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June 1977

ALTERNATIVE AUTOMATED DATA PROCESSING SYSTEM CONCEPTS FOR SUPPORT OF THE FMF (1980-1990)

Volume IV: Description and Analysis of Alternative ADPS Concepts

By: L. S. PETERS, K. R. AUSICH, G. F. WALLACE, C. G. KERNS, and E. B. SHAPIRO,

Prepared for:

COMMANDANT OF THE MARINE CORPS
HEADQUARTERS MARINE CORPS
WASHINGTON, D.C. 20380
AND
OFFICE OF NAVAL RESEARCH (CODE 230)
DEPARTMENT OF THE NAVY
ARLINGTON, VIRGINIA 22217

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This document is one volume of a five volume final report that describes the results of a study effort to identify alternative ADP concepts for the Fleet Marine Force (FMF) during the 1980s. The focus of the study was the administrative type information processing associated with the management of manpower, operations, and logistics activities of the FMF rather

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than the tactical control activities. The goal of the study was to define alternative ADP concepts that could serve the FMF's needs in garrison, afloat, and within a combat area. A systematic analysis approach was employed that analyzed requirements, ADP technology, ADP system architectures, operational effectiveness, and system cost. The individual volumes of the final report are titled: Volume I: Study Overview and Results; Volume II: FMF Information Processing Requirements; Volume III: ADPS Technology Estimate for the 1980s; Volume IV: Description and Analysis of Alternative ADPS Concepts; Volume V: Cost Analysis for Alternative ADPS Concepts.

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DEPARTMENT OF THE NAVY
ARLINGTON, VIRGINIA 22217

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Approved by:

AL BIEN, *Director*
Naval Warfare Research Center

ROY M. TIDWELL, *Executive Director*
Engineering Systems Division

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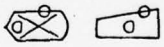
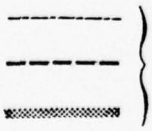
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LIST OF SYMBOLS

Symbol	Primary Significance	Additional Features
	Computer processor	On a given diagram circles of different sizes represent computers of different size and/or functional capability
	Storage/memory capacity	
	Hardcopy capability	
	I/O and/or communications capability	
	Intelligent terminal	
	Semi-intelligent terminal	
	Unintelligent (dumb) terminal	The use of the different symbols may signify differing terminal characteristics
	ATS terminals	
	Typewriter (OCR font)	
	Keying operation (e.g. keypunch)	
	Magnetic tape units	
	Removable recording units	These symbols are usually comined with other symbols, as in the following: 
	Hardcopy capability	
	Data flow paths of successively larger capacity	Each path represents a telecommunications link operating in store and forward mode and/or an alternative link over which recordable computer storage media such as magnetic tapes or diskettes can be physically transported.

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PREFACE

This volume is part of the final report of SRI Research Project No. 4950, entitled "Alternative Automated Data Processing System Concepts for Support of the FMF (1980-1990)."* SRI initiated this 20-month study in November 1975 for Headquarters, U.S. Marine Corps under Contract No. N00014-76-C-0582 from the Office of Naval Research. HQMC project management was initially provided by the Information Systems Support and Management Division, now a part of the Command, Control, Communications, and Computer Systems Division.

The study followed the approach described in the SRI Study Plan, "Alternative Automated Data System Concepts for Support of the FMF (1980-1990)," dated 1 January 1976--as approved and modified by CMC ltr RDS/ISMS-11-pmb 5230/1 dtd 26 Mar 76.

This is Volume IV of the final report which consists of five volumes whose titles are:

Volume I : Study Overview and Results

Volume II : FMF Information Processing Requirements

Volume III: ADPS Technology Estimate for the 1980s

Volume IV : Description and Analysis of Alternative ADPS Concepts

Volume V : Cost Analysis for Alternative ADPS Concepts.

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*As defined by governing Marine Corps documents, an automated data processing system (ADPS) is an interacting assembly of procedures, processes, methods, personnel, communications, and automatic data processing equipment (ADPE) to perform a series of data processing operations--a combination of automatic data processing resources and automated data systems. An automated data system (ADS) is an assembly of procedures, processes, methods, routines, or techniques (including but not limited to computer programs) united by some form of regulated interaction to form an organized whole, specifically designed to make use of ADPE.

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Volume I describes the research objectives and provides an overview of the entire project, along with a comprehensive study bibliography. It also includes an Executive Summary.

Much of the material contained in these volumes was published previously in draft form during the course of the project as SRI Technical Notes. However, the material has been revised and reissued in the final report, which then supersedes all the previously published interim and draft material.

I INTRODUCTION

This document reports the results of the SRI research to identify, describe, and analyze alternative ADPS concepts that could support the requirements of the FMF in the 1980s. The goal of this research was to investigate a large set of candidate ADPS concepts, to relate them to the FMF information processing requirements and FMF operating context, and to select a small number of the most promising concepts for detailed description and life cycle cost analysis.

The approach that SRI used in this process was to incorporate the information derived in its FMF information processing requirements analysis (Volume II of this study report) and the information derived in its ADP technology analysis (Volume III of this study report) in a set of criteria that are most significant to the implementation of an effective ADPS for the FMF beginning in the early 1980 decade. These criteria were then used to eliminate all but the most promising of the candidate concepts.

Section II of this volume describes the rationale by which SRI was able to apply the FMF requirements and ADP technical considerations to the reduction of the number of alternative ADPS concepts that would be considered in detail. Sections IV and V present detailed descriptions of the ADPS concepts that appeared best on that basis. The current ADPS concept was described in Section III for comparative purposes, even though it did not meet the conditions on which the other concepts were selected.

Section VI relates the alternative concept descriptions to one another and to the FMF requirements to identify the relative costs and benefits of the different approaches.

Three appendices support the material contained in the main body. One addresses FMF ADPS security perspectives that will impact on the characteristics of 1980 concepts for deployed FMF units. Another addresses the question of manpower resources available to support future FMF ADPS concepts based on the types of skill that will be required and the relation of these requirements to the current FMF manpower pool. Finally, a third appendix addresses the magnitude of FMF ADS digital traffic that 1980 ADPS might be expected to generate.

II SELECTION OF ALTERNATIVE ADPS CONCEPTS

A. Introduction

A primary SRI study objective was to restrict the set of alternative ADPS concepts for the FMF to a manageable number. Since a significant effort was to be expended: (1) to describe each alternative, (2) to assess its advantages and disadvantages relative to other alternatives of the set, and (3) to provide a life cycle cost estimate for it, the depth of the analysis would have decreased in proportion to the number of alternatives that were examined. Hence, the selection of an appropriate set of best candidate alternatives was a major decision point.

To make that decision SRI prepared a logical argument to exclude all but a certain class of concepts from further consideration. Based on the requirements analysis and ADPS technology review efforts SRI also performed for the study, this argument defines an exclusive set of alternatives--a set that SRI believes contains the alternatives that best serve the FMF's needs, as they can be fulfilled by the available technology.

Since the definition of the exclusive set was quite restrictive, it allowed SRI to narrow the study of alternatives to the point where more organizational tradeoffs (location of ADP equipment, transition logic between the operational environments, and so on) could be considered as variations on a basic theme. The life cycle costing effort benefited because fewer equipments and function-related costs had to be identified. In any case, however, the current ADPS concept was retained as an alternative for further consideration.

The following subsection defines and defends the exclusive set of alternatives. Several alternatives that are not included in the set are then identified and discussed as to why they do not meet the FMF's ADPS requirements as well as do members of the set. Sections, III, IV, and V present detailed descriptions of alternatives that survived the selection criteria.

The first is a baseline system; this is essentially the system that now supports the FMF. This concept does not meet the criteria of the exclusion argument contained in the next section, but it is included for comparison purposes. The other two alternatives meet the five conditions that SRI judges must be met, if the alternative is to satisfy the FMF requirements.

B. Selecting a Set of ADPS Alternatives

SRI's evaluation of FMF ADPS requirements and review of the applicable ADP technology have provided a basis for restricting the set of alternative ADPS concepts that warrant further consideration. This section will argue that every ADPS alternative that deserves detailed consideration as a 1980 FMF system must satisfy a minimum suite of conditions. Together, these conditions imply a restricted set of alternatives. The conditions are defined by the following statements:

(1) A tightly coupled network of ADP systems for on-line, real-time sharing of computing power or data bases via communication system cannot be supported in all FMF combat environments. However, batch teleprocessing (in a store and forward mode) can be supported in such environments.

(2) A hierarchy of ADPS systems supporting ADP services of different capacity and function must be present to serve the multilevel needs of the FMF organization.

(3) A minimum of three levels must be contained in the ADP system hierarchy.

(4) The lowest level of the ADP system hierarchy should not possess an ADP capability less than that contained in stand-alone intelligent terminals.

(5) Each level of the hierarchy must be able to operate autonomously to serve the primary needs of the users of that level.

The SRI study team believes that unless the ADPS developed for the FMF meets these conditions, it cannot simultaneously meet the following two objectives, given the operational, technical, and economic realities of the early 1980s:

- Support all the input requirements of Class I ADS and satisfy the reporting needs of the various HQMC functional managers;
- Satisfy the operational requirements of the FMF commanders in the three FMF environments (garrison, afloat, ashore) as well as support the several MAGTF configuration options.

The remainder of this section is designed to identify, expand, and defend the implications of this conclusion. Part 1 addresses each condition separately--based on the knowledge SRI has gained in its requirements analysis and its technology review. Part 2 identifies ADPS alternatives that do not meet the conditions for inclusion in the set. Such alternatives did not, in SRI's judgment, warrant further detailed consideration.

1. Defense of the Exclusion Conditions

Each of the five exclusion conditions is addressed in detail in the paragraphs that follow. Arguments for their validity are presented, based primarily on four considerations: (1) SRI's analysis of the FMF echelon information processing requirements; (2) FMF operational concepts that affect the ADS concept characteristics; (3) Marine Corps resource constraints in the ADP area; and (4) SRI's review of the state of the ADP technology.

a. Condition (1): A tightly coupled network of ADP systems for on-line, real-time sharing of computing power or data bases via a communication system cannot be supported in all FMF combat environments. However, batch transmission (in a store and forward mode) can be supported in such environments.

Within the FMF ADPS, two classes of computer information would be carried by telecommunications. The first would be files or portions of files to be transferred between the data bases of geographically separated processing systems. The second would be inquiry/response traffic typically related to operator activity at a system terminal.

The FMF ADPS application is such that file transfers need not be accomplished in time frames faster than those that span one to several minutes. Query/response traffic, however, to be viable needs to be serviced in times of 0.5 to 3 seconds.

A telecommunication network, such as LFICS, can connect the geographically dispersed elements of an ADPS by two techniques.

- A subnetwork of dedicated circuits
- Circuit sharing (with all FMF users) through circuit switching, message switching, or packet switching.

Any of these techniques should satisfy the file transfer response time requirement. Only dedication, circuit switching, or packet switching (but not message switching) will satisfy the inquiry/response requirement.

Condition (1) is technically supported, therefore, on the following rationale:

- Technology will permit LFICS to support all but packet switching in the late 1970's and early 1980's. Packet switching will not be available until the late 1980's.

- In view of this, the exchange of inquiry/response traffic between processors of the ADPS would (until the late 1980's) place a large demand upon LFICS resources--resources needed by other high priority LFICS users.
- Packet switching requires, among other capabilities, high speed switching of data, adaptive routing processes, and high levels of data security. For the ADP equipment to perform these functions it would be necessary to provide high performance, complex and costly facilities.
- Current packet switching systems, other than those in the research environment, provide only limited ability to support rapidly reconfiguring networks, as would be encountered in field deployment. None provide other than a modest degree of data security.

Completely independent of the technical factors, SRI believes that there are strong information processing system implications supporting this condition. These are based on SRI's judgment that:

- If one considers the local unit ADP need in isolation of the Class I reporting function, there appears to be no overriding justification for on-line, real-time access to data bases other than the one contained within the local unit.
- If one considers the Class I reporting function in isolation of the local unit ADP need, there is no strong justification for the responsiveness of an on-line, real-time system. Critical data can be handled on a priority basis, and aggregated historical information can follow in a time frame quite suitable for the general management function it supports.

b. Condition (2): A hierarchy of ADP systems supporting ADP services of different capacity and function must be present to serve the multi-level needs of the FMF organization.

SRI's analysis of FMF information processing requirements supports the need for a hierarchy of processors on the basis that:

- The lower FMF echelons have ADS requirements that emphasize different ADP functions than are emphasized at higher echelons

- The size of the data base, volume of activity, and detail of information are distinctly different among the FMF echelons
- Each echelon level has a need for local ADP support using data that it collects itself.

Given the need for ADP support, the FMF operational concepts support the need for a hierarchy of processors on the basis that:

- The mobility requirements, especially of the lowest administrative echelons require highly transportable ADP systems--and systems that meet this criteria do not have enough capacity to meet the needs of the higher echelons
- The requirement to be able to adapt to any MAGTF configuration--without undue waste of resources--demands the flexibility that accompanies a hierarchy of modular capability
- The need for security and backup ADP capability at each level of the FMF organization, as well as for the total FMF favors a hierarchy of processors.

Marine Corps resource constraints are not violated by a hierarchy of processors; rather they are served by such a approach on the basis that:

- User-oriented, easily maintained, rugged processors may be located at the lower echelons, while more capable processors (subject to less stringent physical and environmental constraints) may be reserved to serve the higher echelons
- The FMF cannot afford to send ADP specialists to accompany the lower echelons and support them to the degree that they support the large ADP facilities
- A hierarchy of processors enhances the FMF's economic ability to augment processing capacity at appropriate points should the intensity of operations increase over time.

The available technology supports the feasibility of a hierarchy of processors on the basis that:

- Computer systems are now produced in families that span a wide range of capability, price, and support
- 1980 ADPE technology will provide capabilities that meet various level FMF needs in packages that are transportable, self-contained, and environmentally independent to the degree required by the echelon level they will support
- The ADP industry itself has shown a strong inclination toward multi-level ADP distributed throughout the management levels of large organizations.

c. Condition (3): A minimum of three levels must be contained in the ADP system hierarchy.

SRI is not necessarily proposing three different kinds of machines to meet FMF requirements (although that may be a viable option). Rather, what is envisioned is a hierarchy of systems capability with at least three distinct ranges of capacity and utilization. The solution could be a graduated family of processors available from a single vendor or system contractor, where all members of the family have similar and compatible characteristics but differ in such respects as cost, physical size, storage capacity, and throughput.

The battalion/squadron echelon level is certainly a candidate for one level of the processor hierarchy. The processors at this level must serve local unit requirements (mobility, harsh environment, data entry, inquiry/retrieval from a restricted local data base). Another obvious candidate is the division/wing echelon level. This echelon must aggregate information and report it to the HQMC functional managers through the larger Class I systems. Its system capability requires a processor that can handle a significantly larger volume of information and an increased transaction rate.

At least one more level of intermediate processor capability must reside between these two. Such a level would provide the "swing" function

that is necessary to maintain the flexibility to configure and support all MAGTF's. It would also provide flexibility in establishing the boundaries and scope of the other two levels--based on their technical ability to cope with ADP problems as well as mobility, security, redundancy, and backup. Finally, it could provide flexibility to meet the different functional and larger capacity requirements of particular units of the combat service support element, as opposed to the air and ground elements.

The primary justification of this condition, therefore, lies in matching the ADP flexibility with the FMF operating concept. Specifically, it is based on the following:

- ADS should emphasize continuity of required support of FMF units in garrison, aboard ship, or deployed in a combat area; as structured in garrison or in MAGTF
- The Navy provides no complete system capability aboard ship with the particular mix of ADP functions that the Marine Corps would use in amphibious operations; nor is any program underway by the Navy to provide this capability
- ADS support should recognize and respond to the fact that there is a greater probability of deploying a MAB or MAU configured MAGTF than a MAF. The most probable MAGTF for amphibious operations is a MAB, and the nucleus for a MAB is likely to come from an already deployed MAU.

The availability of technology certainly does not prevent a system approach composed of three levels, especially if the coupling between the levels is not based on an on-line, real-time communication capability. SRI does not view this capability as being required by the FMF (see discussion under Condition (1)).

d. Condition (4): The lowest level of the ADP system hierarchy should not be provided with capability less than that contained in stand-alone intelligent terminals.

The analysis of FMF echelon information processing requirements has revealed that this condition is justified on the basis that:

- The Source Data Automation (SDA) experiments conducted in the FMF have demonstrated a need for this level of processing capability at the battalion/squadron level and the utility and applicability of an intelligent terminal type device at this level.

This condition is strongly justified on the basis of the status of technology in this area. An analysis of that status reveals that:

- Advances in hardware technology are making available devices that will satisfy the mobility requirements of the FMF, as well as make available the computing power and throughput capacity to satisfy the ADS requirements at the battalion/squadron level for about the same cost and burden that one would have with a data entry device alone
- Stand-alone intelligent terminals will be rugged enough and self-contained enough to meet field conditions at the battalion/squadron level.

From an operational viewpoint, this condition is justified on the following rationale:

- Verification and validation of data entry can begin at the lowest administrative echelon level--thus guaranteeing fewer errors in the reporting process
- The ability to use and manipulate one's own local data will increase responsiveness of the ADP system at the lowest level--thus, resolving a persistent shortcoming of the present system
- It could provide an essential low level link to the rifle companies who could interact with the ADS through preformatted messages communicated through the use of Digital Communications Terminals (DMT's) contained in the initial MTACCS equipment.

e. Condition (5): Each level of the hierarchy must be able to operate autonomously to serve the primary needs of the users at that level.

SRI's analysis of FMF information processing requirements supports the need for a capability to support local unit ADP needs autonomously on the basis that:

- The data being captured and processed to satisfy the reporting requirements of the HQMC functional managers comprises a significant portion of the data needed by the FMF commander to serve the needs of his local unit
- The FMF's local unit ADP needs are handled much more responsively and in some cases only if data can be used at the time of capture
- The FMF local unit need for ADP service is that of an operational tool. Like any tool supporting the unit, it is desirable that it be capable of being as autonomous as the unit it supports.

FMF operational requirements support the need for a capability to support local unit ADP needs autonomously on the basis that:

- An ADP capability matched to the using unit and able to operate autonomously (at least in degraded conditions) is the foundation for reserve capacity, graceful degradation, survivability, and security in the deployed environment.
- It provides another dimension in the flexibility that the FMF needs for assembling a MAGTF, for transitioning between environments (especially at the critical times when telecommunications may not be established), and for reinforcing deployed units.
- It does not preclude the effective and desirable use of telecommunications under those conditions in which it is available; in fact, it may better support economic use of those facilities.

Marine Corps resource constraints do not prevent the implementation of this concept since:

- Equipment that does not require ADP specialists' support, maintenance, or interface can be placed at appropriate levels in the FMF organization. Local level users with minimal technical training will be able to make the equipment function capably and over a long term.
- There is only a nominal equipment cost associated with providing lower level echelons with equipment that supports their local needs in addition providing for their reporting requirement.

The available technology supports the feasibility of autonomous local unit ADP capability on the basis that:

- An extensive experience base is available to provide ADP hardware, ADS services, system responsiveness, portability, reporting, data base management, and so on that are well matched to the unique needs of the various levels within a multi-level organization
- It is the most practical and realistic technical approach now available to cope with problems of security, reserve capacity, flexibility, degraded operation, and so on. It does not require burdensome teleprocessing controls and equipment; it has high availability; and it is the most responsive approach to local needs. It has the capability to expand its service via telecommunications when the situation allows.

2. Excluded ADPS Alternatives

The previous subsection presented and defended an argument restricting to a limited few those alternative ADPS concepts that should be considered further. It is important at this point, however, also to identify specific alternative concepts that SRI believes cannot match the operational capability/cost advantages of alternatives that satisfy the conditions stated above. This section will argue that such alternatives include:

- A large centralized interactive data base concept supported by on-line, real-time communications between organizational levels and/or with CONUS
- A ring network concept of distributed processors that communicate interactively and that share data files, applications software, compilers, or computational power on a cooperative basis among members of the ring.

Each of these is addressed below.

The two alternatives were chosen for discussion here, based on a considered reasoning of potential alternatives for FMF ADP. The large centralized interactive data base alternative is addressed because it is a recognized system concept currently found in the commercial ADP sector, and because it is the "system antithesis" of the various distributed concepts. The ring network is addressed because it has a system philosophy that was selected by NALCOMIS prior to the 1976 re-organization of its program development.

a. Large Centralized Interactive Data Base System

Based on the technology that will be available in the 1980s, an ADP system of this type probably carries with it no greater technical problems than those alternatives described in Sections IV and V. Large interactive systems exist today, and the telecommunications and system software associated with them do not present insurmountable problems--if one is willing to accept the burdens they impose.

The burdens are primarily the following:

- Inefficient intra-theatre telecommunications links.

  Interactive use of a centralized data base depends upon very fast responses to queries made against the data base. Condition (1) argues that packet switching will not be available before the late 1980s. Until then LFICS will support both store-and-forward switching and circuit switching as well as dedicated circuits. Store-and-forward

switching does not provide adequate response times for interactive use because of transmission delays inherent in the process. Although circuit switching entails several seconds of set-up time at the start of each interactive session, the circuits once set up provide adequate response times for interactive use. However, this generally constitutes very inefficient use of communication system resources because interactive use often requires only a small fraction of the circuits' information carrying capacity. An even less efficient approach is the dedication of circuits for the exclusive use of the ADPS.

- Satellite telecommunications dependence.

  Access to a large central data base in CONUS carries with it the need to rely on satellite telecommunications. Technically this is feasible, but the necessary satellite links probably will not be under the control of the Marine Corps; so the priority assigned FMF administrative traffic may not be sufficient to guarantee on-line real-time capability.

- Large amounts of telecommunications traffic.

  The philosophy of the large central data base being the controlling repository of information generally eliminates both the motive and the provisions for summarization, aggregation, and storage of information at any level other than the central data processing facility. All users must forward all their data to the central facility, and any user needing any data must have it sent to him from the central facility. Thus the telecommunications traffic is large both out of and into the combat theatre.

- Redundancy of large central ADPE.

  To assure availability of the on-line, real-time central system, it s conceivable that an almost entire duplicate central facility must be maintained. Large facilities are primarily justified on their achieved throughput. A large central system in reserve cuts overall cost/effectiveness in half.

The implications of these burdens relate to cost rather than technology. Circuit-switched or dedicated circuits (intra-theatre or satellite) pose little technical risk, but they do carry an added fiscal burden. Increased channel capacity--necessitated by the type and form of information transmitted--

also add to cost. Certainly, almost total ADPE and site redundancy for a large data processing center is a costly alternative.

Operationally speaking, perhaps even a stronger argument exists against such a system. The large central data base concept can support the Class I ADS reporting requirement of the FMF very well, but unless this concept also meets Conditions (2), (3), (4), (5) it does not serve the FMF local unit information processing need nor the deployment considerations associated with flexibility, redundancy, security, survivability, and combat unit autonomy.

If this concept embraces a suite of ADPE that <u>does meet</u> these four conditions, the concept moves closer to the distributed systems with the primary difference being the expensive telecommunications capability imposed on top of the distributed system. Given the good capability of store and forward telecommunications means and transferrable storage technologies (diskettes, cassettes, non-rotating storage means) to provide for flow of administrative traffic, the expense does not appear warranted.

b. <u>Ring Network System</u>

In a ring configuration, all the processors (e.g., minicomputers) are interconnected by a common communications ring. By means of this ring, any processor can converse with any other processor. The operation of the ring is independent from the processors. That is, it will continue to operate despite the loss of one or more processors.

The original NALCOMIS concept was based on a ring network system connecting approximately 14 (or fewer) minicomputers. The connection was to be by cable, and all the minicomputers within a ring were to be located in close proximity (within 2000 feet) to one another. Given this context the concept retains a high viability. For the purpose of serving

the FMF, however, ADS concepts cannot depend on cable, nor can processors be located in a small geographical area if Conditions (2), (3), (4), and (5) are to be met.

If cable connections must be replaced by radio connections within the LFICS concept, all the arguments of Condition (1) apply. The result is the need to use comparatively inefficient circuits until the latter part of the 1980s. Even if the radio connections were available, the survivability of the system depends on the survivability of the telecommunications net--and this may be the most vulnerable element of the entire system.

The NALCOMIS ring network concept was also predicated on the use of only one processor type, and it was not conceived to serve simultaneously several user organizational levels except through terminal input. Hence, there was little need to have sophisticated control and access built in the NALCOMIS concept. The FMF problem is more complicated, if the objective of supporting all echelon levels is to be accomplished.

Finally, it may be argued that the ring network provides a capability that the FMF does not need. The requirements of the lower echelon units do not appear to include significantly large information queries of information contained in other units above them or horizontally within the organization--if they have access to the information that they generate about themselves. Nor are the information processing requirements of such capacity or complexity that they cannot be served by ADPE that can travel with the local units. The ring network concept, therefore, appears to be an unnecessary adjunct to the basic philosophy of distributed ADP capability within the FMF.

III BASELINE SYSTEM CONCEPT

A. Concept Overview

1. System Logic

BASELINE provides centralized computing power to the FMF at the higher command levels. Each MAF is provided two large general purpose computing systems; these are used to provide a range of centralized ADP support primarily to the division/wing/FSSG echelon, and secondarily (through the division/wing/FSSG echelon) to the lower echelons. Each such facility at the MAF level serves the local user community that is located within its geographic area of responsibility. Additionally the air groups within each wing have an organic data processing capability provided by a smaller general purpose computing system. This system is dedicated to support of Naval Aviation supply and maintenance systems. General purpose computing systems also reside at FMF headquarters level.

The physical size and the burdensome support requirements of the BASELINE computers severely limit their mobility. Deployed MAGTF's cannot be supported afloat by the MAF computers, and deployment of these systems to an objective area requires from 60 to 120 days. All BASELINE computers require closely controlled environmental conditions characteristic of the second and early third generation equipment that they represent.

BASELINE is a rigid and narrowly focussed system. It supports the division/wing/FSSG echelon well in garrison, but it has little flexibility to accomodate the afloat or deployed ashore environments, and it does not support MAB's, MAU's, or lower echelon units responsively, if at all.

BASELINE is designed to support the flow of administrative information

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(manpower, operations, logistics, financial) from the FMF to higher headquarters. This is accomplished by transcribing the manual data input from the lower echelons to computer cards or OCR media, organizing the data, and either locally processing the data for MAF level use or passing the cards and OCR media on to the Supporting Establishment. Generalized reports on a strictly scheduled basis flow back to the lower echelons from the MAF-level computers.

Force automated service centers (FASC's) provide deployable, generalized data processing capability to the three MAF's. There are six such FASC's (two per MAF), and they are resident with elements of the MAF in garrison. Each MAF possesses and IBM 360/65 system and an IBM 360/50 system. These systems are intended primarily to support (subject to the need for garrison efficiency) ground combat elements and combat service support elements.

Within each MAG is contained a computer system that provides a deployable, Navy supply dedicated data processing capability to support the air combat element. BASELINE includes seventeen U-1500 (AN/UYK-5) computer systems for this purpose.

Aboard LCC- and LHA-class ships, the USMC Commander Landing Force (CLF) has access to a computer system on which he may exercise the ASIS shipboard command and control system. Aboard the LCC's, the computer system is the second generation UNIVAC CP-642B; aboard the LHA's the computer system is the third generation UNIVAC AN/UYK-7.

BASELINE to a large extent is computer card and paper oriented. The flow of information is primarily through the physical transportation of paper. AUTODIN is used for some high level electronic communication, but no provision has been made to use LFICS.

BASELINE provides a manual/automated system for reporting Class I ADS information to the upper FMF echelons and Supporting Establishment,

but there are no effective resources for providing functional capabilities to meet the local units' command and management information processing requirements. Figure 1 outlines the ADP system and organizational relationships for BASELINE in a deployed MAGTF.

2. System Implementation

BASELINE's structure provides for a single, centralized, large computer system to be located at the MAF command level. This is an IBM 360/65, and it is the principal ADPE for the FASC. This computer system operates under a service type of concept that serves the three combat elements (air, ground, CSS) of the FMF. Functionally, it sits at the top of a manual/semi-automated information reporting system, so that it is the focus for the FMF's automated interaction with the Supporting Establishment.

BASELINE also includes a UNIVAC 1500 computing system located with each Marine Air Group. This system is dedicated to Navy aviation supply, so that it's usage concept is much more narrow than that of the FASC.

A summary of the component systems contained in BASELINE is contained in Table 1, along with an overview of the system functions that they provide. Additional detail is presented in succeeding subsections.

B. Distribution of ADP Resources

The distribution of ADP resources in BASELINE provides for general automated support only at the MAF command level. Dedicated automated support (Navy aviation supply) is provided at the Marine Air Groups (MAG's). Lower units and commands that do not have ADPE utilize computer listings provided on schedules from the FASC. Data entry in these units and commands is primarily manual, with some keypunch support in certain sections.

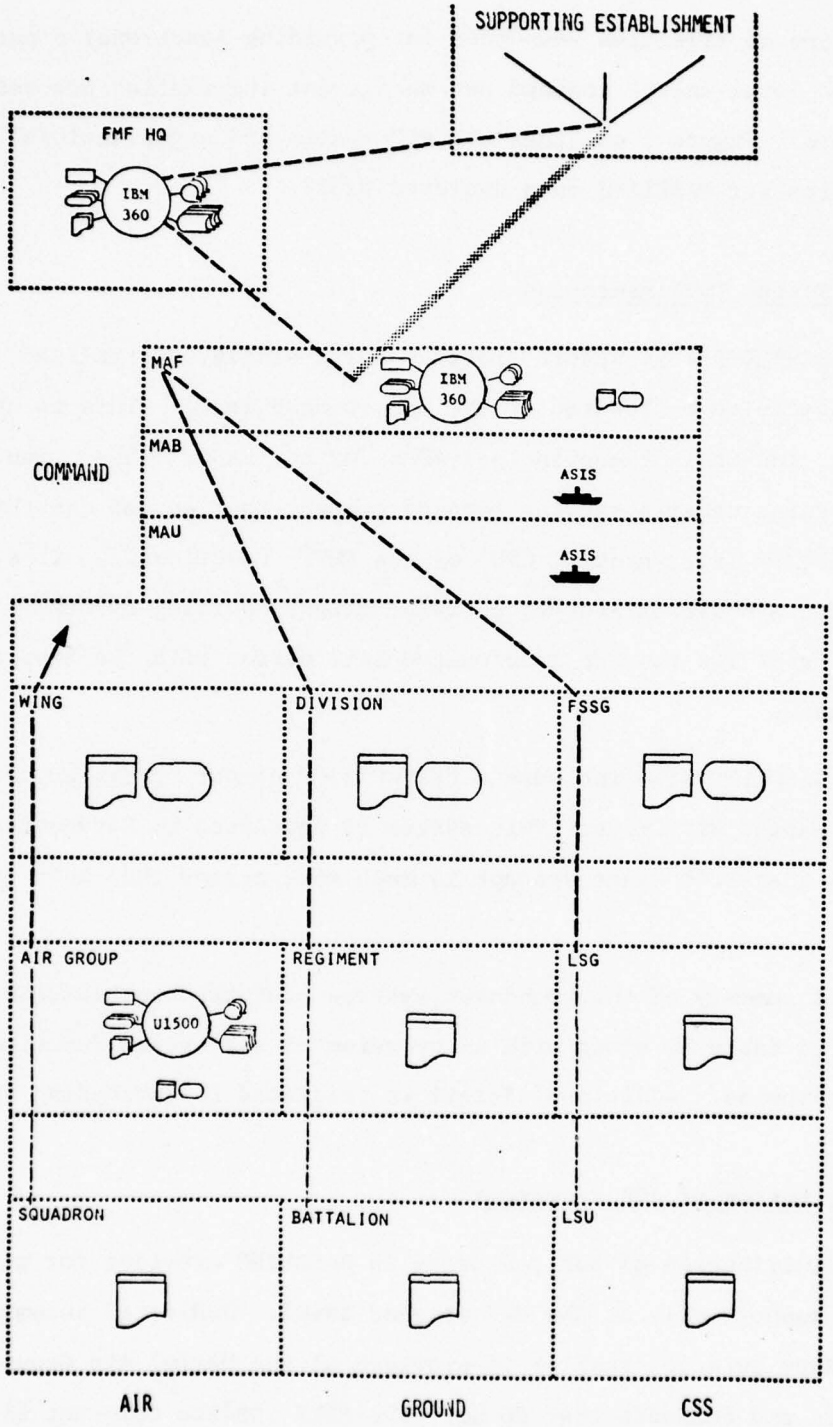
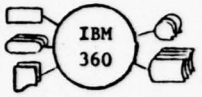
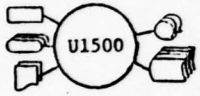


FIGURE 1 BASELINE OVERVIEW

Table 1

BASELINE ADPS IMPLEMENTATION

Component Systems	Hardware Characteristics	System Software Features	Supported System Functions
 IBM System 360	Large scale 3rd generation general purpose computer system Extensive disk auxiliary memory Extensive tape auxiliary memory One or more high speed hard copy printers Punch-card I/O devices Interactive keyboard terminals Telecommunications interface	Multiprogramming operating system Utility program library Low level language processor (assembler) Higher level language compiler and programming aids File management and retrieval package Text handling package	Data entry Data handling Report generation Data retrieval File creation for data forwarding
 UNIVAC 1500	Medium scale, 2nd-3rd generation, partially militarized general purpose computer system One magnetic tape unit One high-speed hardcopy printer One teletypewriter One punch-card reader/punch	Executive program Assembler program Language compiler Loader Utility package	Data entry Data handling Report generation File creation for data forwarding

The nature of BASELINE's ADP capabilities is described by (1) the ADPS capabilities furnished to each echelon, and by (2) the usage constraints of the ADP system configuration where they reside.

1. ADPS Capability

The BASELINE concept centralizes the ADPS capability at the MAF command level. The effect of this approach, as it is applied throughout the FMF, is that the air, ground, and CSS elements share a single system resource, and they interact with that system in the same general way.

a. Battalion/Squadron/LSU Level

This echelon level is not supported by ADPE capability in BASELINE. ADS generated reports are provided from the FASC on a scheduled basis or on a submitted request. Information is also input to ADS executed at the FASC, but this is primarily manual input on paper--requiring keypunching by an intermediary section prior to submission to the FASC computing center.

b. Regiment/Group/LSG Level

At the regiment and LSG level, the system capabilities to be provided by BASELINE are basically the same as those stated for the battalion/squadron/LSU level.

At the air group level, the system capabilities are provided by the UNIVAC 1500 computer system that is dedicated to processing Navy aviation supply data. Those capabilities include:

- Support batch processing
- Read and punch computer cards
- Print at medium speed (450-600 lines per minute)

- Sort, merge, copy, update files
- Perform search and retrieval from files
- Perform equipment diagnostics.

c. Division/Wing/FSSG Level

At this organizational level, the system capabilities to be provided by BASELINE are basically the same as those stated for the battalion/squadron/LSU level.

d. MAGTF Command Level

At the MAF level, the system capabilities BASELINE provides are contained in the IBM 360 computer system that acts as a service bureau for support of all of the elements of the MAF. Those capabilities include:

- Select applications (e.g., a Class I ADS update)
- Enter Class I ADS input
- Enter local file data
- Sort, merge, copy, update (modify, create, delete) files
- Create, edit, format, output text
- Monitor resource status and utilization
- Perform equipment diagnostics
- Transmit, receive files via telecommunications
- Read, write files via removable medium
- Perform complex, high volume search and retrieval from files
- Develop complex reports
- Execute high volume report output
- Support background batch
- Develop and compile local programs.

At the MAB and MAU level, no ADP capability exists in the BASELINE system; hence, the MAB and MAU are, practically speaking, without ADS support when they are deployed. Some capability for data input, inquiry, and retrieval exists aboard certain command ships in the ASIS system, but this is limited by Navy control of the onboard computer.

e. FMF Headquarters Level

At this organizational level, the system capabilities to be provided by BASELINE primarily embrace those stated for the MAF command level.

2. Usage Constraints

The BASELINE concept provides ADP equipment and ADS capability to lower units of the FMF primarily from a centralized computer resource at the MAF level. That equipment and ADS is available to all functional area users (manpower, intelligence, operations, logistics, financial) within the MAF. Allocation of those resources to individual users results from procedures and priorities established at the ADP center that best integrate the total workload.

The usage constraints identified in the paragraphs below pertain to the shared use of physical system elements (displays, keyboards, CPU, telecommunications ports), based on what elements are available at each echelon level. Other usage constraints based on the allocation of machine time to different applications, on the desire for privacy and security of information, and on the freedom (or lack of freedom) for pursuing independent software development are addressed in succeeding subsections that describe the software concept and the flow of management information.

a. Battalion/Squadron/LSU Level

No ADP equipment exists at this level in BASELINE.

b. Regiment/Group/LSG Level

At the regiment and LSG level, BASELINE provides no ADP equipment.

At the air group level, the usage constraint on the UNIVAC 1500 system is that associated with the fact that the system operates in a single stream batch processing mode. Hence, only one application may be processed at a time.

c. Division/Wing/FSSG Level

No ADP equipment exists in BASELINE at this level.

d. MAGTF Command Level

The constraints on system usage of the IBM 360 computer system located at the MAF level are those imposed by the batch processing, card oriented system concept. There are no user terminals.

No ADP equipment exists at the MAB and MAU command levels.

e. FMF Headquarters Level

The constraints at this level are the same as for the MAF command level.

C. Generic Description of ADP Hardware

Table 1 provides an overview of the hardware component systems that together comprise the BASELINE system concept. This section provides greater detail and some initial quantification of hardware attributes for the ADP equipment in BASELINE. Both data processing characteristics and the actual physical characteristics are described in the following subsections.

1. ADPE System Components

The component computer systems within the BASELINE concept are described below under the echelon level of the FMF that they exist.

a. Battalion/Squadron/LSU Level

At this level, BASELINE provides no ADP equipment.

b. Regiment/Group/LSG Level

At the regiment and LSG level, BASELINE provides no ADP equipment.

At the air group level, BASELINE provides the following system configuration:

- 1 U-1218 CPU (versatile stored program, medium scale, general purpose, solid state digital computer with 32 Kword (18 bit word) mass store)
- 1 U-1240 magnetic tape unit
- 1 U-1533 I/O teletypewriter
- 1 U-1549 card reader-punch
- 1 U-1569 high speed printer
- Numerous k ypunches and verifiers.

c. Division/Wing/FSSG Level

At this level, BASELINE provides no ADP equipment.

d. MAGTF Command Level

At the MAF level, the ADPE configuration is described by the following:

- 2 IBM 360 computer systems (1 IBM 360/65 and 1 IBM 360/50)
- 7-17 magnetic tape drives (per system)
- 0-2 core storage units (per system)
- 6-9 disk units (per system)
- 2 card reader-punches (per system)
- 0-5 OCR units (per system)
- 2-5 high speed printers (per system)
- 1-3 input consoles (per system)
- 7-37 card and tape punches/verifiers.

At the MAB and MAU levels, BASELINE provides no ADP equipment.

e. FMF Headquarters Level

At this level, the ADPE configuration is generically similar to the smaller system found at the MAF level.

2. ADPE Physical Description

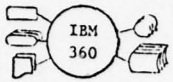
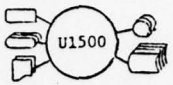
ADPE included in the BASELINE concept have the physical characteristics that mark the second and early third generation of computer hardware. These include relatively bulky and heavy equipment, narrow environment tolerances, and relatively difficult maintenance problems. Table 2 identifies the primary weight, cube, and environmental attributes of the component computing systems in BASELINE.

D. Software Concept

The BASELINE software concept addresses support of the specific equipment described above, as well as the assembly of applications programs currently existing in the FMF.

Table 2

PHYSICAL CHARACTERISTICS OF BASELINE ADPE

Component Systems / Characteristics	 IBM System 360	 UNIVAC 1500
Size and Weight	Housed in a portable shelter. Size and weight such that deployment requires considerable effort and 30 to 60 days.	Housed in two 2.7m x 2.7m x 6.2m standard avionics vans having a combined loaded weight of approximately 10,000 kg.
Sheltering	Environmentally controlled protable shelter.	Environmentally controlled vans.
Electricity Supply	Line- or generator-supplied alternating current.	Line- or generator-supplied alternating current.
Heat Generation	Estimated greater than 3000 watts.	Estimated greater than 2000 watts.
Ambient Air Temperature Tolerance	Requires air conditioned environment.	Requires air conditioned van.
Humidity	Requires humidity controlled environment.	Requires humidity controlled environment.
Dust and Grit Resistance	Requires air filtering.	Requires air filtering.
Shock and Vibration Resistance	Requires substantial packaging effort for deployment.	Transportable in its own vans.

1. Component Systems Support

a. Battalion/Squadron/LSU Level

No ADP equipment exists at this level in BASELINE.

b. Regiment/Group/LSG Level

At the regiment and LSG level, no ADP equipment exists in BASELINE.

At the air group level, the software capability included in the BASELINE concept is that which supports the UNIVAC 1500 computing system. It includes:

- Assembler program
- Executive program
- Language compiler
- Loader
- Utility package.

c. Division/Wing/FSSG Level

No ADP equipment exists at this level in BASELINE.

d. MAGTF Command Level

At the MAF level, the software capability included in the BASELINE concept is that which supports the IBM 360 computing system. It includes:

- Multiprogramming operating system
- Utility program package
- Low level language processor (assembler)
- High level language compiler

- High level programming aids
- File management and retrieval package
- Text handling package.

At the MAB and MAU levels, no ADP equipment exists in BASELINE.

e. FMF Headquarters Level

At this level, the software capability provided by BASELINE is very similar to that described above for the MAF command level.

2. Software Development and Maintenance

Control of ADS software is exercised in BASELINE through a centralized design and programming concept. There are two main features of this concept. The first is the designation of a small number of data processing facilities as Central Design and Programming Activities (CDPA's). The second feature is the categorization of all ADS applications as being Class I, Class II, or Class III systems. The purpose of these features is to control the proliferation of ADS applications (many of which may be redundant) and to provide the support benefit of experienced and centralized service agencies for system development and maintenance.

CDPA's are dedicated to administrative functional areas--primarily manpower at Kansas City, primarily logistics at Albany, and primarily financial/operations/aviation at Washington, D.C. They are under the management control of the HQMC functional manager that they support, so that all activity is audited through the relevant functional office from origination by the system sponsor to disposition at the user level.

The categorization of ADS applications into the three classes recognizes both the need to control the development and maintenance of major ADS, as well as to allow users some latitude to create ADS applications to

meet unique local requirements. The following definitions indicate the philosophy of the applications categorization:

> Class I Systems--Those centrally managed Marine Corps standard ADS that are controlled by a functional manager at HQMC. These systems are designed, programmed, and maintained by a CDPA. Modifications of Class I systems by field ASC's, FASC's, and Data Processing Installations (DPI's) are not permitted.
>
> Class II Systems--Those centrally managed Marine Corps ADS that are initiated and sponsored by the FMF or Supporting Establishment to meet recurring local management requirements. These systems are designed, programmed, and maintained by a CDPA after approval of the appropriate HQMC functional manager and the Director, Information Systems Support and Management Division. Modifications of Class II Systems by field ASC's, FASC's and DPI's are not permitted.
>
> Class III Applications--Limited to those locally programmed data base inquires or special reports which draw, by means of a data management system or application program, on existing magnetically readable data maintained by or for a Class I or Class II system. Exceptions must be specifically authorized by HQMC.

E. Communications Concept

BASELINE does not embrace an overall communications concept for the passage of digital data within the FMF. Data entry is accomplished at the lower echelons in paper form, and so, the reporting system is primarily one of paper flow until the data reaches MAF level. At MAF level, the data is entered on machine readable media, and the potential exists for this information to be communicated electronically.

The primary channel for telecommunications from (and to the MAF from higher headquarters) is that provided by the AUTODIN network. The MAF interacts with this network through communications with an entry point at the closest Navy Communications Station.

It may be stated that, because of the monolithic, centralized nature of the BASELINE concept and because of the mixture of manual and automated procedures employed under BASELINE, telecommunications of digital administrative data is not a dominant characteristic of the system. There is, however, heavy reliance on the physical transportation of administrative information.

A summary of the level of telecommunications activity estimated to occur on each link for a deployed MAF is contained in the matrix of Table 3.

F. ADPS Supporting Manpower

1. User Support

BASELINE is oriented toward the heavy involvement of dedicated data processing personnel in almost every support function that it provides. Operation of the IBM 360 System and UNIVAC 1500 System is based on the concept of a closed shop. User application programs and requests for information may be submitted in a batch mode to the computing center, but following that, control rests solely with the center personnel.

Some user interfaces are provided in the form of data systems officers at the upper echelons to facilitate and encourage user participation with the data processing center.

2. Operations and Maintenance Support

The manpower support requirements of BASELINE include the necessity of providing personnel having the background and training that is associated with the following ADP job categories:

- Analyst/programmer
- Senior analyst/programmer
- Systems programmer

Table 3

ESTIMATED MAF DIGITAL DATA LINK USE IN BASELINE

(Ground and CSS Elements)

	DCS	CATF	MAF HQ	RADIO BN	COMM BN	MAW HQ	FSSG HQ	DIV HQ	HQ BN	RECON BN	DSG HQ	H&S BN	ENG BN	FAG	TANK BN	AMTRAC BN	ARTY REGT	ARTY BN	INF REGT	INF BN	FSSG HQ	LSG HQ	DET H&S BN	DET MNT BN	DET SUP BN	DET MT BN	DET ENG BN	DET MED BN
DCS	●		X																									
CATF		●	M																									
MAF HQ	X	M	●																									
RADIO BN				●																								
COMM BN					●																							
MAW HQ						●																						
FSSG HQ							●																					
DIV HQ								●																				
HQ BN									●																			
RECON BN										●																		
DSG HQ											●																	
H&S BN												●																
ENG BN													●															
FAG														●														
TANK BN															●													
AMTRAC BN																●												
ARTY REGT																	●											
ARTY BN																		●										
INF REGT																			●									
INF BN																				●								
FSSG HQ																					●							
LSG HQ																						●						
DET H&S BN																							●					
DET MNT BN																								●				
DET SUP BN																									●			
DET MT BN																										●		
DET ENG BN																											●	
DET MED BN																												●

NOTE: (S) Less than 500 Kbytes daily; (M) Between 500-5000 Kbytes daily;
(L) Between 5000-30,000 Kbytes daily; (X) Greater than 30,000 Kbytes daily

Table 3

ESTIMATED MAF DIGITAL DATA LINK USE IN BASELINE (Continued)

(Air Element)

	MAW HQ	MWHS	WSG HQ	H&MS SQ	ENG SQ	MTR TR SQ	MACG	H&HS	MWCS	MACS	MASS	LAAM BN	FAAD BTRY	MAG VH	H&MS	HMM	HMH	HML	HMA	VMO	MAG VE/VA	H&MS	VMA	VMFA	VMGR	DET VMAQ	DET VMFP
MAW HQ	●																										
MWHS		●																									
WSG HQ			●																								
H&MS SQ				●																							
ENG SQ					●																						
MTR TR SQ						●																					
MACG							●																				
H&HS								●																			
MWCS									●																		
MACS										●																	
MASS											●																
LAAM BN												●															
FAAD BTRY													●														
MAG VH														●													
H&MS															●												
HMM																●											
HMH																	●										
HML																		●									
HMA																			●								
VMO																				●							
MAG VE/VA																					●						
H&MS																						●					
VMA																							●				
VMFA																								●			
VMGR																									●		
DET VMAQ																										●	
DET VMFP																											●

- Senior systems programmer
- ADPE operators
- ADPE maintenance.

The number and distribution of men having these qualifications among elements of the FMF in BASELINE are indicated in Table 4.

The overall maintenance concept that appears to support BASELINE calls for on-site ADPE maintenance at the computer centers using highly trained maintenance personnel. Technical assistance and guidance may also by provided by a factory representative. Maintenance is assisted by the fault isolation properties of diagnostic routines that are a part of the ADP systems.

The total manpower requirement to operate and maintain BASELINE is estimated to be approximately 862 man-years per year. Of this total, the estimated profile of skills required is summarized in the following tabulation:*

Job Category	Man-Years	Percent of Total
Analyst/programmer	201	23%
Senior analyst/programmer	94	11%
Systems programmer	23	3%
Senior systems programmer	22	3%
ADPE operator	487	56%
ADPE maintenance	35	4%

These job categories do not match exactly the jobs that are currently performed in BASELINE. Appendix B addresses the correlation reasoning that has been used to derive the above tabulation.

*These numbers were extracted from FMF Tables of Organization summaries based on selected MOS billet requirements.

Table 4

ORGANIZATIONAL BREAKDOWN OF ADP PERSONNEL IN BASELINE

Combat Echelon Breakdown	Representative Staffs per Component System					
	System Programmer (Senior)	System Programmer	Analyst/Programmer (Senior)	Analyst/Programmer	ADPE Operator	ADPE Maintenance
FMF Headquarters	1	3	2	16	36	7
MAGFT Command						
MAF Command	2	4	2	32	34	7
MAB Command	---	---	---	---	---	---
MAU Command	---	---	---	---	---	---
Ground Element						
Division	---	---	---	---	---	---
Regiment	---	---	---	---	---	---
Battalion	---	---	---	---	---	---
Air Element						
Wing	---	---	---	---	---	---
Group	---	---	1	2	4	2
Squadron	---	---	---	---	---	---
CSS Element						
FSSG	---	---	---	---	---	---
LSG	---	---	---	---	---	---
LSU	---	---	---	---	---	---

G. Operational Capability

1. Environmental Coverage

BASELINE provides ADPS support primarily at the MAF level, with specialized support at the Marine Air group. This support embraces the major FMF operating environments of garrison, afloat, and ashore--covering the requirements of administrative organization, as well as task organization. Garrison support of these levels far exceeds, however, the support for deployed units. Furthermore, little or no support exists for deployed MAB's and MAU's.

ADPE equipment in BASELINE can not be considered to be adequately mobile to meet the FMF requirement. The FASC deployment requires at least 30-60 days.

To demonstrate BASELINE's coverage of MAGTF configurations in a deployed environment, Figures 2, 3, and 4 show the component system distributions for a representative MAF, MAB, and MAU respectively. Summary totals of component systems are as follows:

MAGTF Configuration	IBM 360	UNIVAC 1500
MAF	1	5
MAB	---	1
MAU	---	---

The processing activities and constraints attributed to each FMF echelon in the BASELINE concept may be summarized in a profile of ADS services that are available to the three combat elements in the environments of garrison, afloat, and ashore. Table 5 describes, by echelon, the ADS services for which the various echelon levels have direct access to ADS services in BASELINE. (Direct access is defined here to mean either physical residence of ADPE at that particular echelon, or telecommunication links to non-residence ADPE.)

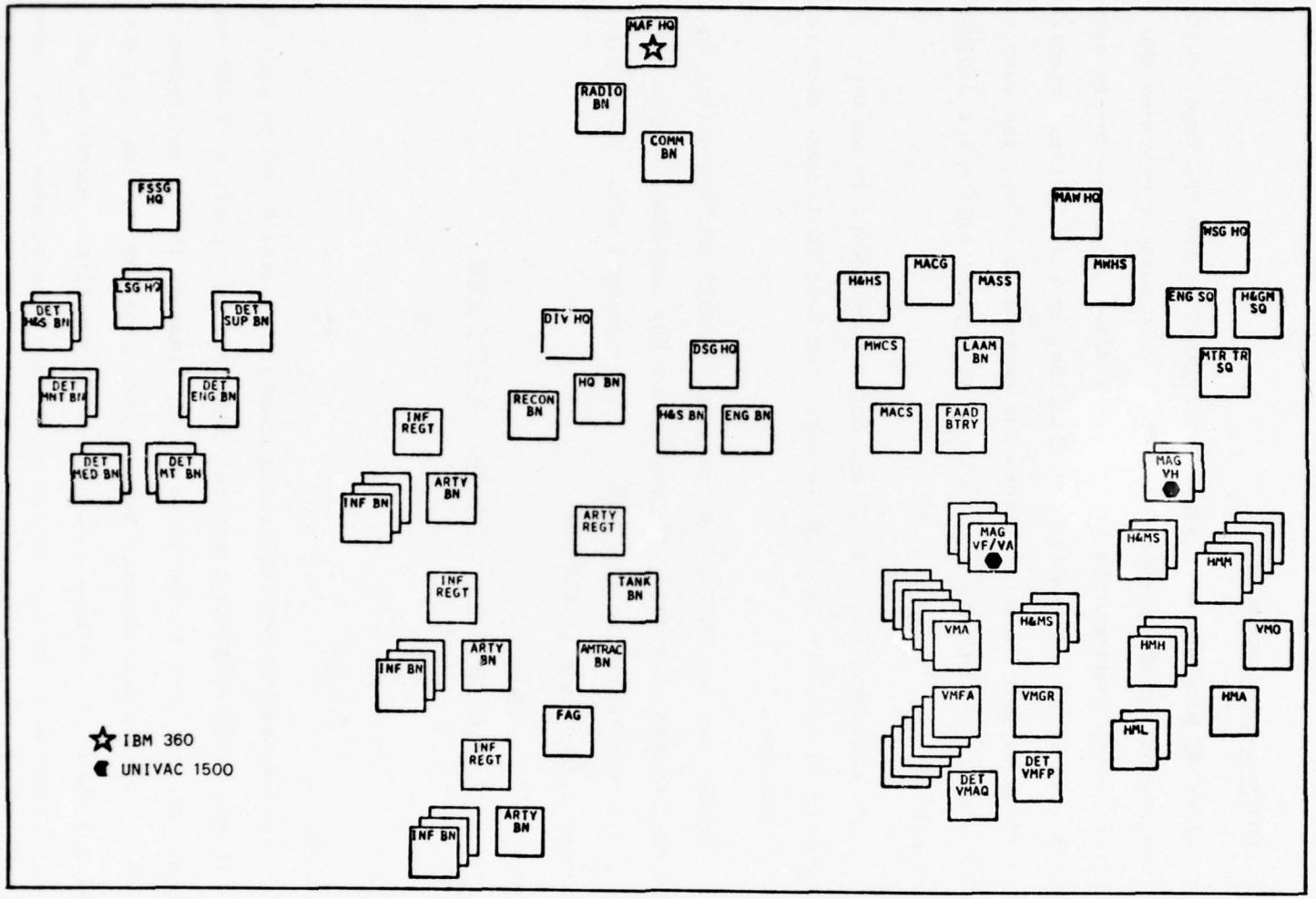


FIGURE 2 MAF DISTRIBUTION OF ADPE IN BASELINE

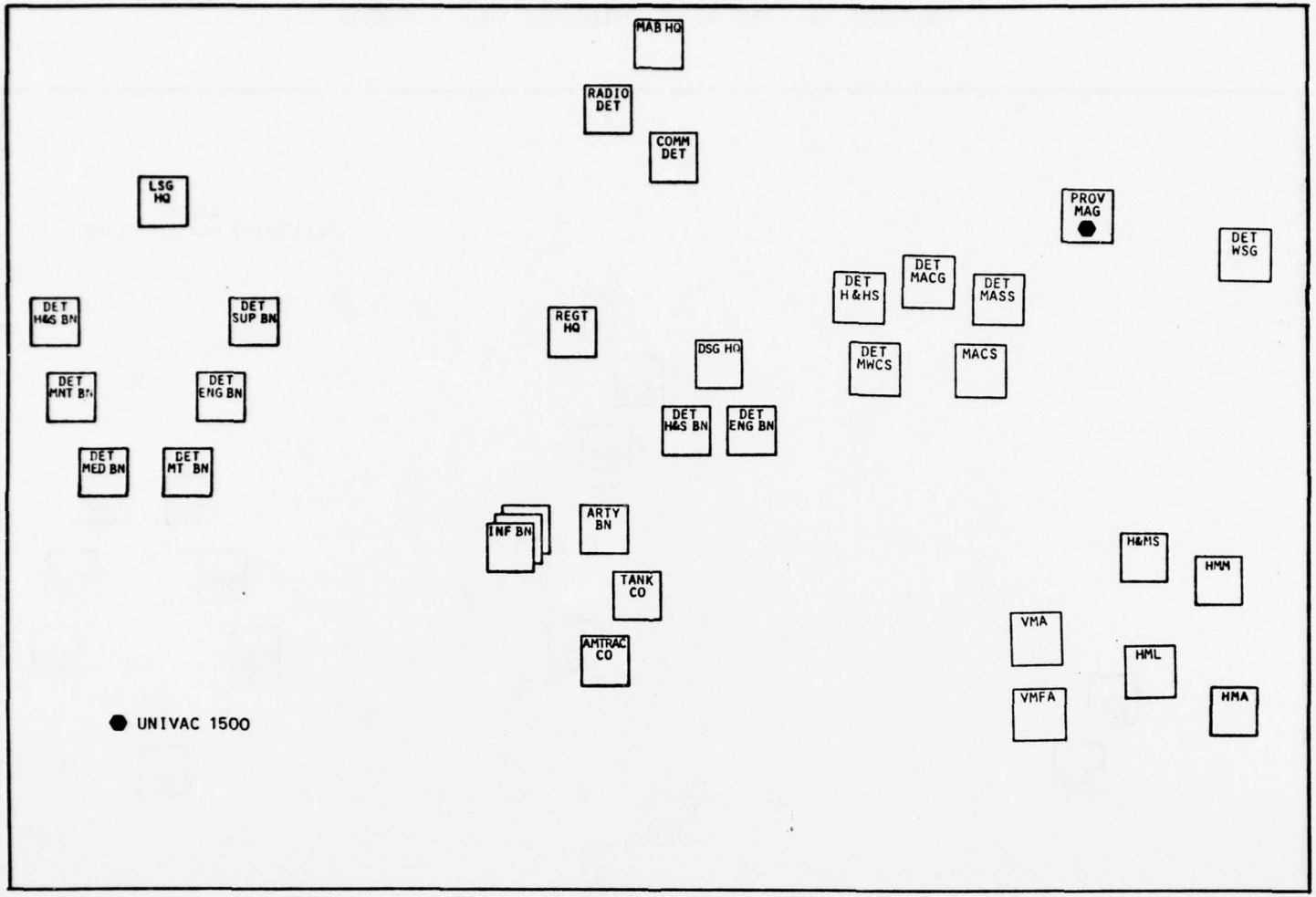


FIGURE 3 MAB DISTRIBUTION OF ADPE IN BASELINE

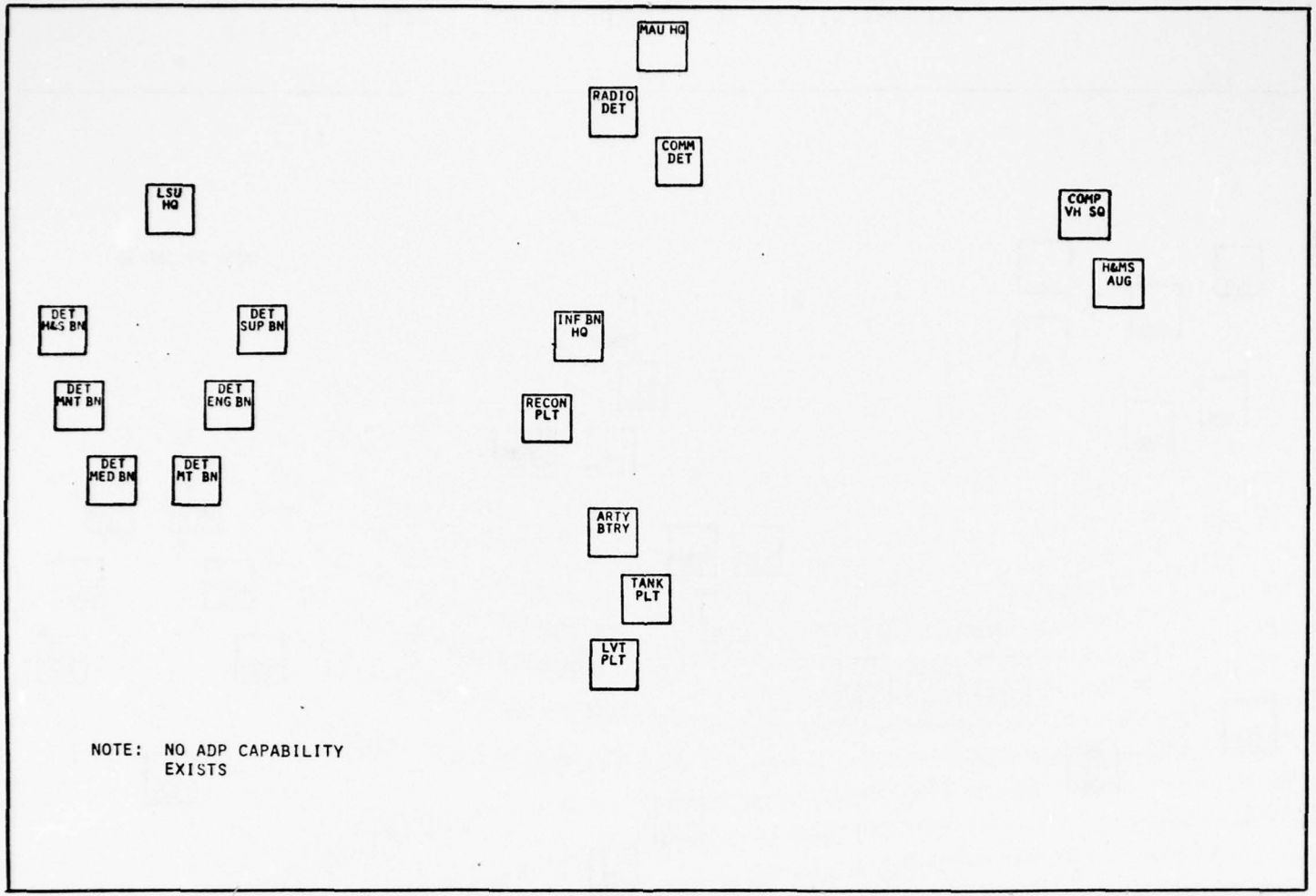


FIGURE 4 MAU DISTRIBUTION OF ADPE IN BASELINE

Table 5

SUMMARY OF DIRECT AVAILABILITY OF ADS SERVICES IN BASELINE

Combat Element Echelon Breakdown	Data Entry Verification & Validation		Alphanumeric Text Processing		File Management		Information Storage & Retrieval		I/O Formatting		Report Generation		Numerical Calculation		Simulation & Analysis Programming		I/O of Files by Removable Medium	Electronic Transmission of Files
	S*	C+	S	C	S	C	S	C	S	C	S	C	S	C	S	C		
FMF Headquarters		G		G		G		G		G		G		G		G	G	G
MAGTF Command																		
MAF Command		G,As		G,As		G,As		G,As		G,As		G,As		G,As		G,As	G,As	G,As
MAB Command					Af			Af	Af		Af							
MAU Command					Af			Af	Af		Af							
Ground Element																		
Division																		
Regiment																		
Battalion																		
Air Element																		
Wing																		
Group		All				All		All		All		All		All			All	
Squadron																		
CSS Element																		
FSSG																		
LSG																		
LSU																		

Note: (G) Garrison
(Af) Afloat Environment
(As) Ashore Environment
(All) All Environment

*Simple and/or Preprogrammed

+Complex and/or Programmable

2. Transitioning Logic

The transitioning logic for BASELINE calls for one FASC to be deployed with a MAF, and the other FASC to remain at its garrison location. The UNIVAC 1500 systems are conceptually designed to follow the Marine Air Group that they support both afloat and deployed ashore in the combat area.

H. Management Information Flow and Control

1. Information Flow

The flow of management information in BASELINE from the operating FMF units to the supporting establishment management systems follows, in general terms, the process diagrammed in Figure 5.

Inasmuch as BASELINE provides no general application ADP equipment below MAF level, lower echelon units must rely on cyclic reports from higher level commands or on their own manually kept and updated files. BASELINE does provide for MARK IV information retrieval, but it too is resident at MAF level, and requests from lower echelons for its use are subject to time lags.

The information flow in BASELINE exhibits several characteristic features:

- Multiple transcription and transmission steps in the process of converting captured data to machine-readable form
- Significantly large volumes of activity in all error correction channels
- Persistent discrepancies between information stored at one node in the process and the same information stored at another node
- Long update/validation intervals.

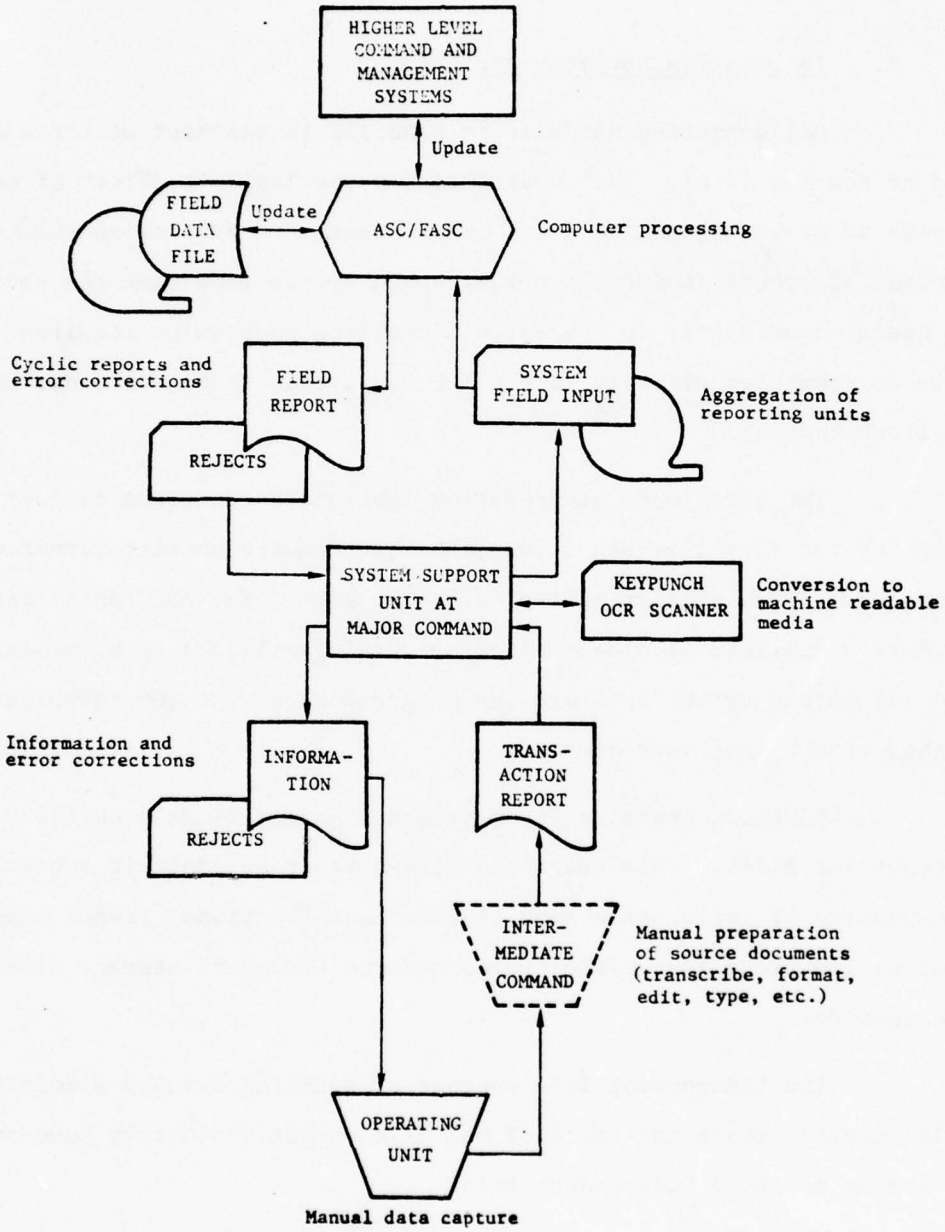


FIGURE 5 MANAGEMENT INFORMATION FLOW IN BASELINE

All functional areas in BASELINE share, to a large degree, these common characteristics.

2. Information Security and Privacy

All computing hardware in BASELINE is resident at the MAF level and at the MAG level. Such residence has the implicit effect of controlling access by providing ADS services only through higher echelon channels. Control of access is further strengthened by the fact that the hardware is operated primarily in the batch processing mode which requires that jobs be submitted directly to the ADP facilities to be run under their explicit control.

The batch mode of operation implicitly restricts the use of the computer for many time-sensitive jobs that require shorter turnaround times than batch processing typically can give. The ADP facilities are primarily operated as closed shops--requiring all jobs to be programmed and maintained by the applications programmers at the ADP installation rather than by the user himself.

BASELINE operates its data bases primarily as a collection of independent files. This operating mode acts as an implicit control on the sharing of information among the various functional areas; hence, it fosters lag times for update cycles and the redundant storage of some information.

The independent file concept of BASELINE creates a measure of file security since the users of one file do not ordinarily have any means of access to other independent files.

IV DISTRIBUTED HIERARCHICAL (DISHIER) SYSTEM CONCEPT

A. Concept Overview

1. System Logic

DISHIER provides graduated computing power to the FMF from the highest command level down to the battalion/squadron level. This is accomplished through assignment of a structure of mutually supporting ADP workload responsibilities--organized similarly for each combat element (air, ground, CSS). At each echelon the workload is supported by a processing resource that ranges from large variable-configuration minicomputer systems at FMFPAC/FMFLANT level through minicomputer based systems to small stand-alone micro-processor systems at the battalion/squadron echelon.

The physical size and support requirements of the component systems are matched to the support capabilities and mobility requirements of the units they support. Hence, deployed MAGTF's can be supported afloat/ashore using the same ADP equipment and procedures that serve their garrison requirements.

The overall system concept provides modularity through a hierarchy of component systems that differ in size, capacity, and function. The flexibility of these modular building blocks allows DISHIER to accomodate readily different MAGTF configurations and differing intensities of operations.

DISHIER is designed to support all Class I administrative reporting requirements (manpower, operations, logistics, financial) at each echelon level, as well as some intelligence reporting at lower echelons (see p. 46 of Vol. II). This is achieved through an SDA-like capability to capture information

in machine-readable form close to the source. That capability is augmented by editing, validating, summarization, and aggregation capabilities at each echelon, as well as each echelon's ability to transmit the reporting information up and down the organizational chain.

Vertical information flow paths exist between successive echelons in DISHIER. Each of these consists of one or more two-way electronic data transmission links (through LFICS). In the absence of such links, digital data on machine readable media (e.g., cassettes or floppy disks) can be physically transported from point to point via any suitable transportation means.

DISHIER further provides functional capabilities to meet the local units' internal command and management information processing requirements. These capabilities (local inquiry, retrieval, update, sort, etc.) are tailored to correspond to the nature and the volume of the workload assigned each echelon level. The use of and access to these capabilities are oriented toward actual users of the information (commanders and unit staff members) rather than the data processing intermediaries.

Serving simultaneously the reporting and local usage requirements, DISHIER is in every sense a generalized management tool. It is a tool that is shared among the functional management areas (manpower, operations and training, logistics, and finance)--serving the particular needs of the unit, rather than those of one functional area. As such, the capability DISHIER provides must be shared among a group of users according to the need and priority to be established at each echelon.

Figure 6 outlines the ADP system and organizational relationship for DISHIER in a deployed MAGTF. One of the distinguishing characteristics of DISHIER is the symmetry of computing power in each combat element. It is also apparent that computer power at any point in the hierarchy is roughly

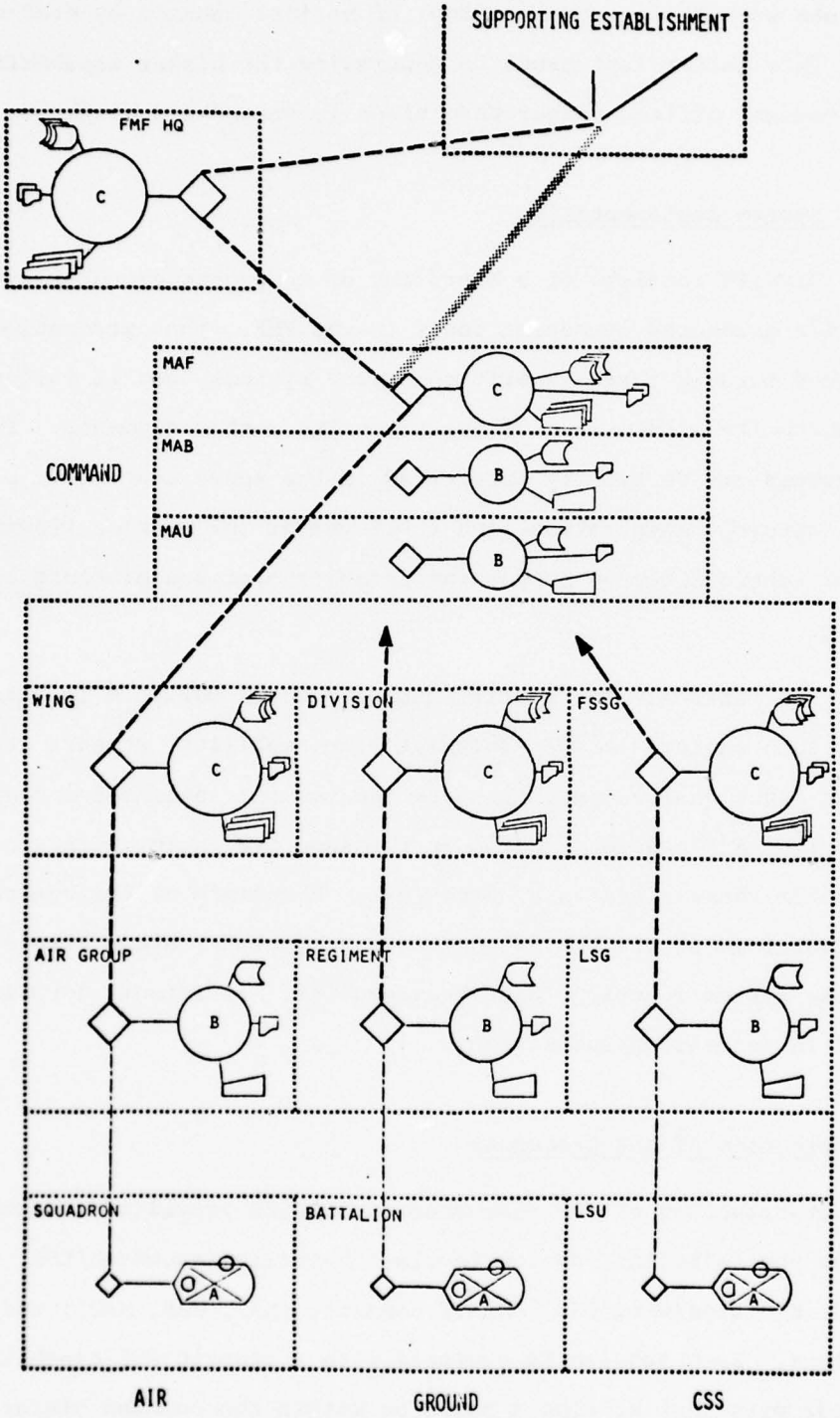


FIGURE 6 DISHIER OVERVIEW

commensurate with the aggregate number of Marines managed by each command echelon. This latter fact tends to centralize the higher capability ADPE close to command offices rather than close to warehouses or shops.

2. System Implementation

DISHIER consists of a hierarchy of component computer systems that provide graduated computing power to the FMF. That graduation is accomplished through three generic component systems, and it follows the command authority within each of the three FMF combat elements. The component systems are vertically integrated in the sense that their capabilities for data capture, manipulation, and retrieval of information flowing from the lowest echelons to the Supporting Establishment are distinct but mutually supporting.

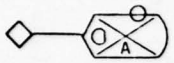
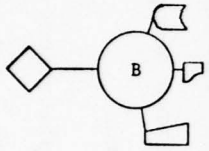
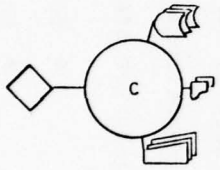
The rationale for partitioning the total workload is based on tailoring such factors as ADP equipment size, mobility, support requirements, and functional compatibility to the command information requirements at the various FMF echelons--while at the same time maintaining an appropriate system responsiveness at each unit. A summary of the component systems contained in DISHIER is contained in Table 6, along with an overview of the system functions that they provide. Additional detail is presented in succeeding subsections.

B. Distribution of ADP Resources

The distribution of ADP resources in DISHIER provides for automated support at the following echelon levels: battalion/squadron/LSU; regiment/group/LSG; division/wing/FSSG; MAGTF commands (MAF, MAB, MAU); and FMF headquarters. Each echelon is equipped with a generic ADP capability that corresponds with that echelon's position within the command hierarchy. The nature of those ADP capabilities is described by (1) the ADS capabilities

Table 6

DISHIER ADPS IMPLEMENTATION

Component Systems	Hardware Characteristics	System Software* Features	Supported System Functions
 System A	Micro-processor based system Programmable or PROM processor RAM main storage Auxiliary storage Keyboard/display input device Hardcopy output device Telecommunications interface Removable magnetic I/O medium	Control program System utilities Application language processors System diagnostic routines Preprogrammed applications Text handler	Data capture, verification, and editing Simple word and text processing Simple file management of small files Simple information storage and retrieval Numerical calculation Report formatting System self-diagnosis Data communication
 System B	Mini-processor based system Programmable processor Multiprogramming processor hardware Sizeable main and auxiliary storage Multiple keyboard/display input devices Multiple hardcopy printers Telecommunications interface Removable magnetic I/O medium	Operating system for batch and interactive processing Report generator program Preprogrammed applications Query language Rudimentary programming aids	Foreground/background processing Sophisticated storage and retrieval File management Report generation Data communication
 System C	Mini-processor system--variable configuration Multiprogramming processor hardware Ample main storage Extensive auxiliary storage Multiple keyborad/display input devices Multiple hardcopy printers Telecommunications interface Removable magnetic I/O medium	Multiprogramming operating system Compilers for high-level languages Utility program library Diagnostic program package	Multiprogramming and interactive processing String processing General data base management Interoperability interfaces High speed, high volume data communication

*It is anticipated that many of these features may be implemented in firmware.

furnished to each echelon, and by (2) the usage constraints of the ADP system configuration at each echelon.

1. ADPS Capability

The DISHIER concept attempts to maximize the similarity of ADPS capability at a given echelon level. For example, an infantry battalion, an aviation squadron, and an LSU detachment are furnished functionally equivalent ADPS resources. That is, units at this level are assigned the same basic computer system configuration. Units with higher workload levels may be given more than one system configuration (e.g., H&MS in a Marine Air Group or Supply Battalion in the FSSG), while units with lower workload levels will only be provided one system configuration (e.g., an Infantry Battalion). The effect of this approach, as it is applied throughout the FMF hierarchy, is that the air, ground, and CSS elements embody the same system topology and the same basic system logic.

a. Battalion/Squadron/LSU Level

This echelon level is DISHIER's lowest entry point for the automated flow of information upward to large FMF-oriented systems (e.g., SASSY and MIMMS), or to Supporting Establishment systems (e.g., JUMPS/MMS and MUMMS). ADS support is provided to aid automated reporting and to maintain locally useful files; the underlying concept is one of providing a set of functional capabilities and preprogrammed procedures. The following capabilities are included:

- Select applications (e.g., a Class I ADS update)
- Enter Class I ADS input
- Enter local file data
- Verify and validate data during entry
- Sort, merge, copy, update (modify, create, delete) files
- Perform simple search and retrieval from files

- Invoke preprogrammed I/O formats
- Create, edit, format, output text
- Generate preprogrammed reports
- Execute preprogrammed computational procedures
- Monitor resource status and utilization
- Perform equipment diagnostics
- Transmit, receive files via telecommunications
- Read, write files via removable medium.

b. Regiment/Group/LSG Level

At this organizational level, the system capabilities to be provided by DISHIER include, in addition to (or at a significantly higher level of sophistication) those identified for the battalion/squadron/LSU level, the following:

- Perform complex, high volume search and retrieval from files
- Develop complex reports
- Execute high volume report output
- Support multiple users on-line and background batch.

The capability orientation of this level is multi-faceted; it provides for summarization and aggregation of lower level information, capability for distributing the data processing burden (to increase efficiency in garrison, and to meet the capacity requirements of combat deployments), and capability for MAGTF configuration flexibility (to match the various MAGTF deployment options with the minimum number of systems and support). While the functional capability is more general and flexible than at the lower level, programming, per se, is not emphasized.

c. Division/Wing/FSSG Level

At this organizational level, the system capabilities to be provided by DISHIER include, in addition to (or at a significantly higher level of sophistication) those identified for the regiment/group/LSG level, the following:

- Develop and compile local programs
- Place programs in library
- Call programs from library and execute.

The capability orientation of this level is multi-faceted; it provides capability for the final editing, error checking, verification, and validation of data prior to a system update (e.g., a SASSY update within the FMF or a JUMPS/MMS update in the Supporting Establishment), capability for summarization and aggregation of lower unit information, and capability that embraces the data manipulation necessary to administrate the remaining management functions of this level. The functional capability is very general and flexible; in addition, there is a provision for a local programming activity.

d. MAGTF Command Level

At the MAF level, the system capabilities to be provided by DISHIER include, in addition to (or at a significantly higher level of sophistication) those identified for the division/wing/FSSG level, the following:

- Develop and compile complex programs using high level languages
- Utilize external data (compatibility and interoperability).

These added capabilities do not really represent a separate component system from the one that resides at the division/wing/FSSG level; rather,

the capabilities will be achieved by a different software configuration of the same type of ADPE found at the division/wing/FSSG level. The capability orientation of the system at the MAF level is toward the higher management functions of monitoring performance, readiness, and operations rather than being in a direct data processing linkage (including verification and validation of data) to the Supporting Establishment.

At the MAB and MAU level, the system capability that DISHIER provides is the same one that is provided at the regiment/group/LSG level except that the software configuration is more directed to the management functions mentioned directly above for the MAF--with appropriate allowances for task responsibilities and intensities.

e. FMF Headquarters Level

At this organizational level, the system capabilities to be provided by DISHIER primarily embrace those stated for the MAF command level, with some extended capability for simulations, computerized games, and contingency planning and guidance. Also provision is made for information repositories and historical files embracing the entire purview of FMFLANT or FMFPAC--with the appropriate interfaces with the Navy and higher military authority.

2. Usage Constraints

The DISHIER concept provides ADP equipment and ADS capability to units at several echelon levels in the FMF; that equipment and ADS is available to all functional area users (manpower, intelligence, operations, logistics, financial) within the unit. Allocation of those resources to individual users will result from procedures and priorities established at that unit that best integrate the total unit workload. Hence, DISHIER provides a user's resource to be applied to any functional area need, rather than a specialized

piece of equipment and procedures to satisfy one or two restricted Class I ADS applications.

The usage constraints identified in the paragraphs below pertain to the shared use of physical system elements (displays, keyboards, CPU, telecommunications ports), based on what elements are available at each echelon level. Other usage constraints based on the allocation of machine time to different applications on the desire for privacy and security of information, and on the freedom (or lack of freedom) for pursuing independent software development are addressed in succeeding subsections that describe the software concept and the flow of management information.

a. Battalion/Squadron/LSU Level

Bounds on system usage at this organizational level include the following:

- The ADP system can perform no more than one activity at any given time
- The ADP system must be centrally located to all users within the unit for shared usage.

b. Regiment/Group/LSG Level

While many activities can be currently underway using the system configuration found at this level, certain restrictions do exist. These include:

- One terminal must be dedicated to each of the following activities for the time the subject activity is underway:
  - Inquiry
  - Data entry
  - Batch file processing (e.g., sort, merge)
  - Batch processing for a report
  - Telecommunication I/O
  - Removable media I/O
  - Maintenance diagnostics

- Of the activities listed immediately above, only inquiry, data entry, batch file processing, and batch processing for a report can be underway simultaneously at more than one terminal. Only one of the others can be underway at any time
- Any combination of the activities that can be underway simultaneously can be concurrently executed, limited only by the number of available terminals
- Concurrent operation of batch processing resources requires that an I/O terminal be dedicated to each activity for the duration of the action
- The report output activity can be concurrently underway on each printer terminal on a system
- Each report output activity must be initiated by an I/O terminal, but once the activity has been initiated that I/O terminal is released.

c. Division/Wing/FSSG Level

The activity constraints at this level are the same as for the regiment/group/LSG level except that:

- Only inquiry, data entry, and maintenance diagnostics activities require I/O terminals dedicated for the duration of each activity. All other activities need only be initiated from an I/O terminal. Once the activity is initiated the terminal is released.

d. MAGTF Command Level

The constraints at the MAF level are the same as for the division/wing/FSSG level. The constraints at the MAB and MAU levels are the same as for the regiment/group/LSG level.

e. FMF Headquarters Level

The constraints at this level are the same as for the division/wing/FSSG level.

C. Generic Description of ADP Hardware

Table 6 provides an overview of the hardware component systems that together comprise the DISHIER system concept. This section provides greater detail and some initial quantification of hardware attributes for the ADP equipment needed to make DISHIER a complete system. Both data processing characteristics and the actual physical characteristics are described in the following subsections.

1. ADPE System Components

The hierarchy of component computer systems within the DISHIER concept is well defined in the difference in hardware configuration found at each echelon level of the FMF. The levels and their equipment configuration are as follows.

a. Battalion/Squadron/LSU Level

At this level, the ADPE configuration is generically defined to include:

- 1 standard CPU (500 ns cycle time CPU that executes 16-bit operations plus character and string manipulations, with 64-128 Kbyte (8 bit byte) non-volatile main store having a 500 ns access time)
- 1-2 Mbyte mass store
- 1 interactive I/O device (display and keyboard with refresh and edit functions)
- 1 hardcopy printer
- 1 telecommunications device (interface to LFICS)
- 1 device for removable data medium (e.g., cassette tape, tape cartridge, or floppy disk)

This hardware configuration describes the generic System A that is referred to throughout the DISHIER description.

b. Regiment/Group/LSG Level

At this level, the ADPE configuration is as follows:

- 1 standard CPU (500 ns cycle time CPU that executes 16-bit operations plus character and string manipulations, with 256-512 Kbyte (8 bit byte) non-volatile main store having a 500 ns access time)
- 4-6 Mbyte mass store
- 3-5 interactive I/O devices (display and keyboard with refresh and edit functions)
- 3-5 hardcopy output devices (terminal associated printers, independent high speed printer, facsimile)
- 1 telecommunications device (interface to LFICS)
- 1 device for removable data medium (e.g., cassette tape, tape cartridge, or floppy disk)
- 1 resident or easily accessible System A.

Except for the residence or easy access to a System A,* this hardware configuration describes the generic System B that is referenced through the DISHIER description. The residence or accessibility of System A is included to accomodate the data entry function at this level with ADPE and software identical to that of the lower echelon. This strategy is believed to decrease software development and maintenance problems that would arise by emulating System A capability in the software of System B. If System A costs are low enough, it will be economically justified as well.

c. Division/Wing/FSSG Level

At this level, the ADPE configuration is generically defined to include:

---

*Residence refers to a System A co-located with the System B configuration that supports this level. Easy access refers to the close physical location of another unit that has a System A (i.e., the H&MS will be co-located with MAG headquarters in all environments; hence, MAG headquarters could use the H&MS System A).

- 1 Standard CPU (500 ns cycle time CPU that executes 16-bit operations plus character and string manipulations, with 512-1024 Kbyte (8 bit byte) non-volatile main store having a 500 ns access time)
- 12-16 Mbyte mass store
- Removable mass storage medium (disk packs, magnetic tape)
- 6-10 interactive I/O devices (display and keyboard with refresh and edit functions)
- 6-10 hardcopy output devices (terminal associated printers, independent high speed printers, facsimile)
- 1 telecommunications device (interface to LFICS)
- 1-2 devices for removable data medium (e.g. cassette tape, tape cartridge, floppy disk)
- 1 resident or easily accessible System A.

Except for the last entry, this hardware configuration describes the generic System C that is referenced throughout the DISHIER description. The residence or accessibility of System A is included for the same reasons cited for its inclusion at the regiment/group/LSG level.

d. MAGTF Command Level

At the MAF level, the ADPE configuration is generically similar to that found at the division/wing/FSSG, with expanded mass store and telecommunications resources. At the MAB and MAU levels, the ADPE configuration is generically similar to that found at the regiment/group/LSG level.

e. FMF Headquarters Level

At this level, the ADPE configuration is generically similar to that found at the division/wing/FSSG level, with expanded mass store and telecommunications resources.

2. ADPE Physical Description

ADPE included in the DISHIER concept have the physucal characteristics that mark the present generation of hardware: light weight, small volumes, wide environment limits, module packaging, low power requirements, and easy maintenance access. Table 7 identifies the primary weight, cube, and environmental attributes of the component computing systems in DISHIER.

D. Software Concept

The very nature of the hierarchy of component systems that differ in size, capacity, and function implies a similar hierarchy of software support and capability. DISHIER does, indeed, have a software hierarcy ranging from psuedo-software (hardwired functions) and firmware at the lower echelons to highly sophisticated operating systems at the upper echelons. Together these provide for responsive use of equipment at each echelon level--with mutually supporting functions as information flows up and down the command chain.

1. Component Systems Support

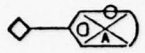
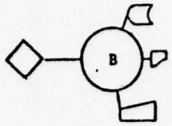
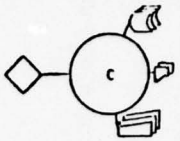
a. Battalion/Squadron/LSU Level

At this level the software support supplied by the DISHIER concept to support the System A configuration includes:

- Control program
- Driver programs for the following devices:
  - Display
  - Keyboard
  - Printer
  - Mass store
  - Telecommunication
  - Removable storage medium

Table 7

PHYSICAL CHARACTERISTICS OF DISHIER ADPE

Component Systems / Characteristics	 System A	 System B	 System C
Size and Weight	Volume: (0.5m x 0.5m x 0.2m). Weight: 15 kg.	Volume: Desk size, 0.75m x 0.9m x 1.8m in 3 modules. Weight: Less than 115 kg total--no module greater than 45 kg.	Volume: CPU & Mass Store (0.6m x 0.6m x 1.5m each). Printer (0.6m x 0.6m x 1.0m). Interactive I/O Device (0.6m x 0.6m x 1.0m). Weight: Less than 360 kg total--less than 120 kg per module.
Sheltering	Protective case integral with unit.	Normal office environment for long term operation. For short term any shelter offering protection from sun, wind, excessive dust.	Air conditioned van or building.
Electricity Supply	Line- or generator-supplied alternating current, 200 watt.	Line- or generator-supplied alternating current, 1000 watt.	Line- or generator-supplied alternating current, 2000 watt.
Heat Generation	200 watt.	1000 watt.	2000 watt.
Ambient Air Temperature Tolerance	-30° to 55°C for electronic mechanisms. -10° to 55°C for hardcopy output device and drive for removable output medium.	-30° to 55°C for electronic mechanisms. -10° to 55°C for hardcopy output device and drive for removable output medium.	5° to 30°C.
Humidity Tolerance	0 to 95%.	0 to 90%.	20 to 80%.
Dust and Grit Resistance	Impervious to dust when not in operation. Only hardcopy output device and drive for removable I/O medium are subject to airborne grit during operation.	Electronic components essentially impervious to dust. Electro-mechanical mechanisms subject to airborne grit.	Requires filtered air for normal operation.
Shock and Vibration Resistance	At least equivalent to that of standard field radios.	Suitable for hauling in standard military trucks.	Suitable for hauling and airlifting when suitably secured and packaged.

NOTE: The characteristics shown are representative; they are not specifications.

- Application programs for:
  - Menu selection
  - Inquiry
  - Data entry
  - Batch file operations
  - Report preparation
  - Report output
  - Text editing
  - Numeric calculations
  - Telecommunication
  - Removable storage media
- Maintenance diagnostic routines.

b. Regiment/Group/LSG Level

At this level the software supplied by the DISHIER concept to support the System B configuration includes all those capabilities identified above for System A plus the following extensions or additions:

- On-line multiprogramming operating system
- New applications
  - Enhanced inquiry by high level query capability
  - Report generator
  - Enhanced text editor

c. Division/Wing/FSSG Level

At this level the software supplied by the DISHIER concept to support the System C configuration includes all those capabilities identified above for System B plus the following extensions or additions:

- New applications
  - Data base management system
  - Macro-language compiler
  - Macro-language debug aids
  - Library maintenance utility

d. MAGTF Command Level

At the MAF level, the software capability would extend the System C capability stated above to include:

- New applications
  - High level language compiler
  - High level language debug aids

At the MAB and MAU levels, the software capability is very similar to that described for System B at the regiment/group/LSG level.

e. FMF Headquarters Level

At this level, the software capability provided by DISHIER is very similar to that described above for the MAF command level.

2. Software Development and Maintenance

The approach to software development and maintenance in DISHIER is guided by two principles:

(1) Operating units of the FMF, especially at the lower and middle echelons, must not be burdened with development and maintenance activities.

(2) Development and maintenance activities must be responsive to the specific user needs of the FMF elements.

The following development and maintenance arrangements are consistent with these principles, as they might be implemented in DISHIER.

a. Basic Operating Software

Basic operating software components, including control programs, operating systems, device driver programs, language processors, diagnostic routines, and file management programs will be supplied by a commercial vendor. Certain general purpose software packages, such as the

text editing package, may be supplied by a vendor as well. Vendor support will be responsible for furnishing the software, tailoring it as necessary to the particular needs of the FMF ADS, implementing it on the hardware, and maintaining it through initial operation. Long term maintenance on this class of software will be the responsibility of a commercial contractor for the life of the system.

b. Class I ADS Software

DISHIER will embrace the present Class I software presently processed in the FMF (SASSY, MIMMS, MAGFARS, FREDS, MEDS, etc.) in whatever form the conversion process leave it. DISHIER will also embrace software for entry, verification, and validation of Class I data to be processed in the Supporting Establishment (JUMPS/MMS, MUMMS, FORSTAT, etc.). User protocols for this software must be the same for both FMF and Supporting Establishment ADP systems. Specifications for this software will emanate from functionally oriented CDPA's. Implementation in the FMF will be accomplished by a centralized software development and maintenance activity (FASA concept*) that will support the FMF as part of the DISHIER concept.

c. Class I ADS-Related Software

As described above, a portion of the DISHIER software exists primarily to handle Class I ADS reporting requirements. However, closely associated software must also exist to satisfy strictly FMF requirements. This reflects the underlying DISHIER design principle requiring that data collected for Class I reporting also be available for local use by the collecting unit.

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*This centralized software development and maintenance activity is proposed to be included in DISHIER under a concept called FMF ADS Support Activity (FASA). A description of the FASA concept is provided in Appendix B, Section 2.

Some software would act to extract Class I data from the initial data entry action and build appropriate local unit files (e.g., automated T/O's and T/E's). This class of software will be developed and maintained under the FASA concept.

d. FMF-Wide Applications Software

Some DISHIER software may be strictly internal to the FMF ADS for use only by units of the FMF. This class of software will be of a general nature so that its usage would extend throughout the units of the different FMF combat elements. An example might be mountout logistic supplies software. Such software will be developed and maintained under the FASA concept.

e. Element-Unique Applications Software

Some DISHIER software is unique to one of the FMF combat elements (air, ground, CSS), or to all units at a specific echelon level throughout the FMF, or to all FMF units of one specific type. An example might be vehicle (aircraft) maintenance history software. Such software will be developed and maintained under the FASA concept.

f. Unit-Unique Applications Software

Under the DISHIER concept individual FMF units (possessing the capability) have the opportunity to create and use software meeting the unique needs of that unit. Examples might be aircrew training and proficiency records, or technical skills inventories. Such software will be developed and maintained by personnel assigned throughout the FMF as part of the regular manning of the component ADP systems. Such personnel are assigned at the regiment/group/LSG level and upward.

E. Communications Concept

DISHIER relies upon communication resources to support digital traffic internal and external to the FMF. Digital traffic in DISHIER includes both classified and unclassified information. Within the FMF, DISHIER incorporates two primary communications concepts. The first is electronic via the LFICS, and the second is physical via the transportation of magnetic storage media (floppy disks, cassettes). Transmission between high FMF headquarters and the Supporting Establishment is via AUTODIN or the physical transportation of magnetic storage media. The DISHIER philosophy is to make maximum use of telecommunications--when it is available and prudent to do so--while at the same time maintaining a communications capability independent of telecommunications.

DISHIER will make use of the secure LFICS telecommunications channels for internodal digital traffic (i.e., between separate computer systems). Intranodal digital traffic (i.e., between terminals and processors) will be hardwired and accomodated as part of the ADPS design. Communications security will be part of the telecommunications system; so DISHIER's ADPE will not bear any size/weight/capability burdens to provide communications security--except from point of origin to point of entry into LFICS or AUTODIN.

Physical transportation of digital traffic by a floppy disk or cassette is analogous to the present paper flow within the FMF. The particular media to be transported can be classified and subject to the same procedures that govern the transfer of classified documents now. Translation of digital data to text will be accomplished on classified ADPE at the receiving unit.

Data traffic is, with few exceptions, the same administrative data that is presently reported to the existing Class I Marine Corps ADS. Digital communications will support the reporting requirement for the functional areas of manpower, operations, logistics, and finance. Additionally the intelligence functional area will be supported at echelons below division/wing (where MAGIS operates).

The reporting philosophy underlying DISHIER is "exception reporting". Exception reporting to the Class I systems principally involves digital reporting of records of events that would alter a particular system's data base (e.g., the MMS/JUMPS data base). Reporting is characterized by a scheduled batch submission (usually daily) from reporting units up from the battalion/squadron echelon. On this basis, it may be stated that:

- The DISHIER concept will not require telecommunication links between nodes other than those already envisioned by the LFICS architecture to support future MTACCS systems
- The transmissions will be batch-oriented--with no interactive transfer of data or query of data bases between LFICS nodes (intranodal interactivity between terminals and processor is allowed)
- The majority of data to be transferred will have a precedence commensurate with its administrative (rather than tactical) orientation and its nonperishable nature.

By virtue of the DISHIER concept, digital traffic flows (1) predominately upward within the hierarchical structure (versus downward or laterally), and (2) it flows always on a point-to-point basis; that is, a given traffic source directs the bulk of its traffic to the same destination point. A summary of the level of activity estimated to occur on each link for a deployed MAF is contained in the matrix of Table 8, as well as in Appendix C.

F. ADPS Supporting Manpower

1. User Support

DISHIER is functionally oriented for use by three stereotype users in the FMF: (1) administrative clerks recording manpower, intelligence, operations, logistics, and financial "events", (2) commanders and their staffs who are responsible for internal management of men, equipment, and information within their respective units, and (3) analysts who oversee the functional area information flow and analysis throughout the FMF chain of command. To

Table 8

ESTIMATED MAF DIGITAL DATA LINK USE IN DISHIER

(Ground and CSS Elements)

Send \ Receive	DCS	CATF	MAF HQ	RADIO BN	COMM BN	MAW HQ	FSSG HQ	DIV HQ	HQ BN	RECON BN	DSG HQ	H&S BN	ENG BN	FAG	TANK BN	AMTRAC BN	ARTY REGT	ARTY BN	INF REGT	INF BN	FSSG HQ	LSG HQ	DET H&S BN	DET MNT BN	DET SUP BN	DET MT BN	DET ENG BN	DET MED BN
DCS	●		L																									
CATF		●	M																									
MAF HQ	X	M	●	S	S			M													M							
RADIO BN			S	●																								
COMM BN			S		●																							
MAW HQ			L			●	M																					
FSSG HQ			L				●															S						
DIV HQ			L					●	S	S	M			S	S	S	S		S		L							
HQ BN								S	●																			
RECON BN								S		●																		
DSG HQ								M			●	S	S															
H&S BN											S	●																
ENG BN											S		●															
FAG								S						●														
TANK BN								S							●													
AMTRAC BN								S								●												
ARTY REGT								M									●	S										
ARTY BN																	S	●										
INF REGT								M											●	S								
INF BN																			S	●								
FSSG HQ			L																		●	S						
LSG HQ																					M	●	S	S	S	S	S	S
DET H&S BN																						S	●					
DET MNT BN																						M		●				
DET SUP BN																						M			●			
DET MT BN																						S				●		
DET ENG BN																						S					●	
DET MED BN																						S						●

NOTE: (S) Less than 500 Kbytes daily; (M) Between 500-5000 Kbytes daily;
(L) Between 5000-30,000 Kbytes daily; (X) Greater than 30,000 Kbytes daily

Table 8

ESTIMATED MAF DIGITAL DATA LINK USE IN DISHIER (Continued)

(Air Element)

Send \ Receive	MAW HQ	MWHS	WSG HQ	H&GM SQ	ENG SQ	MTR TR SQ	MACG	H&HS	MWOS	MACS	MASS	LAAM BN	FAAD BTRY	MAG VH	H&MS	HHM	HMH	HML	HMA	VMO	MAG VF/VA	H&MS	VMA	VMFA	VMGR	DET VMAQ	DET VMFP
MAW HQ	●	S	S				M							M							M						
MWHS	S	●																									
WSG HQ	M		●	S	S	S																					
H&GM SQ			S	●																							
ENG SQ			S		●																						
MTR TR SQ			S			●																					
MACG	M						●	S	S	S	S	S	S														
H&HS							S	●																			
MWOS							S		●																		
MACS							S			●																	
MASS							S				●																
LAAM BN							S					●															
FAAD BTRY							S						●														
MAG VH	M													●	S	S	S	S	S	S							
H&MS														M	●												
HHM														S		●											
HMH														S			●										
HML														S				●									
HMA														S					●								
VMO														S						●							
MAG VF/VA	M																				●	S	S	S	S	S	S
H&MS																					M	●					
VMA																					S		●				
VMFA																					S			●			
VMGR																					S				●		
DET VMAQ																					S					●	
DET VMFP																					S						●

use DISHIER effectively, data processing backgrounds are not needed by the administrative clerks or commanders and their staffs; data processing backgrounds are required of the analysts.

To accomodate the unsophisticated user, DISHIER emphasizes hardware and software transparency. Users interact directly with the computing capability of the various ADPS through a "comfortable" interface (terminal or keyboard) through uncomplicated instructions related to the work that they are doing. In this way, the computer becomes a tool that is functionally limited in the same way that hand calculators are functionally limited by the number of keys they provide. Further assistance is provided to the unsophisticated user because the ADS in DISHIER is designed to be "friendly", i.e., step-by-step instruction of data input requirements may be provided directly over a keyboard on a terminal display and this capability is interactive.

The training requirements for the unsophisticated user, therefore, are nominal--ranging from one to no more than two weeks of instruction and hands on experience. An assumption is, however, made that the user is familiar with the particular job that he is performing--i.e., is a qualified supply clerk, administrative clerk, for example.

The more sophisticated analyst users, naturally, require an appropriate amount of data processing training--including training on the equipment that they use, general training such a knowledge of programming languages, and so on.

2. Operations and Maintenance Support

The manpower support requirements of DISHIER include the necessity of providing personnel having the background and training that is associated with the following ADP job categories:

- Analyst/programmer
- Senior analyst/programmer
- Systems programmer
- Senior systems programmer
- ADPE operators
- ADPE maintenance

The number and distribution of men having these qualifications among elements of the FMF in DISHIER are indicated in Table 9.

Operations and maintenance are facilitated in DISHIER by several means. At the lower units, especially, the ADP system is such that firmware provides a significant portion of the capability--thus reducing software generation. Equipment diagnostics are included to facilitate the identification of hardware malfunctions. When hardware repairs need to be made, the semiconductor technology inherent in the DISHIER ADPE is susceptible to simple card replacement.

The overall maintenance concept that appears to support DISHIER adequately calls for on-site ADPE maintenance at the higher echelon nodes (by module replacement) utilizing spare modules stocked at the node site (with backup spares stocked at the FSSG), and for contact team maintenance for low echelon ADPE (also by module replacement). Module replacement will be assisted by the fault isolation properties of the diagnostic routines that are a part of each component ADP system. Higher level maintenance will have to be supported from an electronics section in the FSSG.

The total manpower requirement to operate and maintain DISHIER is estimated to be at least 540 man-years per year. Of this total, the estimated profile of skills required is summarized in the following tabulation:*

*These numbers were generated by multiplying the representative staffs of Table 9 by the number of component systems in 3 representative MAF's and adding staff for the FASA. This total was then inflated by one-third to account for off-duty time during the year.

Table 9

ORGANIZATIONAL BREAKDOWN OF ADP PERSONNEL IN DISHIER

Combat Echelon Breakdown	Representative Staffs per Component System					
	System Programmer (Senior)	System Programmer	Analyst/Programmer (Senior)	Analyst/Programmer	ADPE Operator	ADPE Maintenance
FMF Headquarters	1	---	1	2	6	2
MAGTF Command						
MAF Command	1	---	2	1	6	2
MAB Command	---	---	---	1	4	1
MAU Command	---	---	---	1	4	1
Ground Element						
Division	---	1	1	2	6	2
Regiment	---	---	---	1	4	1
Battalion	---	---	---	---	---	---
Air Element						
Wing	---	1	1	2	6	2
Group	---	---	---	1	4	1
Squadron	---	---	---	---	---	---
CSS Element						
FSSG	---	1	1	2	6	2
LSG	---	---	---	1	4	1
LSU	---	---	---	---	---	---

Note: These numbers reflect an estimate based on an assumed 1½ to 2 shift level of effort 5 days a week.

Job Category	Man-Years	Percent of Total
Analyst/programmer	81	13%
Senior analyst/programmer	39	7%
Systems programmer	12	2%
Senior systems programmer	13	2%
ADPE operator	308	58%
ADPE maintenance	87	16%

Especially at the lower echelon levels, DISHIER is designed to be used by persons without data processing backgrounds. System software and hardware configurations will support this type of operation. There will be, however, a nominal training burden for typical user types--administrative clerks, as well as commanders and their staffs.

G. Operational Capability

1. Environmental Coverage

DISHIER provides ADPS support for all FMF elements down to the battalion/squadron/LSU echelon level. This support embraces the major FMF operating environments of garrison, afloat, and ashore--covering the requirements of administrative organization, as well as task organization. Furthermore, the DISHIER concepts provides for the same equipment to be used in the deployed environments as is used in garrison.

Physically small, mobile ADPS that require little in the way of special environmental controls and supporting resources provide the basis for this capability in DISHIER. Because each unit possessing an administrative command capability is provided with ADPS capable of producing the automated support needed by that unit, DISHIER has the inherent flexibility to configure a suitable ADPS for every contingency. This includes the capability to configure for different intensities of operation, different

geographic factors, and for different concepts of operation. This applies equally for each of the three combat elements, as well as for the command element.

The ability to operate on ship or deployed ashore is also fostered by the on-the-job training of Marine Corps personnel (on the same equipment and using approximately the same procedures) in the garrison environment. Furthermore, the DISHIER concept of sharing common equipment among the functional areas of manpower, intelligence, operations, logistics, and finance means that there will be large group of people capable of providing mutual support.

To demonstrate DISHIER's comprehensive coverage of MAGTF configurations in a deployed environment. Figures 7, 8, and 9 show the component system distributions for a representative MAF, MAB, and MAU respectively. Summary totals of component systems are as follows:

MAGTF Configuration	System A	System B	System C
MAF	87	12	4
MAB	21	4	---
MAU	6	1	---

The processing activities and constraints attributed to each FMF echelon in the DISHIER concept may be summarized in a profile of ADS services that are available to the three combat elements in the environments of garrison, afloat, and ashore. Table 10 describes, by echelon, the ADS services for which the various echelon levels have direct access to ADS services in DISHIER. (Direct access is defined here to mean either physical residence of ADPE at that particular echelon, or telecommunication links to non-resident ADPE.)

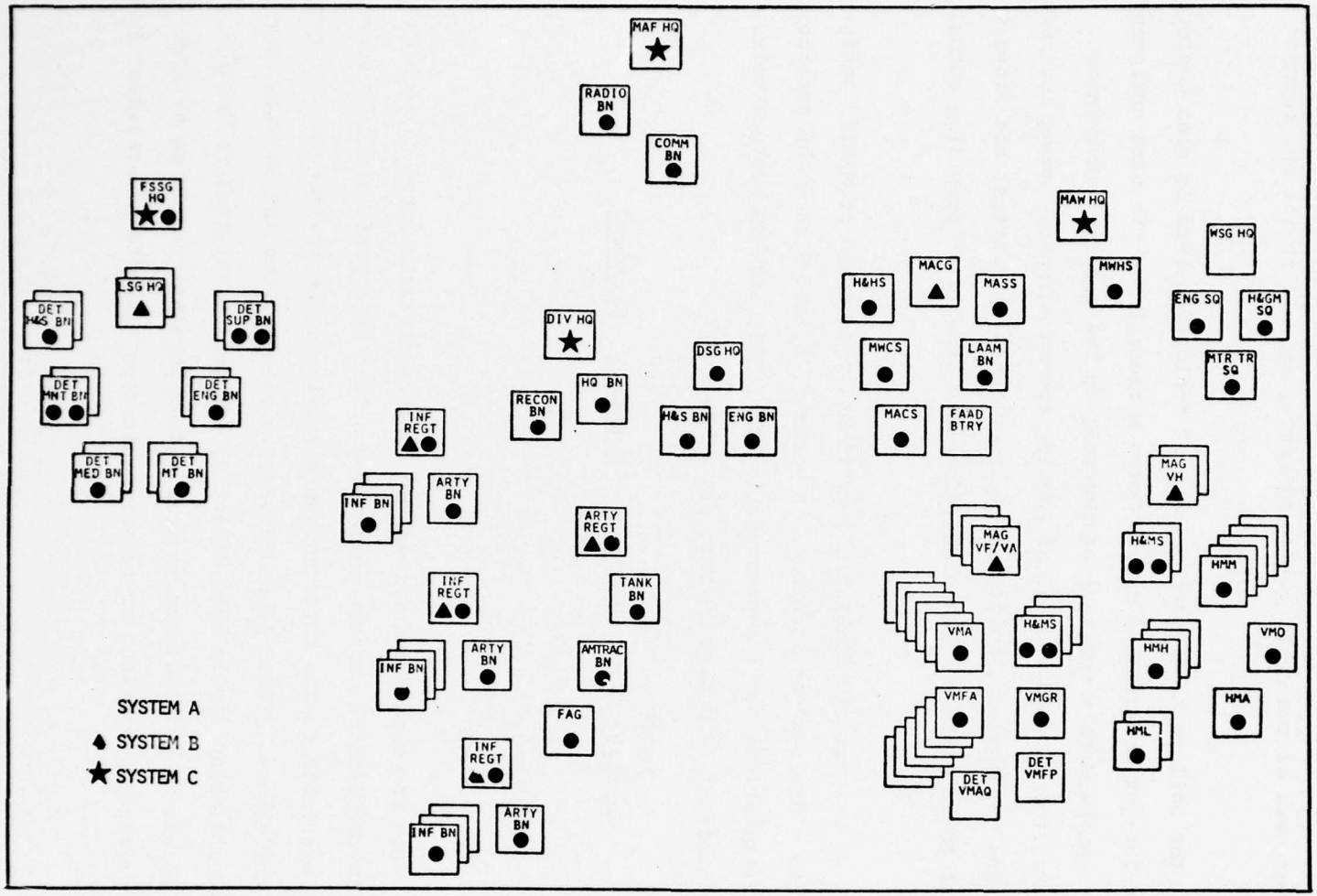


FIGURE 7 MAF DISTRIBUTION OF ADPE IN DISHIER

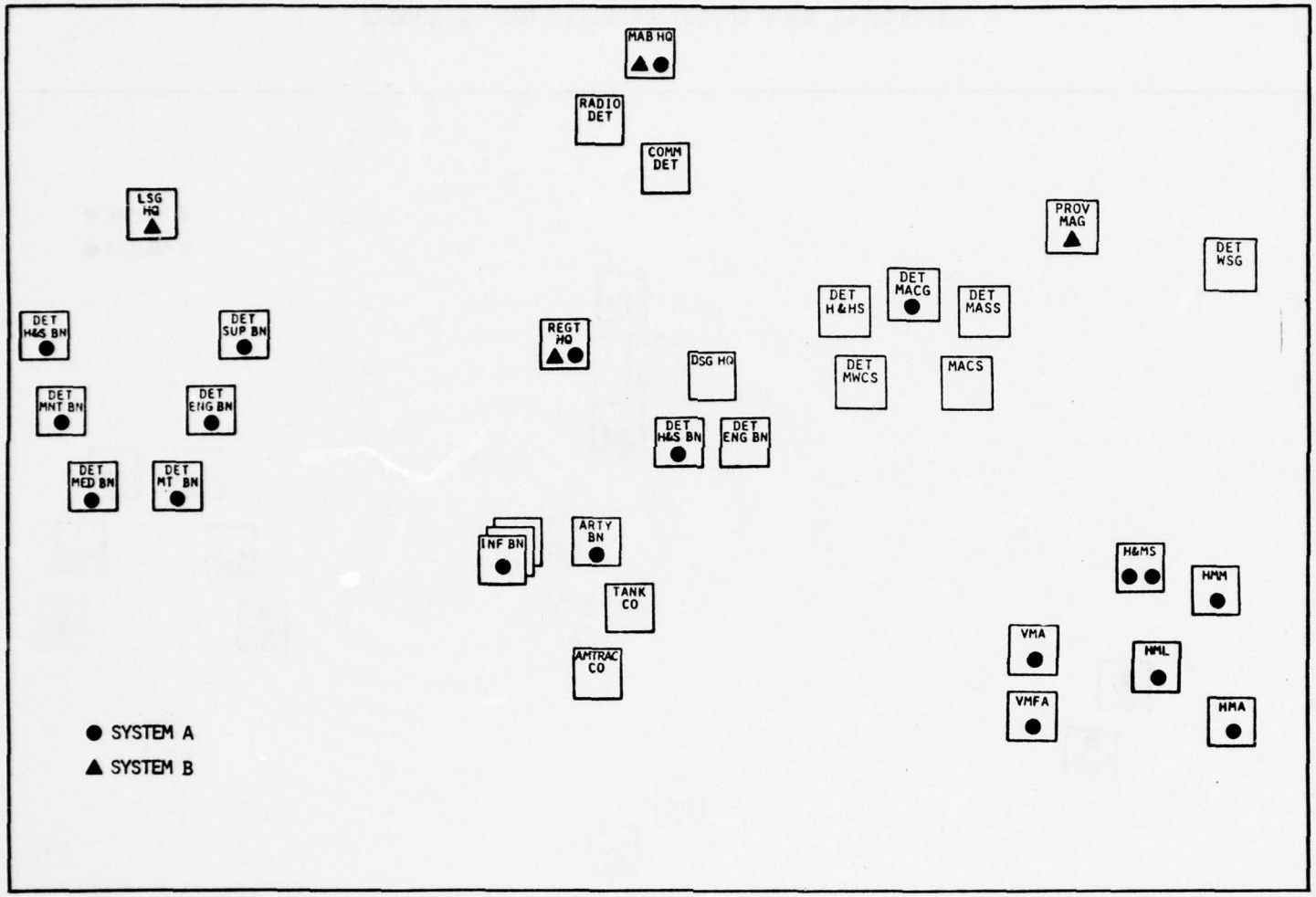


FIGURE 8 MAB DISTRIBUTION OF ADPE IN DISHIER

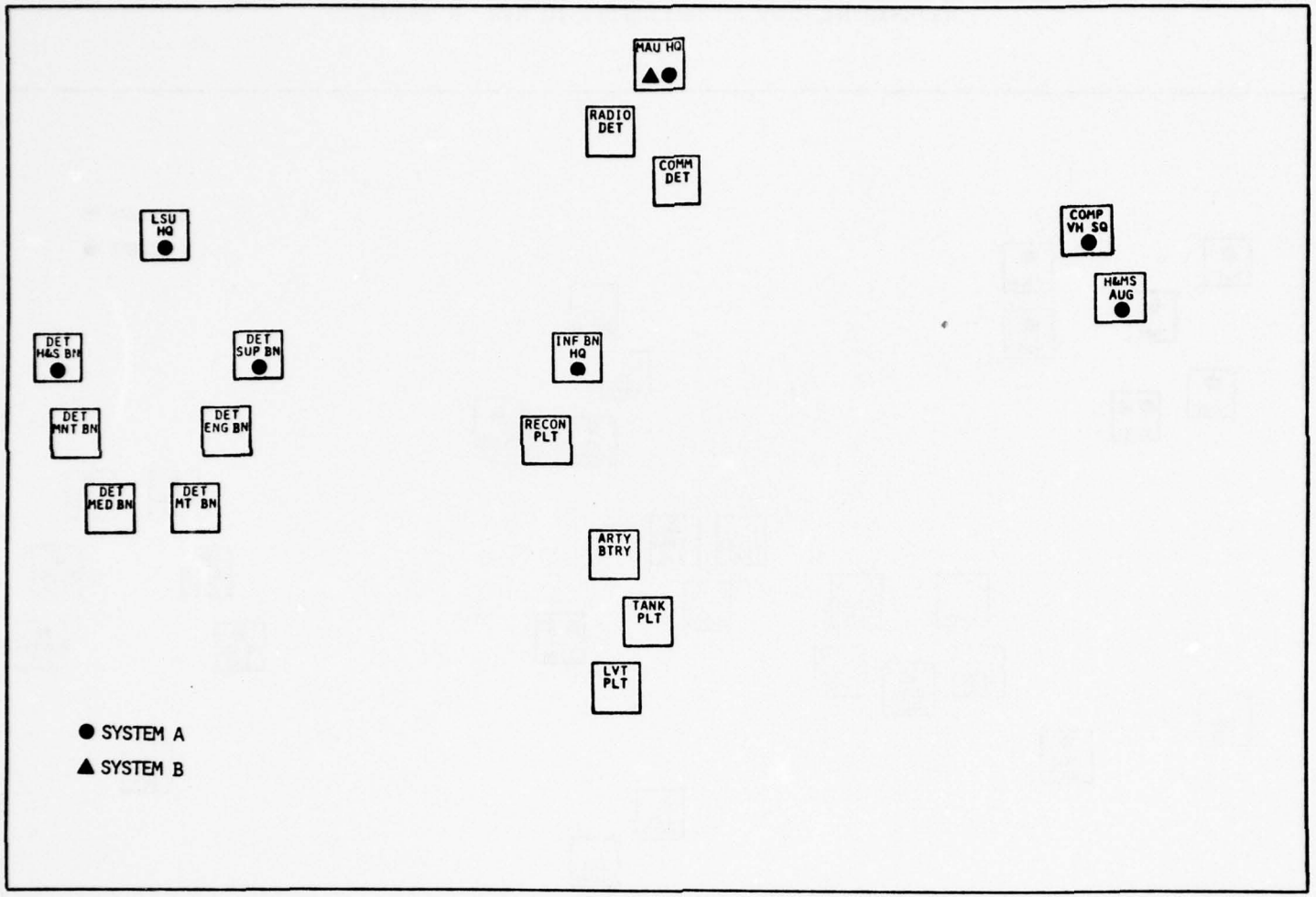


FIGURE 9 MAU DISTRIBUTION OF ADPE IN DISHIER

Table 10

SUMMARY OF DIRECT AVAILABILITY OF ADS SERVICES IN DIGHIER

Combat Element Echelon Breakdown	Data Entry, Verification & Validation		Alphanumeric Text Processing		File Management		Information Storage & Retrieval		I/O Formatting		Report Generation		Numerical Calculation		Simulation & Analysis Programming		I/O of Files by Removable Medium	Electronic Transmission of Files
	S*	C+	S	C	S	C	S	C	S	C	S	C	S	C	S	C		
FMF Headquarters		G		G		G		G		G		G		G		G	G	G
MAGTF Command																		
MAF Command		All		All		All		All		All		All		All		All	All	All
MAB Command	All		All			All		All		All		All	All		All		All	All
MAU Command	All		All			All		All		All		All	All		All		All	All
Ground Element																		
Division		All		All		All		All		All		All		All		All	All	All
Regiment	All		All			All		All		All		All	All		All		All	All
Battalion	All		All		All		All		All		All		All		---		All	All
Air Element																		
Wing		All		All		All		All		All		All		All		All	All	All
Group	All		All			All		All		All		All	All		All		All	All
Squadron	All		All		All		All		All		All		All		---		All	All
CSS Element																		
FSSG		All		All		All		All		All		All		All		All	All	All
LSG	All		All			All		All		All		All	All		All		All	All
LSU	All		All		All		All		All		All		All		---		All	All

Note: (G) Garrison Environment
(Af) Afloat Environment
(As) Ashore Environment
(All) All Environments

*Simple and/or Preprogrammed

+Complex and/or Programmable

2. Continuity of ADPS Support

DISHIER is designed to serve the transitioning needs of the FMF elements as they go from garrison, to afloat, to combat deployment ashore. That is, the implementation of DISHIER is envisioned to provide continuous ADP support as the FMF units mobilize, embark, debark, and set up and conduct combat operations. The basic system capability to do this extends from the modularity and mobility of component systems that provide various sized building blocks of computer power and capacity. These basic building blocks may be aggregated or segregated to the degree necessary to meet the total ADP support requirements of the FMF.

Significant features of the DISHIER concept that provide the basis for continuous ADP support within the FMF operating environments and during the transitions among them include:

- The ADPE will belong to individual FMF units; these units will use the same ADPE in garrison, afloat, and ashore.
- Enough ADPE will be procured to support combat deployed MAGTFs, as well as garrison remnants of units that are deployed.
- Equipment commonality among various units of the FMF will allow:
  - Sharing of ADPE to accommodate unit detachments during deployments and exercises (that is, neighboring unit sharing)
  - Sharing of ADPE in a restricted geographic area (for example, aboard ship) where support constraints (floor space, power, and so on) may be a factor
- Software characteristics will provide flexibility and transportability of FMF ADP applications.

Each point is further expanded below.

DISHIER ADPE is mobile and environmentally capable of operations in all three environments. The systems will be carried onboard the ships as the troops embark; they will be operated aboard ship according to the

needs of the units that they support; and they will be debarked as a tool of that same unit for the combat deployment ashore. This is not to suggest, however, that each and every ADPE is expected to operate aboard ship. Shipboard space and power constraints may necessitate the sharing of a few ADP resources by several units on one ship. Because the afloat environment will not generate the ADP activity levels that the combat ashore environment will, the sharing of ADP resources should not unduly constrain ADP support of any unit.

It is evident that the deployed combat environment will generate the greatest ADP activity levels. Since it is imperative that the MAGTFs be supported in this environment, enough ADPE must be procured to meet this requirement, as well as to meet the needs of remnants of units that do not deploy with their parent unit. One aspect of this situation should be provided for in DISHIER through the procurement of ADPE for MAGTF command headquarters that are active in garrison, non-combat deployments, or exercises. These systems would not be mothballed for part-time use since such headquarters have a continuing responsibility for planning and contingency development. A first estimate is that 3 MAF systems, 3-4 MAB systems, and 3-4 MAU systems be procured for this reason.

Because there is a considerable replication of ADP component systems of each type in DISHIER within the FMF organization, an option also exists to share ADPE in those situations where detachments or administrative attachments separate FMF unit components from the ADP support that would serve them normally. Such sharing is accommodated and fostered by the software that is a part of the DISHIER concept. Under that concept, software will have the commonality, flexibility, transportability, and ease of use that will allow each unit to transport its applications and data files to another ADPE of the same type and operate effectively. For example, a particular unit's applications programs and data files may be placed on transportable magnetic media such as cassettes or floppy disks to accompany that unit wherever its responsibilities might take it.

As a recap of the capability of the DISHIER concept to provide continuity of ADP support for the various operating environments and MAGTF configurations, the reader's attention is directed to Figures 7 and 8. Figure 7 identifies the total allocation of ADPE that might be expected for the component units of a MAF. Figure 8 identifies portions of the combat elements of the MAF that typically would deploy for a MAB size operation, as well as the ADPE that they would take with them. (Remaining ADPE would stay with the units of the MAF that do not deploy).

A comparison of Figures 7 and 8 indicates that all units (both those that deploy and those that remain in garrison) will have their normal complement of ADPE with two exceptions. One exception is the MAB headquarters which does not appear in the MAF configuration of Figure 7. ADPE capability in this situation would most commonly come from one of the extra systems provided in garrison for MAB planning and exercise deployments, as discussed three paragraphs above. The other exception occurs in all those cases of the MAB configuration where less than a battalion/squadron is deployed. Reference to Figure 8 indicates that this situation occurs for the Radio Battalion detachment, the Communications Battalion detachment, the Tank Company, the Amtrac Company, and so on. In such cases, these unit components would normally be administratively attached to a higher headquarters which have sufficient capability and capacity to share ADPE resources to accommodate the additional workload imposed by the attached units.

H. Management Information Flow and Control

1. Information Flow

The logic of information flow in DISHIER is based on satisfying two needs at each echelon, those being:

- Support of the flow of administrative information up the chain of command--in some cases, all the way to the Functional Area Managers in the Supporting Establishment
- Support of the local unit management needs (planning, programming, evaluating, monitoring/inventorying, forecasting, supervising/controlling) in a mix suited to the unique needs of each echelon.

DISHIER satisfies the first of these through data capture close to the source through a combination of data capture and data entry. The smooth flow of information up the organizational structure is facilitated by placing portions of such capabilities as editing, summarization, aggregation at each echelon so that (1) data links are not clogged by raw data, and (2) the percentage of error traffic relative to the general flow is low.

The means by which DISHIER supports the local unit management needs is to copy relevant information as it is collected at that unit or as it passes that unit in the normal flow of information upward. This process may be thought of as making a carbon copy of useful information as this information is initially collected or as it passes by. Since each echelon level is provided with the capability to manipulate and access that data through ADPE locally available, there is no need for locally useful information to be forwarded to a central location to be processed and returned.

The processes of reporting and local use of information are complementary but separable. Figure 10 indicates the nature of this separation within the context of the DISHIER concept. Information is kept on local files at each level of the organizational hierarchy as part of the normal reporting process.

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ALTERNATIVE AUTOMATED DATA PROCESSING SYSTEM CONCEPTS FOR SUPPO--ETC(U)
JUN 77 L S PETERS, K R AUSICH, G F WALLACE N00014-76-C-0582

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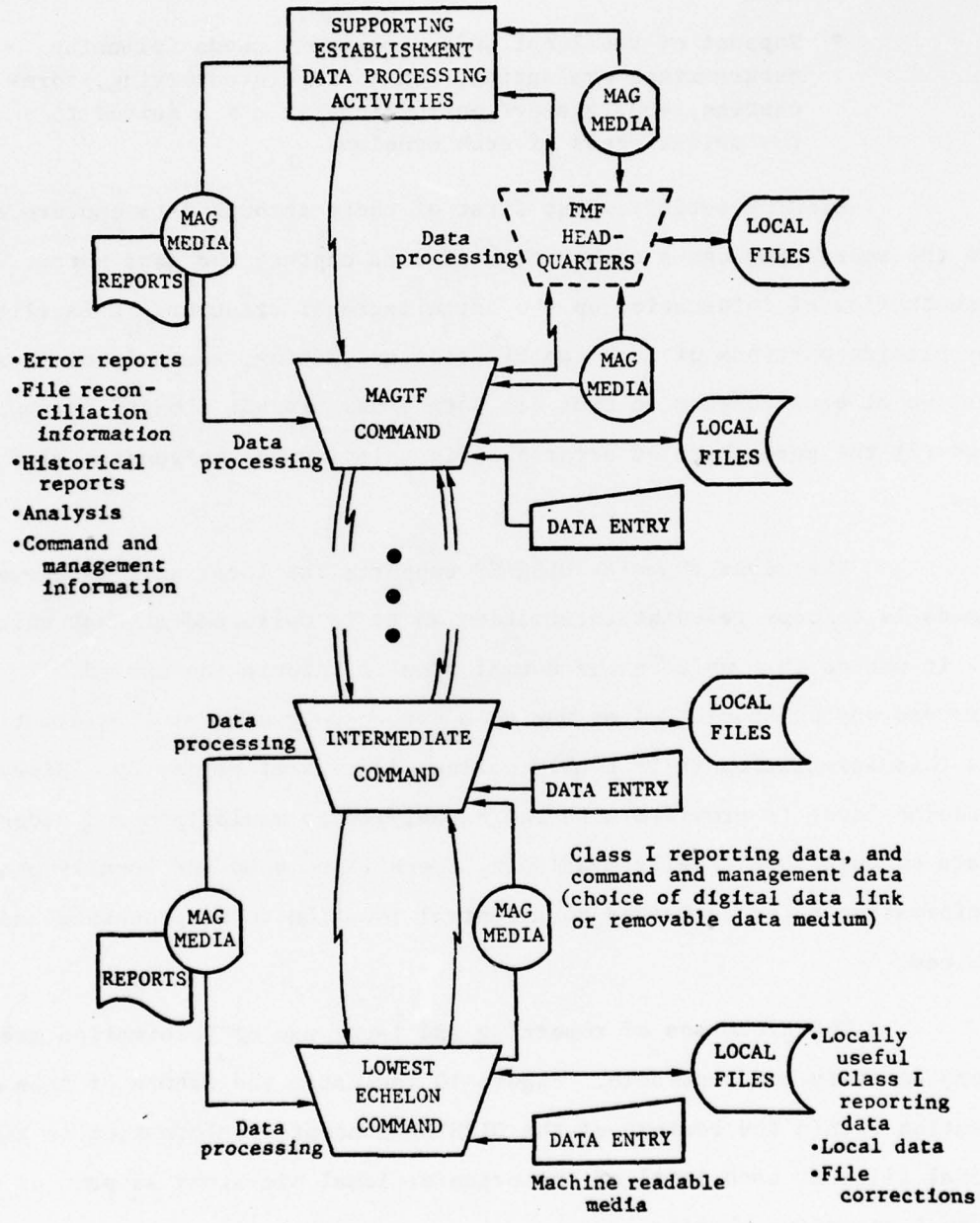


FIGURE 10 MANAGEMENT INFORMATION FLOW IN DISHIER

2. Information Security and Privacy

Within the precepts of DISHIER, adequate information control can be exerted in several ways to meet the evident security and privacy concerns of the FMF.

There is every intent in the hardware and software design to assure that the current and predicted state of the art for information access control and file security and integrity be readily achievable. Furthermore, the design itself, which is not dependent on multilevel dynamic interactive access, eliminates many of the problems and much of the complexity often associated with multilevel interactive systems.

The computer system at the lowest echelon level, being a stand-alone device, can be protected and controlled in much the same fashion as current low echelon records are. Physical access to the machine can be controlled in the same fashion as access to filing cabinets is now; just as a key is now used to open a cabinet, so it may also be required to activate the computer. Further, since the information is stored in a non-human-readable form on a non-manual or non-human-interpretable medium, it is less subject to compromise than conventional records. Within the system itself, further safeguards can be provided, certainly at the file level and very likely at the data field or data element level to assure that information which is sensitive from the privacy point of view is protected. Thus, items such as medical history and performance ratings will be accessible only to those who have a need to know; a personnel clerk making up a duty roster, for example, would not have access to pay information.

In the medium and larger scale machines, the same types of physical access controls are valid. In addition, because the capability for on-line interaction with these systems will exist, adequate user log-on, or access, controls must be implemented in system software. These controls will include positive identification of the user and authorization appropriate to

the usage profile of that user. Only those files, records, and data elements that the individual, according to his usage profile, is privileged to interrogate, copy, amend, correct, replace or delete, will be accessible to him. Consideration must be given in the design of the system control programs and utilities to maintaining the integrity of the data; these programs themselves must not modify or destroy information. Furthermore, systems at all levels should have full resource utilization logging and analysis capabilities and also capabilities to record resource use and data access together with user identification.

Since one of the basic premises of DISHIER is the use of commercially available hardware devices and standard software packages, the integrity of these components should be comparatively easy to ascertain. Indeed one of the requirements for components to be incorporated into DISHIER may be that they are certified by DoD or other authorities as to their compliance with security and privacy provisions.

The use of standard packages lessens the need for the Marine Corps to employ a large number of programmers, some of whom may not be fully trained, completely cognizant of hardware and software security principles, or adequately supervised. This eliminates one major potential opportunity for overt and inadvertent breeching of the security and privacy provisions of the system.

With DISHIER there will be a requirement (just as there is now and with any system) for comprehensive management control. One can never be free from concern about lapses of personal integrity, the safekeeping of the information media, and the proper and authorized use of the equipment. Also, there will always be a concern with the appropriateness and accuracy of the data and the knowledge, use, and distribution of the information provided by the system. There is no machine or software system that can replace human judgment and discipline; however, DISHIER should augment

the exercise of these facilities by making the constraints visible and workable, thereby, enforcing their application.

3. Interoperability

An important aspect of the information flow in DISHIER is the necessity for compatibility of information processing methods between the reporting commands of the deployed MAGTF and higher commands. The Marine Corps wears two hats in the operational chain and this causes an additional interface for the reporting process that includes the Fleet Commanders, Joint Task Force Commanders, Joint/Combined Task Force Commanders and CINCs, as well as strictly Marine Corps activities. The requirements for interoperability involve such concerns as reconciling data types and formats, both from a data processing perspective and from a telecommunications perspective. It also involves assuring a means of reconciling differences in ADP among different computer systems.

The DISHIER concept addresses the interoperability requirement primarily through software capabilities located at the upper echelons of the FMF organization. (In some extreme cases, additional ADPE and telecommunications equipment may also be required at these levels.) Specifically, capability is assigned in DISHIER to the division/wing/FSSG echelon level, as well as to the MAF, MAB, and MAU command elements, to foster the efficient and effective passage (and use) of information up and down the operational chain of command. By placing the interoperability focus of the information flow at the upper commands of the MAGTF, the interface problem can be centralized and minimized. Both the Marine Corps and the Navy information processing systems at lower echelons, therefore, need not be burdened by interoperability concerns with the other Service.

V DISTRIBUTED ACTIVITY (DISACT) SYSTEM CONCEPT

A. Concept Overview

1. System Logic

DISACT provides workload-associated computing power to the FMF from the highest command level down to the battalion/squadron level. Processing resources range from large variable-configuration minicomputer systems at FMFPAC/FMFLANT level through minicomputer based systems for activities with large workloads, to small stand-alone micro-processor systems for activities with smaller workloads. The system logic connecting the computer resources at the various activities is mutually supporting within a particular combat element (air, ground, CSS). Accordingly, in the vertical workload and processing resource requirements of the separate combat elements create differences in the topology of ADP systems as they are conceived for air, ground, and CSS.

The physical size and support requirements of the component systems do not unduly constrain the support capabilities and mobility requirements of the units they support. Hence, deployed MAGTF's can be supported afloat/ashore using equipment and procedures that also serve their garrison requirements.

DISACT provides modularity through the mix of component systems that differ in size, capacity, and function. The flexibility inherent in such resources allows DISACT to accomodate readily different MAGTF configurations (MAF, MAB, and MAU), as well as differing intensities of operations.

DISACT is designed to support the flow of administrative information (manpower, operations, logistics, financial) within the FMF and from the FMF to higher headquarters, as well as some intelligence reporting at lower

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echelons (see p. 46 of Vol. II). This is achieved through an SDA-like capability to capture information in machine-readable form close to the source. That capability is augmented by editing, validating, summarization, and aggregation capabilities within each combat element, as well as the ability to transmit the reporting information up and down the organizational chain.

Vertical information flow paths exist between successive echelons in DISACT. Each of these consists of one or more two-way electronic data transmission links (through LFICS). In the absence of such links, digital data on machine readable media (e.g., cassettes or floppy disks) can be physically transported from point to point via any suitable transportation means.

DISACT further provides functional capabilities to meet the local units' internal command and management information processing requirements. These capabilities (local inquiry, retrieval, update, sort, etc.) are tailored to correspond to the nature and the volume of the workload at each echelon level and the other levels it may support. The use and access to these capabilities are oriented toward actual users of the information rather than a data processing intermediary.

Serving simultaneously the reporting and local usage requirements, DISACT is in every sense a generalized management tool. It is a tool that is shared among the functional management areas (manpower, operations, and training logistics, and finance)--serving the particular needs of the unit, rather than those of one functional area. As such, the capability DISACT provides must be shared among a group of users according to the need and priority to be established at each echelon.

Figure 11 outlines the ADP system and organizational relationship for DISACT in a deployed MAGTF. Immediately apparent in the overview is the dissimilarity among the distributions of ADS resources in the three

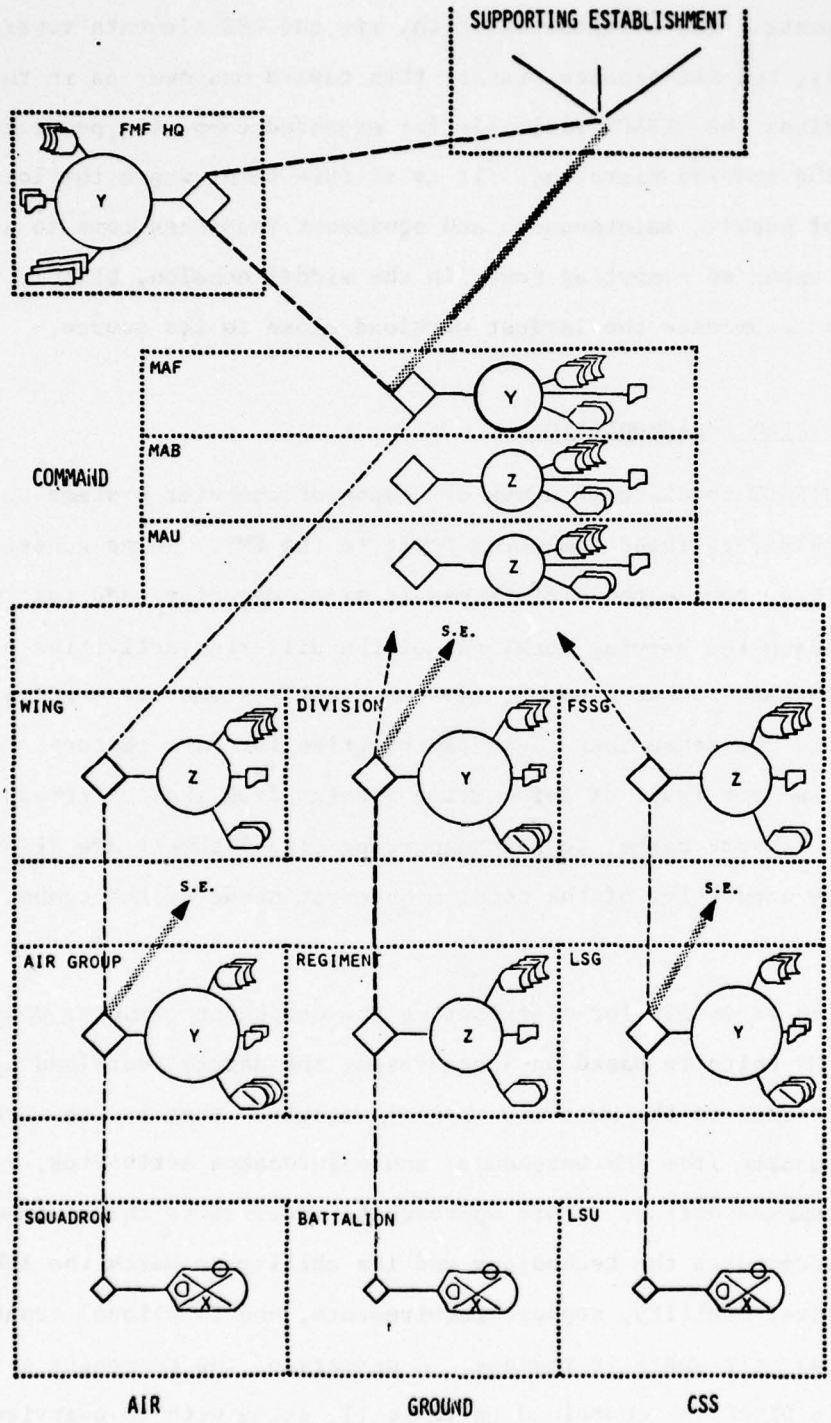


FIGURE 11 DISACT OVERVIEW

combat elements. The orientation of the air and CSS elements toward equipment, supply, and maintenance (rather than toward manpower as in the ground element) drives the DISACT rationale for expanded computing power in the middle of the echelon hierarchy. It is at this point where the logistics functions of supply, maintenance, and equipment readiness come to a focus. By placing expanded computing power in the middle echelon, DISACT, then, attempts to accomodate the largest workload close to its source.

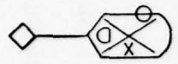
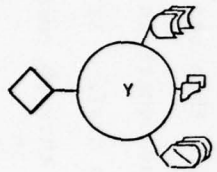
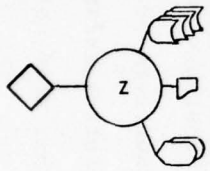
2. System Implementation

DISACT consists of a mix of component computer systems that provide workload-tailored computing power to the FMF. Three generic component systems provide the differences in size, capacity, and function that accomodate the varying workloads of the different activities of the FMF. Within each combat element, the component systems are vertically integrated in the sense that their capabilities for data capture, manipulation, and retrieval of information flowing from the lowest echelons upward and, in some cases, to the Supporting Establishment are distinct but mutually supportive of the total management needs of the combat element.

The rationale for distributing the component computer systems among the FMF units is based on accomodating the natural workload at a facility internal to the activity where it occurs. That is, the greatest workloads emanate from FMF warehouses and maintenance activities, rather than from command offices. This approach is modified to the minimum degree to accomodate the technology and its ability to match the ADP equipment size, mobility, support requirements, and functional capability to the actual unit where it resides. A summary of the component systems contained in DISACT is contained in Table 11, along with an overview of the system functions that they provide. Additional detail is presented in succeeding subsections.

Table 11

DISACT ADPS IMPLEMENTATION

Component Systems	Hardware Characteristics	System Software Features*	Supported System Functions
 System X	Micro-processor based system Programmable or PROM processor RAM main storage Auxiliary storage Keyboard/display input device Hardcopy output device Telecommunications interface Removable magnetic I/O medium	Control program System utilities Application language processors System diagnostic routines Preprogrammed applications Text handler	Data capture, verification, and editing Simple word and text processing Simple file management of small files Simple information storage and retrieval Numerical calculation Report formatting System self-diagnosis Data communication
 System Y	Mini-processor system--variable configuration Multiprogramming processor hardware Ample main storage Extensive auxiliary storage Multiple keyboard/display input devices Multiple hardcopy printers Telecommunications interface Removable magnetic I/O medium	Operating system for batch & interactive processing Report generator program Preprogrammed applications Query language Rudimentary programming aids Data management package	Foreground/background processing Sophisticated storage and retrieval Data management Report generation Data communication Activity oriented applications
 System Z	Mini-processor based system Programmable processor Multiprogramming processor hardware Sizeable main and auxiliary storage Multiple keyboard/display input devices Multiple hardcopy printers Telecommunications interface Removable magnetic I/O medium	Multiprogramming operating system Compilers for high-level languages Utility program library Diagnostic program package Data management package	Multiprogramming and interactive processing String processing General data base management Interoperability interfaces High speed, high volume data communication

*It is anticipated that many of these features may be implemented in firmware.

B. Distribution of ADP Resources

The distribution of ADP resources in DISACT provides for automated support at the following echelon levels: battalion/squadron/LSU; regiment/group/LSG; division/wing/FSSG; MAGTF commands (MAF, MAB, MAU); and FMF headquarters. Each echelon is equipped with a generic ADP capability that corresponds with the natural information/communication workload associated with various units and commands at that echelon. The nature of those ADP capabilities is described by (1) the ADS capabilities furnished to each echelon, and by (2) the usage constraints of the ADP system configuration at each echelon.

1. ADPS Capability

The DISACT concept attempts to maximize the similarity of ADPS capability at the lowest echelon level at which automation is provided. For example, an infantry battalion, most aviation squadrons, and an LSU detachment are furnished functionally equivalent ADPS resources. That is, these units are assigned the same basic computer system configuration.

At other units and echelon levels, DISACT places the greatest amount of computing power at the nodes of greatest activity. For example, H&MS in a Marine Air Group or the Supply Battalion in the FSSG are nodes of great activity. They are provided with a computer resource having a greater throughput capability than the computer resource provided for the Wing Headquarters or FSSG Headquarters. This action is in response to the heavy logistics information traffic at the H&MS or Supply Battalion--detailed traffic that need not pass through command headquarters.

The result is that the air, ground, and CSS elements embody different system topologies and different system logics in DISACT because the activities in these elements are distributed differently.

a. Battalion/Squadron/LSU Level

This echelon level is DISACT's lowest entry point for the automated flow of information upward to large FMF-oriented systems (e.g., SASSY and MIMMS), or to Supporting Establishment systems (e.g., JUMPS/MMS and MUMMS). ADS support is provided to aid automated reporting and to maintain locally useful files; the underlying concept is one of providing a set of functional capabilities and preprogrammed procedures. The following capabilities are included:

- Select applications (e.g., a Class I ADS update)
- Enter Class I ADS input
- Enter local file data
- Verify and validate data during entry
- Sort, merge, copy, update (modify, create, delete) files
- Perform simple search and retrieval from files
- Invoke preprogrammed I/O formats
- Create, edit, format, output text
- Generate preprogrammed reports
- Execute preprogrammed computational procedures
- Monitor resource status and utilization
- Perform equipment diagnostics
- Transmit, receive files via telecommunications
- Read, write files via removable medium.

b. Regiment/Group/LSG Level

At the regiment level, the system capabilities to be provided by DISACT include, in addition to (or at a significantly higher level of sophistication) those identified for the battalion/squadron/LSU level, the following:

- Perform complex, high volume search and retrieval from files
- Develop complex reports
- Execute high volume report output
- Support multiple users on-line and background batch.

The capability orientation at regiment level is multi-faceted; it provides for summarization and aggregation of lower level information, capability for distributing the data processing burden (to increase efficiency in garrison, and to meet the capacity requirements of combat deployments), and capability for MAGTF configuration flexibility (to match the various MAGTF deployment options with the minimum number of systems and support). While the functional capability is more general and flexible than at the lower level, programming per se, is not emphasized.

At the air group level, DISACT provides functional system capabilities similar to those provided at the regiment, but with significantly greater throughput and storage capabilities capable of handling a large supply and maintenance activity that is a part of the responsibility of H&MS. The functional capability emphasis is changed from that of the regiment, therefore, to meet the needs of the supply warehouses and maintenance shops of the air group. At this level, also, DISACT provides capability for the final editing, error checking, verification, and validation of data emanating from the lower squadron level.

At the LSG level, the Supply and Maintenance Battalions, as well as LSG headquarters, are provided with functional capabilities that exceed those of the regiment in terms of throughput and activity levels. The functional capability emphasis here, like that of the air group, toward the logistics activity that comes to a focus at this level.

c. Division/Wing/FSSG Level

At the division level, the system capabilities to be provided by DISACT include, in addition to (or at a significantly higher level of sophistication) those identified for the regiment level, the following:

- Develop and compile local programs
- Place programs in library
- Call programs from library and execute.

The capability orientation of this level is multi-faceted; it provides capability for the final editing, error checking, verification, and validation of data prior to a system update (e.g., a SASSY update within the FMF or a JUMPS/MMS update in the Supporting Establishment), capability for summarization and aggregation of lower unit information, and capability that embraces the data manipulation necessary to administer the remaining management functions of this level. The functional capability is very general and flexible; in addition, there is a provision for a local programming activity.

At the wing level, DISACT provides functional system capabilities similar to those at division, but with a reduced system capacity, since the greater computing power at the air group level handles the large workloads of the air element.

At the FSSG level, DISACT provides functional system capabilities similar to those at division, but with a reduced system capacity, since the greater computing power at the LSG, Supply Battalion, and Maintenance Battalion handles the large workloads of the CSS element.

d. MAGTF Command Level

At the MAF level, the system capabilities to be provided by DISACT include, in addition to (or at a significantly higher level of sophistication) those identified for the division level, the following:

- Develop and compile complex programs using high level languages
- Utilize external data (compatibility and inter-operability).

These added capabilities do not really represent a separate component system from the one that resides at the division level; rather, the capabilities will be achieved by a different software configuration of the same type of ADPE found at the division. The capability orientation of the system at the MAF level is toward the higher management functions of monitoring performance, readiness, and operations rather than being in a direct data processing linkage (including verification and validation of data) to the Supporting Establishment.

At the MAB and MAU level, the system capability that DISACT provides is the same one that is provided at the wing/FSSG level except that the software configuration is more directed to the management functions mentioned directly above for the MAF--with appropriate allowances for task responsibilities and intensities.

e. FMF Headquarters Level

At this organizational level, the system capabilities to be provided by DISACT primarily embrace those stated for the MAF command level, with some extended capability for simulations, computerized games, and contingency planning and guidance. Also, provision is made for information repositories and historical files embracing the entire purview

of FMFLANT or FMFPAC--with the appropriate interfaces with the Navy and higher military authority.

2. Usage Constraints

The DISACT concept provides ADP equipment and ADS capability to units at several echelon levels in the FMF; that equipment and capability is available to all functional area users (manpower, intelligence, operations, logistics, financial) within the unit. Allocation of those resources to individual users will result from procedures and priorities established at that unit that best integrate the total unit workload. Hence, DISACT provides a users' resource to be applied to any functional area need, rather than a specialized piece of equipment and procedures to satisfy one or two restricted Class I ADS applications.

The usage constraints identified in the paragraphs below pertain to the shared use of physical system elements (displays, keyboards, CPU, telecommunications ports), based on what elements are available at each echelon level. Other usage constraints based on the allocation of machine time to different applications, on the desire for privacy and security of information, and on the freedom (or lack of freedom) for pursuing independent software development are addressed in succeeding subsections that describe the software concept and the flow of management information.

a. Battalion/Squadron/LSU Level

Bounds on system usage at this organizational level include the following:

- The ADP system can perform no more than one activity at any given time
- The ADP system must be centrally located to all users within the unit for shared usage.

b. Regiment/Group/LSG Level

While many activities can be currently underway using the system configuration found at this level, certain restrictions do exist. For the regiment system these include:

- One terminal must be dedicated to each of the following activities for the time the subject activity is underway:
  - Inquiry
  - Data entry
  - Batch file processing (e.g., sort, merge)
  - Batch processing for a report
  - Telecommunication I/O
  - Removable media I/O
  - Maintenance diagnostics
- Of the activities listed immediately above, only inquiry, data entry, batch file processing, and batch processing for a report can be underway simultaneously at more than one terminal. Only one of the others can be underway at any time
- Any combination of the activities that can be underway simultaneously can be concurrently executed, limited only by the number of available terminals
- Concurrent operation of batch processing resources requires that an I/O terminal be dedicated to each activity for the duration of the action
- The report output activity can be concurrently underway on each printer terminal on a system
- Each report output activity must be initiated by an I/O terminal, but once the activity has been initiated that I/O terminal is released.

For the air group and LSG level systems, the activity constraints are the same as for the regiment except that:

- Only inquiry, data entry, and maintenance diagnostics activities require I/O terminals dedicated for the duration of each activity. All other activities need only be initiated from an I/O terminal. Once the activity is initiated the terminal is released.

c. Division/Wing/FSSG Level

The activity constraints at this level are the same as for the regiment level except that:

- Only inquiry, data entry, and maintenance diagnostics activities require I/O terminals dedicated for the duration of each activity. All other activities need only be initiated from an I/O terminal. Once the activity is initiated the terminal is released.

For the wing and FSSG level, the activity constraints are the same as for the regiment system.

d. MAGTF Command Level

The constraints at the MAF level are the same as for the division level. The constraints at the MAB and MAU levels are the same as for the regiment level.

e. FMF Headquarters Level

The constraints at this level are the same as for the division level.

C. Generic Description of ADP Hardware

Table 11 provides an overview of the hardware component systems that together comprise the DISACT system concept. This section provides greater detail and some initial quantification of hardware attributes for the ADP equipment needed to make DISACT a complete system. Both data processing characteristics and the actual physical characteristics are described in the following subsections.

1. ADPE System Components

The hierarchy of component computer systems within the DISACT concept is well defined by the differences in hardware configuration found at each echelon level of the FMF. The levels and their equipment configuration are as follows:

a. Battalion/Squadron/LSU Level

At this level, the ADPE configuration is generically defined to include:

- 1 standard CPU (500 ns cycle time CPU that executes 16 bit operations plus character and string manipulations, with 64-128 Kbyte (8 bit byte) non-volatile main store having a 500 ns access time)
- 1-2 Mbyte mass store
- 1 interactive I/O device (display and keyboard with refresh and edit functions)
- 1 hardcopy printer
- 1 telecommunications device (interface to LFICS)
- 1 device for removable data medium (e.g., cassette tape, tape cartridge, or floppy disk)

This hardware configuration describes the generic System X that is referred to throughout the DISACT description.

b. Regiment/Group/LSG Level

At the regiment level, the ADPE configuration is as follows:

- 1 standard CPU (500 ns cycle time CPU that executes 16 bit operations plus character and string manipulations, with 256-512 Kbyte (8 bit byte) non-volatile main store having a 500 ns access time)
- 4-6 Mbyte mass store

- 3-5 interactive I/O devices (display and keyboard with refresh and edit functions)
- 3-5 hardcopy output devices (terminal associated printers, independent high speed printer, facsimile)
- 1 telecommunications device (interface to LFICS)
- 1 device for removable data medium (e.g., cassette tape, tape cartridge, or floppy disk)
- 1 resident or easily accessible System X.

Except for the residence or easy access to a System X,* this hardware configuration describes the generic System Z that is referenced through the DISACT description. The residence or accessibility of System X is included to accomodate the data entry function at this level with ADPE and software identical to that of the lower echelon. This strategy is believed to decrease software development and maintenance problems that would arise by emulating System X capability in the software of System Z. If System X costs are low enough, it will be economically justified as well.

At the air group and LSG level, the ADPE configuration is very similar to that of generic System Y that is described below for the division level.

c. Division/Wing/FSSG Level

At the division level, the ADPE configuration is generically defined to include:

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*Residence refers to a System X co-located with System Z configuration that supports this level. Easy access refers to the close physical location of another unit that has a System X (e.g., the MWHS will be co-located with Wing headquarters in all environments; hence, Wing headquarters could use the MWHS System X).

- 1 Standard CPU (500 ns cycle time CPU that executes 16 bit operations plus character and string manipulations, with 512-1024 Kbyte (8 bit byte) non-volatile main store having a 500 ns access time)
- 12-16 Mbyte mass store
- Removable mass storage medium (e.g., disk packs, magnetic tape)
- 6-10 interactive I/O devices (display and keyboard with refresh and edit functions)
- 6-10 hardcopy output devices (termial associated printers, independent high speed printers, facsimile)
- 1 telecommunications device (interface to LFICS)
- 1-2 devices for removable data medium (e.g., cassette tape, tape cartridge, floppy disk)
- 1 resident or easily accessible System A.

Except for the last entry, this hardware configuration describes the generic System Y that is referenced throughout the DISACT description. The residence or accessibility of System X is included for the same reasons cited for its inclusion at the regiment level.

At the Wing and FSSG level, the ADPE configuration is very similar to that of generic System Z that was described above for the regiment level.

d. MAGTF Command Level

At the MAF level, the ADPE configuration is generically similar to that found at the division, with expanded mass store and telecommunications resources. At the MAB and MAU levels, the ADPE configuration is generically similar to that found at the regiment level.

e. FMF Headquarters Level

At this level, the ADPE configuration is generically similar to that found at the division level, with expanded mass store and telecommunications resources.

2. ADPE Physical Description

ADPE included in the DISACT concept have the physical characteristics that mark the present generation of hardware: light weight, small volumes, wide environment limits, module packaging, low power requirements, and easy maintenance access. Table 12 identifies the primary weight, cube, and environmental attributes of the component computing systems in DISACT.

D. Software Concept

The very nature of the hierarchy of component systems that differ in size, capacity, and function implies a similar hierarchy of software support and capability. DISACT does, indeed, have a software hierarchy ranging from psuedo-software (hardwired functions) and firmware in the lower capability systems to highly sophisticated operating systems in the higher capability systems. Together these provide for tailored use of equipment at each activity node--with mutually supporting functions as information flows up and down the command chain of each combat element.

1. Component Systems Support

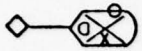
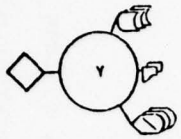
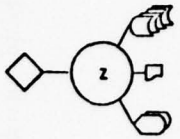
a. Battalion/Squadron/LSU Level

At this level the software support supplied by the DISACT concept to support the System X configuration includes:

- Control program

Table 12

PHYSICAL CHARACTERISTICS OF DISACT ADPE

Component Systems / Characteristics	 System X	 System Y	 System Z
Size and Weight	Volume: (0.5m x 0.5m x 0.2m). Weight: 15 kg.	Volume: CPU & Mass Store (0.6m x 0.6m x 1.5m each). Printer (0.6m x 0.6m x 1.0m). Interactive I/O Device (0.6m x 0.6m x 1.0m). Weight: Less than 360 kg total--less than 120 kg per module.	Volume: Desk size, 0.75m x 0.9m x 1.8m in 3 modules. Weight: Less than 115 kg total--no module greater than 45 kg.
Sheltering	Protective case integral with unit.	Air conditioned van or building.	Normal office environment for long term operation. For short term any shelter offering protection from sun, wind, excessive dust.
Electricity Supply	Line- or generator-supplied alternating current, 200 watt.	Line- or generator-supplied alternating current, 2000 watt.	Line- or generated-supplied alternating current, 1000 watt.
Heat Generation	200 watt.	2000 watt.	1000 watt.
Ambient Air Temperature Tolerance	-30° to 55°C for electronic mechanisms. -10° to 55°C for hardcopy output device and drive for removable output medium.	5° to 30°C.	-30° to 55°C for electronic mechanisms. -10° to 55°C for hardcopy output device and drive for removable output medium.
Humidity Tolerance	0 to 95%.	20 to 80%.	0 to 90%.
Dust and Grit Resistance	Impervious to dust when not in operation. Only hardcopy output device and drive for removable I/O medium are subject to airborne grit during operation.	Requires filtered air for normal operation.	Electronic components essentially impervious to dust. Electro-mechanical mechanisms subject to airborne grit.
Shock and Vibration Resistance	At least equivalent to that of standard field radios.	Suitable for hauling and airlifting when suitably secured and packaged.	Suitable for hauling in standard military trucks.

NOTE: The characteristics shown are representative; they are not specifications.

- Driver programs for the following devices:
  - Display
  - Keyboard
  - Printer
  - Mass store
  - Telecommunication interface
  - Removable storage medium
- Application programs for:
  - Menu selection
  - Inquiry
  - Data entry
  - Batch file operations
  - Report preparation
  - Report output
  - Text editing
  - Numeric calculations
  - Telecommunication
  - Removable storage media
- Maintenance diagnostic routines.

b. Regiment/Group/LSG Level

At the regiment level the software supplied by the DISACT concept to support the System Z configuration includes all those capabilities identified above for System X plus the following extensions or additions:

- On-line multiprogramming operating system
- New applications
  - Enhanced inquiry by high level query capability
  - Report generator
  - Enhanced text editor

At the air group and LSG level, the software supplied by the DISACT concept to support the System Y configuration is similar to that described for the division below.

c. Division/Wing/FSSG Level

At the division level the software supplied by the DISACT concept to support the System Y configuration includes all those capabilities identified above for System Z plus the following extensions or additions:

- New applications
  - Data base management system
  - Macro-language compiler
  - Macro-language debug aids
  - Library maintenance utility

At the Wing and FSSG level, the software supplied by the DISACT concept to support the System Z configuration is similar to that described for the regiment above, plus the following extensions:

- Macro-language compiler
- Macro-language debug aids
- Library maintenance utility.

d. MAGTF Command Level

At the MAF level, the software capability would extend the System Y capability stated above to include:

- New applications
  - High level language compiler
  - High level language debug aids

At the MAB and MAU levels, the software capability is very similar to that described for System Z at the regiment level.

e. EMF Headquarters Level

At this level, the software capability provided by DISACT is very similar to that described above for the MAF command level.

2. Software Development and Maintenance

The approach to software development and maintenance in DISACT is guided by two principles:

(1) Operating units of the FMF, especially at the lower and middle echelons, must not be burdened with development and maintenance activities.

(2) Development and maintenance activities must be responsive to the specific user needs of the FMF elements.

The following development and maintenance arrangements are consistent with these principles, as they might be implemented in DISACT.

a. Basic Operating Software

Basic operating software components, including control programs, operating systems, device driver programs, language processors, diagnostic routines, and file management programs will be supplied by a commercial vendor. Certain general purpose software packages, such as the text editing package, may be supplied by a vendor as well. Vendor support will be responsible for furnishing the software, tailoring it as necessary to the particular needs of the FMF ADS, implementing it on the hardware, and maintaining it through initial operation. Long term maintenance on this class of software will be the responsibility of a commercial contractor for the life of the system.

b. Class I ADS Software

DISACT will embrace the present Class I software presently processed in the FMF (SASSY, MIMMS, MAGFARS, FREDS, MEDS, etc.) in whatever form the conversion process leaves it. DISACT will also embrace software for entry, verification, and validation of Class I data to be processed in

the Supporting Establishment (JUMPS/MMS, MUMMS, FORSTAT, etc.). User protocols for this software must be the same for both FMF and Supporting Establishment ADP systems. Specifications for this software will emanate from functionally oriented CDPA's. Implementation in the FMF will be accomplished by a centralized software development and maintenance activity (FASA concept*) that will support the FMF as part of the DISACT concept.

c. Class I ADS-Related Software

As described above, a portion of the DISACT software exists primarily to handle Class I ADS reporting requirements. However, closely associated software must also exist to satisfy strictly FMF requirements. This reflects the underlying DISACT design principle requiring that data collected for Class I reporting also be available for local use by the collecting unit. Such software would act to extract Class I data from the initial data entry action and build appropriate local unit files (e.g., automated T/O's and T/E's). This class of software will be developed and maintained under the FASA concept.

d. FMF-Wide Applications Software

Some DISACT software may be strictly internal to the FMF ADS for use only by units of the FMF. This class of software will be of a general nature so that its usage would extend throughout the units of the different FMF combat elements. An example might be mountout logistic supplies software. Such software will be developed and maintained under the FASA concept.

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*This centralized software development and maintenance activity is proposed to be included in DISACT under a concept called FMF ADS Support Activity (FASA). A description of the FASA concept is provided in Appendix B, Section 2.

e. Element-Unique Applications Software

Some DISACT software is unique to one of the FMF combat elements (air, ground, CSS), or to all units at a specific echelon level throughout the FMF, or to all FMF units of one specific type. An example might be vehicle (aircraft) maintenance history software. Such software will be developed and maintained under the FASA concept.

f. Unit-Unique Applications Software

Under the DISACT concept individual FMF units (possessing the capability) have the opportunity to create and use software meeting the unique needs of that unit. Examples might be aircrew training and proficiency records, or technical skills inventories. Such software will be developed and maintained by personnel assigned throughout the FMF as part of the regular manning of the component ADP systems. Such personnel are assigned at the regiment/group/LSG level and upward.

E. Communications Concept

DISACT relies upon communication resources to support digital traffic internal and external to the FMF. Digital traffic in DISACT includes both classified and unclassified information. Within the FMF, DISACT incorporates two primary communications concepts. The first is electronic via the LFICS, and the second is physical via the transportation of computer magnetic storage media (floppy disks, cassettes). Transmission between high FMF headquarters and the Supporting Establishment is via AUTODIN or the physical transportation of magnetic storage media. The DISACT philosophy is to make maximum use of telecommunications--when it is available and prudent to do so--while at the same time maintaining a communications capability independent of telecommunications.

DISACT will make use of the secure LFICS telecommunications channels for internodal digital traffic (i.e., between separate computer systems). Intranodal digital traffic (i.e., between terminals and processors) will be hardwired and accomodated as part of the ADPS design. Communications security will be part of the telecommunications system; so DISACT's ADPE will not bear any size/weight/capability burdens to provide communications security--except from point of origin to point of entry into LFICS or AUTODIN.

Physical transportation of digital traffic by a floppy disk or cassette is analogous to the present paper flow within the FMF. The particular media to be transported can be classified and subject to the same procedures that govern the transfer of classified documents now. Translation of digital data to text will be accomplished on classified ADPE at the receiving unit.

Data traffic is, with few exceptions, the same administrative data that is presently reported to the existing Class I Marine Corps ADS. Digital communications will support the reporting requirement for the functional areas of manpower, operations, logistics, and finance. Additionally the intelligence functional area will be supported at echelons below division/wing (where MAGIS operates).

The reporting philosophy underlying DISACT is "exception reporting". Exception reporting to the Class I systems principally involves digital reporting of records of events that would alter a particular system's data base (e.g., the MMS/JUMPS data base). Reporting is characterized by a scheduled batch submission (usually daily) from reporting units up from the battalion/squadron echelon. On this basis, it may be stated that:

- The DISACT concept will not require telecommunication links between nodes other than those already envisioned by the LFICS architecture to support future MTACCS systems

- The transmissions will be batch oriented--with no interactive transfer of data or query of data bases between LFICS nodes (intranodal interactivity between terminals and processor is allowed)

- The majority of data to be transferred will have a precedence commensurate with its administrative (rather than tactical) orientation and its nonperishable nature.

By virtue of the DISACT concept, digital traffic flows (1) predominately upward within the hierarchical structure (with lateral flow toward and away from high activity nodes), and (2) it flows always on a point-to-point basis; that is, a given traffic source directs the bulk of its traffic to the same destination point. A summary of the level of activity estimated to occur on each link for a deployed MAF is contained in the matrix of Table 13, as well as in Appendix C.

F. ADPS Supporting Manpower

1. User Support

DISACT is functionally oriented for use by three stereotype users in the FMF: (1) administrative clerks recording manpower, intelligence, operations, logistics, and financial "events", (2) commanders and their staffs who are responsible for internal management of men, equipment, and information within their respective units, and (3) analysts who oversee the functional area information flow and analysis throughout the FMF chain of command. To use DISACT effectively, data processing backgrounds are not needed by the administrative clerks or commanders and their staffs; data processing backgrounds are required of the analysts.

To accomodate the unsophisticated user, DISACT emphasizes hardware and software transparency. Users interact directly with the computing capability of the various ADPS through a "comfortable" interface (terminal

Table 13

ESTIMATED MAF DIGITAL DATA LINK USE IN DISACT

(Ground and CSS Elements)

	DCS	CAIF	MAF HQ	RADIO BN	COMM BN	MAW HQ	FSSG HQ	DIV HQ	HQ BN	RECON BN	DSG HQ	H&S BN	ENG BN	FAG	TANK BN	AMTRAC BN	ARTY REGT	ARTY BN	INF REGT	INF BN	FSSG HQ	LSG HQ	DET H&S BN	DET MNT BN	DET SUP BN	DET MT BN	DET ENG BN	DET MED BN
DCS	●		L																									
CAIF		●	M																									
MAF HQ	X	M	●	S	S			M													M							
RADIO BN			S	●																								
COMM BN			S		●																							
MAW HQ			L			●	M																					
FSSG HQ			L				●															S						
DIV HQ			L					●	S	S	M			S	S	S	S		S		L							
HQ BN								S	●																			
RECON BN								S		●																		
DSG HQ								M			●	S	S															
H&S BN											S	●																
ENG BN											S		●															
FAG								S						●														
TANK BN								S							●													
AMTRAC BN								S								●												
ARTY REGT								M									●	S										
ARTY BN																	S	●										
INF REGT								M											●	S								
INF BN																			S	●								
FSSG HQ			L																		●	S						
LSG HQ																					M	●	S	S	S	S	S	S
DET H&S BN																					S		●					
DET MNT BN																					S			●				
DET SUP BN																					S				●			
DET MT BN																					S					●		
DET ENG BN																					S						●	
DET MED BN																					S							●

NOTE: (S) Less than 500 Kbytes daily; (M) Between 500-5000 Kbytes daily;
(L) Between 5000-30,000 Kbytes daily; (X) Greater than 30,000 Kbytes daily

Table 13

ESTIMATED MAF DIGITAL DATA LINK USE IN DISACT (Continued)

(Air Element)

	MAW HQ	MWHS	WSG HQ	H&MS SQ	ENG SQ	MTR TR SQ	MACG	H&HS	MWCS	MACS	MASS	LAAM BN	FAAD BTRY	MAG VH	H&MS	HMM	HMH	HML	HMA	VMO	MAG VF/VA	H&MS	VMA	VMFA	VMGR	DET VMAQ	DET VMFP
MAW HQ	●	S	S				S							S							S						
MWHS	S	●																									
WSG HQ	M		●	S	S	S																					
H&MS SQ			S	●																							
ENG SQ			S		●																						
MTR TR SQ			S			●																					
MACG	M						●	S	S	S	S	S	S														
H&HS							S	●																			
MWCS							S		●																		
MACS							S			●																	
MASS							S				●																
LAAM BN							S					●															
FAAD BTRY							S						●														
MAG VH	M													●	S	S	S	S	S	S							
H&MS														M	●												
HMM														S		●											
HMH														S			●										
HML														S				●									
HMA														S					●								
VMO														S						●							
MAG VF/VA	M																				●	S	S	S	S	S	S
H&MS																					M	●					
VMA																					S		●				
VMFA																					S			●			
VMGR																					S				●		
DET VMAQ																					S					●	
DET VMFP																					S						●

or keyboard) through uncomplicated instructions related to the work that they are doing. In this way, the computer becomes a tool that is functionally limited in the same way that hand calculators are functionally limited by the number of keys they provide. Further assistance is provided to the unsophisticated user because the ADS in DISACT is designed to be "friendly", i.e., step-by-step instruction of data input requirements may be provided directly over a keyboard on a terminal display, and this capability is interactive.

The training requirements for the unsophisticated user, therefore, are nominal--ranging from one to no more than two weeks of instruction and hands-on experience. An assumption is, however, made that the user is familiar with the particular job that he is performing; that is, he is a qualified supply clerk or administrative clerk, for example.

The more sophisticated analyst users, naturally, require an appropriate amount of data processing training--including training on the equipment that they use, general training such as a knowledge of programming languages, and so on.

2. Operations and Maintenance Support

The manpower support requirements of DISACT include the necessity of providing personnel having the background and training that is associated with the following ADP job categories:

- Analyst/programmer
- Senior analyst/programmer
- Systems programmer
- Senior systems programmer
- ADPE operator
- ADPE maintenance.

The number and distribution of men having these qualifications among elements of the FMF in DISACT are indicated in Table 14.

Operations and maintenance are facilitated in DISACT by several means. At the lower units especially, the ADP system is such that firmware provides a significant portion of the capability--thus reducing software generation. Equipment diagnostics are included to facilitate the identification of hardware malfunctions. When hardware repairs need to be made, the semi-conductor technology inherent in the DISACT ADPE is susceptible to simple card replacement.

The overall maintenance concept that appears to support DISACT adequately calls for on-site ADPE maintenance at the higher echelon nodes (by module replacement) utilizing spare modules stocked at the node site (with backup spares stocked at the FSSG), and for contact team maintenance for low echelon ADPE (also by module replacement). Module replacement will be assisted by the fault isolation properties of the diagnostic routines that are a part of each component ADP system. Higher level maintenance will have to be supported from an electronics section in the FSSG.

The total manpower requirement to operate and maintain DISACT is estimated to be at least 757 man-years per year. Of this total, the estimated profile of skills required is summarized in the following tabulation:*

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*These numbers are generated by multiplying the representative staffs of Table 14 by the number of component systems in 3 representative MAF's and adding staff for the FASA. This total was then inflated by one-third to account for off-duty time during the year.

Table 14

ORGANIZATIONAL BREAKDOWN OF ADP PERSONNEL IN DISACT

Combat Echelon Breakdown	Representative Staffs per Component System					
	System Programmer (Senior)	System Programmer	Analyst/Programmer (Senior)	Analyst/Programmer	ADPE Operator	ADPE Maintenance
FMF Headquarters	1	1	2	3	5	1
MAGTF Command						
MAF Command	1	1	1	2	3	1
MAB Command	---	---	---	1	3	---
MAU Command	---	---	---	1	3	---
Ground Element						
Division	---	1	1	2	5	1
Regiment	---	---	---	2	3	1
Battalion	---	---	---	---	---	---
Air Element						
Wing	1	2	1	2	3	1
Group*	---	1/1	0/1	2/2	3/5	1/2
Squadron	---	---	---	---	---	---
CSS Element						
FSSG	---	1	1	2	3	---
LSG+	---	1/0	1/0	2/2	5/5	1/1
LSU	---	---	---	---	---	---

Note: These numbers reflect an estimate based on an assumed 1½ to 2 shift level of effort 5 days a week

*MACG staffing/MAG(VH or VF/VA) staffing

+LSG Hq staffing/Supply Bn or Maintenance Bn staffing

Job Category	Man-Years	Percent of Total
Analyst/programmer	168	24%
Senior analyst/programmer	65	9%
Systems programmer	55	8%
Senior systems programmer	17	2%
ADPE operator	352	51%
ADPE maintenance	100	15%

Especially at the lower echelon levels, DISACT is designed to be used by persons without data processing backgrounds. System software and hardware configurations will support this type of operation. There will be, however, a nominal training burden for typical user types--administrative clerks, as well as commanders and their staffs.

G. Operational Capability

1. Environmental Coverage

DISACT provides ADPS support for all FMF elements down to the battalion/squadron/LSU echelon level. This support embraces the major FMF operating environments of garrison, afloat, and ashore--covering the requirements of administrative organization, as well as task organization. Furthermore, the DISACT concept provides for the same equipment to be used in the deployed environments as is used in garrison.

Physically small, mobile ADPS that require little in the way of special environmental controls and supporting resources provide the basis for this capability in DISACT. Because each unit possessing an administrative command capability is provided with ADPS capable of producing the automated support needed by that unit, DISACT has the inherent flexibility to configure a suitable ADPS for every contingency. This includes the capability to configure for different intensities of operation, different

geographic factors, and for different concepts of operation. This applies equally for each of the three combat elements, as well as for the command element.

The ability to operate on ship or deployed ashore is also fostered by the on-the-job training of Marine Corps personnel (on the same equipment and using approximately the same procedures) in the garrison environment. Furthermore, the DISACT concept of sharing common equipment among the functional areas of manpower, intelligence, operations, logistics, and finance means that there will be large group of people capable of providing mutual support.

To demonstrate DISACT's comprehensive coverage of MAGTF configurations in a deployed environment. Figures 12, 13, and 14 show the component system distributions for a representative MAF, MAB, and MAU respectively. Summary totals of component systems are as follows:

MAGTF Configuration	System X	System Y	System Z
MAF	78	11	9
MAB	19	2	4
MAU	7	---	1

The processing activities and constraints attributed to each FMF echelon in the DISACT concept may be summarized in a profile of ADS services that are available to the three combat elements in the environments of garrison, afloat, and ashore. Table 15 describes, by echelon, the ADS services for which the various echelon levels have direct access to ADS services in DISACT. (Direct access is defined here to mean either physical residence of ADPE at that particular echelon, or telecommunication links to non-resident ADPE.)

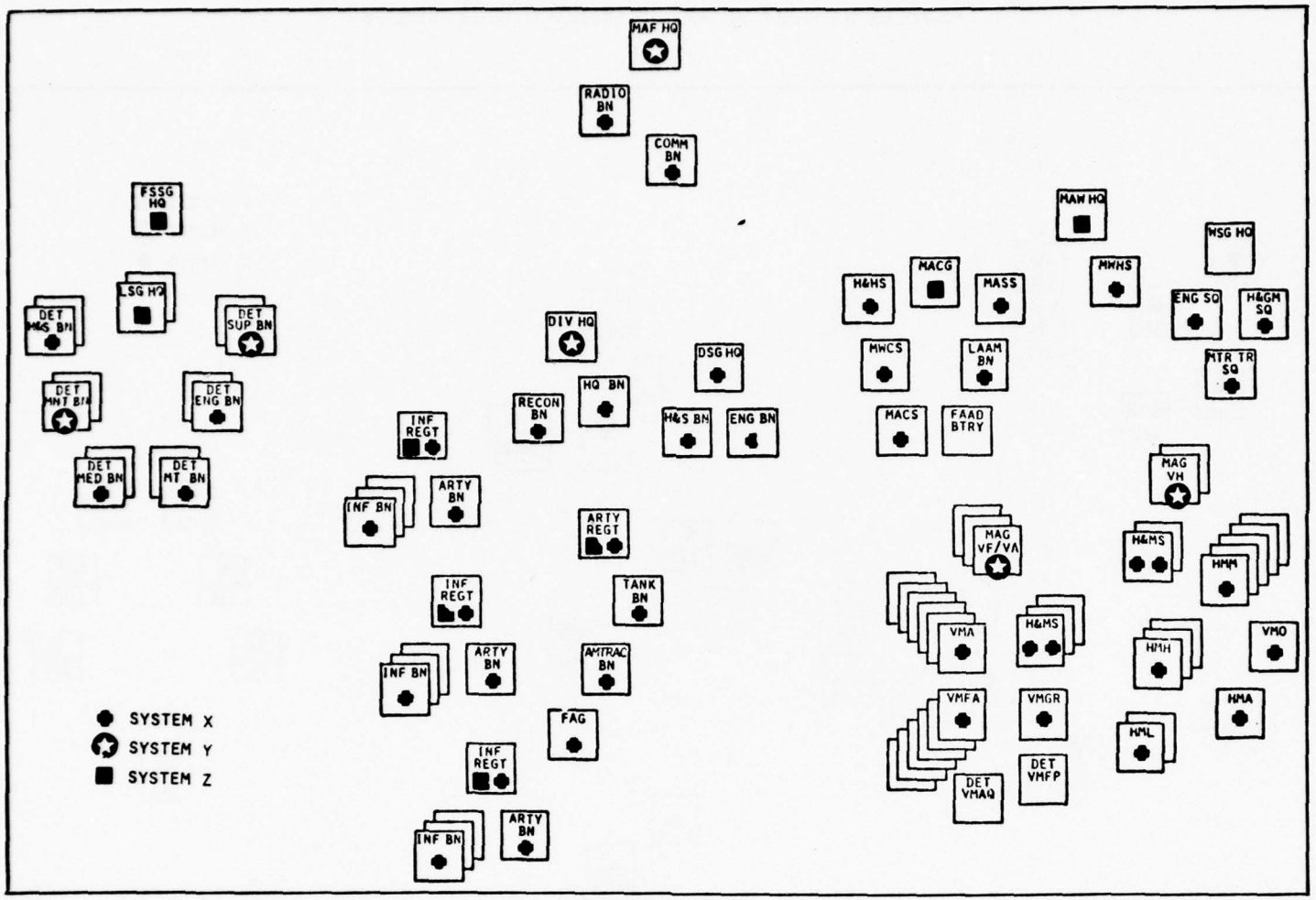


FIGURE 12 MAF DISTRIBUTION OF ADPE IN DISACT

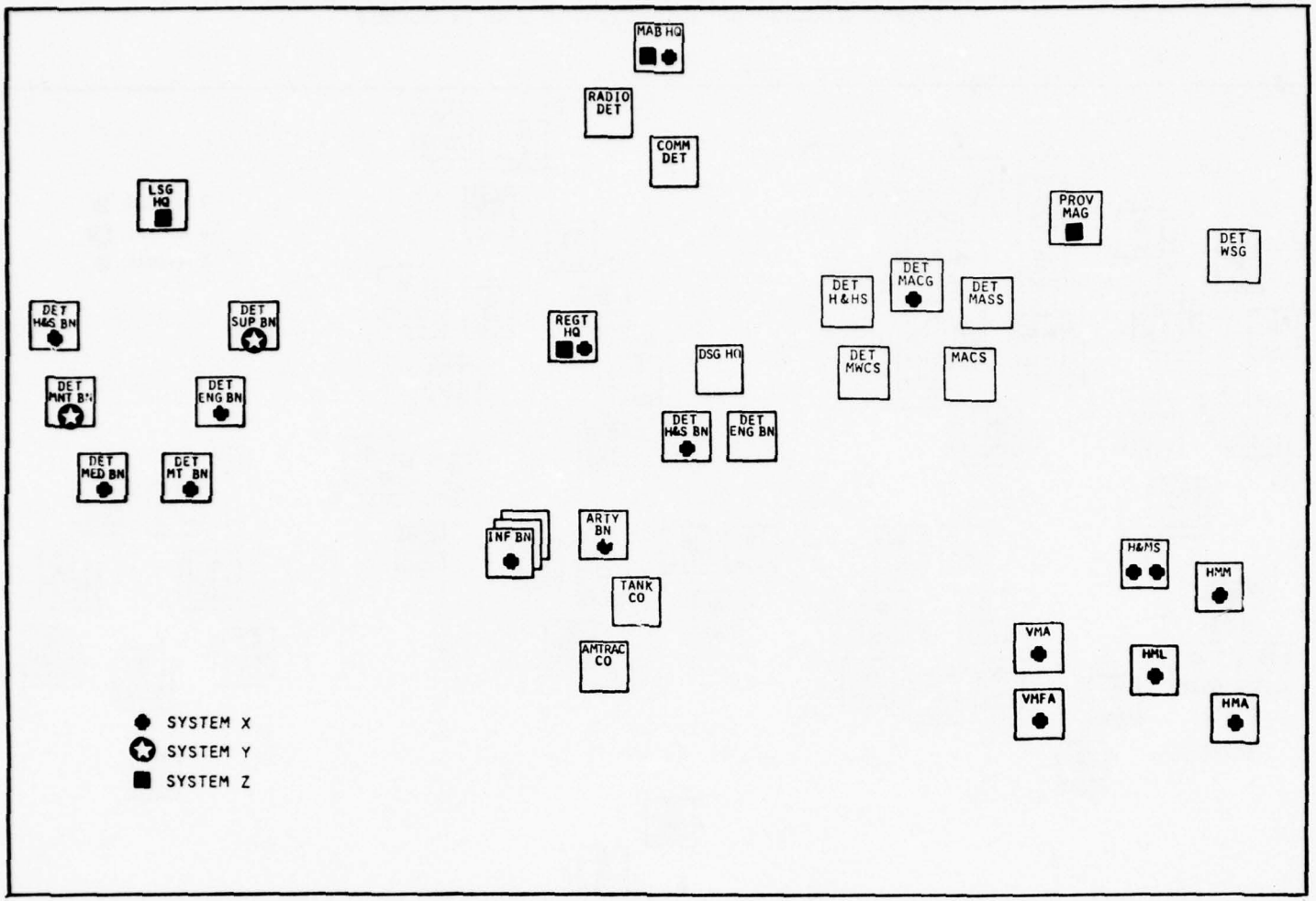


FIGURE 13 MAB DISTRIBUTION OF ADPE IN DISACT

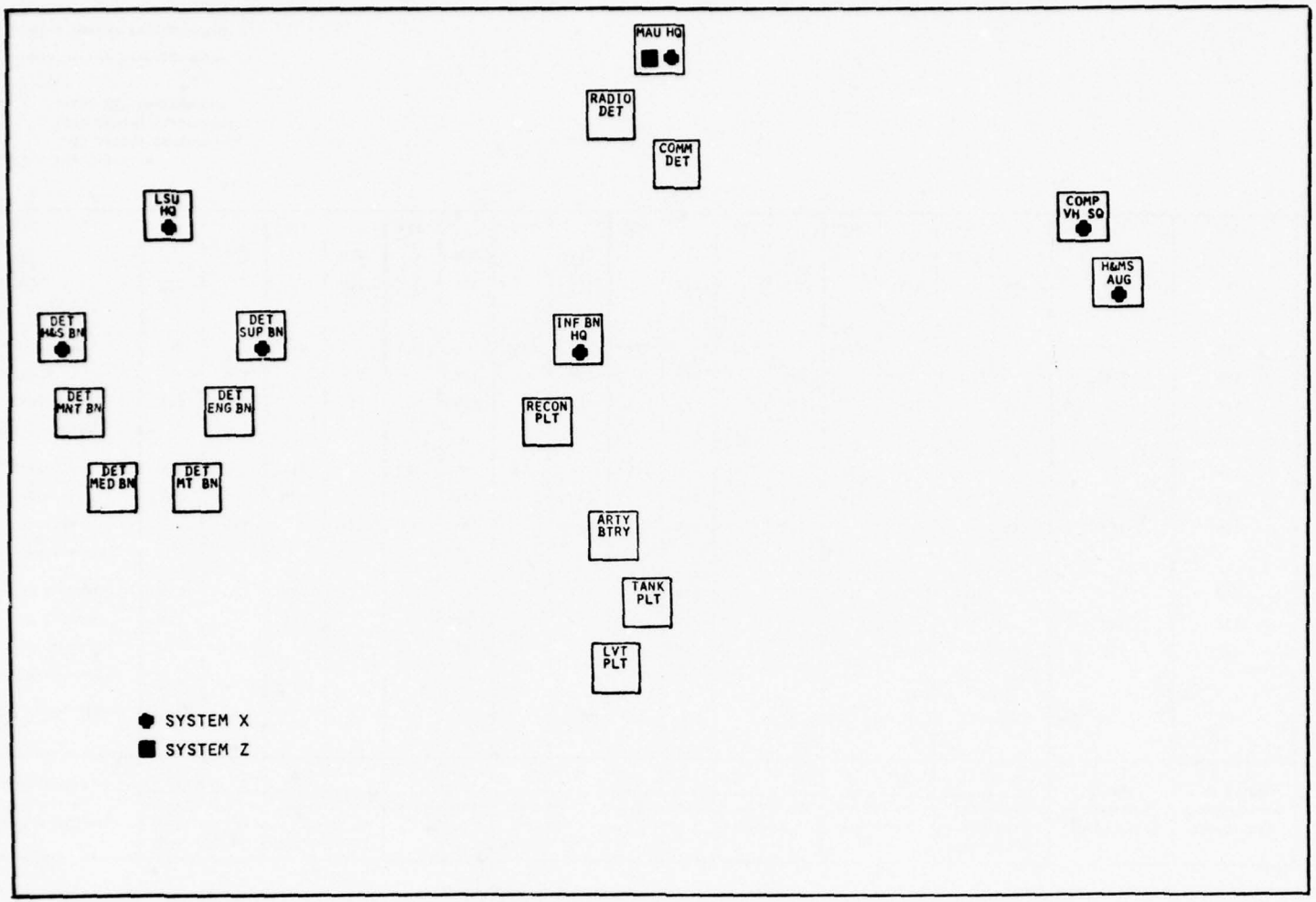


FIGURE 14 MAU DISTRIBUTION OF ADPE IN DISACT

Table 15

SUMMARY OF DIRECT AVAILABILITY OF ADS SERVICES IN DISACT

Combat Element Echelon Breakdown	Data Entry Verification & Validation		Alphanumeric Text Processing		File Management		Information Storage & Retrieval		I/O Formatting		Report Generation		Numerical Calculation		Simulation & Analysis Programming		I/O of Files by Removable Medium	Electronic Transmission of Files
	S*	C+	S	C	S	C	S	C	S	C	S	C	S	C	S	C		
FMF Headquarters		G		G		G		G		G		G		G		G	G	G
MAGTF Command																		
MAF Command		All		All		All		All		All		All		All		All	All	All
MAB Command	All		All			All		All		All		All	All		All		All	All
MAU Command	All		All			All		All		All		All	All		All		All	All
Ground Element																		
Division		All		All		All		All		All		All		All		All	All	All
Regiment	All		All			All		All		All		All	All		All		All	All
Battalion	All		All		All		All		All		All		All		---		All	All
Air Element																		
Wing	All			All		All		All		All		All		All		All	All	All
Group		All		All		All		All		All		All		All	All		All	All
Squadron	All		All		All		All		All		All		All		---		All	All
CSS Element																		
FSSG	All			All		All		All		All		All		All		All	All	All
LSG		All		All		All		All		All		All		All	All		All	All
LSU	All		All		All		All		All		All		All		---		All	All

Note: (G) Garrison
(Af) Afloat Environment
(As) Ashore Environment
(All) All Environment

*Simple and/or Preprogrammed

+Complex and/or Programmable

2. Continuity of ADPS Support

DISACT is designed to serve the transitioning needs of the FMF elements as they go from garrison, to afloat, to combat deployment ashore. That is, the implementation of DISACT is envisioned to provide continuous ADP support as the FMF units mobilize, embark, debark, and set up and conduct combat operations. The basic system capability to do this extends from the modularity and mobility of component systems that provide various sized building blocks of computer power and capacity. These basic building blocks may beaggregated or segregated to the degree necessary to meet the total ADP support requirements of the FMF.

Significant features of the DISACT concept that provide the basis for continuous ADP support within the FMF operating environments and during the transitions among them include:

- The ADPE will belong to individual FMF units; these units will use the same ADPE in garrison, afloat, and ashore.
- Enough ADPE will be procured to support combat deployed MAGTFs, as well as garrison remnants of units that are deployed.
- Equipment commonality among various units of the FMF will allow:
  - Sharing of ADPE to accommodate unit detachments during deployment s and exercises (that is, neighboring unit sharing)
  - Sharing of ADPE in a restricted geographic area (for example, aboard ship) where support constraints (floor space, power, and so on) may be a factor
- Software characteristics will provide flexibility and transportability of FMF ADP applications.

Each point is further expanded below.

DISACT ADPE is mobile and environmentally capable of operations in all three environments. The systems will be carried onboard the ships as the troops embark; they will be operated aboard ship according to the

needs of the units that they support; and they will be debarked as a tool of that same unit for the combat deployment ashore. This is not to suggest, however, that each and every ADPE is expected to operate aboard ship. Shipboard space and power constraints may necessitate the sharing of a few ADP resources by several units on one ship. Because the afloat environment will not generate the ADP activity levels that the combat ashore environment will, the sharing of ADP resources should not unduly constrain ADP support of any unit.

It is evident that the deployed combat environment will generate the greatest ADP activity levels. Since it is imperative that the MAGTFs be supported in this environment, enough ADPE must be procured to meet this requirement, as well as to meet the needs of remnants of units that do not deploy with their parent unit. One aspect of this situation should be provided for in DISACT through the procurement of ADPE for MAGTF command headquarters that are active in garrison, non-combat deployments, or exercises. These systems would not be mothballed for part-time use since such headquarters have a continuing responsibility for planning and contingency development. A first estimate is that 3 MAF systems, 3-4 MAB systems, and 3-4 MAU systems be procured for this reason.

Because there is a considerable replication of ADP component systems of each type in DISACT within the FMF organization, an option also exists to share ADPE in those situations where detachments or administrative attachments separate FMF unit components from the ADP support that would serve them normally. Such sharing is accommodated and fostered by the software that is a part of the DISACT concept. Under that concept, software will have the commonality, flexibility, transportability, and ease of use that will allow each unit to transport its applications and data files to another ADPE of the same type and operate effectively. For example, a particular unit's applications programs and data files may be placed on transportable magnetic media such as cassettes or floppy disks to accompany that unit wherever its responsibilities might take it.

As a recap of the capability of the DISACT concept to provide continuity of ADP support for the various operating environments and MAGTF configurations, the reader's attention is directed to Figures 12 and 13. Figure 12 identifies the total allocation of ADPE that might be expected for the component units of a MAF. Figure 13 identifies portions of the combat elements of the MAF that typically would deploy for a MAB size operation, as well as the ADPE that they would take with them. (Remaining ADPE would stay with the units of the MAF that do not deploy).

A comparison of Figures 12 and 13 indicates that all units (both those that deploy and those that remain in garrison) will have their normal complement of ADPE with two exceptions. One exception is the MAB headquarters which does not appear in the MAF configuration of Figure 12. ADPE capability in this situation would most commonly come from one of the extra systems provided in garrison for MAB planning and exercise deployments, as discussed three paragraphs above. The other exception occurs in all those cases of the MAB configuration where less than a battalion/squadron is deployed. Reference to Figure 13 indicates that this situation occurs for the Radio Battalion detachment, the Communications Battalion detachment, the Tank Company, the Amtrac Company, and so on. In such cases, these unit components would normally be administratively attached to a higher headquarters which have sufficient capability and capacity to share ADPE resources to accommodate the additional workload imposed by the attached units.

H. Management Information Flow and Control

1. Information Flow

The logic of information flow in DISACT is based on satisfying two needs at each echelon, those being:

- Support of the flow of administrative information up the chain of command--in some cases, all the way to the Functional Area Managers in the Supporting Establishment

- Support of the local unit management needs (planning, programming, evaluating, monitoring/inventorying, forecasting, supervising/controlling) in a mix suited to the unique needs of each echelon.

DISACT satisfies the first of these through data capture close to the source through a combination of data capture and data entry. The smooth flow of information up the organization structure is facilitated by placing portions of such capabilities as editing, summarization, aggregation at each echelon so that (1) data links are not clogged by raw data, and (2) the percentage of error traffic relative to the general flow is low.

The means by which DISACT supports the local unit management needs is to copy relevant information as it is collected at that unit or as it passes that unit in the normal flow of information upward. This process may be thought of as making a carbon copy of useful information as this information is initially collected or as it passes by. Since each echelon level is provided with the capability to manipulate and access that data through ADPE locally available, there is no need for locally useful information to be forwarded to a central location to be processed and returned.

The processes of reporting and local use of information are complementary but separable. Figure 15 indicates the nature of this separation within the context of the DISACT concept. Information is kept on local files at each level of the organizational hierarchy as part of the normal reporting process. Figure 15 also highlights the important role that certain activities (primarily supply and maintenance activity nodes such as the Supply and Maintenance Battalions or the H&MS) serve

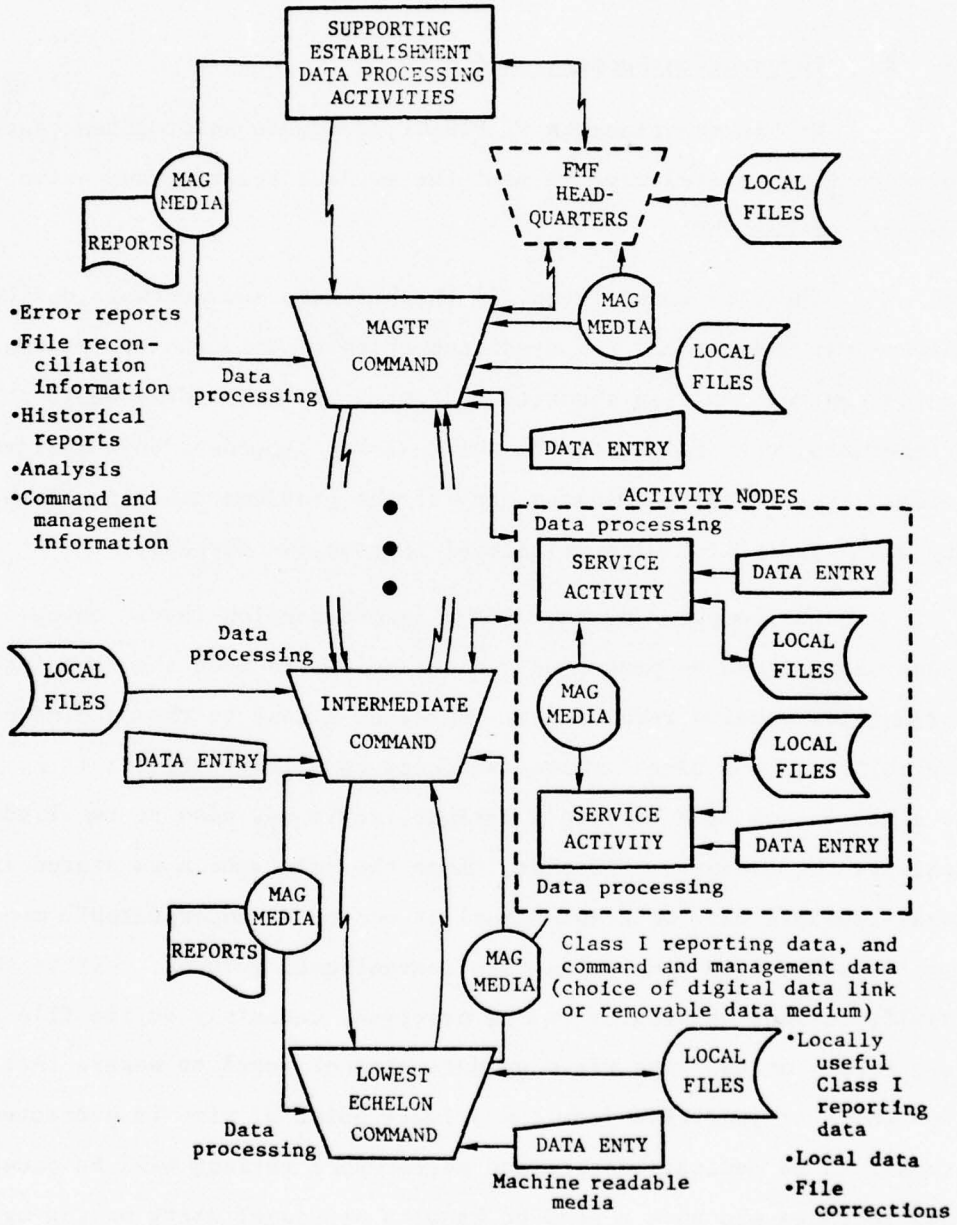


FIGURE 15 MANAGEMENT INFORMATION FLOW IN DISACT

in the DISACT information system concept. By the very nature of the workload, these activities become a focus for information input and usage--close to the source of the actual physical labor.

2. Information Security and Privacy

Within the precepts of DISACT, adequate information control can be exerted in several ways to meet the evident security and privacy concerns of the FMF.

There is every intent in the hardware and software design to assure that the current and predicted state of the art for information access control and file security and integrity be readily achievable. Furthermore, the design itself, which is not dependent on multilevel dynamic interactive access, eliminates many of the problems and much of the complexity often associated with multilevel interactive systems.

The computer system at the lowest echelon level, being a stand-alone device, can be protected and controlled in much the same fashion as current low echelon records are. Physical access to the machine can be controlled in the same fashion as access to filing cabinets is now; just as a key is now used to open a cabinet, so it may also be required to activate the computer. Further, since the information is stored in a non-human-readable form on a non-manual or non-human-interpretable medium, it is less subject to compromise than conventional records. Within the system itself, further safeguards can be provided, certainly at the file level and very likely at the data field or data element level to assure that information which is sensitive from the privacy point of view is protected. Thus, items such as medical history and performance ratings will be accessible only to those who have a need to know; a personnel clerk making up a duty roster, for example, would not have access to pay information.

In the medium and larger scale machines, the same types of physical access controls are valid. In addition, because the capability for on-line interaction with these systems will exist, adequate user log-on, or access, controls must be implemented in system software. These controls will include positive identification of the user and authorization appropriate to the usage profile of that user. Only those files, records, and data elements that the individual, according to his usage profile, is privileged to interrogate, copy, amend, correct, replace or delete, will be accessible to him. Consideration must be given in the design of the system control programs and utilities to maintaining the integrity of the data; these programs themselves must not modify or destroy information. Furthermore, systems at all levels should have full resource utilization logging and analysis capabilities and also capabilities to record resource use and data access together with user identification.

Since one of the basic premises of DISACT is the use of commercially available hardware devices and standard software packages, the integrity of these components should be comparatively easy to ascertain. Indeed one of the requirements for components to be incorporated into DISACT may be that they are certified by DoD or other authorities as to their compliance with security and privacy provisions.

The use of standard packages lessens the need for the Marine Corps to employ a large number of programmers, some of whom may not be fully trained, completely cognizant of hardware and software security principles, or adequately supervised. This eliminates one major potential opportunity for overt and inadvertent breeching of the security and privacy provisions of the system.

With DISACT there will be a requirement (just as there is now and with any system) for comprehensive management control. One can never be free from concern about lapses of personal integrity, the safekeeping

of the information media, and the proper and authorized use of the equipment. Also, there will always be a concern with the appropriateness and accuracy of the data and the knowledge, use, and distribution of the information provided by the system. There is no machine or software system that can replace human judgment and discipline; however, DISACT should augment the exercise of these facilities by making the constraints visible and workable, thereby, enforcing their application.

3. Interoperability

An important aspect of the information flow in DISACT is the necessity for compatibility of information processing methods between the reporting commands of the deployed MAGTF and higher commands. The Marine Corps wears two hats in the operational chain and this causes an additional interface for the reporting process that includes the Fleet Commanders, Joint Task Force Commanders, Joint/Combined Task Force Commanders and CINCs, as well as strictly Marine Corps activities. The requirements for interoperability involve such concerns as reconciling data types and formats, both from a data processing perspective and from a telecommunications perspective. It also involves assuring a means of reconciling differences in ADP among different computer systems.

The DISACT concept addresses the interoperability requirement primarily through software capabilities located at the upper echelons of the FMF organization. (In some extreme cases, additional ADPE and telecommunications equipment may also be required at these levels.) Specifically, capability is assigned in DISACT to the division/wing/FSSG echelon level, as well as to the MAF, MAB, and MAU command elements, to foster the efficient and effective passage (and use) of information up and down the operational chain of command. By placing the interoperability focus of the information flow at the upper commands of the MAGTF, the interface problem can be centralized and minimized. Both the Marine Corps and the Navy information processing systems at lower echelons, therefore, need not be burdened by interoperability concerns with the other Service.

VI ANALYSIS OF ALTERNATIVE ADPS CONCEPTS

This section discusses the benefits and costs of the three alternative ADPS concepts relative to one another. The discussion is primarily qualitative, and it is directed toward the technical and operational aspects of the alternatives. A companion analysis of the fiscal aspects of the development, procurement, and operation of the three alternatives is contained in the life cycle cost (LCC) analysis reported in Volume V of SRI's study report.

The objectives of the comparative analysis of the three alternative ADPS concepts were to: (1) assess each alternative's capability to support the FMF in the 1980s based on FMF command and management requirements and the FMF's operational concept, and (2) identify the relative advantages and disadvantages of the three alternatives from technical and operational viewpoints.

The nature and scope of the analysis was strongly shaped by the fidelity of the concept descriptions. The SRI study team determined early in the study that it was particularly difficult to attempt significant quantification of the analysis, since general concept descriptions rather than rigorous system designs were being examined. Quantitative analysis, therefore, was directed toward the LCC analysis and to certain aspects of the alternative concepts such as the number of personnel required to support the systems and the amount of equipment that would be required to meet the operational considerations.

The qualitative analysis that SRI performed focused upon the investigation of outstanding ADP issues that have plagued FMF ADPS previously, or new issues that could be predicted from the inherent characteristics

of the proposed ADP philosophies and technologies. A "weighted" analysis, evaluating the relative importance of one issue to another, was not attempted.

The results of SRI's analysis are presented in two parts below. The first part contrasts the suitability of DISHIER and DISACT, in general, versus the suitability of BASELINE to serve the FMF in the 1980s. This is appropriate because DISHIER and DISACT share many important characteristics. Both concepts make use of the same basic ADP hardware, software, and operations philosophies. Also, they both incorporate the same advanced base of ADP technology. The second part addresses the significant differences between DISHIER and DISACT in a one-to-one comparison.

A. Comparison of BASELINE with the Alternatives

An overall conclusion that can be drawn regarding the capability of BASELINE relative to DISHIER and DISACT is that BASELINE would not effectively support a broad base of FMF ADP requirements in the 1980s, but that DISHIER and DISACT would (although in somewhat different degrees, as discussed in Part B of this section). That base of requirements includes the following major elements:

- The requirement to provide effective and efficient support to the Marine Corps Class I ADS reporting system.
- The requirement to provide support to the management of manpower and materiel resources at all administrative levels of the FMF down to the battalion/squadron level--including assistance or augmentation of planning, programming, evaluating, forecasting, supervising, and inventorying activities.
- The requirement to provide effective and responsive automated support in all FMF environments and during the transitions among them.
- The requirement to increase FMF readiness and operational effectiveness.

The rationale for this assessment stems from two primary BASELINE weaknesses relative to the two alternatives. The first weakness is the impending obsolesence of the BASELINE ADPE. The second weakness is the relative lack of flexibility of the BASELINE configuration to meet rapidly changing demands, whether they be changing or expanding user requirements, FMF deployment demands, MAGTF reconfiguration demands, or increased workload demands. DISHIER and DISACT, in contrast, enjoy the benefits of 1980 ADP technology, and they have been designed with the requisite flexibility as an objective.

More specifically, DISHIER and DISACT offer considerable advantages over BASELINE across a spectrum of ADP hardware, software, and ADPS operations considerations. These are discussed in the following subsections.

1. ADP Hardware

BASELINE hardware is rapidly approaching its cost-effective lifetime. That fact has considerable significance to the FMF because of the increasing support burdens that obsolesence brings. In particular, the current BASELINE hardware will be less reliable, harder and more expensive to maintain, and more demanding environmentally (in terms of power sources and environmental control) than the equipment in DISHIER or DISACT.

Whereas the BASELINE equipment requires a special shelter with air conditioning, humidity control, and air filtering, much of the ADPE in DISHIER and DISACT will require nothing more special than a normal office environment. The lowest level ADPE, in fact, is envisioned to be capable of operation in the field with little more in the way of support than a cover and power. Physical packaging and advanced solid-state technology make such ADPE extremely rugged relative to their previous counterparts.

One significant aspect of the physical nature of the ADP hardware is the deployability of the ADPS configurations because support of the deployed MAGTFs has the highest priority. BASELINE ADPE is bulkier, heavier, more fragile, and less transportable than ADPE in DISHIER and DISACT. Except for the MAG U-1500 configuration, BASELINE ADPE cannot be operated aboard ship or early during an amphibious landing. If the BASELINE FASC does deploy it takes at least 30 to 60 days to move it, set it up, and check it over. Because of the size of the FASC configuration, it will only deploy to support a MAF-size operation. If the BASELINE FASC does not deploy, there are insufficient telecommunications capabilities in BASELINE to provide effective remote support of the deployed MAGTFs. The end result of this situation is that the MABs and MAUs do not have adequate automated support of their activities.

In contrast, DISHIER and DISACT employ ADPE that can be operated aboard ship, as well as in the amphibious landing area. Equipment is assigned to individual units down to the battalion/squadron level, so that when a unit deploys its ADPE can go with it. The size, weight, and transportability of the ADPE has been taken into account in the DISHIER and DISACT concepts so that it will not decrease the mobility of the unit to which it is assigned. Telecommunications capabilities in DISHIER and DISACT that couple them with LFICS allow these concepts to readily transmit information among the echelons of the FMF, and from the FMF to the Supporting Establishment via AUTODIN.

BASELINE embraces a large centralized aggregation of computing power in the FASCs. The functional scope of this computing power makes the FASCs unsuited to serve the lesser needs of MABs and MAUs, even if the resources could be made available. The result is that the BASELINE hardware is relatively inflexible to different deployment configurations, and cannot easily be expanded or contracted (in terms of modular amounts of computer power) to meet different intensity operations.

DISHIER and DISACT, however, are highly adaptable configurations with three levels of functional system capability, all of which are deployable. In the simplest terms, if an FMF unit of any size is deployed, an ADP system deploys with it, and if the intensity of operations increases more modules of the same equipment can be added or otherwise combined as needed. The number of equipments that might be deployed in support of a MAGTF also inherently supplies redundant and backup capability in case of the loss of availability of particular system components.

Another result of the centralization of the current BASELINE ADPE configuration is that there is little accomodation of real-time inquiry and retrieval through user-oriented interactive terminals. The lack of terminal interfaces means that access to BASELINE computing power almost always requires physical access to the FASC location. Such access is particularly difficult for outlying units. DISHIER and DISACT avert this shortcoming by providing on-line terminals at each ADPS configuration from battalion/squadron up.

The one major advantage that BASELINE provides in the hardware area is that the majority of Marine Corps ADPE (with the exception of the MAG U-1500) is from a single vendor. This fact promotes system compatibility and eases the hardware maintenance burden. It has a positive effect on lessening the number and skill of Marines required to operate and maintain BASELINE. There is no reason, however, why DISHIER and DISACT cannot be acquired from a single vendor/contractor source who will act as system integrator and be responsible for furnishing a system having uniform and coordinated installation, maintenance, and operation requirements.

In summary, the hardware disadvantages in BASELINE relative to the hardware contained in DISHIER and DISACT are several and significant. Obsolesence is the major problem. It is true that several of the points made here concerning BASELINE disadvantages could be lessened by modifica-

tion to the current hardware configuration, but the fact remains that the BASELINE concept of a few large centralized ADPE configurations to support the FMF is less attractive and less capable in meeting the major elements of the FMF information processing requirements than the more distributed configurations of ADPE contained in DISHIER and DISACT.

2. Software

BASELINE software is more oriented toward the management needs and uses of the large Class I ADS developed for high level functional managers than it is toward the management applications of local FMF unit functional users. As a result, ADP services to lower level FMF echelons are constrained or relatively unresponsive in the current BASELINE concept.

The orientation of DISHIER and DISACT software is toward equal satisfaction of the Class I ADS reporting requirement and the management needs of several echelons of FMF units. This orientation is accomplished by an assortment of functional software resources that are matched in capability and sophistication to the unit being supported.

BASELINE software is batch processing oriented; therefore, the ability to have inquiry and retrieval of selected information from BASELINE data bases in a real-time or interactive way is small. Batch programs typically have a turnaround time of about 1 day, and physical proximity of ADP users to the FASC is required. DISHIER and DISACT, in addition to batch processing, provide for on-line user interactions through terminals. This added capability will be provided through functional software resources and language facilities that are very much easier for users to employ than traditional BASELINE computer programming.

Due to the batch operations in BASELINE and the extensive use of punched cards in the FASC, FMF data may undergo several manual transcriptions before it finally updates a computer data base. Furthermore,

such data is typically sent to a central location for visual editing and validation. DISHIER and DISACT provide, by comparison, one-time data capture on machine-readable media through entry at terminals close to the source of the data. In both these alternatives, data entry will be assisted by automated logic and format checks, as well as user prompts and explanatory assistance.

Relative to the DISHIER and DISACT software configurations, BASELINE is judged to have very limited capability for the following software functions important for a variety of resource management activities at the several echelon levels of the FMF:

- Inquiry/retrieval
- Source data entry (data capture, edit, and validation)
- Data base management (including the ability to integrate data bases effectively and efficiently)
- Text handling.

DISHIER and DISACT provide a set of such functional tools at each of the levels of the FMF organization. The sophistication and scope of the tools are matched to the ADP requirement and ADP support capability at each level. At the lowest level, many of these functional tools are envisioned to be provided by firmware for simple and efficient use and control. At the highest level, high level computer languages and sophisticated functional applications packages will provide extensive capabilities for larger data bases and higher volumes of activity.

The orientation of the BASELINE software toward the needs of the large Class I ADS leaves it relatively inflexible to meet the changing demands of local unit commanders and managers in the FMF. In particular, future BASELINE applications software can be expected to be more difficult to develop, maintain, and modify than the software contained in DISHIER and DISACT. Certainly it can be expected to take more time to develop such applications using the BASELINE software.

DISHIER and DISACT, in comparison, are very user oreinted, and their software concept heavily emphasizes user functional capability. This has the inherent advantage of more efficiently involving FMF users in the development of new applications. A substantial portion of the FMF applications in DISHIER and DISACT will be directly implemented by FMF staffs and functional area users who will be working on their own applications with easy-to-understand interactive functions and high level languages.

3. ADPS Operations

Characteristics and consequences of the operational concept of BASELINE are well known and documented. Major deficiencies involve the difficulties in making the reporting process less error prone, and in the synchronization of the various data bases that support or use the central data bases. Another major deficiency is BASELINE's inability to address and satisfy the management support requirements within the various units of the FMF, beginning at the offices of the division/wing/FSSG echelon and extending downward to the battalion/squadron/LSU echelon.

From an ADP operations viewpoint, BASELINE's combination of hardware, software, and procedures does not provide the same capability or ease of use that DISHIER and DISACT do. In particular, BASELINE is unable to support a large body of management-oriented data processing activities performed by low echelon FMF units and by specialized staff offices at higher echelons of the FMF. This body of activities includes planning, programming, evaluating, forecasting, monitoring, inventorying, and supervising functions of command staff, warehouse managers, and maintenance shop managers in the three FMF combat elements.

Because BASELINE does not support such activities effectively, parallel manual data bases must be maintained and information dissemination is slow. Selective, responsive data inquiry, retrieval, modification,

or analysis is difficult in BASELINE. DISHIER and DISACT, however, provide significant ADP capabilities at all echelons down to battalion/squadron/LSU. These include the capability to capture, store, and retrieve information in an automated fashion. These ADP capabilities will effectively support local unit management activities in an efficient, coordinated, and responsive manner.

The Class I ADS reporting operations in BASELINE are marked by slow system updates and by a large number of errors that generate rejection and reprocessing of data entered at the central data bases. In comparison, DISHIER and DISACT promise to improve the reporting process through one-time entry of data on machine-readable media, lower level editing and validation checks, user-oriented data entry assistance, and electronic transmission of digital data. This capability will significantly reduce the number of errors introduced in the reporting process, and it will reduce the number of man-hours spent entering data into the reporting system.

a. Data Base Control

Key aspects of any FMF ADPS are its data bases. To be useful elements in management and decision-making processes, however, these data bases must reasonably represent the real world they purport to typify. Errors in values, lack of timeliness and lack of synchronization (that is, major inconsistencies among elements of the data bases) detract from that usefulness. These failings have many causes. Poorly applied procedures, shortages of resources, and system faults are major ones.

In the BASELINE concept, problems are recognized in correctly capturing data at the time of initial system transcription, in detecting and subsequently correcting in a timely manner the resulting errors, and in propagating changes to the data base located at various nodes of the FMF organization.

The alternative ADPS concepts of DISHIER and DISACT will minimize the magnitude of these problems and their subsequent events through the application of tailored hardware, software, and procedures. Improvement over the BASELINE concept will be substantial even though elimination of all data base control problems is not possible.

(1) BASELINE Experience

The BASELINE system, in terms of data base control, has the following important characteristics:

- Data capture for Class I ADS reporting is typically carried out as a separate, manual adjunct to the maintenance of command and management information records within the FMF units. That is, the reporting system and local unit records are effectively independent in the sense that data of the Class I ADS type entered at the lower echelons is destined for central automated data bases rather than for automated local unit use. The data for the automated data bases may undergo multiple transcriptions from its initial manual recording before it satisfies the format of the main automated data base. The audit trail of the data, therefore, exists in a combination of loosely connected manual records, computer cards, computer generated error reports, and the automated data bases.
- Access control to the automated data base is by procedures. The automated data base protection is accomplished by computerized error checks once the data is in machinable form and it occurs later and typically at a considerable distance from the point of data transcription.
- There is little provision for telecommunications supporting the transfer of digital data, with most communications relying on slower means of information transfer.

(2) Alternative ADPS Concepts

The DISHIER and DISACT concepts differ from the BASELINE concept in several ways that contribute to more effective data base control. The most important of these differences are: distributed processing intelligence at the lower FMF echelons, information access and integrity protection, and machine processable information transfer including telecommunications of digital data.

The DISHIER and DISACT concepts provide processing intelligence at the point of initial data transcription for data checking and validation. At the moment of transcription, errors can be detected and immediately indicated to the user so that the frequency of errors (both of commission and omission) can be reduced. The number of errors in data accepted by the system at the initial entry point can be significantly reduced as a result of this capability. Additionally, an audit trail on the entered data is established at the point of entry in a machine processable form. This allows automated methods to be employed in resolving synchronization problems.

The DISHIER and DISACT concepts provide for reporting to a central data base with retention of as many as three levels of automated files containing Class I ADS information subsets and local unit generated data useful to the FMF echelons. This automation scheme provides for two lower levels of automated information processing and retention than are, in fact, in use with the BASELINE concept (the latter having only a copy listing at the reporting unit, or the unit's own manually generated and analyzed records). This reduces the requirement for main data base access and reduces the complexity of that aspect of data base access control. The lower level automation also significantly increases the responsiveness of the information processing system at the lower levels for retrieving and manipulating data of concern to FMF units locally.

Automation at the successive levels of the FMF organization information processing system also allows the application of information access and protection schemes. The benefit of this capability is that information down to the record level can be written, tagged with respect to its date of entry or some other identifier, and protected from access until a release mechanism is initiated (such as the acknowledgement of data acceptability at the central data base).

The DISHIER and DISACT concepts also provide for manually controlled, machine-processable information transfer among the data bases at the various echelon levels, for information flow both up and down the reporting hierarchy. Both telecommunications and removable recording media (for example, magnetic tape cassettes, or floppy disks) may be used for the information transport. This provides for automated processes to help protect the main data bases from unauthorized access or inadvertent data contamination.

b. Effects of the Alternative Concepts

Because of the improved error checking and validation at several levels within the FMF, together with the use of error checked transmission media, a major source of reporting errors will be removed in DISHIER and DISACT. Timeliness and synchronization will also be improved because once data is accepted at the central data base and acknowledgement of the acceptance is forwarded to all reporting unit systems (to remove any access controls on their use) there will be a completed reconciliation for the cycle that was initiated by the original data entry.

The use of machine processable communication media will foster rapid flow of data between data bases; this too will improve timeliness and synchronization. For the full benefits to accrue, it will be necessary that processing and data transmission not be delayed at any level. In the case of multilevel processing and data bases, as in the

DISHIER and DISACT concepts, each added level can contribute to a loss of timeliness and synchronization. This should mainly be a matter of procedure and scheduling and resource allocation.

If data bases fall out of synchronization (that is, differences persist among data bases), their reconciliation may be more complex, primarily because of the increased number of levels involved in the DISHIER and DISACT concepts, relative to the two levels of the BASELINE. However, DISHIER and DISACT have significantly more automated capability that may be brought to bear on this problem than does BASELINE. DISHIER and DISACT are based on highly mechanized processes that should, in fact, promote rapid reconciliation--copies of files can be readily created, transported, and compared by automated computer processes. Hence, the problem of finding differences in DISHIER and DISACT should be much simpler than in BASELINE, and it will occur much less frequently.

Once a difference is found, it is still a task to determine which data base contains the "correct" information. That process is primarily a procedural one. Once determined, however, correct data re-entry into the entire system should be aided all along the way by the processing intelligence available to check and validate the correction, and by the rapid transmission to all related data bases.

c. ADP Resource in Future Data Base Control

The capabilities ascribed to DISHIER and DISACT in the previous paragraphs arise through application of a tailored set of hardware, software, and procedures that these two alternatives are envisioned to bring to FMF information processing. System configurations in DISHIER and DISACT are a compromise and balance of the technical capabilities that will be available in the computers, telecommunications, and software capable of meeting the FMF information processing and operational objectives, beginning early in the 1980s.

While the exact specification of software resources and applied procedures for implementing DISHIER or DISACT are beyond the scope of this study, it should be clear that an appropriate mix of system capabilities and resources will be available in these concepts to bring satisfactory performance to the data base control process in the FMF. This is not to underestimate the magnitude of the problem facing the FMF reporting process because it is, indeed, complex.

Clearly, the success of DISHIER and DISACT for meeting this complex problem lies in the availability of a set of software resources that can effectively implement FMF-wide data base control as described above. Included in such a set of software must be the following information handling capabilities: an information capture and correction capability, an information management capability, an information query and response system, an information analysis system, a report generation system, and an information access and protection system.

All elements of such a family of software are available today across a range of computer types (including minicomputers), and their unified application in the early 1980 time frame across the range of ADPE described for DISHIER and DISACT seems assured. Together with hardware capabilities and telecommunications that will be available in the near-term, these software resources will support a high level of data base control and timely information transfer. Estimates of the time necessary to achieve synchronization between a deployed MAGTF data base and a CONUS central data base under the DISHIER or DISACT concepts (for a cross-section of potential scenarios) indicates that the synchronization cycle should meet a four to six day requirement believed to be satisfactory for Class I ADS such as JUMPS/MMS.

B. Comparison of DISHIER and DISACT

Although DISHIER and DISACT exhibit many common characteristics, largely due to the fact that they both incorporate the same advanced base of ADP technology, they also exhibit several important differences. The consequences of these differences are apparent in the fiscal and manpower resources that they are forecast to require.

Based on the life cycle cost estimates generated by SRI, DISACT is expected to cost approximately $90 million more than DISHIER over the systems acquisition cycle and a 10 year operating period. The actual figures are $334.3 million for DISACT and $244.8 million for DISHIER (see Volume V of this study report). In parallel with its greater life cycle cost, DISACT is estimated to require approximately 220 more men for ADP operations and maintenance than DISHIER (see Volume IV of this study report).

The basis for the differences in scope betwen the alternative ADPS concepts is contained in the allocation and distribution of computing capability and capacity among the elements of the FMF. This physical manifestation is, however, only the consequence of different approaches to providing ADP services at each command and activity of the FMF. The implementation of such services is, likewise, closely tied to the source, composition, and size of data bases held at the various levels and activities of the FMF. Over all, the effects of these factors distinguish the DISHIER and DISACT concepts with respect to the degree and manner in which they satisfy the FMF reporting and local management requirements.

Concisely stated, DISACT requires more fiscal and manpower resources than DISHIER because its approach provides for more equipment, greater storage capacity, expanded functional capability, wider and more immediate access to automated tools, and greater responsiveness for certain aspects of the information processing activity carried out in the FMF. Exactly how this is envisioned to occur and the rationale behind it are discussed in the following subparts of this section.

1. Computing Capacity

An aggregate representation of the relative computing capacities of DISHIER and DISACT can be constructed by summing several components of the ADPS configurations of these alternatives across the total FMF organization. Table 16 provides such a representation in the form of terminal counts, aggregate auxiliary storage capacity, and required operations and maintenance manpower.

Terminal count is representative of the breadth and depth of organizational coverage by highly responsive computing tools, and it can be associated with the aggregate amount of automated input/output activity that is taking place within the organization. Auxiliary storage capacity is viewed as representative of the size of total data storage that is possible with the system. Operations and maintenance manpower is indicative of the complexity of processing, as well as the amount of computing activity that is taking place within the organization.

Table 16 shows that the totals for the DISACT concept exceed those of the DISHIER concept in all three of these areas. The greatest differences occur at the middle echelon level (regiment/air group/LSG level) where the terminal count and auxiliary storage capacity of DISACT are nearly double that of DISHIER. At this echelon level also, the DISACT concept requires approximately 80% more operations and maintenance personnel. At the lower and upper echelon levels the ADP resources of both alternatives are substantially equal.

The expansion of computing capacity at the middle echelon level in DISACT is attributable primarily to the expanded ADP services that DISACT provides for the combat service support (CSS) element and the air element. It is in these MAGTF elements and at the middle echelon level where the greatest amounts of high volume logistics activity are conducted and coordinated. That is, these are the organized entities responsible for assembling

Table 16

COMPUTING CAPACITY OF ALTERNATIVE ADPS CONCEPTS

Alternative ADPS	Lower Echelon	Middle Echelon	Upper Echelon	Total
DISHIER				
• Terminals	261	108-180	84-140	453-581
• Auxiliary storage	261-522 Mbytes	144-216 Mbytes	168-192 Mbytes	573-930 Mbytes
• Manpower	---	287	224	511
DISACT				
• Terminals	234	225-375	66-110	525-719
• Auxiliary storage	234-468 Mbytes	408-558 Mbytes	120-164 Mbytes	762-1190 Mbytes
• Manpower	---	550	178	728

and applying the majority of supply, maintenance, transportation, and financial information. In contrast, the ADPS configuration for the ground combat element is substantially the same in both ADPS concepts.

A further breakdown of the relative coverage of the various combat elements of the FMF is contained in Table 17. In this breakdown it is readily apparent where ADP resources are applied in DISHIER and DISACT, and in what specific areas DISACT provides an expanded capability. Following subparts describe the functional rationale and data base implementation that form the basis for such differences in the application of ADP resources.

2. ADP Functional Services

The concepts for DISHIER and DISACT provide for different degrees of ADP functional services to meet the information processing responsibilities of the FMF commands and activities. Consistent with the allocation and distribution of ADP resources discussed above, major differences in the provision of ADP functional services between the two alternatives arise at the middle echelon in the CSS and air elements.

A summary overview of the major ADP services provided by each alternative is contained in Table 18. It is shown that the ADP services provided by DISHIER are encompassed and complemented in the DISACT concept (primarily in the logistics support activities carried out in the CSS and air elements) by an expanded set of available services. The effect of these additional capabilities allows for more extensive, efficient, and effective satisfaction in DISACT of several local management responsibilities at major logistics-related activity nodes of the FMF organization.

Whereas the focus of the ADP functional services in DISHIER is directed toward Class I ADS reporting and local unit status monitoring (primarily serving the command staff at each level), the focus of DISACT extends beyond to the automated satisfaction of daily supervision, control,

Table 17

DISTRIBUTION OF ALTERNATIVE CONCEPT ADP RESOURCES

Alternative ADPS	Ground Combat Element			Air Element			CSS Element		
	DIV	REGT	BN	WING	GROUP	SQN	FSSG	LSG	LSU
DISHIER									
• Terminals	18-30	36-60	210	18-36	54-90	132	18-36	18-30	51
• Manpower	36	72	---	36	108	---	36	36	---
DISACT									
• Terminals	18-30	36-60	210	9-15	99-165	132	9-15	90-150	24
• Manpower	36	72	---	30	186	---	21	126	---

Table 18

COMPARISON OF ADP FUNCTIONAL SERVICES

Major DISHIER ADP Services	Major DISACT ADP Services*
• Automated data entry and telecommunications for Class I ADS reporting • Automated data checking • Automated command staff inquiry/retrieval and status monitoring • Automated command staff text handling and hardcopy output • Automated command staff analytic support	• All capabilities ascribed to DISHIER • On-line applications for interactive management (supply, maintenance, transportation) • Automated retention and processing of G-4/S-4, supply, maintenance shop, transport pool historical information • Automated coordination of logistics with other functional areas • Expanded analytic support for G-4/S-4 and logistics managers

*Services listed apply to the logistics area of the CSS and air elements. This area was chosen as an example because the differences between the alternatives are most distinguishable in the logistics arena.

inventorying, and resource allocation problems of the major FMF logistic activity nodes. Such nodes include supply warehouses and distribution points, maintenance shops, and transportation pools. Management of these activities requires interactive, dynamic coordination of men, repair equipment, repair parts, and transportation resources. Such coordination requires up-to-date information and the ability to construct schedules and ascertain priorities. The functional capabilities that DISACT provides assures that automated tools capable of meeting these needs are available close to the source of the workload, so that the ADP system is responsive and well adapted to the needs of its users.

Clearly, the same responsibilities must be met by the FMF if DISHIER were implemented, but they would be met in different ways. Much of the logistics-related management activity would be done manually in the DISHIER concept, as it is today. Other portions might be accumulated at the middle echelon level and forwarded to the upper echelon ADPS configurations which have the capacity and capability to conduct appropriate analysis. This action will reduce responsiveness for the middle echelon user, however.

3. Capacity and Source of Echelon Data Bases

To accomodate the ADP functional services envisioned to be provided at the various FMF echelon levels, data must be collected and stored at each echelon level. Of significant interest, therefore, is the source and size of the data bases that will reside at each echelon under the DISHIER and DISACT concepts. As might be expected from the discussions on functional services and distribution of ADP resources, significant differences exist between DISHIER and DISACT with respect to the automated collection, retention, and use of data in the various elements and units of the FMF organization.

Figure 16 provides an abstract representation of the major data base characteristics that will be found in the DISHIER and DISACT concepts.

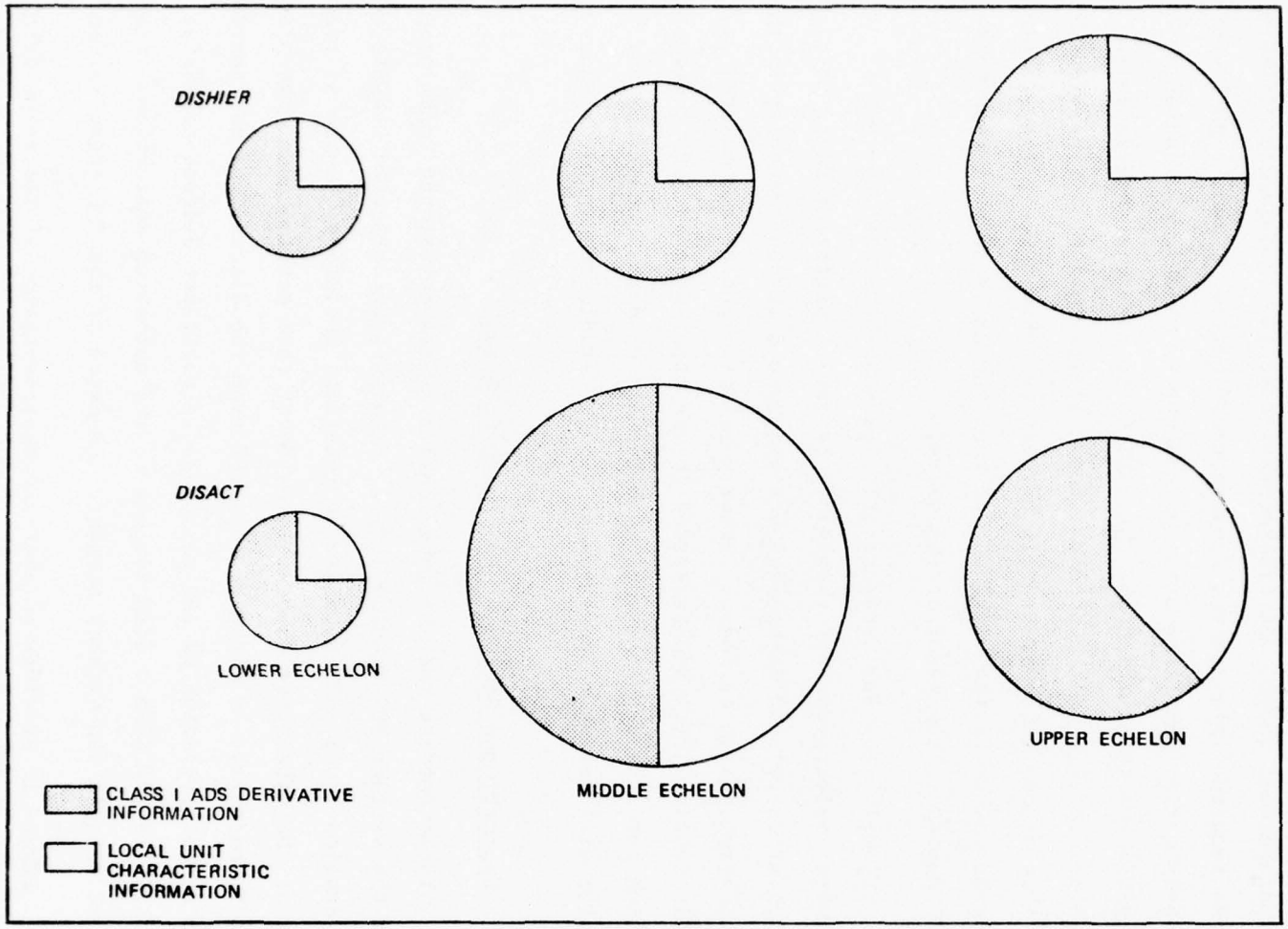


FIGURE 16 CAPACITY AND SOURCE OF ECHELON DATA BASES

In this representation the information contained in each data base is categorized as Class I ADS derivative information or local unit characteristic information. The distinction is important because the Class I ADS derivative information is gathered as a natural part of the reporting function, and the effort necessary to include it in a local unit data base consists primarily of entering it on a local unit computer file before it is forwarded along the reporting chain. Local unit characteristic information, in contrast, is information that is of concern only to the local unit or activity at which it is collected. It is collected in addition to the information collected for the Class I reporting; hence a dedicated effort must be made by the using unit or activity to assemble it for their own purposes.

Addressing the DISHIER data base representation first, it is noted in Figure 1 that the size of the data base stored at each echelon level increases at higher echelon levels. (Data base size is represented by the diameter of the circles at the various echelons in Figure 16.) This result coincides directly with the DISHIER philosophy of a hierarchical concept, where data is collected at the lower echelons and forwarded to succeedingly higher echelons for aggregation and summarization.

Another characteristic of the DISHIER data base implementation is the amount of Class I ADS derivative information stored relative to the amount of local unit characteristic information stored. As shown in Figure 16, the majority of information held at each level of the DISHIER concept is Class I ADS derivative information. This results from the DISHIER emphasis on reporting and status monitoring activities. The sources of information for these two activities are largely the same; hence, they dominate the local unit characteristic information in the DISHIER concept.

Figure 16 also shows that the ratio of Class I ADS derivative information to the local unit characteristic information in DISHIER is

approximately the same at all echelon levels. This is also a direct consequence of the reporting and status monitoring emphasis because in addressing these activities DISHIER replicates several functions at all levels, with the only difference being in degree or detail. For example, data may be entered and initially checked at the lower echelon, aggregated and further checked at the middle echelon, and summarized and checked for the final time at the upper echelon. The focus of each echelon's ADP, therefore, is much the same.

By comparison, the DISACT data base representation in Figure 16 indicates the large expansion of information at the middle echelon due to the increased ADP activity of the logistics-related activities of the CSS and air elements. The capacity for data storage at the lower and upper echelon approximately corresponds to that of DISHIER, however.

Although the amount of Class I ADS derivative information relative to that of the local unit characteristics information in DISACT is roughly analogous to that of DISHIER at the lower echelon level, this is clearly not the case at the middle and upper echelons. In fact, at the middle echelon the Figure 16 representation for DISACT shows a rough equivalence between the amount of Class I ADS derivative information stored versus the amount of local unit characteristic information. The additional local unit characteristic information stored is the source of data for the exercise of the DISACT local management services identified in the preceding subpart of this section.

Whereas the data checking, summarization, and aggregation processes are replicated in DISHIER at each echelon level, the DISACT concept calls for final data checking, summarization, and aggregation to take place at the middle echelon of the CSS and air elements' logistics-related activities. This fact has the consequences of relieving higher echelons of this burden. As a consequence, there can be a more distinct partitioning

of functions in DISACT with a large portion of the upper echelon's resources dedicated to analysis, evaluation, forecasting, and decision aiding rather to data checking and number crunching.

4. Composition of the Data Bases

The previous discussion indicated that the DISACT concept calls for a significant increase in the amount of data stored among FMF units and activities over that which would be stored in the DISHIER concept. Because of the use that will be made of the expanded data bases, the composition of the stored information also differs in the two concepts.

Figure 17 shows an abstract representation of the composition of the data bases at each echelon in the two alternative concepts. For the purposes of this representation, three types of data are defined:

- Historical information--Included in this category are such information as: maintenance histories, consumables usage rates, work-time histories, operations histories and lessons, weapon systems effectiveness, financial transaction histories, past combat activity, and so on.
- Current status information--Included in this category are such information as the types of status information currently reported in the Class I ADS such as JUMPS/MMS, SASSY, MIMMS, 3M, FREDS, MAGFARS, FORSTAT, and so on.
- In-process activity information--Included in this category is such information as: in-process maintenance jobs, status of requisitions, maintenance bench schedules, work assignment schedules, preventative maintenance schedules, in-process operations such as embarkation and debarkation, transportation schedules, and so on.

As shown in Figure 17, a major difference in the DISHIER and DISACT formulations occurs in the amount of historical information and in-process activity information that is collected and stored among elements of the FMF. This difference occurs primarily at the middle and upper echelons where the local unit management functions are expanded in DISACT over those in DISHIER, as discussed previously.

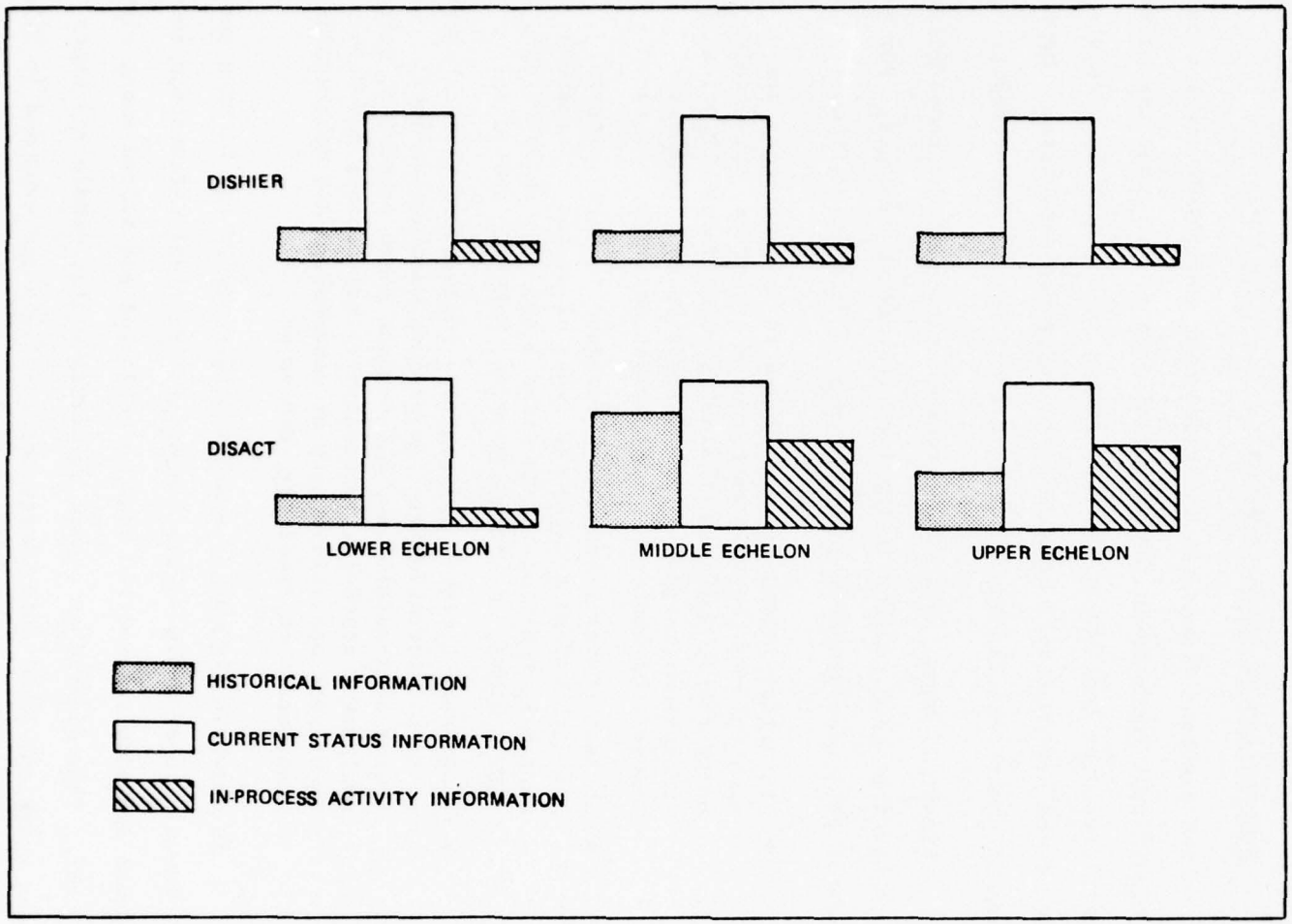


FIGURE 17 COMPOSITION OF ECHELON DATA BASES

By maintaining a substantial amount of historical information, the middle echelon in DISACT, especially, has the capability of consulting that information for evaluation, scheduling, and assignment of current activity. Previous trends can be analyzed and extrapolated for more effective planning and allocation of resources. Likewise, the collection assembly, and on-line retrieval of in-process activity information allows much more responsive management of dynamic FMF environments where changing priorities are intermingled with complex schedules of supply delivery, maintenance activity, and transportation.

At the upper echelon level, the increase in historical information and in-process activity information in DISACT versus that in DISHIER allows for consultation of the data for the exercise of planning and contingency functions. Automated tools in the form of simulations, games, and other decision aiding algorithms are expected to play a larger part in future upper level command and management. Operations of these tools will require somewhat different data input from the information that is currently reported to Class I ADS systems. The upper echelon increase in the historical information and in-process activity information in DISACT reflects that understanding.

5. Summary Contrast

The foregoing discussions comparing DISHIER and DISACT have indicated the extent to which the allocation and distribution of ADPE, the ADP functional service philosophy, and the implementation of data bases differentiate the two concepts. In almost every discussion it has been indicated that the DISACT concept exceeds or expands the capability of the DISHIER concept. One should not get the impression, however, that the DISHIER concept is deficient in a systems sense. DISHIER is, in fact, a complete, balanced, and flexible system. It provides a large jump in automated capability over the current BASELINE system, and the consequences of that jump should be significant in terms of the readiness and productivity of the FMF units.

The scope of DISHIER's ADP is purposely limited to the satisfaction of Class I ADS reporting requirements and to the satisfaction of a limited set of local unit management functions that focus upon and emphasize the monitoring of FMF status. For this, much of the information is derivable from data that is reported to the upper echelons of the FMF and to the Supporting Establishment. The benefit of the DISHIER approach clearly falls in the area of reduced commitment of resources. The lower life cycle cost and manning levels of DISHIER relative to DISACT do, indeed, reflect the intended benefit.

DISACT, in contrast, actively supports the automation of an extensive set of local unit management functions, as well as the automated satisfaction of Class I ADS reporting requirements. One rationale for proposing this approach is that much of the same type of work that DISACT would support by ADP in the FMF environment is being currently supported in an automated fashion by segments of the commercial world, where the motivation is profit. Hence, such capability is thought to be not just nice to have, but rather justifiable on a cost-effective basis that will probably increase through the 1980's. Even so, the initial investment and commitment of personnel to such functions is a tradeoff that has many aspects.

The nature of the FMF information processing requirement is such that the evaluation of any alternative concept must include consideration of that alternative's capability to meet the ADPS functional capability, timeliness, capacity, and availability needs of the FMF units they are designed to support. Support of the separate FMF units includes support of both Class I ADS reporting activity and the local unit management activity.

Figure 18 provides a schematic framework for summarizing the system characteristics and for distinguishing the differences between DISHIER and DISACT. There are four major axes in Figure 3 that represent respectively: (1) increasing ADPS functional capability, (2) timeliness,

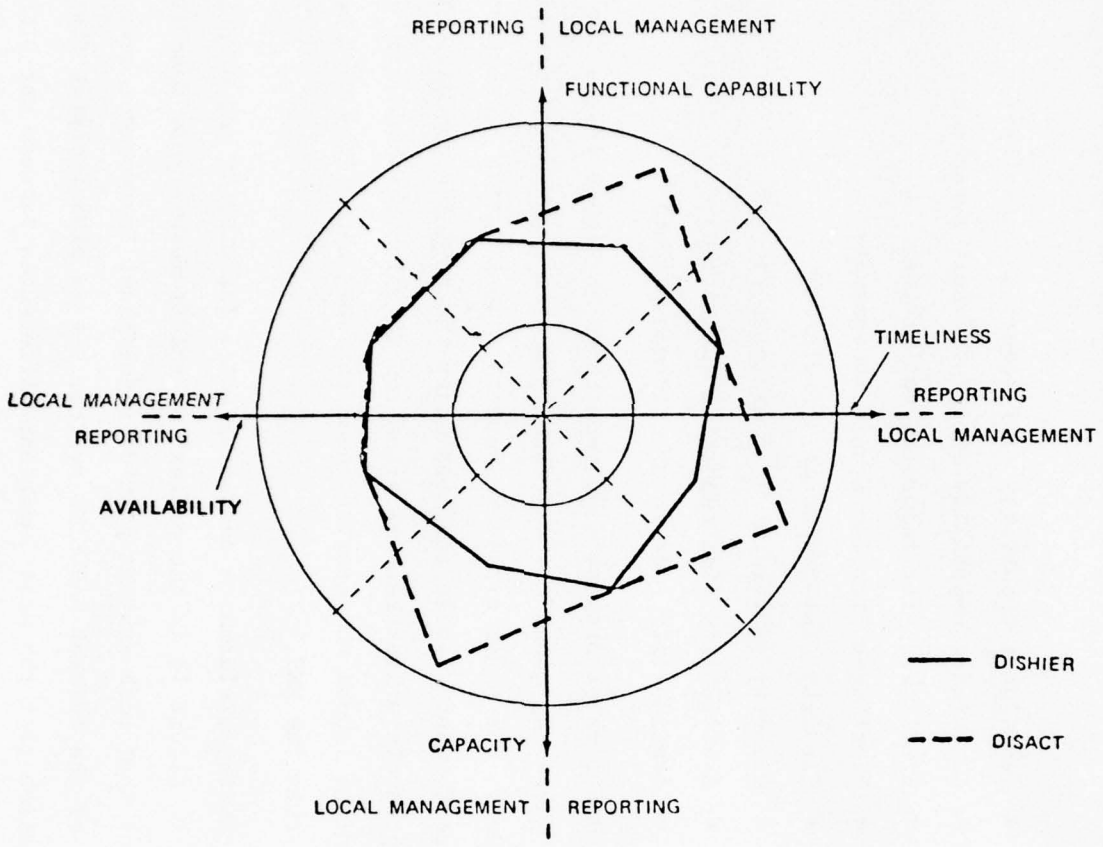


FIGURE 18 OVERVIEW COMPARISON OF DISHIER AND DISACT

(3) capacity, and (4) availability. The quadrants defined by these four axes are further split (by dotted line) to accomodate the inclusion of reporting activity and local unit management considerations. By this means the following major characteristics of the alternatives can be qualitatively compared:

- Functional capability (for reporting activities)
- Functional capability (for local unit management)
- Timeliness (for reporting activities)
- Timeliness (for local unit management)
- Capacity (for reporting activities)
- Capacity (for local unit management)
- Availability (for reporting activities)
- Availability (for local unit management).

Other major artifacts of importance in Figure 18 are the concentric circles. These represent two extremes of system performance relative to the defined axes. The inner circle represents a qualitative indication of the existing performance levels achieved under the BASELINE concept. The outer circle represents a hypothetical situation in which the bounds on resources and technology impose no restriction on the ADPS capability that could be applied within the FMF.

System performance characteristics for DISHIER and DISACT are presented in Figure 18 in the context of the framework just described. It is apparent that both systems provide significant improvement over the capabilities of the current BASELINE system. It is also apparent from that representation that the most important differences between the DISHIER and DISACT concepts occur in the following areas:

- Functional capability (for local unit management)
- Timeliness (for local unit management)
- Capacity (for local unit management).

All system characteristics for the Class I ADS reporting activity are substantially the same since DISHIER and DISACT both employ similar reporting philosophies, procedures, and communications means. Likewise, there appears to be little difference in the availability of ADP service (based on the reliability and maintainability of ADPE) in either the reporting activity or local unit management since the same ADP technology is the basis for both concepts.

The differences in functional capability for local unit management, as identified previously, arise primarily in the logistics-related activities of the CSS and air elements. The additional services that DISACT provides over DISHIER include on-line applications tools for daily management of scheduling, work assignment, and in-process controlling activity. These are services that are important for the local unit command and management of resources, but their degree of detail is such that they have little significance for upward reporting.

The differences in timeliness for local unit management arise from the allocation and distribution of ADPE in the two concepts. The number of equipments and the degree of processing capability in DISHIER, for example, makes it necessary to pass some of the information processing load from lower echelons to higher echelons where the computing capacity is more capable of fulfilling it. The passage of information upward, queues at the higher processing nodes, and the passage of information back to the requesting unit introduces potentially significant time delays. For some applications these delays are too long for the process to be of benefit. In contrast, DISACT provides adequate computing capability at each echelon to accomodate the workload and activity of that echelon close to the source, thus increasing the timeliness of the DISACT system over that of DISHIER.

The differences in capacity for local unit management arise primarily in the capability of the two alternatives to have sufficient

storage for historical and in-process information in addition to the regular status information. DISHIER is limited in this sense; hence, historical data is not as comprehensive, and in-process information is not so extensive as it is in the more unrestricted situation of DISACT.

Appendix A

FMF ADPS SECURITY PERSPECTIVES

Appendix A

FMF ADPS SECURITY PERSPECTIVES

At the forefront of potential obstacles for a FMF organization-wide ADP system for command and management information are the security requirements of the tactical environment. During the course of SRI's FMF ADPS study numerous concerns have been voiced (or conversely discounted) that apply to security of future FMF ADPS. Security questions have arisen most commonly, however, in an ad hoc fashion, based primarily on singular viewpoints of individuals addressing only selected portions of the overall security question.

The purpose of this appendix, therefore, is to state SRI's understanding of the total problem, to identify driving factors, to identify working assumptions, and to relate these factors to the task of addressing the adequacy of alternative ADPS concepts to satisfy the security concerns. The total security problem appears to involve three areas. These areas are:

- Security in the flow of digital command and management information among the units of the FMF
- Physical security of the ADPE and the data bases that reside with them
- Susceptibility of ADPE to compromise due to the electromagnetic radiation that they emit, or to damage (or downtime) due to interference from other emitters within the FMF electronic equipment suite.

Each of these areas of concern are addressed separately in the following sections.

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1. Digital Data Flow for FMF ADPS

Alternative ADPS concepts will require field deployment of terminals, processors, and data storage units--in various combinations. The exact configuration of these elements, as well as the physical residence of data bases and data source nodes within the FMF organization, will dictate the communication system requirements. One aspect of FMF ADPS security therefore involves the security of the means by which the ADS digital data is transferred.

In the alternative ADPS concepts that SRI is investigating, there are two primary means of transferring data available to the FMF. The first means is electronically via the LFICS (or AUTODIN from MAF to points outside the FMF) and the second is via the physical transportation of magnetic storage media (floppy disks, cassettes, etc.). Security during data transfer then assumes either of two levels:

- The security of the electronic link over which digital data is carried when it is transferred by telecommunications
- The security of the physical means of transporting the digital data (special courier, ordinary mail, etc.) when it is manually transferred.

Projected plans call for the Marine Corps to have a secure telecommunications system in LFICS, with the emphasis upon the use of digitized, secure voice channels. AUTODIN provides a secure communication channel. Potential ADPS would also be expected to make use of these secure telecommunications channels to support exchanges of data among computer systems in the ADPS alternative concepts. Encryption, therefore, will be embedded in the telecommunications system, and the ADPE will not bear any size/weight burdens to provide for communications security--except from point of origin to point of entry into LFICS or AUTODIN.

Physical transportation of digital data contained in a floppy disk or cassette is analogous to the present paper flow within the FMF. The

particular disk to be transported can be classified and be subject to the same procedures that govern the transfer of classified documents now. The fact that it will take an ADPE to read the digital data at the receiving unit should be of no consequence with respect to this kind of information transfer. Additionally, this alternative is always available in the alternative ADPS concepts to cover near term deficiencies in secure telecommunications.

Based on these considerations, SRI believes that the physical act of transporting FMF ADS data among FMF units, as proposed in the alternative ADPS concepts, is at least as secure as present methods for exchanging present hard copy or voice/teletypewriter information of like classification. Since the present methods have proven adequately secure, it follows that the ADPS concepts should not be compromised by a lack of security in the flow of information within the FMF organization.

2. Security of ADPE and Resident Data Bases

As mentioned above, alternative ADPS concepts will require field deployment of terminals, processors, and data storage units--in various combinations. Elements so deployed are potentially vulnerable to capture and use by the enemy. Enemy exploitation can extend from simple compromise of the data that may be stored in the ADPE to active use of the ADPE to access other data banks or to disrupt the telecommunications system with which the captured ADPE normally interacts.

The compromise of FMF unit data through capture of an ADPE appears to be a possible event that carries with it no greater risk or significance than if that same unit's field file cabinet were captured. This is to say, in the alternative ADPS concepts that SRI is investigating, a given unit's information base will be approximately the same whether or not an automated system exists. The basic difference will be that the automated information base will be more current and more easily used. SRI believes therefore that

the possible capture a digitized data base at a forward unit is an event that does not warrant exclusion of ADPE at forward sites--certainly, too, the means to destroy that ADPE prior to its capture is well within the means of any FMF unit.

Exploitation by the enemy of captured ADPE is a similar, but not identical, problem of vulnerability that faces the FMF voice communication channels and equipment. The special problems of the ADP equipment tend to aggregate the vulnerability issue--these problems are listed below:

- Communications between terminals and computers, or between computers and computers may involve no human being other than a single operator having a knowledge of the system
- Via remotely located terminals, access is potentially available to critical and sensitive data that may read, added to, or otherwise altered
- Remote computers may be a first line of security against unauthorized access to large data bases, but such computers may themselves be vulnerable (albeit in a restricted sense)
- While data safeguards may be adequate, features to protect system integrity may not be adequate. Via captured terminals or computers, the potential exists to overload portions of the entire system, such that performance is seriously degraded.

The alternative ADPS concepts that SRI has proposed for continued study contain features that lessen the problem of an enemy accessing computer data bases from captured ADPE. First, the alternatives have excluded interactive sharing of computer data bases (i.e., access of one computer to data bases held in another computer simply through an operator request at the first computer); hence, all computer to computer transfer of data files will be a batch transmission process in which standard operating procedures involving at least two humans can govern the request, verification, and subsequent transmission.

Terminal to computer coupling may be interactive, and so the capture of a single terminal may compromise the entire computer based system with

which that captured terminal is an integral component. It is probable, however, that the intranodal terminal to computer coupling in which there is the capability for interactive access to data bases will be hardwired; therefore, the loss of a terminal should not jeopardize an adjacent system of the same type. Knowledge of the capture of a hardwired terminal would also allow that wire to be disconnected and alleviate the access concern. Finally, in the distributed system configurations that SRI is investigating, there is a graduation in the amount of information kept on a deployed ADPE. At the lower levels (e.g., battalion) where capture is a greater possibility, the amount and type of information that may be compromised is of a type that pertains only to a restricted tactical and geographic area.

Again, based on the fact that interactive communication is allowed only on the terminal to computer coupling, the ability of the enemy to exploit a captured terminal to disrupt portions of the telecommunications system is reduced. For this type of concern, in fact, it appears that the introduction of an ADPE at an entry point to the telecommunications system provides the enemy little additional capability to disrupt communications over that he would have if he captured equipments of the telecommunications system itself. Hence this concern should not unduly influence the deployment of ADPE.

3. Emanations Security

Unless appropriate precautions are taken, electromagnetic or acoustic radiations from FMF ADP equipment might result in unauthorized disclosure of classified information. Required precautions against compromising emanations (also referred to as TEMPEST requirements) are addressed below in a qualitative manner.

The Department of the Navy has an established policy regarding the processing of classified information by activities and commands of the

Navy and Marine Corps. This policy, contained in OPNAV INSTRUCTION C5510.93B (Navy Implementation of National Policy on Control of Compromising Emanations for Facilities, Systems, or Equipment Used to Process Classified Information),[1] complies with and implements the National Policy on the Control of Compromising Emanations, as approved by the United States Communications Security Board (USCSB) on 7 October 1970.

OPNAVINST C5510.93B defines specific Navy Department responsibilities and guidelines for control of compromising emanations. It applies to all activities of the Department of the Navy which have responsibilities for the design, procurement, installation, operation, maintenance, or repair of equipment or systems used to process classified information.

a. The TEMPEST Problem

Some electronic systems, such as ADPS, may radiate electromagnetic or acoustic signals which may result in unauthorized disclosure of classified information. There are three primary ways of dealing with the problem: (1) design the hardware so that it does not radiate such signals (above specified, tolerable levels), (2) provide shielding and enclosures that will contain the radiated signals within a secure area, or (3) tolerate the radiation.

The avoidance of processing classified information is excluded from consideration; that is, all systems within the FMF ADPS are expected to process classified information. This is especially true in the deployed environment.

The sequence of events leading to unauthorized disclosure are listed below:

- Classified text, in the clear, is electrically processed in the system, e.g., written on the face of a CRT, input via a keyboard, or output via printer equipment

- These signals are radiated and mingled with other electronic signals (e.g., from communications hardware)
- This intermingled signals plus ambient noise are detected by enemy radio sensors
- The sensed signals are processed by the enemy to:
  - Extract the desired signals from all other signals and from noise
  - Derive data from the desired signals
  - Extract the classified data from the desired data.

The critical parameters for the enemy's extraction of information are the level of the radiation, the distance from the emanating ADPE to the enemy's sensor (since the signal degrades over distance), and the sensitivity and sophistication of the enemy's sensor and signal processing capability.

b. Compromising Emanations Control

Both individual ADPE and entire ADP systems are subject to TEMPEST control. In turn, TEMPEST requirements specifications are set to accomodate the ADP system usage concept and its concept of physical security. Hence, TEMPEST policy addresses control of access to the proximity of the ADPS, as well as control of the emanations themselves. In the economic and pragmatic implementation of TEMPEST policy, tradeoffs arise with respect to equipment design, equipment modification, area control, and ADPS usage that impact TEMPEST resolution.

Amplifying guidance for the resolution of such tradeoffs are contained in OPNAVINST C5510.93B. That guidance states:

> Control measures will be established as necessary to prevent the unauthorized detection of compromising emanations that are unintentionally radiated or conducted from any equipment or system that processes classified information. The control measures applied will be commensurate with the sensitivity and amount of classified information processed and must consider the vulnerability of the information or data processing installation to successful intercept.

a. The preferred method to achieve the control of compromising emanations from ADPE (automatic data processing equipment) is to provide the data processing installation with a control zone sufficient to preclude a successful hostile intercept. In most cases, a control zone of 50 feet will permit the strength of compromising signals from the majority of ADPE to attenuate to nondetectability in the ambient noise level. The chief exceptions to the foregoing are: (1) input/output devices whereby the data are created by the use of a keyboard in which the circuits creating or transferring data operate at high voltage and/or current levels; and (2) cathode ray tube display devices of the type requiring reiterative refreshing of the viewing screen and their associated buffers. These devices, if not modified to restrict radiated or conducted signals, may need a control zone of several hundred feet.

b. A second method used to control compromising emanations from ADPE is by designing or modifying equipment to limit the strength of compromising signals to acceptable limits considering the available control zone. Radiation limit requirements should be considered on a cost effective basis for certain types of equipment when being purchased or leased to process classified information. Incorporation of radiation limits in technical specifications for procurement of ADPE will be accomplished only after review by the COMNAVELECSYSCOM (Commander, Naval Electronic Systems Command). Specifications for the proposed equipment along with pertinent technical background information will be forwarded to COMNAVELECSYSCOM via CNO (OP-009D).

A significant concept expressed in the direction of this guidance is the concept of a control zone. As defined in OPNAVINST 5510.93B, a control zone is:

> The area over which physical security measures are established and enforced sufficiently to prevent clandestine detection and exploitation of compromising emanations. Control zones are defined as follows:
>
> (1) Shore activities. An area under the positive control of a command or activity.
>
> (2) Ships. The ship's hull is considered the control zone under the jurisdiction of the commanding officer.
>
> (3) Aircraft. The "skin" of an aircraft is considered the control zone.

It is the responsibility of the command or activity processing classified information to define the limits and conditions of the control zone, as well as the procedures for assuring its effectiveness.

As stated above, Department of the Navy policy emphasizes the establishment of control zones as a preferred method of TEMPEST control. Other methods are less desirable to various degrees, including shielding for which the following guidance is provided by OPNAVINST 5510.93B:

> Shielded enclosures should be considered only as a last resort when compromising emanations cannot be contained within the control zone. Selection of the particular type of enclosure to be used will depend on environmental security considerations and the type of compromising emanations involved, i.e., electromagnetic, acoustic or both.

Because the matter of compromising emanations is so multi-faceted and interrelated with operational concepts, it is apparent that equipment and systems which process classified information should be planned with TEMPEST suppression considered from the outset. Additionally, to foster long-range economy and standardization, an important objective in the procurement of new ADPE should be to obtain operationally suitable equipment which has been designed to minimize compromising emanations.

By focussing on the design aspects of ADP system acquisitions, considerable cost savings can ac rue. It is estimated that the consideration of TEMPEST suppression in the design of ADPE typically inflates the cost of that equipment by 10-15%, but that retrofit modification of the same equipment were TEMPEST suppression not considered initially can inflate the cost of equipment by upwards to 100%, depending on the particular problem and circumstances of the operational environment.

In addressing TEMPEST concerns in the context of future ADPS development and acquisition, the Marine Corps has the opportunity to use the resources and experience of the TEMPEST Engineering Division, Naval

Electronic Systems Security Engineering Center (Security Station), Department of the Navy for a variety of assistance. This office is available to provide guidance and support related to operational scenario definition, TEMPEST requirements specifications, assistance in formulating RFP specifications, listing of TEMPEST tested ADPE, and assistance in arranging for ADP system tests for TEMPEST suppression.

Appendix B

MANPOWER RESOURCES FOR FMF ADPS

Appendix B

MANPOWER RESOURCES FOR FMF ADPS

1. Current Resources for Future Requirements

The alternative FMF ADPS concepts being generated as part of the SRI study encompass a combination of equipment, personnel, and associated procedures. From a total system viewpoint, the contributions from each of these components must be matched and be made internally consistent to provide the most effective and efficient information system capability. Where constraints exist for any separate component, capability must be provided from other areas, or performance expectations must be lowered.

From the onset of the study, the manpower resource constraint facing the Marine Corps in general, and the FMF in particular, has been very evident. The constraint extends both to the number of people who can be dedicated to ADP functions, and to the skill level that such people will possess. SRI's concepts for ADPE and ADS procedures have attempted to alleviate the effect of such constraints through means that make usage of the equipments easy for non-ADP oriented people at the lowest levels, that make electronic maintenance and environmental support non-burdensome, and that match software capabilities directly to the user's needs.

These actions have somewhat reduced the manpower resource requirements, but significant personnel commitments must still be made. These commitments will be derived in large extent from the pool of ADP-oriented people now serving the FMF under the current limited automation system. To determine the characteristics and magnitude of this resource, SRI analyzed the present Tables of Organization (T/O's) of the FMF (T/O 9990 and T/O 9101 from the Table of Manpower Requirements dated 29 October 1976).

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Within the current FMF organizational structure, there appear to be approximately 862 T/O billets for dedicated ADP personnel (i.e., primarily MOS Field 40). A breakdown of those billets is contained in Table B-1, along with the current distribution of these people in the ground and air sectors. This pool of manpower resources provides a directly transferable resource to the support of the 1980 FMF ADPS alternatives that SRI investigated. To determine the closeness of the fit between the existing skill pool and those manning categories needed by the 1980 FMF ADPS, SRI attempted to map current FMF MOS billets into anticipated job prototypes that will support 1980 FMF ADS.

SRI envisions that the following job prototypes* will be required to support 1980 FMF ADS:

- Analyst/programmer--Occupational skill that provides programming development and support for application software that is unique to local user needs, and that is intended to be used only at a particular site--medium and high capability computer systems only
- Senior analyst/programmer--Occupational skill that extends beyond the skill of the high capability computer systems' analyst/programmer to include expert knowledge of at least one functional area (manpower, logistics, operations, finance)--MAF level or higher
- Systems programmer--Occupational skill that provides program maintenance and support for other applications software--medium and high capability computer systems only
- Senior systems programmer--Occupational skill that extends beyond the skill of the high capability computer systems' systems programmer to include expert knowledge of operating system software and macro- or high-level languages used in supported units--MAF level or higher

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*The training requirements for these job prototypes are described in Appendix A of Volume V.

Table B-1

CURRENT FMF DATA SYSTEMS MANPOWER SUMMARY*

Military Occupational Specialty (MOS)	Number of Billets		
	FMF Ground	FMF Air	FMF Total
Officers:			
3060 Aviation Supply Officer	---	24	24
4002 Data Systems Officer	38	3	41
4006 Data Systems Operations Officer	10	---	10
4010 Data Systems Software Officer	9	---	9
9648 Management, Data Systems Officer	6	---	6
Enlisted:			
3073 UNIVAC 1500 Logistics Computer Operator	---	64	64
4016 Data Processing Equipment Operator	121	88	209
4034 Computer Operator IBM S/360	230	---	230
4038 Data Control Coordinator	48	---	48
4044 Operator/Programmer, UNIVAC 1500	---	32	32
4063 Programmer, COBOL, IBM S/360	117	---	117
4065 Programmer, ALC IBM S/360	1	---	1
4069 Systems Programmer IBM S/360	36	---	36
5982 Digital Data Systems Technician--U1500	---	35	35
Totals	616	246	862

*Based on T/O billet requirements. Onboard strength levels for the FMF in August 1977 were approximately 650 men from these MOS categories.

- ADPE operator--Occupational skill that provides for system operation, such as library maintenance, job scheduling, I/O handling, system startup and shutdown, system restart, and fault reporting--medium and high capability computer systems only
- ADPE maintenance man--Occupational skill that provides repair service for system hardware faults, and performs preventative maintenance on mechanical elements such as printers or rotating storage devices--medium and high capability computer systems only.

Table B-2 correlates current MOS populations from the FMF with the job prototypes just described. While SRI understands that the correlations in every case are not exact, they are indicative of current T/O manpower capability resources that are potentially transferable to the future FMF ADPS, or that involve similar levels of training.

In addition to the MOS's identified in Table B-2, it appears that non-Occupational Field 40 personnel--including some of those involved in supply, finance/accounting, administration, and analysis--may also be considered for one or more of the future ADS job prototypes. This is not to suggest that data systems billets be increased; rather, it recognizes a potential skill pool that could be used to fill the quota of future data systems billets.

The MOS categories that are presented as candidates for ADPE maintenance have not previously been identified by title. They are:

MOS	Title
2805	Telecommunications maintenance officer
2822	Electronic switching equipment technician
2827	Mobile data terminal technician
5982	Digital data systems technician--UNIVAC 1500
5994	Tactical data systems maintenance chief

Future FMF ADPS appear to have the option of sharing some of these billets, or at least sharing some of the basic training resources that will be common to these occupational specialties.

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Table B-2

TRANSFERABILITY OF CURRENT MOS's TO FUTURE FMF ADS

Job Prototypes for Future FMF ADS	Current MOS Candidates	FMF T/O Totals
Analyst/programmer	4002 (O)	40
	4006 (O)	10
	3073 (E)	64*
	4044 (E)	32*
	4063 (E)	117
Senior analyst/programmer	9648 (O)	4*
	4044 (E)	32*
	4063 (E)	117
	4065 (E)	1
Systems programmer	4010 (O)	9*
	4069 (E)	36
Senior systems programmer	4010 (O)	9*
	4069 (E)	36
ADPE operator	4016 (E)	209
	4034 (E)	230
	4038 (E)	48
ADPE maintenance	2805 (O)	52
	2822 (E)	16
	2827 (E)	26
	5982 (E)	35
	5994 (E)	10

Note: (O) Officer MOS
(E) Enlisted MOS

*Number to be shared with another job prototype

Additionally, the terminal users responsible for the largest share of data entry are not expected to be extensively educated in ADP systems. Rather, they will be oriented in one to two week courses on the particular ADPE that they will operate in the context of their particular job. The pool of people available to fulfill this function include:

MOS	Title	FMF Totals
0121 (E)	Personnel clerk	329
0131 (E)	Unit diary clerk	388
0151 (E)	Administrative clerk	1168
3451 (E)	Accounting clerk	36
4111 (E)	Bookkeeper, non-appropriated funds	14

Commanders and their staffs (S-1, S-2, S-3, S-4) are also envisioned to interact easily with portions of the ADP systems that will allow them to enter and extract information and reports of interest to them. This capability can also be gained from nominal one to two week courses and machine orientation.

Based on these analyses, it appears that the following totals are realizable for manning of 1980 FMF ADS from the current data systems capability residing within the FMF:

Job Prototype	Number of Personnel
Analyst/programmer	201
Senior analyst/programmer	94
Systems programmer	23
Senior systems programmer	22
ADPE operator	487
ADPE maintenance	35+

These numbers were arrived at using the information contained in Table B-2. In the cases where certain current MOS populations are shared by future job prototypes the MOS populations have been equally split between the job prototypes.

These totals, then, become the basic statement of the manpower resource constraints for future FMF ADPS. Each alternative concept must address its manning levels with attention to these resources.

2. Centralized Software Development Support

a. Functional Requirement

The integration of system hardware, software, system design, and user procedures for future FMF systems will be quite different from the approach currently being used to support Marine Corps computing activities. Even though the current software support approach will evolve to accommodate a new system environment in the Supporting Establishment (brought about by hardware changes), this evolution will not likely possess the necessary attributes for the support environment required by the future FMF ADPS.

In order to evaluate the desirability of alternative approaches to software support of ADPS in the FMF it is important to understand what software is required and the environment in which it is utilized. While it is possible that the software entities in the FMF could be nearly identical to those used on Supporting Establishment equipment, this cannot be counted on due to differences in the chronology of the various updates, acquisitions, and consolidations taking place in the Supporting Establishment.

The primary software entity required in an FMF ADPS is the control or operating system. In both DISHIER and DISACT, this software facility would be functionally similar across the computer system architectures of the three echelon levels. On the smaller computer systems the operating system would merely offer a subset of the functions, and support a smaller number of peripherals, than the operating system of the larger systems. It is quite likely that in the stand-alone devices at

the lowest level of the computer system hierarchy the operating system will be implemented in firmware (for example, ROM or PROM).

The rest of the basic software facilities which will reside in the FMF ADPS would be members of a family of packages constituting a highly integrated Information Handling System. The components of this system will consist of an Information Capture and Correction subsystem; an Information Management subsystem; an Information Query and Response subsystem; and an Information Analysis and Report Generation subsystem. This particular family of software systems will be an integral part of the initial system acquisition and must be supported throughout the ADPS life cycle by the system supplier. That is, modifications, additions, and error corrections must be furnished by the supplier on an ongoing basis so as to allow easy incorporation into the FMF ADPS. In connection with this family of basic software, the major activity falling on the Marine Corps will be the administering of some aspects of software maintenance rather than dealing in the technical complexities of software design, modification, and integration.

For certain applications in some elements of the FMF additional general purpose software packages will be required. These will be maintained in the more traditional manner and their utilization will require dedicated support by an analyst/programmer staff well acquainted with the requirements of the FMF as well as the particular functional area involved.

It is assumed that future ADPS development in the Marine Corps will be developed in the spirit of the ADSM, or revisions thereof, whereby the system sponsor and the development team will proceed through the systems development cycle in a logical manner for all Class I systems. This will result at some point in time in a detailed set of systems specifications which must then be implemented on operational computer facilities of both the Supporting Establishment and the FMF. This activity will require personnel who are proficient in accomplishing this implementation on the various computer systems.

In the current mode of operation, much of the design and development activities for Class I systems fall within the cognizance of one of the CDPA's. There is an area of system requirement (FMF support) not now being met which does not clearly fall in the purview of any of the established CDPA's. The current activities of the CDPA's are designed to support a relatively fixed set of users with well established ADP requirements and cyclic, regular work cycles in a non-changing operational environment. With the advent of the new ADPS in the FMF, there will exist a large body of users--literally hundreds over a large geographic area--with dozens of individual computer systems that must support garrison, afloat, and combat ashore operations whose capability and response requirements must be established and validated by future FMF users. The proper support of this user community dictates a dedicated supporting activity that is flexible and, above all, totally familiar with the FMF needs and desires.

It is clear that just as there is a requirement to have dedicated staffs for fiscal, manpower, and logistical management concerns, there is a similar requirement for a dedicated staff to support the information system needs of the FMF's operational activities.

b. The FASA Concept

SRI judges that initial implementation and long term support of future software systems in the FMF can best be accomplished by a team of specialists dedicated to the support of FMF users. Therefore, SRI proposes that an FMF ADPS Support Activity (FASA) be included as part of each alternative ADPS concept. The FASA will be composed of a software development facility, as well as a team of specialists. The FASA team would have the full responsibility for the maintenance of all hardware-unique or FMF-internal software of the FMF. They would receive the detailed system or program specifications for Class I systems from the responsible CDPA or ADS development team as required by the ADSM and

implement these specifications in the FMF environment on the FMF equipments. Further, this staff would be responsible for defining and specifying all FMF automated information needs which are intrinsic (organic) to FMF operational requirements and interoperational objectives. These needs can translate to a potentially large body of local unit management services and applications.

The initial conversion and transition from the current ADPS to that of a new FMF ADPS, is a separate, unique, and one-time problem that should be considered independently; however, the inclusion of the FASA team in this initial transition activity would have beneficial consequences.

As already indicated, for the long term, there are several support roles for which the FASA team should be responsible. A major role is the support of the Class I data capture and reporting activities. The initial development or translation, and implementation of these requirements would be the products of the initial conversion effort. The subsequent maintenance modifications to these requirements would normally be translated to program specifications by the responsible CDPA for use in the Supporting Establishment. These same program specifications would be translated and implemented in software by the FASA for use in the FMF hardware environment. This approach alleviates the necessity for any Supporting Establishment CDPA to become proficient in use of the FMF computers and operating systems and it allows the FASA--an activity more attuned to FMF problems--to produce a more effective software product.

As time passes, evolutionary changes in the Class I requirements will impact on the ancillary analyses by users of this Class I data in the FMF environment. These impacts can best be determined by the FASA, and the FMF ADS modified accordingly.

Another class of software to be maintained by the FASA is the intra-FMF service programs where a particular requirement exists across

all elements of the FMF (air, ground, CSS), or where a unique requirement exists in all echelons of a particular element. Examples include a combat training data base, a deployable warehouse inventory and control system, or a maintenance shop scheduling and assignment system. These systems would be developed and maintained totally by the FASA for FMF users. While considerable benefit would be gained from working with functional manager personnel proficient in these areas, it is unrealistic to expect a functionally oriented CDPA team to provide well adapted systems for the FMF operations environment.

It should be noted that the class of software just described is one area where pre-existing (canned) systems developed by vendors might be an advantageous and cost-effective solution to some requirements. These systems could be adopted or adapted in the FASA framework in a very satisfactory manner.

A third area of responsibility for the FASA team is in support of the specific analysis requirements of the upper level echelons of the FMF. Since the satisfaction of these requirements is based on the output of the FMF hierarchy of software, the effective implementation of this analyses will be dependent on a thorough understanding of the software hierarchy as it is operated in the different FMF environments. The problems associated with deployment will have significant impact on the approach to system design that will guarantee the high level commander a current and accurate data base on which to base decisions.

Finally, one of the most significant activities of this team will be the coordination of local analysis and development efforts. Since the opportunity and necessity exist for local solutions to local problems, an activity that is cognizant of these developments is necessary to assure that the widest distribution and knowledge is made of available problem solutions. Since the FASA is defined as being user oriented, it is expected to be in direct and continuous contact with all level of operations

in FMF ADS. This will allow the FASA team to be readily available to gather and provide information on system requirements, design, development, implementation, and existing solutions at all levels in every element of the FMF. A summary of the FASA responsibilities and interface with Supporting Establishment CDPA's is shown in Figure B-1.

c. Resources Requirements

The FASA concept includes a software development facility consisting of ADPE, software development tools, administrative support for specification and user documentation, and a team of specialists. By the very nature of the character of FASA, it is desirable to locate the facility and specialists both physically and operationally close to the FMF. There appear to be several options--a few of which include:

- Locating the FASA within the FMF at one site
- Locating the FASA within the FMF at two sites (e.g., (e.g., Camp Pendleton and Camp Lejeune)
- Locating the FASA at Quantico.

It is not SRI's intent to select one of these options; they are mentioned merely to indicate that where the FASA resides, geographically and organizationally will influence the ADPE and manpower resources that it would require, as well as the manner in which it interacts with its user population.

For example, location in close proximity to the FMF might allow sharing of ADPE resources. (There will be excess ADPE capacity in the garrison FMF, since the deployed combat environments require higher capacity capabilities and these must be provided for in the ADPS procurement). Location at two sites could conceivably require slightly higher manning levels, but it also implies less travel. Locating the FASA near the Computer Science School at Quantico might appear attractive from a resource sharing point of view, but it would remove the FASA from the FMF.

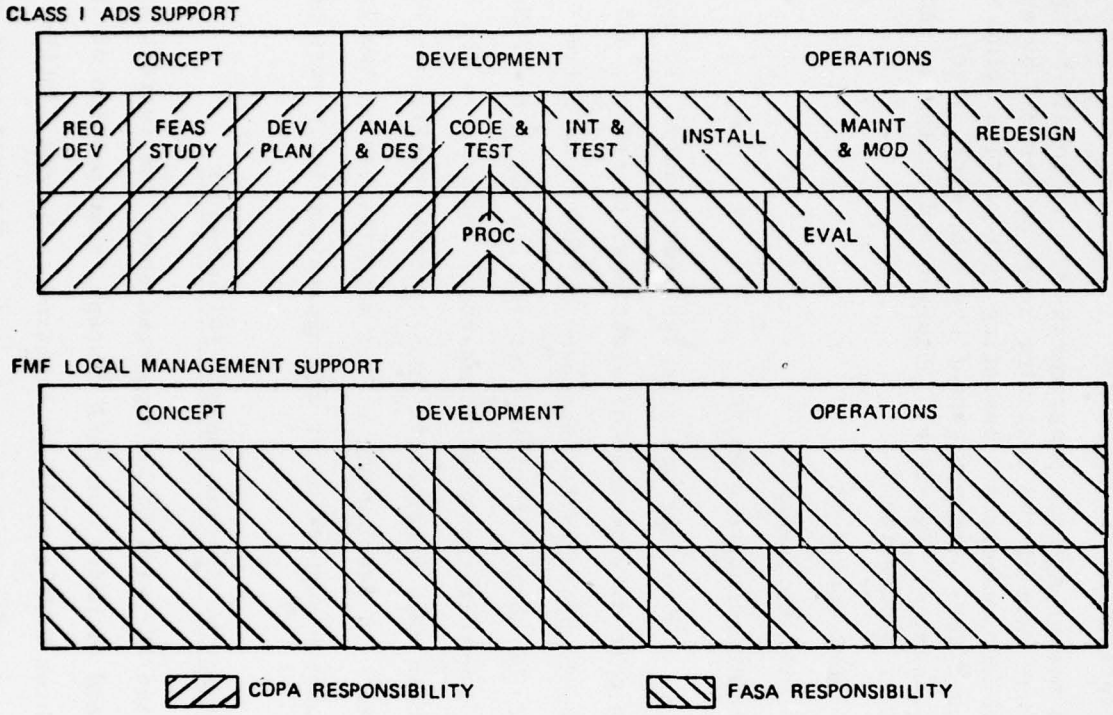


FIGURE B-1 SOFTWARE DEVELOPMENT CYCLE (FASA CONCEPT)

SRI judges that a core manning level for the FASA located at one site would be the following:

- 12 senior analyst/programmers--The rationale being that each functional area (manpower, intelligence, operations, logistics, finance, aviation) would be represented by two people
- 5 senior systems programmers--The rationale being that each of the following areas be covered by at least one person: operating system, file maintenance/data base management systems, macro-level languages, high-level languages and analysis, and text processing
- 3 ADPE operators
- 1 ADPE maintenance
- Administrative support.

This estimate is a core that would be desired on duty. To account for time away from that duty because of vacations, transfers, and so on, the total staff should probably be increased by about one-third. This estimate appears to be about the minimum staff with which the FASA could operate. The considerations mentioned above, as well as the ADP manning strategies within each alternative ADPS concept itself, may alter this estimate upward. In particular, a FASA activity having two locations for more responsive support might add approximately 20 more people.

d. Alternative Systems Support Philosophies

If the FMF were to be supported under the current system philosophy, instead of under the FASA concept, some portion of the staff at each of the three CDPA's would be required to become familiar with the FMF hardware and software systems as well as the particular and peculiar requirements of the FMF. Each CDPA would then take on the responsibility to extend the development, support, implementation, and maintenance of a subset of Class I functionally oriented systems into the FMF in all of

its operating environments (garrison, afloat, and ashore). This would entail replicating the FMF computer systems at each of the CDPA's as well as maintaining vendor liaison for these systems. Under this approach, the additional manning requirement for each CDPA would be, at a minimum, 5 senior system programmers, 3-5 analyst programmers, operators, maintenance personnel, and administrative support at each of the existing CDPA's. These manning requirements project a larger total manning requirement than would be the case under a FASA concept.

A second alternative would be to assign the responsibility for total support of all functionally related ADS, including implementing and maintaining them in the FMF, to the CDPA's while at the same time establishing an additional activity to handle all FMF-unique software. This additional activity would have the sole responsibility for the development and support of the FMF-unique requirements, and applications, as well as FMF user liaison, coordination, and support. This alternative, like the preceding, would still require the replication of hardware and basic system support in each of the CDPA's but would lessen the total requirement for application-oriented support personnel. The organization handling of FMF-unique software, while logically independent, might be located in the FMF to make use of the available system resources there and provide a high level of responsiveness, or it might be co-located with one of the existing CDPA's.

With regard to these alternatives, it would seem to be more advantageous to have a single entity carry the responsibility for supporting the myriad of users and usages in the FMF without having the additional burden of wearing the two hats required by having to support the functional manager in the manner in which he has been accustomed as well as mucking around in the mud with the troops. The FASA concept is envisioned by SRI to be the best means for supporting the expanded and reoriented ADP capability provided to the FMF by the alternative ADPS concepts. The CDPA's

will continue to support the HQMC functional managers and the large Class I ADS. The FASA will complement the CDPA's and implement their specifications into the FMF context in the most efficient and responsive manner.

Appendix C

FMF ADS DIGITAL DATA TRAFFIC

Appendix C

FMF ADS DIGITAL DATA TRAFFIC

1. Background

In the alternative ADPS concepts that SRI investigated, there are two primary means of tranferring data from one point to another within the FMF. The first means is via the LFICS, and the second is via the physical transportation of magnetic storage media (floppy disks, cassettes, and so on). LFICS is envisioned as the preferred means to insure rapid communications and hence a responsive ADPS--with the provision for physical transportation supporting the ADPS concept in the absence of telecommunications or in those operational conditions where transmission is to be avoided. AUTODIN provides communications external to the FMF.

Data to be transferred is, with few exceptions, the same administrative data that is presently reported to the existing Class I Marine Corps ADS. Data transfer will include support of the reporting requirement for the functional areas of manpower, operations, logistics, and finance. Additionally, the intelligence functional area will be supported at echelons below division/wing (where MAGIS operates).

The reporting philosophy supports the concept of "exception reporting". As practiced by the Marine Corps, exception reporting to the Class I ADS principally involves submission of 80 character records of events that would alter a particular system's data base. Reporting is characterized by a daily submission from reporting units down to the battalion/squadron level. On this basis, it may be stated that:

- The ADPS concepts will not require telecommunication links between nodes other than those already envisioned by LFICS

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- The transmissions will be batch oriented--with no interactive transfer of data or query of data bases between LFICS nodes (intranodal interactivity is allowed)
- The majority of data to be transferred will be of a precedence commensurate with its administrative (rather than tactical) orientation and its nonperishable nature.

2. Estimate of FMF ADS Traffic Volume

A first estimate has been made of the volume of data communication traffic to be generated by an FMF ADPS. This estimate assumes a system concept like the DISHIER and DISACT concepts that are described in the main body of this volume.

Summaries of the estimated traffic flows are shown for a deployed MAF in Table C-1. These estimates were based on information provided by two other studies.[2,3] Minor adjustments were made to this source material to reflect the characteristics of the information flow of DISHIER- and DISACT-type concepts. The minimum traffic figures in Table C-1 represent daily averages for a MAF in a combat environment. The maximum traffic figures in Table C-1 represent a case where the monthly peak in each ADS reported by a given unit is assumed to occur on the same day--again for a MAF in a combat environment. (This is a worst case.)

The focus of the source data was primarily the garrison environment, and it was collected during the first half of calendar 1974. Since a "worst case" estimate was desired, the combat ashore environment was targeted. To accomodate this analysis, the garrison values were doubled to project the traffic estimate to the ashore environment (as per the analysis of Reference 2). No correction factors were applied to transform the estimates from the 1974 to the 1980 time domain.

The characteristics of the DISHIER and DISACT concepts have significant influence on the digital data traffic that LFICS would be called upon to

Table C-1

ESTIMATED DAILY FMF ADS TRAFFIC

Digital Data Link (From - To)	Daily Data Traffic (Kilocharacters)
MAF-DCS	5382-29522
DCS-MAF	1776-9742
FSSG-MAF	1307-6038
MAF-FSSG	431-1992
DIV-MAF	1833-8706
MAF-DIV	605-2873
WING-MAF	2242-14778
MAF-WING	740-4877
DIV-FSSG	697-1738
FSSG-DIV	230-573
WING-FSSG	781-1235
FSSG-WING	258-408
DSG-DIV	384-486
DIV-DSG	127-162
IREGT-DIV	259-948
DIV-IREGT	85-316
IBN-IREGT	71-213
IREGT-IBN	24-71
ABN-AREGT	61-337
AREGT-ABN	20-112
AREGT-DIV	109-1235
DIV-AREGT	36-412
FAG-DIV	109-624
DIV-FAG	36-208
TANK BN-DIV	66-297
DIV-TANK BN	22-99
AMTRAC BN-DIV	76-397
DIV-AMTRAC BN	25-132
MACG-WING	194-1726
WING-MACG	64-575
MAG(VH)-WING	437-2617
WING-MAG(VH)	144-872
MAG(VH/VMO)-WING	449-2732
WING-MAG(VH/VMO)	148-911
MAG(VF/VA)-WING	580-2625
WING-MAG(VF/VA)	191-876
MAG(VF/VA)-WING	593-2324
WING-MAG(VF/VA)	196-775
MAG(VF/VA)-WING	531-2091
WING-MAG(VF/VA)	175-408
WSG-WING	239-804
WING-WSG	79-268
LSG-FSSG	1754-6623
FSSG-LSG	579-2185

support. The following points apply:

- The nature of the ADPS concepts is such that each echelon level has a capability to retain data it collects (if that data is useful to its activity)
- The ratio of downward flowing information in the ADPS concepts to the upward flowing information is estimated to be small (on the order of one-third or less); hence, the larger problem is contained in the upward information flow
- Large updates directed to lower echelon data resources (for example, monthly aggregations or summaries) do not have to be communicated electronically, given the lower echelon capability to read magnetic storage media (floppy disks, cassettes) that can be transported to them physically
- Information is not time-critical in the sense of real-time tactical control information; so, network imposed delays (due to transmission and queuing) of minutes up to about 8 hours appear to be acceptable.

SRI based its estimate of the protocol overhead on the following rationale:

(1) A message frame will be 128 characters (8-bit) with longer messages segmented into the requisite number of message frames. It is assumed that 114 of these characters will be available for data; hence, the usable channel capacity for this consideration is 89%.

(2) There is an assumed detected error rate of 1 in 10^5 bits. Therefore, the probability that a message frame will be correct is placed at 0.99.

(3) The protocol is such that it allows 75% useful time for the transmission of traffic. This is probably a conservative estimate for a full-duplex link, as SRI assumed.

Based on these considerations, the usable channel capacity for traffic appears to be abour 66%. This channel capacity figure means that about a 50% total overhead charge must be assessed against the traffic volumes identified in Table C-1. That is, the required channel capacity may be determined by multiplying the traffic figures in Table C-1 by 1.5.

3. Digital Data Transfer Afloat

The previous discussion has concentrated on the Marine Corps' organic telecommunication resources for data transfer between MAGTF units in an ashore combat environment. As indicated in that discussion, the responsibility for such data transfer falls under the cognizance of the LFICS concept.

In the afloat environment, however, FMF units must rely on Navy communication resources for transfer of data from ship to shore or vice versa, and from ship to ship. For the administrative reporting of Class I ADS data, the FMF link afloat with the Supporting Establishment is through a Naval Communications Station (NAVCOMMSTA) to the Defense Communications System (DCS). At present, it appears that the primary means of communicating FMF administrative type bulk data from afloat platforms to the NAVCOMMSTA is via a formatted Navy message also used for narrative traffic. Once received at the NAVCOMMSTA, the data can then be entered into the DCS network via AUTODIN.

Future plans for Naval telecommunications are stated in the "Naval Telecommunications System Architecture 1975-1985."[4] These plans indicate that the Naval Telecommunications System (NTS) of 1985 will be expected to satisfy greater demands and overcome more serious threats than today's system is able or required to do. Prominent among the techniques available at that time will be the use of satellites for beyond-line-of-sight command and control communications and for exchanging bulk traffic between the DCS and ships.

The future scope of the NTS is described in the following extracts of its definition from Reference 4:

> The NTS is a complex of terminal, transmission, switching, cryptographic and control devices that collectively provide the electrical and optical communications capability for the exercise of command and control over Naval operating forces, for the transmission of

operational information to and between units of such forces, and for the administration of forces, shore establishments and other components of the Navy.

To meet Naval and Marine operational requirements the NTS may be expanded or extended to incorporate the interface with communications systems of other Services, nations, or treaty organization.

The essence of the NTS capability with regard to Marine Corps ADPS afloat can be discussed in relation to the near-term and long-term capabilities of NTS. The near-term capability (formatting data in the form of a Naval message and transmitting via HF media) is a slow, cumbersome, and potentially high error rate means of communicating such information as contained in the FMF ADPS. Current transmission media were not designed for information transfer of this type or amount; hence, the capability and capacity of such resources for meeting FMF requirements are suspect.

In the long-term (circa 1985) the NTS will have developed its capability beyond the current capability primarily through the provision of satellite links with the NAVCOMMSTA or directly into DCS. This should provide high transfer channels with small error rates more desirable for FMF ADPS. However, it appears that the Navy plan is for use of these channels for tactical data first and foremost, and administrative data as a lower priority. Furthermore, no channels have been designated strictly for use by Marine Corps units afloat. Hence, the Marine Corps will have to compete for telecommunications resources with their Navy counterparts.

Lastly, consultation with Navy offices responsible for NTS development has indicated that FMF information transfers of the type envisioned for future FMF ADPS afloat have not been taken into account for capacity determinations, nor are they known in a definitive sense to the Navy. It must be concluded, therefore, that FMF units afloat may encounter delays and conflicts with respect to transferring digital data. This situation should be one of continuing concern to the future development of FMF ADPS.

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