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MILITARY MESSAGE EXPERIMENT. VOLUME I. EXECUTIVE SUMMARY.(U)
MAR 82 S H WILSON, N C GOODWIN, E H BERSOFF
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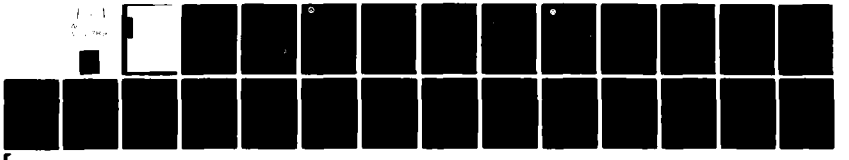

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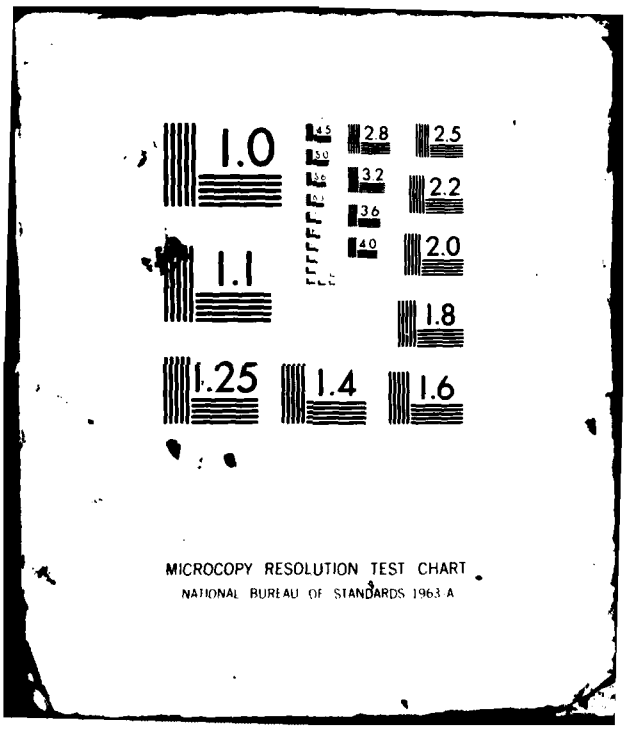
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MME	Security kernel
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Military Message Experiment (MME) was designed to evaluate the utility of user-oriented message processing systems in a military environment and to aid in determining the features useful in such a system. The experiment was a cooperative effort between the Commander-in-Chief, Pacific, the Navy, and the Defense Advanced Research Projects Agency. To conduct the experiment, a PDP-10-based system was installed at CINCPAC Headquarters for use by a portion of the Operations directorate. The message processing functionality was provided by SIGMA, a program written by the Information

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20. ABSTRACT (Continued)
Sciences Institute of the University of Southern California. It was supported by the TENEX operating system, and the user terminals were modified HP-2649A CRTs.

The MME system was designed to give the user the capability to handle his message traffic (both incoming and outgoing, formal and informal) on the system. The system enforced multilevel security rules based on a modification of the security kernel model developed at Mitre. The rule enforcement was not rigorous enough for certification, but it was sufficiently rigorous to determine the effects on the users' interactions with the system. Most of the functions needed for a user's message-related tasks were provided by the system: message filing, message replies, message commenting and "chopping," and message release.

The following conclusions were reached as a result of the experiment:

a. An Automated Message Handling System (AMHS) can be extremely useful in a military environment, especially during a crisis. It must be extremely reliable and routinely available.

b. There are not significant differences between message system requirements in normal and crisis operation. During a crisis, the system must handle a higher volume of traffic. An AMHS will be effective during a crisis only if the personnel use it daily and are, thus, thoroughly familiar with its operation.

c. An AMHS must provide services to everyone involved with message handling. Each user may not have a terminal; thus, the system must have well thought-out procedures for including these individuals in procedures that have been automated (e.g., distribution).

d. An AMHS must have the capability to produce hardcopy. In the MME, many users preferred paper copies for reviewing messages and preferred manual to automated coordination.

e. An AMHS should be an integral part of the user's information handling system. Users who draft messages need to refer to many documents, including other messages, reports, and letters. Many of these may be stored on other automated systems, such as word processors and command and control systems. A single work station is needed to support all of these user functions.

f. An acceptable user interface can be developed based on the security kernel concept.

g. A user-oriented message system and the telecommunications center message system with which it is associated must be integrated. Failure to integrate these functions will result in reduced reliability and increased cost because of incompatible interfaces and duplication of functions.

h. An AMHS is a more complex program than is generally thought. It must exhibit the characteristics of a well-designed data base system, a user-oriented message processor, an interactive command and control system, and a rapid message handling system.

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To: [illegible]
Via: [illegible]

Subj: Military Message Experiment (MME)

Ref: (a) [illegible] Memorandum of Agreement of [illegible]
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(c) COMNAVELEX ltr Ser [illegible]

Encl: (1) MME Final Report (Volumes I, II, [illegible])

1. Enclosure (1) is submitted as the final report [illegible] Message Experiment (MME) conducted at [illegible] (CINCPAC) Headquarters, Camp Smith, Hawaii, in accordance [illegible] agreement of reference (a). Volume I provides [illegible] Executive Summary of the Experiment. Volume [illegible] detailed final report, while Volume [illegible] comments on the Experiment and the military utility [illegible] message systems. References (b) and (c) [illegible] the Experiment "Quick-Look" and "Mid Experiment" [illegible].

2. The Experiment was a mutual effort [illegible] Advanced Research Projects Agency; Naval [illegible] Command; and Naval Electronic Systems Command [illegible] was assigned responsibility for the evaluation [illegible] and the preparation of this final report.

3. Measuring the utility to a major command [illegible] Message Handling System has been a difficult [illegible] recognized at the outset that evaluating [illegible] a computer-based [illegible] difficult, but the [illegible] hardware reliability, [illegible] the [illegible]

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4. [illegible] in their [illegible] highlights the [illegible] inadequate [illegible] all. The [illegible] MME. Volume I provides a [illegible] summary which covers the major [illegible] of the experiment [illegible] only require a [illegible] summary of the subject. [illegible] deeply in each [illegible] to read at least Volumes I, II, and III carefully.

5. The submission of this final report concludes the Military Message Experiment. Volumes IV through VII provide [illegible] supporting data and analysis and may be obtained separately.

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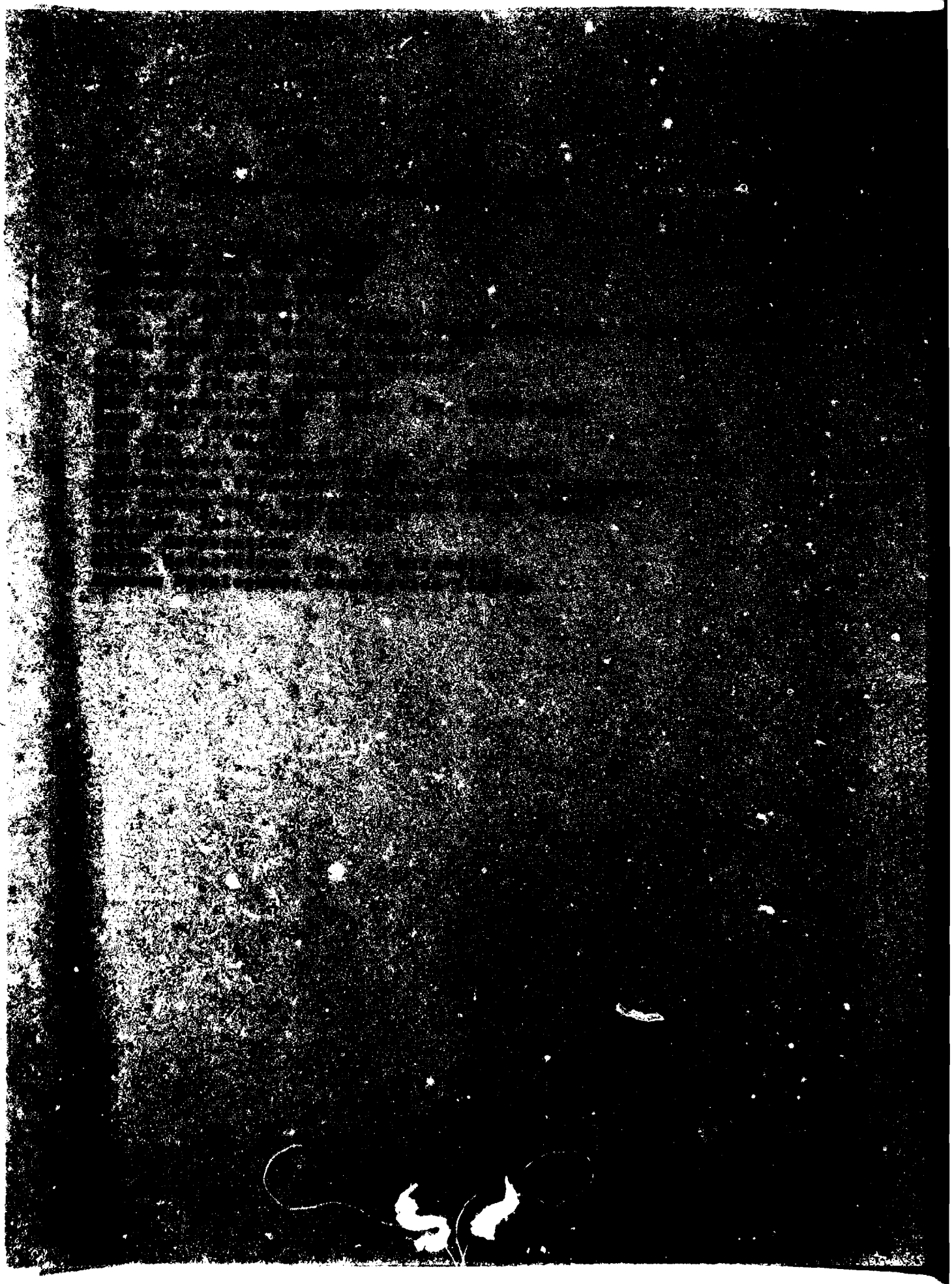

OVERVIEW
THE MILITARY MESSAGE EXPERIMENT

INTRODUCTION

The Military Message Experiment was a joint DARPA/Navy/CINCPAC experiment to determine the utility of an interactive message service in a military command environment. The experiment was conducted by developing a message system, installing it at CINCPAC with a connection to the AUTODIN communication system, and then using the system for a period of 15 months in the daily message handling tasks performed by the Operations Directorate (J-3). Extensive measurements were made prior to and throughout the experiment; the results are documented in a series of seven volumes.

THE MESSAGE SYSTEM

A message system known as SIGMA was developed for the experiment. Operating on a DEC PDP-10 computer, it supported a total of 25 display terminals and 7 hard copy units located at selected user spaces throughout the J-3 office areas. The system provided access to formal AUTODIN message traffic up to SECRET classification level via a connection to the Local Digital Message Exchange (LDMX). Memos and informal notes capabilities were also provided. The SIGMA system provided the user with an extensive user interface that included capabilities to create, edit, read and file messages. A central database of messages permitted sharing of common messages by all who had appropriate access. Users with appropriate access could release messages directly to the AUTODIN system. These and additional capabilities such as forwarding, assigning action, coordinating draft messages, retrieving messages from the archive, etc. are described in more detail in volumes II and V of the final report. Additional features were added to SIGMA throughout the course of the experiment; this was possible because of a cooperative working relationship established between the system developers and the CINCPAC users.

CONCLUSIONS

The conclusions which are summarized here have been derived from data collected by the SIGMA message system, interviews with users, and observations by the experimenters.

1. An automated message handling system (AMHS) is useful in a military environment. An AMHS provides faster delivery of messages than a manual system; it provides greater accessibility to the messages which are stored in a shared database and to information distributed through an electronic readboard; it improves efficiency in processing messages, especially in the area of message retrievals; it provides greater flexibility in such tasks as searching on user-specified criteria, forwarding messages to other users, and using the system for informal communication.

2. The advantages of an AMHS can be achieved only if the system is responsive and reliable. In fact, greater reliability is demanded of an interactive system because the user, being directly involved, is more aware of system availability and is less tolerant when it is down.

3. An AMHS is the core around which an integrated information/communication system should be built. The need to create and edit files and store and retrieve text objects are common to many message handling, word processing and command and control functions. A single workstation with a common user interface is needed to support these functions.

4. There are no significant differences between system requirements in normal and crisis operation. A key requirement during a crisis is to be able to filter incoming traffic under saturation conditions so that critical messages can be responded to promptly. An AMHS will be effective during a crisis only if the personnel who must use it are thoroughly familiar with its operation. This implies that they use it in their daily message handling tasks.

5. The Telecommunication System and the User-oriented Automated Message Handling System must be integrated. In the case of the MME, these systems were the LDMX and SIGMA. Failure to properly integrate these functions will result in reduced reliability through incompatible interfaces, costly duplication of functions, and increased operating and maintenance costs.

IMPLICATIONS FOR FUTURE SYSTEMS

The experience with the MME helped identify a number of characteristics which future military message systems should provide. The key characteristics are briefly summarized below.

1. Breadth of Coverage. The AMHS must be available to all segments of an organization. About 60 terminals would have been needed to adequately support J-3 and about 200 terminals to support all of CINCPAC. Failure to provide adequate coverage will necessitate supporting a secondary system, will reduce the responsiveness of the organization, will preclude the use of certain kinds of on-line services such as coordination, and will inhibit achieving that level of user proficiency necessary for effective crisis operation.

2. System Architecture. The system architecture must be able to support a large number of users with reliable, responsive service, and it must be able to expand gracefully to accommodate new requirements. The system used in the MME failed to meet this requirement because of the large computational load placed on the timesharing system. The recent emergence of distributed processing provided by dedicated workstations which are interconnected by a high bandwidth local network provides a basis on which a future AMHS could be implemented.

3. Security. Future message systems must be able to support the processing of messages of different classification levels and support users with different security clearances, i.e., they must be multi-level secure message systems. The SIGMA system used in the NMC provides a good model for the user interface for a secure message system and demonstrated its acceptability to the user community. Much research is still needed to develop a provably secure multi-level system.

4. Functionality. In addition to the conventional message handling functions of reviewing, creating, editing and releasing messages, the following capabilities proved extremely useful and should be included in future systems: handling informal memo and notes; rapid scanning in any order of message summaries within a file; selective retrieval of messages using user-specified criteria; and alerting a user when important messages arrive.

5. Design for Change. A message system must be designed so that most user-suggested changes can be easily incorporated.

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MILITARY MESSAGE EXPERIMENT
FINAL REPORT
EXECUTIVE SUMMARY

1.0 BACKGROUND

1.1 Introduction

During the late 1960s, two American ships, the USS Liberty and the USS Pueblo, were involved in separate crises. Each crisis was exacerbated by unacceptably long delays in the delivery of critical military messages. Members of Congress investigated the quality of U.S. military communications [1-4] and identified several causes for the delays. Further, they noted that there were numerous, apparently uncoordinated, military message centers under development by various elements of the Department of Defense. This resulted in a memorandum from the Director, Telecommunications and Command and Control, OSD, in June 1975, directing that techniques needed for secure interactive message systems be developed. This directive, and parallels between message processing systems being developed by the Defense Advanced Research Projects Agency (DARPA) and emerging user requirements within military staffs, led to a Memorandum of Agreement (MOA) [5] between DARPA, the Naval Telecommunications Command (NAVTELCOM), the Naval Electronic Systems Command (NAVELEXSYSCOM), and the Commander in Chief Pacific (CINCPAC) for the conduct of a military message experiment (MME). This report summarizes the results of the experiment as viewed by these organizations.

The specific objective of the MME was to determine the utility of an interactive message service in a major military headquarters. As a part of this determination, alternative features and capabilities were to be identified; the use of the features was to be observed and measured as a means of determining the requirements that staff officers and action officers have for automation of message systems. These requirements are to be used as a baseline for developing automated message handling systems for future military use. Accordingly, the specific objectives identified in the MOA were to:

(a) determine and demonstrate the usefulness of automated message capabilities and the necessary features to support a military message handling system in an operational environment;

(b) determine the effect of an automated message handling system on operational procedures, manpower, and logistics in an operational environment;

(c) determine the training requirements associated with the introduction of an automated message handling system;

(d) determine the characteristics of an acceptable user interface for an interactive automated message handling system;

Manuscript submitted December 19, 1980.

(e) determine multilevel security design characteristics and their impact on the user interface; and

(f) obtain the data necessary to assist in the future design and development of a family of automated message handling systems for DoD use.

At the time it was decided to conduct the MME, there were two efforts funded by DARPA to develop military versions of interactive message systems. Work at Bolt, Beranek, and Newman (BBN) of Cambridge, MA., led to the development of HERMES, and work at the Information Sciences Institute of the University of Southern California (ISI) led to the development of SIGMA. An additional data-base oriented message system had been developed by MIT under DARPA funding.

These organizations were chosen to modify their work on automated message systems so that they could be used by military personnel to send and receive messages via the AUTODIN system. Preliminary designs for "militarized" versions of these three candidate message systems were submitted by BBN, MIT, and ISI. In order to aid the developers in tailoring their systems to the military environment, a set of capabilities needed for a secure military message processing system was developed by DARPA, Navy, and contract personnel [6,7]. During the period 22 February through 3 March 1977, representatives from the Navy, DARPA, MITRE Corp., CTEC, Inc., and the CINCPAC staff evaluated the three candidate message systems.

The evaluators concluded that SIGMA, the message service developed by USC-ISI, presented the user with an interface and features that would allow the most useful data to be derived from the experiment, but noted that SIGMA, at that time, could not adequately support the experiment and that there was "a considerable risk in upgrading the performance of SIGMA to an acceptable degree." A plan was developed to improve performance and the features related to security and message handling based on the evaluation. At the conclusion of the evaluation (documented in [8,9]) SIGMA was selected and subsequently installed as a part of the MME system at CINCPAC in May 1977.

As expected, the initial version of SIGMA installed in May 1977 did not provide adequate response or reliability, and there was a prolonged period of shakedown and user training. Some upgraded hardware and software were installed, and a period of limited experimental use began in July 1978. The system was continually improved; by October 1978, the original processor had been replaced with a more powerful one and a final increment had increased the main memory from the original 256K to one-million words. The final impediment to a reliable hardware suite was overcome when a marginal power filter external to the MME equipment was removed in early March 1979. The users began full experimental use of the system in February 1979, and the experiment was concluded in September 1979.

During the experiment, the users were required to maintain the existing paper system as well as to use the new automated system. This, of course, caused an increase in the user's message-handling workload above what it would have been for the automated system alone, and in some cases caused a delay in the users' acceptance of the automated system.

1.2 Report Structure

This report summarizes activity at CINCPAC during the experiment, identifies conclusions drawn on the basis of that activity, and discusses potential implications for future automated message handling systems. Two previous reports cover earlier phases of the experiment in detail. The Quick Look Report [10] discusses the inception and early operation of the system and provides a summary of the SIGMA message service software, which served as the basis for user interaction with the MME System. Additional SIGMA details can be found in [11-14]. A second report, the Mid-Experiment Report [15] covers operational activity during the period November 1978 to April 1979 and provides a discussion of the telecommunications interface aspects of the experiment.

The Final Report of the Military Message Experiment is structured as a series of volumes--published both individually and jointly by participating organizations. The following lists the volumes of the report.

Volume Number	Objectives Discussed	Topic
I	(a)-(f)	Executive Summary
II	(a)-(f)	Final Report [16]
III	(a),(b) (c),(f)	CINCPAC's User View [17]
IV	(a),(b)	*Message System Utility* [18]
V	(a),(d) (f)	ISI's Developer View [19]
VI	(a),(b)	Data Analysis [20]
VII	(c)	Training [21]

Volumes I-III describe the basic experiment and its results. The remaining volumes present supporting data and analyses for volumes I-III.

1.3 System Description

The basic elements of the MME system as used in the experiment included:

(a) Hardware: a DEC PDP-10 computer with TENEX operating system installed in a TOP SECRET facility with on-line connection to the AUTODIN system via the Local Digital Message Exchange (LDMX), a terminal interface processor (PDP-11), 25 user terminals and 7 printers located in the J3 office areas of CINCPAC.

(b) Software: a message service software system (SIGMA) installed on the PDP-10 and a terminal interface system and LDMX interface system installed on the PDP-11.

(c) Experiment Support Staff: system operators, technicians, training and management personnel.

The SIGMA system allows users to draft and edit messages on-line interactively using standard message formats. These messages can then be communicated informally within the command center or formally coordinated for release to AUTODIN in electronic form. Actual release is performed by someone with release authority. Incoming messages from AUTODIN can be distributed and read via SIGMA. For a complete description of the features of SIGMA, see Vol. V (ref [19]) of this series.

One of the major goals, emphasized strongly during the conception, execution, and analysis of the experiment, was to determine the feasibility of a secure message processing system. Because the message system was implemented on an existing suite of hardware and software, there was never an intent to certify the system for multilevel operation; the intent was to determine whether or not the use of a particular security model would be compatible with the functions and user interface of an interactive military message processing system. The security model chosen was the "security kernel."

The two major requirements for a secure system are to ensure that users cannot gain access to information for which they are not cleared and to ensure that the security classification of information in the system cannot be modified improperly. The specific security requirements for the experimental system are detailed in [6] and [7]; the results of the evaluation of the security design of the three candidate message processing systems are contained in [9]. The SIGMA security system is also discussed in more detail in Vol. II (reference [16]) of this series.

2.0 USE OF SIGMA BY THE STAFF

2.1 CINCPAC Operations with the MME System

This section presents a brief overview of the use of the MME system at CINCPAC; for a more detailed description see [16], [19], and [20]. During the experiment, members of the Operations Directorate (J3) at CINCPAC Headquarters, Camp Smith, Hawaii, used the computer system for receiving, redistributing, filing, and retrieving incoming messages. The system was also used for the generation, coordination, and release of outgoing AUTODIN messages and the creation and distribution of formal and informal notes and memoranda. Initially, the operation of SIGMA mirrored the paper system in detail. As the experiment progressed, alternative patterns of use emerged which were effective in speeding delivery of messages to their destinations.

2.1.1 Message Receipt and Distribution

AUTODIN messages for CINCPAC are received from the AUTODIN Service Center at the Camp Smith LDMX (Local Digital Message Exchange). The LDMX transmits high precedence messages directly to the CINCPAC Command Center in additional to the normal distribution. During the experiment, messages that the LDMX determined should be routed to the Operations Directorate (J3) for ACTION or Information (INFO) were transmitted electrically to the SIGMA system. (Backup paper copies were generated by the LDMX and picked up later by J3 personnel.)

Once SIGMA received a message, it was placed in the SIGMA message file and protected from changes. A summary of the message was placed in the Administrative Branch's (J301) pending file (SIGMA's version of an "electronic in-box") and in the datefile (a file of messages with a common date of origin).

Using SIGMA, J301 usually began the day by displaying the pending file and moving J3 INFO messages to a file called the "Today" file. Foreign Broadcast Information Service (FBIS) messages were deleted. When the pending file had been cleared of these messages, the distribution task began. To distribute messages, the J301 user executed a sequence of three instructions. The first selected a set of messages of interest to a particular division (based on criteria specified by a "selector" it had specified). The second routed the messages for ACTION to that division, forwarded copies for information to other divisions, filed a J301 copy, if desired, and deleted the set of messages from J301's pending file. The third instruction displayed to the user the remaining set of messages that had not yet been processed. This sequence of instructions was repeated until all predefined selectors had been used. The remaining message summaries were scanned, with the user often making routing decisions on the basis of the summary itself. About 13% of all the messages were actually read by J301, presumably to help in routing decisions. The message distribution function could have been automated easily with J301 distributing only those messages that were not handled by the pre-defined selectors.

After a message (actually a summary) was delivered to a user's pending file, it was his responsibility to take the proper action. If the user was logged in at the time, the information that a message had arrived was placed at the top of his screen. Most users did not maintain a constant vigil at the terminal, but periodically processed their pending files. The action officers maintained and used SIGMA message files; they spent an average of 6-30 minutes a day using message files. This was significantly less than the time previously spent carrying out similar functions with hard copy files.

Many action officers did not wait for J301 to route the messages, but accessed the datefile directly and selected those messages that were of possible interest. Thus, they were able to use more flexible selection criteria than the profile being used by J301, and they were able to get the messages earlier. Toward the end of the experiment, it was clear that J301's manual routing function was becoming less important and that future systems could rely on automated routing systems that could be changed easily by the users.

Because the system in use prior to SIGMA was maintained as a backup for the Command Center Watch Team (CCWT) and because high-precedence messages were transmitted directly from the LDMX to the printer in the Command Center, the changes in message distribution were not as dramatic for the Command Center Watch Team as for the action officers. The CCWT used SIGMA to build and access files and to build the readboard for J3; except for the direct delivery of high-precedence traffic, the use of the system by the CCWT was about the same as that by action officers.

2.1.2 Message Creation, Coordination and Release

CINCPAC J3 is typical in that the directorate receives more messages than it transmits. But the number of man-hours per message to create, coordinate, and release an outgoing message is considerably higher than the number of man-hours per message to process incoming messages. A two-dimensional screen editor was used to create messages and edit them on a display terminal. Anyone with authorized access to a terminal could create messages, display them, produce hardcopy printouts on any of several printers or send them electronically to other users of the SIGMA system. The coordination of any given message was required prior to its release via AUTODIN. Actual release of coordinated messages was straightforward, but was permitted only by authorized users. The SIGMA system enforced this requirement. The design and implementation of a satisfactory system for coordinating outgoing messages were difficult, but towards the end of the experiment, the on site team and the CINCPAC users had devised a system that was beginning to be used by the users. The major coordination problems were:

(a) usually, not all persons needed for coordination of an outgoing message were system users,

(b) all coordinators might not be logged on,

(c) some background material needed for coordination was not on the automated system, and

(d) some users believed the social intercourse of face-to-face coordination was needed.

2.1.3 Other Uses of SIGMA

SIGMA was used to file incoming messages on-line for a period of 30 days, after which the messages were automatically archived to magnetic tape if unused for that period. Message retrieval was easily accomplished since the system maintained a list of message citations (summaries) on-line for the entire experiment. From the list of citations, a user could select one or more messages for display or printout. On-line messages would be displayed immediately while archived messages, if selected, were automatically retrieved and available for display, typically within fifteen minutes.

Messages received at CINCPAC which were to be redistributed to organizations outside CINCPAC required readdressal. In the manual system, this was a cumbersome process requiring much time and paperwork. This was accomplished easily in the SIGMA system using a single function key to initiate the readdressal. The necessary additional information was provided by using a form generated by SIGMA on the display.

Readboards in the manual system were a collection of key messages (outgoing and incoming) and action items prepared daily for the J3. An electronic version of the readboard was prepared by the command center personnel using SIGMA to make this information available to the J3 staff as well as the J3. This kept the staff aware of current items brought to the J3's attention and disseminated the readboard information to many more people than before.

SIGMA provided a capability to create informal notes and formal memos for intra-directorate communications. They were used extensively toward the end of the experiment. The principal users were action officers and members of the CCWT. SIGMA was also used as an office word processing system to generate material for use in briefings, draft letters, notes on projects, status of action, and day-logs to aid in watch-shift transitions.

2.2 Benefits of the Automated System

To aid in determining the functions needed in future message handling systems, auditing programs in SIGMA recorded the use of the system functions; these data were then analyzed to determine the most-frequently used instructions, type of use by various offices, the pattern of use in exercises and normal periods, etc. This information is reported fully in [16], and a detailed analysis of the data is contained in [20]. The following is a synopsis of the inferences based on the collected statistics. This information, along with observations, analyses of user interviews, etc., was used to form the conclusions reported in section 3 of this report.

Use of Sigma reduced the distribution effort (in man-hours) by 51% and the average age of a message delivered to an action officer by 75%. The most-important features to the distribution function were:

(a) pre-defined selectors,

(b) the route command, and

(c) the ability to deal with citations vice complete messages.

The most-important features related to the use of the system for filing, retrieving, and using the informational content of the messages were:

(d) access to more information,

(e) selective retrieval,

(f) easy access to archived messages, and

(g) access to the daily readboard prepared for the J3 brief.

The most-important features related to the use of the system for originating and transmitting messages were:

(h) the word-processing capabilities used for editing,

(i) the copy-text feature that provided more complete and more accurate text because no errors were introduced by retypings,

(j) the readdressal feature,

(k) the ability to generate formal and informal notes and memoranda, and

(1) the on-line coordination capability (see [16], [17], [19], and [20], however, for the problems associated with developing and using the coordination capability).

3.0 CONCLUSIONS

3.1 Introduction

The following conclusions are derived from the analysis of experimental data collected, interviews with users, and observations by the evaluators.

3.2 Conclusions from the Experiment

(a) An automated message system can be extremely useful in a military environment during both normal and crisis operations (1) by reducing message distribution times, (2) by providing more accurate and efficient distribution and retrieval through user-specified criteria, and (3) by providing word-processing capabilities for generating messages and other documents, thus reducing errors in preparation and release.

For these advantages to be achieved, the system must be extremely reliable and routinely available. Because SIGMA was used interactively, the users demanded more reliability and availability of it than they did of the LDMX.

(b) There are no significant differences between system requirements in normal and crisis operation. During a crisis, the volume of traffic will usually increase; thus, incoming traffic must be filtered so that critical messages can be identified and responded to promptly. An Automated Message Handling System (AMHS) will be effective during a crisis only if the personnel who must use it are thoroughly familiar with its operation. The system should be in daily use and sized to handle worst-case expected traffic loads.

(c) An automated message system must provide services to everyone involved with message handling. Failure to provide adequate coverage will reduce the effectiveness of the organization and will inhibit achieving the level of user proficiency needed for effective use of the system during a crisis. Further, each user may not have a terminal; therefore, the system must have a well thought-out procedure for including these individuals in processes that have been automated (e.g., distribution). The design of the system should consider both users who will usually interface with the system using paper copies and clerk/typists.

(d) An automated message system must have the capability to produce hard copy. In the MME, many users preferred paper copies for reviewing messages and preferred not to use the automated coordination because it did not provide the face-to-face contact that some felt was important.

(e) An automated message system should be an integral part of the user's information handling system. Users who draft messages need to refer to many documents, including other messages, reports, and letters -- many of which may be stored on other automated systems. A single workstation is needed to support the user's message-handling, command-and-control, and word-processing functions.

(f) An acceptable user interface can be developed based on the security kernel concept. While the MME experiment did not explicitly test a security kernel, the user interface was designed and implemented to operate with such a kernel. The restrictions on the user imposed by the security controls were acceptable and did not detract from the usefulness and convenience of the message system.

(g) A user-oriented message system and the telecommunications center message system with which it is associated must be fully integrated. Failure to integrate these functions will result in reduced reliability and increased cost because of incompatible interfaces and duplication of functions.

(h) An automated military message system is a more complex program than is generally thought. It must exhibit the characteristics of a well-designed data base system, a user-oriented word processor, an interactive command and control system, and a rapid message handling system.

3.3 Implications for Future Systems

(a) Breadth of Coverage. A system must have an adequate number of terminals and printers to be accessible throughout the organization it serves. It must also have the functionality and sufficient processing power to support a critical mass of users. It should be used on a regular basis (e.g. daily) to insure adequate familiarity on the part of the user.

(b) Capacity. An AMHS should be sized to handle worst-case expected traffic loads.

(c) Reliability. The system reliability and availability must approach 100%. Further, it must be perceived by the users as reliable and available. The user must be able to depend upon the system in time of need.

(d) Architecture. The system must be able to expand gracefully to accommodate additional users or new functions. Alternative architectures based on the use of distributed processing appear to be more appropriate choices than a centralized time sharing system.

(e) Useful Functions. The following are useful in a military message processing system: handling of informal memos and notes; rapid scanning in any order of message summaries within a file; selective retrieval of messages using user-specified criteria; alerting a user when an important message arrives. In addition, a terminal with

multiple windows allows viewing related material while composing a message or performing other similar tasks.

(f) Design for Change. The system must be designed so that most user-suggested changes can be easily incorporated.

(g) Security. Future message systems must be able to support messages with different classification levels and users with different clearances. Further research in this area is warranted.

3.4 Concluding Remarks

(a) The handling of formal military messages will continue to be a combination of paper handling and interactive message handling. In future years, the amount of interactive message handling in the DoD will increase. However, because some message processing tasks cannot be automated easily and because of organizational preferences, certain manual procedures will probably be retained.

(b) The limitations of current large centralized message processing systems coupled with decreasing hardware costs will encourage the development of distributed message system architectures. In some cases, each user's terminal may be powerful enough to act as his own dedicated message processor. These processors will be connected together via local networks.

(c) Although the MME system could only handle text messages, future systems should support new types of messages, such as facsimile, voice, and graphics. Human factors issues, workstation design, and protocols for supporting these new messages should be explored or developed. In addition, new functional capabilities such as automated distribution of messages should be included.

(d) Although there are numerous examples in which privacy controls would be useful, a comprehensive design of privacy controls for military message systems does not exist; such a design should be formulated and tested.

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