NRAC 88-6

NAVAL
RESEARCH
ADVISORY
COMMITTEE
REPORT

MARINE CORPS

COMMAND AND CONTROL

SYSTEMS

INTRA/INTEROPERABILITY

OCTOBER 1988

OFFICE OF THE ASSISTANT SECRETARY OF THE NAVY
(RESEARCH, DEVELOPMENT AND ACQUISITION)
WASHINGTON, D.C. 20350-1000

UNCLASSIFIED

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

EXECUTIVE SUMMARY

The Naval Research Advisory Committee (NRAC) was tasked in December 1985 to undertake a study of Marine Corps Command and Control (C2) systems interoperability. According to the terms of reference, as revised 20 March 1987, this study was to examine the C2 requirements of Marine Corps forces in the near and mid-term and to make recommendations, as appropriate, to enhance Marine Corps C2 system intra/interoperability capabilities. The Panel, which was organized to address these issues, concentrated its efforts on the Marine Tactical Command and Control System (MTACCS). The Panel traced the history of this integrated C2 automation concept since its 1969 inception, and examined current systems status, capabilities, and future plans. The program's management structure, intra/interoperability documentation, as well as system interface requirements were analyzed in some detail. Two interim assessments were presented to the Marine Corps leadership in May 1987 and February 1988, respectively.

The Panel finds that the original MTACCS goal of an integrated tactical C2 system correctly anticipated needs of Marine Corps commanders for automated decision aids based on enhanced battlefield information processing, display, and communication. This need has become acute in recent times because of two trends, both of which are expected to continue in the foreseeable future. First, advances in sensor systems are contributing to enormous increases in the volume of tactically significant information. Second, increasing mobility of tactical forces is confronting commanders with shrinking decision times.

While MTACCS was a very farsighted concept, its implementation posed an extreme challenge given the technology available in the early 1970's. The goals set for MTACCS have not been realized to date. The system architecture has changed significantly during the past 20 years, including the separation of Marine Corps information systems into Tactical Data Systems (TDS) and Automated Information Systems (AIS). The latter, largely administrative in nature, are not considered part of the tactical C2 architecture. While personnel and logistics support were originally part of MTACCS, these functions are now included in the AIS category even though they are intended for field deployment. To date, only a limited number of planned tactical data systems have been fielded; e.g., certain elements of the Marine Aviation C2 System, the Digital Communication Terminal (DCT), and the Position Location Reporting System (PLRS). Some elements of the Marine Air-Ground Intelligence System (MAGIS) have also been developed. On the other hand, development of a key element, the Marine Integrated Fire and Air Support System (MIFASS), was cancelled in 1987 because of cost and performance problems. It appears that the requirements originally included in MIFASS and the Tactical Combat Operations (TCO) system will be addressed by a new combined program called the Fire Support and Maneuver (FIREMAN) system.

Although efforts are continuing to achieve the MTACCS objectives, the strong central coordination envisioned in the beginning has been lacking. As a result, serious intraoperability deficiencies exist in the current baseline. Many essential TDS interface requirements are inadequately defined or satisfied. Interface requirements between TDS's and deployed AIS's remain undefined. Moreover, it is unlikely that existing or planned tactical communication systems will have adequate capacity, connectivity, robustness, and multi-level security to support future battlefield information systems. Current intra/interoperability documentation efforts

also fall short of essential requirements. The documents are reactive rather than directive in nature, and are not always internally consistent. Indeed, intra/interoperability standards have not been enforced uniformly.

The Panel believes that problems encountered in developing the desired integrated tactical C2 system have been caused primarily by weak configuration management control over MTACCS and its associated systems as evidenced, for example, by a persistent open-ended requirements process. Requirements escalation has been driven by rapid growth in the assessed threat, as well as by the unprecedented pace of technological progress. Unfortunately, the generation of system requirements and specifications has generally not been subjected to adequate systems-engineering discipline, especially in regard to performance simulation. The participation of operating forces in establishing requirements has also been too limited. In the absence of centralized configuration management, the integrated C2 system originally envisioned has evolved into a number of relatively independent subsystems whose individual capabilities have responded to changing requirements without sufficient consideration of impact on overall systems performance.

Despite serious implementation delays, including termination of MIFASS development, the ideas underlying the original MTACCS remain sound. Indeed, the Panel believes that the need for automated support of Marine tactical command and control will continue to grow. The Marine Corps recognizes this fact, and is in a position to benefit from experience gained in the MIFASS and TCO testbed programs. Taken as a whole, MTACCS experience can provide important guides to future progress. The principal critical "lessons learned" are:

(1) The importance of design freezes as a means of controlling requirements "creep".

(2) The strong interdependence of requirements, system performance, and cost.

(3) The crucial role of intra/interoperability as a determinant of C2 system performance.

(4) The importance of systems engineering, supported by simulation testing, especially during the planning phase of any complex system development.

Major organizational changes in the Marine Corps are currently being implemented which have the potential for improving the management of intra/interoperability issues. Other encouraging indications include the good progress being made in Marine aviation-specific systems, and the excellent cooperation between the Navy and Marine Corps in addressing and resolving interoperability problems between the two Services.

Based on its findings, the Panel recommends that the Marine Corps take necessary steps expeditiously to address three general areas of concern:

(1) Systems Engineering: A comprehensive re-examination of tactical C2 system requirements should be conducted leading to an updated baseline definition. Within limits imposed by performance/cost tradeoffs, the new baseline should address near-term mission needs, while providing options for future incremental enhancements consistent with anticipated mission trends. Toward this end, the baseline definition should be based on an open architecture featuring standardized interfaces. It should also make maximum practical use of past

investments, focus on what is achievable in the near term, and aim for maximum integration of TDS's, deployed AIS's, and tactical communication systems. The rebaselining effort should be supported by establishment of a system simulation capability.

Future mission requirements and emerging technological opportunities should be analyzed on a continuing basis. An evolutionary development strategy should be adopted and block upgrades provided as appropriate. Because of the crucial importance of standardized interfaces the Marine Corps should place added emphasis on participation in relevant DOD standards activities.

(2) **Management**: A strong, centralized intra/interoperability configuration management and change control authority should be established with unambiguous responsibility for all TDS's, deployed AIS's (i.e., personnel and logistics support systems), and tactical communication systems. This critically important function must have access to adequate systems-engineering resources to assure an objective basis for decisions. In that regard, strengthening of the Tactical Systems Inter- and Intra-operability Program (TACSIIP) would be a useful step. The establishment of a Correlation Control Group should also be considered.

The baseline documents (C2MP, TIDP, TIC, IMP, etc.) should be transformed into authoritative guides, and a management process be instituted for their timely, orderly updating. Improvements are also needed in management continuity for complex programs. Career planning and development for Marine Corps acquisition officers should be strengthened. Long-term technical support for program managers should be improved.

(3) **Implementation Strategy**: Near-term efforts should concentrate on the required intra/interoperability documentation updates, implementing FIREMAN system development, and planning for an enhanced tactical communications backbone.

The current cycle of documentation revisions should transform the baseline documents into the recommended authoritative guides. Coverage should be expanded to include intra/interoperability requirements for both TDS's and relevant AIS's.

In planning the FIREMAN program, it is essential that this system be treated as part of the larger C2 system architecture specified in the recommended baseline re-definition. In particular, it is important that all system interfaces be defined at the outset. An evolutionary development approach should be aimed at early implementation of minimum essential functional capabilities and subsequent block upgrades. A "build a little"/"test a little"/"field a little"/"build a little more"/--- approach should be followed. Use of "off-the-shelf" equipment and software should be encouraged where applicable. Knowledge gained in the Army ACCS program (e.g., AFATDS) should be applied to Marine Corps programs where technically appropriate.

Command and Control data communication requirements for all phases of MAGTF operations, including over-the-horizon assaults, should be re-evaluated. Interface and data-traffic load requirements should be analyzed. All critical system design constraints (such as data security/integrity and system robustness) must be defined. An architecture should be adopted which satisfies near term needs and can also support future growth.

TERMS OF REFERENCE

NAVAL RESEARCH ADVISORY COMMITTEE PANEL ON U.S. MARINE CORPS COMMAND AND CONTROL SYSTEMS INTRA/INTEROPERABILITY

Marine Corps command and control systems must intraoperate within the Marine Corps and interoperate with the tactical and strategic command and control systems of other services during joint and combined operations. Increasing automation coupled with the diversity of command and control systems throughout the services continue to complicate efforts to achieve effective intra/interoperability. It is proposed that the Naval Research Advisory Committee examine the command and control requirements of Marine Corps forces in the near and mid-term and make recommendations, as appropriate, to enhance Marine Corps command and control system intra/interoperability capabilities. The study should:

1. Review the command and control intra/interoperability requirements of Marine Corps forces in the near and mid-term with emphasis on joint naval operations.

2. Examine Marine Corps intra/interoperability concepts, management procedures, command and control system architectures and program plans to identify potential problems and alternative solutions. Issues of particular interest are:

   a. Interoperability of Marine Corps Tactical Command and Control Systems (MTACCS) with Navy shipboard command and control systems.

   b. Employment of the Joint Tactical Information Distribution System (JTIDS) in the Marine Air Command and Control Systems (MACCS).

   c. The definition of required interfaces for the Marine Integrated Fire and Air Support System (MIFASS).

   d. The definition of required interfaces for the Tactical Combat Operations (TCO) System.

The Naval Research Advisory Committee (NRAC) Panel on U.S. Marine Corps Command and Control (C2) Systems Intra/Interoperability, hereinafter referred to as the "Panel", was appointed by the Director, Naval Research at the direction of the Secretary of the Navy. The original Terms of Reference for the Panel were promulgated by NRAC Memo 9410, Ser: OONR/534402 dated 13 December 85, and amended by NRAC Memo 9410, Ser: OONR1/707614 dated 20 March 87. See Appendix A.

PANEL MEMBERSHIP

Dr. Albert Narath (Chairman)
VP, AT&T Bell Laboratories
(Member, Naval Research Advisory Committee)

Mr. Edward C. Brady
VP, The MITRE Corporation

Mr. Thomas R. Evans
Applied Physics Laboratory
The John Hopkins University

Dr. Roger Hagengruber
Sandia National Laboratories

Mr. David Shore
Independent Consultant

BGEN Paul D. Slack USMC (Ret.)
VP, IOMEGA Corporation

Major Louis L. Boros USMC
Panel Executive Secretary

(Mr. J. J. Brett and Mr. W. E. Smith were also appointed to the Panel initially, but were able to serve for only a short time because of conflicting commitments)

I. SCOPE OF STUDY

I.1. SCOPE

* Tracked Marine Corps C2 Automation/MTACCS Concept From 1969 To The Present

* Outlined Changes In Automated Equipment/MTACCS Sub-Elements Management Structure

* Reviewed Intra/Interoperability Documentation
  - USMC/Navy
  - Other Services/JTIDS

* Reviewed Interface Requirements Of 13 MTACCS Elements And Sub-Elements

* Provided Interim Assessment Reports

[I.1. SCOPE]

The Panel met a total of eight times and gathered information concerning key USMC command and control, and intra/interoperability matters via briefings by HQMC staff officers, and by examining pertinent documents. The Panel also traveled to the West Coast to visit the First Marine Amphibious Force (I MAF) - now designated the First Marine Expeditionary Force (I MEF) - in order to gain insight into the "field" requirements of Fleet Marine Forces (FMF). Briefings by Marine Corps Development Center (DevCenter) personnel and the Fourth Marine Brigade (4th MAB) rounded out joint and combined command and control considerations. Meeting Agendas are attached as Appendix B.

[Note: A Glossary of Terms used is attached to this Report as Appendix C.]

MTAACS. The Panel reviewed the history of the Marine Tactical Command and Control System (MTACCS) and associated systems beginning with the original (1969) concept of an integrated C2 system with organic data communications. (See Appendix D).

Management Structure. The Panel examined the evolutionary history of the existing management structure for all Marine Corps C2 intra/interoperability activities. (See Appendix E).

Interface Requirements. The Panel initially examined the joint requirements primarily for interoperability between Fleet Marine Forces and the Navy (and to a limited degree with other services), with emphasis on the degree to which these requirements are being met. However, the Panel found internal USMC interfaces to be a more serious concern. Subsequent efforts, therefore, focused mainly on Marine Corps intraoperability requirements. (See Appendix F).

Documents Review. The Panel examined and reviewed the requirements and present status of all USMC intra/interoperability efforts with special emphasis on analysis of thirteen MTACCS related programs. (See Appendix G).

Interim Assessments. Due to the fact that the Marine Corps was in the process of making significant and far-reaching MTACCS-related decisions, an informal assessment was prepared. On 7 May 87, the Chairman met with the Chief of Staff of the Marine Corps and with the Director of C4 Systems Division to discuss the preliminary findings of the Panel. A second assessment was provided on 9 February 88, following completion of the first draft report.

Acknowledgement: The Panel acknowledges and appreciates the assistance of Mr. Bob Garrow, the MITRE Corporation, who made significant contributions in the preparation of Appendices D, E, F, and G.

II. FINDINGS AND CONCLUSIONS

II.1. BACKGROUND

II.1.1. MARINE CORPS

Mission. (National Security Act Of 1947-Amended)

* Provide Fleet Marine Forces Of Combined Arms For:
  - Seizure/Defense Of Advanced Naval Bases
  - Conduct Land Operations In Support Of Naval Campaign
* Provide Detachments For Service On Armed Vessels And Installations Of The Navy
* Develop With Other Services Doctrines, Tactics, Techniques And Equipment Employed By Landing Forces
* Provide, As Required, Marine Forces For Airborne Operations
* Be Prepared To Mobilize Reserves
* Perform Duties As The President May Direct

Marine Air-Ground Task Force (MAGTF)

* Command Element (CE)
* Ground Combat Element (GCE)
* Aviation Combat Element (ACE)
* Combat Service Support Element (CSSE)

[II.1.1. MARINE CORPS]

The primary mission of the Marine Corps is to conduct amphibious/expeditionary combat operations in support of the national objectives of the United States. This inherently requires that Marine forces be trained and equipped to conduct operations across hostile shores from the sea, building combat power from zero to a degree sufficient to achieve victory over the enemy.

In order to fulfill its mission, the Marine Corps has developed the Marine Air Ground Task Force (MAGTF) concept. A combined arms force, the Marine Corps relies upon careful planning, and the close cooperation and integration of its Marine Command Element (CE), Ground Combat Element (GCE), Aviation Combat Element (ACE), and Combat Service Support Element (CSSE). MAGTF operations are conducted in tandem with the Navy and often with other Services or countries. Thus, development of all automated command and control systems must take into account the nature and requirements of the MAGTF as a whole.

II.1. BACKGROUND

II.1.2. INFORMATION MOVEMENT AND MANAGEMENT (IM&M)

* Effective IM&M Is A Critical Factor In Battlefield Success

* Needs For Automated Support Are Growing Rapidly
  - Improved Sensor Systems
  - Shrinking Decision Times

[II.1.2. INFORMATION MOVEMENT AND MANAGEMENT (IM&M)]

Combat leaders require the means to gather, process, store, display and forward essential information and operational orders. Improved sensor systems have created an unprecedented volume of information available to the MAGTF commander. By the mid-1990's, the need to cope with the growing information processing load and to deal effectively with the time/decision constraints imposed by increasingly fluid tactical situations will confront MAGTF commanders with profound challenges. In order to alleviate this problem, the Marine Corps is introducing automated assistance into virtually every functional area of command and control, (e. g. ground operations, fire and air support, intelligence, communications, logistics and manpower management).

II.1. BACKGROUND

II.1.3. SYSTEM AUTOMATION

* C2 Functions Must Be Automated In A Manner Which Supports, But Not Supplants, Command Authority
* Functionally Effective Interconnectivity Of C2 Nodes Is Key To System Performance
* Human Interfaces Are Critical System Design Elements
* System Architecture Must Permit Functional Evolution
* Automation Must Preserve System Flexibility And Robustness

[II.1.3. SYSTEM AUTOMATION]

Automated C2 systems, as the term is used in this report, involve information sources (i.e., sensors), storage, retrieval, processing, display, communication, and related functions. They are intended to facilitate the performance of tasks previously performed manually, but will not supplant the commander's decision-making authority or capability. Command and Control within the Marine Corps is exercised at each echelon of command and resides in Combat Operations Centers (COC's), also referred to as Operational Facilities (OPFAC's). The structure of C2 support in each OPFAC has organizational (i.e., functional, procedural, and equipment) dimensions. It is clear that C2 efficacy is strongly dependent on information exchange within and between OPFAC's.

The effectiveness of automated C2 systems also depends to a large extent on the interaction between system elements and the human operator/user. Indeed, to the extent that automation emulates routine and repetitive human actions, there is an assurance that automated systems will fit naturally and synergistically into the existing command structure. The design of automated C2 systems must therefore take the need for user "friendliness" into account from the outset.

Because of inevitable changes in operational requirements, technology, and funding support during the extended life cycle of a complex C2 system, the architecture must support an "evolutionary" implementation approach. Clearly defined stages of development, allowing for the early fielding of initial (perhaps limited) capabilities are essential. Furthermore, it is highly likely that such evolution will continue indefinitely, making the need to accommodate changes a permanent feature of overall systems development and procurement strategy. Early fielding will also allow users to participate meaningfully in defining the subsequent evolution of system requirements.

During combat operations, particularly those which include "forced entry", the successful insertion of automated systems depends heavily on the ability to sustain their use during specific phases of an operation. In practice, some functions may need to use manual procedures (e.g., voice radio) initially, transitioning to automated support as the tactical situation permits. Allowance must also be made for system impairments resulting from battlefield damage. A critical design requirement for any C2 system is an adequate "fail-safe" margin. In the event of equipment loss or failure, critical C2 capabilities must be preserved by system reconfiguration and/or manual backup, as appropriate. Overall system-configuration flexibility is therefore essential.

Size, weight, and power limitations also need to be considered within the realistic context of intended battlefield use. The degree of "ruggedization/militarization" should be part of the overall analysis of user needs.

II.1. BACKGROUND

II.1.4. INTRA/INTEROPERABILITY CONSIDERATIONS

* Intra/Interoperability Considerations Are Fundamental To Systems Integration
* Support Of Common Interface Standards Is Essential
* Achievement Of Maximum Intraoperability Should Be A Major Design Objective
* Achievement Of Universal Interoperability Is Generally Not Feasible For Economic And Other Reasons
* In The Event Of Unavoidable System Incompatibilities "Workaround" Solutions Should Be Adopted Where Necessary

[II.1.4. INTRA/INTEROPERABILITY CONSIDERATIONS]

Developing a complex, integrated tactical command and control system, such as that envisioned by the Marine Corps, requires that intra/interoperability considerations be taken into account at every stage of system design. System interfaces must be carefully specified and controlled because of the critical importance of information exchange as a determining factor in system performance. The trend toward distributed data bases and distributed processing adds weight to the argument that C2 systems must be designed for maximum intraoperability. One of the primary considerations should be the means whereby automated systems interface with the Marine Corps communications system. All systems designed to perform in an integrated fashion should support common, relevant standards at all protocol levels (e.g., data transmission, signaling, message format, application software, etc.).

It is likely that the MAGTF will frequently operate in conjunction with Army and Air Force elements in a combat zone. Additionally, during amphibious/expeditionary assault operations interoperability with various Navy shipboard systems is essential. Marine ground elements may require supplementary air support from Air Force or carrier-based Navy air elements. Thus, joint service interoperability needs are also extremely important. In considering interoperability requirements, it is important to recognize that acquiring interoperability between uncommon systems complicates the acquisition process significantly, and normally entails additional cost. In general, it is not feasible (nor desirable) to make "everything interoperate with everything". Careful analysis is required to identify minimum <u>essential</u> information exchange requirements in joint/combined operations and plan accordingly. Approaches offering procedural and/or equipment "workaround" solutions should be adopted as necessary where system incompatibilities are unavoidable. However, availability of such solutions must not be used to justify neglect of interoperability requirements during the design phase.

II.2. MARINE CORPS AUTOMATED C2 SYSTEM DEVELOPMENT

II.2.1. TACTICAL C2 SYSTEM CONCEPT

* The Marine Tactical Command And Control System (MTACCS) Was Conceived As An Integrated, Automated System Composed Of Five Major Subsystems.
  - Tactical Combat Operations (TCO)
  - Marine Integrated Fire And Air Support System (MIFASS)
  - Tactical Air Operations (TAO)
  - Marine Integrated Personnel And Logistics System (MIPLOGS)
  - Communications (COMMS)

* Additional Support Was To Be Provided by "Associated" Systems
  - Position Location/Navigation (PLANS)
  - Combat Intelligence (MAGIS)

[II.2.1. TACTICAL C2 SYSTEM CONCEPT]

In the late 1960's the Marine Corps conceived MTACCS as an integrated, automated command and control system based on enhanced battlefield data processing, information presentation and communications subsystems. The MTACCS sought to automate supporting functions in the areas of maneuver control, fire support, tactical air operations, and personnel and logistics management. MTACCS plans originally also called for the development and fielding of a subsystem designated COMMS. A comprehensive communications system incorporating digital technology, it was intended to support the data transmission/switching requirements of the other automated command and control nodes of MTACCS. COMMS was to modernize the entire Marine Corps tactical communications architecture to provide MAGTF commanders with a reliable, secure, efficient, survivable and supportable communications backbone. Position location/navigation and tactical intelligence information was to be supplied by "associated" systems. The necessary intraoperability of all MTACCS and "associated" systems was to be assured by tight coordination of the separate development programs. The original objective of the Marine Corps was to field these systems during the 1975-1985 time frame.

II.2. MARINE CORPS AUTOMATED C2 SYSTEM DEVELOPMENT

II.2.2. TACTICAL C2 SYSTEM STATUS

* After 20 Years And Numerous Program Changes MTACCS Is Still Not A Reality
* The MTACCS Concept Has Undergone Significant Changes
* A Coherent, Integrated Communications Architecture Has Not Been Implemented
* Development Of A Major Element, MIFASS, Has Been Terminated
* A New Program, Fire Support And Maneuver System (FIREMAN) Has Been Initiated

[II.2.2. TACTICAL C2 SYSTEM STATUS]

Much time and effort has been expended to make the MTACCS a reality. Yet, some twenty years after its conception, the desired integrated command and control system is still largely under development. Moreover, the system concept has changed significantly during this period. A notable example is the de-emphasis of integrated communications. The original COMMS evolved into the Landing Force Integrated Communications System (LFICS) concept. Execution of COMMS/LFICS as a coherent, integrated whole has not, however, been achieved. Indeed, neither the term COMMS nor the term LFICS appear to be in use within the Marine Corps currently.

Another major change has been the separation of Marine Corps information systems into two categories: Tactical Data Systems (TDS) and Automated Information Systems (AIS). The latter consist of primarily administrative data processing systems and are therefore not considered to be part of the tactical C2 system architecture. While personnel and logistics support was originally part of MTACCS (i.e., MIPLOGS), these functions are now included in the AIS category.

To date only a small number of planned tactical data systems have been fielded, such as certain elements of the Marine Aviation C2 System, the Digital Communications Terminal (DCT), and the Position Location Reporting System (PLRS). Some elements of the Marine Air-Ground Intelligence System (MAGIS) have also been developed. On the other hand, development of the Marine Integrated Fire and Air Support System (MIFASS), one of the major elements of the MTACCS, was halted in 1987 due to excessive development costs and failure to meet design specifications during operational testing. Development of the Tactical Combat Operations (TCO) System, intended to be the automated tactical plans/operations/maneuver control system of the Corps, was originally delayed pending completion of the MIFASS. At times, these two programs were linked, at other times they were pursued independently of each other. With the demise of MIFASS the present plans for the TCO System are not clear. The Panel was informed that the Marine Corps intended to fulfill the requirements originally included in MIFASS and TCO through a new development program called the Fire Support and Maneuver System (FIREMAN). Efforts also continue to produce the automated intelligence, logistics, and manpower elements of the original MTACCS, without the strong central coordination, however, which was envisioned in the beginning. In fact, the Panel understands that the term MTACCS, denoting an integrated automated system, is no longer in use.

II.3. SYSTEM DEFICIENCIES

II.3.1. SYSTEM INTRAOPERABILITY

* Intraoperability Deficiencies Are More Limiting Than Interoperability Deficiencies

* Several Major System Elements Have Not Been Implemented

* Many Essential TDS Interface Requirements Are Inadequately Defined Or Satisfied; e.g.:
  - ULMS/MIFASS
  - PLRS/MIFASS
  - DCT/MIFASS
  - TCO/MIFASS

* Interface Requirements Between TDS's And Deployable AIS's Are Undefined

[II.3.1. SYSTEM INTRAOPERABILITY]

Initial MTACCS plans identified the required system interfaces. As program plans evolved over the years, control over interface specifications eroded. As a result, essential interface requirements between MTACCS subsystems are only partially satisfied. Some of the required interfaces have not been designed, have been waived or have been delayed. From an operational effectiveness standpoint, the lack of adequate intraoperability appears far more limiting than do interoperability deficiencies. As an example, plans called for use of the Unit Level Message Switch (ULMS) as the primary switching device for message transport between OPFAC's over the Marine Corps communication system. Yet, development of the ULMS was not coordinated with the systems it was intended to support. Thus, MIFASS was developed using message protocols which were incompatible with the ULMS. Problems with the PLRS/MIFASS interface forced the development of a PLRS workaround within the MIFASS software. This had the unfortunate result of slowing down an already overburdened system. Incompatibilities also appeared in the Digital Communication Terminal (DCT) interface with MIFASS, requiring more software changes. Due to the uncertain linkage of TCO and MIFASS the interfaces between the systems intended to provide the commander automated support for maneuver control and essential fire-support coordination were never specified. Finally, because of the programmatic separation of TDS's and AIS's, no interface requirements have been established between these system types.

II.3. SYSTEM DEFICIENCIES

II.3.2. INTEGRATED COMMUNICATIONS

* It Is Unlikely That Existing Or Planned Tactical Communication Systems Can Support Traffic Loads Of Future Tactical Data And Automated Personnel/Logistics Systems

* Important Issues Include:
  - System Connectivity For Future Combat Scenarios (e.g. OTH)
  - Communication Protocols
  - Link Capacity
  - System Robustness
  - Security

[II.3.2. INTEGRATED COMMUNICATIONS]

It is unclear whether the existing or planned communications structure of the Corps will support the extensive demands of future Tactical Data Systems (TDS) and deployable Automated Information Systems (AIS). The Marine Corps, like the other Services, is planning to increase its use of automation in virtually every field. Yet, no recent up-to-date analysis exists which defines in detail the communications system capable of simultaneously supporting Marine Corps TDS and AIS requirements. Clearly, most of the automated C2 elements will interface with, or use, tactical communications. While data transport is relatively easy in a garrison environment, field applications will be more difficult and require careful study. The added data-traffic load from deployed AIS's (e.g., personnel/logistics) is an especially important issue. New requirements arising from future missions, such as over-the-horizon (OTH) assaults, as well as potential solutions (e.g. satellite communications, fiber-optic data links, etc.) need to be better understood to assure adequate communications support. Adequacy of link capacities and communication protocols under battlefield conditions will require careful attention. As system complexity increases with time, system robustness and security will become issues of growing importance.

II.3. SYSTEM DEFICIENCIES

II.3.3. INTRA/INTEROPERABILITY DOCUMENTATION

* Key Documents Fall Short Of Essential Requirements
  - Reactive, Rather Than Directive
  - Not Always Internally Consistent
  - Currently In Revision, But Central Coordination Is Lacking

[II.3.3. INTRA/INTEROPERABILITY DOCUMENTATION]

At present, some intra/interoperability documents relating to Marine Corps programs are under revision. Specifically, the Command and Control Master Plan (C2MP), the Tactical Interface Concepts (TIC) document, and the Marine Corps Interoperability Management Plan (IMP), are being revised. These documents tend to be reactive, rather than directive in nature. Despite efforts to coordinate the information included within them they are not always internally consistent. The Marine Corps formally recognizes the importance of these documents in laying the foundation for automated systems intra/interoperability and increased attention is being paid to these matters. However, it is not certain that current revisions will significantly improve future systems development. The content and implementation of these documents taken as a whole is not centrally or forcefully coordinated. If past practices are followed, the result is likely to be the development of systems that do not conform to USMC standards as set forth in these documents.

II.4. PRINCIPAL PROBLEM CAUSES

II.4.1. REQUIREMENTS

* MTACCS Has Suffered From An Open-Ended Requirements Escalation Process Driven By:
  - Recognition Of Growing Threat
  - Unprecedented Pace Of Technological Advances
* Subsystem Capabilities Have Evolved In Response To Changing Requirements, Without Assessment Of Impact On Overall System Performance
* System Requirements And Specifications Have Generally Been Generated Without Adequate Systems Engineering Support, Especially In Regard To Performance Simulation
* The Involvement Of Operating Forces Has Been Inadequate

[II.4.1. REQUIREMENTS]

When first conceived, MTACCS was a farsighted concept which correctly anticipated future mission needs. However, it also represented an extremely ambitious undertaking when viewed in terms of the level of technology in existence at that time. The subsequent history of MTACCS, particularly that of the MIFASS subsystem, reflects a continuing open-ended requirements process. The driving forces have been the growing military capability of potential enemies and the unprecedented pace of technological advance in electronics. The promise of increased performance afforded by newer technology was a powerful stimulus for requirements escalation. Unfortunately, the incorporation of new technology during development has proven to be a slow and difficult task. The net result has been that in most of the developing systems the equipment does not approach current technological levels in performance, size and weight. Moreover, the frequent program changes have often led to unbalanced designs. Long after an equipment suite was selected (and technical limits thereby established), additional capability was frequently requested and included in program scope. In MIFASS, for example, such changes forced significant increases in the size of the application software. The hardware was unable to support the resulting growth in processing requirements because of the decision to use existing standard military computers. This choice not only impacted performance but also resulted in equipment which was excessively large and heavy for the intended use.

Assessment of the impact on development plans and schedules due to changes in requirements was made by functional sponsors on a case-by-case basis. At no time was a full system assessment conducted. Each individual decision seemed justified in light of an increasingly sophisticated enemy threat and the potential capability enhancement afforded by newer technology. The generation of MTAACS requirements and specifications has generally not been supported by an adequate level of systems engineering. In particular, system specifications and design evolved over time without sufficient use of simulation testing. Such modelling is essential for system optimization. For example, it might have given useful insights long before system delivery into the operator workload problems experienced in the Operational Test of MIFASS. From an intra/interoperability standpoint, the analysis of data-traffic loads and the performance of system and subsystem interfaces is especially important.

Similarly, FMF influence over system requirements and specifications has been minimal, despite the critical role of the operator/machine interface in gaining user acceptance.

II.4. PRINCIPAL PROBLEM CAUSES

II.4.2. PROGRAM MANAGEMENT

* Since Its Inception, MTACCS And Its Associated Systems Have Lacked Adequate Management Control
* The System Has Not Been Managed As An Integrated "System Of Systems" But Rather As A Set Of Relatively Independent Subsystems Without Overall Configuration Control
* Although Recognized As Important From The Beginning, Intra/Interoperability Standards Have Not Been Enforced Consistently

[II.4.2. PROGRAM MANAGEMENT]

Following its inception, responsibility for each of the subsystems of MTACCS was vested in a functional sponsor within Headquarters, Marine Corps. Managerial responsibility was entrusted to an Acquisition Coordinating Committee (ACG) made up of mid-level action officers representing the various Divisions/Departments of Headquarters, the Marine Corps Development Center (Quantico, Virginia), and other service program development activities, as appropriate. Developmental responsibility was vested in the Development Center. Insufficient provision, however, was made for configuration management and change control over the entire MTACCS as an integrated "system of systems". Thus, each of the subsystems was developed by a different team acting nearly autonomously. Effective management has also been hindered at times by lack of adequate acquisition-management experience and continuity. (Details on the evolution of the MTACCS management structure are given in Appendix E.)

Requirements for interaction between elements of the MTACCS were always recognized, and efforts were made to formulate common intra/interoperability standards. However, the Director, C4 Systems Division was not given the authority to enforce compliance, and the effort was not assigned the priority it deserved. As a result, the standards process has not kept pace with development of the individual subsystems and has had little or no influence on the software or message standards implemented within them. Acquisition milestone reviews have not taken intra/interoperability concerns into adequate consideration. Another factor driving perturbations in MTACCS subsystems derived from design changes implemented in systems outside of the MTACCS, including those of other Services. An effort was made to keep up with design and standards changes implemented in systems with which the MTACCS planned to interface. Although the (USMC) Tactical Systems Intra/Interoperability Program (TACSIIP) has been tasked with developing common automated system standards, this work had not received the required priority in the past.

II.5. REASONS FOR OPTIMISM

II.5.1. FUTURE NEEDS

* The Need For Automated Support Of Marine Tactical C2 Systems Will Continue To Grow
* Despite Delays The MTACCS Concept Remains Sound
* Termination Of MIFASS Development Did Not Decrease Requirement For An Automated Integrated Fire And Air Support System

[II.5.1. FUTURE NEEDS]

Despite difficulties encountered in implementing the MTACCS concept the need for C2 automation has not diminished. On the contrary, the combined pressures of increasing information flow and decreasing tactical decision times have given added urgency to this effort. It is an inescapable conclusion that the original concept of automated command and control support for MAGTF commanders is still sound. In particular, cancellation of the MIFASS program by the Commandant of the Marine Corps in June 1987 did not eliminate the need for an automated fire and air support system to assist MAGTF commanders. [The Panel has learned that the Marine Corps has decided to develop the Fire Support and Maneuver System (FIREMAN) to meet this need. It is believed that FIREMAN may also include the tactical planning, tactical operations and tactical intelligence requirements formerly included in the Tactical Combat Operations (TCO) System.]

II.5. REASONS FOR OPTIMISM

II.5.2. EXPERIENCE BASE

* The Marine Corps Is In A Good Position To Build On Important "Lessons Learned"
* Valuable Experience Has Been Gained From MIFASS And TCO Testbed Programs
* Growing Numbers Of Personal Computers Are Used In The FMF, Providing Considerable Experience In The Application Of Automated Support Systems
* Major Organizational Changes Are Taking Place Which Have The Potential For Improving The Management Of Intra/Interoperability Issues

[II.5.2. EXPERIENCE BASE]

Taken as a whole, MTACCS experience to date provides a significant body of knowledge which can serve as a guide to future progress. Among the critical "lessons learned" are:

(1) the importance of controlling requirements "creep"
(2) the strong interdependence of requirements, system performance, and cost
(3) the crucial role of systems intra/interoperability
(4) the importance of simulation testing during all development phases

The Marine Corps has gained valuable operational and systems design experience from the MIFASS Engineering Development Model (EDM) testing process and TCO testbed. Intra/interoperability concerns have been highlighted. The Corps has undertaken a reassessment of the requirements for these programs.

The large and growing number of personal computers (PC's) in use throughout the FMF provides a powerful impetus toward continuation of automated systems development. The fact that many of these devices have a common operating system and that a great deal of commercial applications software is available contributes to this process. Several of the developing MTACCS systems are exploring the use of common hardware. Commercial local area networks (LAN's) are increasingly available for linking PC's into distributed data systems.

The Marine Corps understands the difficulty of developing effective automated C2 systems, and is increasingly recognizing the need for careful reassessment of intra/interoperability issues. Several major organizational changes are underway aimed at centralizing the development and acquisition activities of the Corps. It is hoped that these steps will result in increased emphasis on the effectiveness of automated C2 systems integration.

II.5. REASONS FOR OPTIMISM

II.5.3. MARINE AVIATION COMMAND AND CONTROL

* Aviation Specific Systems Are Making Good Progress
  - Tactical Air Operations Module (TAOM)
  - Advanced Tactical Air Command Central (ATACC)
  - Marine Air Traffic Control And Landing System (MATCALS)

[II.5.3. MARINE AVIATION COMMAND AND CONTROL]

The extensive Marine Aviation Command and Control System (MACCS) development and product upgrade programs are making good progress. The aviation community within the Marine Corps has long had experience with automated systems, (TAOC, TAOM, Search/Acquisition Radars, etc.). Acceptable levels of interoperability with other services are a reality. To date, many, if not all, of the requirements definition and integration problems experienced on the ground combat side have been overcome. However, the desired integration of air and ground C2 systems still needs to be accomplished. The introduction of next generation aircraft (for example, the MV-22, Osprey) will also pose new challenges.

II.5. REASONS FOR OPTIMISM

II.5.4. NAVY/MARINE CORPS INTEROPERABILITY

* Cooperation Between The Navy And Marine Corps Is Effective In Overcoming Problems As They Arise

* Assuring Adequacy Of Future Marine C2 Shipboard Space Continues To Be A Challenge

[II.5.4. NAVY/MARINE CORPS INTEROPERABILITY]

The Marine Corps and the Navy have an effective program in place to identify interoperability concerns and are actively working to integrate command and control systems. Although some equipment incompatibilities exist, the primary difficulty encountered at this point arises from constraints imposed by limited shipboard systems and spaces. These inherent limitations necessitate identification of Marine requirements five to seven years prior to the launching of a particular ship. Obviously, extensive, continuing coordination between the Marine Corps and Navy is required to ensure that mutual interoperability needs are satisfied. It would appear that cooperation between the Navy and the Marine Corps is currently effective in overcoming problems as they arise. It is also apparent that the personal and professional regard which develops between the action officers of the two services is a key ingredient in the success of these efforts.

II.5. REASONS FOR OPTIMISM

II.5.5. BASELINE DOCUMENTATION

* An Intra/Interoperability Documentation Structure Exists And Can Be Made Effective

* The TACSIIP Program Could Be An Important Aid To Coordination Efforts

[II.5.5. BASELINE DOCUMENTATION]

The baseline intra/interoperability documentation structure necessary for the orderly development of automated systems is already in place and can be made to work. The Marine Corps has recognized the inadequacy of some of these documents and an analysis of required standards and revisions is underway. Coordination internal to the Marine Corps between C2 system-development programs has shown some improvement. The TACSIIP program is conducting an extensive review and analysis of the information flow between the various nodes of the Marine Corps C2 system. A database is being built which, when completed and kept current, will be a valuable aid in determining the degree of intra/interoperability required. Such information is of greatest value during the system definition phase. [Unfortunately, the importance of the TACSIIP effort is not yet widely recognized within the Marine Corps, and funding has consequently been unstable and generally inadequate.]

III. RECOMMENDATIONS

III.1. SYSTEMS ENGINEERING

III.1.1. BASELINE DEFINITION

* A Comprehensive Re-Examination Of Tactical C2 System Requirements Should Be Conducted With Emphasis On:
  - Near-Term Mission Needs, As Well As Anticipated Future Trends
  - Requirements/Performance/Cost As Interactive Factors

* Adopt An Updated System Baseline Definition Which:
  - Is Based On An "Open Architecture", To The Extent Possible
  - Makes Maximum Use Of Past Investments, Where Practical
  - Focuses On What Is Achievable And Operationally Useful In The Near Term
  - Aims For Maximum Integration Of TDS, Deployable AIS, And Tactical Communication Systems
  - Deals Effectively With Special Battlefield Requirements, Such As: Communication Security; Data-Base Integrity; System Reconstitution

* Establish A System Simulation Capability

[III.1.1. BASELINE DEFINITION]

A comprehensive re-examination and re-evaluation of the entire MTACCS concept should be conducted in the light of valuable experience gained in the last several years. The objective should be to re-baseline the MTACCS to reflect essential functionality and intra/interoperability requirements, while minimizing the loss of past investments and momentum.

An urgent need exists to analyze Marine Corps tactical C2 requirements. It is essential that such an analysis begin with a definition of near-term requirements consistent with both the expressed needs of the operational forces as well as demonstrated levels of technological capability. In view of the rapid pace of technological advances, likely future trends should also be identified. Concurrently, operational concepts must be refined in order to validate requirements for C2-system automation. For purposes of establishing a new system baseline, requirements should be frozen at the earliest opportunity in order to avoid continued requirements "creep". The new baseline must make allowance for the strong interdependencies of requirements, performance, and cost. It is imperative that a "should cost" approach be adopted and "will cost" projections (based on realistic assessments) be maintained. Any not-absolutely-essential requirement which drives excessive cost growth should be reviewed for possible elimination.

The re-baselined C2 system should adopt an "open architecture" (i.e., a modular system structure with standard interface specifications), to the extent possible. (For illustrative purposes, a rudimentary analysis of interface requirements is given in Appendix F.) This will minimize the need for designing special system interfaces and will thereby facilitate future system upgrades. The objective should be the eventual integration of all TDS's, deployed AIS's, and tactical communication systems, while protecting continued utility of currently fielded systems. Immediate focus should be on those operationally useful capabilities which can be attained in the near term, especially by using (or adapting) commercially available equipment and software. Early design freezes on equipment suites and software are essential for each increment to be fielded.

Issues which demand careful attention in re-baselining the MTACCS include system interconnectivity; system robustness to equipment failure or enemy countermeasures; communications and computer security/integrity; role of space-based systems; equipment mobility; and training constraints. As part of the new baseline the Required Operational Capabilities (ROC) documents for all of the MTACCS elements should be updated. The utility of a master development document which coordinates the individual ROC's should also be considered.

The development process must make much greater use of system simulation techniques than has been practiced by the Marine Corps to date. A simulation capability should therefore be established for system evaluation. A formal procedure should be instituted to involve users in field commands in defining critical experiments to be carried out in the course of system development.

III.1. SYSTEMS ENGINEERING

III.1.2. PLANNING FOR FUTURE GROWTH

* Future Mission Requirements And Emerging Technological Opportunities Should Be Analyzed On A Continuing Basis
* Adopt An Evolutionary Development Strategy For Future System Enhancements
* Increased Emphasis Should Be Placed On Marine Corps Participation In DOD Standards Activities

[III.1.2. PLANNING FOR FUTURE GROWTH]

A continuing level of study effort must be supported by the Marine Corps to maintain an up-to-date understanding of the interactive dynamics of changing mission needs, technological progress, and estimated cost. Such understanding provides the essential foundation for rational future planning. Since automated C2 systems represent a very large investment it is not feasible to replace them in their entirety as missions and technology evolve in time. Instead, added system capabilities will depend on systematic, evolutionary enhancements based largely on incremental improvements (e.g., block upgrades). To be practical, such a strategy requires that essential system intra/interoperability be preserved at every step. A program of continuing study/evaluation is a necessary condition for maintaining a coherent development plan which meets that objective, and which ensures that future upgrades keep pace with technological advances and with the evolving requirements of the Fleet Marine Forces.

Because of the crucial role of standardized interfaces in achieving the desired "open architecture", the Marine Corps should place added emphasis on participation in relevant DOD standards activities. For example, studies and adoption of data-communication protocols leading to advanced tactical data links (e.g., JTIDS, Mk-XV IFF, etc.) bear directly on future intra/interoperability considerations.

III.2. MANAGEMENT

III.2.1. CONFIGURATION CONTROL

* Establish Strong, Centralized Intra/Interoperability Configuration Management And Change Control Authority
  - Include All TDS's, Deployable AIS's, And Tactical Communication Systems
  - Provide Adequate Level Of Systems - Engineering Support
  - Strengthen TACSIIP
  - Consider Establishing Correlation Control Group
* Transform Baseline Documents Into Authoritative Guides
* Institute Process For Timely, Orderly Updating Of Key Documents

[III.2.1. CONFIGURATION CONTROL]

Intra interoperability requirements must be made a critical element in systems design, and must be effectively enforced. Successful development of an extensive automated system, such as the MTACCS, composed of large subsystems with numerous pieces of ancillary equipment, requires careful system-wide planning and execution at every stage. This requires a program manager who can function as systems-integrator with authority over the entire program, including all subsystems. The Marine Corps should therefore establish an appropriate unambiguous, central point of responsibility and accountability for automated C2 systems development matters, with authority to define and enforce intra/interoperability standards. Such a central authority should be made responsible for configuration management of the overall system, including all TDS's, deployable AIS's, and tactical communication systems.

Although Congressionally mandated regulations require that acquisition of primarily administrative computer systems be separated from tactical data systems, this separation does not mirror the reality of C2 system automation. Many of the systems used in garrison are of benefit to the commander in the field. The management of manpower and logistics information is a case in point. The existing dichotomy in the development of TDS's and AIS's should therefore be eliminated to the extent necessary. All automated systems intended for deployment in a combat environment should be developed so that they conform to the same standards and are compatible. They must be able to interface with the Marine Corps communications system and with one another, as necessary.

The recommended central authority must be provided adequate systems-engineering support under his control to accomplish critical functions, such as trade-off analyses, risk-reduction planning (e.g., prototyping and "fall-back" options), etc. A significant strengthening of the TACSIIP activity would be a useful step toward establishment of the needed support.

The impact of proposed program changes should be carefully assessed by the configuration management authority as well as by individual program managers. Formal development and acquisition reviews should treat intra/interoperability as a key factor when making decisions. The Marine Corps might also benefit from instituting a "Correlation Control Group", patterned after those used in many weapon-systems development programs, to ensure that the impact of any proposed deviation from accepted standards is understood and agreed to by all involved.

The standards reflected in the baseline intra/interoperability documents, (C2MP, TIDP, TIC, IMP, etc.,) should be made authoritative, indeed directive in nature. The guidelines and standards promulgated through these documents should be enforced. Document-revision procedures should be strengthened, formalized and enforced.

III.2. MANAGEMENT

III.2.2. CORPORATE MEMORY

* Management Continuity For Complex Programs Should Be Improved
* Career Planning And Development For Marine Corps Acquisition Officers Should Be Strengthened
* Long-Term Technical Support To Management Should Be Strengthened

[III.2.2. CORPORATE MEMORY]

The development of large, complex systems requires management continuity and experience. Acquisition management is a professional skill. These facts have been recognized by the Marine Corps and the other Services. However, in accordance with present policy, project officers within the Corps are transferred every three years. This frequently has the effect of introducing undesirable perturbations into development programs. Replacement officers are often untrained and arrive after their knowledgeable predecessors have left. Many program delays and changes can be attributed directly to this circumstance. The Marine Corps should therefore consider implementing manpower management practices which might include: (1) Identification of officers with acquisition/development expertise, (2) The Assignment of an acquisition Military Occupational Specialty (MOS) to these officers, (3) Establishment of a career-track which alternates assignment of these officers between the FMF and acquisition duties. The "professionalization" of Marine Corps acquisition duties will contribute to fewer system development delays.

A second management step which should be considered by the Corps is the improvement of technical-support expertise. While it is recognized that the Marine Corps does not have the resources to establish a full-fledged technical support command, it is recommended that steps be taken to obtain the services of civilian engineers who can provide needed long-term support to action officers tasked with the development of complex systems.

III.3. IMPLEMENTATION STRATEGY

III.3.1. DOCUMENTATION REVISIONS

* Complete Current Cycle Of Revisions, With An Objective Of Establishing The Recommended Authoritative Guides

* Expand Coverage To Include Intra/Interoperability Requirements For Both TDS's And Relevant AIS's:
  - MCO 3093: Define Terms, Items/Systems, And Responsibilities
  - TIC 87: Define All C2 Nodes Which Must Be Supported By Data Systems, And Describe Types Of Data To Be Exchanged
  - TIDP 87: Include Data Interchange Requirements For All Major MAGTF Combat Scenarios
  - C2MP: Should Become A Management Directive
  - IMP, MCIC-MP: Combine Into Single Intra/Interoperability Configuration Management Plan; Define Update Procedures

[III.3.1. DOCUMENTATION REVISIONS]

The current cycle of baseline-documentation revisions should be completed in a manner which will lead to a self-consistent set of authoritative guides. In the process, responsibility for these revisions should be centralized. The standards thus documented should become directive in nature and provide the foundation for an integrated USMC command and control system architecture. The automated systems standards documentation should be expanded to include intra/interoperability requirements for both TDS's and deployable AIS's within the Marine Corps.

A history of the baseline documents, as well as an evaluation of their current state and specific recommendations, are detailed in Appendix G.

III.3. IMPLEMENTATION STRATEGY

III.3.2. FIRE SUPPORT AND MANEUVER SYSTEM (FIREMAN)

* MIFASS And TCO "Lessons Learned" Should Be Applied To New Program
  - Treat As Part Of A Larger C2 System Architecture
  - Identify Interface Requirements
  - Identify Communications Requirements
  - Document MIFASS Software Architecture And Evaluate FIREMAN Applicability

* Adopt Evolutionary Development Approach
  - Baseline In Accordance With Minimum Functional Requirements Initially, But Adopt System Architecture Which Will Support Future Growth
  - Plan On Follow-On Phases To Upgrade System Capability (i.e., "Build A Little"/"Test A Little"/"Field A Little"/"Build A Little More"/---)
  - Make Use Of "Off-The-Shelf" (NDI) Equipment And Software Where Possible

* Maintain Knowledge Of Army ACCS Program (e.g. AFATDS; MCS) And Apply To Marine Corps Programs Where Technically Appropriate

[III.3.2. FIRE SUPPORT AND MANEUVER SYSTEM (FIREMAN)]

As the Marine Corps proceeds with the FIREMAN effort, the important lessons learned from the MIFASS experience should be transferred to this new system. Of primary importance is the recognition that FIREMAN must be capable of functioning as part of a larger C2 architecture, independent of specific battlefield scenarios. In this regard the specification of the FIREMAN/TCO-communications systems interfaces is especially critical. Special efforts should also be made to document the software structure (i.e., architecture) especially at functional interfaces. Although it is unlikely that the existing MIFASS software can or should be ported to another system, the question whether FIREMAN can benefit in any way from past investments in MIFASS software development should be addressed.

Additionally, development of FIREMAN should be predicated on an evolutionary approach. An initial baseline of minimum essential functional capability should be identified, developed, tested and fielded. Concurrent with the rapid fielding of the first increment of FIREMAN, efforts should continue toward the definition of follow-on phases. For this approach to be practical it is essential that a system architecture be adopted at the outset which will support future growth in both hardware and software functionality. Carefully planned system modularity will facilitate subsequent incremental upgrades, and will thereby ensure introduction of a system which provides basic functions while also offering the flexibility of "local tailoring" to suit the needs of individual commanders. The Panel believes that early fielding of a minimum acceptable capability would also be aided by use of (or adaptation of) available hardware and software.

Although it does not appear that the Army's AFATDS program can satisfy Marine requirements for integrated fire and air support automation assistance, lessons learned in the Army program should be applied to FIREMAN where technically appropriate.

III.3. IMPLEMENTATION STRATEGY

III.3.3. COMMUNICATIONS BACKBONE

* Re-evaluate C2 Data Communication Requirements For All Phases Of MAGTF Operations, Including Over-The-Horizon Assaults
  - Analyze Interface Requirements
  - Analyze Data-Traffic Demands
* Establish Critical Constraints
  - Data Security And Integrity
  - System Robustness
  - System Mobility
  - Transmission Modes (e.g. Digital/Analog)
* Adopt Architecture Which Is Consistent With An Evolutionary Implementation Plan

[III.3.3. COMMUNICATIONS BACKBONE]

The Marine Corps needs to assess its total data-transport requirements, now and in the foreseeable future, based on a comprehensive examination of all of the information which must be transmitted to/from and around the battlefield. This analysis should include existing and planned TDS's and AIS's. This assessment must take into account the unique, task-organized nature of MAGTF's and their employment during the various stages of an amphibious/expeditionary operation/assault. It is obvious that data-transport requirements vary depending upon the particular MAGTF configuration (i.e., MEU, MEB, MEF) as well as the tactical situation faced by the combat Marine. Over-the-horizon operations will pose especially demanding communication challenges. The possible role of satellite communications, fiber-optic data links, and other advanced-technology techniques should be evaluated. It is essential that critical data transmission paths be differentiated from those which the commander can do without, if necessary. These interfaces are the ones which need to be implemented in automated systems as the first priority.

The recommended study should establish detailed functional requirements, especially in regard to data-traffic loads and timing, data security and integrity, system robustness (e.g., countermeasure vulnerability), and equipment mobility (e.g., size/weight). Because of the increasing importance of tactical intelligence, multilevel secure internet capabilities are likely to be required in the foreseeable future. Opportunities for data compression by means of real-time processing to reduce bandwidth requirements should also be examined.

A communication architecture which can satisfy near-term requirements, and also support future enhancements in response to changing mission needs, should be defined and documented. Implementation should be guided by a Marine Corps Communications/Data Transmission Plan which should become integrated with the Marine Corps C2 Master Plan. This plan should be evolutionary in character and be based on adoption of standard interfaces wherever possible.

APPENDICES

APPENDIX A
TERMS OF REFERENCE

DEPARTMENT OF THE NAVY
NAVAL RESEARCH ADVISORY COMMITTEE
ARLINGTON, VIRGINIA 22217-5000

IN REPLY REFER TO
9410
Ser OONR1/707
20 March 1987

MEMORANDUM FOR THE ASSISTANT SECRETARY OF THE NAVY
(RESEARCH, ENGINEERING AND SYSTEMS)

Subj: APPROVAL REQUEST FOR REVISED TERMS OF REFERENCE FOR NRAC MARINE CORPS COMMAND AND CONTROL SYSTEMS INTEROPERABILITY PANEL

Encl: (1) Revised proposed Terms of Reference for the NRAC Marine Corps Command and Control Systems Interoperability Panel
(2) Original Terms of Reference for the NRAC Marine Corps Command and Control Systems Interoperability Panel

Ref: (a) NRAC Executive Director memo 9410 Ser OONR/534402 of 13 Dec 1985 w/ approval dated 19 Feb 1986
(b) NRAC Executive Director memo 9410 Ser OONR1/609316 of 9 Apr 1986 w/ approval dated 18 Apr 1986

1. References (a) and (b) approved the Terms of Reference (TOR) and panel chairman for the NRAC Marine Corps Command and Control Systems Interoperability Panel.

2. The NRAC panel has rewritten the subject TOR with a view toward providing more focus for their study. Headquarters, U. S. Marine Corps has approved the revised TOR, enclosure (1), and requested formal ASN(RE&S) approval. The original TOR is provided for your information as enclosure (2).

Very respectfully,

J. B. MOONEY, JR.
Rear Admiral, USN
Executive Director

APPROVED: _____ 1987

DISAPPROVED: _____

TERMS OF REFERENCE
NAVAL RESEARCH ADVISORY COMMITTEE PANEL ON U. S. MARINE CORPS COMMAND AND CONTROL SYSTEMS INTRA/INTEROPERABILITY

Marine Corps command and control systems must intraoperate within the Marine Corps and interoperate with the tactical and strategic command and control systems of other services during joint and combined operations. Increasing automation coupled with the diversity of command and control systems throughout the services continue to complicate efforts to achieve effective intra/inter-operability. It is proposed that the Naval Research Advisory Committee examine the command and control requirements of Marine Corps forces in the near and mid-term and make recommendations, as appropriate, to enhance Marine Corps command and control system intra/interoperability capabilities. The study should:

1. Review the command and control intra/interoperability requirements of Marine Corps forces in the near and mid-term with emphasis on joint naval operations.

2. Examine Marine Corps intra/interoperability concepts, management procedures, command and control system architectures and program plans to identify potential problems and alternative solutions. Issues of particular interest are:

a. Interoperability of Marine Corps Tactical Command and Control Systems (MTACCS) with Navy shipboard command and control systems.

b. Employment of the Joint Tactical Information Distribution System (JTIDS) in the Marine Air Command and Control Systems (MACCS).

c. The definition of required interfaces for the Marine Integrated Fire and Air Support System (MIFASS).

d. The definition of required interfaces for the Tactical Combat Operations (TCO) System.

APPENDIX B
PANEL MEETING AGENDAS

First Meeting
Naval Research Advisory Committee
Panel on U. S. Marine Corps
Command and Control Systems Interoperability

Time/Date: 0900-1600, 24 Oct 86

Location: Room 2215 (Intelligence Div Conf Room)
Arlington (Navy) Annex
Federal Office Building #2
South Gate Road/Columbia Pike
Arlington, VA 22214

Note: Will Require Identification To Enter The Building
If escort is required: Call 4-4522 or 4-2082 and
ask for Major BOROS.

AGENDA

Friday, 24 October 1986 (Closed to the Public)

0900-1000	Panel Organization/Administrative Matters
1000-1130	USMC Organization for Warfighting Briefing
1130-1200	Panel Executive Session
1200-1300	Lunch
1300-1530	Overview of Service Interoperability Briefing
1530-1600	Panel Executive Session

Second Meeting
Naval Research Advisory Committee
Panel on U.S. Marine Corps
Command and Control Systems Interoperability

Dates: 20-21 November 1986

Location: Arlington Annex

20 Nov: Room #2116
21 Nov: Room #G504
(Federal Office Building #2)
South Gate Road/Columbia Pike
Arlington, VA 22214

Note: Will require identification to enter the building. If escort is required call: Maj Boros, 42082/44522 from the gate.

AGENDA

Thursday, 20 November 1986 (Closed to the Public)

0900-0930 Administrative Matters

0930-1000 Terms of Reference (TOR) Discussion

1000-1130 USMC Communications (Bfiefing)

1130-1230 Lunch

1230-1515 The USMC Communications System (Briefing)

1515-1600 Executive Session

Friday, 21 November 1986 (Closed to the Public)

0900-0915 Administrative Matters

0915-1000 Maritime Prepositioned Equipment (Briefing)

1000-1100 PHIBSTRIKE-95 (Brief)

1100-1200 Lunch

1200-1300 The Amphibious Strategy (Brief)

1300-1500 Executive Session

Third Meeting
Naval Research Advisory Committee
Panel on U.S. Marine Corps
Command and Control Systems Interoperability

Dates: 08-09 January 1987

Location: Arlington Annex
Room G501 (Near Cafeteria)
(Federal Office Building #2)
South Gate Road/Columbia Pike
Arlington, VA 22214

Note: Will require identification to enter the building. If escort is required call Maj BOROS from the gate Extension: 44522/42082.

TENTATIVE AGENDA

Thursday, 08 January 1987 (Closed to the Public)

0900-0915 Administrative Matters

0915-1200 USMC C2 Master Plan/Interoperability Management (Briefing)

1200-1300 Lunch

1300-1430 MACCS/JTIDS (Briefings)

1430-1500 Executive Session

* * *

Friday, 09 January 1987 (Closed to the Public)

0900-0915 Administrative Matters

0915-1000 4thMAB/Combined Ops Comm Plan (Briefing)

1000-1130 MIFASS/TCO (Briefing)

1130-1230 Lunch

1230-1500 Executive Session

Fourth Meeting
Naval Research Advisory Committee
Panel on U. S. Marine Corps
Command and Control Systems Interoperability

Dates: 26-27 February 1987

Location: First Marine Amphibious Force (IMAF)
MCB, Camp Pendleton, CA
(Note: Specific locations TBD)

Note: Will require positive identification to enter the base.

TENTATIVE AGENDA

Wednesday, 25 February 1987: Travel

Thursday, 26 February 1987 (Closed to the Public)

0900-0930 Welcome

0900-1200 I MAF Operational Briefings

1200-1300 Lunch

1300-1600 I MAF Interoperability Briefings

1500-1600 Executive Session

Friday, 27 February 1987 (Closed to the Public)

0900-0915 Administrative Matters

0915-1100 MIFASS/LCAC Site Visits

1100-1200 Lunch

1200-1400 Executive Session

1400+ Travel

Fifth Meeting
Naval Research Advisory Committee
Panel on U. S. Marine Corps
Command and Control Systems Interoperability

Dates: 31 March-1 April 1987

Location: Arlington Annex (Fed Bldg. No. 2)
Columbia Pike and South Gate Rd.
Arlington, Virginia

Note: Attendees will require government issued identification to attend meeting. For assistance contact Maj Boros at Von: 224-2082 or Comm: (202) 694-2082.

TENTATIVE AGENDA

Tuesday, 31 March 1987 (Closed To The Public)

0900-0915 Administrative Matters

0915-1200 Briefings on Development Programs:

Unit Level Message Switch (ULMS)

Unit Level Circuit Switch (ULCS)

Digital Communications Terminal (DCT)

Position Location Reporting System (PLRS)

1200-1300 Lunch

1300-1530 Executive Session

Wednesday, 1 April 1987 (Closed to the Public)

0900-0915 Administrative Matters

0915-1200 Special Assignments-Status Report

1200-1300 Lunch

1300-1530 Executive Session

Sixth Meeting
Naval Research Advisory Committee
Panel on U. S. Marine Corps
Command and Control Systems Interoperability

Dates: 29 - 30 April 1987

Location: Room G502 (Near Cafeteria)
Arlington Annex (Fed Bldg. No. 2)
Columbia Pike and South Gate Rd.
Arlington, Virginia

Note: Attendees will require government issued identification to attend meeting. For assistance contact Maj Boros at Von: 224-2082 or Comm: (202) 694-2082.

AGENDA

Wednesday 29 April 1987 (Closed To The Public)

0900-0920 Administrative Matters

0920-1030 Executive Session

1030-1200 Lunch

1200-1415 Executive Session

Thusday, 30 April 1987 (Closed to the Public)

Meeting cancelled by the Chairman

Seventh Meeting
Naval Research Advisory Committee
Panel on U. S. Marine Corps
Command and Control Systems Interoperability

Dates: 3 - 4 June 1987

Location: 3 June 1987
Conference Room, Hochmuth Hall
Marine Corps Development and Education Command
(MCDEC) Development Center (Dev Ctr)
MCB Quantico, Virginia

4 June 1987
Room 3203, Navy Annex
Arlington, VA

Note: Attendees will require government issued identification to attend meeting. For assistance contact Maj Boros at Von: 224-2082 or Comm: (202) 694-2082.

AGENDA

Wednesday, 3 June 1987 (Closed to the Public)

0900-0930 Administrative Matters/Welcome

0930-1030 Brief By CG, Dev Ctr

1030-1130 Brief: Status of Ada Implementation in USMC

1130-1200 Executive Session*

1200-1300 Lunch

1300-1400 Demonstration: Implementation of C2 MP and TIDP

1400-1500 Executive Session*

Thursday, 4 June 1987 (Closed to the Public)

0900-0915 Administrative Matters

0915-1030 Brief: USMC Interoperability Matrix

1030-1200 Executive Session

1200-1300 Lunch

1300-1500 Executive Session

* DEVCTR C3I Personnel Standby to Answer Panel Questions.

Eight Meeting
Naval Research Advisory Committee
Panel on U. S. Marine Corps
Command and Control Systems Interoperability

Dates: 26 October 1987

Location: Room G503, Federal Building #2
(Navy Annex)
South Gate Rd. and Columbia Pike
Arlington, Virginia

Note: Attendees will require government issued identification to attend meeting. For assistance contact Maj Boros at Von: 224-2082 or Comm: (202) 694-2082.

TENTATIVE AGENDA

Monday, 26 Oct 1987 (Closed to the Public)

0900-0915 Administrative Matters/Welcome

0915-1000 HQ, USMC Reorganization Discussion

1000-1030 AFATDS Discussion

1030-1200 Executive Session

1200-1230 Lunch

1230-1500 Executive Session

APPENDIX C
GLOSSARY OF TERMS

ACE	Air Combat Element (of a MAGTF)
ACFT	Aircraft, any type
ACMC	Assistant Commandant of the Marine Corps
ACG	Acquisition Coordination Group
AIS	Automated Information System
ASLT UNITS	Assault Units
ATACC	Advanced Tactical Air Command Central
ATDS	Airborne Tactical Data System, Navy
AUTODIN	Automatic Digital Network
BCS	Battery Computer System, AN/GYK-29
BLT	Battalion Landing Team
C2	Command and Control
C2MP	C2 Master Plan
CC, CODE	Director, C3, HQMC
CCO	Communications Collection Outstation
COC	Combat Operations Center
COC-GCE	COC - Ground Command Element (of a MAGTF)
COMM	Communications
CP	Command Post
DASC	Direct Air Support Center
DC/S RDA	Deputy Chief of Staff, Research, Development and Acquisition
DC/S RDS	Deputy Chief of Staff for Research, Development and Studies
DC S, Aviation	DC/S for Air, HQMC
DC/S, Training	DC/S for Training, HQMC
DCT	Digital Communications Terminal, AN/PSC-2
FAMDS	Field Artillery Meteorological Data System
FDC	Fire Direction Center
FDDS	Flag Data Display System, AN/UYQ-88, Navy
FIREMAN	Fire Support and Maneuver System
FMF	Fleet Marine Force
FMF-EUCE	FMF End-User Computer Equipment
FSCC	Fire Support Coordination Center
FSSE	Force Services Support Element (of a MAGTF)
GCE	Ground Combat Element (of a MAGTF)
G S-2	Intelligence Staff Section
G S-3	Operations Staff Section
HAWK AFU	HAWK Assault Fire Unit, AN/MSW-14
HAWK BCC	HAWK Battery Control Center, AN/TSW-11
HQMC	Headquarters, Marine Corps
HQO	HQMC Order
IIO	Inter- and Intra-Operability
IAC	Intelligence Analysis Center, AN/TYQ-19
IDASC	Improved Direct Air Support Center
IFF	Identification Friend or Foe
IIF	Imagery Interpretation Facility, AN/TYQ-12(V)2
IMP	Interoperability Management Plan
INTEL	Director of Intelligence, HQMC
IOC	Initial Operational Capability
ISIS	Integrated Signals Intelligence System (obsolete; redesignated MSSS, Multispectral Sensor Suite)
ITAWDS	Integrated Tactical Amphibious Warfare Data System
JINTACCS	Joint Interoperability of Tactical Command and Control Systems
JTIDS	Joint Tactical Information Distribution System
LFICS	Landing Force Integrated Communications System

MAF	Marine Amphibious Force
MAGIS	Marine Air-Ground Intelligence System
MAGTF	Marine Air-Ground Task Force
MATCALS	Marine Air Traffic Control and Landing System
MCICMP	Marine Corps Interoperability Configuration Management Plan
MC-INTEL	Marine Corps Intelligence (OPFAC in MAGTF)
MCO	Marine Corps Order
MEB	Marine Expeditionary Brigade
MEF	Marine Expeditionary Force
MEU	Marine Expeditionary Unit
MIFASS	Marine Integrated Fire and Air Support System
MILOGS	Marine Integrated Logistics Support System
MIPLOGS	Marine Integrated Personnel and Logistics Support System
MIPS	Marine Integrated Personnel Support System
MOS	Military Occupational Specialty
MPS	Maritime Pre-positioning Ship
MTACCS	Marine Tactical Command and Control System
NAVELEX	Naval Electronic Systems Command (Obsolete)
NIPS	Naval Intelligence Processing System AN/SYQ-9(V)3
NRAC	Naval Research Advisory Committee
OPFAC	Operational (command and control) Facility
PLANS	Integrated Landing Force Position Location and Navigation System (Obsolete)
PLRS	Position Location Reporting System
PDA	Principal Development Activity
ROC	Required Operational Capability
SMIC	Shipboard MTACCS Interface Controller
SSCC/SSCT	Special Security Communications Center/Team
SSG	Systems Support Group (HQMC - Obsolete)
TACSIIP	Tactical Systems Inter- and Intra-Operability Program
TACS/TADS	Tactical Air Control System/Tactical Air Defense System
TAO	Tactical Air Operations (System) (Obsolete)
TAOM	Tactical Air Operations Module, AN/TYQ-23
TAOC	Tactical Air Operations Center
TCAC	Technical Control and Analysis Center, AN/TSQ-30
TCO	Tactical Combat Operations (System)
TDS	Tactical Data System
TIC	Technical Interface Concept (Document)
TIDP	Technical Interface Design Plan
TIMS	Tactical Intelligence Management System
ULMS	Unit-Level Message Switch
ULCS	Unit-Level Circuit Switch

APPENDIX D
HISTORY OF MTAACS AND ASSOCIATED SYSTEMS

D.1 SYSTEM CONCEPT

The original concept of the Marine Tactical Command and Control System (MTACCS) program was to develop an integrated command and control system with organic data communications. The MTACCS subsystems were basically divided along the functional lines of operations and combat intelligence, fire and air support, tactical air operations support, administrative and logistics support, and communications. Location and navigation support and all-source intelligence support were based on "associated" systems. The evolution of the system since its inception is traced in Figure D.1-1. The stated interconnectivities in 1977, 1978 and 1984 are shown in Figures D.1-2, D.1-3, and D.1-4, respectively.

D.2 SYSTEM ELEMENTS

* Tactical Combat Operations (TCO) System. The functions of the TCO were to provide semi-automated support to MAGTF staff elements, primarily Operations (G-3/S-3) and Intelligence (G-2/S-2) functions within all of the elements of the MAGTF, [HQ Element (HQE), Ground Combat Element (GCE), Aviation Combat Element (ACE), and Combat Service Support Element (CSSE)] down to the Squadron/Battalion levels. The Sponsor for the TCO System was the Director, Command, Control, Communications and Computers (C4) Systems Division, Headquarters, U.S. Marine Corps, and his predecessors. The Initial Operational Capability (IOC), or fielding, of TCO was projected for FY86.

* Tactical Air Operations (TAO). The TAO, later the Tactical Air Operations Central-85, and now called the Tactical Air Operations Module (TAOM), provides tactical air control and in-flight following capabilities to the MAGTF commander, and is under the control of the Commander, ACE. The Sponsor for the system in all of its evolutions has been the DC/S, Aviation. The original IOC date for TAO was projected for FY83.

* Marine Integrated Fire and Air Support System (MIFASS). The intended functions of MIFASS were to provide semi-automated support to MAGTF Operational Facilities (OPFAC's). Specifically, the Fire Support Coordination Center (FSCC) at the GCE, the Direct Air Support Center (DASC) at the ACE, and the Fire Direction Center (FDC) at Artillery units. In an early version of MIFASS, the functions of the FSCC (integration and coordination of ground and naval fire support) and the DASC (coordination of close air support operations), were to be combined into a single organization known as the Fire and Air Support Center (FASC). This idea was dropped in favor of retaining the original organizational concept. The Sponsor for MIFASS was the Director, C4 Systems Division. The original IOC for MIFASS was planned for FY85.

* Marine Integrated Personnel and Logistics System (MIPLOGS). MIPLOGS, which was later split into two separate systems [MIPS (Personnel) and MILOGS (Logistics)], was to provide automated support to the MAGTF commander in the performance of Personnel and Logistics functions which must be carried out by all units in a "field" situation. The Sponsor for MIPS was the DC/S Manpower with an IOC planned for FY86. The MILOGS was sponsored by DC/S Installations and Logistics (I&L) with a projected IOC of FY88.

* Communications (COMM). The COMM function was originally intended to provide a dedicated communications "backbone" for data transfer among the MTACCS subsystems. The Sponsor for COMM was the Director, C4 Systems Division. The IOC's for equipment included within this program varied by item. Key components of COMM were the Unit Level Message Switch (ULMS) and the Unit Level Circuit Switch (ULCS).

The following systems were termed "associated but separate systems":

* Marine Air-Ground Intelligence System (MAGIS). MAGIS was to provide semi-automated support to the Intelligence functions of the MAGTF, ACE and GCE headquarters. The MAGIS consisted of several subsystems with varying IOC's. The Sponsor for MAGIS was the Director, Intelligence. The original IOC for the Intelligence Analysis Center was projected for FY83.

* Integrated Landing Force Position Location and Navigation System (PLANS). PLANS, now known as the Position Location Reporting System (PLRS), was to provide friendly unit location information to a centralized facility (Master Station), and to the using units. PLANS included an interface with the MIFASS and TCO to provide automated position location information to the Combat Operations Centers (COC's) of the MAGTF. The Sponsor for PLRS was the Director, C4 Systems Division, and the Original IOC for the system was FY76. The first PLRS system was delivered to the Marine Corps in September 1987.

D.3 SYSTEM INTEGRATION

The TCO System and MIFASS were to be co-located and possibly were to share common equipment. The COMM system was to be dedicated to the support of the MTACCS. TCO was intended as the "focal point" for the integration of displayed data from all of the other systems, including PLRS, and to a limited extent MAGIS. Systems interconnectivity was to be provided by 16 Kb/sec digital data circuits. Information exchange was to conform to the Joint Interoperability of Tactical Command and Control Systems (JINTACCS) and the Tactical Air Control System/Tactical Air Defense System (TACS/TADS) joint standards. These standards were mandatory in the early 1970's for message formats and systems interfaces.

D.4 SYSTEM CHANGES

Many changes have taken place since 1977 in the composition and interface requirements among the MTACCS subsystems, but remarkably few of them were due to change in the overall concept, Marine Corps doctrine, or operational philosophy. On the contrary, many of the significant changes have taken place because systems or standards external to the MTACCS (sometimes external to the Marine Corps) with which elements of the MTACCS were required to interface, underwent revision, change, delay or cancellation on their own account. Of course, certain of the MTACCS programs, notably MIFASS, TCO and the Integrated

Systems Intelligence System (ISIS), a sub-element of MAGIS, underwent notable requirement modifications, and also encountered significant technical problems.

The Required Operational Capability (ROC) document for any development program outlines the requirement for its development, along with the basic concept for its use, and its need for interaction with other systems or equipment within the Marine Corps, or joint (i.e., other services), inventory. The ROC's describing the need for each of the subelements of the MTACCS changed repeatedly during the course of their developments.

The most striking changes in the overall approach to the integrated command and control concept has been the separation of the Administrative and Logistics support functions from the MTACCS architecture. Another significant change occurred in the COMM program which was pursued not as a coherent system as originally envisioned, but rather as individual pieces of equipment. Indeed, it is no longer correct to refer to MTACCS because the Marine Corps has converted to terminology which refers to Tactical Data Systems (TDS) and Automated Information Systems (AIS); thus separating the tactical and administrative worlds of automation. TDS's and AIS's are not developed to the same standards.

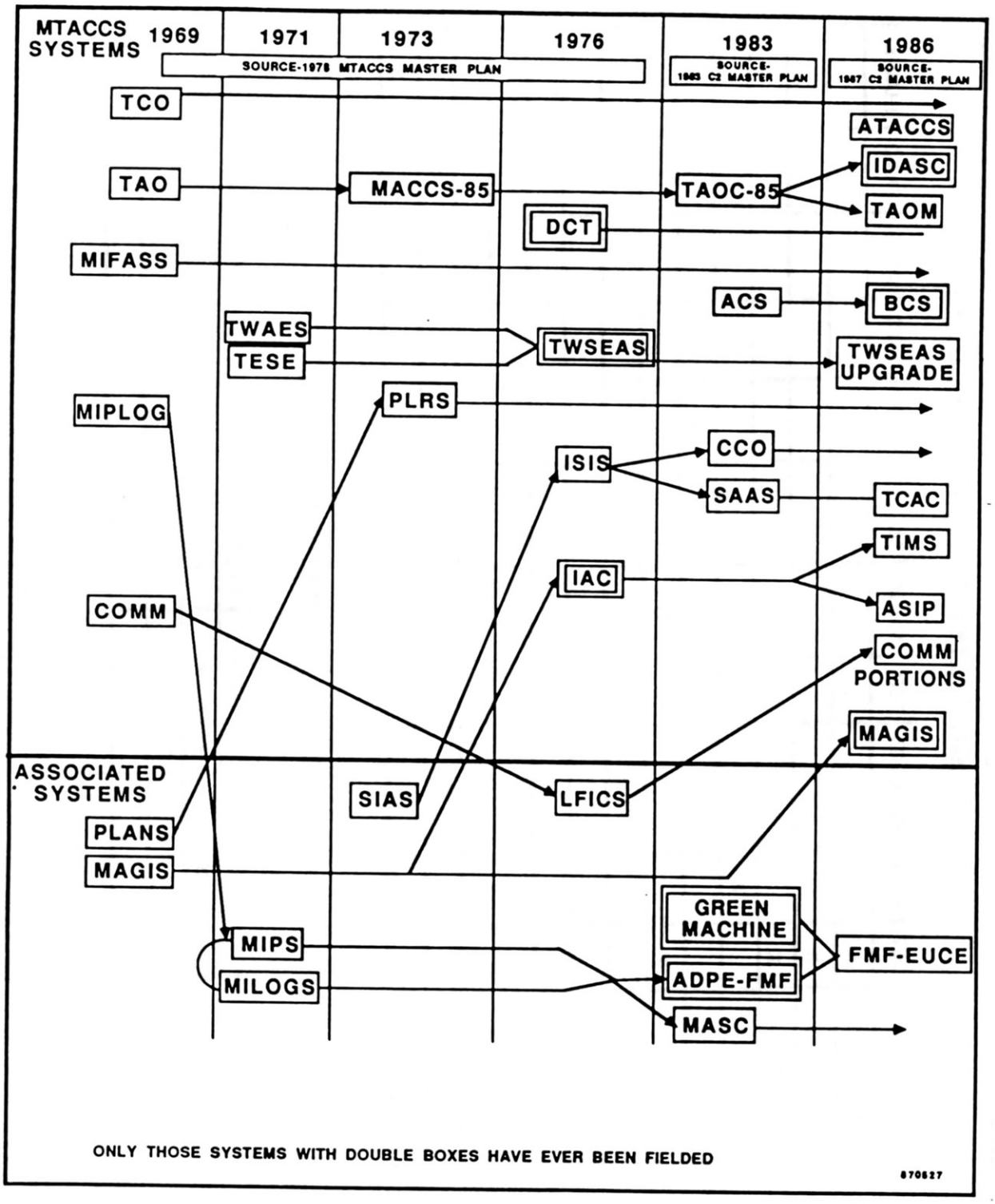


FIGURE D.1-1 SYSTEMS EVOLUTION AND MUTATIONS

STATED INTERFACE REQUIREMENTS AMONG SYSTEMS AS OF 1977

	MIFASS	ULMS	DCT	PLRS	MACCS-85	TCO	MAGIS	MATCU	NTDS	TACS	ATDS	FAAD	IHAWK
MIFASS	X	X	X	X	X	X	X						
ULMS	X	X	X										
DCT	X	X	X			X							
PLRS	X			X									
MACCS-85	X	X			X	X	X	X	X	X	X	X	X
TCO	X		X		X	X	X						
MAGIS					X	X	X						
MATCU					X			X					
NTDS					X				X				
TACS					X					X			
ATDS					X						X		
FAAD					X							X	
IHAWK					X								X

STATED LOCATIONS OF SYSTEMS AT OPFACS AS OF 1977

	FASS	FASC	FDC	FO	NGF SHIP	TAOC	TACC	COC	WING OPS	FSSG
MIFASS	X	X	X	X	X	X	X			
DCT				X	X					
MACCS-85						X	X			
TCO						X		X	X	X
MIPS	LOCATED AT ALL G/S-1									
MILOGS	LOCATED AT ALL G/S-4									

870526

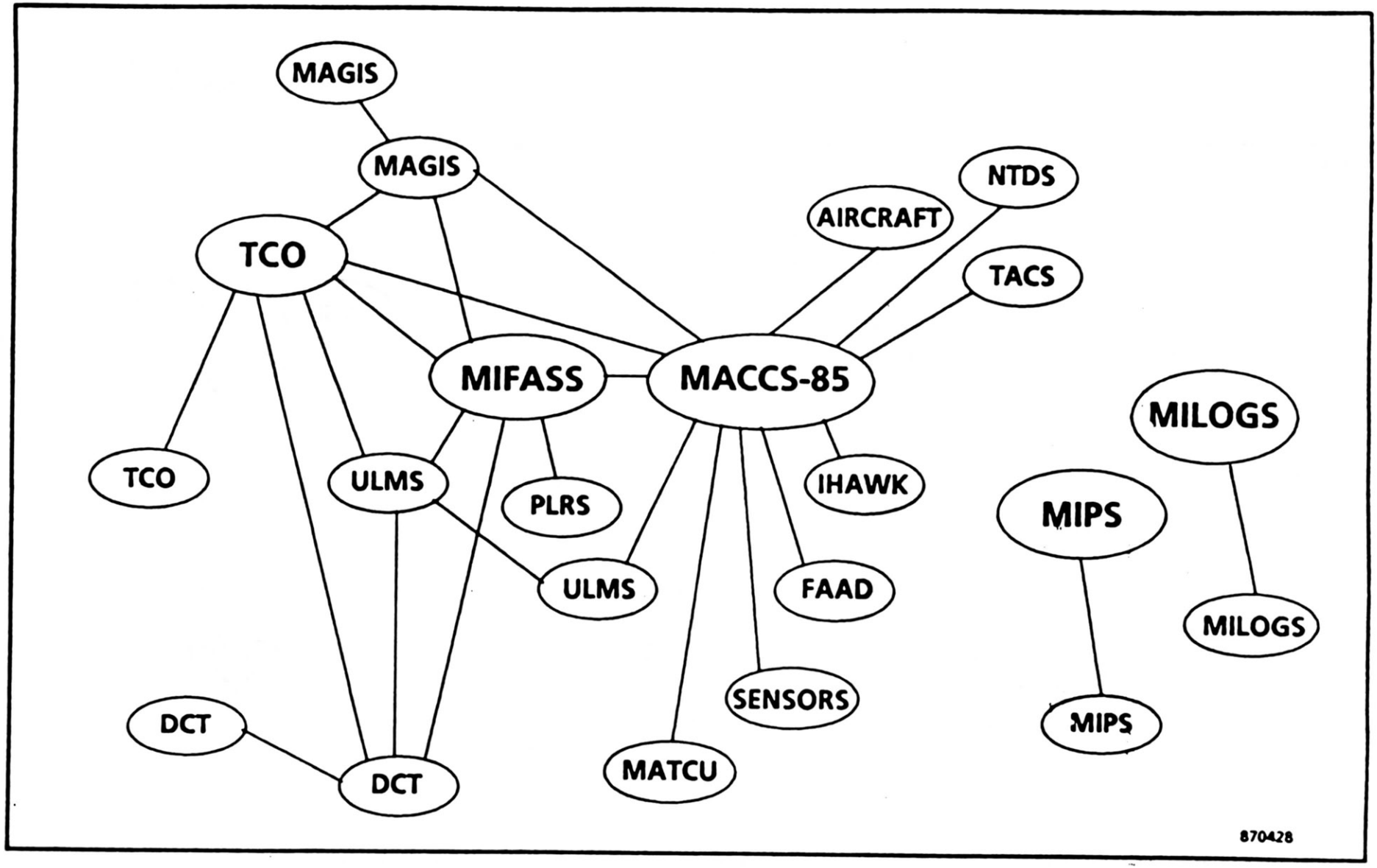
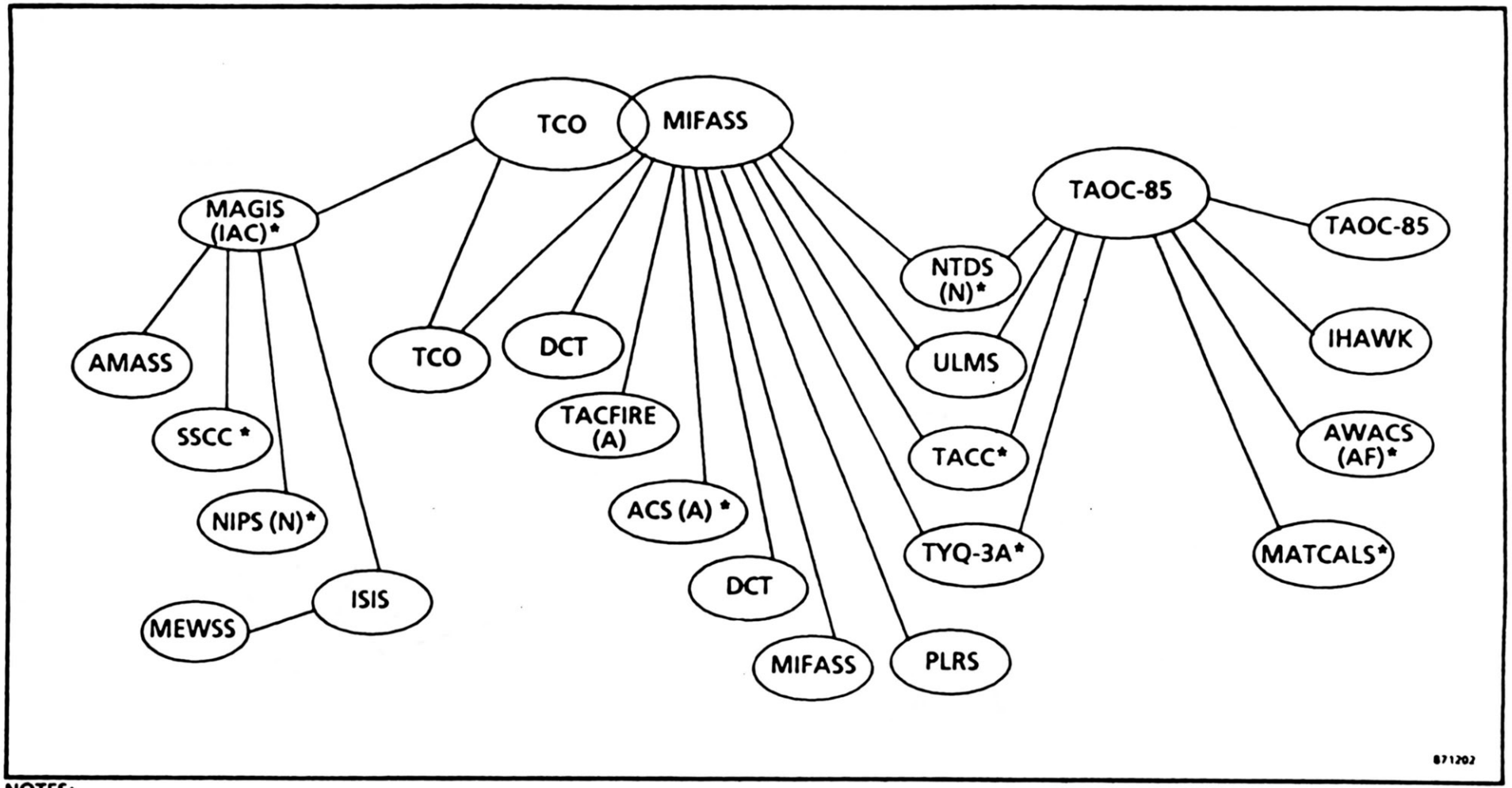


FIGURE D.1-3: 1978 MTACCS INTERFACES (PER MTACCS MASTER PLAN 1978)



NOTES:

1. AT THIS TIME, TCO AND MIFASS WERE JOINT PROGRAM.
2. MIPS AND MILOGS ARE GONE.
3. ONLY SYSTEMS MARKED WITH AN ASTERISK (*) EXISTED IN 1984

FIGURE D.1-4: 1984 MTACCS SYSTEM INTERFACES (PER 1984 TIC)

APPENDIX E

EVOLUTION OF MANAGEMENT STRUCTURE

E.1 ORIGINAL MANAGEMENT STRUCTURE

Coordination. Marine Corps Headquarters Order (HQO) 5420.24 dated 25 June 1969, established a charter for the MTACCS which delineated the function of the HQMC staff in support of the MTACCS project. This order also established the billet of MTACCS Project Coordinator within the office of the Director, Management Analysis Group. His mission was to monitor and coordinate the entire MTACCS project through its development and integration. By this order, MAGIS also became part of the MTACCS structure.

Sponsors. Although MTACCS was conceived as a single cohesive program, the program development and execution for the individual subsystems was parceled out to cognizant HQMC staff divisions. The specific Sponsor for each of the MTACCS systems was identified in Appendix D.

ACG's. Each separate development program was coordinated by an Acquisition Coordination Group (ACG), unique to that program. Even though decisions made by the ACG could effect intra/interoperability, to the point of having a vital impact on other programs, ACG decisions were not always coordinated through the appropriate Intra/Interoperability staff agencies.

Testbed Activity. On 11 August 1969, the Marine Corps Development Center (DEVCTR) was named the Field Activity Testbed for the MTACCS project. By this directive, the DEVCTR became responsible for performing the necessary functions to make the MTACCS a reality.

Development Authority. On 12 February 1969, the Commander, NAVELEX, (now the Commander, SPAWARSYSCOM), was named as the designated Principal Development Authority (PDA) for the MTACCS. Working with the DEVCTR, the PDA was to provide engineering support and contract negotiation/execution functions in support of the MTACCS project.

E.2 MANAGEMENT CHANGES

* On 16 January 70, the Management Analysis Group was redesignated the Systems Support Group (SSG). The SSG included a Tactical Systems Branch in which was found the HQMC MTACCS Coordinator. The SSG became part of the Development Branch of the Research, Development and Studies Division (RD&S) at HQMC.

* On 15 July 75, a Command and Control Branch was established in the Operations Division of what is now the Operations and Training Department, HQMC.

* On 2 October 75, a HQMC Command and Control Systems Coordinating Committee was established with membership from each of the Sponsors, along with a member from the DEVCTR Command, Control and Communications (C3) Division. The Committee Chairmanship was assigned to the Head, Tactical C2 Systems Branch, who, de facto, superseded the former MTACCS Coordinator.

* On 1 November 76, a number of HQMC offices were consolidated and designated the Command, Control, Communications and Computers (C4) Systems Division (Code CC). The Director, C4 Systems Division, a Brigadier-General, became the chairman of the Coordinating Committee and assumed responsibility for planning, coordinating and directing staff activities on matters relating to C2 Systems, Telecommunications, and Automated Data Transmission Systems. Staff

cognizance and sponsorship for elements of the MTACCS remained separated: Aviation Radar and C2 Systems remained with the DC/S Aviation, a Lieutenant-General; Intelligence Systems remained with Director, Intelligence Division, a Brigadier-General; Personnel and Logistics programs remained with the DC/S for Manpower and the DC/S, I&L, respectively, both positions occupied by a Lieutenant-General.

* Marine Corps Order (MCO) 3093.1B, dated 5 June 87, established two intra interoperability oversight panels. An Interoperability Policy Board (IPB) was to advise the Commandant on interoperability policy matters. The Director, C4 Systems Division, was tasked to establish policy and procedures for the IPB. The CG, MCDEC was tasked to establish an Interoperability Configuration Control Board (ICCB). The ICCB was given responsibility to make recommendations to the CG, MCDEC regarding proposed changes in Marine Corps intraoperability and interoperability standards. The Order also assigned configuration control of Marine Corps interoperability standards to the CG, MCDEC. System sponsors were assigned life-cycle responsibility and required to participate in configuration management of their system from an "operational perspective". Configuration management of fielded TDS software was assigned to the CMC(L). Although it is clear that MCO 3093.1B recognizes the importance of intra/interoperability issues, it is equally clear that ambiguities in assigned responsibilities remain.

* Beginning in late 1987 a series of sweeping reorganizations of HQMC functions was initiated by the Commandant. The reorganization established a Marine Corps Research, Development and Acquisition Command (MCRDAC) in November 1987, and a Marine Corps Combat Development Command (MCCDC) in December 1987. The detailed structure of these organizations had not been finalized at the time this report was completed (March 1988). It is known, however, that MCRDAC will be responsible for systems acquisition and fielding. It will also incorporate the development functions of the HQMC sponsors and of the Development Center at Quantico. MCCDC will define and document requirements for new systems or programs. It is intended that validation of requirements be expedited by close interaction with the Fleet Marine Forces. The existing Doctrine Center and the Plans section of the Development Center will be absorbed by MCCDC. The establishment of a MAGTF Warfare Center in MCCDC will support the requirements process through mission analyses, and related activities.

APPENDIX F

INTRA/INTEROPERABILITY REQUIREMENTS: ILLUSTRATIVE EXAMPLES

F.1 BACKGROUND

The success of a large-scale, many-faceted C2 system automation project, such as the one contemplated by the Marine Corps, requires careful attention to the functional requirements for such a system. The requirements can best be determined through analysis of the communications links required during all phases of an amphibious/expeditionary operation, including the pre-assault phases.

F.2 EXAMPLES

In an effort to evaluate the Marine Corps baseline C3I requirements documentation, a rudimentary analysis was performed for illustrative purposes. The analysis also served as a tool for evaluation of the 1984 TIC and the system intraoperability/interface structure which is currently projected. A comprehensive analysis of the intraoperability requirements of a MAGTF is beyond the scope of this report. However, based upon a MEB-level amphibious operation, a short analysis was carried out using the steps described below. The results are reflected in Figures F.2-1 through F.2-5:

- Establish the scenario and task organization.
- Select a phase and stage of the operation.
- Project a "snapshot" of OPFAC's and communication needlines (direct and indirect).
- Construct a chart and matrix of needlines.
- Estimate the types of information that should be exchanged over each needline.
- Determine the equipments/systems which are planned for each OPFAC.
- Estimate the types of information which should be exchanged between systems at each OPFAC.
- Extract and plot appropriate data from current documents on each chart.

It should be understood that many interpretations of the requirements for communications/data transmission are possible. The charts are presented for illustrative purposes only and are not intended as interface recommendations of the Panel.

* Figure F.2-1 is a graphic view of the earliest portion of the assault phase of a MEB-level operation; the period during which all command and control, except for the COC's of the assault elements ashore, are still aboard ship. Duplicate facilities (except for Comm/Message Centers aboard ship) have been eliminated. The agencies and units, as well as the interfaces depicted, were gleaned from tactical and communications doctrine and have been verified by instructors at the Marine Corps Communications Officer School. An assumption has been made that the presence of a unit on a particular radio net implies the need for that unit to contact another station on that net.

* Figure F.2-2 is a matrix which illustrates the interfaces depicted in Figure F.2-1. The chart also shows certain implied indirect interfaces. These are included because some information will have to be relayed between indicated units even though no direct interface is required. This could indicate a requirement for reformatting or retransmission of the data. A "circle" located at an intersection indicates that the interface was identified in the 1984 TIC.

* Figure F.2-3 depicts the 1984 TIC description of the types of

information which have to be exchanged between OPFAC's in the given situation. Black dots indicate interfaces mentioned in the TIC but not defined as to the information which must be exchanged.

* Figure F.2-4 depicts a nominal estimate of the interfaces and types of information required. (No "school solution" is implied by this chart; figures depicted are for illustration only!)

* Figures F.2-5(1) and F.2-5(2) expand the information depicted in Figure F.2-4 to include systems which are currently planned to be implemented at each of the units with the exception of voice radio and telephone. (Note: TCO and MIFASS are included in these charts to indicate that the requirement for the functions included within these systems remain in force despite the cancellation of the programs.) The two types of background shading are used to highlight the 'direct' and 'indirect' interfaces. The letters located at the intersections show, to the extent possible, the general types of data which will, or should be, exchanged between units by means of the indicated systems. The number "1" in certain intersections indicates an interface between systems aboard ship which will be implemented by the Shipboard MTACCS Interface Controller (SMIC). The matrix serves to highlight some of the requirements for system-to-system interfaces and additional system distribution within the Amphibious Task Force (ATF). Consideration at this point of requirements during later stages of the assault will result in the inclusion of capabilities for communications "backboning" and system redundancies.

It should also be recognized that the above analysis is based upon 1987 structure, plans and organization, not upon a full functional analysis of actual combat requirements. Nonetheless, it illustrates a useful methodology for verification and validation of concepts and plans.

In order to analyze the full range of system and interface requirements for the purpose of determining system and interface requirements, the analysis should begin with a functional analysis of each mission area and continue through projected scenarios to data needlines and data traffic volumes. Such analyses would yield data-system and communications requirements.

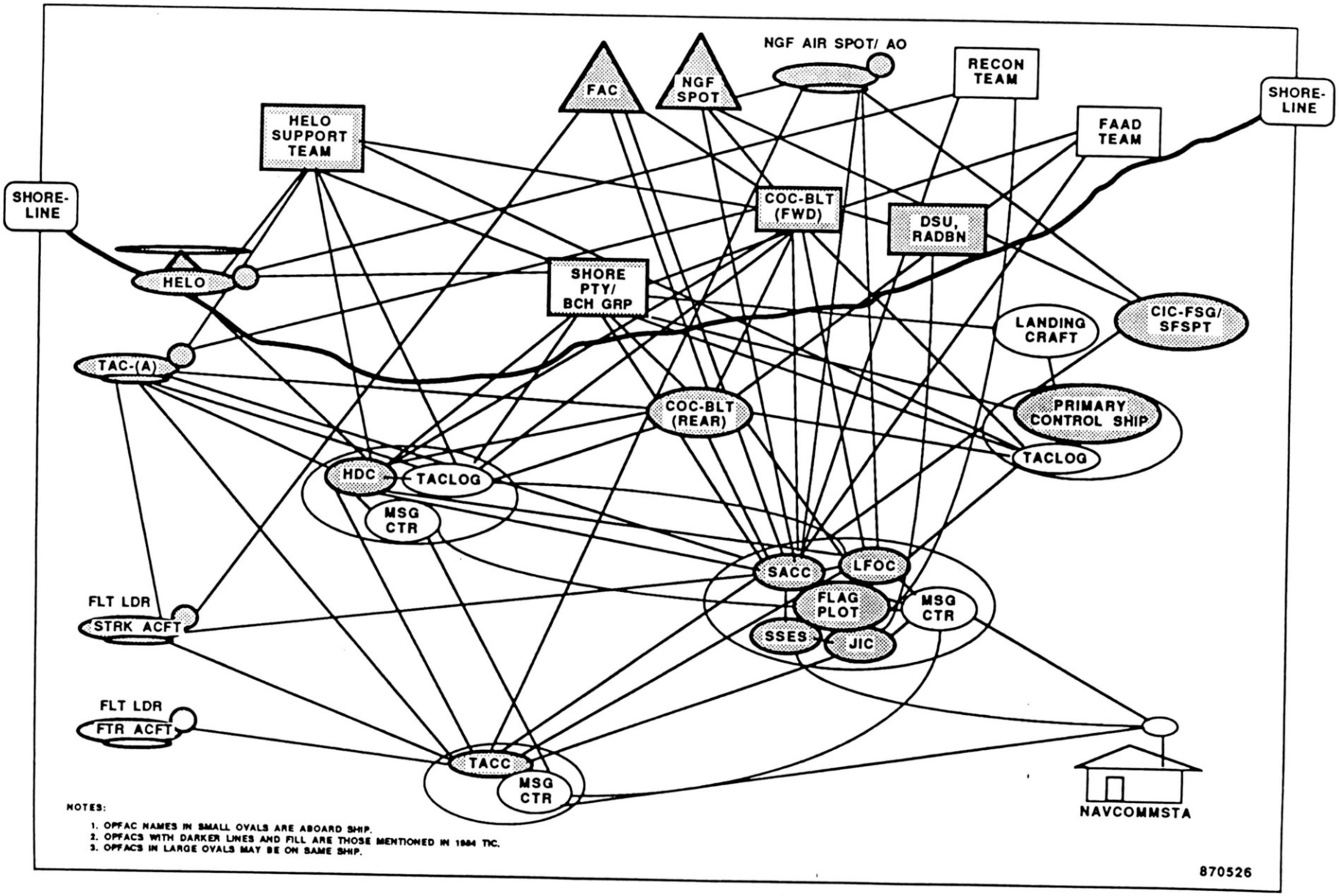
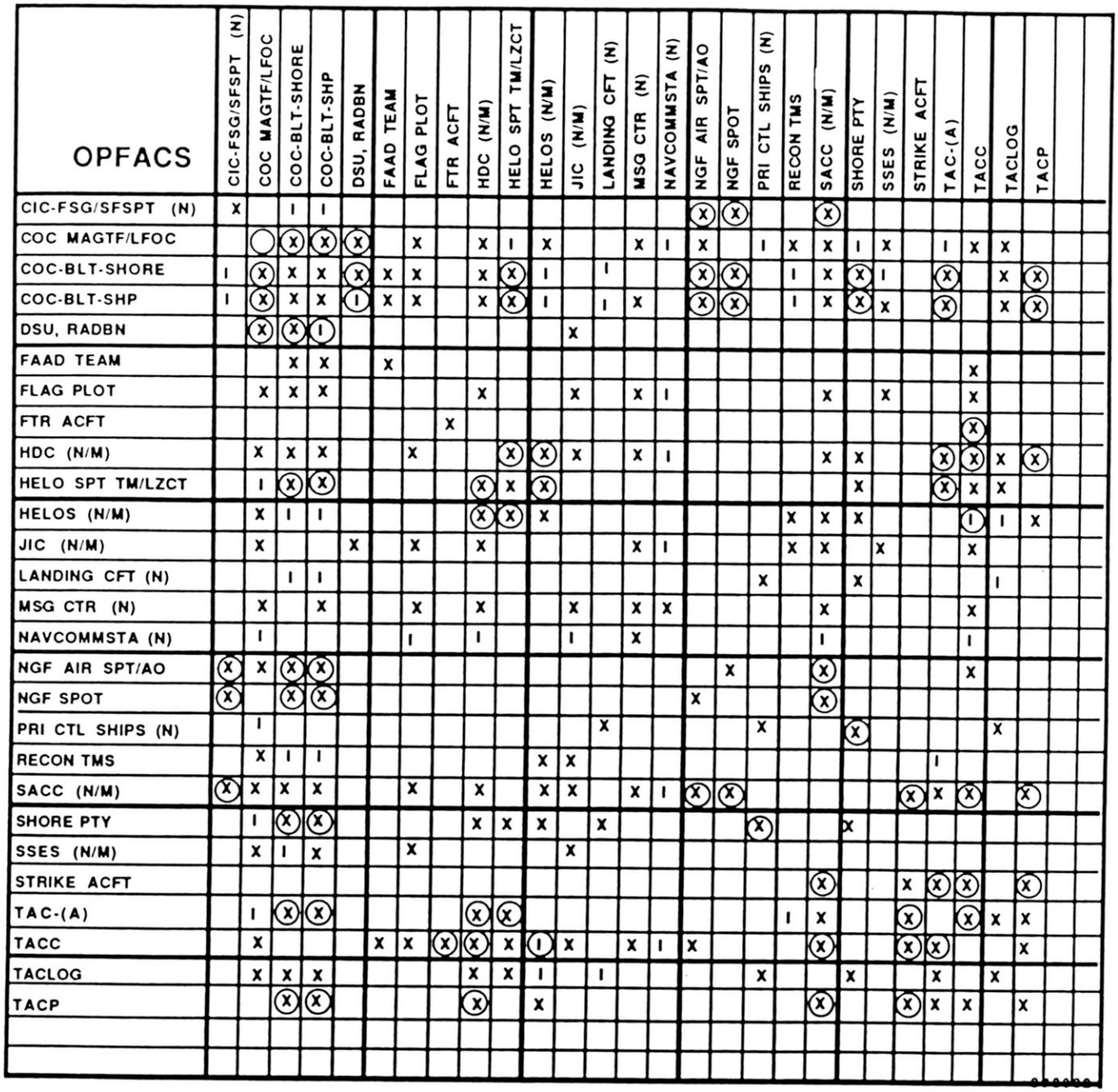


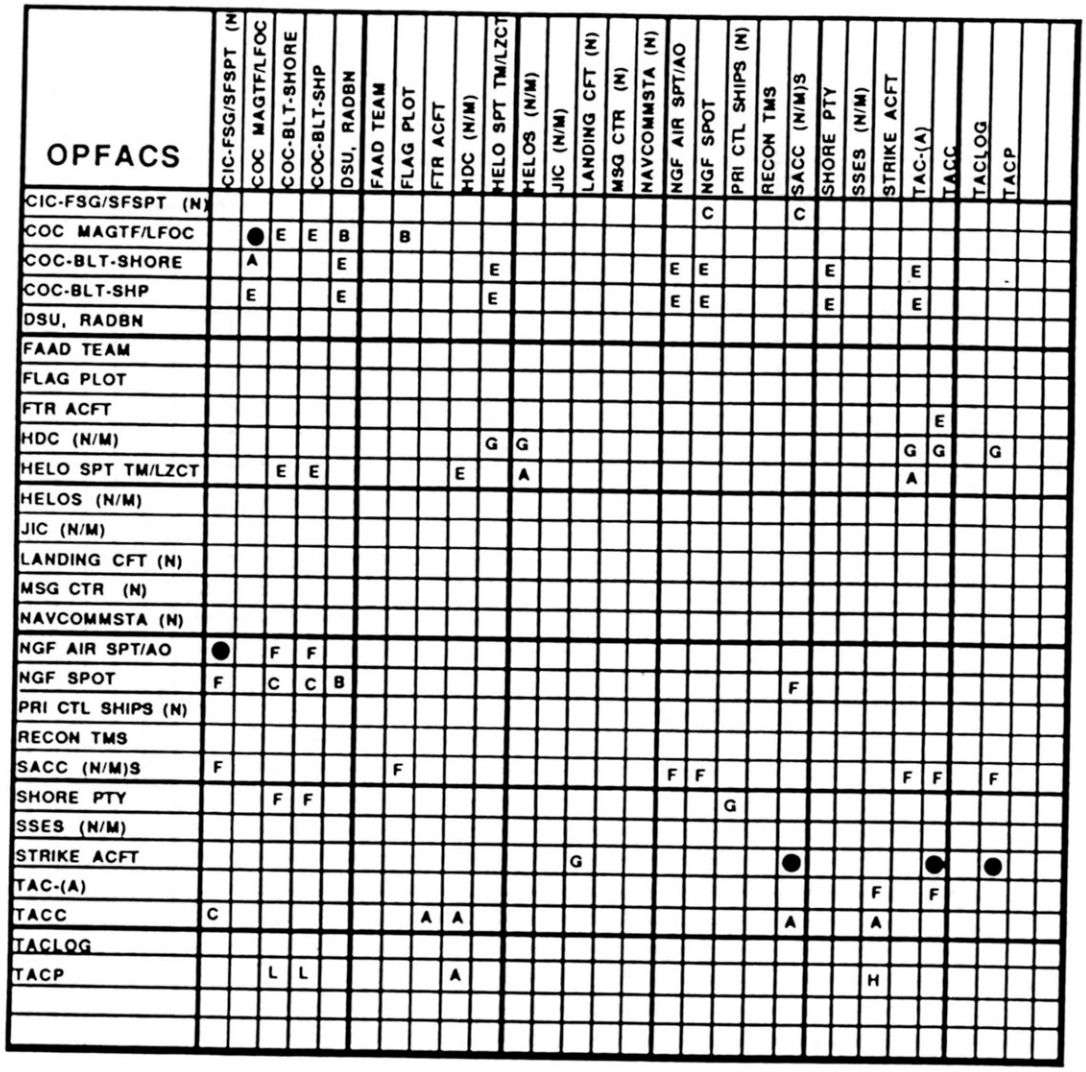
FIGURE F.2-1: OPFAC INTEROPERATION DURING ASSAULT PHASE OF MAB AMPHIBIOUS OPERATION



NOTES:

1. X = CURRENT DOCTRINAL INTEROPERATION
2. I = INTERFACE NOT CURRENT DOCTRINE, BUT REQT MAY EXIST FOR DATA RELAY
3. ○ = THIS INTERSECTION IS SHOWN IN 1984 TIC.

FIGURE F.2-2: OPFAC INTEROPERATION DURING ASSAULT PHASE OF MAB AMPHIBIOUS OPERATION (NOMINAL AMPHIBIOUS MAB WITH TWO BLTS, NO OTHER SERVICE OR NATION)



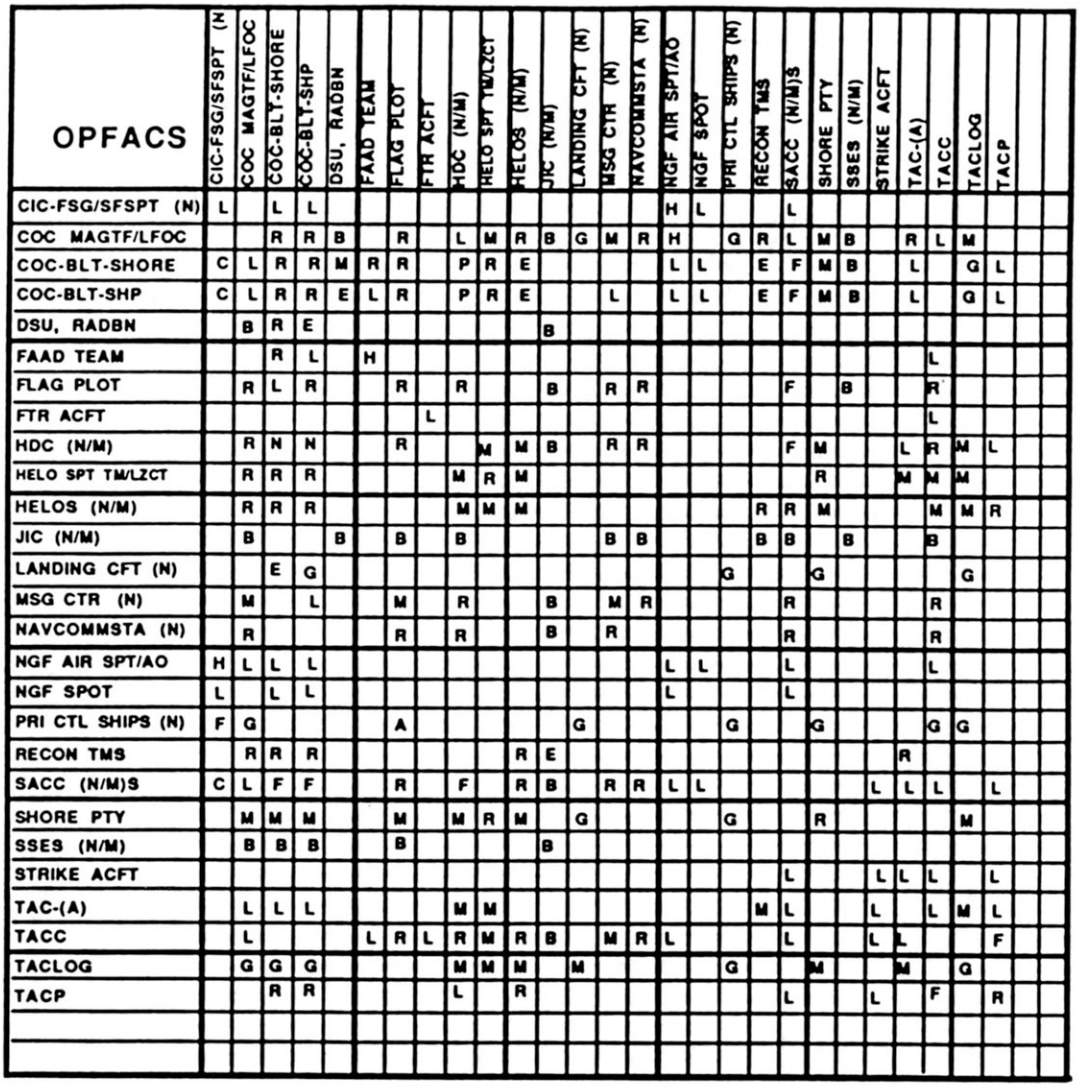
KEY: THE LETTERS IN THE INTERSECTIONS INDICATE THE TYPE OF INFORMATION WHICH MUST BE PASSED ON THE INDICATED LINK. OTHER TYPES OF DATA MUST BE PASSED BETWEEN THE INDICATED UNITS, BUT MAY BE PASSED BY COURIER, VOICE RADIO, OR OTHER MEANS.

A-MANEUVER (INCLUDES PLI)
B-INTELLIGENCE
C-FIRE SUPPORT
D-LOGISTICS/ADMINISTRATIVE
E-MANEUVER & INTEL
F-MANEUVER & FIRE SUPPORT
G-MANEUVER & LOG/ADMIN
H-INTEL & FIRE SUPPORT
I-INTEL & LOG/ADMIN
K-FIRE SUPPORT & LOG/ADMIN
L-MANEUVER & INTEL & FIRE SUPPORT
M-MANEUVER & INTEL & LOG/ADMIN
N-MANEUVER & FIRE SUPPORT & LOG/ADMIN
P-INTEL & FIRE SUPPORT & LOG/ADMIN
R-MANEUVER & INTEL & FIRE SUPPORT & LOG/ADMIN

● - INFO EXCHANGE NOT SPECIFIED

870626

FIGURE F.2-3: OPFAC INFORMATION EXCHANGE REQTS DURING MAB ASSAULT PHASE (PER 1984 TIC)



OPFACS	CIC-FSG/SFSPT (N	COC MAGTF/LFOC	COC-BLT-SHORE	COC-BLT-SHP	DSU, RADBN	FAAD TEAM	FLAG PLOT	FTR ACFT	HDC (N/M)	HELO SPT TM/LZCT	HELOS (N/M)	JIC (N/M)	LANDING CFT (N)	MSG CTR (N)	NAVCOMMSTA (N)	NGF AIR SPT/AO	NGF SPOT	PRI CTL SHIPS (N)	RECON TMS	SACC (N/M)S	SHORE PTY	SSES (N/M)	STRIKE ACFT	TAC-(A)	TACC	TACLOG	TACP		
CIC-FSG/SFSPT (N)	L		L	L												H	L			L									
COC MAGTF/LFOC			R	R	B		R		L	M	R	B	G	M	R	H		G	R	L	M	B		R	L	M			
COC-BLT-SHORE	C	L	R	R	M	R	R		P	R	E					L	L		E	F	M	B		L		G	L		
COC-BLT-SHP	C	L	R	R	E	L	R		P	R	E			L		L	L		E	F	M	B		L		G	L		
DSU, RADBN		B	R	E								B																	
FAAD TEAM			R	L		H																		L					
FLAG PLOT		R	L	R			R		R			B		R	R					F		B		R					
FTR ACFT								L																L					
HDC (N/M)		R	N	N			R			M	M	B		R	R					F	M			L	R	M	L		
HELO SPT TM/LZCT		R	R	R					M	R	M										R			M	M	M			
HELOS (N/M)		R	R	R					M	M	M								R	R	M				M	M	R		
JIC (N/M)		B			B		B		B					B	B				B	B		B			B				
LANDING CFT (N)			E	G														G			G					G			
MSG CTR (N)		M		L			M		R			B		M	R					R					R				
NAVCOMMSTA (N)		R					R		R			B		R						R					R				
NGF AIR SPT/AO	H	L	L	L												L	L			L					L				
NGF SPOT	L		L	L												L				L									
PRI CTL SHIPS (N)	F	G					A						G					G			G				G	G			
RECON TMS		R	R	R							R	E											R						
SACC (N/M)S	C	L	F	F			R		F		R	B		R	R	L	L						L	L	L		L		
SHORE PTY		M	M	M			M		M	R	M		G					G			R					M			
SSES (N/M)		B	B	B			B					B																	
STRIKE ACFT																				L			L	L	L		L		
TAC-(A)		L	L	L					M	M									M	L			L		L	M	L		
TACC		L				L	R	L	R	M	R	B		M	R	L				L			L	L			F		
TACLOG		G	G	G					M	M	M		M					G			M			M		G			
TACP			R	R					L		R									L			L		F		R		

KEY: THE LETTERS IN THE INTERSECTIONS INDICATE THE TYPE OF INFORMATION WHICH MUST BE PASSED ON THE INDICATED LINK. OTHER TYPES OF DATA MUST BE PASSED BETWEEN THE INDICATED UNITS, BUT MAY BE PASSED BY COURIER, VOICE RADIO, OR OTHER MEANS.

A-MANEUVER (INCLUDES PLI)
B-INTELLIGENCE
C-FIRE SUPPORT
D-LOGISTICS/ADMINISTRATIVE
E-MANEUVER & INTEL
F-MANEUVER & FIRE SUPPORT
G-MANEUVER & LOG/ADMIN
H-INTEL & FIRE SUPPORT
I-INTEL & LOG/ADMIN
K-FIRE SUPPORT & LOG/ADMIN
L-MANEUVER & INTEL & FIRE SUPPORT
M-MANEUVER & INTEL & LOG/ADMIN
N-MANEUVER & FIRE SUPPORT & LOG/ADMIN
P-INTEL & FIRE SUPPORT & LOG/ADMIN
R-MANEUVER & INTEL & FIRE SUPPORT & LOG/ADMIN

870603

FIGURE F.2-4: OPFAC INFORMATION EXCHANGE REQTS DURING MAB ASSAULT PHASE (CURRENT ESTIMATE)

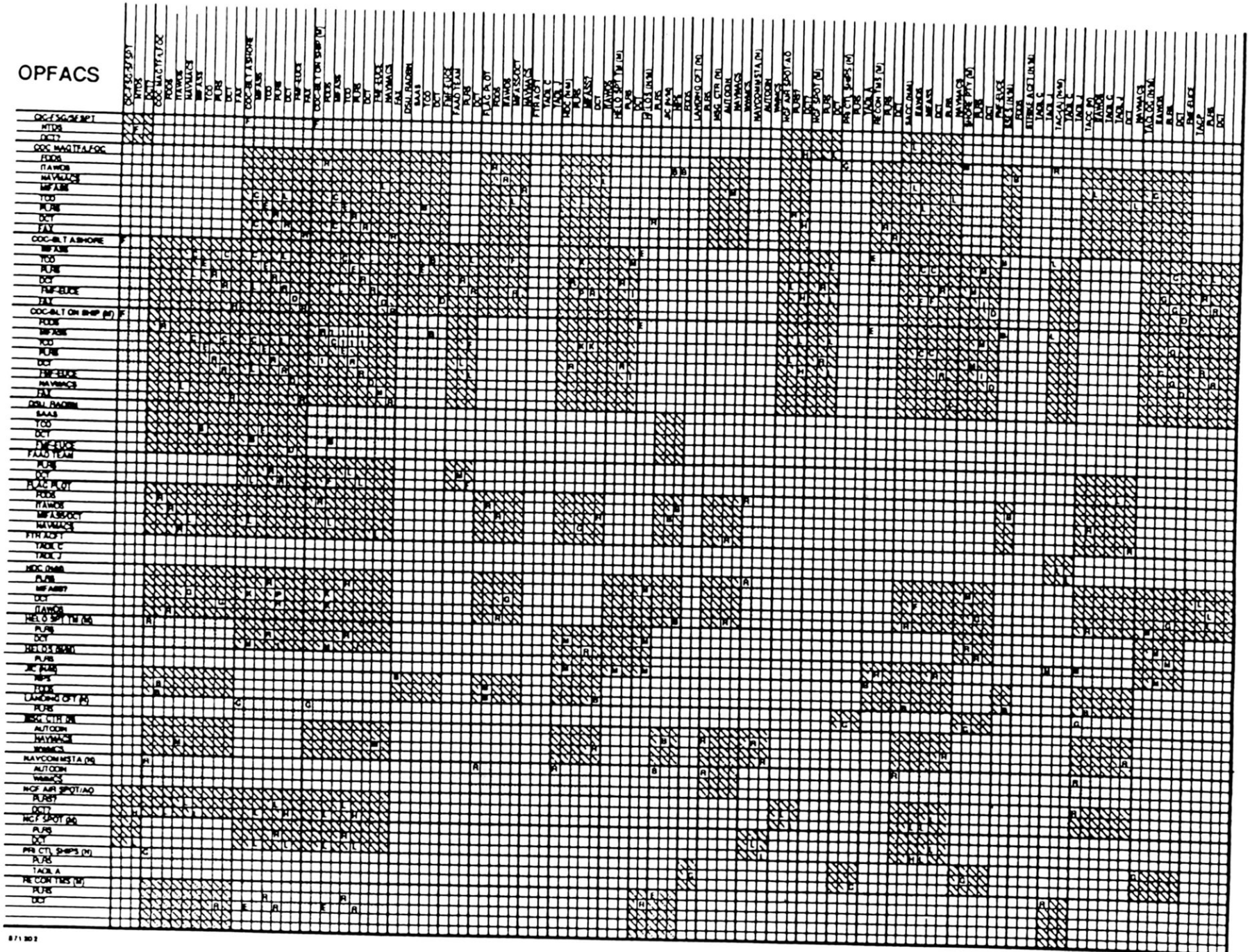
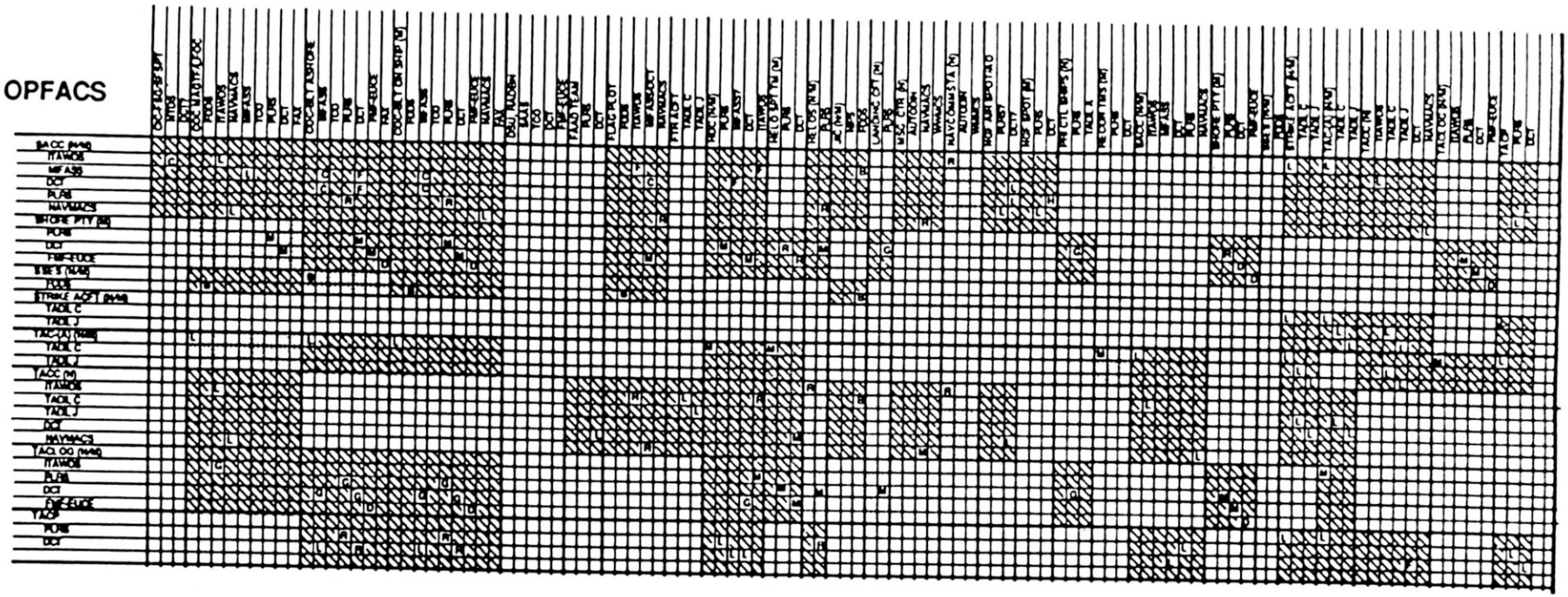


FIGURE F.2-5 (1): OPFAC / SYSTEM INTRAOPERATION DURING ASSAULT PHASE OF MAB AMPHIBIOUS OPERATION (PAGE 1 OF 2)
(NOMINAL AMPHIBIOUS MAB WITH TWO BLTS, NO OTHER SERVICE OR NATION)



KEY: THE LETTERS IN THE INTERSECTIONS INDICATE THE TYPE OF INFORMATION WHICH MUST BE PASSED ON THE INDICATED LINK. OTHER TYPES OF DATA MUST BE PASSED BETWEEN THE INDICATED UNITS, BUT MAY BE PASSED BY COURIER, VOICE RADIO, OR OTHER MEANS.

- A- MANEUVER (INCLUDES FLS)
- B- INTELLIGENCE
- C- FIRE SUPPORT
- D- LOGISTICS/ADMINISTRATIVE
- E- MANEUVER & INTEL
- F- MANEUVER & FIRE SUPPORT
- G- MANEUVER & LOG/ADMIN
- H- INTEL & FIRE SUPPORT
- I- INTEL & LOG/ADMIN
- K- FIRE SUPPORT & LOG/ADMIN
- L- MANEUVER & INTEL & FIRE SUPPORT
- M- MANEUVER & INTEL & LOG/ADMIN
- N- MANEUVER & FIRE SUPPORT & LOG/ADMIN
- P- INTEL & FIRE SUPPORT & LOG/ADMIN
- R- MANEUVER & INTEL & FIRE SUPPORT & LOG/ADMIN
- T- INTERFACE BY MEANS OF THE EMIC

= OPFACS/UNITS IN DIRECT CONTACT

= OPFACS/UNITS IN INDIRECT CONTACT

FIGURE F.2-5 (2): OPFAC / SYSTEM INTRAOPERATION DURING ASSAULT PHASE OF MAB AMPHIBIOUS OPERATION (PAGE 2 OF 2)
(NOMINAL AMPHIBIOUS MAB WITH TWO BLTS, NO OTHER SERVICE OR NATION)

ASLT UNITS ASHORE
AUTODIN
BLT
CATF
COC
COMM CTR (R)
CTL SHIPS (R)
DCT
FAAD TEAM
FAX
FDDS
FLAG PLOT
FMF-EUCE
FO (M)
FTR ACFT
FWD AIR CTRLR
HDC (N/M)
HELO SPT TM (M)
HELOS (N/M)
ITAWDS
JIC (N/M)
LANDING CFT (N)
LFOC (M)
MIFASS
NAVCOMMSTA (R)
NGF AIR SPOT
NGF SPOT (R)
NIPS
PLI
PLRS
RECON TMS (M)
SACC (N/M)
SF SPT SHIPS (N)
SHORE PTY (R)
SMIC
SSES (N/M)
STRIKE ACFT (N/M)
TAC (A) (N/M)
TACC (N/M)
TACLOG (N/M)
TADIL A
TADIL C
TADIL J
TCO
WWMCCS

GLOSSARY

ASSAULT UNITS
AUTOMATIC DIGITAL NETWORK
BATTALION LANDING TEAM
COMMANDER, AMPHIBIOUS TASK FORCE
COMBAT OPERATIONS CENTER ASHORE
COMMUNICATIONS CENTER (ON SHIP)
CONTROL SHIPS
DIGITAL COMMUNICATIONS TERMINAL (AN/PSC-2)
FORWARD ANTI-AIR DEFENSE TEAM (STINGER RS)
FACSIMILE (AN/UXC-)
FLAG DATA DISPLAY SYSTEM (AN/UYQ-66(V))
FLAG PLOT (CATF OPERATION CENTER)
FLEET MARINE FORCE END USER COMPUTER EQUIPMENT
FORWARD OBSERVER
FIGHTER AIRCRAFT
FORWARD AIR CONTROLLER
HELICOPTER DIRECTION CENTER
HELICOPTER SUPPORT TEAM
HELICOPTERS
INTEGRATED TACTICAL AMPHIBIOUS WARFARE DATA SYSTEMS
JOINT INTELLIGENCE CENTER
LANDING CRAFT
LANDING FORCE OPERATIONS CENTER (ON SHIP)
MARINE INTEGRATED FIRE AND AIR SUPPORT SYSTEM
NAVAL COMMUNICATIONS STATION (SHORE STATION)
NAVAL GUNFIRE SPOTTER - AIRBORNE (ALSO AIR OBSERVER)
NAVAL GUNFIRE SPOT TEAM
NAVAL INTELLIGENCE PROCESSING SYSTEM
POSITION/LOCATION INFORMATION
POSITION LOCATION REPORTING SYSTEM (AN/TSQ-129 & AN/PSQ-4)
RECONNAISSANCE TEAMS (INCLUDES RADIO RECON)
SUPPORTING ARMS COORDINATION CENTER
SHORE FIRE SUPPORT SHIPS
SHORE PARTY (INCLUDES BEACH GROUP)
SHIPBOARD NTADS INTERFACE CONTROLLER
SHIP'S SIGNALS EXPLOITATION SPACES
STRIKE AIRCRAFT
TACTICAL AIR CONTROLLER-AIRBORNE
TACTICAL AIR COMMAND CENTER
TACTICAL LOGISTICS GROUP
TACTICAL DIGITAL INFORMATION LINK A (WAS NTDS/LINK 11)
TACTICAL DIGITAL INFORMATION LINK C
TACTICAL DIGITAL INFORMATION LINK J
TACTICAL COMBAT OPERATIONS SYSTEM
WORLD-WIDE MILITARY COMMAND AND CONTROL SYSTEM

APPENDIX G

KEY DOCUMENTATION AND DIRECTIVES

G.1 BACKGROUND

The documents listed in Figure G.1-1 are the basic documents used by the Marine Corps to manage the intra/interoperability of Marine Corps automated command and control systems.

The baseline Marine Corps intra/interoperability documents have been revised periodically, but the revisions have not always been mutually coordinated. Consequently, the developers have had some "moving targets". It should be noted that the Technical Interface Concepts (TIC) and the Technical Interface Design Plan (TIDP) documents were prepared in direct response to Joint Service requirements and were intended primarily to describe the systems which have other service impact. Probably as a result of this fact, systems and Operational Facilities (OPFACs) which only effected internal Marine Corps intraoperability issues were omitted or given minimal attention. The detrimental effect of this approach is that the Marine Corps decision to make the TIC and TIDP the "source documents for intra/interoperability requirements" resulted in the "intra" portion of the requirements receiving inadequate attention. The Panel's evaluation is summarized in Figure G.1-2, and in greater detail in the following sections.

G.2 HISTORY

G.2.1. **MCO 3093.1B (Intra/Interoperability of Marine Corps Tactical Data Systems (TDS's) and Interconnecting Equipment)**. The original of this document (MCO 3093.1A) dated 21 December 84, was published in conjunction with the 1984 version of the TIC. The order was worded quite loosely and allows Sponsors to retain nearly full authority to waive established standards. (This authority was often exercised in the past.) The current document (MCO 3093.1B, dated 5 June 87) has been coordinated and is in the process of being promulgated. It strengthens somewhat the role of the Coordinator in the development of systems, but still does not "solve" the fundamental intra/interoperability management problems outlined in this report. Additionally, the order states that it applies to "TDS's and Interconnecting Equipment", but does not define the equipment, nor provide an unequivocal definition of TDS's. The order also seems to cite the TIC as the source for the definition of specific TDS's, but does not do so explicitly.

G.2.2. **Technical Interface Concept (TIC)**.

* In August 1977, a preliminary TIC was issued which attempted to describe in functional terms the interfaces among Operational Facilities. This document moved away from the original MTACCS concept by omitting systems and OPFAC's which were not "air and ground operations" oriented. The only systems interfaces shown were for the original MTACCS systems and non-Marine Corps systems.

* The most current version of the TIC was published in 1984 in conjunction with MCO 3093.1A. This document, like its predecessor, was intended to provide a baseline for intra/interoperability of Marine Corps C2 systems.

- The structure of the document makes it very difficult to track the functions of the OPFAC's listed.

- The "tasks" listed are very broadly drawn. As an example: one task of the FSCC is to "ensure during the planning and execution stages, the integration of all air, artillery, mortar, and naval gunfire support of the scheme of maneuver of the ground forces". This task is cited in Section 3.4.4 of the TIC as applicable to every interface between the FSCC and every other OPFAC of the MAGTF. When one attempts to correlate this task with the messages and data groups outlined in the TIDP, one becomes lost in the gap between levels of detail. No breakdown of tasks into successive levels is provided. In addition, the TIC and the TIDP use different referents for OPFAC's and tasks.

- A second, serious problem exists in the 1984 TIC. The TIC is predicated on the existing structure of Marine Corps OPFAC's rather than on a methodical breakdown of combat functions and support requirements. Consequently, the document shows many OPFACs which are routinely collocated. A person not acquainted with Fleet Marine Force (FMF) operations would find few clues to indicate that the Combat Operations Center-Ground Combat Element (COC-GCE), the senior Fire Support Coordination Center (FSCC), the Direct Air Support Center (DASC), the Marine Corps Intelligence (MCINTEL) and the Special Security Communications Center/Team (SSCC/SSCT) OPFAC's are routinely collocated. It is conceivable that some of the communications requirements between them might be met by passing a note from one field desk to another. Thus some of the automated interfaces planned between them might be postponed in favor of more immediate needs.

- Many OPFAC's, such as the Tactical Logistics Center (TACLOG), are vital to amphibious operations but are not addressed in the TIC or TIDP, and therefore, are not considered to be part of the "formal" FMF combat structure. More importantly, they are not considered to be requirements under the configuration management vested in the TACSIIP because the TACSIIP only recognizes the TIC and the TIDP as the "base documents" for interoperability.

- In addition to the shortfalls which may exist due to omissions from the TIC, many interfaces/commonalities have been waived or deferred within the individual systems-development programs.

- It is understood that the Marine Corps is working on a revision of the TIC at this time.

G.2.3. **Technical Interface Design Plan (TIDP)**. Various versions of the TIDP were produced in 1979, 1980, with the last complete issue of the plan occurring in 1981. (The Marine Corps TACSIIP activity is actively working to update all six volumes of the TIDP.) This set of documents describes the message elements and standards, and provides a message element dictionary for automated command and control systems. Unfortunately, the configuration of these documents was not rigidly controlled in the past. Consequently, adherence to the standards therein by the various development programs has been less than exact.

G.2.4. **MTACCS Master Plan**. On 28 October 75, a requirement was established for an MTACCS Master Plan to be published under the supervision of the C4 Systems Plans Branch with the assistance of the DEVCTR. The MTACCS Master Plan was consequently published in 1977. It directs that JINTACCS and TACS/TADS standards be implemented in MTACCS systems. It also describes a

structure for the management of changes. This document was later subsumed by the Marine Corps C2 Master Plan (C2MP).

G.2.5. Landing Force Integrated Communications System (LFICS) Architecture 1978-1990. This document, published in October 1977, provided a plan and proposed structure for the communications support of Marine FMF Command and Control systems. It was subsequently incorporated into the C2MP.

G.3 CURRENT EVALUATION AND RECOMMENDATIONS

G.3.1. Baseline Documents. At the time of this report, all of the documents with the exception of the Marine Corps Interoperability Configuration Management Plan (MCICMP), are in the process of revision. Although the Marine Corps is bringing the process of systems management into focus and under control, the concerns surfaced above are not removed by the proposed revisions. It does appear that better coordination between the writers of the various documents is taking place. It should be noted however, that the dichotomy between AIS's and TDS's continues since AIS's are not included in the baseline documents. AIS's are a special case, taking input from deployed units in various forms to update databases and to facilitate requests. AIS's may or may not be "on-line" with TDS's on the battlefield, depending on the specific operational situation.

G.3.2. TIC-87. The TIC is under revision at this time. The Panel was unable to view a draft copy, but was briefed on the content of the proposed revisions.

This document should be expanded to define all command and control functions which will be supported by data systems in garrison and in the field throughout the Marine Corps. Both TDS's and AIS's should be included in this document. The general types of data which must be exchanged during the various phases of amphibious combat operations should be examined and spelled out. These actions, and orderly, periodic updates of the order, will result in a comprehensive, dynamic document which provides continuity for the data transfer needs of the Corps both internally and externally.

G.3.3. TIDP-87. Four volumes of the six-volume document are available at the writing of this report. The other volumes are under development and review.

This document should be expanded to reflect the data interchange requirements expected during execution of the major combat scenarios depicted in Marine Corps operational plans. It should be based on the employment of the various MAGTF configurations of Marine combat units. The TIDP will then reflect the realistic communications and data transfer requirements internal and external to the FMF. This will make it one of the central planning tools for determining the type and degree of future automation needed to enhance Marine command and control systems.

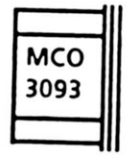
G.3.4. C2MP-87. The 1987 version of the C2MP has been published. It is the only document that combines information on communications and data systems required by the Marine Corps, with an architecture for implementation. The greatest problem with this document is that it is published for "Information Only". It contains a set of policy statements which are excellent, but are not policy since they have not been promulgated in an authoritative document.

The C2 Master Plan should be expanded and augmented to become the key document for the implementation of long-range Marine Corps C3I plans. It should be the planning "glue" that hold other intra/interoperability documents together. As the USMC C3I Plan, it should reflect the scope, direction, schedule and goal of all (TDS, AIS, Intelligence, Manpower, Logistics, Maneuver, Fire and Air Support, etc.,) Marine Corps automated systems and equipment under development in support of Marine Corps requirements.

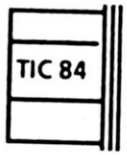
G.3.5. **Interoperability Management Plan (IMP)**. The IMP is a companion document to MCO 3093.1B. It was available to the Panel only in draft form. The IMP specifies that its provisions apply only to TDSs, not to AISs. It does not provide a reference indicating which systems are included within the TDS designation, merely referring to the systems listed in MCO 3093.1B. That order defines TDS's as: Tactical Command and Control Systems; Tactical Computer Systems and Equipment; Intelligence Systems; Sensor Systems and Equipment; Communications Systems and Equipment; and, Tactical Command, Control, Communications and Intelligence (C3I) Systems.

Marine Corps Interoperability Configuration Management Plan MCIC-MP). This document was not available for review by the Panel.

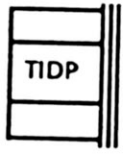
The existing Interoperability Management Plan (IMP), and the Marine Corps Interoperability/Configuration Management Plan (MCIC-MP), should be combined into one document, which should then reflect all activity related to intra/interoperability. The MCIC-MP should clearly define the proper procedures for responding to changing interoperability requirements and specifications within any system or development program. Approved changes should be reflected in this document.



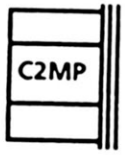
Marine Corps Order 3.093.1B- Basic USMC Policy for Intra/Interoperaability.



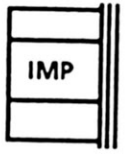
Technical Interface Concept - Contains baseline for functional interoperability.



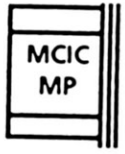
Technical Interface Design Plan - Contains Details of data interchange, requirements, message standards and message dictionary.



Command and Control Master Plan - Contains details of system implementation, fielding, and tactical integration, along with policies and system description.



Interoperability Management Plan - Describes how "interoperability" is to be managed.



Marine Corps Interoperability Configuration Management Plan - Describes how interfaces and system configurations are to be managed.

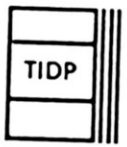
870603

FIGURE G.1-1: KEY DOCUMENTATION AND DIRECTIVES

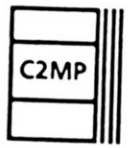
THESE COMMENTS APPLY ONLY TO THE CURRENT VERSIONS OF THE DOCUMENTS

- Does not clearly assign management responsibility for interoperability.
- Is not clear in defining systems which it addresses.

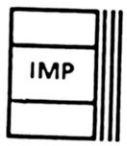
- Is not internally consistent.
- Does not address all appropriate MAGTF OPFACs.
- Tasks are too broad.
- Does not address all phases of amphibious warfare and requirements.



- Not internally consistent. Is not fully consistent with TIC 84.
- Does not address all phases of amphibious warfare and requirements.



- 1987 version reviewed in draft.
- Not directive. Published "for information".
- Not really a "Master Plan" because it does not govern development or interoperability. No complete Engineering Plan found.



- States that it applies only to TDSs.
- Does not define TDSs in sufficient detail, nor does it list them.
- Not fully integrated with other documents.

- Not available for review.

871201

FIGURE G.1-2: EVALUATION OF KEY DOCUMENTATION