1.0

4.5
50
56
6.3

2.8   2.5

3.2   2.2

3.6

4.0   2.0

1.1

1.8

1.25   1.4   1.6

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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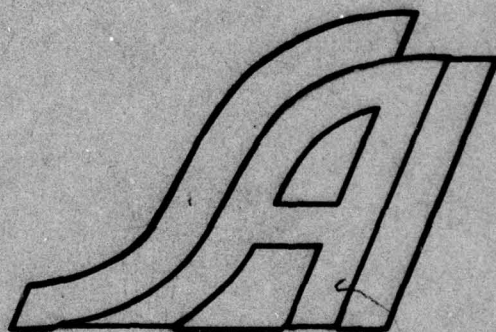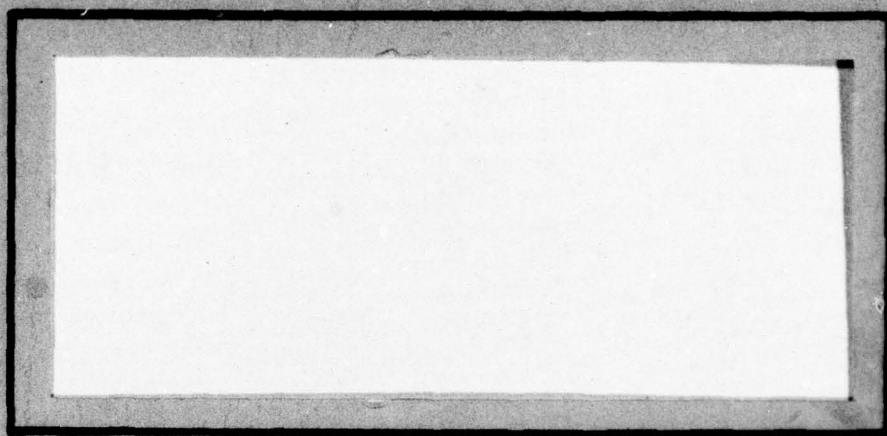
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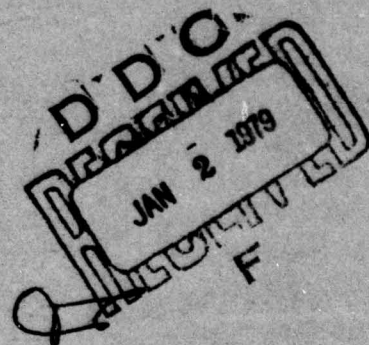
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SHIPBOARD LOGISTIC DATA
COMMUNICATIONS STUDY
FOR
SNAP II PROGRAM

FINAL REPORT – PART 1

15 AUGUST 1978
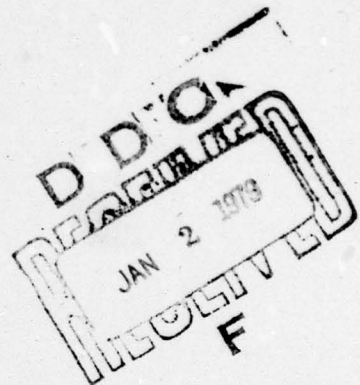
Prepared for: David W. Taylor, Naval Ship
Research and Development Center
Under Contract N00600-76-A-0973
Delivery Order 0004

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SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Shipboard Logistic Data Communication Study for SNAP II Program. Part 1.		5. TYPE OF REPORT & PERIOD COVERED Final Report, Part 1 April August 1978 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Robert P. Feaga, Jr. Senior Engineer SAI Comsystems Corporation		8. CONTRACT OR GRANT NUMBER(s) N00600-76-A-0973 Delivery Order 0004
9. PERFORMING ORGANIZATION NAME AND ADDRESS Science Applications Incorporated, Comsystems Corporation 7921 Jones Branch Drive, McLean, Virginia 22102		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62760N, F53531 TF 5351001, 1824-001
11. CONTROLLING OFFICE NAME AND ADDRESS David W. Taylor Naval Ships Research and Development Center Code 182, Mr. A.W. Camara, Bethesda, Md. 20084		12. REPORT DATE 15 August 1978 13. NUMBER OF PAGES 44 48p.
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Shipboard Logistic Data, External Logistic Communications Requirements, Shipboard Non-tactical ADP Program, SNAP II, Logistic Data Volumes, Logistic Data Channel Assignments.

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The Shipboard Non-tactical ADP Program II (SNAP II) is intended to modernize and expand the non-tactical automatic data processing capability afloat. SNAP II system is planned to be installed aboard approximately 450 surface ships and submarines between FY 1980 and FY 1985.

In order to plan and properly implement the SNAP II capability aboard

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ship, the internal and external logistic data communication channel require-
ments must be adequately defined. SAI Comsystems defined the SNAP II
logistic data communications channel requirements in a two part final re-
port.

Part 1 provides the current and near term logistic data communications
channel requirement for the SNAP II nucleus system. This study identifies
the logistic data and provides a quantifiable assessment of the volume of
logistic data communicated off the SNAP II ships, based on the current
functional reporting requirements of the off ship users. This report
establishes the SNAP II baseline for shipboard logistic data communication
requirements.

Part 2 provides future projections of the current (baseline) logistic
data communications channel requirements based on the expanded capability
of the SNAP II system and the expected changes in off ship users reporting
requirements for SNAP II logistic data. Part 2 evaluates the feasibility
of interfacing SNAP II with the future communication channel requirements.
The shipboard internal and external interface design concepts are developed
for each communication channel both at sea and in port.

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FOREWARD

The Shipboard Logistic Data Communications Study for the Shipboard Non-tactical ADP Program II (SNAP II) has been prepared by SAI Comsystems in two separate reports, Part 1 and Part 2.

Part 1 was prepared to meet the immediate needs of Navy planners in determining the current logistic data communications channel requirements for the SNAP II nucleus system. Part 1 identifies the logistic data and provides a quantifiable assessment of the volume of logistic data required to be communicated off the SNAP II ships, based on the current functional reporting requirements of the off-ship users. Part 1 establishes the SNAP II baseline for shipboard logistic data communication requirements. As new or expanded shipboard logistic functions are automated by the SNAP II system, the external communications required for the new functions can be added block by block to the baseline.

Part 2 provides future projections of the current (baseline) logistic data communications channel requirements based on the expanded capability of the SNAP II system. These projections are based on reasonable estimates of increased reporting requirements being established by off-ship user's and made possible by the increased data handling capability of the expanded SNAP II system. Part 2 also evaluates the feasibility of interfacing SNAP II with the current and future communication channels. The internal shipboard interfaces between SNAP II workstations and the communication center, and the external SNAP II interfaces between ship and shore, are developed for each communication channel. Deficiencies are identified and appropriate RDT&E efforts are recommended where hardware and software are not commercially available to meet the interface requirements.

Section I - Introduction

A. Purpose

The purpose of this study is to identify the current shipboard logistic com-
munication requirements for the Shipboard Non-tactical ADP Program - II (SNAP
II) nucleus system. The U.S. Navy, through the SNAP II Program intends to
automate the preparation and submission of shipboard logistic data as part
of a program to improve the overall fleet logistic support and responsiveness.
When SNAP II is developed and operational aboard ships, the present manual
logistic procedures will be automated, including the preparation of logistic
data for off-ship communications. An analysis of these off-ship communications
requirements is considered a prerequisite to the design of communication inter-
faces.

B. Objectives

The objectives of this study are: to identify the shipboard logistic data
required to be transmitted off-the-ship; determine the volume of external
logistic data communications; define the logistic data communications channel
requirements in terms of channel size and frequency of use; and allocate
logistic data to appropriate channels based on current reporting requirements
of the off-ship users.

C. Scope

The scope of this study is limited to the SNAP II nucleus system software as
defined in the Automated Data System (ADS) Development Plan of 1 February 1978.
The nucleus system is planned to support the shipboard automation of:

- Maintenance Data System (MDS)
- Planned Maintenance System (PMS)
- Supply Requisition and Inventory Control, and Financial
  OPTAR Accounting
- Source Data System (SDS) input to the Pay and Personnel
  Administrative Support System (PASS)

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The SNAP II expanded system discussed in the ADS Development Plan requires much more development and further definition, as compared to the nucleus system, and is not included in the scope of this study.

D. Background

Requirements for the Shipboard Non-tactical ADP Program were identified by the Fleet Non-Tactical ADP Requirements Definition Working Group, and included in a report dated 12 November 1976 in the form of application programs to support specific functions. The SNAP II system will be able to support those requirements applicable to small ships, through its ability to process high level languages, store, manipulate, and access large quantities of data, interface with users in a conversational mode, process several unique applications concurrently, etc. The initial set of application programs that will be provided with the nucleus hardware system will address a supply, maintenance and personnel data management subset of the total set of indentified requirements for automated information processing. Expansion of this nucleus software capability will be addressed by subsequent programs, separately justified through normal Navy ADP management procedures.

It is the objective of the SNAP II to provide automatic data processing equipment to all submarines and surface ships (frigates and larger, including new construction) which currently do not have non-tactical ADP equipment on board. Through the use of ADP equipment in support of maintenance, supply, pay and personnel, the timeliness and accuracy of data and reported information will be greatly improved. Additionally, the time consuming and error prone manual preparation of forms will be reduced.

The preparation of forms through source data automation produces tangible benefits. However, the primary value of ADP systems is the aggregation of data into useful information for the shipboard manager, which can be used for the timely solution of complex problems. In the past, this capability was reserved for shorebased staffs with access to large processing facilities. The new technology provides the opportunity to equip the shipboard manager with similar tools in much smaller packages scaled to the afloat manager's needs.

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SNAP II will provide, in effect, an expandable shipboard ADP utility, similar in concept to a shore-based Data Processing Service Center (DPSC). The SNAP II prototype system, which is planned to be installed aboard 12 ships and submarines in both LANTFLT and PACFLT, will include a nucleus system of applications programs and a central data base. This nucleus capability will be of sufficient scope to evaluate the effective achievement of the SNAP concept across a spectrum of small to medium size ships. The prototype system will also be the primary method used for resolving remaining uncertainties.

Section II - Statement of the Problem

The SNAP II program provides shipboard personnel with a much improved capability to handle and process logistic data. This improved capability creates new internal and external shipboard communications requirements which must be defined and evaluated. The present non-automated ships mail or hand carry their raw logistic data to shore-based Data Processing Service Centers (DPSCs) for processing, formatting, and transmitting to the off-ship users. SNAP II provides the DPSC capability aboard ship.

In order to most effectively utilize this improved capability, the external communications channel requirement must be identified and the external shipboard communications must be in the same format provided by shore-based DPSCs. The external logistic data communication volumes must be quantitatively defined. The logistic data volumes must be allocated to appropriate channels based on user's needs. The channels must be defined in terms of window size and frequency of use.

The shipboard external logistic data communication channel requirements are the problems to be defined and evaluated by SAI Comsystems under this contract effort.

Section III - Technical Approach

The technical approach used by SAI Comsystems during this study to determine
the SNAP II logistic data communication requirements are discussed below by
the tasks performed:

A. Task 1 - Data Collection and Evaluation

SAI Comsystems was tasked by NAVSEASYSCOM to prepare the Automated Data Sys-
tem (ADS) Development Plan for SNAP II Program. The ADS Plan was delivered
1 February 1978. As a product of this work effort, much of the data required
to perform the communication requirements study had been collected. This
data was reviewed and evaluated for its usefulness as inputs to the communica-
tion study. SAI Comsystems reported to the contract sponsor, the value of the
available data, its limitation in completeness and accuracy, and their plan
for collecting additional data where the data was suspect or insufficient.

B. Task 2 - Identify Logistic Data

Using the data obtained from Task 1, the logistics data automated by SNAP II
and subject to off-ship communications was identified by form number or other
positive identification. The data identified was limited to the shipboard
logistics functions planned to be automated by the SNAP II nucleus system.

C. Task 3 - Sort Logistic Data

The logistic data identified in Task 2 was then sorted into functional logis-
tic categories and allocated to appropriate channels for both at-sea and in-
port situations. The allocation to channels was based on the submission re-
quirements of the logistic data off-ship users, and the appropriate channels
defined as either electronic, mail or hand carry.

D. Task 4 - Channel Requirements Analysis

With the external logistic data identified and sorted by appropriate channel,
SAI Comsystems performed a detailed logistic data volume analysis to deter-
mine the channel requirements in terms of window size and frequency of use.

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The channel window size was defined by the total number of logistic data transactions required to be communicated off the ship per month and per day. The frequency of channel use was defined by the ships daily high, low, and average volume of characters per ship per day. With the profiles of logistic data channel requirements defined in this manner, SAI Comsystems converted characters to bits and related the volumes of logistic data identified to the following information channels which varied in data rate and quality:

- Very low speed, manual (hand carry or mail)
- Low speed voice lines
- Radio communications
- Optical Frequency Communications

The feasibility and effectiveness of the various information channels was evaluated with recommendations for SNAP II logistic data communication channel assignmmets.

E. Task 5 – Final Report – Part 1

The results, conclusions and recommendations for Task 1 through 4 were documented in the Shipboard Logistic Data Communication Study for the SNAP II Program, Final Report – Part 1.

Section IV - Identification of Logistic Data

The identification of logistic data for purposes of this study is defined as the data to be automated by the SNAP II nucleus system which is required to be communicated off-the-ship. The logistic data identified by SAI Com-systems does not purport to be all the logistic data automated by SNAP II or all the logistic data required to be communicated off-the-ship. By this we mean, much of the logistic data automated by SNAP II is intended to be used internal to the ship, e.g., ship's inventory status of parts and consumables, ship's personnel listings and watch bills, etc. Also, not all of the shipboard logistic functions are intended to be automated by the nucleus SNAP II system, some data of which requires communications off-the-ship,(e.g. Personnel Fitness reports for officers and enlisted, Enlisted Advancement Examinations, and many of the SNAP II expanded system functions).

The purpose of identifying the shipboard logistic data in this manner, is to establish the SNAP II baseline for shipboard logistic data communication requirements. As new or additional shipboard logistic functions are automated by SNAP II system, the external communications required for the new functions can be added block by block to the baseline. The baseline identified in this study is also separable by blocks. This modular construction will permit the selection of specific logistic data to be transmitted off-the-ship in times of reduced communication channel availability.

The functional applications to be automated on the SNAP II nucleus system will support the following shipboard areas:

- **Maintenance**
  Maintenance Data System (MDS)
  Planned Maintenance System (PMS)
- **Supply**
  Requisition and Inventory Control
  Financial Operational Target (OPTAR) Accounting

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- <u>Pay and Personnel</u>

   Source Data System (SDS) of the Pay and Personnel
   Administrative Support System (PASS)

The identification of shipboard external logistic data for each of the SNAP II automated functional areas are shown in Table 1. Tabulated for each functional area is the logistic data form number, title, description of use, and off-ship destination.

To put Table 1 into perspective, it should be understood that the SNAP II nucleus system is primarily intended to reduce the shipboard requirements for manually preparing logistic forms through SNAP II hardware/software automation capabilities. As the functional users have time to improve their shipboard automation procedures, through the expanded SNAP II and communication hardware/software development programs, the necessity and reliance on logistics forms will give way to event or transaction type reporting directly between ship and off-ship user in a digital/magnetic media. Forms will not leave the ship but be maintained in the ship's data base as retrievable hard copy back up as required.

For the purposes of this study, however, the external logistic data automated by SNAP II nucleus system, although not necessarily in the same format, is considered equal to information on the forms identified in Table 1. This assumption was used in allocating logistic data to appropriate channels and in the logistic data volume analysis for the communication channel requirements analysis. SAI Comsystems believes that this assumption provides a valid baseline and reasonable estimate for the shipboard logistic data communication requirements for SNAP II nucleus system.

FUNCTIONAL AREA	FORM IDENTIFIER	TITLE	DESCRIPTION OF USE	OFF-SHIP DESTINATION
PAY AND PERSONNEL 1. OCR Personnel	a. NAVPERS 1070/601 (F601R)	Immediate Reenlistment Contract	For regular Navy enlisted personnel reenlistment contract.	All OCR Personnel Data is submitted to Bureau of Naval Personnel, Washington, D.C.
	b. NAVPERS 1070/601 (601-RR)	Immediate Reenlistment Contract	For enlisted reserve personnel reenlistment contract.	
	c. NAVPERS 1070/621 (F621R)	Agreement to Extend Enlistment	Request for regular Navy enlisted personnel to extend active duty enlistment.	
	d. NAVPERS 1070/621 (1F621R)	Agreement to Extend Enlistment	Execution of agreement to extend enlistment contract for regular Navy enlisted personnel.	
	e. NAVPERS 1070/622 (F622R)	Assignment to and Extension of Active Duty	Request for assignment or extension of active duty for enlisted reserve personnel.	
	f. NAVPERS 1070/622 (1F622R)	Assignment to and Extension of Active Duty	Execution of agreement to assign or extend active duty for enlisted reserve personnel.	
	g. NAVPERS 1070/606 (F601-6R)	Record of Unauthorized Absence	Reports the record of unauthorized absence for active duty personnel.	
	h. NAVPERS 1070/607 (F601-7R)	Court Memorandum	Report the courts findings and disposition for Navy Judiciary cases.	
	i. NAVPERS 1070/610 (F610)	Record of Personnel Actions	Report rate changes and proficiency pay changes for active duty enlisted personnel.	
2. OCR Pay	a. NAVCOMPT 3052	Employees Witholding Exemptions Listing	Records pay and witholding exemptions for federal income taxes.	All OCR Pay Data is submitted to Navy Finance Center, Cleveland, Ohio.
	b. NAVCOMPT 3053	Allotment Authorization	Authorized the payment of allotments to family of Navy personnel.	
	c. NAVCOMPT 3055	Military Pay Voucher	Acknowledge receipt of Navy pay check. Submitted each pay day on the 15th and last day of each month.	

TABLE 1 - IDENTIFICATION OF SHIPBOARD EXTERNAL LOGISTIC DATA (Sheet 2 of 5)

FUNCTIONAL AREA	FORM IDENTIFIER	TITLE	DESCRIPTION OF USE	OFF SHIP DESTINATION
2. OCR Pay (Cont'd.)	d. NAVCOMPT 3056	Military Payroll Money List	Lists name, rate/rank, SSN, and amount of pay check. Submitted each pay day.	
	e. NAVCOMPT 3057 and 3058	Family Separation Allowance (Individual and Groups)	Request for family separation allowance for qualified individual and groups.	
	f. NAVCOMPT 3060 and 3061	Military Pay and Order (Single and Multiple)	Military pay order for individual and group of personnel.	
	g. NAVCOMPT 3062	Orders for Hazardous or Special Duty	Request hazardous or special duty pay for individuals or groups.	
	h. NAVCOMPT 3063	Overseas Station Allowances	Request overseas station allowance for qualified personnel.	
	i. NAVCOMPT 3064	Basic Allowance for Subsistance	Request basic allowance for subsistance for qualified personnel.	
	j. NAVCOMPT 3065	Leave Authorization	Reports leave authorized for officer and enlisted personnel. Prepared by the Administration Office.	
	k. NAVCOMPT 3065A	Leave Authorization	Report leave authorization for officer and enlisted personnel. Prepared by Dispersing Office.	
	l. NAVCOMPT 3066	Uniform Allowance Claim	Request uniform allowance claim for qualified personnel.	
	m. NAVCOMPT 3067	Detaching (Departing) Endorsement to Orders	Reports departure of personnel with orders.	
	n. NAVCOMPT 3068	Reporting (Arrival) Endorsement to Orders	Reports arrival of personnel with orders.	
	o. NAVCOMPT 3069	Detaching/Reporting Endorsement to Orders - Group Travel	Reports departure or arrival of a group of personnel with orders.	
	p. NAVCOMPT 1070/602	Dependency Application/Record of Emergency Data	Report changes in dependents and designates beneficiaries for service member.	

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FUNCTIONAL AREA	FORM IDENTIFIER	TITLE	DESCRIPTION OF USE	OFF SHIP DESTINATION
3. Personnel Diary	a. Personnel Diary	Gains	Reports number of new personnel reporting to ships company under orders. Does not include TAD personnel.	All Diary Entry Data is Submitted to Enlisted Personnel Management Cente New Orleans, Louisiana.
		Losses	Reports number of personnel detached from ships company under orders. Does not include TAD personnel.	
		Miscellaneous	Reports changes or corrections to the personnel records of individuals, e.g., SSN, Pay entry base date, date received, designator, etc.	
SUPPLY 1. Internal Re- quisitions from ship's supply department for non-automated ships.	a. NAVSUP Form 1250 (DD Form 1250)	Single Line Item Consumption/ Management Document.	Used by shipboard maintenance and supply per- sonnel to request materials, report usage of materials obtained from other than supply sources, and turn in excess RFI material.	Submitted to Maintenance Support Office Depart- ment (MSOD) via the Data Processing Center Support- ing the Ship.

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FUNCTIONAL AREA	FORM IDENTIFIER	TITLE	DESCRIPTION OF USE	OFF SHIP DESTINATION
SUPPLY (Cont'd.) 2. External Requisitions from ship's supply department for non-automated ships	a. DD Form 1348	DoD Single Line Item Requisition System Document.	Used by supply personnel aboard non-automated ships for replenishing assigned stock or requisitioning supplies and parts not carried aboard the ship. Also use to request follow up status for overdue requisitions.	Sent to Navy Supply Center Supporting Ship.
3. Supply, Financial Reports	a. NAVCOMPT 2156	OPTAR Document Transmittal Report	Used to balance and verify the total net value of the ships OPTAR (Operational Target) account.	Sent to Navy Regional Finance Center three times per month - 10th, 20th, and last day of month.
	b. NAVCOMPT 2157	Budget OPTAR Report	Serves a dual purpose: Part I reports ACCESS data to TYCOM and Part II reports monthly OPTAR data to Fleet Accounting Office and TYCOM.	Sent to Navy Regional Finance Center, copy to TYCOM no later than the second day of the month following the end of the month being reported.
MAINTENANCE 1. Maintenance Data System (MDS)	a. OPNAV 4790/2K	Ship's Maintenance Action Form	Used to report ship's maintenance actions in accordance with OPNAVINST 4790.4, 3M manual.	Submitted to Maintenance Support Office Department (MSOD) via the Data Processing Center Supporting the Ship.
	b. OPNAV 4790/2L	Supplemental Form	Used to report narrative remarks to amplify or clarify the 4790/2K form.	

TABLE 1 - IDENTIFICATION OF SHIPBOARD EXTERNAL LOGISTIC DATA (Sheet 5 of 5)

FUNCTIONAL AREA	FORM IDENTIFIER	TITLE	DESCRIPTION OF USE	OFF SHIP DESTINATION
	c. CSMP	Current Ship's Maintenance Projects (3 types). • Report 1 - 5 Options • Report 2 - Listing by JSN • Report 3 - Listing by EIC	Used as the ship's maintenance management tool to provide a consolidated listing of deferred corrective maintenance projects to be accomplished. The CSMP is presently prepared for the non-automated ships by Data Processing Centers supporting the ship.	Peroidically submitted to Type Commander (TYCOM) as required.
2. Planned Maintenance System (PMS)	The PMS Forms that are automated by SNAP II nucleus system are used internal to the ship and have no off-ship communications requirement. This will probably change, however, in the expanded SNAP II system.			

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Section V - Allocation of Logistic Data to Appropriate Channels

The allocation of the logistic data to appropriate channels for off-ship communications was primarily based on the submission requirements of the off-ship users of the logistic data,to provide improved logistic support to the ship. The ability of the ship to respond to these submission requirements is intended to be provided by the SNAP II hardware and automated shipboard communication systems. The submission requirements of the off-ship users was obtained by SAI Comsystems and is discussed by shipboard functional area in the following paragraphs:

A. Pay and Personnel

The shipboard reporting of the Pay and Personnel Administrative Support System (PASS) has not been finalized by BUPERS PASS Office at the time of this study. However,SAI Comsystems was told by the BUPERS PASS Officials that it is their desire to have the shipboard reporting requirement identical to the shore-based PASS Offices, if such reporting is technically feasible and cost effective. The PASS organizational and management concept for SNAP II reporting requirements is discussed below:

1. SNAP II hardware will be provided with PASS/SDS software by the BUPERS Source Data System (SDS) development office. The SNAP II system data base will have all SDS files for personnel assigned to the ship. The same personnel, pay and transportation functions will be performed on the SNAP II ships as are performed at a PASS office ashore. The personnel/pay office on board ship is equivalent to a Personnel Support Department (PSD) ashore. The data processing by SNAP II on the ship performs the same functions as the Processing Center (PC) ashore. The ship CO, therefore, has the same responsibility regarding PASS/SDS as the CO of a Personnel Support Activity (PSA) ashore.

2. The SNAP II/SDS capability afloat will provide the same data entry and management information support capabilities as are provided

ashore. Input methodology, edit criteria and retrieval capabilities
will not vary between ashore and afloat PASS offices. The data entry
requirements ashore are receipt at the headquarters master files (MAPMIS
and JUMPS) within 24 hours of valid terminal entry from any PASS office
in the network. The proposed PASS system network will consist of 39
Personnel Support Activities (PSA) and 140 Personnel Support Detachment/
Personnel Support Branch Offices (PSD/PSBD) located around the world.

In order to meet the same shore-based PASS reporting requirements for SNAP II
ships, there are three possible channel allocations depending on the location
and operations of the ship. When at sea, two channels are possible: (1) Trans-
mission direct from the SNAP II computer to headquarters, regardless of location,
and (2) linking into PASS/SDS land-line network, from any mode, and communi-
cating directly to the headquarters in the same manner as the shore PASS of-
fice. When in port one additional channel is possible, (3) the SNAP II com-
puter could produce the logistic data on a temporary storage device (tape
or cassette) which is hand carried to a designated PASS Office ashore for trans-
mission to headquarters.

B. <u>Supply Requisitions</u>

The submission requirements for supply requisitions was taken from NAVSUP
P-485, Afloat Supply Procedures Manual. In accordance with P-485, the fol-
lowing chart is a guide for maximum shipboard response time for processing
supply requisitions.

1. <u>Material Onboard</u> - DD Form 1250 is used to requisition material
   carried on board for non-automated ships. Processing and issue
   time for 1250's is on the Urgency of Need Designation (UND), i.e.,

	DD Form 1250
<u>UND</u>	<u>Process and Issue Time</u>
A	1 hour
B	2 hours
C	24 hours

The DD Form 1250, from a supply viewpoint, is an internal ship's doc-
ument used by ship's maintenance and supply personnel for requesting,

issuing, and turn in of spare parts and maintenance material held on board the ship. However, the usage of spare parts in a ship's maintenance action is of concern to the Navy 3-M System. In accordance with OPNAVINST 4790.4, Ship's 3-M Manual, Volume II, all DD Form 1250s are to be submitted weekly by the ship's 3M coordinator to the Maintenance Support Office Department (MSOD), Mechanicsburg, Pennsylvania, via the Data Processing Center supporting the ship. With the data processing capabilities of SNAP II hardware, the DD Form 1250 can be processed aboard ship and mailed weekly directly to MSOD, resulting in considerable time saving in the thru put to MSOD.

2. <u>Material Not On-Board</u> - DD Form 1348 is used by supply personnel for requisitioning material not carried on the ship or for the replenishment of authorized stock and consumable supplies. The submission requirement for 1348's are based on Priority Designation (PD) assigned by the supply department based on the urgency of need designation discussed above, i.e.,

UND	PD	DD Form 1348 Preparation Req't.	DD Form 1348 Submission Req't.
A	01-03	Within 2 hours	Within 8 hours
B	04-08	Within 8 hours	Within 24 hours
C	09-15	Within 24 hours	Within 72 hours

C. Supply Financial Reports

The submission requirements for Supply Financial Reports was taken from NAVSO P-3013-2, Financial Management of Resources Operating Procedures (Operating Forces), dated November 1974. The OPTAR Document Transmittal Report, NAVCOMPT 2156, is submitted to the Navy Regional Finance Center three times each month on the 10th, 20th, and last day of each month. This document is used to balance the requisition/OPTAR Log (NAVCOMPT Form 2155) 3 times each month and contains number and money value of obligation documents, confirmed cancellations of obligations previously ordered, and returned documents from the regional finance center. The Budget/OPTAR Report, NAVCOMPT 2157, is submitted monthly, usually by message, to the Fleet Accounting Office and the Type Commander, to be received no later than the second day of each month following the end of the month being reported.

D. Maintenance

The submission requirements for the Maintenance Data System was taken from OPNAVINST 4790.4, Ship's 3M Manual, Volume II, which states that the Ship's 3M Coordinator will submit at least once a week all Maintenance Data Collection System (MDCS) documents that have been screened to the data processing activity servicing the ship. MDCS documents, except supply documents, shall leave the ship within seven days of origination. For the purposes of this study, the MDCS documents are identified as: OPNAV 4790/2K, OPNAV 4790/2L, CSMP, and DD Form 1250.

As discussed prior, the SNAP II hardware will eliminate the need to send the MDCS documents to the data processing activity. The MDCS documents can be prepared by the ship in the same format as the data processing center and transmitted directly from the ship to MSOD, Mechanicsburg, Pennsylvania.

Based on the off-ship user requirement for shipboard logistic data discussed above, SAI Comsystems allocated the logistic data to appropriate channels for off-ship communications. The results of this effort are tabulated in Table 2. Table 2 contains for each shipboard external logistic data requirement, the shipboard submission requirement to off-ship user, the logitic data channel allocation both at sea and in port, and the logistic data output media from the ship. The channel allocation is defined as the minimum off-ship communication channel required to satisfy the shipboard logistic data submission requirements. The three channels selected for this allocation were: Hand Carry, U.S. Mail, or Electronic.

This first cut channel allocation for off-ship logistic data communications is further evaluated and studied in Section VI where the allocated channels are stressed with the volume of logistic transactions required to flow over the channels. The electronic channels are expanded to voice, radio, and optical communications, and various combinations of manual and electronic channels are evaluated as to feasibility and effectiveness of channel assignment.

The SNAP II hardware is capable of producing output data in different media, i.e., hard copy, paper tape, magnetic tape, cassette, or floppy disc. The

Table 2 - Allocation of Logistic Data to Appropriate Channels (Sheet 1 of 2)

EXTERNAL LOGISTIC DATA	SHIPBOARD SUBMISSION REQ'T.	COMMUNICATION CHANNEL ALLOCATION		SHIPBOARD OUTPUT MEDIA
		AT SEA	IN PORT	
1. Pay and Personnel a. OCR Personnel b. OCR Pay c. Diary Entries	Submitted daily to arrive at headquarters within 24 hours from shipboard terminal entry.	Electronic	Electronic Preferred, Hand Carry Acceptable.	Digital/Magnetic
2. Supply Requisitions a. DD Form 1250 Note: (1250's may be replaced aboard SNAP II ships by 1348's for reporting maintenance parts usage to MSOD).	Submitted Weekly to MSOD for prior weeks DD 1250's processed.	Mail	Mail	Digital/Magnetic
b. DD Form 1348 UND PD	Submitted to Navy			
A 01-03	Within 8 hours	Electronic	Electronic Preferred, Hand Carry Acceptable.	Digital/Magnetic
B 04-08	Within 24 hours	Electronic	Hand Carry.	Digital/Magnetic
C 09-15	Within 72 hours	Electronic	Hand Carry.	Digital/Magnetic

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Table 2 - Allocation of Logistic Data to Appropriate Channels (Sheet 2 of 2)

EXTERNAL LOGISTICS DATA	SHIPBOARD SUBMISSION REQ'T.	COMMUNICATION CHANNEL ALLOCATION		SHIPBOARD OUTPUT MEDIA
		AT SEA	IN PORT	
3. Supply Financial a. NAVCOMPT 2156	Submitted three times each month to Navy Regional Finance Center (NRFC).	Electronic Preferred, Mail Acceptable.	Electronic Preferred, Mail Acceptable.	Digital/Magnetic
b. NAVCOMPT 2157	Submitted monthly no later than 2nd day of each month to NRFC and Type Commander.	Electronic	Electronic	Digital/Magnetic and Hard Copy of Form for Type Commander.
4. Maintenance Data System a. OPNAV 4790/2K	Submitted weekly to MSOD for prior weeks maintenance action forms processed.	Mail	Mail	Digital/Magnetic
b. OPNAV 4790/2L	(Same as Above)	Mail	Mail	Hard Copy of Form
c. CSMP	Sumbitted Periodically to Type Commander as required	Mail	Mail	Hard Copy of Form

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logistic data output media in Table 2 is based on the off-ship users input requirements for logistic data.

Section VI – Logistic Channel Requirements Analysis

In this section SAI Comsystems will quantitatively define the logistic data communication channel requirements and evaluate the feasibility and effectiveness of the logistic data channel allocations. This section is organized in four parts and presents the analysis and results for:

- Logistic data volume study for SNAP II external communications expressed in numbers of transactions and characters per ship per month;

- Logistic data channel requirements expressed in terms of window size and frequency of use;

- Evaluation of the logistic data channel assignments to various information channels;

- Recommendations for SNAP II external logistic data channel assignments;

A. Logistic Data Volume Study

The logistic data volume study provides a quantifiable look at the surface shipboard logistic data automated by the SNAP II nucleus system and communicated off-the-ship. No attempt was made to study submarine platforms, non-SNAP ships, or other mobile units like Aviation Squadrons, CB Battalions, Detachments, etc. The volume identified represents the frequency and amount of logistic data coming from the ships. No attempt was made to study the volume of logistic data sent to the ship. The SNAP II system is intended to validate and verify the logistic data aboard ship prior to any external transmission, therefore most of the logistic communications sent to the ship concerning improper data entry and errors should be eliminated.

To facilitate the logistic data volume study, SAI Comsystems selected, with the assistance of BUPERS, a representative sample of ships planned for SNAP II installations. A total of 16 ships was selected representing different functions, equipments, and numbers of personnel assigned. The sample ships

hull number, name, unit identification code (UIC), and number of personnel assigned is listed below:

HULL NUMBER	NAME	UIC	NUMBER OF PERSONNEL
FF 1037	Bronstein	54035	227
FF 1038	McCloy	54036	223
FF 1040	Garcia	54037	274
FF 1052	Knox	54057	256
CG 18	Worden	52689	402
CG 43	Fox	52708	439
AOE 1	Sacramento	05832	582
AOE 2	Camden	05833	596
AOE 3	Seattle	05848	583
AOE 4	Detroit	20120	596
LPH 2	Iwo Jima	07350	685
LPH 7	Guadalcanal	07352	656
LPH 10	Tripoli	07198	676
LPH 12	Inchon	20009	643
CG 10	Albany	03623	962
CG 11	Chicago	03636	1068

With the sample of ships determined, SAI Comsystems selected a period of 15 months, from January 1977 to March 1978, to analyze the monthly volume of logistic data communicated off each of the sample ships. The following data was collected, for each ship, over the 15 month period, by the three functional areas of pay and personnel, maintenance and supply:

- Type of transaction
- Average number of transactions per ship per month
- Average number of characters per transaction
- Average number of characters per ship per month
- Percent of total transactions for each type of transaction

The results of this effort are tabulated in Table 3. This table provides a quantifiable assessment by shipboard functional area of the average monthly volume of logistic data transactions and numbers of characters communicated off the sample ships.

TABLE 3   TOTAL EXTERNAL LOGISTICS DATA VOLUME PER SHI

TYPE OF SHIP	SHIPS IN SAMPLE				PAY AND PERSONNEL					VOLUME	
	HULL NUMBER	NAME	UIC	NUMBER OF PERSONNEL	TYPE OF TRANSACTION	AVERAGE NUMBER OF TRANSACTION PER SHIP PER MONTH	AVERAGE NUMBER OF CHARACTERS PER TRANSACTION	AVERAGE NUMBER OF CHARACTERS PER SHIP PER MONTH	PERCENT OF TOTAL TRANSACTIONS	TYPE OF TRANSACTION	AVERAG TRANSA SHIP
Supply Ships	AOE 1	Sacramento	05832	582	OCR Personnel	79.5	160	12,720	6%	OPNAV 4790/2K&2L	12
	AOE 2	Camden	05833	596	OCR Pay	1179.8	100	117,980	91%	DD Form 1250	28
	AOE 3	Seattle	05848	583	Diary Entry	42.0	80	3,360	3%		
	AOE 4	Detroit	20120	596							
					Sub Total	(1301.3)	(103)	(133,980)	(100%)	Sub Total	(3
Amphibious Assult Ships	LPH 2	Iwo Jima	07350	685	OCR Personnel	82.5	160	13,200	5%	OPNAV 4790/2K&2L	15
	LPH 7	Guadalcanal	07352	656	OCR Pay	1625.3	100	162,530	92%	DD Form 1250	17
	LPH 10	Tripoli	07198	676	Diary Entry	64.0	80	5,120	3%		
	LPH 12	Inchon	20009	643							
					Sub Total	(1771.8)	(102)	(180,850)	(100%)	Sub Total	(28
Large Combatants					OCR Personnel	125.7	160	20,112	5%	OPNAV 4790/2K&2L	33
● Heavy Cruisers	CG 10	Albany	03623	962	OCR Pay	2293.9	100	229,390	92%	DD Form 1250	65
	CG 11	Chicago	03636	1068	Diary Entry	84.3	80	6,744	3%		
					Sub Total	(2503.9)	(102)	(256,246)	(100%)	Sub Total	(10
● Light Cruisers	CG 18	Worden	52689	402	OCR Personnel	45.8	160	7,328	4%	OPNAV 4790/2K&2L	21
	CG 43	Fox	52708	439	OCR Pay	1096.8	100	109,680	93%	DD Form 1250	3
					Diary Entry	30.0	80	2,400	3%		
					Sub Total	(1172.6)	(102)	(119,408)	(100%)	Sub Total	(5
Small Combatants	FF 1037	Bronstein	54035	227	OCR Personnel	28.6	160	4,576	5%	OPNAV 4790/2K&2L	7
	FF 1038	McCloy	54036	223	OCR Pay	486.3	100	48,630	91%	DD Form 1250	14
	FF 1040	Garcia	54037	274	Diary Entry	21.0	80	1,680	4%		
	FF 1052	Knox	54047	256							
					Sub Total	(535.9)	(102)	(54,886)	(100%)	Sub Total	(2
AVERAGE FOR ALL SHIPS IN SAMPLE					OCR Personnel	72.4	160	11,587	5%	OPNAV 4790/2K&2L	1
					OCR Pay	1336.4	100	133,642	92%	DD Form 1250	3
					Diary Entry	48.3	80	3,861	3%		
					Total	1457.1	102	149,090	100%	Total	4
PERCENT OF TOTAL EXTERNAL LOGISTICS DATA VOLUME					Pay and Personnel	48% Transactions		50% Characters		Maintenance	Tra

VOLUME OF EXTERNAL LOGISTICS DATA BY FUNCTIONAL AREA

TYPE OF TRANSACTION	AVERAGE NUMBER OF TRANSACTION PER SHIP PER MONTH	AVERAGE NUMBER OF CHARACTERS PER TRANSACTION	AVERAGE NUMBER OF CHARACTERS PER SHIP PER MONTH	PERCENT OF TOTAL TRANSACTIONS	TYPE OF TRANSACTION	AVERAGE NUMBER OF TRANSACTION PER SHIP PER MONTH	AVERAGE NUMBER OF CHARACTERS PER TRANSACTION	AVERAGE NUMBER OF CHARACTERS PER SHIP PER MONTH	PERCENT OF TOTAL TRANSACTIONS	AVERAGE NUMBER OF TRANSACTIONS	AVERAGE NUMBER OF CHARACTERS
			MAINTENANCE					SUPPLY		TOTAL EXTERNAL LOGISTICS DATA VOLUME PER SHIP PER MONTH	
4790/2K&2L	120.9	160	19,344	37%	DD 1348 Requisitions	621.4	80	49,712	83%		
Form 1250	207.1	80	16,568	63%	DD 1348 Follow ups	124.5	80	9,942	16%		
					NAVCOMPT 2156	3	900	2,700	< 1%		
					NAVCOMPT 2157	1	2100	2,100	< 1%		
Sub Total	(328.0)	(110)	(35,912)	(100%)	Sub Total	(749.7)	(86)	(64,454)	(100%)	2379.0	234,346
4790/2K&2L	159.3	160	25,488	56%	DD 1348 Requisitions	381.0	80	30,480	83%		
Form 1250	127.0	80	10,160	44%	DD 1348 Follow ups	76.2	80	6,096	16%		
					NAVCOMPT 2156	3	900	2,700	< 1%		
					NAVCOMPT 2157	1	2100	2,100	< 1%		
Sub Total	(286.3)	(125)	(35,648)	(100%)	Sub Total	(461.2)	(90)	(41,376)	(100%)	2519.3	257,874
4790/2K&2L	326.2	160	52,192	32%	DD 1348 Requisitions	2091.0	80	167,280	83%		
Form 1250	697.0	80	55,760	68%	DD 1348 Follow ups	418.0	80	33,440	16%		
					NAVCOMPT 2156	3	900	2,700	< 1%		
					NAVCOMPT 2157	1	2100	2,100	< 1%		
Sub Total	(1023.2)	(106)	(107,952)	(100%)	Sub Total	(2513.0)	(82)	(205,520)	(100%)	6040.1	569,718
4790/2K&2L	213.5	160	34,160	39%	DD 1348 Requisitions	952.0	80	79,360	83%		
Form 1250	330.5	80	26,440	61%	DD 1348 Follow ups	198.4	80	15,872	16%		
					NAVCOMPT 2156	3	900	2,700	< 1%		
					NAVCOMPT 2157	1	2100	2,100	< 1%		
Sub Total	(544.0)	(111)	(60,600)	(100%)	Sub Total	(1194.4)	(84)	(99,732)	(100%)	2911.0	279,740
4790/2K&2L	79.1	160	12,656	35%	DD 1348 Requisitions	438.0	80	35,040	83%		
Form 1250	146.0	80	11,680	65%	DD 1348 Follow ups	87.6	80	7,008	16%		
					NAVCOMPT 2156	3	900	2,700	< 1%		
					NAVCOMPT 2157	1	2100	2,100	< 1%		
Sub Total	(225.1)	(108)	(24,336)	(100%)	Sub Total	(529.6)	(88)	(46,848)	(100%)	1290.6	126,070
4790/2K&2L	179.8	160	28,768	37%	DD 1348 Requisitions	904.7	80	72,374	83%		
Form 1250	301.5	80	24,121	63%	DD 1348 Follow ups	180.9	80	14,472	16%		
					NAVCOMPT 2156	3	900	2,700	< 1%		
					NAVCOMPT 2157	1	2100	2,100	< 1%		
Total	481.3	110	52,889	100%	Total	1089.6	85	91,646	100%	3028.0	293,625
Maintenance	16% Transactions		18% Characters		Supply/Financial	36% Transactions		32% Characters		100% Transactions	100% Characters

B. Logistic Data Channel Requirements

Using the volume data developed in Table 3, SAI Comsystems developed the following logistic data profiles as the means to defining the SNAP II shipboard logistic data channels size and frequency of use.

1. Pay and Personnel Logistic Data Profile

Pay and personnel logistic data transactions make up about one half of the total shipboard external logistic data communications requirements, i.e., 48% of the transactions and 50% of the characters. The pay and personnel logistic data transactions consist of, on the average: 3% Personnel Diary Entries, 5% OCR Personnel Forms, and 92% OCR Pay Forms. The large percentage of OCR Pay transactions is caused by the NAVCOMPT Forms 3055 and 3056 which are submitted each pay day on the 15th and last day of the month for each man assigned to the ship. Because of this dependence on the OCR pay transactions, the total number of Pay and Personnel Transactions per ship per month can be expressed in terms of the number of personnel assigned. The following algorithms will provide a fair estimate of the shipboard external Pay and Personnel transactions per ship per month:

$$T_{p+p} = 2.48 \times \text{number of personnel assigned.}$$

Where T_{p+p} is the average number of pay and personnel transactions per ship per month.

$$C_{p+p} = 245 \times \text{number of personnel assigned.}$$

Where C_{p+p} is the average number of pay and personnel characters per ship per month.

These algorithms will provide more accurate estimates when an equal mix of both large and small ships are being considered. Smaller ships, especially combatants, tend to have fewer pay and personnel transactions than larger ships. This may be a function of the workload and number of support personnel assigned to the smaller ships. If this is valid, the implementation of SNAP II and PASS Source Data System aboard ship should provide increased capability to support assigned personnel and thereby increase the average number of pay and personnel transactions per month for the smaller ships.

To look at the profile of external pay and personnel communication off-the-ship for any typical month, the average of the 16 ships in the sample was used to plot the following:

Days of the Month	Average Number of Transactions Daily	Average Number of Characters Daily	Cumulative Monthly Number Of Characters
1-14	12	1,275	17,850
15	566	56,675	74,525
16-29	12	1,275	92,415
30	566	56,675	149,090

2. Maintenance Logistic Data Profile

The maintenance logistic data reported off-the-ship is the smallest volume of all the external logistic data, i.e., 16% of the transactions and 18% of the characters. The ship's maintenance reporting requirements are determined by OPNAVINST 4790.4, 3M Manual, Volume II. The two forms used to report maintenance data off-the-ship are the OPNAV 4790/2K with supplemental form 4790/2L if required, and DD Form 1250. Not all OPNAV 4790/2K or 2L forms prepared by shipboard maintenance personnel are required to be sent off-the-ship. Only the maintenance deferred or completed for those equipments on the Selected Equipment List, published by MSOD, require submission of OPNAV 4790/2K to MSOD each week. The DD Form 1250 is required to be prepared and submitted weekly to MSOD for every completed maintenance action requiring the use of spare parts. The ratio of surface ship maintenance reporting off-ship between these two forms is 37% OPNAV 4790/2K and 2L and 63% DD form 1250.

NOTE: (In Table 3, the percentage of Total Transactions for amphibious ships maintenance is misleading due to very low maintenance activity of sample ship Tripoli LPH-10. If LPH-10 data is deleted the amphibious ships transaction ratio is more in line with 37 to 63 ratio of the average ship).

The volume of OPNAV 4790/2K's sent off the ships to the data processing centers for preparation of the Current Ships Maintenance Projects (CSMP) will be unnecessary for SNAP II ships. The CSMP will be prepared and maintained aboard ship using the SNAP II equipment when installed.

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To look at the profile of external maintenance communications off-the-ship for any typical month, the average of the 16 ships in the sample was used to plot the following:

Days of the Month	Average Number of Transactions Daily	Average Number of Characters Daily	Monthly Cumulative Number of Characters
1-5	16	1,763	8,815
6-30	16	1,763	52,889

The typical weekly submission of maintenance data to MSOD will consist of 30 OPNAV 4790/2K forms and 50 DD 1250 Forms, i.e., 80 Maintenance Transactions or 8,815 characters per ship every 5 days.

3. Supply and Financial Logistic Data Profile

The supply and finanical data reported off-the-ship makes up approximately one third (1/3) of the total external logistic data volume, i.e., 36% of the transactions and 32% of the characters. The ratio between supply transactions and financial reports is 99% supply and 1% financial. The actual number of supply transactions was not available for each of the sample ships by unit identification code, therefore SAI Comsystems used the following procedures to estimate the number of DD 1348 transactions per ship per month.

SAI Comsystems was told by SURFLANT that for each DD 1250 prepared by the ship for significant spare parts (excluding pre-expended bin materials) a DD Form 1348 Supply Requisition was prepared to replace the spare part used in shipboard maintenance. There is a 1 to 1 ratio between significant spare parts used for maintenance (DD 1250) and supply requisitions for spare parts replenishment (DD 1348). Since the number of 1250s per ship per month, used in maintenance for significant spare parts (excluding pre-expended and consumable supplies), was obtained from MSOD for the sample ships, SAI was able to determine the number of DD1348 spare parts requisitions. SURFLANT also reported that the spare parts requisitions were approximately one third (1/3) of the total ship's supply demands, and that consumable supplies make up the other two thirds. (2/3). Based on this information, SAI Comsystems derived

the number of DD 1348 requisitions per ship per month by the following formula:

$$
\left[\begin{array}{c}
\text{Number of} \\
\text{DD 1250s} \\
\text{per ship} \\
\text{per month}
\end{array} \quad X \quad 3 \right] + 20\% =
\begin{array}{l}
\text{TOTAL Number of} \\
\text{Supply DD 1348} \\
\text{Transactions per} \\
\text{ship per month.}
\end{array}
$$

(Significant spare parts requisitions)   (Consumable supplies requisitions)   (Requisition follow-ups)

The 20 % requisition follow-up was derived from a supply transaction volume study for the automated supply ships which was obtained from NAVSUPSYSCOM. This data showed that approximately 20% of the DD 1348's submitted by the ships were followed up with a status request. The status request for the automated ships is a resubmission of the original DD 1348 coded to request status in accordance with NAVSUP-P-485.

The financial reports submitted off-the-ship was much more straight forward and derived from NAVSO P-3010-2. The volume of financial reports is quite small compared to the volume of DD 1348's. There are 4 Supply Financial Reports submitted per ship per month which make up less than 1% of the total transactions and 5% of the total characters.

To look at the profile of external supply and financial communications off-the-ship for any typical month, the average of the 16 ships in the sample was used to plot the following:

Day of the Month	Average Number of Transactions Daily	Average Number of Characters Daily	Monthly Cumulative Number of characters
1	36	2,895	2,895
2	37	4,995	7,890
3-9	36	2,895	28,155
10	37	3,795	31,950
11-19	36	2,895	58,005
20	37	3,795	61,800
21-29	36	2,895	87,851
30	37	3,795	91,646

4. Average Ship's Total External Logistic Data Channel Requirements

The channel size and frequency of use for the average ship's total external logistic data communicated off the ship was developed from the individual profiles of the three functional areas, i.e., Pay and Personnel, Maintenance, and Supply/Financial. The channel requirements developed by SAI Comsystems is shown in Figure 1. This figure shows the average number (volume) of characters communicated off the ship per day during a 30 day month. Each day's volume is coded to show the type of logistic data and amount of characters for each type which are communicated off the ship each day of the month. Analyzing the data in Figure 1 the channel requirements of total external logistic data volume in characters per day communicated off the average ship is:

TOTAL EXTERNAL LOGISTIC DATA VOLUME FOR AVERAGE SHIP IN CHARACTERS PER DAY		
HIGH*	LOW*	AVERAGE
60,470	4,170	9,788

*Where the High and Low daily volumes are equal to 6.178 and 0.426 times the Average daily volume, respectively.

5. All SNAP II Surface Platforms Total External Logistic Channel Requirements.

With the total external logistic data channel requirements developed for an average ship based on the sample of 16 ships, consideration was given to the total logistic data required for off ship communications from all the surface ships planned to receive the SNAP II installation. Based on the SNAP II ADS Plan there are a total of 277 surface ships projected for SNAP II hardware. Using these ships and the logistic transaction data previously defined, SAI Comsystems developed the total external logistic data communication requirements for all projected SNAP II surface ships. The results of this effort are shown in Table 4. These results are of particular interest, in that, the weighted monthly averages per ship for total numbers of transactions and characters for all
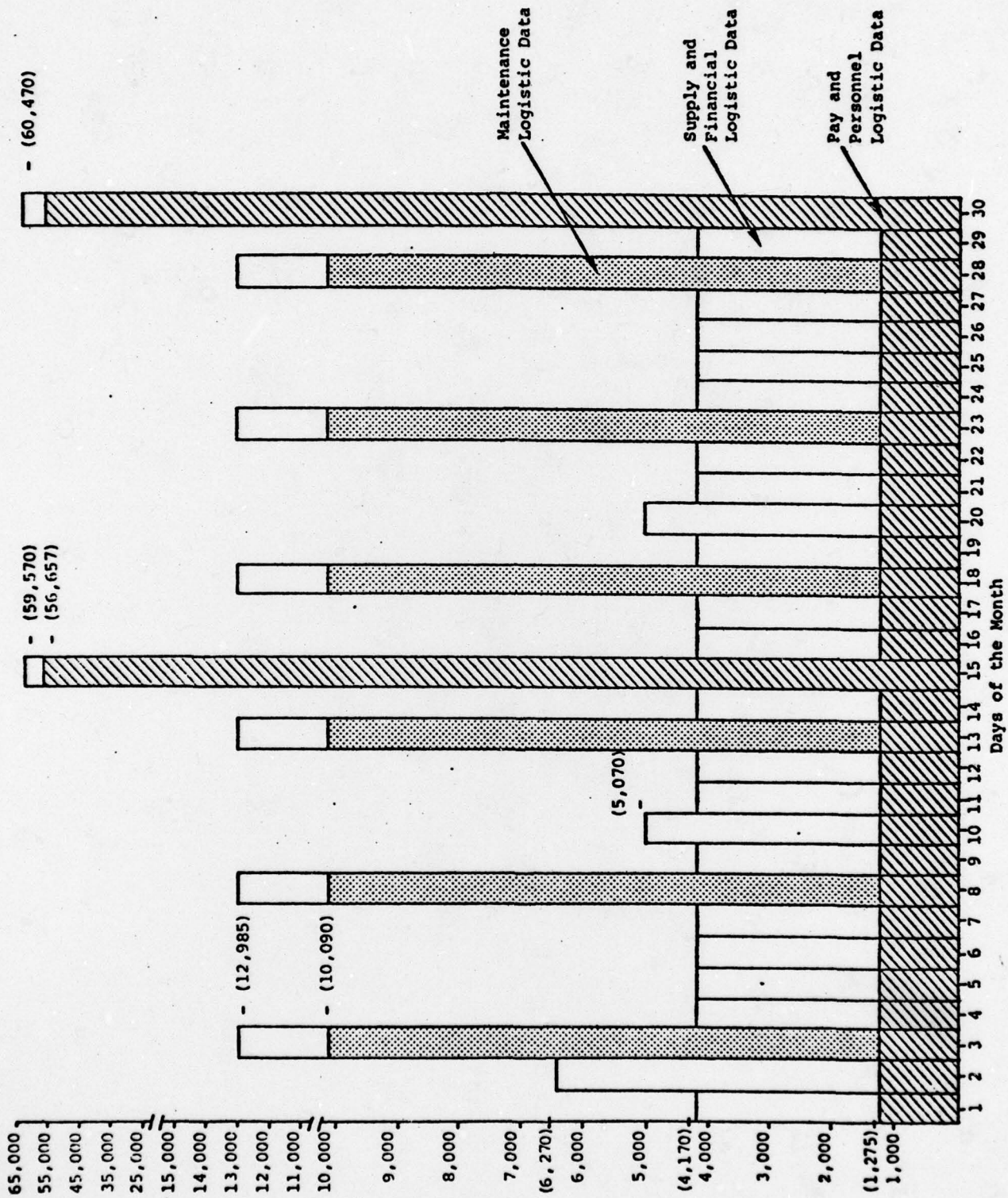
28

Figure 1 - SNAP II Average Ship's Total External Logistics Data Channel Requirements Expressed in Average Number of Characters per Day for a 30 Day Month

TABLE 4 - TOTAL EXTERNAL LOGISTICS DATA VOLUME FOR ALL SNAP II SURFACE SHIPS PER MONTH BY SHIPS TYPES

PROJECTED SNAP II SURFACE PLATFORMS BY TYPE AND CLASS	NUMBER OF EACH PLATFORM FY-78	PERCENT OF TOTAL SURFACE PLATFORMS	AVERAGE MONTHLY EXTERNAL LOGISTICS DATA COMMUNICATIONS BY FUNCTIONAL SHIPBOARD AREA						TOTAL MONTHLY EXTERNAL LOGISTICS DATA COMMUNICATIONS REQUIREMENTS			
			PAY AND PERSONNEL		MAINTENANCE		SUPPLY AND FINANCIAL		AVERAGE PER SHIP PER MONTH		TOTAL ALL SURFACE PLATFORMS PER MONTH	
			NUMBER OF TRANSACTIONS PER SHIP	NUMBER OF CHARACTERS PER SHIP	NUMBER OF TRANSACTIONS PER SHIP	NUMBER OF CHARACTERS PER SHIP	NUMBER OF TRANSACTIONS PER SHIP	NUMBER OF CHARACTERS PER SHIP	NUMBER OF TRANSACTIONS	NUMBER OF CHARACTERS	NUMBER OF TRANSACTIONS	NUMBER OF CHARACTERS
1 Supply Ships - AE, AF, AFDB, AG, AO, ACE, AOR, ASR, AFDM	48	17%	1301.3	133,980	328.0	35,912	749.7	64,454	2379.0	234,346	114,192	11,248,608
2 Amphibious Ships LKA, LXA, LPA, LPD, LPH, LSD, LST	61	22%	1771.8	180,850	286.3	35,648	461.2	41,376	2519.3	257,874	153,677	15,730,314
3 Large Combatants CG, CGN, LCC a Heavy Cruisers	7	3%	2503.9	256,246	1023.2	107,952	2513.0	205,520	6040.1	569,718	42,281	3,988,026
b Light Cruisers	23	8%	1172.6	119,408	544.0	60,600	1194.4	99,732	2911.0	279,740	66,953	6,434,020
4 Small Combatants DD,DDG,FF,FFG	138	50%	535.9	54,886	225.1	24,336	529.6	46,848	1290.0	126,070	178,103	17,397,660
Weighted Average for all Projected SNAP II Platforms	277	100%	1043.3	106,777	303.1	33,957	658.0	57,095	2004.4	197,829	555,206	54,790,628
Percent of Total External Logistic Data Volume			52%	54%	15%	17%	33%	29%	100%	100%		

projected SNAP II platforms are less than those computed for the
average ship shown in Table 3. This is because of the transaction
differences between the types of ships and the differences between
the number of installations projected for each type of ship. The
averages for each type of ship must be weighted by the number of
projected SNAP II installations for each type of ship. For example,
the projected 138 small combatants make up 50% of the total SNAP II
installations. The differences in total external logistic data be-
tween weighted and unweighted average ship is shown below:

TOTAL EXTERNAL LOGISTIC DATA	AVERAGE SHIP UNWEIGHTED SAMPLE OF 16 SHIPS (TABLE 3)	AVERAGE SHIP WEIGHTED FOR 277 SURFACE PLAT-FORMS (TABLE 4)
Number of Transactions Per Ship/Month	3028.0	2004.4
Number of Characters Per Ship/Month	293,625	197,829

Although the weighted average for total external logistic data is lower
than the unweighted sample, the percent of total external logistic data
volume of characters by functional area remains approximately the same,
i.e., 50% to 54% Pay and Personnel, 18% to 17% Maintenance, and 32% to
29% for Supply and Financial.

Using the weighted average ship data in Table 4, the total external
logistic data volume for 277 SNAP II ships is tabulated by number of
average transactions and characters per month and pay day below:

	TOTAL LOGISTIC DATA 277 SHIPS PER MONTH	TOTAL LOGISTIC DATA 277 SHIPS PER DAY*
NUMBER OF TRANSACTIONS	555,206	18,507
NUMBER OF CHARACTERS	54,798,628	1,826,621

* (30 day month)

Using the 1,826,621 characters per day from 277 SNAP II ships, the chan-
nel size and frequency of use for the total external logistic data
volme of characters per day communicated off the projected SNAP II
ships was tabulated as follows:

Average Volume
Per Day

```
                                    ┌─────────────────┐                              High Volume
                           ⎛54%⎞ = │Average Number   │                   ⎛6.178⎞= Per Day
┌─────────────────┐        ⎝   ⎠   │of Pay and Per-  │                   ⎝     ⎠
│Total Logistic   │                │sonnel Characters│
│Data Volume      │                └─────────────────┘
│Per Day for       │─X─⎛17%⎞ = ┌─────────────────┐──X──
│277 Ships        │    ⎝   ⎠   │Average Number of│
│in Characters    │            │Maintenance Charac-│
└─────────────────┘            │ters.            │
                               └─────────────────┘
                           ⎛29%⎞  ┌─────────────────┐                              Low Volume
                           ⎝   ⎠  │Average Number of│                   ⎛0.426⎞= Per Day
                                  │Supply and Finan-│                   ⎝     ⎠
                                  │cial Characters  │
                                  └─────────────────┘
```
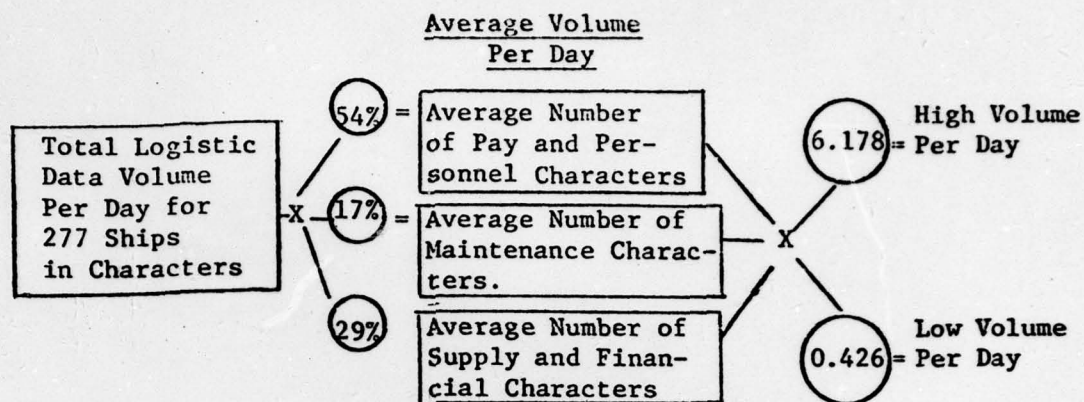
The channel requirements for all SNAP II surface platforms total external logistic data volume in characters per day is shown below:

FUNCTIONAL AREAS	TOTAL EXTERNAL LOGISTIC DATA VOLUME FOR 277 SNAP II SHIPS IN CHARACTERS PER DAY		
	HIGH	LOW	AVERAGE
Pay and Personnel 54%	6,093,824	420,196	986,375
Maintenance 17%	1,918,430	132,284	310,526
Supply and Financial 29%	3,272,610	225,660	529,720
Total All Functional Areas 100%	11,284,864	778,140	1,826,621

By dividing 277 into the total (all functional areas) external logistic data volume of all projected SNAP II ships, the average ship's channel requirements for logistics volume in characters per ship per day was derived as shown below:

TOTAL EXTERNAL LOGISTIC DATA VOLUME FOR AVERAGE SNAP II SHIP IN CHARACTERS PER DAY.		
HIGH	LOW	AVERAGE
40,740	2,809	6,594

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C. Evaluation of Logistic. Data Channel Assignment

To assign the volume of logistic data identified for off-ship communications
to various communication channels, the volume in characters must be con-
verted into bits of information. This conversion is rather simple for the
channels considered in this study, i.e., 1 character is equal to 10 bits.
Therefore, the logistic. channel requirements in characters per day times
10 is equal to the logistic channel requirements in bits per day. Using
this conversion, the total external logistic data volume for the average
SNAP II ship in bits per day is:

- High – 497,400
- Low –   28,090
- Ave.-   65,940

With the total logistic volume identified in bits per day, SAI Comsystems re-
lated this volume to various communication channels which vary in speed and
accuracy. The evaluation of each of these communication channels is dis-
cussed below:

1. Manual Channels.

   a. U.S. Mail – This is the slowest of the communication channels eval-
       uated with a speed of 2 to 7 days depending on mode of travel. This
       channel should be used when the off-ship user requirements can be
       satisfied in days vice hours. The most promising SNAP II off-ship
       media for U.S. Mail would be the flexible (floppy) disc which has
       temporary storage capacities of 90,000 to 2,000,000 bits of information.
       The floppy disc is light in weight and fits easily into a standard
       8 x 10 inch envelope. This channel is available to the SNAP II ships
       both at sea and in port.

   b. Hand Carry – This communication channel is available to the ships
       when in port and if the off-ship user is within 1 to 2 hours of the
       ship, using local transportation. The off-ship media could be hard
       copy of digital/magnetic depending on off-ship user requirements.

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2. Electronic Channels – (Voice, Radio, and Optical)

    a. <u>Existing Voice Grade Lines</u> – These communication channels are available when in port where the ship plugs into the existing telephone lines. These low grade voice lines can operate between 600 and 2400 bits per second. Although, these speeds are adequate for transmission of shipboard logistic data, the reliability of these lines for digital data is low and requires frequent retransmission to insure good copy. AT&T type 3002 plus C1 or C2 conditioning are examples of these types of low speed voice lines.

    b. <u>Dataphone Digital Service (DDS)</u>– DDS is an AT&T end-to-end data transmission system designed specifically to transmit data from one business machine to another in digital form throughout. It offers full duplex point-to-point and multipoint private line service. The mode of transmission is synchronous and speeds of 2400, 4800, 9600, and 56,000 bits per second are offered. Service is considered better than transmission on voice grade or other analog channels. The advertised reliability of DDS is slightly greater than 99.5 percent error free seconds at 56 KBS with better performance at lower speeds. This exceeds the level of performance presently available with transmissions via voice grade channels and should reduce the time spent in retransmission of data in which errors have been detected. The major disadvantage of DDS is that AT&T does not presently have service to all off-ship user locations. When full service is available, the SNAP II ships in CONUS ports could enter the system via land line connections and via Fleet Satellite Communication System when at sea or in non-CONUS ports.. The satellite communication system is discussed later under NAVMACS (paragraph e) below. The following charts show the approximate time, in seconds required to transmit the total volume of logistic data from the average SNAP II ship per day,via the different DDS transmission speeds available:

Total Logistic Data Average Ship in Bits per Day	DDS Transmission Speeds in Bits per Second			
	2400	4800	9600	56,000
High – 407,400	170 sec.	85 sec	43 sec.	7.3 sec.
Low – 28,090	12 sec.	6 sec.	3 sec.	0.5 sec.
Avg – 65,940	28 sec.	14 sec.	7 sec.	1.2 sec.

c. AUTODIN II - AUTODIN II, phase I is a CONUS based communication
    service which will utilize packet technology as the primary
    technique. A packet is defined as a group of binary digits in-
    cluding data and call control signals which is switched as a com-
    posite whole. The data, call control signals, and possibly error
    control information are arranged in specified format. Packet
    switching is the transmission of data by means of addressed packets,
    whereby a transmission channel is occupied for the duration of the
    transmission of the packet only. Packet switching is intended pri-
    marily for real time machine-to-machine traffic, including ter-
    minal-to-computer connections, and is employed to build
    networks. The AUTODIN II packet switching network may be expected
    to deliver its packet in a fraction of a second at rates up to
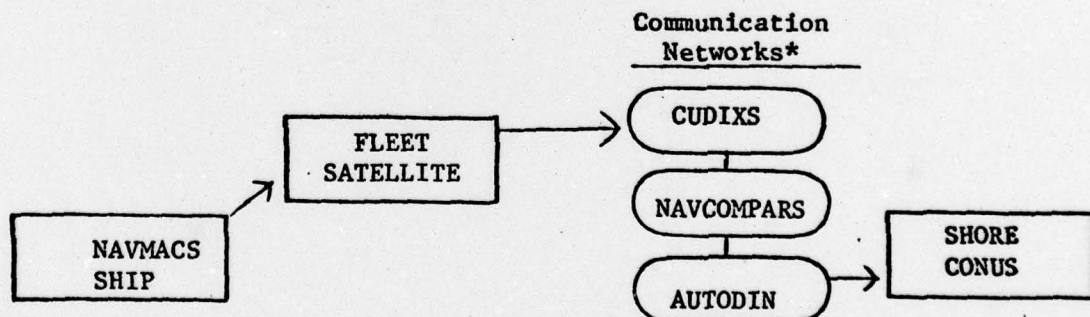   56,000 bits per second.

    Initial operation capability (IOC) of AUTODIN II, phase I is plan-
    ned for 1979. The Office of Secretary of Defense, (OSD), DTACCS,
    has directed that all DOD ADP systems will use AUTODIN II unless
    strong arguments based on special economic or operational considera-
    tions can be presented to support the use of an alternative network.
    COMNAVTELCOM will fund for all validated AUTODIN II usage for ac-
    tivities of the Department of the Navy. The external logistic data
    communication requirements for the SNAP II program placed this sys-
    tem in the category of being an AUTODIN II candidate. Since this
    is a CONUS based network, the shipboard procedures for entering
    the system are the same as discussed for the Dataphone Digital Ser-
    vice (DDS).

d. Conventional Radio Teletype - This standard shipboard communication channel operates at a sub-voice speed of 75 bits per second. At this speed the average SNAP II ship would require approximately 15 minutes of channel time a day. During peak conditions approximately 1 hour and 30 minutes of channel time would be required for external logistic data communications. It is highly probable that during peak reporting conditions with multi-ship reporting, the conventional RATT circuits would be overloaded and unable to handle the shipboard logistic data communication requirements. This, combined with the ship's operational use of these circuits and the availability of higher speed radio channels, makes RATT an unattractive choice as the primary channel for transmission of logistic data.

e. Naval Modular Automated Communications System (NAVMACS) - NAVMACS incorporates currently employed message communication methods and equipment into a totally new automated system that offers unprecedented realms of communication capability. It is designed to greatly increase the speed, efficiency and capacity of all phases of Naval afloat and ashore telecommunications operations, while vastly reducing man hours and margin of error in existing systems. The NAVMACS system presently consists of five configurations which are identified below:

    (1) The V1 system is a low cost NAVMACS with a design to cost objective of $100K. Although this system is currently under development, it will probably consist of a single AN/UYK-20 with two teleprinter units, and utilize paper tape as recording medium. This system is planned on 93 ships of the AE/ARS/ATF/ATS/DD/FF/LKA/LSA/LST classes.

    (2) The V2 system (also known as A+) is currently a follow-on test and evaluation program. The system is presently installed on 46 ships with another 16 planned for installation during the next several years. This system is planned for

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121 ships of the AD/AE/AOE/AOR/AR/CG-51/CV-41/FFG/LPA/LPD classes.

(3) The V3 system, which is currently in the OPEVAL cycle, is the medium sized system and utilizes the AN/USH-26 cartridge magnetic tape unit as the data medium. This unit is planned for 49 ships of the CG/DD-963/DDG classes.

(4) The V4 system, which is not yet under development, will be installed on 17 AF/AS classes of ships.

(5) The V5 system is the largest of the NAVMACS systems and will have the capabilities of distributing and receiving message traffic from remote terminals. This system is planned for 46 ships of the AGF/CG/CGN/CV/CVN-65/LCC/LPD/LPH classes.

The NAVMACS system is capable of processing data at the rate of 2400 bits per second via full duplex MIL-STD-188C, serial, ASCII, a synchronous 2400 buad line. NAVMACS ships at sea communicate with shore activities via Fleet Satellite Communications System. The information flow between ship and shore activity is:

```
                                    Communication
                                     Networks*
                                    _____

                                    ( CUDIXS )
       ┌───────────┐                    │
       │  FLEET    │───▶            (NAVCOMPARS)          ┌─────────┐
       │ SATELLITE │                                      │  SHORE  │
       └───────────┘                    │                 │  CONUS  │
  ┌──────────┐                      ( AUTODIN )──▶         └─────────┘
  │ NAVMACS  │───▶
  │  SHIP    │
  └──────────┘
```

* Networks:
  • CUDIXS – Common User Digital Information Exchange System
  • NAVCOMPARS – Naval Communication Processing and Routing System
  • AUTODIN – Automatic Digital Information Network.

The satellite acts as a microwave relay receiving data at one fre-
quency and transmitting the same data back to earth stations at a
higher frequency. Today's satellites are capable of processing data
at the rate of 50 million bits per second or, depending on the design,
can have 400 channels of 64,000 bps, 600 channels of 40,000 bps, etc.
Because of the satellite's very large capacity to process data and the
numerous possible channels, the NAVMACS provides the best choice for
communicating logistic data to off-ship users when the SNAP II ship
is at sea. On the NAVMACS 2400 baud line (2400 bits per sec) the
SNAP II ship would take approximately 28 seconds to transmit its
logistic data on the average day,and slightly less than 3 minutes
on peak days.

    f. <u>Optical Communications</u> - Recent experiments with infrared and optical
links have been used for transmission of data. These transmissions
require line-of sight (LOS) links and are capable of carrying up to
several million bits per second. Such links can be established at
low cost and require no license to operate as do microwave links.
Their main disadvantage is that the links can be put out of operation
for a brief period by rain downpours of abnormal intensity and for a
longer period by thick fog. However, optical ship-to-shore communi-
cations of logistic data by SNAP II ships in port is certainly feasi-
ble for the expanded SNAP II system. This channel is explored in more
detail in the Final Report - Part 2.

D. <u>Recommendations for SNAP II Logistic Data Channel Assignments</u> - The re-
commendations for SNAP II nucleus system external logistic data channel require-
ments is based on SAI Comsystems'assessment of the various information channels,
discussed above, to transmit the volumes of logistic data identified in this
study, to the off-ship users in accordance with the present reporting require-
ments. The current and near term recommended channel assignments for the SNAP
II nucleus system are shown in Table 5. For each type of logistic data, the
recommended primary and back-up channel is listed for SNAP II ships when At
Sea, In Port Overseas, or In Port Continental United States (CONUS).

TABLE 5 - Recommended Current and Near Term External Logistic Data Channel Assignments for SNAP II Nucleus System.

LOGISTIC DATA	RECOMMEND CURRENT AND NEAR TERM COMMUNICATION CHANNEL ASSIGNMENTS		
	AT SEA	IN PORT OVERSEAS	IN PORT CONUS
PAY & PERSONNEL	NAVMACS-(Primary) Conventional RATT-(Back-up).	Hand Carry to PASS Office if Available, Otherwise Use At-Sea Channels.	AUTODIN II - (Primary) Hand Carry to PASS Office (Back-up)
MAINTENANCE	U.S. Mail-(Primary) NAVMACS-(Back-up)	U.S. Mail-(Primary) NAVMACS-(Back-up)	AUTODIN II - (Primary) U.S. Mail - (Back-up)
SUPPLY REQUISITIONS	NAVMACS-(Primary) Conventional RATT-(Back-up)	Hand Carry to Supply Center if Available, Otherwise Use At-Sea Channels	AUTODIN II - (Primary) Hand Carry to Supply Center-(Back-up)
SUPPLY FINANCIAL	NAVMACS-(Primary) Conventional RATT-(Back-up)	NAVMACS-(Primary) Conventional RATT-(Back-up)	AUTODIN II-(Primary) U.S. Mail - (Back-up)