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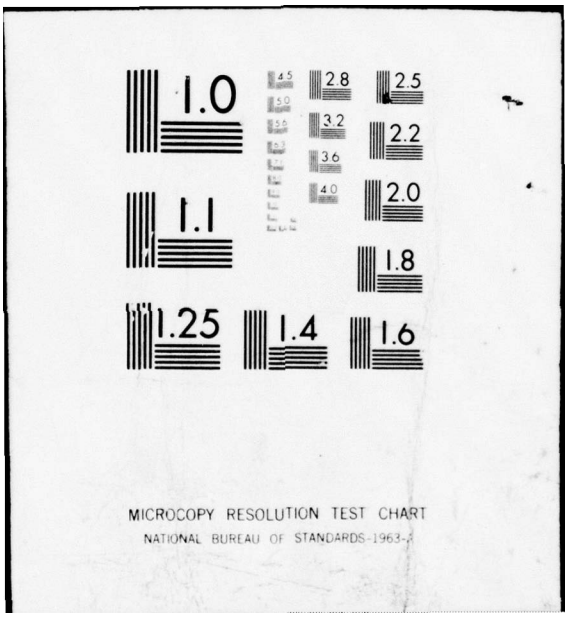
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TECHNICAL REPORT 104

COMPUTER ASSISTED PRACTICE OF CARDIOLOGY (CAPOC) PHASE 1: COMMUNICATIONS STUDY FOR NAVAL REGIONAL MEDICAL CENTER (NRMC) SAN DIEGO

Thomas L Comport

Approved for public release; distribution is unlimited

16 March 1977

Prepared for
DoD Tri-Service Medical Information System
Program Office

R&D, December 1976 to March 1977

NAVAL OCEAN SYSTEMS CENTER
SAN DIEGO, CALIFORNIA 92152

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

Twelve communication methodologies, determined to have the proper data transfer capabilities and cost requirements, were evaluated and further narrowed to four systems suitable to meet CAPOC operational requirements. Fixed and operational costs were then compared to determine the least-cost communication support subsystem. The analysis revealed that no one system was most cost-effective for all sites. Therefore, a hybrid communication system, containing the flexibility for change in networks and the capability to satisfy all requirements at the least possible cost, was recommended. The hybrid network proved to be significantly more cost-effective than using one specific system.

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The scope of this analysis was limited to the communication support subsystem and activities directly pertinent thereto.

OBJECTIVE

Examine available alternatives for a telecommunications network to support automatic data processing equipment which is programmed to provide electrocardiogram analysis support to selected DoD medical treatment facilities.

RESULTS

1. Various communications systems were studied, including combinations of systems, in order to define a telecommunication configuration that will be cost-effective and adequately support the NRMC San Diego CAPOC system.

2. The following systems were considered inadequate: Dataphone Digital Service, Microwave, Automatic Voice Network (AUTOVON), Automatic Digital Network (AUTODIN), AUTODIN II, satellite communications, Telenet Communications, Advanced Research Projects Agency Network (ARPANET), and Foreign Exchange System (FEX).

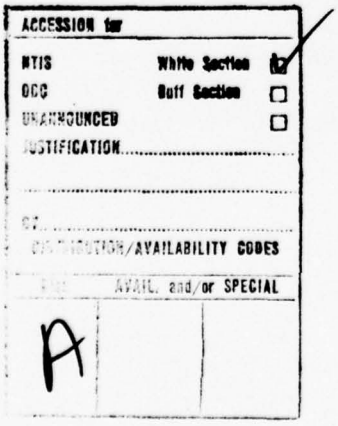
3. The following systems were considered adequate: leased lines, direct distance dialing, Federal Telecommunications System, and Wide Area Telephone Service.

RECOMMENDATION

1. It is recommended that a hybrid communication system be used to provide the flexibility for change in networks required by increased or decreased traffic volumes and ensure that all requirements will be satisfied at the least possible cost.

ADMINISTRATIVE INFORMATION

Work was done from December 1976 to March 1977 under NELC B905 by the Command Control and Communications Programs Department (Code 721). The report was approved for publication 16 March 1977.



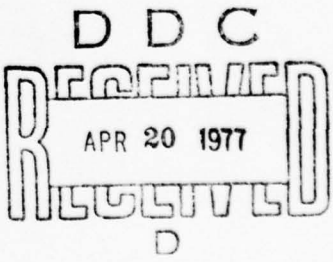


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EXECUTIVE SUMMARY

This document contains a communication requirements analysis for the Computer Assisted Practice of Cardiology (CAPOC) system, to provide automated remote electrocardiogram (ECG) support to Department of Defense hospitals and clinics. This report constitutes phase 1 of a three phase study, sponsored by the Department of Defense Tri-Service Medical Information System Program Office, and covers the Southwestern regions of Nevada and California. The goals of phase 1 of this project were:

(1) To define analog and digital data communication requirements,

(2) To perform cost analysis of communication systems alternatives and,

(3) To identify the least-cost communication system which will meet CAPOC requirements.

Twelve communication methodologies, determined to have the proper data transfer capabilities and cost requirements, were evaluated and further narrowed to four systems suitable to meet CAPOC operational requirements. Fixed and operational costs were then compared to determine the least-cost communication support subsystem. Included in this analysis was a study of electrocardiogram retrieval (duplications) requests to determine their volume and cost impact upon the CAPOC system.

The analysis revealed that no one system was most cost effective for all sites. Therefore, a hybrid communication system,

containing the flexibility for change in networks and the capability to satisfy all requirements at the least possible cost, was recommended. The hybrid network proved to be significantly more cost-effective than using one specific system. To test the utility of the hybrid network, a ten percent increase and a ten percent decrease in monthly traffic volume was calculated. These tests supported the hybrid network selection in that a ten percent increase or decrease in volume affected system cost by only three percent and required only a moderate change in the original circuit composition.

The scope of this analysis was limited to the communication support subsystem and activities directly pertinent thereto.

1.0 INTRODUCTION

This document defines phase 1 communication support requirements and provides cost and performance analysis of alternate methods of transferring analog and digital electrocardiogram information between a central computer site and its associated overread centers and satellite medical treatment facility users.

1.1 Purpose

The communications study contained herein examines available alternatives for a telecommunications network to support Automatic Data Processing Equipment (ADPE) which is programmed to provide electrocardiogram (ECG) analysis support to selected Department of Defense (DOD) Medical Treatment Facilities (MTFs). Specifically, this study covers the Southwestern regions of Nevada and California associated with the Computer Assisted Practice of Cardiology (CAPOC) system that is scheduled for installation at the Naval Regional Medical Center (NRMC), San Diego, California.

This report includes studies pertinent to:

a. Comparison of available alternative communication methodologies and/or combinations thereof capable of supporting the NRMC San Diego CAPOC system.

b. Requirements for a specific communication system.

c. Costs associated with each communication system analyzed.

The objective of this report is to identify a least-cost communications network for the CAPOC system. Recommendations contained in this study are based on the Automated Data Processing Equipment (ADPE) being located at the NRMC San Diego.

1.2 Background.

The Department of Defense (DOD) Tri-Service Medical Information System (TRIMIS) Program Office (TPO) is planning the acquisition of CAPOC systems to provide automated local and remote ECG analysis support to selected MTFs within the DOD. The first CAPOC system, with its supporting ADPE is scheduled to be installed in the NRMC San Diego, California. This CAPOC system will service the MTFs listed in table 1-1.

The Tri-Service Medical Information System Program Office has tasked the Naval Ocean Systems Center (NOSC) San Diego, California to conduct a threefold study of:

a. The effective linking of the MTFs to the CAPOC central computer site in order to provide optimum operational capability.

b. Determination of the data communications network requirements for projected workloads.

c. Determination of specific communications equipments required.

Table 1-1. Medical Treatment Facilities Serviced by the Naval Hospital (NH) San Diego CAPOC Computer Site

SITE AND FUNCTION	LOCATION	DISTANCE (MILES) BETWEEN	
		COMPUTER SITE & USERS	OVERREAD & USERS
NRMC San Diego (Computer, overread and user site)	Naval Hospital San Diego, CA	Collocated	Collocated
Marine Corps Base 29 Palms (user)	Twenty-Nine Palms, CA	117	117
Naval Station San Diego (user)	San Diego, CA	5	5
Naval Air Station North Island (user)	San Diego, CA	3	3
Naval Amphibious Base Coronado (user)	Coronado, CA	3	3
Naval Air Station Miramar (user)	San Diego, CA	9	9
Naval Training Center (user)	San Diego, CA	4	4
Marine Corps Recruit Depot (user)	San Diego, CA	3	3
NRMC Long Beach (overread/user)	Long Beach, CA	96	Collocated
Marine Corps Air Station (user)	Santa Ana, CA	84	26
Naval Hospital Port Hueneme (user)	Port Hueneme, CA	157	100
NRMC Camp Pendleton (overread/user)	Camp Pendleton, CA	37	Collocated
AFH March AFB (overread/user)	Riverside, CA	83	Collocated
AFH Edwards AFB (user)	Edwards, CA	160	78
AFH George AFB (user)	Victorville, CA	127	44
AFCL Norton AFB (user)	San Bernardino, CA	98	11
AFH Vandenburg AFB (user)	Lompoc, CA	235	196
AFH Nellis AFB (user)	Las Vegas, NV	264	201

NOTE: Overread centers precede their satellite user sites.

2.0 SCOPE

This study examines various telecommunications networks, and combinations thereof, to interconnect the NRMC San Diego CAPOC central site to its collocated and remote overread centers and user facilities. Additionally, user site ECG retrieval requests were investigated to determine volume and cost impact. A cost analysis of applicable telecommunication systems was conducted to determine the optimum network configuration for a Southwestern area CAPOC communication system. To determine the sensitivity of the recommended CAPOC network to changes in traffic volume, the effect of a ten percent increase and decrease in traffic volume was evaluated.

2.1 Limitation

The analysis contained herein is limited to communication support for the NRMC San Diego CAPOC system computer site, remote user sites and overread centers (see table 1-1). This analysis encompasses data rates, transmission times, transmission methods, projected workloads, modems and cost summaries on recurring and nonrecurring costs. It does not include the effects of host processor hardware or software, detailed cost analysis of terminal equipment, nor the study of site availability and preparation for equipment installation.

2.2 Data Transfer Requirements

Information developed within the Naval Medical Data Services Center, Bethesda, Maryland has been reviewed and a matrix of traffic requirements was developed (table 2-1) indicating the information

Table 2-1. Daily Transmissions at Computer, Overreads and Remote User Sites

SITES	COMPUTER AND OVERREAD CENTERS					COMPUTER AND REMOTE USER	
	ANALOG INPUT TO COMPUTER (1 min each)	EDITING AND RETRIEVAL TO COMPUTER (1 min each)	REPORTS TO OVERREADS (10 sec ea.)	REPORTS TO COLLOCATED USERS (10 sec ea.)	TRACINGS TO OVERREADS (1 min each)	ANALOG INPUT TO COMPUTER (1 min each)	COMPUTER REPORTS TO REMOTE USERS (1 min each)
NRMC San Diego, CA	178	365	365	178	365		
NRMC Long Beach, CA	45	109	109	45	109		
NRMC Camp Pendleton, CA	66	100	100	66	100		
AFH March, Riverside, CA	29	112	112	29	112		
MCB 29 Palms, CA						4	5
NAVSTA San Diego, CA						14	16
NAS North Island, San Diego, CA						11	12
NAB Coronado, CA						8	12
MCRD, San Diego, CA						6	7
NAS Miramar, San Diego, CA						6	7
NTC San Diego, CA						8	10
MCAS Santa Ana, CA						17	20
NH Port Hueneme, CA						18	26
AFH Edwards, Edwards, CA						8	9
AFH George, Victorville, CA						10	11
AFCL Norton, San Bernardino, CA						11	14
AFH Vandenburg, Lompoc, CA						19	20
AFH Nellis, Las Vegas, NV						12	19
TOTALS	318	686	686	318	686	152	188

to be transferred between sites. This matrix reflects the number of daily transmissions handled by each site. Some batch mode transmissions are anticipated; however, the number of ECGs that will be batch transmitted cannot be determined. Requirements also exist for two different forms of signals (analog and digital) to be used in transferring ECG information. Input to the CAPOC computer from ECG carts will be in analog form. CAPOC computer output, in digital form, (to overread centers and user sites) will be at data rates of 1200 bps and 300 bps respectively as shown in figure 2-1.

2.2.1 Transmission Time

From the matrix developed in table 2-1, transmission time per month was calculated in relation to direct ECG inputs, retrievals, edits, tracings and computer output. ECG transactions (whether direct analog input, computer tracings and/or reports to overreads or users and editing and retrieval processing between the computer and overreads) were specified to require an average of one minute transmission time. Retrieval requests, from remote user sites to overreads, are estimated at two minutes in duration. Computer reports to overreads require ten seconds transmission time. Some transactions occur in parallel; e.g., an ECG analysis and its associated tracing are transmitted from the computer site to an overread center simultaneously on separate lines to different terminals. Each transaction must therefore be considered, for cost and line analysis, as individual transmissions. Monthly volumes

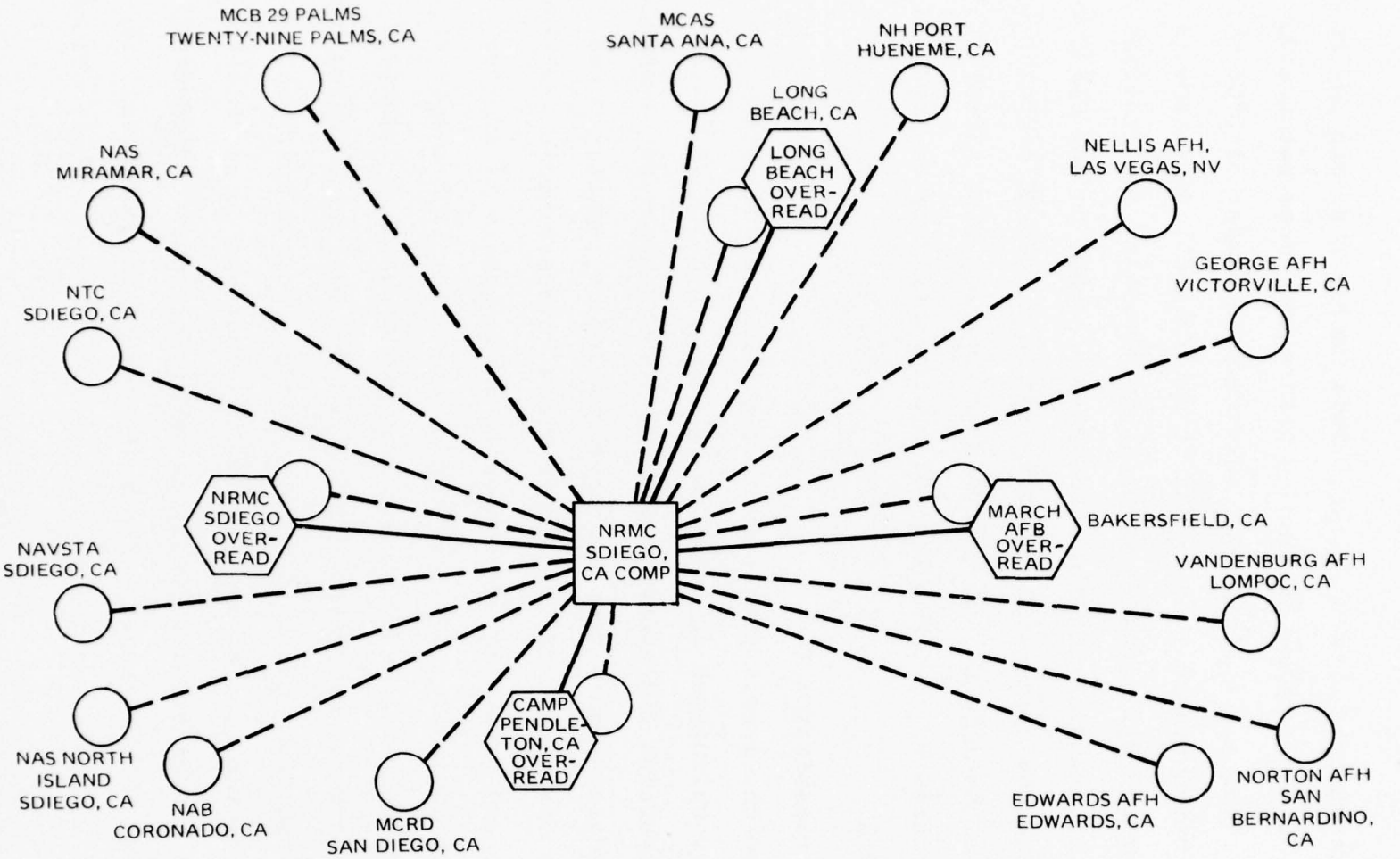


FIGURE 2-1. NAVAL HOSPITAL SAN DIEGO CAPOC SYSTEM COMMUNICATION CONFIGURATION

and transmission times for each of the medical treatment facilities in the Southwestern area CAPOC system are based on twenty-two work days per month and are reflected in table 2-2.

2.2.2 Communications Services

Services examined include analog and digital methods over common carrier and private lines and networks with both common carrier and commercially available data communications equipment.

Data communications equipment contained in each study is defined as the modulator-demodulators (MODEMS) utilized to convert a digital bit stream to analog signals for transmission and subsequent reconstruction to a digital bit stream. Transmission lines studied are standard voice grade lines capable of carrying analog or digital data at specified rates.

Table 2-2. CAPOC Sites Input and Output Requirements (Monthly)

SITES	NUMBER OF TRANSMISSIONS				TRANSMISSION TIMES FOR EACH CAPOC SITE			
	OVERREAD & USERS TO COMPUTER		COMPUTER TO OVERREAD & USERS		OVERREADS & USERS TO COMPUTER		COMPUTERS TO OVERREADS & USERS	
	USER ANALOG XMISSIONS	OVERREAD DIGITAL XMISSIONS	TO OVERREAD ANALOG XMISSIONS	DIGITAL XMISSIONS	USER ANALOG HR:MIN	OVERREAD DIGITAL HR:MIN	OVERREAD ANALOG HR:MIN	DIGITAL HR:MIN
CAPOC COMPUTER NH SAN DIEGO	13,860	19,492	19,492	34,518	231:00	324:52	324:52	95:53
NRMC SAN DIEGO	3,916	8,030	5,038	11,946	65:16	133:50	83:58	33:11
NRMC LONG BEACH	990	2,398	1,760	3,388	16:30	39:58	29:20	9:25
NRMC CAMP PENDLETON	1,452	2,200	1,672	3,652	24:12	36:40	27:52	10:08
AFH MARCH	638	2,464	1,958	3,102	10:38	41:05	32:38	8:37
MCB 29 PALMS	88			110	1:28			1:50
NAVSTA SAN DIEGO	308			352	5:08			5:52
NAS NORTH ISLAND	242			264	4:02			4:24
NAB CORONADO	176			264	2:56			4:24
NAS MIRAMAR	132			154	2:12			2:34
MCRD SAN DIEGO	132			154	2:12			2:34
NTC SAN DIEGO	176			220	2:56			3:40
MCAS SANTA ANA	374			440	6:14			7:20
NH PORT HUENEME	396			572	6:36			9:32
AFH EDWARDS	176			198	2:56			3:18
AFH GEORGE	220			242	3:40			4:02
AFCL NORTON	242			308	4:02			5:08
AFH VANDENBURG	418			440	6:58			7:20
AFH NELLIS	264			418	4:24			6:58

3.0 ANALYSIS

Specific factors considered in this analysis are: (1) user site access contention to computer for direct ECG inputs, (2) number of ECG retrievals, method of initiating ECG retrieval action and resultant impact on the CAPOC system and, (3) ECG processing and report distribution methodologies.

3.1 Line Contention at Computer Interface Units

3.1.1 Marquette Computer Interface Units

The Marquette computer interface unit has three input telephone lines with ring sequencing (no hold) and one computer input line. When one line is connected to the CPU for data acquisition, the other two lines will ring until they are answered in turn and begin transmitting the ECG signal. A user receives a busy signal only when all three lines are occupied. Additional interface units can be added to provide additional telephone input lines or computer input lines.

3.1.2 Hewlett-Packard Computer Interface Unit

The Hewlett-Packard computer interface unit differs (from the Marquette computer interface unit) in its configuration in that it has one incoming telephone line and one computer input line. Two additional telephone input lines to the interface can be provided by use of a multiplexer. The ring sequencing is the same as for the Marquette interface.

3.1.3 Electrocardiogram (ECG) Carts

As shown in table 3-1, Hewlett-Packard carts and Marquette ECG carts are distributed among the user sites. It should be noted

Table 3-1. ECG Data Input in Number of Calls During Peak Hour (0900-1000 daily)

SITE	HEWLETT-PACKARD		MARQUETTE	
	# CARTS	# CALLS	# CARTS	# CALLS
NRMC San Diego	2	9	4	17
NAVSTA San Diego			1	3
NAS Norris			1	6
MCB 29 Palms	1	0		
NTC San Diego			1	3
NAS Miramar			1	2
MCRD San Diego			1	1
NAB Coronado			1	1
NRMC Long Beach			3	1
MCAS Santa Ana			1	2
NH Pt Hueneme	1	2		
NRMC Camp Pendleton	2	6		
AFH March	2	4		
AFH Edwards			1	2
AFH George	1	2		
AFCL Norton			1	4
AFH Nellis			1	2
AFH Vandenburg	1	2		
TOTALS	10	25	17	44
Erlangs		.42		.73

that the carts differ in operation and are compatible only with their respective interface units, i.e., Marquette carts with Marquette computer interface device.

3.1.4 Peak Volume of ECG Data Input

Based on daily workload volumes provided in Naval Medical Data Services Center letter 5260/5 of 15 October 1976, it is estimated that the peak daily volume of data input to the computer occurs in the time period between 0900 and 1000. Table 3-1 shows the peak load data input by user site.

3.1.5 Grade of Service

The required number of incoming telephone lines to the interface units is determined from the customer's blocked call requirements and the line usage (traffic volume). Traffic volume in telephone engineering is measured in a unit called erlang. One erlang is the amount of traffic one trunk can handle in one hour if it is busy all the time. Based on the number of erlangs, the number of lines required for a desired grade of service can be determined. Systems Analysis for Data Transmission, by James Martin, Prentice-Hall, Inc., 1972, was used as a reference in determining blocked call probabilities.

3.1.5.1 Block Probabilities to Computer ECG Interface Units. The average data input transmission time per ECG is one minute. Batch processing of ECGs was not considered in this analysis. Block probabilities for each type of interface are:

a. Marquette Interface

1. Peak hour load - 44 calls

2. Call duration - 1 minute

3. Erlangs - .73

4. Blocking probability to computer

a) One line - 0.42

b) Two lines - 0.13

5. Block probability to interface*

a) 3 lines - 0.03

b) 4 lines - 0.01

b. Hewlett-Packard Interface

1. Peak hour load - 25 calls

2. Call duration - 1 minute

3. Erlangs - .42

4. Blocking probability to computer

a) One line - .30

b) Two lines - .06

5. Blocking probability to interface*

a) 1 line - .30

b) 2 lines - .06

c) 3 lines - .01

*Probability of getting a busy signal

3.1.5.2 Number of ECG Interface Units Recommended. In order to provide a grade of service of 0.01, which means that at least 99 out of 100 calls from the carts go through without a busy signal, we should provide the following service:

a. Two Marquette interface units. It is noted that if only one interface unit is provided, blocking probability to the computer would be 0.42 during the peak hour while two interface units would reduce that blocking probability to 0.13.

1. Four telephone access lines to the two Marquette interface units would provide a grade of service to the user of 0.01.

b. One Hewlett-Packard interface unit. Blocking probability to the computer would be 0.30. One additional interface unit would reduce blocking probability at the computer to 0.1 but the additional cost does not appear to be warranted.

1. Three telephone access lines to the Hewlett-Packard interface (with multiplexer) will provide a grade of service to the user of 0.01.

3.2 ECG Retrievals

3.2.1 Retrievals Impact on the CAPOC System

ECG retrievals are currently programmed to be obtained by the overread centers for their respective collocated and remote user sites. The number of retrievals appear insignificant when considered by each site, but collectively amount to approximately one-third of the daily traffic volume on the NRMC San Diego CAPOC system. Table 3-2 reflects the daily and monthly volume of ECG retrievals to be handled on the NRMC San Diego CAPOC System.

Table 3-2. ECG Retrieval Requests (Daily and Monthly)

SITES	OVERREAD CENTERS				REMOTE USER SITES				CAPOC COMPUTER CENTRAL							
	RETRIEVAL REQUESTS FOR COLLOCATED USER SITES		TRANSMISSION TIME REQUIRED (1 Min each)		RETRIEVAL REQUESTS TO OVERREAD CENTERS BY REMOTE USER SITES		TRANSMISSION TIME REQUIRED (2 Min each)		RETRIEVAL REPORTS/TRACINGS TO OVERREAD CENTERS		TRANSMISSION TIME REQUIRED (10 Sec each)		RETRIEVAL REPORTS TO REMOTE USE SITES		TRANSMISSION TIME REQUIRED (1 Min each)	
	DAY	MO	DAY	MO	DAY	MO	DAY	MO	DAY	MO	DAY	MO	DAY	MO	DAY	MO
NRMC San Diego, CA	125	2750	2:05	45:50					250	5500	:42	15:16				
MCB 29 Palms, CA					1	22	:02	:44					1	22	:01	:22
NAVSTA San Diego, CA					2	44	:04	1:28					2	44	:02	:44
NAS Norris, San Diego, CA					1	22	:02	:44					1	22	:01	:22
NAB Coronado, CA					4	88	:08	2:56					4	88	:08	1:28
NAS Miramar, San Diego, CA					1	22	:02	:44					1	22	:01	:22
MCRD San Diego, CA					1	22	:02	:44					1	22	:01	:22
NTC San Diego, CA					2	44	:04	1:28					2	44	:04	:44
NRMC Long Beach, CA	18	396	:18	6:36					36	792	:06	2:12				
MCAS Santa Ana, CA					3	66	:06	2:12					3	66	:03	1:06
NH Port Hueneme, CA					8	176	:16	5:52					8	176	:08	2:56
NRMC Camp Pendleton, CA	23	506	:23	8:26					46	1012	:07	2:48				
AFH March, Riverside, CA	10	220	:10	3:40					20	440	:03	1:00				
AFH Edwards, Edwards, CA					1	22	:02	:44					1	22	:01	:22
AFH George, Victorville, CA					1	22	:02	:44					1	22	:01	:22
AFCL Norton, San Bernardino, CA					3	66	:06	2:12					3	66	:03	1:06
AFH Vandenburg, Lompoc, CA					1	22	:02	:44					1	22	:01	:22
AFH Nellis, Las Vegas, NV					7	154	:14	5:08					7	154	:07	2:34
TOTALS	176	3872	2:56	64:32	36	792	1:12	26:24	352	7744	:58	21:16	36	792	:42	13:12

Due to the availability of several methods of obtaining ECG retrievals, cost for this function is not computed in the final analysis of the applicable communication systems for CAPOC.

3.3 ECG Distribution

3.3.1 ECG Collection and Reporting Procedures

The ECG transmissions directly related to the communication support network are the ECGs transmitted to and from the computer and the retrieval requests from remote users to the Overread Centers. Input to the CAPOC computer will be from ECG carts at the Remote User Sites and those collocated with an Overread Center. Also the Overread Centers input to the CAPOC computer for Editing and Retrieval functions. Computer output includes Reports, Tracings and Retrieval Reports to the Overread Centers and Reports to the Remote User Sites. Figure 3-1 reflects the collection and reporting procedures of the NRMC San Diego CAPOC System. Although not included in this study, use of dual or multiport MODEMS between the CAPOC computer and overread sites could be considered as a means of reducing the number of leased lines and MODEMS required. (See figure 3-2).

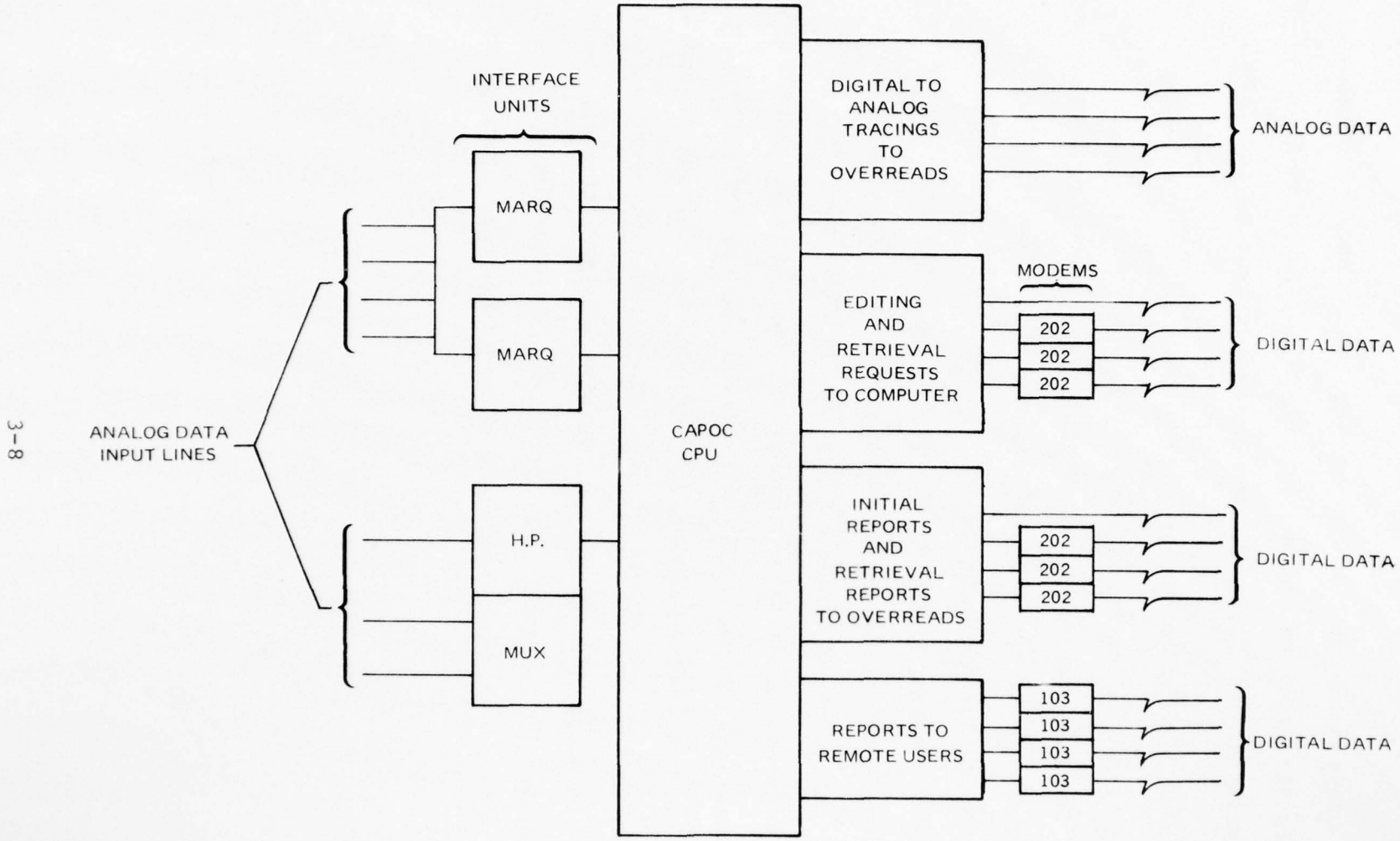
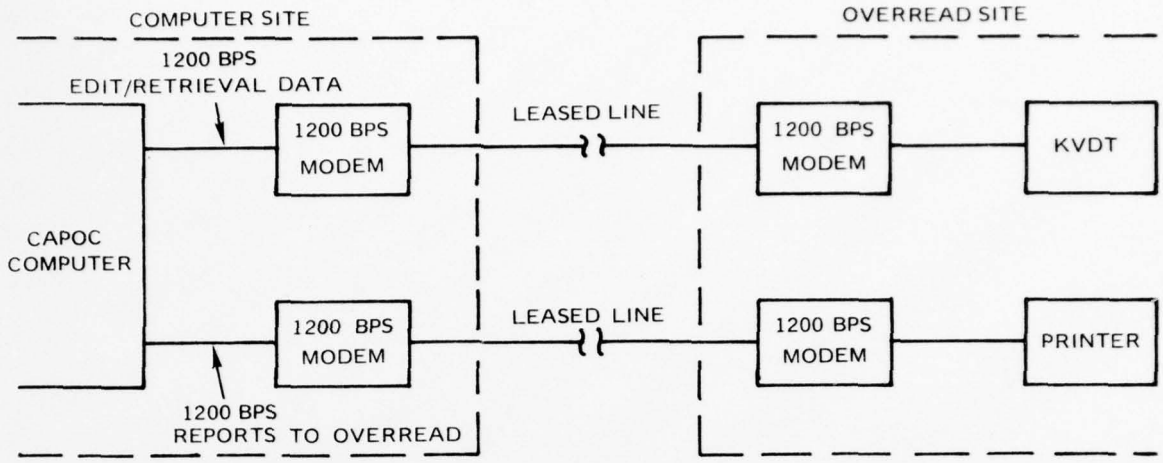
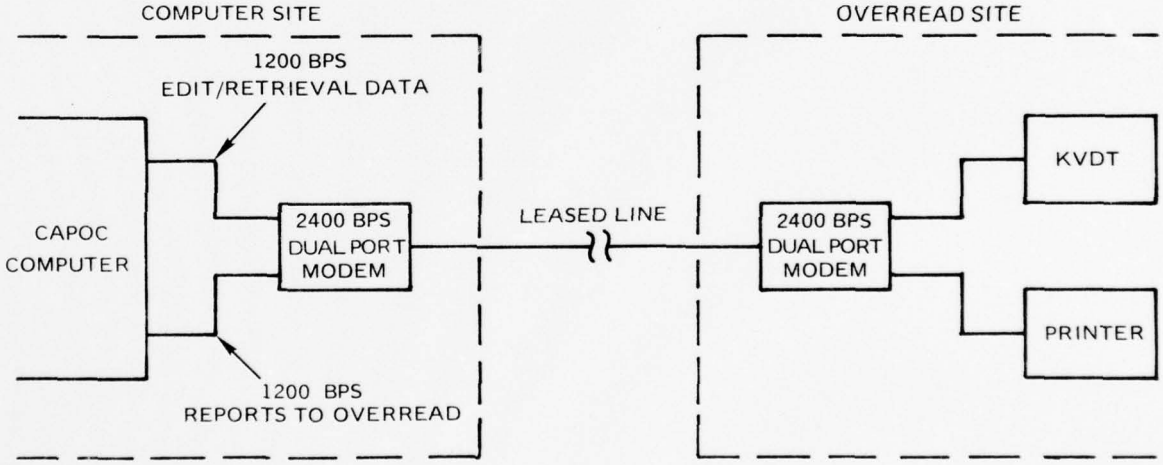


FIGURE 3-1. CAPOC ACCESS LINE AND MODEM REQUIREMENTS



CAPOC SYSTEM CONFIGURATION AS ANALYZED



CAPOC SYSTEM CONFIGURATION ALTERNATIVE

FIGURE 3-2. CAPOC ECG DISTRIBUTION CONCEPTS

4.0 COMMUNICATION SYSTEMS ALTERNATIVES

Various communications systems were studied, including combinations of systems, in order to define a telecommunication configuration that will be cost-effective and adequately support the NRMC San Diego CAPOC System.

4.1 Inadequate Communication Systems

The following communication systems were investigated but considered inadequate to meet the requirements of the southwestern area NRMC San Diego CAPOC system. Rejection of these networks for this particular CAPOC system does not preclude their consideration for other geographical areas, or as an ultimate nationwide communication support system.

4.1.1 Dataphone Digital Service (DDS)

DDS is not available to the San Diego area.

4.1.2 Microwave

Microwave systems are far removed from most military sites and the expense of necessary extended lines would preclude consideration of microwave for the NRMC San Diego CAPOC communications network.

4.1.3 Automatic Voice Network (AUTOVON)

AUTOVON is a worldwide general purpose switched voice network of the Defense Communications System (DCS). A query-response (QR) mode for data transmission is available only upon approval of the

Joint Chiefs of Staff (JCS). If approved, a limitation of 18 minutes per transmission and one hour per day is imposed. In addition, "backbone" charges are doubled (in most cases) when AUTOVON is used for data transmission.

The limitation of 18 minutes per transmission will preclude using the option to input to the CAPOC computer in a batch mode from cassette tapes on special batch ECG carts. Also, the approximately 400 "long distance" calls to the computer from the user sites would greatly exceed the one hour per day transmission limitation. A waiver of these limitations would be required.

Other disadvantages of AUTOVON are the high contention to enter the AUTOVON net and the pre-emptive interrupt situation. (Higher precedence calls preempt any telephone call of lower precedence.)

For the foregoing reasons, AUTOVON is not considered to be feasible for general CAPOC use. However, for retrievals which involve voice interactive requests from users to overread sites and are not time critical, AUTOVON could provide adequate service.

Assuming AUTOVON service is available at each user site and overread site, cost for eight and nine level telephone service at each site is $7.50 per month plus $41.00 installation for a business line or $6.55 per month plus $18.00 installation for a Centrex line. There would be no additional AUTOVON charge, but in instances where AUTOVON access lines are busy and a delay in service cannot be tolerated, direct distance dialing (DDD) would be an alternate at standard DDD rates.

4.1.4 Automatic Digital Network (AUTODIN)

The Defense Communications System (DCS) Automatic Digital Network (AUTODIN) is a worldwide Department of Defense computerized general purpose communications system which provides for transmission of narrative and data pattern traffic in store-and-forward, query/response, and bulk data applications. Direct access to the AUTODIN system is by three alternative modes:

a. Offline, direct to an AUTODIN Switching Center (ASC).

b. Offline, via a Local Digital Message Exchange (LDMX).

c. Online, direct to an ASC.

Only the third alternative would provide the on-line service required for CAPOC, but because of the high costs associated with on-line service, AUTODIN is not considered practicable. Table 4-1 shows the AUTODIN costs for CAPOC.

4.1.4.1 AUTODIN II

AUTODIN II is a Department of Defense teleprocessing and record digital communication system, that is scheduled to be operational in post 1979, and will initially be used only for CONUS. It will be a distributed network using packet switching techniques and will provide for computer interactive, query/response, and bulk data transfer functions. AUTODIN II is considered inadequate for the CAPOC system due to the following reasons:

a. AUTODIN II initial operational capability is limited and is not scheduled for use until 1979.

Table 4-1. AUTODIN Costs for CAPOC

COMMUNICATIONS COSTS	COST PER SITE	
	NRMC San Diego and 3 overread sites (1200 bps)	14 user sites (300 bps)
1. Modem and access line installation	$ 1,282	$ 1,282
2. Backbone monthly	5,328	1,776
3. Access line monthly	100	100
4. Modem monthly	478	478
5. Interface device monthly	216	216
6. Software development	50,000*	*

*Software for host computer

Recurring Cost	= $ 60,468
Nonrecurring Cost	= 73,076
Annual Recurring Cost	= 725,616
Average monthly cost (8-year amortization)	= 61,229

b. Growth is based on user demand and is therefore uncertain.

c. Users must provide their own interface hardware and software.

d. Costs are a function of total system utilization (numbers of subscribers and amount of traffic carried), and therefore costs may fluctuate widely.

e. The AUTODIN II system is digital and appropriate interfaces and converters must be provided (by users) to convert analog to digital information.

Autodin II subscriber rates, along with certain computations and a number of necessary assumptions are provided in table 4-2.

Table 4-2. AUTODIN II Subscriber Rates,

Computations and Assumptions for CAPOC Cost Analysis

AUTODIN II SUBSCRIBER RATES
(MONTHLY RECURRING CHARGES)
Ref: DCA Business Plan, 1 Nov 76

SPEED	MODEM	DIRECT ACCESS* FIXED	DIRECT ACCESS* MILEAGE	BACKBONE FIXED	BACKBONE TRAFFIC (KPkt)
110 b/s	$ 14.90	$ 86.60	$ .253	$ 50.00	$2.32
150 b/s	14.90	86.60	.253	50.00	2.32
300 b/s	20.10	86.60	.506	50.00	2.32
600 b/s	20.10	86.60	.506	150.00	2.32
1200 b/s	32.00	86.60	.506	150.00	2.32
2400 b/s	59.00	86.60	.506	235.00	2.32
4800 b/s	135.00	86.60	.506	235.00	2.32
9600 b/s	249.00	86.60	.506	235.00	2.32
19.2 Kb/s	--	920.00	3.036	235.00	2.32
50 Kb/s	--	920.00	6.072	235.00	2.32

*Shared Access Rate predicated on Direct Access less 10%.

COMPUTATIONS

Kilopackets/month for analog data:
ECGs/day x 225 Kbits/ECG x 22 days/month $\div \frac{1000 \text{ Kbits}}{\text{Kpacket}}$
Kilopackets/month for digital data:
Reports/day x 22 days/month x 5 lines/report x 80 char/line x 8 bits/char
$\div \frac{1000 \text{ Kbits}}{\text{Kpacket}}$

ASSUMPTIONS

1. Software development and Interface devices will cost the same as for AUTODIN I.
2. Location of AUTODIN II Switching Center is the same as AUTODIN I.
3. 1200 and 300 bps rates will be used.

Using the information contained in table 4-2, an analysis of AUTODIN II costs for CAPOC is presented in table 4-3. Due to the uncertainty of significant cost estimates, e.g.,software and hardware interfaces and installation costs, which could not be verified, the costs contained in table 4-3 should be regarded as a conservative analysis.

4.1.5 Satellite Communications

Direct satellite connections are not available to the San Diego area and the expense of extensive and complex connections to use a satellite would exceed the cost of other currently available communication systems.

4.1.6 Telenet Communications Corporation (TELENET)

Telenet is a nationwide data communications network that uses the "Packet Switching" technology. Telenet provides data transfer communication systems appropriate for enterprises that pass a large amount of digital data over great distances. Telenet does not handle analog data and its operations are based on full duplex transmissions. Because a very significant amount of the CAPOC information is analog data which is transmitted only one way, Telenet is not considered an appropriate communication method for the NRMC San Diego CAPOC system.

4.1.7 Advanced Research Projects Agency Network (ARPANET)

ARPANET is a packet-switched communications subnet oriented toward interactive service and computer-to-computer connectivities. Its primary goal is to permit persons and programs at one research

Table 4-3. AUTODIN II Costs for CAPOC

ITEMS[1]	COMMUNICATION COSTS[2]	
	THREE OVERREAD SITES (1200 bps)	EIGHT USER SITES (300 bps)
1. Access Line (Fixed)	$ 259.80	$ 692.80
2. Access Line (Monthly)	110.16	633.42
3. Backbone (Fixed)	450.00	400.00
4. Backbone (Monthly)	5,398.64	1,707.52
5. MODEMS (Monthly)	192.00	160.80
6. Interface Device (Monthly)	648.00	1,728.00
7. Software Development	50,000.00*	

Recurring Cost (2 + 4 + 5 + 6)	= $ 10,579
Nonrecurring Cost (1 + 3 + 7)	= 51,803
Annual Recurring Cost	= 126,948
Average Monthly Cost (8 year amortization)	= 11,119

1. DDD would be used for the seven local area sites.
2. See table 4-2 for assumptions from which cost computations were used to derive above costs.

*Software for host computer

center to access data and interactively use programs that exist and run in other computers of the network. This system requires a time sharing operation and is not considered compatible to the NRMC San Diego CAPOC project.

4.1.8 Foreign Exchange System (FEX)

A Foreign Exchange (FEX) line, as applied to CAPOC, would result in assigning distant city telephone numbers to the CAPOC Computer Center in San Diego or vice versa. FEX service would enable the CAPOC Computer to place and receive calls from the distant city without paying toll charges on each call. Set line charges to the distant city are determined by the interstate or intrastate relationship of the terminal points and the distance involved. To make the system competitive by cost for CAPOC would require combining several sites into a single FEX line with the computer. Table 4-4 depicts the resulting FEX cost when connecting three intrastate sites with the computer.

Although FEX may be cost competitive in some combinations of interstate use, several factors eliminate this system from contention for consideration at this time. These factors include:

a. A dedicated computer port is required for each FEX line, thus increasing the total number of computer ports required, resulting in greater expense.

b. Carts of different types can not be integrated on a single FEX line. (This would eliminate combining sites into logical groupings for least cost.)

Table 4-4. Foreign Exchange System

INTRASTATE

	FX LINE TO SDIEGO @.55 MI INTERST @6.40 MI INTRAST	FX LINE RATE @ $22 MO	INSTALLATION CHARGES $41 EACH LINE	ONE MIN PHONE CHARGE TO/FM FX	NR ECG RPTS PER MO	LOCAL PHONE FEE 5 ¢ EACH OVER 300	LD CHARGE ECG OUTPUT	BUSINESS LINE (MO)	BUSINESS LINE INSTALLATION	NR RPTS TO USER	LD CHARGE RPT TO USER	% OF CALLS BY STATION (MO)	RECURRING COST (MO)	NONRECURRING COST (MO)	ANNUAL RECURRING COST
MCB 29 PALMS 29 PALMS, CA				$.31	88		$27.28	$7.50	$41	110	$34.10	19	$227.49	$56.58	$2729.88
AFH EDWARDS EDWARDS, CA				.25	176		44.00	7.50	41	198	49.50	36	401.53	70.52	4818.36
AFH GEORGE VICTORVILLE, CA				0	220	0	0	7.50	41	242	0	45	412.56	77.90	4950.72
FX LINES VICTORVILLE TO SDIEGO (127 MI)	$812.80	$22	$82		484					550					$12498.96

NOTE: TOTAL FEX LINE USE IS .015%
BLOCKING FACTOR IS .15

c. California intrastate tariff of $6.40 per FEX mile makes intrastate use very expensive.

4.2 Applicable Communication Systems

Available alternative communication systems and combinations thereof, which will provide the requisite connectivities to satisfy the NRMC San Diego CAPOC system are described herein. Only the transmission lines and required modems are presented.

4.2.1 Leased Lines

This configuration provides for dedicated circuits between the CAPOC Computer, the Overread Centers and the Remote Users Sites. There is no line contention and sites may be added or deleted without affecting any other site. This network also accommodates almost unlimited expansion of traffic volume (limited only by the number of interface units that can be applied to the computer). Figure 2-1 shows the connectivities and table 4-5 reflects the associated costs.

4.2.2 Direct Distance Dialing (DDD)

This system provides multipoint communications at the discretion of each site in the network. Again, traffic volume expansion capacity is unlimited, dependent only upon the number of interface units at the computer. It is noted that with DDD line charges accrue only for actual use. Figure 4-1 depicts multipoint connectivities and table 4-6 denotes monthly charges for this system.

4.2.3 Federal Telecommunications System (FTS) Service

FTS is a civilian government service parallel to AUTOVON, but

Table 4-5. Monthly Cost of Leased Lines for CAPOC

SUMMARY

RECURRING COST	$ 6,394
NONRECURRING COST	$ 4,520
ANNUAL RECURRING COST	$76,728
8 YEARS (MONTHLY)	$ 6,441

FROM	ACCESS MILES TO NRMC SDIEGO	DIGITAL DATA								ANALOG DATA			
				TERMINATION FEES		MODEMS						TERMINATION FEES	
		NR LINES REQUIRED	LINE COST @ .55 PER MILE	RECURRING CHARGES	NON-RECURRING CHARGES	NR REQUIRED	(202T=1200 bps) TYPE (103=300 bps)	RECURRING CHARGES	NON-RECURRING CHARGES	NR REQUIRED	LINE COST @ .55 PER MILE	RECURRING CHARGES	NON-RECURRING CHARGES
NRMC SAN DIEGO, CA	0	2	—	—	—	—	—	—	—	7	—	$ 14.00	$280.00
NRMC LONG BEACH, CA	96	2	$105.60	$160.00	$ 80.00	4	202T	$160.00	$300.00	2	$105.60	160.00	80.00
NRMC CAMP PENDLETON, CA	37	2	40.70	160.00	80.00	4	202T	160.00	300.00	2	40.70	160.00	80.00
AFH MARCH, CA	83	2	91.30	160.00	80.00	4	202T	160.00	300.00	2	91.30	160.00	80.00
MCB 29 PALMS, CA	117	1	64.35	80.00	40.00	2	103	60.00	120.00	1	64.35	80.00	40.00
NAVSTA SAN DIEGO, CA	5	1	2.75	80.00	40.00	2	103	60.00	120.00	1	2.75	80.00	40.00
NAS NORTH ISLAND, CA	3	1	1.65	80.00	40.00	2	103	60.00	120.00	1	1.65	80.00	40.00
NAB CORONADO, CA	3	1	1.65	80.00	40.00	2	103	60.00	120.00	1	1.65	80.00	40.00
NAS MIRAMAR, CA	9	1	4.95	80.00	40.00	2	103	60.00	120.00	1	4.95	80.00	40.00
NTC SAN DIEGO, CA	4	1	2.20	80.00	40.00	2	103	60.00	120.00	1	2.20	80.00	40.00
MCRD SAN DIEGO, CA	3	1	1.65	80.00	40.00	2	103	60.00	120.00	1	1.65	80.00	40.00
MCAS SANTA ANA, CA	84	1	46.20	80.00	40.00	2	103	60.00	120.00	1	46.20	80.00	40.00
NH PORT HUENEME, CA	157	1	86.35	80.00	40.00	2	103	60.00	120.00	1	86.35	80.00	40.00
AFH EDWARDS, CA	160	1	88.00	80.00	40.00	2	103	60.00	120.00	1	88.00	80.00	40.00
AFH GEORGE, CA	127	1	69.85	80.00	40.00	2	103	60.00	120.00	1	69.85	80.00	40.00
AFCL NORTON, CA	98	1	53.90	80.00	40.00	2	103	60.00	120.00	1	53.90	80.00	40.00
AFH VANDENBURG, CA	235	1	129.25	80.00	40.00	2	103	60.00	120.00	1	129.25	80.00	40.00
AFH NELLIS, NV	264	1	145.20	84.10	105.10	2	103	40.00	50.00	1	145.20	84.10	105.10
TOTALS	1485	22	$935.55	$1604.10	$865.10	12	202T	$1300.00	$2510.00	27	$935.55	$1618.10	$1145.10
						28	103						

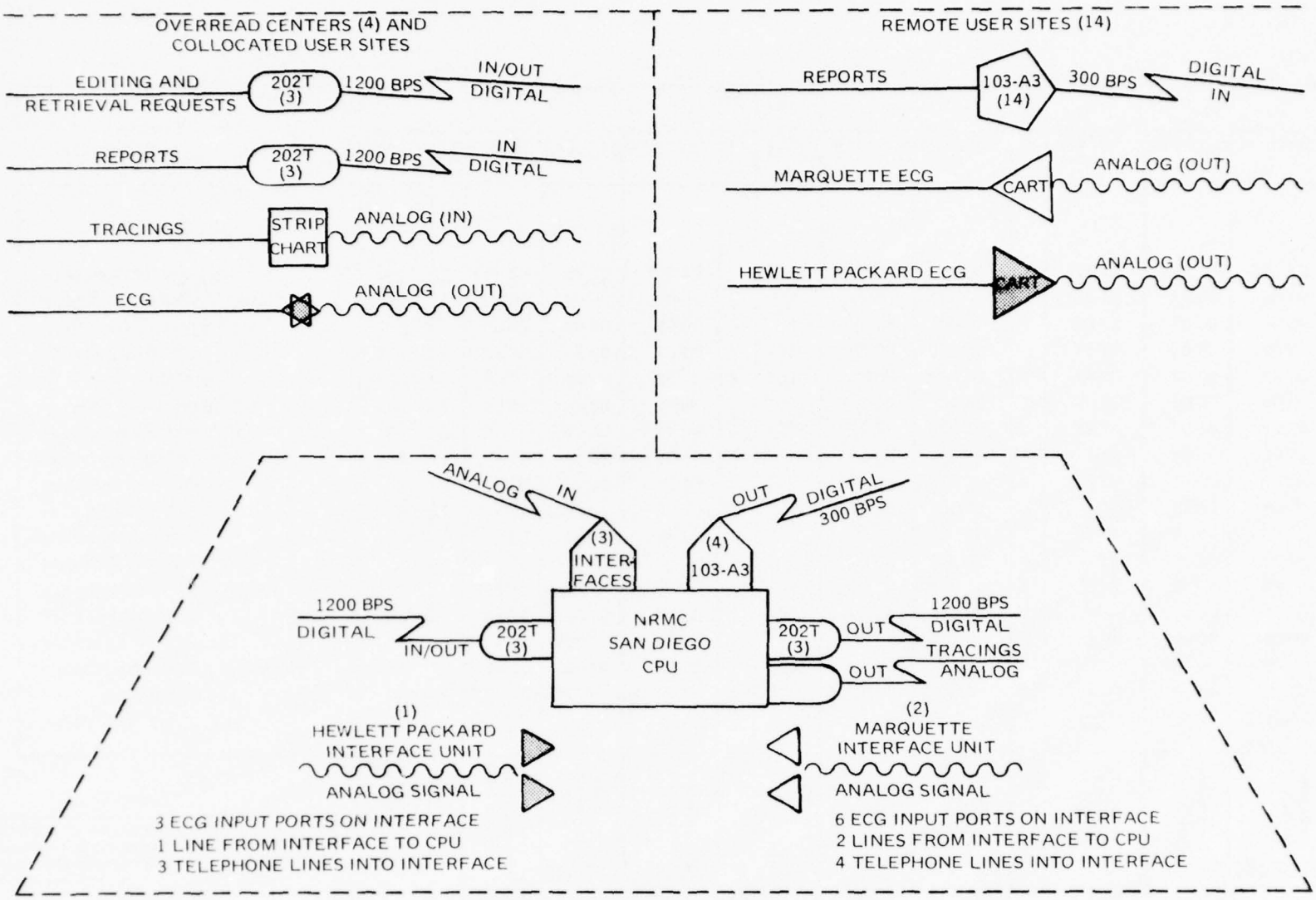


FIGURE 4-1. DDD OR FTS BETWEEN CAPOC COMPUTER, OVERREAD CENTERS AND REMOTE USER SITES

Table 4-6. Direct Distance Dial Costs between CAPOC Computer, Overread Centers, Remote User Sites

(Monthly)

SUMMARY	
RECURRING COST	$ 12,071
NONRECURRING COST	$ 4,149
ANNUAL RECURRING COST	$144,852
8 YEARS (MONTHLY)	$ 12,114

	COMPUTER SEND			OVERREAD SEND	USER SEND	CENTREX LINES			BUSINESS LINES			MODEMS			
SITES	ANALOG TRACINGS TO OVERREADS	DIGITAL REPORTS TO OVERREADS	DIGITAL REPORTS TO REMOTE USERS	DIGITAL EDITS & RETRIEVALS TO COMPUTER	ANALOG INPUT TO COMPUTER FROM COLLOCATED & REMOTE USER SITES	NR LINES	RECURRING COST	NONRECURRING COST	NR LINES	RECURRING COSTS	NONRECURRING COSTS	NUMBER	103A3 (300 BPS) TYPE 202T (1200 BPS)	RECURRING COST	NONRECURRING COSTS
CAPOC COMPUTER, SAN DIEGO, CA						7[1]	$45.85	$126.00	4	$30.00	$164.00		NOTES 2/3	$ 80.00	$ 100.00
NRMC SAN DIEGO, CA						9[4]	18.00	360.00							
NAVSTA SAN DIEGO, CA			$ 17.60		$ 15.40				2	15.00	82.00	1	103-A3	30.00	60.00
NAS NORRIS, SAN DIEGO, CA			13.20		12.10				2	15.00	82.00	1	103-A3	30.00	60.00
MCB 29 PALMS, CA			37.40		23.32				2	15.00	82.00	1	103-A3	30.00	60.00
NTC SAN DIEGO, CA			11.00		8.80				2	15.00	82.00	1	103-A3	30.00	60.00
NAS MIRAMAR, SAN DIEGO,CA			7.70		6.60				2	15.00	82.00	1	103-A3	30.00	60.00
MCRD SAN DIEGO, CA			7.70		6.60				2	15.00	82.00	1	103-A3	30.00	60.00
NAB CORONADO, CA			13.20		7.70				2	15.00	82.00	1	103-A3	30.00	60.00
NRMC LONG BEACH, CA	$ 704.00	$ 1355.00		$ 959.00	319.44	1	6.55	18.00	4	30.00	164.00	4	202T	160.00	300.00
MCAS SANTA ANA, CA			149.60		120.55				2	15.00	82.00	1	103-A3	30.00	60.00
NH PORT HUENEME, CA			257.40		178.20				2	15.00	82.00	1	103-A3	30.00	60.00
NRMC CAMP PENDLETON, CA	418.00	913.00		550.00	337.48	1	6.55	18.00	4	30.00	164.00	4	202T	160.00	300.00
AFH MARCH, CA	724.00	1148.00		912.00	200.42	1	6.55	18.00	4	30.00	164.00	4	202T	160.00	300.00
AFH EDWARDS, CA			89.10		79.20				2	15.00	82.00	1	103-A3	30.00	60.00
AFH GEORGE, CA			96.80		83.38				2	15.00	82.00	1	103-A3	30.00	60.00
AFCL NORTON, CA			113.96		69.74				2	15.00	82.00	1	103-A3	30.00	60.00
AFH VANDENBURG, CA			224.40		192.06				2	15.00	82.00	1	103-A3	30.00	60.00
AFH NELLIS, NV			192.28		111.98				2	15.00	82.00	1	103-A3	20.00	25.00
TOTAL	$1846.00	$3416.00	$1231.34	$2421.00	$1772.97	19	$83.50	$540.00	44	$330.00	$1804.00	12 18	202T 103-A3	$970.00	$1805.00

NOTE:
1. CENTREX LINES TO COMPUTER ECG INTERFACE UNITS.
2. FOUR 103-A3 MODEMS REQUIRED AT COMPUTER FOR 300 bps XMSN TO REMOTE USERS.
3. COST OF 202T (1200 bps) MODEMS ALLOCATED TO OVERREAD CENTERS.
4. NINE "ROOM CIRCUIT" LINES AT $2.00 RECURRING AND $40.00 INSTALLATION CHARGE EACH.

without the preemptive interrupt structure. It has been a popular alternative to AUTOVON for data transmission for this reason. Under the overall management of the General Services Administration (GSA), FTS provides voice, record, data and facsimile services over point-to-point and switched networks. Data Service is available under controlled conditions for direct subscriber access by federal agencies for the transmission of data which can be accommodated over normal unconditioned voice-grade switched channels.

Data transmission during daylight hours (0700-1900 EST Monday through Friday except holidays) is charged at the rate of 18 cents per minute. Data transmission during nighttime hours, holidays and weekends is provided without additional charge. FTS service must be approved by GSA as being practical from both an engineering standpoint and cost-effective through analysis of toll usage and predicted requirements. Figure 4-1 provides an example of possible communications links and tables 4-7 and 4-7A present the monthly charges for employing this system. FTS costs analysis is based on the best information currently available pertinent to this system.

4.2.4 Wide Area Telephone Service (WATS)

WATS is a service which permits a customer, by use of an access line, to make calls to telephone terminals in a specific zone on a dial-up basis for a flat monthly charge. These charges are based on the size of the area in which the calls are placed and a monthly ceiling transmission time, according to the type of service subscribed. There is a maximum number of calls that can be made for the initial and hourly charges. The maximum is based

Table 4-7. FTS Costs Between CAPOC Computer, Overread Centers, Remote User Sites
(Static Monthly Costs)

SITES	SERVICING FTS SWITCH LOCATION (Note 1)	MILES FROM SITE TO SWITCH	REQUIRED NUMBERS LEASED LINES FROM SITE TO FTS SWITCH	LINE COSTS FROM SITE TO SWITCH (RECURRING)	TERMINATION FEES		MODEMS			
					SERVICE TERMINATION CHARGES (RECURRING)	INSTALLATION CHARGES (NON-RECURRING)	NR REQUIRED	(202T = 1200 BPS) TYPE (103 = 300 BPS)	RECURRING CHARGES	NON-RECURRING CHARGES
CAPOC COMPUTER NH SAN DIEGO	San Diego, CA	2	23	$ 128.00	$ 172.50	$ 414.00	6 4	202T 103	240.00 $ 120.00	450.00 $ 240.00
NRMC SAN DIEGO	San Diego, CA	Note 2		18.00	—	360.00				
NRMC LONG BEACH	San Pedro, CA	5	4	56.00	30.00	72.00	2	202T	80.00	150.00
NRMC CAMP PENDLETON	Laguna Niguel, CA	34	4*	73.44	320.00	160.00	2	202T	46.00	100.00
AFH MARCH	Riverside, CA	5	4	56.00	30.00	72.00	2	202T	80.00	150.00
MCB 29 PALMS	San Bernardino, CA	72	2*	77.76	160.00	80.00	1	103	20.00	25.00
NAVSTA SAN DIEGO	San Diego, CA	5	2	28.00	15.00	36.00	1	103	30.00	60.00
NAS NORTH ISLAND	San Diego, CA	5	2	28.00	15.00	36.00	1	103	30.00	60.00
NAB CORONADO	San Diego, CA	5	2	28.00	15.00	36.00	1	103	30.00	60.00
NAS MIRAMAR	San Diego, CA	5	2	28.00	15.00	36.00	1	103	30.00	60.00
MCRD SAN DIEGO	San Diego, CA	5	2	28.00	15.00	36.00	1	103	30.00	60.00
NTC SAN DIEGO	San Diego, CA	5	2	28.00	15.00	36.00	1	103	30.00	60.00
MCAS SANTA ANA	Santa Ana, CA	5	2	28.00	15.00	36.00	1	103	30.00	60.00
NH PORT HUENEME	Van Nuys, CA	42	2*	45.36	160.00	80.00	1	103	20.00	25.00
AFH EDWARDS	Glendale, CA	57	2*	61.56	160.00	80.00	1	103	20.00	25.00
AFH GEORGE	San Bernardino, CA	30	2*	32.40	160.00	80.00	1	103	20.00	25.00
AFCL NORTON	San Bernardino, CA	5	2	28.00	15.00	36.00	1	103	30.00	60.00
AFH VANDENBURG	Bakersfield, CA	96	2*	103.68	160.00	80.00	1	103	20.00	25.00
AFH NELLIS	Las Vegas, NV	5	2	28.00	15.00	36.00	1	103	30.00	60.00

NOTE: 1. NEAREST FTS SWITCH TO SITE
2. NINE "ROOM CIRCUIT LINES" AT $2.00 RECURRING AND $40.00 INSTALLATION CHARGE EACH.

*DENOTES USE OF TELPAC LINES

Table 4-7A. FTS Costs Between CAPOC Computer, Overread Centers, Remote User Sites
(Monthly Variable/Summary Costs)

SUMMARY	
RECURRING COST	$ 9,296
NONRECURRING COST	$ 3,557
ANNUAL RECURRING COST	$111,556
8- YEARS (MONTHLY)	$ 9,333

	VOLUME DEPENDENT FTS CHARGES					STATIC CHARGES[1]				COST SUMMARY			
	COMPUTER SEND			OVER-READ SEND	USER SEND	LEASED LINES		MODEMS					
SITES	ANALOG TRACINGS TO OVERREADS	DIGITAL REPORTS TO OVERREADS	DIGITAL REPORTS TO REMOTE USERS	DIGITAL EDITS AND RETRIEVALS TO COMPUTER	ANALOG INPUT TO COMPUTER FROM COLLOCATED & REMOTE USER SITES	RECURRING CHARGES	NON-RECURRING CHARGES	RECURRING CHARGES	NON-RECURRING CHARGES	TOTAL RECURRING COSTS	TOTAL NONRECURRING COSTS	MONTHLY COSTS (8 - YEAR LIFE)	ANNUAL RECURRING COSTS
CAPOC COMPUTER NH SAN DIEGO	$	$	$	$	$	$ 301.30	$ 414.00	$ 360.00	$ 690.00	$ 661.30	$1104.00	$ 672.80	$ 7,935.60
NRMC SAN DIEGO						18.00	360.00	80.00	150.00	18.00	360.00	21.75	216.00
NRMC LONG BEACH	317.00	610.00		432.00	178.20	86.00	72.00	80.00	150.00	1703.20	222.00	1705.51	20,438.40
NRMC CAMP PENDLETON	301.00	657.00		396.00	261.36	393.44	160.00	46.00	100.00	2054.80	260.00	2057.51	24,657.60
AFH MARCH	352.00	558.00		444.00	114.84	86.00	72.00	80.00	150.00	1634.84	222.00	1637.15	19,618.08
MCB 29 PALMS			19.80		15.84	237.76	80.00	20.00	25.00	293.40	105.00	294.49	3,520.80
NAVSTA SAN DIEGO			63.36		55.44	43.00	36.00	30.00	60.00	191.80	96.00	192.80	2,301.60
NAS NORTH ISLAND			47.52		43.56	43.00	36.00	30.00	60.00	164.08	96.00	165.08	1,968.96
NAB CORONADO			47.52		31.68	43.00	36.00	30.00	60.00	152.20	96.00	153.20	1,826.40
NAS MIRAMAR			27.72		23.76	43.00	36.00	30.00	60.00	124.48	96.00	125.48	1,493.76
MCRD SAN DIEGO			27.72		23.76	43.00	36.00	30.00	60.00	124.48	96.00	125.48	1,493.76
NTC SAN DIEGO			39.60		31.68	43.00	36.00	30.00	60.00	144.28	96.00	145.28	1,731.36
MCAS SANTA ANA			79.20		67.32	43.00	36.00	30.00	60.00	219.52	96.00	220.52	2,634.24
NH PORT HUENEME			102.96		71.28	205.36	80.00	20.00	25.00	399.60	105.00	400.69	4,794.00
AFH EDWARDS			35.64		31.68	221.56	80.00	20.00	25.00	308.88	105.00	309.97	3,706.56
AFH GEORGE			43.56		39.60	192.40	80.00	20.00	25.00	295.56	105.00	296.65	3,546.72
AFCL NORTON			55.44		43.56	43.00	36.00	30.00	60.00	172.00	96.00	173.00	2,064.00
AFH VANDENBURG			79.20		75.24	263.68	80.00	20.00	25.00	438.12	105.00	439.21	5,257.44
AFH NELLIS			75.24		47.52	43.00	36.00	30.00	60.00	195.76	96.00	196.76	2,349.12
TOTALS	$ 970.00	$1825.00	$ 744.48	$1272.00	$1156.32	$2392.50	$1802.00	$936.00	$1755.00	$9296.30	$3557.00	$9333.35	$111,555.60

NOTE 1: STATIC CHARGES COMPILED FROM TABLE 4-7 ON PAGE 4-15

on an average (not minimum) of one minute per call. For example, with WATS 10-hour service, the maximum is 600 calls for the initial 10 hours charged and 60 calls for each additional hour.

Because the "Inward" WATS service requires a dedicated computer port for each WATS line, this particular WATS service would result in unmanageable computer contention unless an excessive number of interface units were applied.

In order to maintain the number of interface units (two Marquette and one Hewlett-Packard) and sustain the proper grade of service outlined in paragraph 3.1.5.2, all sites were provided with the "Outward" WATS lines which enables them to call into the Centrex numbers at the respective computer interface units. The CAPOC Computer Central was provided ten outward WATS lines to support its reporting functions. Each of the Overread Centers were allocated two outward WATS lines; one for initial ECG data input by collocated users and one for the Editing and Retrieval operations carried out at the Overread Centers. Each of the remote user sites was given one outward WATS line for ECG data input.

WATS line installation charges are $50.00. Intrastate monthly charges are $260 for WATS 10-hour service with each additional hour costing $19.00, or $700 for WATS 100 hour service with $8.00 for each additional hour. Interstate charges for WATS 10 hour service are $234 and $17.55 for each added hour, with the WATS 240 hour charge being $1610 and each additional hour $4.47. Figure 4-2 provides the connectivities and tables 4-8 and 4-8A show the costs associated with this system.

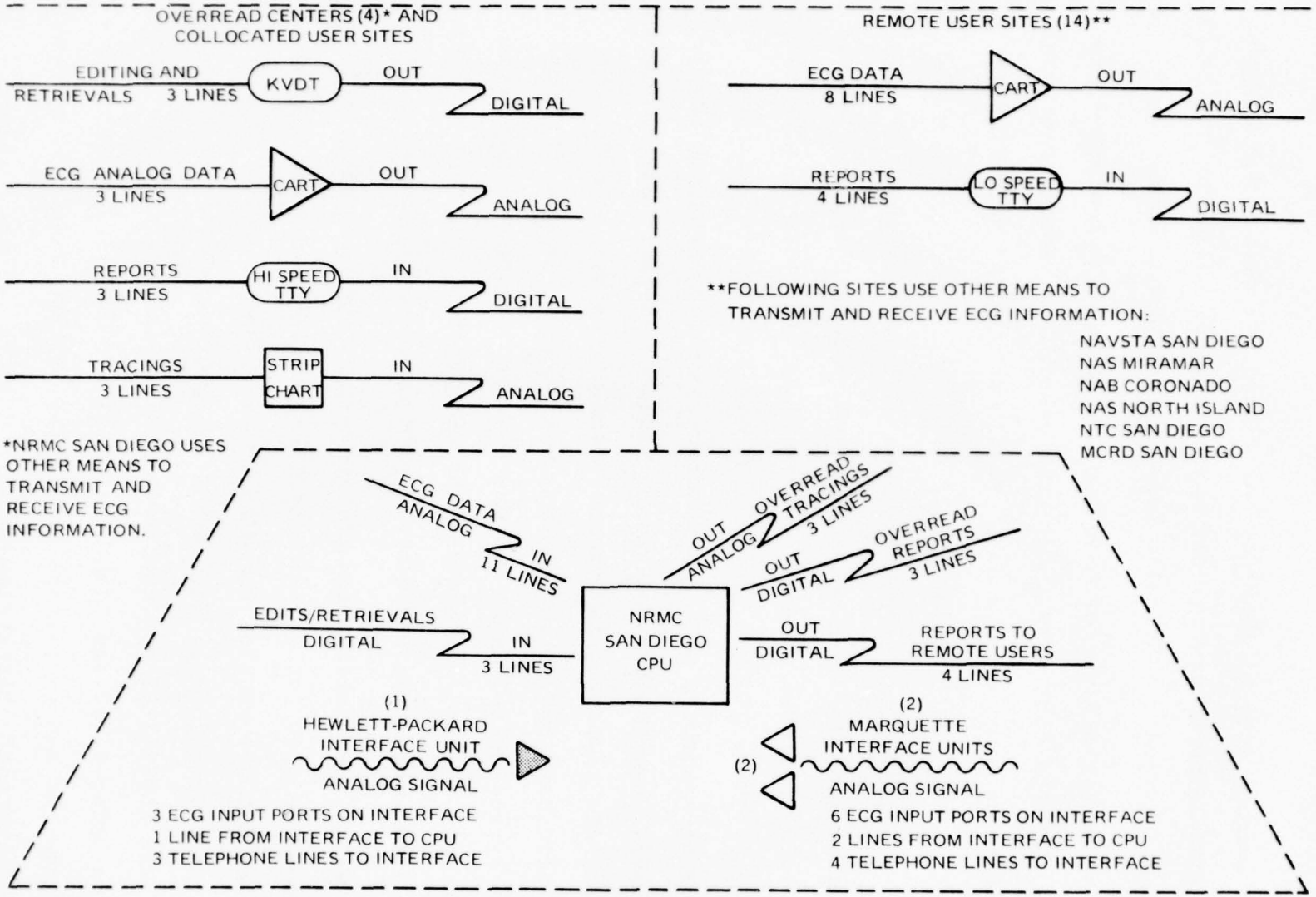


FIGURE 4-2. OUTWARD WATS SERVICE BETWEEN CAPOC COMPUTER, OVERREAD CENTERS AND REMOTE USER SITES

Table 4-8. Outward WATS from Overread Centers and Remote User Sites to CAPOC Computer

TO: CAPOC COMPUTER NH SAN DIEGO FROM:	DIGITAL DATA									ANALOG DATA				
			LINE & TERMINATION FEES			MODEMS					LINE & TERMINATION FEES			
	TRANSMISSION TIME (HOURS & MINUTES)	NR LINES REQUIRED	RECURRING CHARGES	OVERTIME CHARGES	NON-RECURRING CHARGES	NR REQUIRED	(202=1200bps) TYPE (103=300bps)	RECURRING CHARGES	NON-RECURRING CHARGES	NR LINES REQUIRED	TRANSMISSION TIME (HOURS & MINUTES)	RECURRING CHARGES	OVERTIME CHARGES	NON-RECURRING CHARGES
NRMC LONG BEACH, CA	39:58	1	$ 700.00		$ 50.00	2	202T	$ 80.00	$150.00	1	16:30	$ 260.00	$ 123.60	$ 50.00
AFH MARCH, CA	41:05	1	700.00		50.00	2	202T	80.00	150.00	1	10:38	260.00	12.16	50.00
MCB 29 PALMS, CA										1	1:28	260.00		50.00
AFH VANDENBURG, LOMPOC, CA										1	6:58	260.00		50.00
NH PORT HUENEME, CA										1	6:36	260.00		50.00
MCAS SANTA ANA, CA										1	6:14	260.00		50.00
AFCL NORTON, SAN BERNARDINO, CA										1	4:02	260.00		50.00
AFH GEORGE, VICTORVILLE, CA										1	3:40	260.00		50.00
AFH EDWARDS, EDWARDS, CA										1	2:56	260.00		50.00
AFH NELLIS, LAS VEGAS, NV										1	4:24	234.00		50.00
NRMC CAMP PENDLETON, CA	36:40	1	700.00		50.00	2	202T	80.00	150.00	1	24:12	260.00	269.84	50.00
NRMC SAN DIEGO, CA*	133:50	1*								8*	65:16			
NAVSTA SAN DIEGO, CA*										1*	5:08			
NAS NORTH ISLAND, SAN DIEGO, CA*										1*	4:02			
NAB CORONADO, CA*										1*	2:56			
NAS MIRAMAR, SAN DIEGO, CA*										1*	2:12			
NTC SAN DIEGO, CA*										1*	2:56			
MCRD SAN DIEGO, CA*										1*	2:12			
TOTAL		3	$2100.00		$ 150.00	6	202T	$240.00	$450.00	11		$2834.00	$ 405.60	$550.00

*WATS NOT APPLICABLE TO THESE STATIONS, RECOMMEND DDD FOR LOCAL AREA SITES

Table 4-8A. Outward WATS from CAPOC Computer to Overread Centers and Remote User Sites

TABLES 4-8 AND 4-8A

SUMMARY	
RECURRING COST	$ 10,810
NONRECURRING COST	$ 4,010
ANNUAL RECURRING COST	$129,716
8 YEARS (MONTHLY)	$ 10,851

FROM: CAPOC
COMPUTER NH SAN DIEGO
TO:

	DIGITAL DATA									ANALOG DATA				BUSINES LINES FOR TERMINAL EQUIPMENT	
			LINE & TERMINATION FEES			MODEMS				LINE & TERMINATION FEES					
	TRANSMISSION TIME (HOURS & MINUTES)	NR LINES REQUIRED	RECURRING CHARGES	OVERTIME CHARGES	NON-RECURRING CHARGES	NR REQUIRED	(202T=1200 bps) TYPE (103=300 bps)	RECURRING CHARGES	NONRECURRING CHARGES	NR LINES REQUIRED	TRANSMISSION TIME (HOURS & MINUTES	RECURRING CHARGES	OVERTIME CHARGES	NON-RECURRING CHARGES	NR LINES REQUIRED	RECURRING CHARGES	NON-RECURRING CHARGES
NRMC LONG BEACH, CA	9:25	1	$260.00		$ 50.00	2	202T	$ 80.00	$150.00	1	29:20	$260.00	$ 367.40	$ 50.00	2	$ 15.00	$ 82.00
AFH MARCH, RIVERSIDE, CA	8:37	1	260.00		50.00	2	202T	80.00	150.00	1	32:38	260.00	430.16	50.00	2	15.00	82.00
MCB 29 PALMS, CA	1:50	1	260.00	165.44	50.00	4	103	120.00	240.00						1	7.50	41.00
AFH VANDENBURG, LOMPOC, CA	7:20														1	7.50	41.00
NH PORT HUENEME, CA	9:32														1	7.50	41.00
MCAS SANTA ANA, CA	7:20	1	260.00	186.36	50.00	5	103	150.00	300.00						1	7.50	41.00
AFCL NORTON, SAN BERNARDINO,CA	5:08														1	7.50	41.00
AFH GEORGE, VICTORVILLE, CA	4:02														1	7.50	41.00
AFH EDWARDS, EDWARDS, CA	3:18														1	7.50	41.00
AFH NELLIS, LAS VEGAS, NV	6:58	1	234.00		50.00	2	103	40.00	50.00						1	7.50	41.00
NAVSTA SAN DIEGO, CA	5:52	1	260.00	283.92	50.00	7	103	210.00	420.00						1	7.50	41.00
NAS NORTH ISLAND, SAN DIEGO, CA	4:24														1	7.50	41.00
NAB CORONADO, CA	4:24														1	7.50	41.00
NAS MIRAMAR, SAN DIEGO, CA	2:34														1	7.50	41.00
NTC SAN DIEGO, CA	3:40														1	7.50	41.00
MCRD SAN DIEGO, CA	2:34														1	7.50	41.00
NRMC CAMP PENDLETON, CA	10:08	1	260.00	2.56	50.00	2	202T	80.00	150.00	1	27:52	260.00	339.64	50.00	2	15.00	82.00
NRMC SAN DIEGO, CA*	33:11	1*	2.00		40.00					1*	83:58	2.00		40.00			
TOTAL		7	$1796.00	$604.84	$390.00	6 18	202T 103	$760.00	$1460.00	3		$782.00	$1137.20	$190.00	20	$150.00	$820.00

*ROOM CIRCUITS

4.3 Summary

Each of the four applicable telecommunication configurations will support the Southwestern NRMC San Diego CAPOC System, with the exception that WATS is slightly modified by employing DDD for the ECG transmissions of the user sites located within the immediate vicinity of the Computer Center. With such a minor modification, WATS is still considered an individual configuration and is compared equally with the other systems.

4.3.1 Cost Comparisons

Table 4-9 presents a summary of cost comparisons of the four applicable communication networks. The Leased Lines System is clearly the least expensive network at an average 8-year monthly cost of $6,441.00. FTS is the next least expensive system at a 8-year monthly cost of $9,333.00. FTS also has the potential of further savings, dependent upon type and time of transmissions. Although WATS appears as the third system in ranking by cost, with a 8-year monthly cost of $10,851.00, it is again noted that WATS lines were not allocated to the sites located within San Diego. DDD, with an average 8-year monthly cost of $12,114.00, ranks as the most expensive of the four applicable systems.

Table 4-9. Communication Systems Cost Summary

ALTERNATIVE SYSTEMS	TOTAL MONTHLY CHARGES	TOTAL INSTALLATION CHARGES	TOTAL 8 - YEAR COSTS	AVERAGE MONTHLY COST 8 YEARS	ANNUAL RECURRING COSTS
Leased Lines	$ 6,394	$ 4,520	$ 613,824	$ 6,441	$ 76,728
DDD	12,071	4,149	1,158,816	12,114	144,852
FTS	9,296	3,557	892,448	9,333	111,556
WATS	10,810	4,010	1,041,770	10,851	129,716

5.0 RECOMMENDATION

The analysis and presentation of alternate communication systems, in section 4.0, for the Southwestern area NRMC San Diego CAPOC System was accomplished under the presumption that a general purpose computer will be employed. Hewlett-Packard and Marquette ECG computers are, via their particular interface units, compatible only to their respective carts and are limited in computer access lines. All general communication systems which would satisfy the CAPOC requirements were evaluated and submitted for consideration.

5.1 Candidate System

Table 5-1, which provides comparisons of costs by site and type of communication service, clearly shows that one system is more cost effective for certain sites than the other systems. Therefore, it is recommended that a hybrid communication system be used. Such a system provides the flexibility for change in networks, required by increased or decreased traffic volumes, and ensures that all requirements will be satisfied at the least possible cost. Relatedly, an impact study of a ten percent increase and decrease in traffic volume is contained in Appendix A and B respectively.

5.2 Cost Summary

Table 5-2 contains a cost summary of the CAPOC Communication System by site. This hybrid network, at a 8-year monthly average of $4,327, is significantly more cost-effective than using one specific system. Cost of the CAPOC Communication System is compared

Table 5-1. Comparison of Costs by Site and Type of Communication Service

(Monthly)

SITES	FTS			DDD			LEASED LINES			WATS		
	RECURRING COSTS	NONRECURRING COSTS	8-YEAR COST (MO)	RECURRING COSTS	NONRECURRING COSTS	8-YEAR COST (MO)	RECURRING COSTS	NONRECURRING COSTS	8-YEAR COST (MO)	RECURRING COSTS	NONRECURRING COSTS	8-YEAR COST (MO)
NRMC SAN DIEGO,CA (NOTE 1)	$	$	$	$	$	$	$ 14.00	$280.00	$ 17.00	$	$	$
NAVSTA SAN DIEGO, CA (NOTE 2)	191.90	96.00	193.00	78.00	142.00	79.00*	226.00	200.00	228.00	127.58	119.33	129.00
NAS NORIS, SAN DIEGO, CA (NOTE 2)	164.08	96.00	165.00	70.30	142.00	72.00*	223.00	200.00	225.00	127.58	119.33	129.00
MCB 29 PALMS, CA	293.40	105.00	294.00	105.72	142.00	107.00*	349.00	200.00	351.00	449.00	188.00	451.00
NTC SAN DIEGO, CA (NOTE 2)	144.28	96.00	145.00	64.80	142.00	66.00*	224.00	200.00	226.00	127.58	119.33	129.00
NAS MIRAMAR, SAN DIEGO, CA (NOTE 2)	124.48	96.00	125.00	59.30	142.00	61.00*	230.00	200.00	232.00	127.58	119.33	129.00
NAB CORONADO, CA (NOTE 2)	152.20	96.00	153.00	65.90	142.00	67.00*	223.00	200.00	225.00	127.58	119.33	129.00
MCRD SAN DIEGO, CA (NOTE 2)	124.48	96.00	125.00	59.30	142.00	61.00*	223.00	200.00	225.00	127.58	119.33	129.00
NRMC LONG BEACH, CA	1703.20	222.00	1706.00	3533.99	482.00	3539.00	691.00	460.00	696.00*	2146.00	582.00	2152.00
MCAS SANTA ANA, CA	219.52	96.00	221.00*	315.15	142.00	317.00	312.00	200.00	314.00	415.00	179.00	417.00
NH PORT HUENEME, CA	399.50	105.00	401.00	480.60	142.00	482.00	393.00	200.00	395.00*	449.00	188.00	451.00
NRMC CAMP PENDLETON, CA	2054.80	260.00	2058.00	2415.03	482.00	2420.00	561.00	460.00	566.00*	2267.00	582.00	2273.00
AFH MARCH, RIVERSIDE, CA	1634.84	222.00	1637.00	3180.97	482.00	3186.00	663.00	460.00	668.00*	2097.00	582.00	2103.00
AFH EDWARDS, EDWARDS, CA	308.88	105.00	310.00	213.30	142.00	215.00*	396.00	200.00	398.00	415.00	179.00	417.00
AFH GEORGE, VICTORVILLE, CA	295.56	105.00	297.00	225.18	142.00	227.00*	360.00	200.00	362.00	415.00	179.00	417.00
AFCL NORTON, SAN BERNARDINO, CA	172.00	96.00	173.00*	228.70	142.00	230.00	328.00	200.00	330.00	415.00	179.00	417.00
AFH VANDENBURG, LOMPOC, CA	438.12	105.00	439.00*	461.46	142.00	463.00	479.00	200.00	481.00	449.00	188.00	451.00
AFH NELLIS, LAS VEGAS, NV	195.76	96.00	197.00*	339.26	107.00	340.00	499.00	260.00	502.00	515.50	191.00	517.00

NOTE: 1. LONG DISTANCE SYSTEMS NOT APPLICABLE.
2. FTS AND WATS APPLICABLE ONLY IF ALL SITES USE SAME SYSTEM (SEE APPLICABLE TABLES).

*DEPICTS LEAST COST SYSTEM

Table 5-2. Summary of CAPOC Communication System Costs

SITE	TYPE OF CONNECTIVITY	MONTHLY RECURRING COST	NON-RECURRING COSTS	MONTHLY 8 YEAR AVERAGE	ANNUAL RECURRING COSTS
NRMC SAN DIEGO	Leased Line	$ 14.00	$ 280.00	$ 17.00	$ 168.00
NRMC LONG BEACH	Leased Line	691.00	460.00	696.00	8,292.00
NRMC CAMP PENDLETON	Leased Line	561.00	460.00	566.00	6,732.00
AFH MARCH	Leased Line	663.00	460.00	668.00	7,956.00
MCB 29 PALMS	DDD	105.72	142.00	107.00	1,268.64
NAVSTA SAN DIEGO	DDD	78.00	142.00	79.00	936.00
NAS NORTH ISLAND	DDD	70.30	142.00	72.00	843.60
NAB CORONADO	DDD	65.90	142.00	67.00	790.80
NAS MIRAMAR	DDD	59.30	142.00	61.00	711.60
NTC SAN DIEGO	DDD	64.80	142.00	66.00	777.60
MCRD SAN DIEGO	DDD	59.30	142.00	61.00	711.60
MCAS SANTA ANA	FTS	219.52	96.00	221.00	2,634.24
NH PORT HUENEME	Lease Lines	393.00	200.00	395.00	4,716.00
AFH EDWARDS	DDD	213.30	142.00	215.00	2,559.60
AFH GEORGE	DDD	225.18	142.00	227.00	2,702.16
AFCL NORTON	FTS	172.00	96.00	173.00	2,064.00
AFH VANDENBURG	FTS	438.12	105.00	439.00	5,257.44
AFH NELLIS	FTS	195.76	96.00	197.00	2,349.12
		$ 4289.20	$ 3531.00	$ 4327.00	$51,470.40

to costs of the other individual systems in figure 5-1. Figure 5-2 provides a comparison of annual recurring costs between the hybrid network and each individual system. The connectivities of the CAPOC Communication System are presented in figure 5-3.

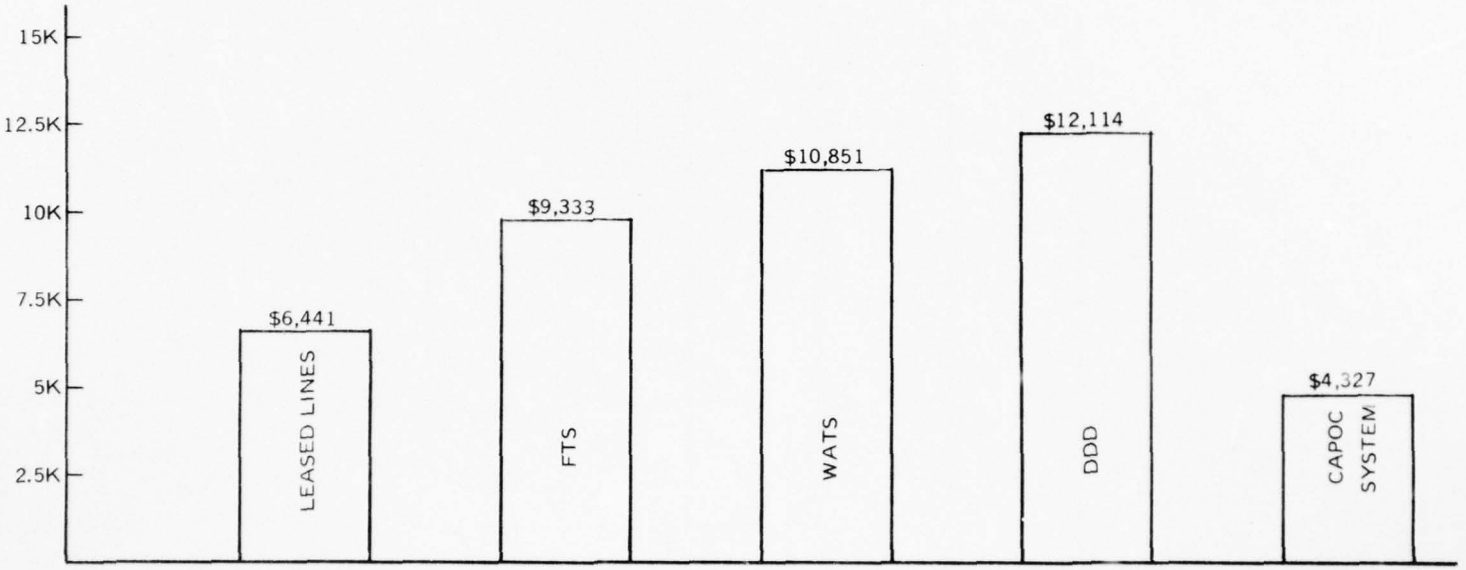


FIGURE 5-1. AVERAGE MONTHLY COST COMPARISON (8 YEAR AMORTIZATION)

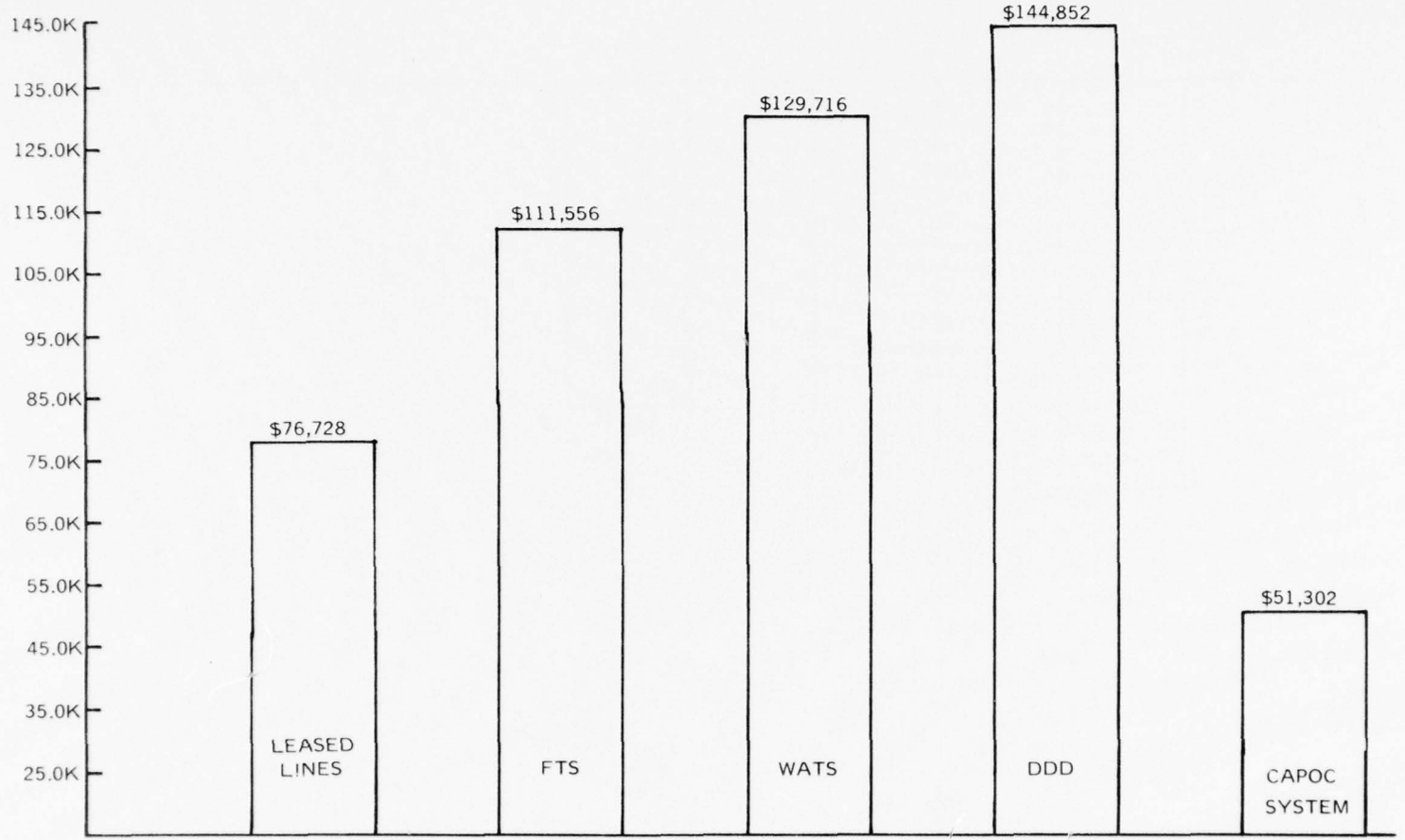


FIGURE 5-2. ANNUAL RECURRING COST COMPARISON

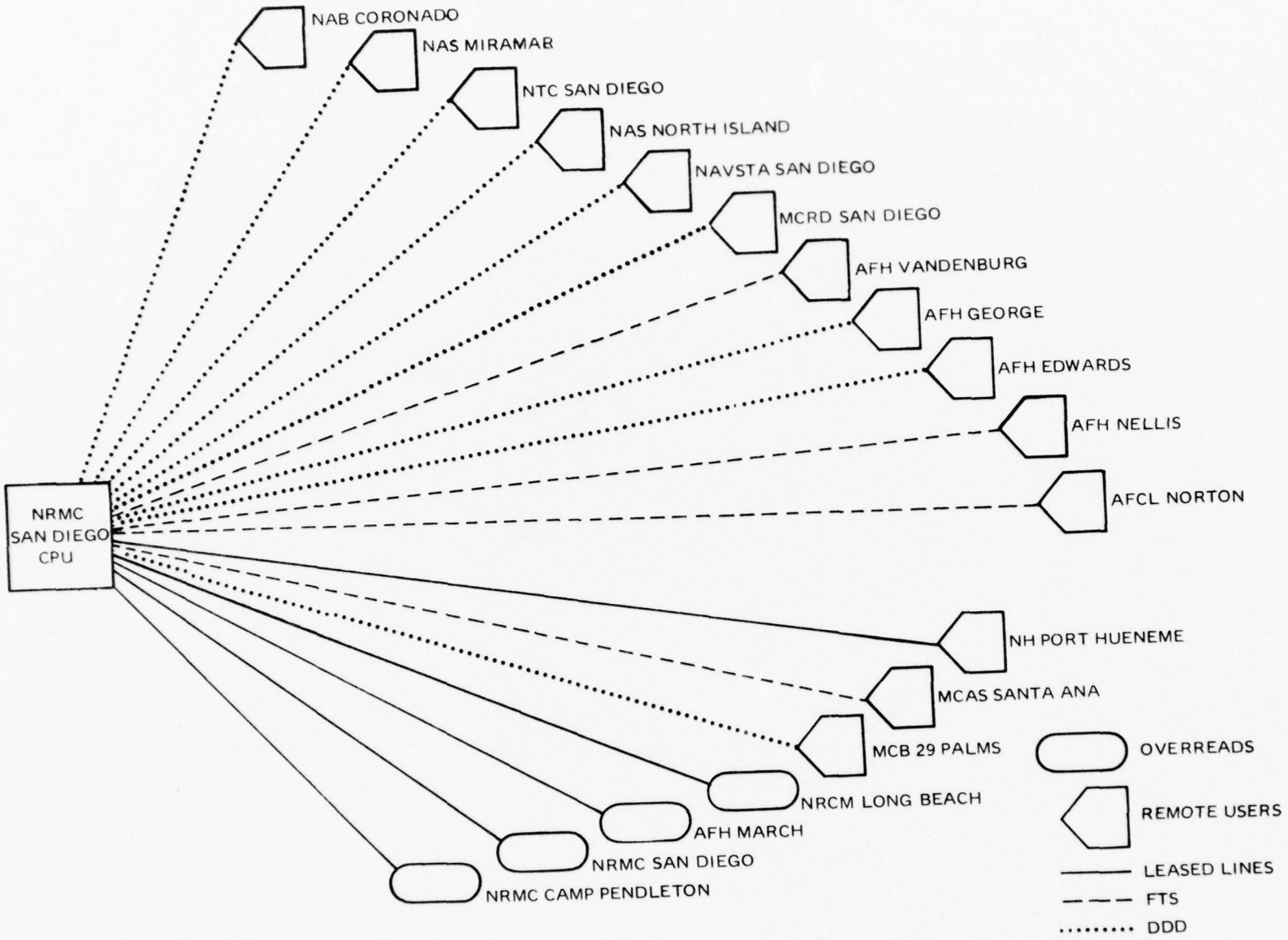


FIGURE 5-3. CAPOC COMMUNICATION NETWORK

APPENDIX A

CAPOC Communications Cost Analysis Based on a 10 Percent Increase in Traffic Volume

PURPOSE

The analysis contained in this appendix is based on increasing the CAPOC traffic volume at each site and the CAPOC computer by 10 percent. This was performed to test the sensitivity of the hybrid communications system to increases in traffic volume and to determine what effects such changes would have on system cost.

BACKGROUND

Tables A1 through A8 and figure A1 contained herein correspond to table 2-2 and tables 4-5 through 5-2 and figure 5-2 of the basic report. Detailed system descriptions have been omitted since the communications configurations of each specific system remain unchanged from the basic analysis.

CONCLUSIONS

The results of this analysis indicate that a 10 percent increase in traffic volume results in only a three percent increase in amortized monthly cost. The most economical means of communicating remain unchanged.

Table A-1. CAPOC Sites Input and Output Requirements (Monthly Increased 10%)

SITES	NUMBER OF TRANSMISSIONS				TRANSMISSION TIMES FOR EACH CAPOC SITE			
	OVERREAD & USERS TO COMPUTER		COMPUTER TO OVERREAD & USERS		OVERREADS & USERS TO COMPUTER		COMPUTER TO OVERREADS & USERS	
	USER ANALOG XMISSIONS	O/R DIGITAL XMISSIONS	ANALOG XMISSIONS TO O/R	DIGITAL XMISSIONS	USER ANALOG HR: MIN	O/R DIGITAL XMISSIONS	OVERREAD ANALOG HR: MIN	DIGITAL HR: MIN
CAPOC COMPUTER NH SAN DIEGO	15,246	21,441	21,441	37,970	254:06	357:21	357:51	105:28
NRMC SAN DIEGO	4,307	8,833	5,542	13,141	71:18	147:13	92:22	36:12
NRMC LONG BEACH	1,089	2,638	1,936	3,728	18:09	43:58	32:16	10:21
NRMC CAMP PENDLETON	1,597	2,420	1,839	4,017	26:37	40:20	30:39	11:09
AFH MARCH	702	2,710	2,154	3,412	11:42	45:10	35:45	9:29
MCB 29 PALMS	97			121	1:37			2:01
NAVSTA SAN DIEGO	339			387	5:39			6:27
NAS NORTH ISLAND	266			290	4:26			4:50
NAB CORONADO	194			290	3:14			4:50
NAS MIRAMAR	145			169	2:25			2:49
MCRD SAN DIEGO	145			169	2:25			2:49
NTC SAN DIEGO	194			242	3:14			4:02
MCAS SANTA ANA	411			484	6:51			8:04
NH PORT HUENEME	435			629	7:15			10:29
AFH EDWARDS	194			218	3:14			3:38
AFH GEORGE	242			266	4:02			4:26
AFCL NORTON	266			339	4:26			5:39
AFH VANDENBURG	460			484	7:40			8:04
AFH NELLIS	290			460	4:50			7:40

Table A-2. Monthly Cost of Leased Lines for CAPOC
(Monthly Increased 10%)

SUMMARY	
RECURRING COST	$ 6,394
NONRECURRING COST	$ 4,520
ANNUAL RECURRING COST	$76,728
8 YEARS (MONTHLY)	$ 6,441

FROM	ACCESS MILES TO NRMC SDIEGO	DIGITAL DATA								ANALOG DATA			
				TERMINATION FEES		MODEMS						TERMINATION FEES	
		NR LINES REQUIRED	LINE COST @ .55 PER MILE	RECURRING CHARGES	NON-RECURRING CHARGES	NR REQUIRED	(202T=1200 bps) TYPE (103=300 bps)	RECURRING CHARGES	NON-RECURRING CHARGES	NR REQUIRED	LINE COST @ .55 PER MILE	RECURRING CHARGES	NON-RECURRING CHARGES
NRMC SAN DIEGO, CA	0	2	—	—	—	—	—	—	—	7	—	$ 14.00	$280.00
NRMC LONG BEACH, CA	96	2	$105.60	$160.00	$ 80.00	4	202T	$ 160.00	$300.00	2	$105.60	160.00	80.00
NRMC CAMP PENDLETON, CA	37	2	40.70	160.00	80.00	4	202T	160.00	300.00	2	40.70	160.00	80.00
AFH MARCH, CA	83	2	91.30	160.00	80.00	4	202T	160.00	300.00	2	91.30	160.00	80.00
MCB 29 PALMS, CA	117	1	64.35	80.00	40.00	2	103	60.00	120.00	1	64.35	80.00	40.00
NAVSTA SAN DIEGO, CA	5	1	2.75	80.00	40.00	2	103	60.00	120.00	1	2.75	80.00	40.00
NAS NORTH ISLAND, CA	3	1	1.65	80.00	40.00	2	103	60.00	120.00	1	1.65	80.00	40.00
NAB CORONADO, CA	3	1	1.65	80.00	40.00	2	103	60.00	120.00	1	1.65	80.00	40.00
NAS MIRAMAR, CA	9	1	4.95	80.00	40.00	2	103	60.00	120.00	1	4.95	80.00	40.00
NTC SAN DIEGO, CA	4	1	2.20	80.00	40.00	2	103	60.00	120.00	1	2.20	80.00	40.00
MCRD SAN DIEGO, CA	3	1	1.65	80.00	40.00	2	103	60.00	120.00	1	1.65	80.00	40.00
MCAS SANTA ANA, CA	84	1	46.20	80.00	40.00	2	103	60.00	120.00	1	46.20	80.00	40.00
NH PORT HUENEME, CA	157	1	86.35	80.00	40.00	2	103	60.00	120.00	1	86.35	80.00	40.00
AFH EDWARDS, CA	160	1	88.00	80.00	40.00	2	103	60.00	120.00	1	88.00	80.00	40.00
AFH GEORGE, CA	127	1	69.85	80.00	40.00	2	103	60.00	120.00	1	69.85	80.00	40.00
AFCL NORTON, CA	98	1	53.90	80.00	40.00	2	103	60.00	120.00	1	53.90	80.00	40.00
AFH VANDENBURG, CA	235	1	129.25	80.00	40.00	2	103	60.00	120.00	1	129.25	80.00	40.00
AFH NELLIS, NV	264	1	145.20	84.10	105.10	2	103	40.00	50.00	1	145.20	84.10	105.10
TOTALS	1485	22	$935.55	$1604.10	$865.10	12	202T	$1300.00	$2510.00	27	$935.55	$1618.10	$1145.10
						28	103						

Table A-3. Direct Distance Dial Costs Between CAPOC Computer, Overread Centers, Remote User Sites
(Monthly-Increased 10%)

SUMMARY	
RECURRING COST	$ 13,142
NONRECURRING COST	$ 4,149
ANNUAL RECURRING COST	$157,704
8 YEARS (MONTHLY)	$ 13,185

	COMPUTER SEND			OVERREAD SEND	USER SEND	CENTREX LINES			BUSINESS LINES			MODEMS			
SITES	ANALOG TRACINGS TO OVERREADS	DIGITAL REPORTS TO OVERREADS	DIGITAL REPORTS TO REMOTE USERS	DIGITAL EDITS & RETRIEVALS TO COMPUTER	ANALOG INPUT TO COMPUTER FROM COLLOCATED & REMOTE USER SITES	NR LINES	RECURRING COST	NONRECURRING COST	NR LINES	RECURRING COSTS	NONRECURRING COSTS	NUMBER	103A3 (300 BPS) TYPE 202T (1200 BPS)	RECURRING COST	NONRECURRING COSTS
CAPOC COMPUTER															
NH SAN DIEGO						7[1]	$ 45.85	$126.00	4	$ 30.00	$164.00		Notes 2/3	$ 80.00	$ 100.00
NRMC SAN DIEGO						9[4]	18.00	360.00							
NRMC LONG BEACH	$ 774.40	$1491.20	—	$ 1055.20	$ 351.36	1	6.55	18.00	4	30.00	164.00	4	202T	160.00	300.00
NRMC CAMP PENDLETON	459.75	1004.25	—	605.00	371.21	1	6.55	18.00	4	30.00	164.00	4	202T	160.00	300.00
AFH MARCH	796.98	1262.44	—	1002.70	220.50	1	6.55	18.00	4	30.00	164.00	4	202T	160.00	300.00
MCB 29 PALMS			$ 41.14		25.78				2	15.00	82.00	1	103-A3	30.00	60.00
NAVSTA SAN DIEGO			19.35		16.95				2	15.00	82.00	1	103-A3	30.00	60.00
NAS NORTH ISLAND			14.50		13.30				2	15.00	82.00	1	103-A3	30.00	60.00
NAB CORONADO			14.50		9.70				2	15.00	82.00	1	103-A3	30.00	60.00
NAS MIRAMAR			8.45		7.25				2	15.00	82.00	1	103-A3	30.00	60.00
NTC SAN DIEGO			12.10		9.70				2	15.00	82.00	1	103-A3	30.00	60.00
MCRD SAN DIEGO			8.45		7.25				2	15.00	82.00	1	103-A3	30.00	60.00
MCAS SANTA ANA			164.56		132.54				2	15.00	82.00	1	103-A3	30.00	60.00
NH PORT HUENEME			283.05		195.75				2	15.00	82.00	1	103-A3	30.00	60.00
AFH EDWARDS			98.10		87.30				2	15.00	82.00	1	103-A3	30.00	60.00
AFH GEORGE			106.40		91.76				2	15.00	82.00	1	103-A3	30.00	60.00
AFCL NORTON			125.43		76.64				2	15.00	82.00	1	103-A3	30.00	60.00
AFH VANDENBURG			246.84		211.56				2	15.00	82.00	1	103-A3	30.00	60.00
AFH NELLIS			211.60		123.08				2	15.00	82.00	1	103-A3	20.00	25.00
TOTALS	$2031.13	$3757.89	$1354.47	$ 2662.90	$1951.63	19	$ 83.50	$540.00	44	$ 330.00	$1804.00	12 18	202T 103-A3	$970.00	$1805.00

NOTE:
1. CENTREX LINES TO COMPUTER ECG INTERFACE UNITS.
2. FOUR 103-A3 MODEMS REQUIRED AT COMPUTER FOR 300 bps XMSN TO REMOTE USERS.
3. COST OF 202T (1200 bps) MODEMS ALLOCATED TO OVERREAD CENTERS.
4. NINE "ROOM CIRCUIT" LINES AT $2.00 RECURRING AND $40.00 INSTALLATION CHARGE EACH.

Table A-4. FTS Costs Between CAPOC Computer, Overread Centers, Remote User Sites

(Monthly Variable/Summary Costs — Volume Increased 10%)

SUMMARY	
RECURRING COST	$ 9,893
NONRECURRING COST	$ 3,557
ANNUAL RECURRING COST	$118,716
8 - YEARS (MONTHLY)	$ 9,930

	VOLUME DEPENDENT FTS CHARGES					STATIC CHARGES[1]				COST SUMMARY			
	COMPUTER SEND			OVER-READ SEND	USER SEND	LEASED LINES		MODEMS					
SITES	ANALOG TRACINGS TO OVERREADS	DIGITAL REPORTS TO OVERREADS	DIGITAL REPORTS TO REMOTE USERS	DIGITAL EDITS AND RETRIEVALS TO COMPUTER	ANALOG INPUT TO COMPUTER FROM COLLOCATED & REMOTE USER SITES	RECURRING CHARGES	NON-RECURRING CHARGES	RECURRING CHARGES	NON-RECURRING CHARGES	TOTAL RECURRING COSTS	TOTAL NONRECURRING COSTS	MONTHLY COSTS (8 - YEAR LIFE)	ANNUAL RECURRING COSTS
CAPOC COMPUTER NH SAN DIEGO	$	$	$	$	$	$ 301.30	$ 414.00	$ 360.00	$ 690.00	$ 661.30	$1104.00	$ 672.80	$ 7,935.60
NRMC SAN DIEGO						18.00	360.00			18.00	360.00	21.75	216.00
NRMC LONG BEACH	348.48	671.04		474.84	196.02	86.00	72.00	80.00	150.00	1856.38	222.00	1858.69	22,276.56
NRMC CAMP PENDLETON	331.02	723.06		435.60	287.46	393.44	160.00	46.00	100.00	2216.58	260.00	2219.29	26,598.96
AFH MARCH	387.72	614.16		487.80	126.36	86.00	72.00	80.00	150.00	1782.04	222.00	1784.35	21,384.48
MCB 29 PALMS			21.78		17.46	237.76	80.00	20.00	25.00	297.00	105.00	298.09	3,564.00
NAVSTA SAN DIEGO			69.66		61.02	43.00	36.00	30.00	60.00	203.68	96.00	204.68	2,444.16
NAS NORTH ISLAND			52.20		47.88	43.00	36.00	30.00	60.00	173.08	96.00	174.08	2,076.96
NAB CORONADO			52.20		34.92	43.00	36.00	30.00	60.00	160.12	96.00	161.12	1,921.44
NAS MIRAMAR			30.42		26.10	43.00	36.00	30.00	60.00	129.52	96.00	130.52	1,554.24
MCRD SAN DIEGO			30.42		26.10	43.00	36.00	30.00	60.00	129.52	96.00	130.52	1,554.24
NTC SAN DIEGO			43.56		34.92	43.00	36.00	30.00	60.00	151.48	96.00	152.48	1,817.76
MCAS SANTA ANA			87.12		73.98	43.00	36.00	30.00	60.00	234.10	96.00	235.10	2,809.20
NH PORT HUENEME			113.22		78.30	205.36	80.00	20.00	25.00	416.88	105.00	417.97	5,002.56
AFH EDWARDS			39.24		34.92	221.56	80.00	20.00	25.00	315.72	105.00	316.81	3,788.64
AFH GEORGE			47.88		43.56	192.40	80.00	20.00	25.00	303.84	105.00	304.93	3,646.08
AFCL NORTON			61.02		47.88	43.00	36.00	30.00	60.00	181.90	96.00	182.90	2,182.80
AFH VANDENBURG			87.12		82.80	263.68	80.00	20.00	25.00	453.60	105.00	454.69	5,443.20
AFH NELLIS			82.80		52.20	43.00	36.00	30.00	60.00	208.30	96.00	209.30	2,499.60
TOTALS	$1067.22	$2008.26	$ 818.64	$1398.24	$1271.88	$2392.50	$1802.00	$ 936.00	$1755.00	$9892.74	$3557.00	$9930.07	$118,716.48

NOTE: 1. STATIC CHARGES COMPILED FROM TABLE 4-7 ON PAGE 4-15

Table A-5. User Outward WATS for CAPOC (Monthly-Increased 10%)

TO: CAPOC COMPUTER NH SAN DIEGO FROM:	DIGITAL DATA										ANALOG DATA			
			LINE & TERMINATION FEES			MODEMS					LINE & TERMINATION FEES			
	TRANSMISSION TIME (HOURS & MINUTES)	NR LINES REQUIRED	RECURRING CHARGES	OVERTIME CHARGES	NON-RECURRING CHARGES	NR REQUIRED	(202=1200bps) TYPE (103=300bps)	RECURRING CHARGES	NON-RECURRING CHARGES	NR LINES REQUIRED	TRANSMISSION TIME (HOURS & MINUTES)	RECURRING CHARGES	OVERTIME CHARGES	NON-RECURRING CHARGES
NRMC SAN DIEGO (NOTE 1)														
NRMC LONG BEACH, CA	43:58	1	$ 700.00		$ 50.00	2	202T	$ 80.00	$150.00	1	18:09	$ 260.00	$ 154.88	$ 50.00
AFH MARCH, RIVERSIDE, CA	45:10	1	700.00		50.00	2	202T	80.00	150.00	1	11:42	260.00	32.44	50.00
MCB 29 PALMS, CA										1	1:37	260.00		50.00
AFH VANDENBURG, LOMPOC, CA										1	7:40	260.00		50.00
NH PORT HUENEME, CA										1	7:15	260.00		50.00
MCAS SANTA ANA, CA										1	6:51	260.00		50.00
AFCL NORTON, SAN BERNARDINO,CA										1	4:26	260.00		50.00
AFH GEORGE, VICTORVILLE, CA										1	4:02	260.00		50.00
AFH EDWARDS, EDWARDS, CA										1	3:14	260.00		50.00
AFH NELLIS, LAS VEGAS, NV										1	4:50	234.00		50.00
NAVSTA SAN DIEGO, CA*														
NAS NORTH ISLAND, SAN DIEGO,CA*														
NAB CORONADO, CA*														
NAS MIRAMAR, SAN DIEGO, CA														
MCRD SAN DIEGO, CA*														
NTC SAN DIEGO, CA*														
NRMC CAMP PENDLETON, CA	40:20	1	700.00		50.00	2	202T	80.00	150.00	1	26:37	260.00	315.84	50.00
		3	$2100.00		$150.00	6	202T	$240.00	$450.00	11		$2834.00	503.16	$550.00

*WATS NOT APPLICABLE TO THESE STATIONS, RECOMMEND DDD FOR LOCAL AREA SITES

NOTE: 1. NRMC SAN DIEGO/CAPOC COMPUTER COMMUNICATIONS PROVIDED BY INTERNAL LINES.

Table A-6. Computer Outward WATS for CAPOC (Monthly-Increased 10%)

SUMMARY	
RECURRING COST	$ 11,168
NONRECURRING COST	$ 4,010
ANNUAL RECURRING COST	$134,016
8 YEARS (MONTHLY)	$ 11,210

FROM: CAPOC
COMPUTER NH SAN DIEGO
TO:

	DIGITAL DATA									ANALOG DATA				BUSINES LINES FOR TERMINAL EQUIPMENT	
			LINE & TERMINATION FEES			MODEMS				LINE & TERMINATION FEES					
	TRANSMISSION TIME (HOURS & MINUTES)	NR LINES REQUIRED	RECURRING CHARGES	OVERTIME CHARGES	NON-RECURRING CHARGES	NR REQUIRED	(202T=1200 bps) TYPE (103=300 bps)	RECURRING CHARGES	NONRECURRING CHARGES	NR LINES REQUIRED	TRANSMISSION TIME (HOURS & MINUTES	RECURRING CHARGES	OVERTIME CHARGES	NON-RECURRING CHARGES	NR LINES REQUIRED	RECURRING CHARGES	NON-RECURRING CHARGES
NRMC LONG BEACH, CA	10:21	1	$260.00	$ 6:72	$ 50.00	2	202T	$ 80.00	$ 150.00	1	32:16	$260.00	$ 423.12	$ 50.00	2	$ 15.00	$ 82.00
AFH MARCH, RIVERSIDE, CA	9:29	1	260.00		50.00	2	202T	80.00	150.00	1	35:45	700.00		50.00	2	15.00	82.00
MCB 29 PALMS, CA	2:01	1	260.00	200.88	50.00	4	103	120.00	240.00						1	7.50	41.00
AFH VANDENBURG, LOMPOC,CA	8:04														1	7.50	41.00
NH PORT HUENEME, CA	10:29														1	7.50	41.00
MCAS SANTA ANA, CA	8:04	1	260.00	224.04	50.00	5	103	150.00	300.00						1	7.50	41.00
AFCL NORTON, SAN BERNARDINO,CA	5:39														1	7.50	41.00
AFH GEORGE, VICTORVILLE, CA	4:26														1	7.50	41.00
AFH EDWARDS, EDWARDS, CA	3:38														1	7.50	41.00
AFH NELLIS, LAS VEGAS, NV	7:40	1	234.00		50.00	2	103	40.00	50.00						1	7.50	41.00
NAVSTA, SAN DIEGO, CA	6:27	1	260.00	293.57	50.00	7	103	210.00	420.00						1	7.50	41.00
NAS NORTH ISLAND, SAN DIEGO, CA	4:50														1	7.50	41.00
NAB CORONADO, CA	4:50														1	7.50	41.00
NAS MIRAMAR, SAN DIEGO, CA	2:49														1	7.50	41.00
MCRD SAN DIEGO, CA	2:49														1	7.50	41.00
NTC SAN DIEGO, CA	4:02														1	7.50	41.00
NRMC CAMP PENDLETON, CA	11:09	1	260.00	21.88	50.00	2	202T	80.00	150.00	1	30:39	260.00	392.48	50.00	2	15.00	82.00
NRMC SAN DIEGO, CA*			2.00		40.00							2.00		40.00			
TOTALS		7	$1796.00	$747.09	$390.00	6 18	202T 103	$760.00	$1460.00	3		$1222.00	$ 815.60	$190.00	20	$150.00	$820.00

*ROOM CIRCUITS

Table A-7. Comparison of Costs by Site and Type of Communication Service
(10% Monthly Increase in Traffic Volume)

SITES	WATS			LEASED LINES			FTS			DIRECT DISTANCE DIAL		
	TOTAL MONTHLY RECURRING COSTS	TOTAL NONRE-CURRING COSTS	AMORTIZED 8 YEAR COSTS	TOTAL MONTHLY RECURRING COSTS	TOTAL NONRE-CURRING COSTS	AMORTIZED 8 YEAR COSTS	TOTAL MONTHLY RECURRING COSTS	TOTAL NONRE-CURRING COSTS	AMORTIZED 8 YEAR COSTS	TOTAL MONTHLY RECUR-RING COSTS	TOTAL NONRE-CURRING COSTS	AMORTIZED 8 YEAR COSTS
NRMC SAN DIEGO (NOTE 1)	$	$	$	$ 14.00	$ 280.00	$ 17.00	$	$	$	$	$	$
NRMC LONG BEACH	2239.72	582.00	2245.78	691.00	460.00	696.00	1856.38	222.00	1858.69	3868.71	482.00	3873.73
NRMC CAMP PENDLETON	2385.20	582.00	2391.36	561.00	460.00	566.00*	2216.58	260.00	2219.29	2636.76	482.00	2641.78
AFH MARCH	2127.44	582.00	2133.50	663.00	460.00	668.00*	1782.04	222.00	1784.35	3479.17	482.00	3484.73
MCB 29 PALMS	461.13	187.67	463.08	349.00	200.00	351.00	297.00	105.00	298.09	111.92	142.00	113.40*
NAVSTA SAN DIEGO (NOTE 2)	134.76	119.33	136.00	226.00	200.00	228.00	203.68	96.00	204.68	81.30	142.00	82.78*
NAS NORTH ISLAND (NOTE 2)	134.76	119.33	136.00	223.00	200.00	225.00	173.08	96.00	174.08	72.80	142.00	77.28*
NAB CORONADO (NOTE 2)	134.76	119.33	136.00	223.00	200.00	225.00	160.12	96.00	161.12	69.20	142.00	70.68*
NAS MIRAMAR (NOTE 2)	134.76	119.33	136.00	230.00	200.00	232.00	129.52	96.00	130.52	60.70	142.00	62.18*
MCRD SAN DIEGO (NOTE 2)	134.76	119.33	136.00	223.00	200.00	225.00	129.52	96.00	130.52	60.70	142.00	62.18*
NTC SAN DIEGO (NOTE 2)	134.76	119.33	136.00	224.00	200.00	226.00	151.48	96.00	152.48	66.80	142.00	68.28*
MCAS SANTA ANA	426.01	178.50	427.87	312.00	200.00	314.00	234.10	96.00	235.10*	342.10	142.00	343.58
NH PORT HUENEME	461.13	187.67	463.08	393.00	200.00	395.00*	416.88	105.00	417.97	523.80	142.00	525.28
AFH EDWARDS	426.01	178.50	427.87	396.00	200.00	398.00	315.72	105.00	316.81	230.40	142.00	231.40*
AFH GEORGE	426.01	178.50	427.87	360.00	200.00	362.00	303.84	105.00	304.93	243.16	142.00	244.64*
AFCL NORTON	426.01	178.50	427.87	328.00	200.00	330.00	181.90	96.00	182.90*	247.07	142.00	248.55
AFH VANDENBURG	461.13	187.67	463.08	479.00	200.00	481.00	453.60	105.00	454.69*	503.40	142.00	504.88
AFH NELLIS	515.50	191.00	517.48	499.00	260.00	502.00	208.30	96.00	209.30*	369.68	107.00	370.79

NOTE: 1. LONG DISTANCE SYSTEMS NOT APPLICABLE.
2. FTS AND WATS APPLICABLE ONLY IF ALL SITES USE SAME SYSTEM (SEE APPLICABLE TABLES).

*DEPICTS LEAST COST SYSTEM

Table A-8. Summary of CAPOC Communications System Costs
(10% Monthly Increase)

SITE	TYPE OF CONNECTIVITY	MONTHLY RECURRING COST	NON-RECURRING COSTS	MONTHLY 8 YEAR AVERAGE	ANNUAL RECURRING COSTS
NRMC SAN DIEGO	Leased Lines	$ 14.00	$ 280.00	$ 17.00	$ 168.00
NRMC LONG BEACH	Leased Lines	691.00	460.00	696.00	8,292.00
NRMC CAMP PENDLETON	Leased Lines	561.00	460.00	566.00	6,732.00
AFH MARCH	Leased Lines	663.00	460.00	668.00	7,956.00
MCB 29 PALMS	DDD	111.92	142.00	113.40	1,343.04
NAVSTA SAN DIEGO	DDD	81.30	142.00	82.78	975.60
NAS NORTH ISLAND	DDD	72.80	142.00	74.28	873.60
NAB CORONADO	DDD	69.20	142.00	70.68	830.40
NAS MIRAMAR	DDD	60.70	142.00	62.18	728.40
NTC SAN DIEGO	DDD	66.80	142.00	68.28	801.60
MCRD SAN DIEGO	DDD	60.70	142.00	62.18	728.40
MCAS SANTA ANA	FTS	234.10	96.00	235.10	2,809.20
NH PORT HUENEME	Leased Lines	393.00	200.00	395.00	4,716.00
AFH EDWARDS	DDD	230.40	142.00	231.40	2,764.80
AFH GEORGE	DDD	243.16	142.00	244.64	2,917.92
AFCL NORTON	FTS	181.90	96.00	182.90	2,182.80
AFH VANDENBURG	FTS	453.60	105.00	454.69	5,443.20
AFH NELLIS	FTS	208.30	96.00	209.30	2,499.60
		$ 4396.88	$ 3531.00	$4433.81	$ 52,762.56

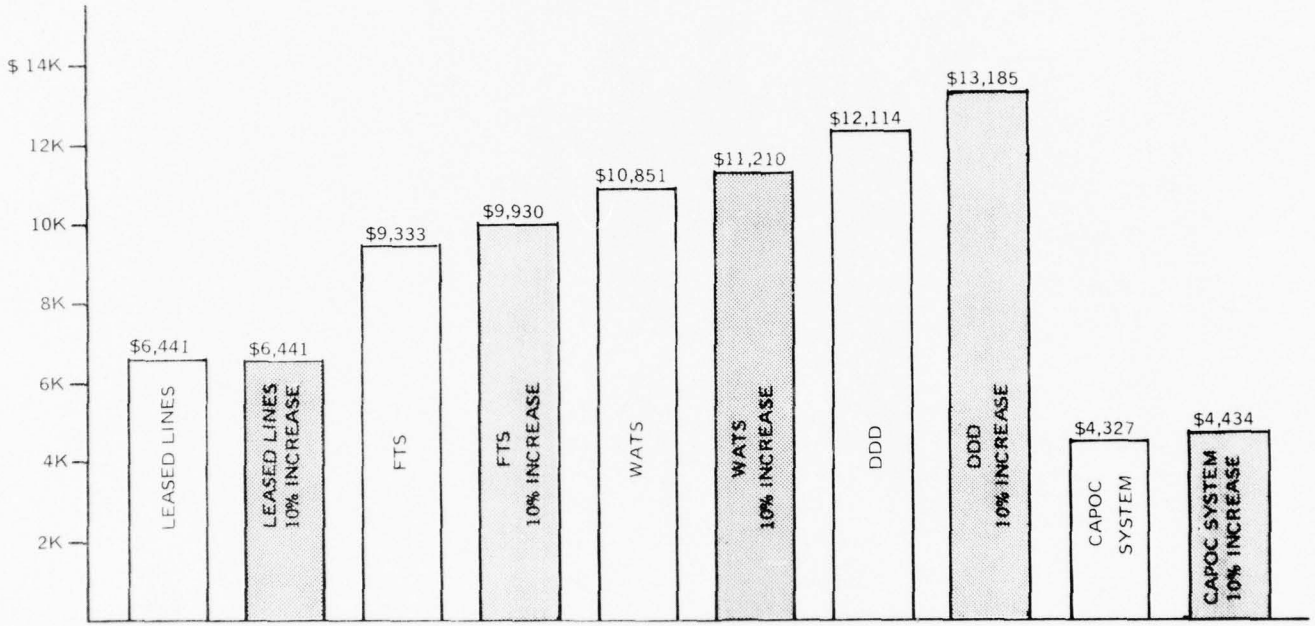


FIGURE A-1. AVERAGE MONTHLY COST COMPARISON (8-YEAR AMORTIZATION) (WITH 10% INCREASE)

APPENDIX B

CAPOC Communications Cost Analysis Based on a 10 Percent Decrease in Traffic Volume

PURPOSE

The analysis contained in this appendix is based on decreasing the CAPOC traffic volume at each site and the CAPOC computer by 10 percent. This was performed to test the sensitivity of the hybrid communications system to decreases in traffic volume and to determine what effects such changes would have on system cost.

BACKGROUND

Tables B1 through B8 and figure B1 contained herein correspond to table 2-2 and tables 4-5 through 5-2 and figure 5-2 of the basic report. Detailed system descriptions have been omitted since the communications configurations of each specific system remain unchanged from the basic analysis.

CONCLUSIONS

The results of this analysis indicate that a 10 percent decrease in traffic volume results in only a three percent decrease in amortized monthly cost. The most economical means of communicating for NH Port Hueneme changed from Leased Lines to FTS and AFH Vandenburg changed from FTS to DDD.

Table B-1. CAPOC Sites Input and Output Requirements (Monthly Decreased 10%)

	NUMBER OF TRANSMISSIONS				TRANSMISSION TIMES FOR EACH CAPOC SITE			
	OVERREAD & USERS TO COMPUTER		COMPUTER TO OVERREAD & USERS		OVERREADS & USERS TO COMPUTER		COMPUTER TO OVERREADS & USERS	
	USER ANALOG XMISSIONS	O/R DIGITAL XMISSIONS	ANALOG XMISSIONS TO O/R	DIGITAL XMISSIONS	USER ANALOG HR: MIN	O/R DIGITAL XMISSIONS	OVERREAD ANALOG HR: MIN	DIGITAL HR: MIN
CAPOC COMPUTER NH SAN DIEGO	12,474	17,543	17,543	31,066	207:54	292:23	292:23	86:18
NRMC SAN DIEGO	3,524	7,227	4,534	10,751	58:44	120:27	75:20	29:52
NRMC LONG BEACH	891	2,158	1,584	3,049	14:51	35:58	26:24	8:29
NRMC CAMP PENDLETON	1,307	1,980	1,505	3,287	21:47	33:00	25:05	9:07
AFH MARCH	574	2,218	1,762	2,792	9:34	36:59	29:22	7:45
MCB 29 PALMS	79			99	1:19			1:39
NAVSTA SAN DIEGO	277			317	4:37			5:17
NAS NORTH ISLAND	218			238	3:38			3:58
NAB CORONADO	158			238	2:38			3:58
NAS MIRAMAR	119			139	1:59			2:19
MCRD SAN DIEGO	119			139	1:59			2:19
NTC SAN DIEGO	158			198	2:38			3:18
MCAS SANTA ANA	337			396	5:37			6:36
NH PORT HUENEME	356			515	5:56			8:35
AFH EDWARDS	158			178	2:38			2:58
AFH GEORGE	198			218	3:18			3:38
AFCL NORTON	218			277	3:38			4:37
AFH VANDENBURG	376			396	6:16			6:36
AFH NELLIS	238			376	3:58			6:16

Table B-2. Monthly Cost of Leased Lines for CAPOC

(10% Monthly Decrease in Traffic Volume)

SUMMARY

RECURRING COST	$ 6,394
NONRECURRING COST	$ 4,520
ANNUAL RECURRING COST	$76,728
8 YEARS (MONTHLY)	$ 6,441

FROM	ACCESS MILES TO NRMC SDIEGO	DIGITAL DATA								ANALOG DATA			
				TERMINATION FEES		MODEMS						TERMINATION FEES	
		NR LINES REQUIRED	LINE COST @ .55 PER MILE	RECURRING CHARGES	NON-RECURRING CHARGES	NR REQUIRED	(202T=1200 bps) TYPE (103=300 bps)	RECURRING CHARGES	NON-RECURRING CHARGES	NR REQUIRED	LINE COST @ .55 PER MILE	RECURRING CHARGES	NON-RECURRING CHARGES
NRMC SAN DIEGO, CA	0	2	—	—	—	—	—	—	—	7	—	$ 14.00	$280.00
NRMC LONG BEACH, CA	96	2	$105.60	$160.00	$ 80.00	4	202T	$160.00	$300.00	2	$105.60	160.00	80.00
NRMC CAMP PENDLETON, CA	37	2	40.70	160.00	80.00	4	202T	160.00	300.00	2	40.70	160.00	80.00
AFH MARCH, CA	83	2	91.30	160.00	80.00	4	202T	160.00	300.00	2	91.30	160.00	80.00
MCB 29 PALMS, CA	117	1	64.35	80.00	40.00	2	103	60.00	120.00	1	64.35	80.00	40.00
NAVSTA SAN DIEGO, CA	5	1	2.75	80.00	40.00	2	103	60.00	120.00	1	2.75	80.00	40.00
NAS NORTH ISLAND, CA	3	1	1.65	80.00	40.00	2	103	60.00	120.00	1	1.65	80.00	40.00
NAB CORONADO, CA	3	1	1.65	80.00	40.00	2	103	60.00	120.00	1	1.65	80.00	40.00
NAS MIRAMAR, CA	9	1	4.65	80.00	40.00	2	103	60.00	120.00	1	4.95	80.00	40.00
NTC SAN DIEGO, CA	4	1	2.20	80.00	40.00	2	103	60.00	120.00	1	2.60	80.00	40.00
MCRD SAN DIEGO, CA	3	1	1.65	80.00	40.00	2	103	60.00	120.00	1	1.65	80.00	40.00
MCAS SANTA ANA, CA	84	1	46.20	80.00	40.00	2	103	60.00	120.00	1	46.20	80.00	40.00
NH PORT HUENEME, CA	157	1	86.35	80.00	40.00	2	103	60.00	120.00	1	86.35	80.00	40.00
AFH EDWARDS, CA	160	1	88.00	80.00	40.00	2	103	60.00	120.00	1	88.00	80.00	40.00
AFH GEORGE, CA	127	1	69.85	80.00	40.00	2	103	60.00	120.00	1	69.85	80.00	40.00
AFCL NORTON, CA	98	1	53.90	80.00	40.00	2	103	60.00	120.00	1	53.90	80.00	40.00
AFH VANDENBURG, CA	235	1	129.25	80.00	40.00	2	103	60.00	120.00	1	129.25	80.00	40.00
AFH NELLIS, NV	264	1	145.20	84.10	105.10	2	103	40.00	50.00	1	145.20	84.10	105.10
TOTALS	1495	22	$935.55	$1604.10	$865.10	12	202T	$1300.00	$2510.00	27	$935.55	$1618.10	$1145.10
						28	103						

Table B-3. Direct Distance Dial Costs Between CAPOC Computer, Overread Centers, Remote User Sites

(Monthly-Decreased 10%)

SUMMARY	
RECURRING COST	$ 11,004
NONRECURRING COST	$ 4,149
ANNUAL RECURRING COST	$132,048
8 YEARS (MONTHLY)	$ 11,047

	COMPUTER SEND			OVERREAD SEND	USER SEND	CENTREX LINES			BUSINESS LINES			MODEMS			
SITES	ANALOG TRACINGS TO OVERREADS	DIGITAL REPORTS TO OVERREADS	DIGITAL REPORTS TO REMOTE USERS	DIGITAL EDITS & RETRIEVALS TO COMPUTER	ANALOG INPUT TO COMPUTER FROM COLLOCATED & REMOTE USER SITES	NR LINES	RECURRING COST	NONRECURRING COST	NR LINES	RECURRING COSTS	NONRECURRING COSTS	NUMBER	103A3 (300 BPS) TYPE 202T (1200 BPS)	RECURRING COST	NONRECURRING COSTS
CAPOC COMPUTER NH SAN DIEGO						7[1]	$ 45.85	$ 126.00	4	$ 30.00	$ 164.00		Notes 2/3	$ 80.00	$ 100.00
NRMC SAN DIEGO						9[4]	18.00	360.00							
NRMC LONG BEACH	$ 633.60	$ 1219.60	—	$ 863.20	$ 287.52	1	6.55	18.00	4	30.00	164.00	4	202T	160.00	300.00
NRMC CAMP PENDLETON	376.25	821.75	—	495.00	303.56	1	6.55	18.00	4	30.00	164.00	4	202T	160.00	300.00
AFH MARCH	651.94	1033.04	—	820.66	180.94	1	6.55	18.00	4	30.00	164.00	4	202T	160.00	300.00
MCB 29 PALMS			$ 33.65		21.20				2	15.00	82.00	1	103-A3	30.00	60.00
NAVSTA SAN DIEGO			15.85		13.85				2	15.00	82.00	1	103-A3	30.00	60.00
NAS NORTH ISLAND			11.90		10.90				2	15.00	82.00	1	103-A3	30.00	60.00
NAB CORONADO			11.90		7.95				2	15.00	82.00	1	103-A3	30.00	60.00
NAS MIRAMAR			6.95		5.95				2	15.00	82.00	1	103-A3	30.00	60.00
NTC SAN DIEGO			9.90		7.90				2	15.00	82.00	1	103-A3	30.00	60.00
MCRD SAN DIEGO			6.95		5.95				2	15.00	82.00	1	103-A3	30.00	60.00
MCAS SANTA ANA			134.64		108.58				2	15.00	82.00	1	103-A3	30.00	60.00
NH PORT HUENEME			231.75		160.20				2	15.00	82.00	1	103-A3	30.00	60.00
AFH EDWARDS			80.10		71.10				2	15.00	82.00	1	103-A3	30.00	60.00
AFH GEORGE			87.20		75.00				2	15.00	82.00	1	103-A3	30.00	60.00
AFCL NORTON			102.49		62.84				2	15.00	82.00	1	103-A3	30.00	60.00
AFH VANDENBURG			201.96		173.07				2	15.00	82.00	1	103-A3	30.00	60.00
AFH NELLIS			172.96		100.88				2	15.00	82.00	1	103-A3	20.00	25.00
TOTALS	$1661.79	$3074.39	$1108.21	$2178.86	$1596.79	19	$ 83.50	$540.00	44	$ 330.00	$1804.00	12 18	202T 103-A3	$970.00	$1805.00

NOTE:
1. CENTREX LINES TO COMPUTER ECG INTERFACE UNITS.
2. FOUR 103-A3 MODEMS REQUIRED AT COMPUTER FOR 300 bps XMSN TO REMOTE USERS.
3. COST OF 202T (1200 bps) MODEMS ALLOCATED TO OVERREAD CENTERS.
4. NINE "ROOM CIRCUIT" LINES AT $2.00 RECURRING AND $40.00 INSTALLATION CHARGE EACH.

Table B-4. FTS Costs Between CAPOC Computer, Overread Centers, Remote User Sites
(Monthly Variable/Summary Costs — Volume Decreased 10%)

SUMMARY	
RECURRING COST	$ 8,695
NONRECURRING COST	$ 3,557
ANNUAL RECURRING COST	$104,338
8 - YEARS (MONTHLY)	$ 8,732

SITES	VOLUME DEPENDENT FTS CHARGES					STATIC CHARGES[1]				COST SUMMARY			
	COMPUTER SEND			OVER-READ SEND	USER SEND	LEASED LINES		MODEMS					
	ANALOG TRACINGS TO OVERREADS	DIGITAL REPORTS TO OVERREADS	DIGITAL REPORTS TO REMOTE USERS	DIGITAL EDITS AND RETRIEVALS TO COMPUTER	ANALOG INPUT TO COMPUTER FROM COLLOCATED & REMOTE USER SITES	RECURRING CHARGES	NON-RECURRING CHARGES	RECURRING CHARGES	NON-RECURRING CHARGES	TOTAL RECURRING COSTS	TOTAL NONRECURRING COSTS	MONTHLY COSTS (8 - YEAR LIFE)	ANNUAL RECURRING COSTS
CAPOC COMPUTER NH SAN DIEGO	$	$	$	$	$	$ 301.30	$ 414.00	$ 360.00	$ 690.00	$ 661.30	$1104.00	$ 672.80	$ 7,935.60
NRMC SAN DIEGO						18.00	360.00			18.00	360.00	21.75	216.00
NRMC LONG BEACH	285.12	548.82		388.44	160.38	86.00	72.00	80.00	150.00	1548.76	222.00	1551.07	18,585.12
NRMC CAMP PENDLETON	270.90	591.66		356.40	235.26	393.44	160.00	46.00	100.00	1893.66	260.00	1896.37	22,723.92
AFH MARCH	317.16	502.56		399.24	98.46	86.00	72.00	80.00	150.00	1483.42	222.00	1485.73	17,801.04
MCB 29 PALMS			17.82		14.22	237.76	80.00	20.00	25.00	289.80	105.00	290.90	3,477.60
NAVSTA SAN DIEGO			57.06		49.86	43.00	36.00	30.00	60.00	179.92	96.00	180.92	2,159.04
NAS NORTH ISLAND			42.84		39.24	43.00	36.00	30.00	60.00	155.08	96.00	156.08	1,860.96
NAB CORONADO			42.84		28.44	43.00	36.00	30.00	60.00	144.28	96.00	145.28	1,731.36
NAS MIRAMAR			25.02		21.42	43.00	36.00	30.00	60.00	119.44	96.00	120.44	1,433.28
MCRD SAN DIEGO			25.02		21.42	43.00	36.00	30.00	60.00	119.44	96.00	120.44	1,433.28
NTC SAN DIEGO			35.64		28.44	43.00	36.00	30.00	60.00	137.08	96.00	138.08	1,644.96
MCAS SANTA ANA			71.28		60.66	43.00	36.00	30.00	60.00	204.94	96.00	205.94	2,459.28
NH PORT HUENEME			92.70		64.08	205.36	80.00	20.00	25.00	382.14	105.00	383.23	4,585.68
AFH EDWARDS			32.04		28.44	221.56	80.00	20.00	25.00	302.04	105.00	303.13	3,624.48
AFH GEORGE			39.24		35.64	192.40	80.00	20.00	25.00	287.28	105.00	288.37	3,447.36
AFCL NORTON			49.86		39.24	43.00	36.00	30.00	60.00	162.10	96.00	163.10	1,945.20
AFH VANDENBURG			71.28		67.68	263.68	80.00	20.00	25.00	422.64	105.00	423.73	5,071.68
AFH NELLIS			67.68		42.84	43.00	36.00	30.00	60.00	183.52	96.00	184.52	2,202.24
TOTALS	$873.18	$1643.04	$670.32	$1144.08	$1035.72	$2392.50	$1802.00	$ 936.00	$1755.00	$8694.84	$3557.00	$8731.88	$104,338.08

NOTE 1: STATIC CHARGES COMPILED FROM TABLE 4-7 ON PAGE 4-15

Table B-5. User Outward WATS for CAPOC (Monthly-Decreased 10%)

TO: CAPOC COMPUTER NH SAN DIEGO FROM:	DIGITAL DATA										ANALOG DATA			
			LINE & TERMINATION FEES			MODEMS					LINE & TERMINATION FEES			
	TRANSMISSION TIME (HOURS & MINUTES)	NR LINES REQUIRED	RECURRING CHARGES	OVERTIME CHARGES	NON-RECURRING CHARGES	NR REQUIRED	(202=1200bps) TYPE (103=300bps)	RECURRING CHARGES	NON-RECURRING CHARGES	NR LINES REQUIRED	TRANSMISSION TIME (HOURS & MINUTES)	RECURRING CHARGES	OVERTIME CHARGES	NON-RECURRING CHARGES
NRMC LONG BEACH, CA	35:58	1	$ 260.00	$482.98	$ 50.00	2	202T	$ 80.00	$ 150.00	1	14:51	$ 260.00	$ 90.21	$ 50.00
AFH MARCH, RIVERSIDE, CA	36:59	1	260.00	501.89	50.00	2	202T	80.00	150.00	1	9:34	260.00		50.00
MCB 29 PALMS, CA										1	1:19	260.00		50.00
AFH VANDENBURG, LOMPOC, CA										1	6:16	260.00		50.00
NH PORT HUENEME, CA										1	5:56	260.00		50.00
MCAS SANTA ANA, CA										1	5:37	260.00		50.00
AFCL NORTON, SAN BERNARDINO,CA										1	3:38	260.00		50.00
AFH GEORGE, VICTORVILLE, CA										1	3:18	260.00		50.00
AFH EDWARDS, EDWARDS, CA										1	2:38	260.00		50.00
AFH NELLIS, LAS VEGAS, NV										1	3:58	234.00		50.00
NAVSTA SAN DIEGO, CA*														
NAS NORTH ISLAND, SAN DIEGO, CA*														
NAB CORONADO, CA*														
NAS MIRAMAR, SAN DIEGO, CA*														
MCRD SAN DIEGO, CA*														
NTC SAN DIEGO, CA*														
NRMC CAMP PENDLETON, CA	33:00	1	260.00	427.80	50.00	2	202T	80.00	150.00	1	21:47	260.00	219.17	50.00
NRMC SAN DIEGO, CA*														
		3	780.00	$1412.67	$150.00	6	202T	$ 240.00	$ 450.00	11		$2834.00	$ 309.38	$ 550.00

*WATS NOT APPLICABLE TO THESE STATIONS, RECOMMEND DDD FOR LOCAL AREA SITES

Table B-6. Computer Outward WATS for CAPOC (Monthly-Decreased 10%)

SUMMARY	
RECURRING COST	$ 10,490
NONRECURRING COST	$ 4,010
ANNUAL RECURRING COST	$125,880
8 YEARS (MONTHLY)	$ 10,532

FROM: CAPOC
COMPUTER NH SAN DIEGO
TO:

	DIGITAL DATA									ANALOG DATA				BUSINES LINES FOR TERMINAL EQUIPMENT	
			LINE & TERMINATION FEES			MODEMS				LINE & TERMINATION FEES					
	TRANSMISSION TIME (HOURS & MINUTES)	NR LINES REQUIRED	RECURRING CHARGES	OVERTIME CHARGES	NON-RECURING CHARGES	NR REQUIRED	(202T=1200 bps) TYPE (103=300 bps)	RECURRING CHARGES	NONRECURRING CHARGES	NR LINES REQUIRED	TRANSMISSION TIME (HOURS & MINUTES)	RECURRING CHARGES	OVERTIME CHARGES	NON-RECURRING CHARGES	NR LINES REQUIRED	RECURRING CHARGES	NON-RECURRING CHARGES
NRMC LONG BEACH, CA	8:29	1	$260.00	$	$ 50.00	2	202T	$ 80.00	$ 150.00	1	26:24	$ 260.00	$ 305.04	$ 50.00	2	$ 15.00	$ 82.00
AFH MARCH, RIVERSIDE, CA	7;45	1	260.00		50.00	2	202T	80.00	150.00	1	29:22	260.00	360.22	50.00	2	15.00	82.00
MCB 29 PALMS, CA	1:39	1	260.00	127.10	50.00	4	103	120.00	240.00						1	7.50	41.00
AFH VANDENBURG, LOMPOC, CA	6:36														1	7.50	41.00
NH PORT HUENEME, CA	8:35														1	7.50	41.00
MCAS SANTA ANA, CA	6:36	1	260.00	145.39	50.00	5	103	150.00	300.00						1	7.50	41.00
AFCL NORTON, SAN BERNARDINO, CA	4:37														1	7.50	41.00
AFH GEORGE, VICTORVILLE, CA	3:38														1	7.50	41.00
AFH EDWARDS, EDWARDS, CA	2:58														1	7.50	41.00
AFH NELLIS, LAS VEGAS, NV	6:16	1	234.00		50.00	2	103	40.00	50.00						1	7.50	41.00
NAVSTA, SAN DIEGO, CA	5:17	1	260.00	207.39	50.00	7	103	210.00	420.00						1	7.50	41.00
NAS NORTH ISLAND, SAN DIEGO, CA	3:58														1	7.50	41.00
NAB CORONADO, CA	3:58														1	7.50	41.00
NAS MIRAMAR, SAN DIEGO, CA	2:19														1	7.50	41.00
MCRD SAN DIEGO, CA	2:19														1	7.50	41.00
NTC SAN DIEGO, CA	3:18														1	7.50	41.00
NRMC CAMP PENDLETON, CA	9:07	1	260.00		50.00	2	202T	80.00	150.00	1	25:05	260.00	280.55	50.00	2	15.00	82.00
NRMC SAN DIEGO, CA*			2.00		40.00							2.00		40.00			
TOTALS		7	$1796.00	$ 479.88	$390.00	6 18	202T 103	$760.00	$1460.00	3		$782.00	$945.81	$190.00	20	$150.00	$820.00

*ROOM CIRCUITS

Table B-7. Comparison of Costs by Site and Type of Communication Service

(10% Monthly Decrease in Traffic Volume)

SITES	WATS			LEASED LINES			FTS			DIRECT DISTANCE DIAL		
	TOTAL MONTHLY RECURRING COSTS	TOTAL NONRE-CURRING COSTS	AMORTIZED 8 YEAR COSTS	TOTAL MONTHLY RECURRING COSTS	TOTAL NONRE-CURRING COSTS	AMORTIZED 8 YEAR COSTS	TOTAL MONTHLY RECURRING COSTS	TOTAL NONRE-CURRING COSTS	AMORTIZED 8 YEAR COSTS	TOTAL MONTHLY RECUR-RING COSTS	TOTAL NONRE-CURRING COSTS	AMORTIZED 8 YEAR COSTS
NRMC SAN DIEGO (NOTE 1)	$	$	$	$ 14.00	$ 280.00	$ 17.00	$	$	$	$	$	$
NRMC LONG BEACH	2093.23	582.00	2099.29	691.00	460.00	696.00*	1548.76	222.00	1551.07	3200.47	482.00	3205.49
NRMC CAMP PENDLETON	2142.52	582.00	2148.58	561.00	460.00	566.00*	1893.66	260.00	1896.37	2193.11	482.00	2198.13
AFH MARCH	2077.11	582.00	2083.17	663.00	460.00	668.00*	1483.42	222.00	1485.73	2882.53	482.00	2887.55
MCB 29 PALMS	436.53	187.67	438.48	349.00	200.00	351.00	289.80	105.00	290.90	99.86	142.00	101.34*
NAVSTA SAN DIEGO (NOTE 2)	120.40	119.33	121.64	226.00	200.00	228.00	179.72	96.00	180.92	74.70	142.00	76.18*
NAS NORTH ISLAND (NOTE 2)	120.40	119.33	121.64	223.00	200.00	225.00	155.08	96.00	156.08	67.80	142.00	69.28*
NAB CORONADO (NOTE 2)	120.40	119.33	121.64	223.00	200.00	225.00	144.28	96.00	145.28	64.85	142.00	66.33*
NAS MIRAMAR (NOTE 2)	120.40	119.33	121.64	230.00	200.00	232.00	119.44	96.00	120.44	57.90	142.00	59.38*
MCRD SAN DIEGO (NOTE 2)	120.40	119.33	121.64	223.00	200.00	225.00	119.44	96.00	120.44	57.90	142.00	59.38*
NTC SAN DIEGO (NOTE 2)	120.40	119.33	121.64	224.00	200.00	226.00	137.08	96.00	138.08	62.80	142.00	64.28*
MCAS SANTA ANA	406.35	178.50	408.21	312.00	200.00	314.00	204.94	96.00	205.94*	288.22	142.00	289.70
NH PORT HUENEME	436.53	187.67	438.48	393.00	200.00	395.00	382.14	105.00	383.23*	436.95	142.00	438.43
AFH EDWARDS	406.35	178.50	408.21	396.00	200.00	398.00	302.04	105.00	303.13	196.20	142.00	197.68*
AFH GEORGE	406.35	178.50	408.21	360.00	200.00	362.00	287.28	105.00	288.37	207.20	142.00	208.68*
AFCL NORTON	406.35	178.50	408.21	328.00	200.00	330.00	162.10	96.00	163.10*	210.33	142.00	211.81
AFH VANDENBURG	436.53	187.67	438.48	479.00	200.00	481.00	422.64	105.00	423.73	420.03	142.00	421.51*
AFH NELLIS	515.50	191.00	517.49	499.00	269.00	502.00	183.52	96.00	184.52*	308.84	107.00	309.95

NOTE: 1. LONG DISTANCE SYSTEMS NOT APPLICABLE.

2. FTS AND WATS APPLICABLE ONLY IF ALL SITES USE SAME SYSTEM (SEE APPLICABLE TABLES).

*DEPICTS LEAST COST SYSTEM

Table B-8. Summary of CAPOC Communications System Costs

(10% Decrease)

SITE	TYPE OF CONNECTIVITY	MONTHLY RECURRING COST	NON-RECURRING COSTS	MONTHLY 8 YEAR AVERAGE	ANNUAL RECURRING COSTS
NRMC SAN DIEGO	Leased Line	$ 14.00	$ 280.00	$ 17.00	$ 168.00
NRMC LONG BEACH	Leased Line	691.00	460.00	696.00	8,292.00
NRMC CAMP PENDLETON	Leased Line	561.00	460.00	566.00	6,732.00
AFH MARCH	Leased Line	663.00	460.00	668.00	7,956.00
MCB 29 PALMS	DDD	99.86	142.00	101.34	1,198.32
NAVSTA SAN DIEGO	DDD	74.70	142.00	76.18	896.40
NAS NORTH ISLAND	DDD	67.80	142.00	69.28	813.60
NAB CORONADO	DDD	64.85	142.00	66.33	778.20
NAS MIRAMAR	DDD	57.90	142.00	59.38	694.80
MCRD SAN DIEGO	DDD	57.90	142.00	59.38	694.80
NTC SAN DIEGO	DDD	62.80	142.00	64.28	753.60
MCAS SANTA ANA	FTS	204.94	96.00	205.94	2,459.28
NH PORT HUENEME	FTS	382.14	105.00	383.23	4,585.68
AFH EDWARDS	DDD	196.20	142.00	197.68	2,354.40
AFH GEORGE	DDD	207.20	142.00	208.68	2,486.40
AFCL NORTON	FTS	162.10	96.00	163.10	1,945.20
AFH VANDENBURG	DDD	420.03	142.00	421.51	5,040.36
AFH NELLIS	FTS	183.52	96.00	184.52	2,202.24
		$ 4170.94	$ 3473.00	$ 4207.83	$ 50,051.28

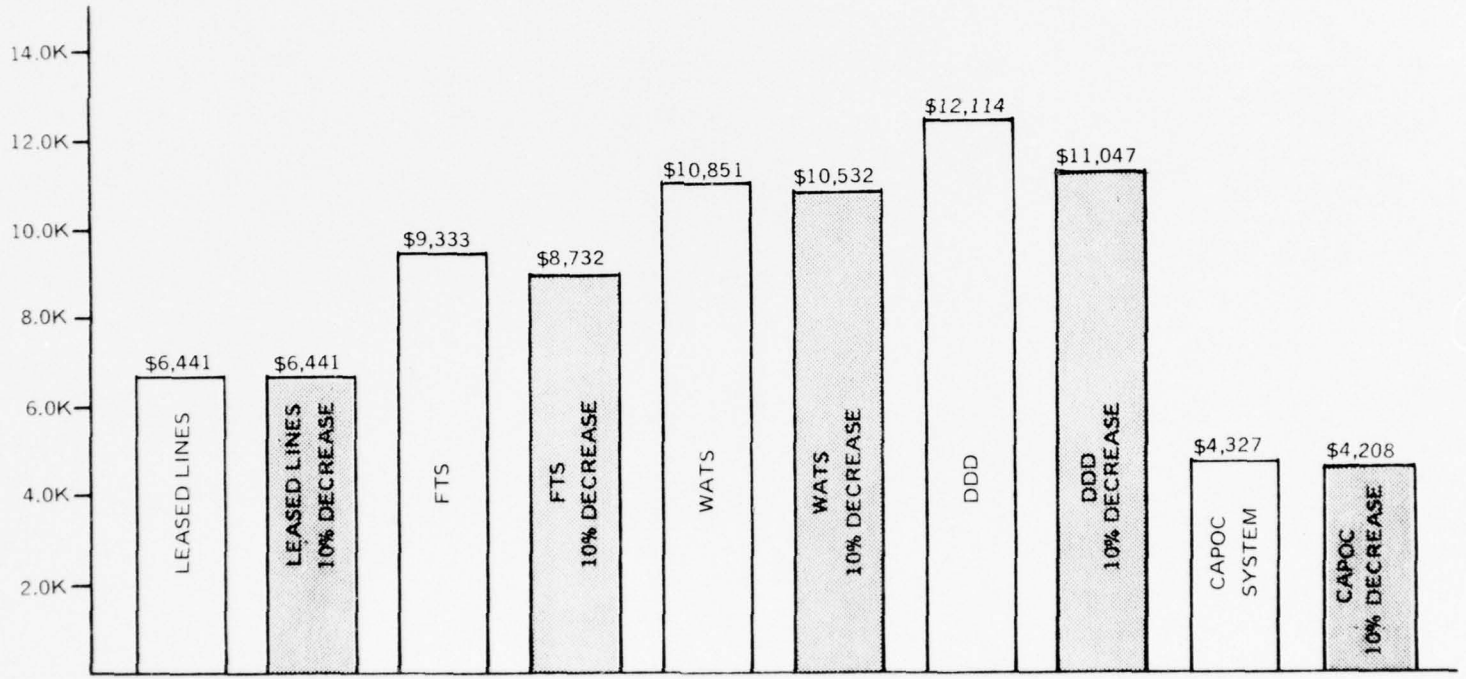


FIGURE B-1. AVERAGE MONTHLY COST COMPARISON (8-YEAR AMORTIZATION) (WITH 10% DECREASE)

GLOSSARY OF TERMS

ACCESS CONTENTION	Occurs when lines are shared with other users.
ACCESS LINE	The line needed to connect a telephone with its nearest switching center.
ADPE	Automated Data Processing Equipment
ANALOG DATA	Data in the form of continuously variable physical quantities
ARPANET	Advanced Research Project Agency Network, a DOD interactive computer teleprocessing network
ASC	AUTODIN Switching Center
AUTODIN	Automatic Digital Network
AUTOVON	Automatic Voice Network
BACKBONE CHARGE	Prorated charge among users for use of a system
BATCH PROCESSING	A method of computer operation in which a number of similar input processes are accumulated and grouped for processing at a later time (usually off-hours)

BLOCKING	A term used when a call is attempted and not completed (blocked) and another attempt is required. This term is associated with dial lines
CAPOC	Computer Assisted Practice of Cardiology
COMMON CARRIER	A company which furnishes communications services to the general public, and which is regulated by appropriate local, state, or federal agencies
CONNECTIVITY	Telephone line interconnections
CONUS	Continental United States
DDD	Direct Distance Dialing
DDS	Dataphone Digital Service
DIGITAL DATA	Information represented by a code consisting of a sequence of discrete elements
DOD	Department of Defense
DUPLEX	Simultaneous two-way transmissions
ECG	Electrocardiogram

ERLANG	A unit defining the amount of traffic one trunk can handle in one hour if it is busy all the time
FEX	Foreign Exchange Service. A service which connects a customers telephone to a telephone company central office normally not servicing the customer's location
FTS	Federal Telecommunications System. A civilian government service parallel to AUTOVON, but without the preemptive interrupt structure
GRADE OF SERVICE	Probability of obtaining service when requested i.e., a 0.05 grade of service means that 95 out of 100 calls will not be blocked
GSA	General Services Administration
HALF-DUPLEX	Circuit designed for two-way transmissions, but in one direction at a time only
HYBRID COMMUNICATION SYSTEM	A combination of different communication systems to support one or more projects

LDMX	Local Digital Message Exchange
LEVEL ACCESS CODE	Used to reach (access) a specific trunk: "0" to reach attendant trunks, "9" to reach local outgoing trunks, "8" to reach tie trunks such as AUTOVON etc.
LINE	A cable (wire) as part of the AT&T telephone network
MODEM	Modulator-Demodulator, permits transmission of digital information on analog telephone lines
MTF	Medical Treatment Facility
MULTIPLEXOR	A device which uses several communication channels at the same time, and transmits and receives messages and controls the communication lines
NELC	Naval Electronics Laboratory Center, part of NOSC
NOSC	Naval Ocean Systems Center
NRMC	Naval Regional Medical Center
PORT	One input/output channel, usually in ADPE

PRIVATE LINE	Denotes the channel and channel equipment furnished to a customer as a unit for his exclusive use, without interexchange switching arrangements.
TELENET	TELENET Communication Corporation, a nationwide data communications network
TRIMIS	Tri-Service Medical Information System
VOICE GRADE LINES	Lines suitable for transmission of speech, digital or analog data, or facsimile, generally with a frequency range of about 300 to 3400 cycles per second
WATS	Wide Area Telephone Service. A service provided by telephone companies which permits a customer to make calls to telephones in a specific zone on a dial basis for a flat monthly charge. The U.S. is divided into six zones to be called on a full-time or measured-time basis.

