(11) EW checklist
(12) Training
(13) Communication-electronics estimate input format
(14) Generator operators checklist
(15) SHF requirements
(16) Amphibious embarkation/debarkation considerations
(17) Communication-electronics materials and supplies

SECTION 1: GENERAL INFORMATION

1. Purpose.

The purpose of this checklist is to provide communication planning and operations officers and supervisors at the local level with a source document applicable for training exercises as well as reaction to real world requirements. This document does not provide implementation procedures. Such procedures are provided by organizational orders, directives, and publications.

This checklist allows communication planners to verify the accomplishment of necessary functions involved with establishing a reliable communications system of any scope. It purposely addresses areas of a logistical and support nature in order to ensure that necessary coordination in all related areas is effected early on. The completion of established milestones utilizing this checklist will allow communication managers and supervisors at all levels to effect timely communications planning, with no loss in communications due to areas that were overlooked or functions assumed to have been accomplished by others.

2. Planning.

The sequence of command and staff planning contained in FMFM 3-1 provides the framework in which the following functional aspects of planning are addressed.

a. When the commander receives the mission and during his mission analysis and while determining information requirements; subordinate commanders/leaders should evaluate readiness in the following areas:

(1) UNIT:

(a) T/O (M/L augmentation requirements)
(b) Training readiness
(c) Medical and dental requirements
(d) OQR/SRB RED update
(e) Identify 782/uniforms/NBC equipment requirements
(f) Weapons assignment
(g) Personnel/equipment/embarkation inspection schedules (includes Commander's personnel and equipment inspections)

(2) PERSONNEL:

(a) Power of attorney
(b) Wills
(c) Security requirements for personal items, e.g., automobiles and stereos
(d) Outstanding bills/allotments
(e) Insurance coverage
(f) Identification cards/tags
(g) Visa/passport/drivers license (SOFA)
(h) Ensure all basic clothing insure items are on hand, serviceable and that they are properly marked

b. The initial staff orientation is begun with the receipt and evaluation of collected information.

c. The commander's planning guidance assists his staff and designated personnel in preparing their estimates. Subordinate commander/leaders should evaluate equipment readiness in the following areas:

(1) Establish an equipment density based on the mission and evaluate available assets for meeting requirements.

(2) Equipment status

(3) Identify T/E equipment/SL-3 shortages

(4) Determine support requirements (equipment/power augmentation)

(5) Coordinate deployment assets accountability between unit supply officer, S-4 and Deployment Commander.

d. The G-3/S-3 develops proposed courses of action which often have been announced subsequent to the issuance of the planning guidance. The commander's staff and subordinate commanders/leaders should keep current and update the following planning considerations. '(See SOP's and PMFM 3-1 and 10-1 for planning estimates).

(1) Planning Requirements

(a) Analysis the mission/courses of action

(b) Reference publications and directives (how many, what types, current editions of CMS materials and their storage and availability on ships/ashore).

(c) Logistical /support requirements

1) Transportation/prime movers
2) Generators
3) POL (diesel, JP-4/5, mogas, oil)
5) Forklift and/or lifting crane
6) Batteries and other expendables
7) Messing (to include MID-RATS)
8) Billeting (tentage with all component parts, cots, sleeping bags, mosquito netting, tent lines, and tent stoves
9) Water
10) Other personal demand items

(d) Review after action reports/lessons learned from previous like operations.

(e) Review applicable SOP's/CEOI's

(f) Review sections (1) through (7)

(g) Attention to detail and close coordination must be maintained.

(2) Detailed planning requirements

(a) Communications site selection.

(b) Communications operations.

1) SYSCON/TECHCON interface
2) Reports/status updating

(c) Unit/section planning considerations.

1) Communications site recon
2) Units and locations
3) CP layout
4) Defense position requirements to include requirements for security of classified materials/equipment.
5) Camouflage
6) Light and noise discipline
7) Power and distribution requirements
8) Antenna farm location/remoting
9) Time estimate for installation/removal
10) Logistic requirements

11) Maintenance requirements (trouble shooting/maintenance procedures/JON #'s for 1st through 4th echelon maintenance, prior to opening an ERO and induction the MIMMS AIG.
12) Support requirements
13) Embarkation/debarkation requirements
14) TE-33's
15) Flashlights
16) Earplugs
17) Weather and terrain
18) Equipment redundancy/back-up
19) Waterproofing materials/procedures
20) HF radiation hazards signs (include translation for country(s) involved)
21) Special equipment parts (prexpended bins)
22) ECM/ECCM
23) Radio wire integration (RWI) requirements
24) Retransmission requirements
25) CP displacement requirements/procedures (command echelons)
26) Communicators requirements (pens, logs, and message books)
27) Procedures for HF/DCS entries
28) CMS requirements (hardware/software)
29) Communications procedures for passing command ashore
30) Communications supplies and materials
31) Pioneer equipment such as picks, shovels, axes, hemp rope/chains, power saws, sledge hammer, and engineer stakes. A special file should be used for sharping axes (requires a high carbon file).
32) Vehicles and winches should be operationally checked
33) Materials/supplies should include PM supplies (self service items, how many of what type). Evaluate on basis of storage and availability for procurement from self service facilities while deployed.
34) Funding allocation should include provisions for self service items, SL-3 replacements and corrective maintenance.
35) Submit TSR, frequency, PLA AIG and other communication requirements with sufficient lead time prior to each exercise/operation.

(d) WIRE UNIT

1) Type of construction to be used
2) Line route map
3) Tagging instructions (cut sheets)
4) Reels of assault cable/amounts of WD-1/WD-16 needed
5) Identification of telephone users
6) Priorities for installation of lines and telephones
7) Responsibility for installation of lateral lines
8) Multiplex/RWI interface (cut sheets)
9) Consider the use of helicopters/ vehicles for wire laying
10) Directories
11) Priority calls
12) Preemption
13) Conference calls
14) Channelization requirements with SYSCON/TECHCON and other units
15) Line conditioning, power sources (primary/alternate)
16) Planned back-up switch board (cabling/ hook-up plan)
17) Operator procedures

(e) RADIO UNIT

1) Selection of communications assets vs. requirements
2) Frequency allocation proposal (Consider profit analysis). General guide for HF is to use day/night frequencies with frequency change schedule with 10% separation from transmit to receive. VHF multichannel radio communications use 1 to 2 MHZ separation for receive to receiver and maximum feasible separation for transmitter to receive.
3) Remote hook ups/routing
4) Special net instructions
5) Net control functions/use of collective call signs
6) RWI operations
7) Retransmission operations
8) SIGSEC/ECM-ECCM/Beadwindow/MIJI
9) Directional Antennas

(f) MULTICHANNEL UNIT

1) SHF
2) Frequency/channel requirements (consider ECAC analysis) VHF multichannel should activate simplex high and then transmit on assigned frequency in ACEOI.
3) Channelization coordination with the wire section.
4) Ensure that 10ft assault cable hooks are rewired for hook-up and channelization is confirmed with cut sheets.
5) Equipment interface TH-81 alignment specifications should be the same.
6) Strapover operations
7) Repeator/drop insert operations
8) Dual diversity
9) Operational instructions
   (a) Profiling
   (b) Antenna polarization
   (c) Aizmuths (Grid or magnetic, specify)
   (d) Adjusting procedures
10) Radio teletype operations
11) Procedures/actions to be taken during power fluxuctions (Klystrons)

(g) FIELD MESSAGE CENTER

1) Staff organization and releasing procedures
2) Courier/messenger service schedule
3) Records/logs/files
4) CMS (hardware/software back-ups)
5) Estimated number of in-coming/out-going messages
6) Number of messages copies required by section/unit (coordinate with G-1)
7) Procedures for handling high precedence traffic
8) Emergency action message procedures
9) Routing of messages
10) Diagram for message center spaces
11) Cryptographic/physical security requirements
12) TYUC-5A interface
13) Message drafting instructions/format
14) Comm shifts (NTP-4 (B))
15) Coordination with radio

16) Environmental requirements (air-conditioning/heating/ additional filtering)

(h) SPECIAL PREPARATIONS

1) Use of commercial power/leased lines
2) Power converters/conditioning
3) Generator muffling devices
4) Additional filtering devices
5) Purged 55 gal drums and hand pumps (Protective tarps/screens)

3. OPERATIONS. The operational aspects of subject matter will list many of the predeployment, afloat, deployment aspects of communications required to support amphibious operations. Continued staff functions and execution of orders will be in accordance with FMFM 3-1 and 10-1 and established operational orders and procedures of commands.

4. COMMAND POST. As part of a command post (CP), the communications unit/site will require close liaison and coordination with the headquarters commandant and other units. The following topics are recommended for resolution.

a. Other communication units/elements placement of communications equipment.

b. Defensive actions to be taken should the enemy infiltrate the external defensive positions.

5. ACTION. This communications planning and operational checklist is applicable to all organizations. Common sense, initiative, cooperation and mutual assistance should prevail in application. It is expected that suggestions and recommendations will broaden the scope and utility of this document.

SECTION 2: PREDEPLOYMENT CHECKLIST

1. The following predeployment checklist is a topical reminder of communication-electronics concerns which will enhance probability of mission accomplishment.

a. Personnel.

(1) Unit assignment (RTD/Attachment/Detachment dates)
(2) Deployment Roster (REDS/Shot Record/Weapon Assignment/Driver License) (SOFA)
(3) Individual operator proficiency (equipment/ operational procedures/trouble shooting/ maintenance)
(4) Uniforms
(5) Training required
 (a) Communication Field Skill Training (FST) School
 (b) On the Job Training (OJT)
 (c) Classroom MOS Training
 (d) Cross Training
 (e) Mission Directed Training
 (f) Military Correspondence Courses
 (g) Individual Training Record: (General Military Skills to include First Aid, Individual Protective Measures, NBC Defense, Markmanship, Physical Training/Testing...etc)
 (h) See Section 12

b. Equipment.

(1) Equipment requirements/density listing (See Section 8
(2) LTI's schedule
(3) Frequency alignment
(4) On-line/off-line watt meter checks for radios, transmission cables and antennas.
(5) SL-3 inventories/DPR reconciliation
(6) Equipment status
(7) Back-up/redundancy requirements
(8) Maintenance procedures (Schedules PM's, MI's, and T.I.'s)
(9) Vehicle winterization (chains, doors, heaters, POL)
(10) Operational checks whenever possible, operational checks should be conducted over realistic terrain and distances)
(11) Schedule for embarking, landing and debarking equipment. Levels of fuel and water required. Landing assignment for air and surface assaults.
(12) See Section 16

c. System Check.

(1) SYSCON/TECHCON interface
(2) Wiring/Tagging of cables to be used at termination points on TRC-97, TSC-15, MRC-134/135 and other equipment as required. Reconcile with TSQ-84/TTC-38 cut sheets.
(3) Cut sheets used by TSQ-84/TTC-38 should reflect wiring and tagging of equipment. In addition, cut sheets must be reconciled between all SYSCON/TECHCON facilities.
(4) Line route maps and cabling plans should include distances, routes between termination points (land marks), line conditioning requirements, and ensure power and assault cabling (WD-1, WD-16, etc,...) aren't run in parallel.
(5) Lost communications procedures
(6) Circuit restoration priorities

d. Embarkation/Debarkation Requirements.

(1) Air and surface transportation support (height/length/weight/cube) for communications equipment/pallets.
(2) Crane/forklift requirements (onload/offload at distant end)
(3) Embarkations boxes (waterproofing/supplies) See Unit SOP
(4) Limitations on degrees of turning capability for specific equipment (e.g., TGC-37'/TYC-5A)
(5) Communications requirements for embarkation/debarkation/convoy control. (Radio and wire)
(6) Inspection of vehicles, generators and any hazardous cargo.

SECTION 3: AFLOAT CHECKLIST

1. THE FOLLOWING CHECKLIST PROVIDES PRE EMBARKATION/EMBARKATION TOPICS OF CONCERN

A. COMMUNICATION GUARD SHIFTS

1. REFERENCES (NTP-4(B).
2. SUBMIT AT LEAST 72 HOURS PRIOR TO REQUIRED EFFECTIVE TIME.

B. US NAVY SHIPS COMM-ELECT EQUIPMENT (SEE SHIPS EQUIPMENT SUMMARY)

C. COMMUNICATIONS ASSETS NORMALLY AVAILABLE FOR USE (EMCON CONSIDERED)

1. DCS ENTRY
2. NARROW BAND SECURE VOICE (NBSV)
3. LF MUX/VCC-2 BETWEEN COMMAND CONFIGURED SHIPS
4. BLINKING LIGHT (NANCY OPS/SEMAPHORE)
5. TASK GROUP ORESTES (TGO)
6. WIRE NOTES WITHIN TASK GROUP (NON-RECORD TTY TRAFFIC)
7. HI COMM (HF SECURE VOICE)
8. PRI CI (TASK GROUP UHF SECURE VOICE)
9. LF TRANSIT CIRCUITS (HF/VHF/UHF/VCC-2)
10. MESSENGERS/COURIER SERVICE (HELICOPTER/LIFE LINE)

D. COORDINATION OF COMMUNICATIONS TOPICS WITH SHIP'S COMM-O/N-5.

1. JOINT INSPECTION OF SHIP'S COMMUNICATIONS FACILITIES
2. DECK MOUNTING OF LF CIRCUITS (REDUNDANCY MUST BE CONSIDERED IN CASE OF OUTAGES TO SHIP'S ASSET'S)
3. RESTORATION PRIORITIES JOINTLY ESTABLISHED
4. FREQUENCIES INTENDED FOR USE SHOULD BE REVIEWED BY THE N-51 SHIPS COMM O FOR SEPARATION
5. EW TRAINING EXERCISES-TRANSIT
6. LF TRANSIT COMMUNICATIONS EXERCISES
7. REHEARSAL COMMUNICATION REQUIREMENTS
8. REHEARSAL/OPERATIONAL REQUIREMENTS (SETTING UP OPERATION OF THE SACC/FSCC/FAC-LOG AND TROOP COMMAND CENTER)
9. MARS OPERATIONS
10. EMCON/HERO
11. NAVY USES THE TERM LINE NUMBERS/USMC USES THE TERM CIRCUIT DESIGNATORS
12. CMS REQUIREMENTS (COORDINATE CHANGE TIME AND SYSTEMS)
13. TASK FORCE DESIGNATORS
14. AIG'S RECONCILIATION
15. SHIPS COMMUNICATION CENTER REQUIREMENTS/RADIO CENTRAL (MESSAGE PICK-UP AUTHORIZATION/ PROCEDURES/MESSAGES ROUTING INSTRUCTIONS-HOW MANY COPIES OF WHAT TYPE OF MESSAGES TO WHOM) SHOULD INCLUDE EMERGENCY ACTION MESSAGES, AMCROSS, WELREPS, OP IMMEDIATE AND HIGHER PROCEDURE MESSAGES, AND PERSONAL FOR MESSAGES
16. ROUTES FOR MESSENGERS
17. DIAGRAMS OF OFFICE AND COMMUNICATION SPACES
18. ROSTER OF TROOPS AND NAVAL OFFICERS ONBOARD, WITH THE FOLLOWING INFORMATION SHOWN AS APPROPRIATE: TITLE, ACTION STATION AND TELEPHONE NUMBER, STATEROOM NUMBER AND TELEPHONE NUMBER
19. CRYPTOGRAPHIC ARRANGEMENTS

20. INTEGRATION OF LANDING FORCE/EMBARKATION TROOPS INTO SHIP'S COMMUNICATIONS SPACES
21. WESTPAC/EASTPAC CIBS
22. SEE N-5/SHIP'S COMM O FOR REMOTING/WIRE LAYING PATHS AND TEMPEST VIOLATIONS REQUIREMENTS.
23. UTILIZATION OF EMBARKED COMMUNICATIONS PERSONNEL TO AUGMENT SHIP'S COMMUNICATIONS SECTION IN RADIO CENTRAL AND FLAGBRIDGE WILL ENHANCE READINESS OF ALL.

SECTION 4: DEPLOYMENT/OPERATIONAL CHECKLIST

1. THE FOLLOWING COMMUNICATION TOPICS ADDRESS SOME PERTINENT ASPECTS FOR DEPLOYMENT/OPERATIONAL CHECKLIST:

A. REVIEW PREVIOUS AFTER ACTION REPORTS AND LESSONS LEARNED
B. COMMUNICATION-ELECTRONICS ESTIMATE BASED ON INITIATING DIRECTIVE, COMMANDER'S GUIDANCE, AREA RECON AND COURSES OF ACTION. (AIR ASSAULT, SURFACE ASSAULT OR COMBINATION AIR/SURFACE ASSAULT). SUBSEQUENT OPERATIONS ASHORE SHOULD BE CONSIDERED FOR EXTENDING COMMUNICATIONS AND CONDUCTING COMMAND POST DISPLACEMENTS.
C. COMMUNICATION OPERATING INSTRUCTIONS TO INCLUDE:

   1. CIRCUIT REQUIREMENTS
   2. FREQUENCY REQUIREMENTS (CHANGING/NON CHANGING) AND USE OF PROPHET PREDICATIONS FROM SERVICING NAVCOMMSTA.
   3. CALL SIGNS (CHANGING/NON CHANGING) TO INCLUDE CW AND VOICE TACTICAL CALL SIGNS.
   4. CRYPTOGRAPHIC INSTRUCTIONS (ALWAYS INCLUDE LOCAL TIME CONVERSION INSTRUCTIONS)
   5. MIJI REPORTS - ECCM TECHNIQUES/PROCEDURES
   6. SIGSEC/BEADWINDOW
   7. EMCON/RADIO SILENCE
   8. NATO MESSAGE DRAFTING AND EXERCISE INSTRUCTIONS
   9. NETS TO BE ACTIVATED FOR COMMEXES/REHEARSALS
   10. CP DISPLACEMENTS (COMMAND GROUP CALL SIGNS/ SHIFTING NCS)
   11. REPORTS

D. COMMUNICATIONS MAINTENANCE
E. TERMINATION REQUESTS
F. COMMUNICATION SITE REQUIREMENTS (ROUTES INTO/OUT, ANTENNA SITTING, REFUELING, LINE ROUTES)
G. COMMUNICATION EQUIPMENT (REDUNDANCY FOR CIRCUITS/DECK MOUNTING)
H. ALTERNATE MEANS OF COMMUNICATIONS (BLINKING LIGHT/ SEMAPHORE, LEASED LINES AND COMMERCIAL POWER)

I. AIR CONDITIONING/HEATING COLD WEATHER COMMUNICATIONS SEE SECTION 9

J. DUST FILTERING - OTHER DESERT COMMUNICATIONS PLANNING REQUIREMENTS (SEE SECTION 10)

K. PREPARE BRIEFS TO INCLUDE SHIPBOARD OP SPACE FAMILIARIZATION (SACC/FSCC/COMMUNICATION FACILITIES ETC.)

1. TECG REQUIREMENT
2. TASK FORCE DESIGNATORS
3. AIG'S
4. PLAIN LANGUAGE ADDRESSES
5. HOST NATION LEASED LINE (LINE CONDITIONING) USE/COMMERCIAL POWER (POWER CONVERSION)
6. C&C HELICOPTER USE
7. RETRANSMISSION - FREQUENCY SEPERATION
8. RADIO WIRE INTEGRATION
9. PERSONNEL STATUS
10. EQUIPMENT STATUS
11. ANTICIPATED PROBLEM AREAS (HF FREQ'S), LINE OF SITE COMMUNICATIONS AND PLANS FOR CORRECTIVE ACTIONS
12. SPECIAL MESSAGE DRAFTING PROCEDURES
13. PRE CUT FIELD EXPEDIENT ANTENNAS

SECTION 5: POST OPERATION/DEPLOYMENT CHECKLIST

1. THE FOLLOWING CHECKLIST TOPICS COVERS AREAS OF CONCERN FOR POST EXERCISE/OPERATIONAL COMMUNICATIONS:

A. ADVANCE PARTY TO SHIP/HOME PORT REQUIREMENTS

1. COMMUNICATION CENTER SUPPORT
2. MESSAGE PICK-UP AUTHORIZATION
3. DEBARKATION REQUIREMENTS (DEBARKATION RADIO/TELEPHONE AND CONVOY CONTROL NETS)
4. SUBMIT RETURN COMM SHIFTS

B. OPERATIONAL AREA

1. ACCOUNT FOR ALL PERSONNEL
2. ACCOUNT FOR ALL MATERIALS (CMS AND EQUIPMENT)
3. POLICE OF OP AREA
4. CONDUCT RETROGRADE
5. WASH DOWN EQUIPMENT
6. REEMBARK

C. MAINTENANCE

1. CONDUCT SL-3 INVENTORY
2. RESTORATION OF EQUIPMENT - CONDUCT MAINTENANCE, UPDATE RECORDS, SUBMIT ERO'S

3. RECONCILE CMR AND DPR
4. SALT WATER CHECKS
5. DESNAILING
6. JOINT LTI'S (CONDITION CODES AND ESTIMATE COST OF REPAIR
7. RETURNED OF TEMP LOANED EQUIPMENT
8. USAGE DATA (BRTY'S, WIRE SUPPLIES, POL)
9. EQUIPMENT STATUS REPORTS

D. INSPECTIONS OF PERSONNEL AND EQUIPMENT

SECTION 6: COMMUNICATIONS SITE SELECTION

1. GENERAL. The selection of a communications site may be dictated by many factors beyond the control of the communication-electronics officer. Where possible, however, as site that is suitable from a operational and communicators viewpoint should be selected. The site should be with open ground, or ground that can be readily cleared, to permit good fields of observation and fire around the installation. Natural obstacles that preclude of delay access into the area are desirable. When the site is isolated, the area should be sufficiently large to accommodate a rotary-wing aircraft landing area within the perimeter for resupply and evacuation.

2. SITE RECONNAISSANCE. When possible, a physical recon of the site should be made with the following considerations to be answered.

a. Will this site provide the communication-electronics the commander requires?

b. Where will the communication-electronics equipment be placed.

(1) Generators - noise, fuel drums separation and fire extinguishers.
(2) Remoting operations and distances.
(3) Distance of site from motor pool.
(4) POL refueling operations accessibility.
(5) Antenna farm and siting (use directional antennas when possible).
(6) Cabling plan - transmission lines, power lines and cables, commercial lines.
(7) METT
    (a) MISSION (assigned and implied)
    (b) ENEMY (know locations and approaches)
    (c) TERRAIN and WEATHER (sun spots, antenna masking etc.)
    (d) TROOPS and FIRE SUPPORT

(8) COCOA
(a) Cover
(b) Observation
(c) Concealment
(d) Obstacles
(e) Avenues of Approach

c. What are the effects of powerlines, electrical stations, hill masses, dense woods and distances on radio communications and the particular effects of command post elevation with respect to that of other communications and intervening terrain where line of sight equipment is used?

d. Effects of distance and terrain on wire, cable and messenger communications.

e. Necessity of wire routes to other units.

f. Routes of communications and traffic conditions. Roads into and out of the site (critical gradients and curves) and the traffic expected on these roads.

g. The availability of cover, concealment and physical security.

3. PRE-RECONNAISSANCE.

a. Arrangements for support required to displace personnel and equipment should be prepared for submission when required. Bulldozers may be required to dig-in positions.

b. The issuance of the Warning Order will enhance personnel and equipment readiness.

c. Check the terrain on the maps before leaving. File a fire support plan with the S-3 before departure with exact primary and alternate routes to be taken.

4. CONDUCT OF RECONNAISSANCE.

a. Check the terrain in the area.

b. Is the site accessible, relatively flat, and provide good overhead concealment from aerial observation?

c. Will the effects of weather allow the unit to leave the area, i.e., mud, snow, and ice?

d. Check the profile of th shot. (Will the use of repeaters, transmission or aerial relay be needed to overcome obstacles)?

e. Check the distance on the map from site location to all units to ensure equipment is within range capabilities and that obstacles can be traversed. If not, what other communication means can meet the requirements.

f. Check the antenna locations for masking or shielding from enemy positions.

g. Select generator locations and how they can be dug in for protection and noise dispersion.

h. Can the site be defended? Once physical security of the site is checked, then identify subscriber locations and cable runs that must be made.

i. Stake the area where equipment is to be placed (routes to billeting areas, messing, work areas, heads and showers, motor pool and antenna farm).

5. SITE RECONNAISSANCE REPORT. This proposed report is attached.

6. ACTION. Use of this checklist will provide communicators the basic information to be considered for communications site selection.

SITE RECONNAISSANCE REPORT

DATE ________________
UNIT ________________
OPORD DESIG ________

1. **SITE/AREA**

MAP
MAP COORDINATES
ELEVATION IN FT/M
LANDMARKS FOR REFERENCE

2. **TERRAIN AND WEATHER**

TYPE OF SOIL
GROUNDING
STAKES - WILL NORMALLY USE GROUND STAKES, TENT STAKE, ANTENNA STAKES BE USED OR ARE ENGINEER STAKES REQUIRED.
CONDITION
WIND DIRECTION
WIND VELOCITY
EFFECTS OF: SNOW
ICE
MUD
DRAINAGE

3. **SITE ACCESS** Fill in the following information on a sketch map with base reference points.

HLZ LOCATION
SIZE
ELEVATION
WIND DIRECTION
OBSTACLES
BEST APPROACH

TYPE ROADS:
WIDTH OF ROADS (COORDINATES)
TURN AROUND POINTS (COORDINATES)
OVERHEAD OBSTACLES (COORDINATES AND ROAD DIRECTION)
RATE OF CLIMB (COORDINATES, CRITICAL GRADIENT AND CURVES)

WATERWAYS
DEPTH
SPEED OF CURRENTS
FORDS
TRAFFICABILITY

4. <u>NEARBY INSTALLATIONS</u> Fill in the following information on a sketch map with base references points.

LOCATION
DISTANCE FROM SITE
TYPE
FUNCTION
CABLING USAGE
LOCAL POWER HOOK-UP REQUIREMENTS
POWER ACCESS
TELEPHONE HOOK-UP ACCESS
LEASE LINE
MAG DROP
BILLETING
MESSING
SHOWERS
HEADS
RECREATION
FIRE PROTECTION/ALARMS

5. <u>COMM-ELECT EQUIPMENT PLACEMENT</u> Draw a site diagram with the following information shown: Use base reference points.

GENERATIONS
CABLING-POWER
HOOK-UP POINTS
VANS
LINE ROUTE FOR WIRE
ANTENNA FARM
OBSTACLES
EQUIPMENT LOCATIONS

6. <u>DEFENSIVE CONSIDERATIONS</u> (DRAW SKETCH)

METT
COCOA
FIRE SUPPORT PLAN
INFANTRY UNIT POSITIONS
OTHER UNIT LOCATIONS

SECTION 7: ORGANIZATIONAL CHART COMM. PERSONNEL

NAME	COC	ORGANIZATION	DUTIES	EQUIPMENT ASSIGNMENT	WATCH ASSIGNMENT

SECTION 8: EQUIPMENT DENSITY PLAN

PALLETS

SOURCE	EQUIPMENT ASSIGNMENT	QTY	EQUIP/SET SER.#	VEHICLE ASSIGNMENT	SHIP/AIR	L	W	H	SQFT	CUFT

SECTION 9: COLD WEATHER COMMUNICATIONS CHECKLIST

1. The following checklist was extracted from FMFM 10-1 and other sources which provide relevant information for cold

A. WINTERIZATION KITS FOR VEHICLES SHOULD INCLUDE DOORS, CHAINS AND HEATERS

B. INSTALL BATTERIES IN RADIOS IN HEATED SHELTERS WHENEVER POSSIBLE

C. CARRY DRY CELL BATTERIES NEXT TO OPERATORS' BODY FOR WARMTH

D. SOME COLD WEATHER BATTERIES MAY BE REACTIVATED BY WARMING AND THEN USING INDOORS

E. NORMAL LUBRICANTS SHOULD BE REPLACED BY ARCTIC LUBRICANTS

F. ALL RADIOS SHOULD BE TURNED ON AND WARMED UP FREQUENTLY WHEN NOT OPERATIONALLY EMPLOYED

G. MOISTURE CAUSED BY BREATH FREEZES ON MICROPHONE ELEMENTS (PLASTIC COVERS OFF BA 4386'S OR SIMILAR BATTERIES WILL DETER THE FREEZING OF MICROPHONES)

H. WET CELL BATTERIES SHOULD BE KEPT AT A HIGH RATE CHARGE TO REDUCE FREEZING AT LOW TEMPERATURES

I. POOR GROUNDING DUE TO FROZEN GROUND REQUIRES EXTENSIVE USE OF COUNTERPOISE. COUNTERPOISE SHOULD BE KEPT ABOVE SNOW TO MINIMIZE CHANGES TO TUNING. GROUND STAKES ARE HARD TO INSTALL IN FROZEN TURF.

J. MESSENGERS SHOULD BE DISPATCHED IN PAIRS

K. INSULATION AND WIRING BECOME BRITTLE IN EXTREME COLD. ANTENNA CABLES SHOULD BE EMPLOYED WITH CARE.

L. MAGNETIC STORMS AND AURORAL ACTIVITY CAN BLACKOUT CERTAIN FREQUENCIES FOR LONG PERIODS OF TIME. VHF AND UHF ARE LESS AFFECTED THAN HF FREQUENCIES (USE AO WITH PROPHET)

M. NYLON GUY ROPES DO NOT ABSORB WATER AS READILY AS HEMP OR COTTON WHICH REDUCES OCCURENCES OF FREEZING AND BREAKING

N. ENGINEER STAKES SHOULD REPLACE ALL WOODEN STAKES AND

ANCHOR ANTENNA GUIDELINES STAKES

O. TEMPERATURE CHANGES CAUSE CONDENSATION ON ELECTRICAL CIRCUITS AND SUBSEQUENT POSSIBLE MALFUNCTION

P. CHECK EQUIPMENT RELAY FOR CONDENSATION WHICH WILL CAUSE FAILURE

Q. CAPACITORS AND RESISTORS MAY CHANGE VALUES IN EXTREME COLD CAUSING EQUIPMENT MALFUNCTIONS

R. WATER CONDENSATION IN FUEL TANKS FREEZES, KEEPING FUEL TANKS FULL AND DRAINAGE OF SEDIMENTS BOWLS AT LEAST ONCE DAILY WILL MINIMIZE OUTAGES

S. LINERS AND STOVES ARE NEEDED FOR TENTS

T. THE USE OF LUBRICANTS WILL HELP PREVENT WATER COLLECTION ON ANTENNAS AND SUBSEQUENT FREEZING

U. HOT BOX(S) FOR DRY CELL BATTERIES. EXTENSIVE CARE MUST BE EXERCISED WITH ALL WET CELL BATTERIES

V. DO NOT SEPARATE PERSONNEL FROM THEIR PERSONAL GEAR

SECTION 10: DESERT CHECKLIST

1. The opposition to successfully establish, operate and maintain communication-electronics are varied and essentially relate to the distance, terrain, wind, heat, corrosion and omnipresent fine sand. The following is recommended as some measures to counter the environmental aspects of desert operations.

A. RADIO COMMUNICATIONS

1. Use VHF (Secure voice OPS, RWI Retransmission and multichannel) capabilities by time sequence. This would include only establishing those circuits absolutely required (LF Comm Coord/ENG) to pass limited traffic until the commander desires full activation of other VHF communications. This would allow for all VHF radios (initially OP checked and nets established then put in stand by mode/off) until activation is required, thereby reducing battery usage and equipment casualty.

2. Use HF equipment with generators.

3. Activate radio circuits at night (include MUX)

4. Pay particular attention to filters in all radios

and power generating equipment. (Have spares)

5. For "heat ducting" move antennas

B. WIRE COMMUNICATIONS

1. Make extensive use of wire communications

2. Consider the use of vehicle and aerial wire laying capabilities

C. VISUAL COMMUNICATIONS

1. Blinking light

2. Semaphore

3. Panels

4. Pyrotechnics

D. MAINTENANCE

Maintenance will be the determining factor for success in terms of equipment reliability

1. Preventive maintenance include:

   a. Training of operators
   b. Establish a maintenance plan
   c. Design and construct additional filtering devices (plywood barriers, boxes with cheese cloth) initiative, exploration and testing are required.

2. Take vacuum cleaners, fans and plastic bags for use.

SECTION 11: EW ESTIMATE CHECKLIST

SITUATION AND COURSE OF ACTION

AREA OF OPERATIONS

1. Are there any unusual atmospheric conditions which will effect electromagnetic radiations?
2. What is the normal or predicted wind direction and speed?
3. Are there any existing or predicted weather conditions which may restrict employment of aircraft or restrict other mobility?
4. Which terrain provides the best electronic observation?
5. Which terrain provides maximum shielding or masking of emissions?
6. Which terrain presents obstacles to mobility of EW and CE systems?

ENEMY SITUATION

1. What are his EW/SIGNT intelligence capabilities?
2. What is his ECM doctrine?
3. What is his demonstrated or known linguist capabilities?
4. What success has he had in jamming our systems?
5. What techniques did he attempt to deceive?
6. Has he attempted to employ deception?
7. What systems did he attempt to deceive?
8. Under what conditions did he attempt to deceive?
9. Why did his deception effort fail?
10. Is there any known or suspected successful deception efforts on his part?
11. What systems/operators did he deceive?
12. Under what conditions was the deception employed?
13. What type of Comm-Elect systems does he use?
14. Which of these systems or the capabilities they augment present a threat to the mission?
15. Which of these systems have proven vulnerable in the past?
16. What type of ECM has proven most successful against these systems?
17. What type of ECCM does he deploy to protect his system?
18. Has he developed a pattern in his usage of EW or those systems which represent a threat to us?
19. What is his EW personnel and equipment status?
20. How well are his CE operators trained?
21. Will he employ jamming against us? If so, what system will he attack and when?

22. Will he attempt deception? If so, what (who) will he attempt to deceive and what will be his objective?

23. Will he employ SIGINT/EW intelligence collection resources against us? If so, what will be his principal targets?

24. Is there a geographical area where he can be expected to concentrate his EW and CE resources?

FRIENDLY SITUATION

1. What EW/SIGINT organizations do we have for this operation?

2. What are their respective EW intelligence, ECM, ESM, and ECCM capabilities?

3. In what respect is our EW intelligence data weak or non-existent?

4. What is our linguist capabilities?

5. What CE systems:
   - are critical to the success of our mission?
   - will add substantially to the success of our mission?
   - have little or no effect on the mission?

6. What are our ECM limitations?

7. How well our operators trained?

8. What is our EW personnel status?

9. What is our ECM intelligence collection capability in relation to the selected enemy threat?

10. how can we employ these resources?

11. What is our ECM, jamming and deception, capability in relation to the selected enemy threat?

12. how and when can we employ these resources?

13. What ECCM procedures will assist most in degrading the enemy threat?

14. What various combinations of those actions identified in 9-14 can be employed in a course of action?

15. Who must employ these techniques and when?

16. How many different courses of action is the S-3 considering and what are they?
   - CA #1
   - CA #2
   - CA #3

17. What are the relative friendly and enemy vulnerabilities to EW intelligence collection, jamming, deception, and CE systems employment?

ANALYSIS OF OPPOSING COURSES OF ACTION

1. What difficulties can be expected with EW Support to our defense against enemy EW for each individual course of action?

2. What EW Support/Defense difficulties are common to all courses of action?

COMPARISON OF OWN COURSES OF ACTION

1. What are the advantages of each course of action?
2. What are the disadvantages of each course of action?

	Advantages	Disadvantages
CA #1		
CA #2		
CA #3		

RECOMMENDATION

1. What enemy systems are to be targeted? Which friendly systems will need protection?
2. Where are they located?
3. What is the desired objective?
4. When is it to be accomplished?
5. How is it to be accomplished?

SECTION 12: TRAINING

The following training topics should be broadened to include other unit requirements.

A. LVTC-7 a thorough indoctrination in operating procedures should be conducted for staffs and communicators who will utilize this command vehicle. Operational checks should include radio and wire equipment, a complete systems check with special emphasis on the sue of staff remotes, main control panel and all radio and wire positions.

B. The following subjects should be specifically addressed in the pre-deployment communications training:

Authentication tables.
Numerical codes
SIGSEC/COMSEC
Defense against ICD (ECCM)
MIJI reporting
Beadwindow procedures/EEFI's
Storage and issuance of COMSEC/CMS materials
Call Signs (Daily changing/non-changing TAC voice Call Signs)
Communication-Electronics Annex
Imposition of radio silence (EMCON PLAN)
Embarkation/Debarkation
External communications
Ship-to-Shore movement

Support of Taclogs from organic personnel and equipment
Control of helicopters
Shore party communications
Unloading equipment during initial assaults
Landing Force communications
Trouble shooting/maintenance
Organic supporting arms communications
Air support communications
Use of operational Brevity codes
Naval Gunfire support communications
Visual communications
Cold weather operations (rotation of batteries, changes in electrolyte, specific gravity, Etc.) See Section 9
Desert operations. See Section 10
Operational water-proofing of equipment

C. During the afloat phase, specific emphasis should be put towards maintaining and improving existing levels of readiness. The following is recommended for communicators afloat

1. TRANSIT COMMEXES AMONG THE EMBARK UNITS
2. TRANSIT EW EXERCISES TO INCLUDE U.S. NAVY SHIPS AND EMBARKED UNITS. ESTABLISH A JOINT EWCC
3. MAKE COORDINATION WITH THE N-5 AND SHIP'S COMMO(S) TO PLACE COMMUNICATIONS PERSONNEL IN COMMUNICATIONS AREAS TO TRAIN AND AUGMENT NAVY WATCHES, E.G., SIGNAL BRIDGES, CIC'S, COMM CENTER.
4. CONDUCT DAILY AND WEEKLY PREVENTATIVE MAINTENANCE SCHEDULES.
5. FIELD EXPEDIENT ANTENNA CLASSES
6. USE SWITCHBOARDS TO ESTABLISH RADIO OPERATOR TRAINING WITH EACH SWITCHBOARD BEING A RADIO NET
7. PRINTING/SPELLING
8. NET CONTROL STATION FUNCTIONS
9. PRACTICE SENDING REPORTS FREQUENTLY USED BY STAFFS
10. LEADERSHIP
11. CW/SEMAPHORE COMMUNICATIONS

D. Operational phase.

1. COMM O'S FIVE PARAGRAPH ORDER EXPLAINING MISSION AND THE WHO, WHAT, WHEN, WHERE AND WHY OF THE INDIVIDUAL'S RESPONSIBILITY AND THE PART PERSONNEL PLAY SIN THE BIG PICTURE
2. REVIEW REQUIREMENTS AND CONCEPT FOR EMPLOYING COMMUNICATIONS
3. CAMOUFLAGE
4. NOISE/LIGHT DISCIPLINE
5. HOW TO PREPARE FIGHTING POSITIONS, WHAT SECTOR'S OF FIRE ARE AND THE ACTIONS TO COUNTER ENEMY AIR, ARTY, NBC ACTIONS

6. SPECIFIC INSTRUCTIONS TO COUNTER THE AFFECTS OF WEATHER AND TERRAIN
7. REMOTING OPS
8. RWI
9. RETRANSMISSION

E. During post operations/post deployment the following training is recommended.

1. MAINTENANCE CLASSES
2. CRITIQUE OF EXERCISE FROM COMM PERSPECTIVE

SECTION 13: COMMUNICATION-ELECTRONICS ESTIMATE INPUT FORMAT

1. The following topics, contained within a letter, will be submitted as required in conjunction with the Communications-Electronics estimates before each operational evaluation.

A. Equipment listing for each course of action and the site where items will be employed.

B. Costs estimates for each course of action. Cost categories will include the following:

(1) Diesel
(2) MOGAS
(3) 30W Oil
(4) Rations
(5) Batteries
(6) Other expendibles

C. Power requirements in each course of action based on equipment at each site, type amount of generators and fuel consumption rate. Consolidation of power requirements for mutual use by all site elements will be included in each estimate.

D. Logistical requirements for each course of action to include the following:

(1) Transportation
(2) Messing-include rosters with meal card numbers and ration requirements.
(3) Tentage types and amounts to include camouflage requirements. Special attention may be required to ensure embarkation of 105 arty shell cannisters, and type of stakes needed, i.e., engineer stakes for desert and rocky terrain.
(4) A list of cots, sleeping bags, mosquito nets, tent liners and other items by amounts. Include

such items as 55 gallon drums and hand fuel pumps.

E. Expendible supplies should be listed by item and quantity needed for each course of action and site.

F. Personnel and equipment requirements for each course of action and site. The following formats are recommended for personnel and equipment estimates.

(1) PERSONNEL ESTIMATE

SECTION	RANK	MOS	BILLET/DUTY

(2) EQUIPMENT ESTIMATE

UNIT	EQUIP	QTY.REQ.	O/H	T/E	NEED	REMARKS

2. In addition to providing action information to appropriate sections, this information will be used by the sections for input as part of the Communication-Electronics Estimate.

SECTION 14: GENERATOR OPERATORS CHECKLIST

1. ADJUSTMENT PROCEDURES

If during generator set operation, it is found that frequency or voltage outputs are over or under their rated values, they must be adjusted to their rated values. To accomplish these adjustments, utilize the frequency and voltage adjustment rheostats, turning the rheostats clockwise to increase rating and counterclockwise to decrease ratings. If frequency and voltage adjustment rheostats will not bring the outputs to their proper rated values, shut down the generator set and report the discrepancy to proper maintenance personnel.

* WARNING

AFTER FORDING OPERATIONS, MAKE SURE THAT ALL WATER IS DRAINED FROM THE GENERATOR SET AND ALL PARTS ARE DRY PRIOR TO STARTING.

(1) Open access doors and remove four plugs from the base to permit water to drain from generator set. Leave doors open to permit generator set to dry out.

(2) Open fuel tank vent valve.

(3) Open engine airbox and battery mount drain cocks.

GENERATOR OPERATORS CHECKLIST

	BEFORE	DURING	AFTER
Check all components	X		X
Check for fuel, oil, water for leaks	X		X
Verify fuel, water, oil, and batter levels	X		X
Listen for unusual noise		X	
Check temp, guage 180 degrees through 220 degrees		X	
Check oil pressure guage 30-60		X	
Check fan belts 3/4" looseness	X		X
Drain fuel cocks twice daily	X	X	X

ECHELON OF MAINT

1st Make a 360 degree check of generator
2nd Have trip ticket for equipment
3rd Ensure leads are inplace and are tight
4th Make sure all elec. connections are tight and that generator is grounded
5th After start, make 360 check
6th After stop, perform 3, 4, and 5 again

SECTION 15: SHF REQUIREMENTS

1. AN/TRC-97C/E Requirements for planning and antenna siting procedures.

A. Antenna site considerations
   (1) Distance between sites
   (2) Accessibility
   (3) Terrain
B. Performance prediction
   (1) Determine the K factor
   (2) Select the topographical maps
   (3) Plot the profile chart

(4) Determine the antenna elevation angles (horizontal angles)
(5) Determine the scatter angle (effective angular distance)
(6) Determine the performance margin
(7) Determine the effects of vegetation
(8) Determine the effects of rainfall
(9) Determine the effects of transmitted power reduction
(10) Plan for alternatives if predicted performance margin is negative. For this condition, some possible alternatives are possible.

(a) Relocation of terminals
(b) Other types of propagation
(c) Operation below the minimum acceptable standards

2. Ensure that the appropriate azimuths are set on both ends of the shot.

3. Units will plan shots and then use ECAC to verify link reliability.

4. Ensure that 10ft assault cables are prewired in accordance with cutsheets.

SECTION 17: AMPHIBIOUS EMBARKATION CONSIDERATIONS

1. General The following personnel, equipment, and communications centers afloat considerations are those which, when properly attended, facilitate team work between Naval and Marine personnel embarked aboard assigned shipping.

A. Personnel
(1) Exact condition of troop spaces (cleanliness, paint, speakers, mechanical devices, air vent covers and heads) should be noted by the troop commander.
(2) Exact inventory of all mattresses, mattress covers, pillows, pillow cases, linen, and blankets must be completed. Accountability and chain of custody is important.
(3) Identify all guard and fire watch requirements.
(4) Identify mess duty requirements.
(5) Accountability of personnel during ship drills is a requirement. Frequently, Marines may be detained by the ship's crew during drills to check on the accuracy of personnel reports.
(6) SNCO billeting/messing may become a morale

problem for SSGT's in that some ships may not accord SNCO privileges to E-6's.

(7) Personnel from embarking units are usually assigned to the ship's platoon and go aboard 304 days in advance.

(8) Embarking communications personnel may be required to operate convoy control and embarkation/debarkation communications.

(9) Spaces for training will require close coordination with ship's X.O. and/or selected representative.

(10) The ship's master at arms will frequently inspect troop spaces for personnel in racks with footwear on, police of troop areas, gambling, etc.

B. Equipment Embarkation

(1) Consider the use of screws and hinges vice nails on embark box openings. This will help prevent damage to box tops.

(2) Tactical loading should be considered by embarking those items first which will be debarked last.

(3) For availability of equipment to perform PM, ensure that tie down don't block access to containers and vans.

(4) Take extra locks to replace those which become corroded from the salt water.

(5) Ensure that sufficient waterproofing materials are embarked and available.

(6) Color coding the bottom of 55 gallon drums and using masking tape strips on Comm-Elect equipment will greatly assist in location items during embarkation/debarkation.

(7) Ensure a chain of custody is maintained for all equipment.

(8) Establish a security guard for classified materials.

(9) Establish a guard for equipment, and a secure area for storage of X-mode cables and easily disconnected accessories.

SECTION 17: COMM-ELECT MATERIALS/SUPPLIES

- REPRODUCTION PAPER
- REPRODUCTION FLUID (STORAGE)
- BATTERIES (HOW MANY OF WHAT TYPE AND STORAGE)
- ROLLS OF PAPER
- OFFICE SUPPLIES
- COLUMBIA FILE BINDERS
- TL-33'S FOR OPERATORS
- COMPASSES FOR EACH COMM SITE
- ELECTRICAL TAPE
- ARCTIC LUBRICANTS FOR EQUIP/ANTENNAS
- CONDITION OF TENTAGE (LINERS)
- FIRE EXTINGUISHERS
- HEATERS
- MALLETS/ENGINEER STAKES FOR TENTS AND GUIDELINES (105 ARTY SHELL CASINGS)
- 55 GAL DRUMS FOR POL (UNIT MARKING ON BOTTOM OF EACH DRUM MAY ASSIST IN IDENTIFICATION/RECOVERY IF STOWED ABOARD SHIP)
- FLASHLIGHTS
- PLASTIC BAGS FOR AREA POLICE
- SPARE FUSES
- WATER PROOFING MATERIALS
- DUST PROOFING (CHEESE CLOTH/PLYWOOD BARRIERS/SCREENS)
- "PIG"TAILS
- LIGHT BULBS

COMMUNICATION PLANNING REFERENCES
(MENU 2.6)

1. REQUIREMENTS OF COMMUNICATION PLANNING

	ITEM	REFERENCE
a.	Selection of planning personnel	NWP 11 ACP176
b.	Combined communication planning staff	ACP 176
c.	Communication planning responsibilities	NWP 11 ACP 176 ATP 8
d.	Scope and application of the plan	LFM 01 ACP 176
e.	General communication planning considerations	LFM 01 NWP 4, 11, 22-1 ACP 122, 176
f.	Organization of command	OPORT (Task Organization) Annex A
g.	Compilation of planning library	NTP 1 ACP 121
h.	Planning data	NWP 4, 11 ACP 167 FM 24-16
i.	Communication orders, instructions, records, and reports	FMFM 3-1 NWP 22-1 ACP 176, 198 FM 24-16
j.	Communication publications (JANAP's, ACP's, and NTP's	FMFM 3-1 ACP 121, 158, 176, 198 NATO SUPP-1
k.	Joint service agreements concerning communications	ACP 121 US 1

l.	Enemy communications-electronics and communications-electronics countermeasures	LFM 01 NWP 33 ACP 125 US 3 ACP 178 ATP 8 FM 24-150, 32-20
m.	Commercial communications	NTP 9
n.	Communications of other United States forces and allies	AXP 3 Interoperability handbook
o.	Locations of headquarters and communications installations	COMM ANNEX OPORD
p.	Supporting plans	Higher, adjacent, and subordinate LFM 01
q.	Tentative plans	NWP 11
r.	Combined instructions	AAP 4 ACP 176

2. ESTIMATE OF COMMUNICATION SITUATIONS

a.	Overall mission	OPORD
b.	Amphibious task force/landing force communication requirements	NWP 4, 11, 22-3 ACP 176
c.	Air-ground task force communication requirements	FMFM 5-1 NWP 22-2 ACP 176 ATP 37
d.	Scheme of maneuver and task organization	OPORD LOI
e.	Type of operation (helicopter, air or waterborne)	ACP 176 ATP 36
f.	Weather, terrain, and geographic area	NWP 11 FM 24-16
g.	Enemy capabilities (include consideration of effect of enemy dispositions, weapons, tactics, unfriendly civilians, etc.)	

h.	Supporting arms communication requirements	FMFM 7-1, 7-2, 7-4
i.	Antiair warfare communication requirements	FMFM 5-5
j.	Combat service support requirements	FMFM 4-2 NWP 11 ATP 16
k.	Communication estimate	FMFM 3-1 NWP 11

3. FORM OF COMMUNICATION INSTRUCTION

a.	Communication Standing Operating Procedures (COMSOP)	FMFM 3-1, 10-1
b.	Communication Operation Instructions (COI)	FMFM 10-1
c.	Basic Communication Plan (COMM PLAN)	FMFM 3-1, 10-1 NWP 4, 11 ACP 176
d.	Paragraph 5 to operation plan/ orders	FMFM 3-1, 10-1 NWP 11, 22-1
e.	Communications-electronics annexes to operation plans/ orders	FMFM 3-1, 10-1 NWP 11, 22-1
f.	Command and Signal	ACP 176

4. FREQUENCIES

a.	Frequency management	NTP 6 ACP 121, 190
b.	Frequency planning	NTP 6 ACP 190 JANAP 195 ECAC ARFA POLICY HANDBOOK
c.	Frequency reliability	ECAC TFMS CHIRPSOUNDER

d. Frequency requests	NTP 6 ACP 190 ABNF
e. Frequency allocation	COI
f. Frequency assignments	NTP 6 ACP 190 COI
g. Frequency usage reports	OPNAVINST 2400.7
h. Alternate frequencies	COI
i. Joint frequency planning	JANAP 195, ANNEX E CSFL OPORD 1-76
j. Worldwide frequency coordination	NTP 6 ACP 121 ACP 190 SUPP 1 ABNF ARFA POLICY HANDBOOK
k. Security of frequencies	NTP 6 ACP 122, 190

5. CALL SIGNS

a. Call sign assignments	ACP 100, 110, 112, 113, 119, 121 AKAI 16 AMSH 1707, 1708, 1709
b. Teletypewriter call signs	ACP 100, 110, 117 CSRF
c. Encrypted call signs	ACP 110 AKAI 16
d. Daily changing call signs	AKAI 16, 21 AMSH 1707, 1708, 1709

6. ALLOCATION OF SHIPBOARD EQUIPMENT FOR TROOP USE

a. Liaison with ship's communication officer and electronics maintenance officer	NWP 4 NWIP 22-6
b. Preembarkation inspection of shipboard communication equipment designated for troop use	NWIP 22-6
c. Operational checks of shipboard communication equipment prior to embarkation	NWIP 22-6
d. Space allocations for landing force communications	LFM 01 SLCP
e. Antenna allocation (KC spread required, DB loss and location of landing force antennas)	Ship's COMM SOP
f. Ship's/landing force's special crypto requirements	COMM ANNEX COI
g. Ship's communications capability (list to be provided)	OPNAVINST 2300.44
h. EMCON policy and activation periods	ACP 176 Ship's COMM SOP
i. Merchant Ship Communication Planning	LFM 01 NWP 22-8 NTP 10 ACP 149

7. COMPOSITION OF NETS TO BE ESTABLISHED

a. Nets available for amphibious operations	ACP 176
b. Shore-to-ship communications (Broadcast)	NWP 22-3 NTP 4 ACP 176 COMM ANNEX
c. Ship-to-shore communications	NWP 22-3 NTP 4 ACP 127
d. Naval gunfire support communications	FMFM 7-2 NWP 22-2 ATP 4

e.	Local and harbor communications	Ship's COMM SOP
f.	Ground-to-air communications	FMFM 5-1 NWP 22-3 ACP 125 US 1 FM 100-26
g.	Establishing beach communications	FMFM 4-3 ACP 176
h.	Communications for shore-based fighter defense of shipping	FMFM 5-1 OPORD
i.	Tactical nets	FMFM 5-1 ACP 176
j.	Command nets	FMFM 5-1 ACP 176
k.	Air support nets	FMFM 5-1 NWP 22-2, 22-3 ACP 176 ATP 36
l.	Air-Sea rescue nets	NWP 37 ACP 135 ATP 10
m.	Air defense communications	FMFM 5-5
n.	Air-to-air communications	FMFM 5-1
o.	Warning nets	FMFM 5-1
p.	Welfare communications	NTP 4, 9
q.	Helicopter nets	FMFM 5-1 NWP 22-3 ACP 176 ATP 36

8. COMMUNICATIONS FOR AMPHIBIOUS OPERATIONS

a.	Task organization communications	ACP 112 MAGTF SOP
b.	Landing force communications	LFM 01 NWP 11, 22-1 ACP 176 ATP 8

c.	Movement reports	NWP 7
d.	Displacement of headquarters for embarkation	FMFM 4-6 NWIP 22-6
e.	Communications during the planing phase	ATP 8
f.	Combined communications systems control	ACP 176
g.	Predeployment check-off list	NWP 11
h.	Preembarkation phase	FMFM 10-1
i.	Loading and embarkation phase	FMFM 10-1 ATP 8
j.	Loading plan including distribution of personnel and equipment to avoid heavy losses	NWIP2206
k.	Loading equipment to ensure access for preventive maintenance	Loading plan
l.	Rehearsals and critiques	LFM 01 ACP 176 ATP 8
m.	Sequence of load to ensure proper unloading sequence	Loading plan
n.	Communications during the embarkation phase	LFM 01
o.	Communications during the rehearsal phase	LFM 01 ATP 8
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