Bolt Beranek and Newman Inc.

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BBN Report No. 3677

Planning for ACCAT Remote Site Operations

Quarterly Technical Report No. 1
14 June 1977 to 15 September 1977

Sponsored by:
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Contract Period: 14 June 1977 to 13 June 1978

Principal Investigator: Robert H. Thomas

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This report describes BBN efforts to perform site surveys and planning for the installation of ACCAT remote site modules at selected sites; to provide general system architecture and design services for the ACCAT program; and to assist the ARPA staff in the planning, maintenance, and conducting of demonstrations of various ARPA computer and communication technologies.

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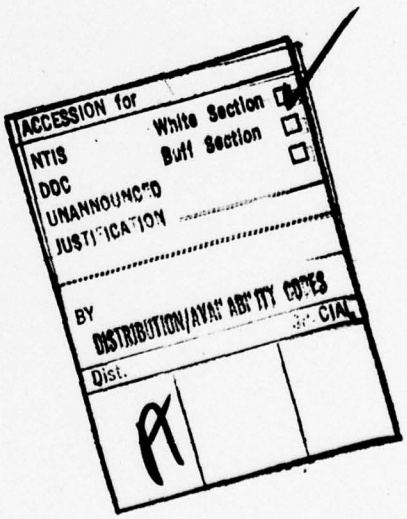

1. Introduction

This is the first quarterly technical report for this contract. It reports on project activity for the period between June 14, 1977 and September 15, 1977.

The Advanced Command Control Architectural Testbed (ACCAT) is a facility designed to support evaluation of the applicability of various new computer-communication and information processing techniques to military command and control problems. The ACCAT program is sponsored jointly by ARPA and the Navy.

The core of the ACCAT facility is located at the Naval Ocean Systems Center (NOSC) in San Diego. It began operation in mid-1977. The testbed is built on a number of existing capabilities including: the ARPANET; the ability to provide secure communication for subnetworks within the ARPANET; the standard interfaces and protocols of the network which enable interoperability of heterogeneous equipment; and a large base of existing software and experience in computer networking, time-sharing and interactive computing.

The ACCAT concept includes support for remote site operations. Initially this will involve secure access from distant locations to the core ACCAT facility at NOSC. At a later time, the ACCAT resources may be enhanced with the addition of computing capability at one or more of these remote sites. ACCAT

activity at a given remote site will be via a "remote site module" (RSM).

The object of this project is to perform site surveys and planning for the installation of ACCAT remote site modules at selected sites; to provide general system architecture and design services for the ACCAT program; and, to develop a plan for making (selected) services of the Fleet Numerical Weather Center (FNWC) available to the ACCAT facility through an FNWC remote site module. In addition, as part of this project we are assisting the ARPA office in the planning, maintenance, and conduct of demonstrations of various ARPA information processing technologies.

Project activity during the past quarter included the following:

- The requirements for the interconnection of ACCAT and the Fleet Numerical Weather Center (FNWC) were analyzed to determine the best approach for providing ACCAT access to FNWC meteorological services. A PDP-11 based front-end system developed by Massachusetts Computer Associates for interfacing Air Force computers to the ARPANET was recommended for this task. The rationale for this choice is detailed in a report that was submitted to ARPA, NAVELEX, and FNWC.

- The remote site survey for the FNWC installation was completed and a site survey report was submitted to ARPA, NAVELEX, and FNWC.

- Site survey activity for the Naval Postgraduate School (NPS) remote site installation was started. An initial visit to NPS was made to confer with NPS personnel and to inspect several candidate locations for the NPS remote site module. We expect that the NPS site survey activity will be substantially completed by the end of the next quarter.

- We attended a meeting hosted by the RAND Corporation to investigate the interprocess communication requirements of ACCAT. At that meeting MSG, the interprocess communication facility developed for the National Software Works system, was tentatively selected as the standard interprocess communication mechanism for ACCAT. Implementations of MSG exist for the TENEX and TOPS-20 operating systems. We will be developing an MSG implementation for the UNIX operating system as part of this contract.

- The Resource Sharing Executive (RSEXEC) program was converted to run under the TOPS-20 operating system. RSEXEC was originally developed to run under TENEX. Due to incompatibilities between TENEX and TOPS-20, the TENEX version of RSEXEC did not operate properly under TOPS-20. This situation was corrected by modifying the RSEXEC program to produce a single executable module which runs correctly under both operating systems.

- We assisted in a demonstration of ARPA information processing technologies conducted at NOSC in August for the Intelligence Research and Development Board. In addition, we have assumed responsibility for maintaining the ARPA demonstration programs and insuring that they operate properly. Several new demonstration programs were written during the quarter.

The remainder of this report describes these activities in more detail.

2. Planning For Remote Site Modules

Our activity in this area centered on the ACCAT remote site modules that will be installed at the Fleet Numerical Weather Center (FNWC) and at the Naval Postgraduate School (NPS).

2.1 Fleet Numerical Weather Center

The Fleet Numerical Weather Center provides a variety of environmental services to Navy users. The purpose of the FNWC remote site module is to make (some of) these services available to users of the ACCAT facility.

ACCAT operates as a secure subnet of the ARPANET. The principal problem here is to interface CDC 6500 computers that operate in a classified mode at FNWC as hosts on the secure ACCAT network. The required security between the ACCAT subnet and FNWC will be provided by a Private Line Interface (PLI) to be installed between the CDC 6500's and their IMP.

The PLI solves the security problem. The problem that remains is the connection between a CDC 6500 and its IMP/PLI. After studying the requirements and constraints for the FNWC remote site module, we recommended that this connection be accomplished by a "front end" machine which serves as an interface between a CDC 6500 and an IMP/PLI.

Two front end systems, both based on the PDP-11, were seriously considered for this task. The front ends considered were: a system developed by Massachusetts Computer Associates (MCA) to interface Air Force CDC computers to the ARPANET; and, a system being developed by a collection of Navy laboratories to connect a variety of Navy computers to the ARPANET as part of the Navy Laboratory Computer Network (NALCON) project.

We carefully evaluated both systems and judged each adequate to meet the expected FNWC requirements. We recommended that the MCA system be used for the ACCAT-FNWC interface. The major reason for this recommendation is that, in our opinion, the MCA system represents a significantly lower risk because of the advanced state of its implementation. It should be pointed out the the NALCON system is likely to be the more flexible system in terms of functionality and that the NALCON hardware configuration can be expected to be somewhat less expensive. However, in our opinion, the NALCON system is more risky (at this time) because of the amount of software design and implementation still necessary to meet FNWC requirements. This design and implementation is planned as part of the NALCON effort. In addition, we note that the MCA hardware is compatible with the NALCON hardware. Therefore, when the necessary NALCON software is available, should it prove to be superior, conversion to it would be a relatively straightforward matter.

Our recommendations on this matter were documented in a report which was submitted to ARPA, NAVELEX and FNWC.

MCA is currently under contract to procure and install a front end system for the FNWC remote site. This front end system will be used to interface two of FNWC's CDC 6500 computers to the secure ACCAT network. The hardware and software of the front end will be configured so that only one CDC computer will be accessible to ACCAT users at any time. The particular CDC computer that is accessible will be switch selectable. The software in the front end and in the CDC 6500 will support terminal and file transfer access between the FNWC CDC computers and the other ACCAT systems.

In addition to the MCA front end system, the equipment for the FNWC RSM will include a PLI. We have performed a site survey at FNWC to plan for the installation of the remote site module equipment. A report [BBN Report No. 3612] detailing site preparation requirements for the equipment installation was prepared and submitted to ARPA, NAVELEX, FNWC and MCA. This report includes environmental and power requirements, equipment layout, cable lengths and specifications, and so forth.

We have been consulting with FNWC and MCA personnel on a regular basis as site preparation and equipment procurement activities proceed in order to help insure that the RSM installation occurs in an orderly manner. We expect to continue

to work with FNWC and MCA personnel until the installation is successfully completed in early 1978.

2.2 Naval Postgraduate School

An ACCAT remote site module is scheduled for installation at the Naval Postgraduate School in the spring of 1978. The objectives of the ACCAT/NPS interface are: to expand NPS student and faculty experience in advanced information processing and command control techniques through access to ACCAT; to provide resources for building an NPS curriculum element in the area of command control; and to improve utilization, exploitation, and value for ACCAT evaluation of FNWC remote site resources, of graphics advances, and of multiple remote site operations (1).

A standard configuration for ACCAT remote site modules has evolved over the past few months. This configuration is nearly identical to the PDP-11 at the NOSC ACCAT core facility. It consists of a PDP-11/70 with 128 K of core and 88 MBytes of disk storage, 6 Ann Arbor terminals, a Tektronix storage tube terminal, and a GCT-3000 graphics system with three graphics terminal stations, each including a precision color monitor, joy stick, and keyboard. The NPS remote site module will be the first standard ACCAT RSM configuration to be installed.

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1. Excerpted from "Concept For ACCAT Remote Sites", 27 July 1977 Version, Information Processing Techniques Office, Defense Advanced Research Projects Agency.

The NPS RSM installation will include: installation of a TIP to provide terminal access to the unclassified ARPANET, including access to ACCAT developmental software and (unclassified) data bases, and to provide network access for the RSM host; installation of an RSM host; and installation of a PLI to provide secure access for the RSM host to the secure ACCAT network. The TIP and RSM host installations are currently scheduled for the spring of 1978. Initially the RSM host will operate in an unclassified mode. In the fall of 1978 the PLI will be installed and the RSM host will begin classified operation with the secure ACCAT network.

We made a preliminary visit to NPS in July to confer with NPS personnel and to inspect candidate locations for the RSM. A location adjacent to the NPS computer center has been selected for the RSM. A second site visit has been scheduled in order to perform the detailed planning for the site preparation and equipment installation. We expect that planning for the NPS RSM installation will be substantially complete by the end of the next quarter.

3. System Design and Architecture Services.

3.1 ACCAT IPC

In July we attended a meeting held at the Rand Corporation to investigate the interprocess communication requirements of the ACCAT program. A diversity of topics were discussed ranging from providing a uniform user interface to all ACCAT resources (e.g., uniform conventions for terminal i/o, line editing, and ACCAT program command languages), to mechanisms for inter-host and intra-host process-to-process communication, to sharing the user context built up by one ACCAT program with other ACCAT programs.

One of the results of this meeting was to (tentatively) establish MSG, the interprocess communication system developed to support the National Software Works (NSW), as the standard mechanism for ACCAT interprocess communication. The MSG communication facility is described in detail in BBN Report No. 3483, "MSG: The Interprocess Communication Facility for the National Software Works System".

The ACCAT network currently includes three host types: TENEX, TOPS-20, and UNIX. As part of our work on the NSW project we have developed MSG implementations for TENEX and TOPS-20 which are suitable for use in ACCAT (see BBN Report No. 3540). At present no implementation of MSG for UNIX, the remaining ACCAT host type, exists. As part of our efforts in this area, we will

develop an implementation of MSG for the UNIX operating system. Work on this implementation will begin during the next quarter. The UNIX MSG implementation will make use of internal UNIX interprocess communication primitives, which are currently in the process of being improved. To the extent possible, our implementation of UNIX MSG will be based on the new "standard" UNIX interprocess communication primitives that are being developed.

3.2 TOPS-20 RSEXEC

The RSEXEC system is a network operating system (1) which serves as the basis for many ARPA demonstrations. RSEXEC was developed to run under the TENEX operating system. Due to incompatibilities between TENEX and the newer DEC TOPS-20 system, the TENEX version of RSEXEC did not operate properly under TOPS-20 and consequently could not be used on the ACCAT TOPS-20 host. This situation was corrected this quarter by modifying the RSEXEC program to operate properly under both operating systems. These modifications were done in a way that allows the same object module to execute on either host type.

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1. R. Thomas, "A Resource Sharing Executive for the ARPANET", AFIPS Conference Proceedings No. 42, p 354-367, 1973; and B.P. Cosell, P.R. Johnson, J.H. Malman, R.E.Schantz, J. Sussman, R.H. Thomas, and D.C. Walden, "An Operational System for Computer Resource Sharing", Proceedings of the Fifth ACM Symposium on Operating System Principles, Austin, Texas, Nov. 1975.

Two problems had to be addressed to accomplish the necessary RSEXEC modifications. First, the TOPS-20 implementations for a number of the operating system calls used by RSEXEC are slightly different from the corresponding TENEX implementations for these calls. For example, while functionally equivalent, the TOPS-20 and TENEX implementations of the PMAP JSYS and the JSYS trap JSYSs have different conventions for passing parameters and returning results. This problem was solved by programming RSEXEC to check the type of the host on which it is executing and to then use the JSYS parameter conventions appropriate to that host type.

The second problem derives from the fact that TENEX and TOPS-20 employ slightly different file name syntaxes. In particular, on TENEX semi-colon (;) is used to separate the extension component of a file name from the version number component, while on TOPS-20 period (.) is used. RSEXEC must be prepared to deal with both syntactic conventions, using each when appropriate, since it must be able to run on both host types and it must be able to cooperate with remote server processes that run on both host types in order to perform file operations. For example, RSEXEC must be able to move the TENEX file named A.B;5 to a TENEX host or to a TOPS-20 host, and to subsequently manipulate it after it is moved; on the TENEX target host the file would be named A.B;5, while on the TOPS-20 target host it would be named A.B.5. There are two aspects to the solution of

this problem. First, a user is permitted to use semi-colon and period interchangeably as punctuation between file extensions and version numbers when inputting file names. Second, RSEXEC was modified to check the host type of a remote host prior to interacting with it in order to ensure that the correct syntactic conventions are used in file operations with a server process on that host.

The modified version of RSEXEC has been operational on BBN's TOPS-20 and TENEX hosts for about a month. We plan to distribute this version of RSEXEC to the ARPANET TENEX and TOPS-20 hosts during the next quarter.

4. ARPA Demonstration Support

The ARPA staff frequently conducts demonstrations designed to illustrate new information processing techniques and concepts that ARPA is investigating, and to present the results of various ARPA programs. Insuring that these demonstrations are effective in illustrating the various technologies and that they proceed as planned with no failures is a time consuming task that requires attention to many details.

As part of this contract we are assisting the ARPA office in the presentation of these demonstrations. This demonstration support includes maintenance of existing demonstration software, development of new demonstrations and demonstration scenarios, and assistance in the demonstration presentations themselves.

During this quarter we developed several demonstration programs and scenarios including: a simple interactive program that generates Pascal's triangle; an automatic file transfer program which is used to demonstate the ability of the ARPANET and its hosts to support file transfers between heterogeneous and geographically separated host computers; and a demonstration of the application of the JANUS system, a relational data base management system that runs on Multics, to a military problem.

We assisted ARPA in the presentation of a demonstration conducted in August at NOSC for the Intelligence Research and

Development Board. In addition, we periodically exercise the demonstration software in order to insure that it remains operational.