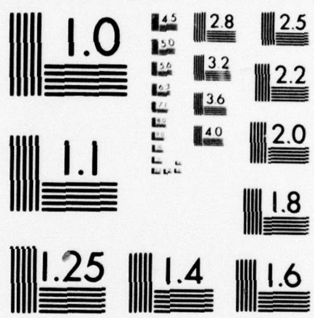
AD-A060 669   DIGITAL TECHNOLOGY INC CHAMPAIGN IL   F/G 9/2
PHASE B EXPERIMENT PLAN.(U)
JUN 78   DCA100-77-C-0069
UNCLASSIFIED   DTI-7   SBIE-AD-E100 083   NL

| OF |
AD
A060669

END
DATE
FILMED
01-79
DDC



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

Digital Technology Incorporated

Phase B Experiment Plan

June 19, 1978
Document 7

(14) DTI Document Number-7

(6) PHASE B EXPERIMENT PLAN

Prepared for the
Defense Communications Agency
under contract
(15) DCA100-77-C-0069

(18) SBIE

(19) AD-E100 083

by

DIGITAL TECHNOLOGY INCORPORATED
Champaign, Illinois 61820

(12) 12p.

(11) 19 Jun[redacted], [redacted]78

Approved for Release Peter A. Alsberg
Peter A. Alsberg, President

Abstract

This document describes the experiments that will be conducted on the Phase B IOC Network Front End (INFE). The INFE will connect a WWMCCS H6000 host to AUTODIN II. In Phase A of the WWMCCS network front end program, an Experimental Network Front End (ENFE) was developed. Phase A experiments extensively measured the ENFE. Most of those experimental results apply to the INFE. Hence, much of the performance of the INFE is predictable from Phase A experiments. Phase B experiments will use Phase A measurement tools to refine some measurements begun in Phase A and to remeasure overhead and gross throughput parameters for the INFE.

Table of Contents

Page

Introduction 1

Analysis of Phase A Results 2

Phase B Priorities 5

Phase B Experiments 6

Introduction

A network front end (NFE) is a computer system interposed between a host computer and a network. The NFE relieves the host of the burden of network interface software. It provides terminal access to the network when the host is down.

The technological basis for a network front end is derived from ARPANET network access machine research. A late development in that research was Network UNIX, which is the immediate basis for the present research effort. UNIX is a general purpose operating system developed by Bell Telephone Laboratories for use on PDP-11 computers. In 1975, staff of the University of Illinois Center for Advanced Computation added ARPANET network control program (NCP) and Telnet software to UNIX to make Network UNIX. In 1976, the Network UNIX staff began Phase A of the WWMCCS NFE program. Network UNIX was modified to frontend a WWMCCS H6000 to the ARPANET. The result of the Phase A effort was the WWMCCS Experimental Network Front End (ENFE).

In October, 1977, Digital Technology Incorporated was formed from the staff of the Network UNIX and WWMCCS NFE projects. In Phase B of the WWMCCS NFE program, Digital Technology Incorporated is modifying the Phase A ENFE to support AUTODIN II protocols. This will provide an initial operational capability (IOC) NFE (INFE) for AUTODIN II.

Analysis of Phase A Results

Phase A ENFE measurement and evaluation activities were described in the "Experimental Network Front End Experiment Plan"[1] and the "UNIX/ENFE Experimental Performance Report"[2]. Additional measurements have been made in Phase B.

The Phase A experiment plan emphasized ENFE performance evaluation and module tuning. However, the Phase A experiments themselves showed that ENFE performance was so dominated by system calls (those calls that enter the UNIX kernel) that module tuning could not significantly improve performance.

For example, in one network-to-H6000 experiment using very short messages (72 bits), the observed throughput was 68 messages per second. Thus the average message processing time was 1000/68 = 14.7 ms. Each message required 21 system calls (most to interprocess communication routines) totaling 13.5 ms. (92% of processing). All network protocol processing, other overhead, and idle time totaled 1.2 ms. (8% of processing).

---

[1] Belford, Geneva and Putnam, Daniel E. "Experimental Network Front End Experiment Plan", CAC Document No. 227, Center for Advanced Computation, University of Illinois at Urbana-Champaign, 1977.

[2] Putnam, Daniel E., Belford, Geneva G., and Healy, David C. "UNIX/ENFE Experimental Performance Report", CAC Document No. 231, Center for Advanced Computation, University of Illinois at Urbana-Champaign, 1977.

Even if the protocol modules, non-system call overhead, and idle time took no time at all, the message rate would only rise to 1000/13.5 = 74 messages/second; if protocol processing, non-system call overhead, and idle time were doubled, the message rate would only drop to 1000/15.9 = 63 messages/second. Hence, the impact of module tuning is negligible.

ENFE throughput is directly proportional to the speed of UNIX system calls. If system call processing could be halved, the message rate would double (6.8 milliseconds system calls + 1.2 milliseconds protocol processing and other = 8.0 milliseconds processing per message; 1000/8.0 = 125 messages per second). System call overhead would still be 85% of processing.

The maximum message throughput rate from the ARPANET through the ENFE to the H6000 is 75 messages per second. The maximum rate in the opposite direction is only 67 messages per second. This is because two more system calls per message are required. Adding a system call to the processing of a message reduces the message processing rate by about 5%.

The maximum ARPANET bandwidth measured on the ENFE is 80 kilobaud (8K-bit messages; 10 messages/second). Because maximum IMP interface bandwidth is also about 80 kilobaud, it is not clear that the ENFE itself limits throughput to 80 kilobaud. If the ENFE is in fact limited to 80 kilobaud, the processing of 8K-bit messages must require on the order of 100 milliseconds. As shown above, processing short messages in the ENFE requires on the order of 15 milliseconds. In the ENFE, only NCP processing increases as message size increases. It is unlikely that increased NCP processing would require an additional 85 milliseconds per message. Therefore, ENFE throughput is most likely limited by the ARPANET. In the absence of a higher bandwidth network interface, measurements of protocol processing time are required in order to accurately estimate ENFE maximum throughput.

Message delay (time required for messages to pass through the ENFE) varies from 50 ms. for small messages to 150 ms. for large messages. About 30 terminals can be supported by the ENFE.

Phase B Priorities

The experiments performed in Phase A showed that the performance of the ENFE was determined by its UNIX-based architecture. The Phase B INFE is also UNIX-based. Improvements have been made in the interprocess-communication mechanism for the INFE to reduce the number of system calls required. In addition, system entry time will be reduced for the INFE system calls. As a result of these changes, we expect modest improvements in INFE performance over ENFE performance. Phase B experiments will analyze the impact of these changes. Phase B measurements will be used to tune INFE system calls.

The performance parameters of a UNIX-based NFE architecture are well understood. Performance is independent of protocol processing time. Other, low overhead NFE architectures have been proposed. In these architectures, protocol processing time will significantly affect performance. In order to tune these architectures, protocol processing requirements must be well understood. At present, little is known about these requirements. Thus, in Phase B experiments, priority will be given to protocol processing measurements.

Phase B Experiments

INFE protocol processing, INFE system calls, and INFE capacity will be measured. The tools and techniques required for these measurements are described in detail in the Phase A experiment plan.

Protocol Processing

Individual INFE protocol modules will be timed using the high resolution timer and UNIX profiling facility used in Phase A experiments. Where appropriate, individual module actions will be timed (e.g., the Channel Protocol Module time for processing a TRANSMIT Command may differ from the time required to process a TRANSMIT Response). Where appropriate, the variation of processing time with message size will be measured.

The INFE protocol modules to be measured are:

1. Link Protocol Module,
2. Channel Protocol Module,
3. TCP Service Module,
4. TCP Module,
5. THP Service Module,
6. THP Module, and
7. SIP Module.

INFE System Calls

All new and modified INFE system calls will be measured. The measurement routines and analysis techniques developed for Phase A system call measurements will be used.

The combination of system call measurements and protocol module measurements should provide a very accurate prediction of INFE capacity under various message mixes.

INFE Capacity

INFE capacity predictions will be verified by actual measurement of INFE terminal, host, and network capacities while the INFE is connected to an H6000 host. Computer Sciences Corporation (CSC) test drivers developed for the Phase A experiments will be used in the H6000 to drive data through the INFE to/from the network and to/from INFE terminals.

In Phase A DTI provided ARPANET message generators and message sinks in the ENFE to support the CSC H6000 test drivers. Where necessary, these generators and sinks will be reimplemented using AUTODIN II protocols. Measurement software will reside in the INFE.

UNCLASSIFIED

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

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER DTI Document Number 7	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Phase B Experiment Plan		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER DTI Document Number 7
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s) DCA100-77-C-0069
9. PERFORMING ORGANIZATION NAME AND ADDRESS Digital Technology Incorporated 302 East John Champaign, IL 61820		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DCA/Command and Control Technical Center ATTN C420 11440 Isaac Newton Square, North Reston, VA 22090		12. REPORT DATE June 19, 1978
		13. NUMBER OF PAGES 11
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

[redacted]

Approved for public release;
distribution unlimited.

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

No restriction distribution

18. SUPPLEMENTARY NOTES

None

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

Network Front End
UNIX

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

Digital Technology Incorporated is developing an IOC Network Front End (INFE) to connect a WWMCCS H6000 to AUTODIN II. A DEC PDP-11/70 running under a modified Network UNIX system is being used for the INFE. This document prevents the experiments to be performed on the INFE and their rationale.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

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