MESSAGE TECHNOLOGY RESEARCH AND DEVELOPMENT

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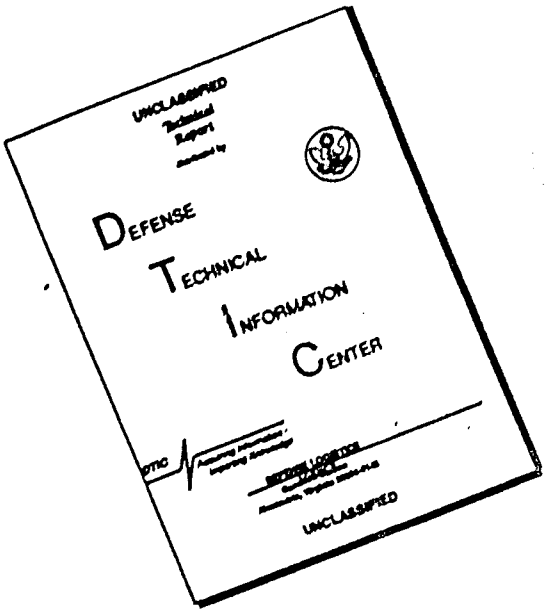

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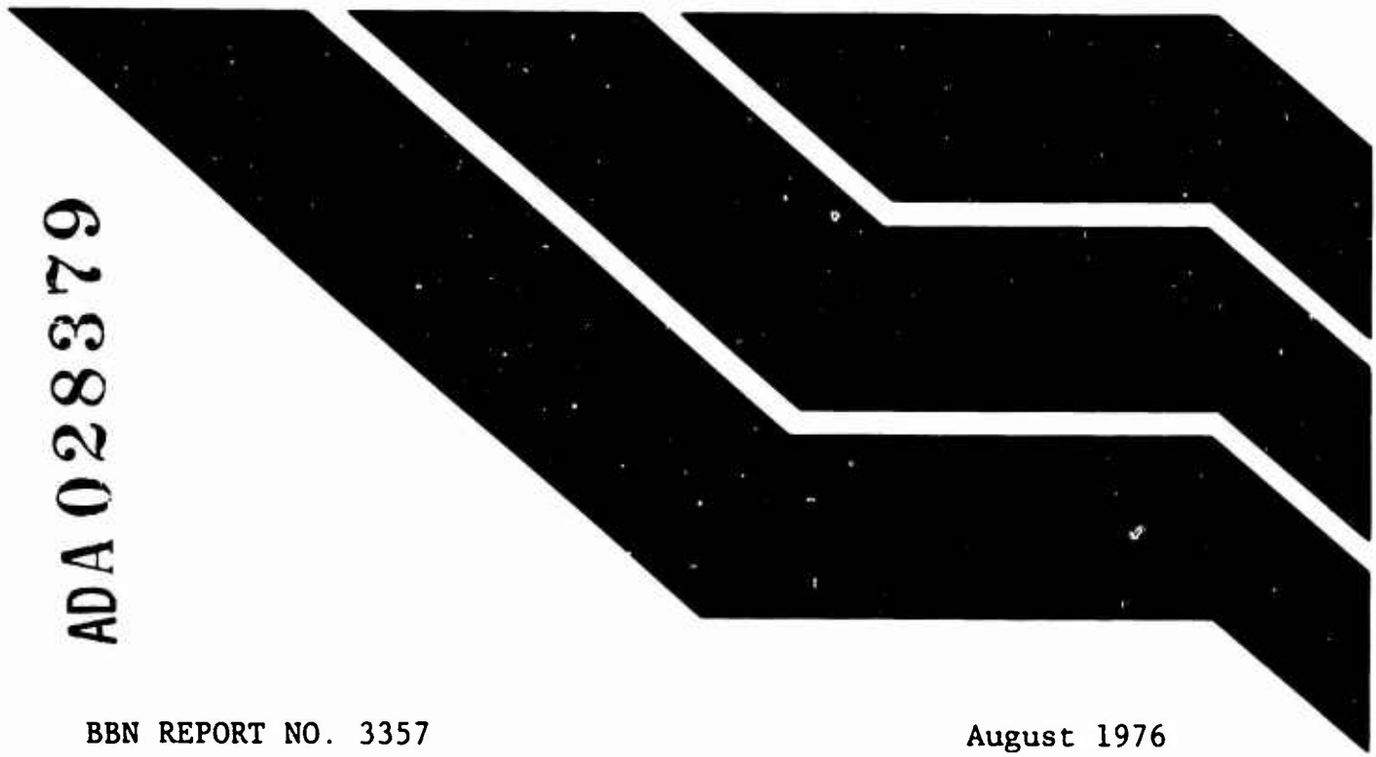

BBN REPORT NO. 3357

August 1976

MESSAGE TECHNOLOGY RESEARCH AND DEVELOPMENT

Quarterly Progress Report No. 2

2 April 1976 to 2 July 1976

PROJECT HERMES

Bolt Beranek and Newman Inc. 50 Moulton Street Cambridge, Mass. 02138

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This report describes BBN efforts in the continuing development of the HERMES message-processing system, with respect to system design, security requirements and preparations for the DARPA/NAVY/CINCPAC interactive test.

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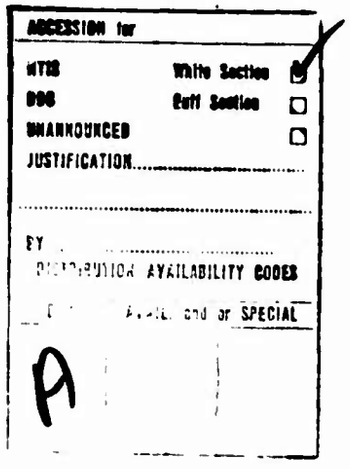

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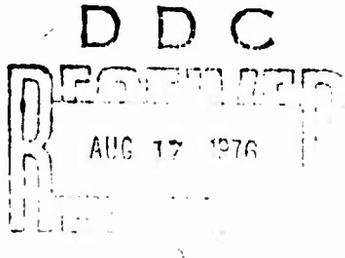

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I. INTRODUCTION

This report covers progress in message technology, including the HERMES Message system, performed under the contract "Message Technology Research and Development" for the period 2 April 1976 through 2 July 1976.

This work is a continuation of work on MAILSYS/HERMES performed under the ARPA Contract "Distributed Computation and TENEX Related Activities" during 1975.

The work leading up to this report is covered in the following earlier quarterly progress reports.

DISTRIBUTED COMPUTATION AND TENEX-RELATED ACTIVITIES

QPR No. 1	1 Nov 74 - 31 Jan 75	BBN Report No. 3012
QPR No. 2	1 Feb 75 - 30 Apr 75	BBN Report No. 3089
QPR No. 3	1 May 75 - 30 Jul 75	BBN Report No. 3117
QPR No. 4	1 Aug 75 - 30 Oct 75	BBN Report No. 3210
QPR No. 5	1 Nov 75 - 30 Jan 76	BBN Report No. 3257

Our major effort during the April-June period has been to move ahead systematically with the development and refinement of MAILSYS/HERMES Version 2, following the phased development program reported in QPR No. 4 (1 Aug 75 - 30 Oct 75) listed above.

Human Factors Evaluation

Version 2.6 of HERMES was implemented and given limited release during this period. Human factors evaluation of each successive modification to HERMES has been accomplished. Suggestions and criticisms from the community of HERMES users have been solicited, and are being correlated and studied to guide the design of the present and future versions of the system.

Documentation

We have released four major new pieces of documentation: two printed manuals "A Tutorial Introduction to HERMES" and the "HERMES Users' Guide", and two on-line interactive programs "Help" and "Explain". The "Describe" documentation, which has been revised to reflect changes in HERMES 2.6, can be used as an adjunct to "Explain".

Improved Message-Reading Specifications

We have greatly improved and simplified the method of specifying sequence arguments for message-reading and message-handling commands. The user can now type a filter whenever HERMES expects a sequence, and HERMES interprets the specification to mean "all those messages that pass the filter". All specifications that depend upon an attribute of the messages, such as RECENT and SEEN, are now filters.

HERMES now automatically stores each sequence specification as it is used in a command. This "previous sequence" can be input again when the next sequence specification is typed.

New Message-Creating Facilities

The new command named EXPLODE allows the user to transform an incoming message stored in a message-file into outgoing message ready for immediate sending or for further editing. New automatic HERMES-created fields are generated corresponding to the new sender and date.

We also added three new user-created message fields of the "date" data-types.

Improved Control Over System Operation

Four new Switches have been added to give the user greater control over the way the system operates. Seven other switches have been changed from two-position to three-position (Ask-Yes-No).

Spelling Correction and Message Encryptor

A new version of the spelling corrector is installed. Work has begun on a message encryptor.

Statistics on HERMES Use

An automatic statistics-gathering mechanism was designed and implemented which utilizes easily modified probes inserted at selected collection points in the HERMES program. The statistics for each HERMES session are recorded in a HERMES message sent to a designated network address.

Applications Programming Level Security

After extended exploration of security designs, we produced a design based on a security kernal, the two-level classification of each message, and a multi-level terminal. HERMES provides four simultaneous jobs multiplexed through a "trusted job" to the terminal.

Rapid Changes in Security Level

Design of programs and strategy to allow rapid changes in Security level was undertaken. This work included study of PMAPPING the HERMES profile and index files so that the HERMES profile can appear as a single environment containing all information from the current and lower security levels.

Monitor-Level Security

The Encapsulator system was completed. The initial set of AIM security enhancements to the TENEX monitor was checked cut. The seond set was coded except for a single section.

The Incoming Message Processor

Work was begun on the HERMES incoming message processor, including: (a) design and partial implementation in a scheme for priority messages, (b) technical documentation, (c) design of parsing routines, and (d) design of a translator between the incoming message format (RIXT-128) and HERMES.

DARPA/NAVY/CINCPAC Test Preparation

The Human Factors group has submitted an "Organization Impact Study Plan" to assess the effect of computer-based message technology on he Navy's message-handling opeations. Human factors personnel have continued consulting on HERMES design and participated in plans fo the DARPA/NAVY/CINCPAC test.

II. HERMES VERSION 2.6

We created HERMES 2.6 to consolidate improvements and corrections suggested by experience with earlier versions.

Active participation by HERMES users, frequently via the improved SUGGESTION command (introduced in Version 2.5), has allowed us to collect a large file of data on the experiences of HERMES users. We are presently analyzing this material and we will circulate the results of this analysis in the next quarter. We will also circulate analyses of statistics on HERMES use. (See Section III.) These will be useful input to the continuing Human Factors evaluation of HERMES.

Also planned for the next quarter is the inclusion in HERMES of an encryptor, which can be used to produce encrypted messages containing only those ASCII characters that can be safely transmitted by the network MAILER program.

A. Documentation

Four major new pieces of documentation were released during the current quarter.

1. The printed manual "A Tutorial Introduction to HERMES.", by C. L. Hausmann and M. C. Grignetti. This is a primer for beginners covering only the basic concepts and arranged in the form of lessons, with exercises for the reader and review topics.

2. The printed manual "HERMES User' Guide", by T. H. Myer and C. D. Mooers, 64 pages. This is a basic reference covering all aspects of HERMES.

3. The on-line interactive program "Help", a question-and-answer guide to user documentation.

4. The on-line interactive program "Explain", a tree-structured, or layered, program that gives a conceptual map of the entire system.

In addition, the "Describe" documentation has been revised to reflect changes in HERMES.

Work is continuing to integrate "Explain", "Describe" and the "Users' Guide" into a unified structure which can provide information on as general or detailed a level as the user desires.

B. Improved Message-Reading Specification.

The method of specifying sequence arguments in message-reading and message-handling commands has been extended and simplified. If a filter, either named or literal, is typed where HERMES expects a sequence (as at the beginning of a sequence argument), HERMES interprets the filter to mean "all those message that pass".

```
...ith <cr>
...nts all messages to Smith, where "To:Smith" is a
literal filter.
```

This makes it no longer necessary to type specifications in the form of "Print */To: Smith" (although the older specification is still legal).

In addition, all system-defined sequence specifications based upon characteristics of the messages, such as RECENT and

SEEN, are handled in a similar, uniform fashion. It is now possible to type sequence specifications such as

>Survey SEEN/RECENT<CR>
Surveys messages that are both SEEN and RECENT.

>Survey RECENT, From: Jones<CR>
Surveys all RECENT messages plus all messages from Jones.

>List Subject: Messages/OLD<CR>
Lists all messages that pass the literal filter "Subject: Messages", i.e., that have the word "Messages" in the Subject:-field, and that pass the fixed filter OLD.

A new system-supported sequence named PREVIOUSSEQUENCE has been added to HERMES. This is a named sequence consisting of the most recent sequence that the user has specified in a command.

>Survey From: Smith<CR>
HERMES prints a survey of all messages from Smith, let us suppose 3, 7, 14:16, 23 and 57.
>Show PREVIOUSSEQUENCE<CR>
3,7,14:16,23,57
>List PREVIOUSSEQUENCE<CR>
HERMES lists messages 3, 7, 14:16, 23 and 57.

A "companion" to PREVIOUSSEQUENCE is <CTRL-P>, a new control character. <CTRL-P> enters the PREVIOUSSEQUENCE as a literal sequence (and as a complete sequence argument), and prints out the message-nos. in the <sequence> position of the command.

>List <CTRL-P>3,7,14:16,23,57<CR>
HERMES lists messages 3, 7, 14:16, 23 and 57.

The method of specifying sequences in HERMES is now under review with the object of making it more powerful and uniform.

C. New Message-Creating Facilities

1. A new command named EXPLODE dissects an incoming message and places its User-created fields in the corresponding fields of the CDRAFT. The user is then left in the DRAFT-EDITOR for further editing. EXPLODE thus turns an incoming message into an outgoing message. Message-fields generated by HERMES are not copied, so that the new outgoing message receives a new SENDER field, a new DATE, and a new MESSAGE-ID.

2. Three new message-fields were added to the fields of the CDRAFT. They are Start-Date:, End-Date: and Suspense-Date:. All are user-created, and all have the same data-type as the DATE field.

```
>Start-Date: <date><CR>
     where date is expressed as day, month and year, in
     any of the forms acceptable to the Date:-field in a
     filter.
```

When these fields are used in filters, they take the same arguments as the DATE field: On, Before and After:

```
>Survey Start-Date: On <date><CR>
>Print Suspense-Date: Before <date><CR>
>List End-Date: After: <date><CR>
```

D. Improved Control Over System Operation

1. Four new three-position switches were installed.

   a) STARTWITHINBOX (Ask-Yes-No) controls whether HERMES Gets the user's Inbox, MESSAGE.TXT;1, when the user enters the system.

b) SAVEPARSE (All-Medium-Minimum). When the user creates a file, ABC.MSG;1, HERMES automatically creates the Index file {ABC.MSG};1 in the user's directory. SAVEPARSE controls how much "parse" information about the structure of a message-file is saved in the Index file.

c) COMPOSE-ERASE (Ask-Yes-No) controls whether HERMES automatically erases the existing text in the CDRAFT when the user gives the command COMPOSE.

d) TRANSMIT-NOW (Ask-Yes-No(Queue)) controls whether HERMES calls the MAILER program to transmit an outgoing message as soon as the user gives the SEND command, or whether the message is placed in an outgoing queue to wait for MAILER.

2. A new temporary two-way switch, CHECK-LOCAL (Yes-No), allows the user to turn off recognition of local addressees unless the addressee name is extended with the Escape-Key <ESC>. At BBN, it is now no longer true that all directory names are listed in the local data base on all BBN systems. This switch allows BBN users to type the names of BBN users on other systems as if they were local. It is a preliminary to installing a full interface with the forwarding database.

3. Eight switches have been changed from two-position to three-position. All are set to the pattern Ask-Yes-No: INITIALSURVEY, FILE-DELETE (former FILE), MOVE-DELETE (former MOVE), COMPOSE-ERASE, TEXT-FORMAT, FORMAT-JUSTIFY (former FORMAT), COMPOSE-SEND, and SEND-ARCHIVE.

4. The DELETE-CONFIRM-Switch has been removed as unneeded.

E. Other Improvements

1. Editing the MESSAGE-FILE-RECORD: When the user deletes a message-file, using the TENEX Exec, and then uses HERMES to Edit the MESSAGE-FILE-RECORD in the Profile to remove the record of the message-file, HERMES automatically deletes the corresponding Index file.

2. Changes to the Reply Command

a) If there is no host name in the From:-field, the REPLY command now takes the default host name from the Sender:-field.

b) The REPLY command now understands attention fields in the Sender: and From:-fields of incoming messages and creates corresponding addresses (i.e., with attention fields) in outgoing messages.

c) The Subject:-field of the REPLY command now consists of the Subject:-field of the original message preceded by "Re:". The "Re:"s do not iterate when the REPLY command is used to reply to a reply.

d) The REPLY command now accepts any kind of sequence as long as it evaluates to precisely one message. The sequence may contain lists and ranges of message-nos., sequences, and filters in any combination. It is still not possible to reply to more than one message at a time.

3. Error-Correcting Characters.

a) The <CTRL-Q> character now performs the same function in HERMES commands as <DEL>, the Delete or Rubout key. Thus the error-correcting commands in text input and in HERMES commands are parallel:

<CTRL-A>	Deletes a single letter in text. Deletes a single letter in a HERMES command to the beginning of a part of an argument in a commandi, e.g., a local name or a host name in an address-field, or a part of a TENEX file-name.
<CTRL-W>	Deletes a word in text. Deletes an argument in a command.
<CTRL-Q>	Deletes a line in text. Deletes a complete line in a commandi; aborts a command before the final <CR> is typed.
<DEL>	Rubout key or Delete key Has the same effect as <CTRL-Q> in a command Has no effect in text.

b) If <CTRL-C> is accidentally typed, the user can now recover by typing "Continue<CR>" to the TENEX prompt "@". If the user does not want to continue, it is usually advisable to type "Reset<CR>".

c) The <CTRL-E> is now trapped in the Text:-field, so that if <CTRL-E> is accidentally typed, the user will no longer automatically lose the text that has been typed. HERMES asks whether the text should be erased, and thus gives the user a chance to recover.

4. Improved Formatting. The Formatter now indents paragraphs the

same number of spaces are typed at the beginning of the paragraph. Their <CTRL-I> (the same character as the TAB key) is used, the formatter Converts it to an indentation of 8 spaces.

Elsewhere in text, the Formatter continues to treat the <CTRL-I> as a word separator. Also unchanged is the use of single or double <CTRL-I>s standing alone on a line to switch the Formatter off or on.

5. Improved Diagnostics.

a) If the DELETE, UNDELETE or MARK commands are used to change the status of a message, and the message already has that status, HERMES prints a diagnostic.

```
>Delete 7<CR>
Message 7 is already marked Deleted.
```

c) If two users are sharing a message-file, and one tries to access a file while the other has the file open, HERMES gives the diagnostic "File is momentarily busy. Try again?" Usually, the next time the user tries, the file will again be free.

d) The diagnostic "Help called ..." has been replaced by the message "Error condition ..." followed by a diagnostic telling whether the user can continue in HERMES.

6. Spelling Corrector. A new experimental version of the spelling corrector for HERMES commands and objects has been installed.

7. Improved Editors.

a) Lists and ranges of numbers are now accepted in the TEMPLATE-EDITOR, the MAILSTAT subcommands, and the MESSAGE-FILE-RECORD-EDITOR.

```
>Edit MYTEMPLATE<CR>
>>Show 2:6<CR>

>MAILSTAT<CR>
>>Print 2,4<CR>

>Edit Profile<CR>
>>Edit MESSAGE-FILE-RECORD<CR>
>>>Delete 1,3,5:7<CR>
```

b) The subcommands of the MAILSTAT command have been reworded to make them clearer. MAILSTAT automatically calls the MAILSTAT subcommands when undeliverable messages exist.

8. A number of bugs have been fixed.

III. STATISTICS ON HERMES USE

During the current quarter, we have designed and implemented an automatic statistics mechanism that monitors HERMES sessions, recording significant events and their key parameters. Initially, the statistics mechanism has been set up to record such information as the real and CPU times at the beginning and end of each command and the length of each message sent.

Message technology is exploited in the satistics gathering. Events occuring in a HERMES session are packages as a message, addressed to a network "maildrop" specified by the HERMES version in use. Initially, "stats messages" from all supported HERMES systems are addressed to TSCAI.STATS. This method of collecting statistics has a number of advantages. Recording events as text makes it possible to inspect the data for reasonableness or perform manual analysis. In past work on data analysis, we have often found that much of significance is revealed by visual inspection. Packaging each session as a message allows us to use the full power of HERMES to process the statisics messages. We can sort and perform selective retrieval on the basis of headers, and extract data with templates.

A data reduction program is being implemented at Project HERMES produces weekly analysis based on approximately 1000 session records per week. We compute the real time used per session, the "think time", i.e., the time HERMES spends idling during a HERMES session, and the computer time (the CPU time in

milliseconds), the number of addresses per message, and the message length. We also compute the average number of times each command is used per session and the average amount of real and CPU time used. Results of these analyses will be reported in the next Quarterly Progress Report.

The mechanism underlying the statistics gathering is a group of "probes". Each probe is a one-line BCPL command which writes one line of information into a specially treated file in the user's directory. The information consists of a label identifying the command being probed, the current readings of the CPU time and real time, and other optional information such as the length of the message being sent and the number of addressees. Typically, a probe is inserted at the beginning and end of a command or a significant part of a command, such as the computation of a sequence of messages.

At the beginning of a session, an initializing command sets up the file and inserts HERMES message headers. At the end of the session, the file is turned into a HERMES message and sent to the specified address.

The statistics system has considerable built-in flexibility.

1. Probes of various types can be inserted at different points in HERMES to collect different kinds of data.
2. The statistics messages from different versions of HERMES can be sent to different collection points.
3. Alternative data reduction programs can be prepared for differing data analyses.

TABLE 1. FORMAT OF A STATISTICS MESSAGE

```
Date: <date> <time>-<zone>
Subject: <Version number> Statistics
From: HERMES at BBN-TELEXA
To: TSCAIR
Message-ID: <[<host computer>]<date> <time>.HERMES>

Initializing data:
BSYS0,    <real     <CPU      <Version       <Verification
           time>,    time>,    Number>,        Code>

Data at beginning and end of parse of message-file:
 BGET1    <real     <CPU
 EGET1     time>     time>

Data at beginning and end of commands:
<command  <real     <CPU
 symbol>   time>,    time>

Data at beginning and end of sequence processing:
BSEQ       <real     <CPU
ESEQ        time>     time>

Date at beginning and end of assembling message for Sending:
 BSND1,   <real     <CPU
           time>     time>
 ESND1,   <real     <CPU      <No. of       <No. of        QUEUE1 or
           time>,    time>,    Addressees    Characters>    IMMEDI

End-of-session data:
ESYS0,    <real     <CPU
           time>,    time>
```

NOTE: Command symbols for top-level commands = first four letters of command name, followed by "0".

```
     Special cases:   LF0 = "<LF>"      ECMD0 = end of command
                     UPAR0 = "^"        CNTE0 = CTRL-E interrupt
                     SEMI0 = ";"        CNTO0 = CTRL-O interrupt
```

Symbols for Draft-Editor commands = first four letters of command name followed by "1", and are indented.

```
     Special cases: ECMD1 = end of command
                    CNTE1 = CTRL-E interrupt
                    CNTO1 = CTRL-O interrupt
```

Since we collect statistics on all HERMES users, we believe it is important, from an ethical standpoint, to preserve the anonymity of the individual users. This is accomplished by limiting the information included in the message generated. An inspection of Table 1 and Example 1 will show that only the host computer and time of the session are revealed.

It would be possible, of course, for a special version of HERMES to record user identity in these messages. We would hope that this would only be done with the informed consent of the users involved.

EXAMPLE 1. A SAMPLE MESSAGE

```
Message 41;  503 chars RECENT
Mail from BBN-TENEXD rcvd at 20-Jul-76 0154-EDT
Date: 20 Jul 1976 0148-EDT
Subject: 2.6.5 Statistics
From: HERMES at BBN-TENEXD
To: TSCAIR at BBNA
Message-ID: <[BBN-TENEXD]20-Jul-76 01:48:35.HERMES>

BSYS0, 0, 183, 20605, 3713406515
 BGET1, 5, 1571
 EGET1, 8, 2562
LF0, 15, 3536
ECMD0, 27, 4563
LF0, 34, 4627
ECMD0, 49, 5435
REPLY0, 77, 5592
 BSEQ1, 81, 5717
 ESEQ1, 81, 5738
 BSND1, 102, 6160
 ESND1, 121, 7609, 1, 275, IMMEDI
ECMD0, 121, 7659
QUIT0, 122, 8056
ESYS0, 124, 8693
```

IV. SECURITY FOR THE DARPA/NAVY/CINCPAC TEXT

A. Applications-Level Security: New Design

After extended exploration of designs to achieve a single environment within HERMES encompassing different security levels, we determined that this approach was not feasible.

In preparation for the Oahu meeting, May 10-13, 1976, we produced a design based on full use of the AIM security enhancements, a single-level terminal, and uniform classification for all parts of each message. In this design, HERMES was to provide four simultaneous jobs at different levels of classfication.

After the Oahu Meeting, we produced a new design to the following specifications: We were to design our own HERMES security kernel; there was to be a multi-level terminal; and user-level jobs would be multiplexed through a "trusted job" to the terminal. Work is proceding on the details of the new design.

B. Applications-Level Security: Rapid Changes in Security Level

Work is proceding on the design of programs and stategy to allow rapid changes in security level. We have undertaken a study of PMAPPING the HERMES Profile and Index files so that the HERMES Profile can appear to the user as a single environment. Whatever the user's current security level, the HERMES profile

will contain all information from current and lower security levels.

C. Monitor-Level Security

a) The Encapsulator system was completed.

b) The initial set of AIM security enhancements to the TENEX monitor was checked out. The second set of AIM security enhancements was coded, except for the JSYS monitor call GTJFN. Work on GTJFN has been partially completed.

V. THE HERMES INCOMING MESSAGE PROCESSOR

Following the completion of the LDMX/TENEX protocols, we have begun the design and implementation of the HERMES incoming message processors.

1) We have designed and partially implemented a scheme for handling priority messages.

2) We have produced a preliminary version of the technical documentation for the interface of the HERMES message system with the LDMX.

3) We have conducted a detailed examination of the content of messages to determine how to parse them so that the messages can be determined to be correct and internally consistent before they are sent to the LDMX.

4) Messages coming from the LDMX will be in the form RIXT-128. Messages going to the LDMX will have the form of a modified ACP-126. We have begun work on a translator that can turn the incoming message format (RIXT-128) into a form that can be used in HERMES.

VI. HUMAN FACTORS

The Human Factors group has continued consulting on HERMES and participated in HERMES design meetings.

The Human Factors group has submitted to NAVELEX an "Organization Impact Study Plan" designed to assess the organization impact of the use of computer-based message technology on Navy message-handling operations.

The long-range plan contemplates building a model so that the impact on an organization can be predicted from knowledge of

a) the system to be used.

b) the state of the organization.

c) how the system is to be introduced into the organiztion.

The short-term objectives for the calendar year 1976 include a brief literature review, and an informal retrospective study of the message-system users at BBN and elsewhere on the ARPA Network. The plan also includes drafting questions on organization impact which MITRE can incorporate into its plan for the DARPA/NAVY/CINCPAC test, and contemplates an advisory memorandum on strategies for introducing the system at CINCPAC. During this quarter, we have compiled a bibliography and begun the review of the literature.

Human factors personnel helped prepare the Project HERMES response to the design for the Oahu Protocol experiment, "Protocol Analysis Objectives" by John Heafner. We commented

that we felt that the Protocol experiment would result in a more user-oriented system, but would not have the same effect of creating user commitment to the system that one would get by encouraging all potential users to suggest improvements before the system design was locked up.